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11.1 muscular system 11.2 skeletal system chapter 12 genetic evolution 12.1 fundamental concept genetics 12.2 change gene pool 12.3 analytical approach genetics alexander stone macnow md áine lorié phd derek rusnak ma kaplan mcat faculty laura l. ambler kaplan mcat faculty krista l. buckley md kaplan mcat faculty kristen l. russell pamela willingham msw melinda contreras ms kaplan mcat faculty kaplan mcat faculty jason r. selzer kaplan mcat faculty m. dominic eggert mcat faculty reviewer elmar r. aliyev james burns jonathan cornfield alisha maureen crowley brandon deason md nikolai dorofeev md benjamin downer ms colin doyle christopher durland m. dominic eggert marilyn engle

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set aside time prep sure rest application personal statement recommendation material ready moment admire complete checklist business preppe start long fruitful journey wear white coat proudly wear white coat hopefully motivation read book want healer go medical school likely familiar importance mcat medical school admission holistic review process put additional

weight experience extracurricular activity personal attribute fact remain gpa mcat score remain important component application portfolio early admission process additional point score mcat push thousand student make attractive applicant mcat simply obstacle overcome opportunity school strong student future leader medicine kaplan job seriously aim help student success mcat future physician work learning science expert ensure date teaching technique resource multiple member team hold advanced degree medicine associate biomedical science commit high level medical education kaplan work mcat 50 year commitment premed student unflagging fact stanley kaplan create company difficulty accept medical school unfair quota system exist time stand beginning new era medical education citizen 21st century world healthcare charge create patient orient culturally competent cost conscious universally available technically advanced research focus healthcare system run compassionate provider suffice easy task problem- base learning integrated curriculum class interpersonal skill response demand excellent workforce workforce soon thrilled choose help journey reach share challenge concern success shape future medicine united states abroad look forward help doctor deserve alexander stone macnow md department pathology laboratory medicine hospital university pennsylvania ba musicology boston university 2008 md perelman school medicine university pennsylvania 2013 world premier science technology magazine old continuously publish magazine united states scientific american commit bring important development modern science medicine technology worldwide audience understandable credible provocative format found 1845 cutting edge scientific american boast 175 nobel laureate author include albert einstein

marie curie francis crick christiane nüsslein volhard stanley prusiner richard axel scientific american forum scientific theory discovery explain broad audience scientific american publish first international edition 1890 1979 first north american magazine publish people republic china today scientific american publish 14 additional language edition scientific american lead online destination [www.scientificamerican.com](http://www.scientificamerican.com) provide late science news exclusive feature

million visitor month e knowledge fill page power spark new idea paradigm vision future science race forward scientific american continue cover promising stride inevitable setback challenge new medical discovery unfold anatomy mcat general overview structure test day chemical physical foundations biological critical analysis reasoning skills cars lunch break optional biological biochemical foundations live psychological social biological foundations satisfaction survey optional e structure section mcat show chemical physical foundations biological systems 44 question passage base 15 discrete stand score 118 132 test general chemistry 30 organic chemistry 15 critical analysis reasoning skill cars question passage base discrete stand- score 118 132 test social science 50 foundation comprehension 30 reasoning text 30 reasoning text 40 biological biochemical foundation living systems 44 question passage base 15 discrete stand score 118 132 test general chemistry 5 organic chemistry 5 psychological social biological foundation behavior 44 question passage base 15 discrete stand score 118 132 test

375 minute 6 hour 15 minute 447 minute 7 hour 27 minute 472 528 scientific inquiry reasoning skill sirs e aamc define scientific inquiry reasoning skills sirs test science section mcat 1 knowledge scientific concept principle 35 question 2 scientific reasoning problem solving 45 question 3 reasoning design execution research 10 4 data base statistical reasoning 10 question let break specific test day behavior note bullet point specific objective sirs take directly official guide mcat exam description behavior mean sample question stem write kaplan skill 1 knowledge scientific concepts principles is probably surprising sir testing science knowledge aer signature quality mcat skill 1 question require follow recognize correct scientific principle identify relationship closely relate concept identify relationship different representation concept verbal symbolic graphic identify example observation illustrate scientific principle use mathematical equation solve problem kaplan simply science knowledge skill 1 question way think skill 1 question step problem e single step realize scientific concept question stem suggest concept state question stem identify answer choice

accurate application skill 1 question particularly prominent discrete question associate passage ese question opportunity gain quick point test day know science concept attach question test day 35 question science section skill 1 sample skill 1 question stem proponent james lange theory emotion interpret finding study cite passage following accurately describe function fsh human menstrual cycle product reaction 1 reaction 2 combine solution result reaction form ionic bond maintain following force skill 2 scientific reasoning problem solving e mcat science section course test straightforward science knowledge skill 2 question common way kaplan critical inking question skill 2 question require following reason scientific principle theory model analyze evaluate scientific explanation prediction evaluate argument cause consequence bring theory observation evidence draw conclusion recognize scientific finding challenge invalidate scientific theory model determine use scientific formula solve problem skill 1 question

model determine use scientific formula solve problem skill 1 question think step problem skill 2 question step problem difficult skill 2 question require step ese question require wide spectrum reasoning skill include integration multiple fact passage combination multiple science content area prediction experiment result skill 2 question tend ask science content actually mention example question describe result experiment ask predict result second experiment actually tell underlie scientific principle work question difficulty figure principle apply order correct answer test day 45 question science section skill 2 question sample skill 2 question stem following experimental condition likely yield result similar figure 2 following conclusion support information passage e likely cause anomalous result find impact person chest quickly reduce volume lung 70 initial value allow air escape mouth percentage force outward air pressure increase 2 cm<sup>2</sup> portion inner surface skill 3 reasoning design execution research e mcat interested ability critically appraise analyze research important day day task physician question skill 3 experimental research design question short skill 3 question require following identify role theory past finding observation scientific identify testable research

question hypothesis distinguish sample population distinguish result support generalization  
population identify independent dependent variable reason feature research study suggest  
association variable causal relationship temporality random assignment identify conclusion  
support research result determine implication result

real world situation reason ethical issue scientific research year aamc receive input medical  
school require practical research skill mcats test taker skill 3 question response demand is skill  
unique outside knowledge need answer skill 3 question teach undergraduate course instead  
research design principle need answer question learn gradually science class especially  
laboratory work complete note skill 3 comprise 10 question science section test day sample  
skill 3 question stem dependent variable study describe passage e major flaw method  
measure disease susceptibility experiment 1 following procedure important experimenter  
follow order study maintain proper randomized sample research subject researcher like test  
hypothesis individual urban area adulthood likely car live urban area birth follow study well  
test hypothesis skill 4 data base statistical reasoning lastly science section mcats test ability  
analyze visual numerical result experiment study data statistical analysis question skill 4  
question require use analyze interpret datum figure graph table evaluate representation  
sense particular scientific observation datum use measure central tendency mean median  
mode measure dispersion range interquartile range standard deviation describe datum  
reason random systematic error reason statistical significance uncertainty interpret statistical  
significance level interpret confidence interval use datum explain relationship variable use  
datum answer research question draw conclusion skill 4 include mcats

physician researcher spend time examine result study study important legitimate conclusion  
sound judgment base datum e mcats test skill 4 science section graphical representation  
datum chart bar graph numerical one table list result summarize sentence paragraph form  
test day 10 question science section skill 4 question sample skill 4 question stem accord

information passage inverse conclusion well support finding display figure medical test rare type heavy metal poisoning return positive result 98 affected individual 13 unaffected individual following type error prevalent fourth trial experiment 1 run yield result 54 compliance follow true discuss sir test mcat daunting prospect give nature skill tend conversation abstract practice able identify skill quickly able apply proper strategy solve problem test day need quick reference remind sir guideline help skill 1 science knowledge question ask remember science content skill 2 critical inking question ask remember science content apply novel situation answer question cleverly combine multiple content area time skill 3 experimental research design question ask let forget science content insight experimental research method involve skill 4 data statistical analysis question ask let forget science content accurately read graph table moment conclusion extrapolation base information present critical analysis reasoning skills

cars e critical analysis reasoning skills cars section mcat test discrete family textual reasoning skill family require high level reasoning use skill 1 foundation comprehension 30 question 2 reasoning text 30 question 3 reasoning text 40 question use skill test humanities- social sciences- theme passage approximately 5 7 question passage let depth look skill bullet point specific objective car take directly official guide mcat exam description behavior mean sample question stem write kaplan foundation comprehension questions skill ask basic fact simple inference passage question similar see reading comprehension section standardized exam like sat ® act ® foundation comprehension question require understand basic component text infer meaning rhetorical device word choice text structure is admittedly cover wide range potential question type include main idea detail inference definition context question find correct answer foundations comprehension question follow basic understanding passage point view author occasionally voice passage sample foundations comprehension question stem main idea—the author primary purpose passage detail base information second paragraph follow accurate summary opinion hold scattered detail accord passage follow false

literary review 1920s inference implication)—which following phrase passage suggestive author personal bias narrative record history inference assumption)—in put argument passage author likely assume definition context—e word obscure paragraph 3 reference historian action nearly mean reasoning text foundation comprehension question usually depend interpret single piece information passage understand passage reasoning text question require thought ask identify purpose particular piece information context passage ask piece information relate reasoning text question require integrate different component text draw relevant conclusion e cars section ask judge certain part passage judge author ese question fall reasoning text skill ask identify authorial bias evaluate credibility cite source determine logical soundness argument identify importance particular fact statement context passage search relevant evidence passage support give conclusion category include function strengthen weaken passage question smattering related rare sample

include function strengthen weaken passage question smattering related rare sample reasoning text question stem function—e author discussion effect socioeconomic status social mobility primarily serve follow strengthen weaken passage)—which follow fact passage prominent piece evidence favor author conclusion strengthen weaken passage)—based role play author argument e possess consider reasoning text e distinguish factor reasoning text question title skill word question test skill large share cars section question skill introduce completely new situation present passage question ask determine influence reasoning text question require apply extrapolate idea passage new context assess impact introduce new factor information condition idea passage e reasoning text skill divide apply strengthen weaken passage question rarely appear question type sample reasoning text question stem apply document locate demonstrate berlioz intend include chorus 700 grande messe des morts author likely respond apply follow good example virtuous rebellion define passage strengthen weaken passage)—suppose jane austen write letter sister strong character force circumstance confront basic question society live relevance strengthen weaken



passage)—which follow sentence add end passage weaken author conclusion paragraph rough foundations comprehension skill cars section test reading skill build grade school albeit context challenging doctorate level passage skill reasoning text reason text mcats demand understand deep structure passage argument advanced level course test tight timing restriction 102 second question include time spend read passage quick reference guide car skill foundation comprehension question ask understand passage main idea passage particular detail true author reasoning text question ask logical relationship idea argue author thesis reasoning text question ask principle passage apply new situation new piece information influence argument section mcats score 118 132 median approximately 125 is

mean total score range 472 528 median 500 peculiar number e aamc stress scale emphasize importance central portion score distribution student score 125 section 500 total put undue focus high end note wrong answer penalty mcats select answer question guess e aamc release 2018–2020 correlation scale score percentile show follow page note percentile scale adjust renormalize time shi slightly year year percentile rank update release aamc 1 year source aamc 2021 summary mcats total section score access december information score reporting include end section aer test mcats policies procedures strongly encourage download late copy mcats ® essentials available aamc website ensure late information registration test day policy procedure document update annually brief summary important rule provide e way register mcats online access aamc registration system [www.aamc.org/mcats](http://www.aamc.org/mcats) able access site approximately month test day e aamc designate registration zones”—gold silver bronze register gold zone opening registration approximately month test day provide flexibility low test fee e silver zone run approximately week test day flexibility high fee bronze zone run approximately week test day flexibility high fee fee fee assistance program fap payment test registration mastercard visa describe early fee register mcats reschedule exam change testing center increase approach test day addition uncommon test center fill advance registration deadline reason recommend identify prefer test day soon

possible register ere ancillary benefit have set test day know date work study hard likely push exam e aamc offer fee assistance program fap student financial hardship help reduce cost take mcat american medical college application service amcas ® application information fap find [www.aamc.org/students/applying/fap](http://www.aamc.org/students/applying/fap) test day require present qualifying form id generally current driver license united states passport

sufficient consult aamc website list qualify criterion register care spell first name middle name suffixe prefixe require verifie test day precisely appear id failure provide id test center difference spelling registration id consider receive refund exam test day registration identity datum collect include digital palm vein scan test day photo digitization valid id signature testing center use metal detection wand ensure prohibit item bring testing room prohibited item include electronic device include watch timer calculator cell phone form record equipment food drink include water cigarette smoking paraphernalia hat scarf religious purpose book note study material require medical device insulin pump pacemaker apply accommodate testing break allow access food drink electronic device include testing center video surveillance aamc potential violation testing security lightly e line know rule break student disability medical condition apply accommodate testing documentation disability condition require request month approve reason recommend begin process apply accommodate testing early possible information apply accommodated testing find test mcat matter feel good leave test center celebrate nap watch movie exercise plan trip outing neglect friend message social media snack drink people like sure absolutely think hard deserve rest relaxation importantly discuss specific detail test important let stress test day relive exam inhibit able significantly examinee agreement sign beginning exam specifically prohibit discuss disclose exam content e aamc know seek individual violate agreement retain right prosecute individual discretion is mean circumstance discuss exam person phone individual include kaplan post information question exam content facebook student doctor network online social media permit comment general exam experience include feel exam overall

individual section fine line summary certain discuss aspect test let silly facebook post stop doctor deserve score typically release approximately month aer test day e release stagger aernoon evening end

5 p.m. eastern standard time is mean examinee receive score exactly time score report include scale score section 118 132 total combine score 472 528 ese score give confidence interval section confidence interval approximately give score  $\pm 1$  total score approximately give score  $\pm 2$  give corresponding percentile rank section score aamc contact information question contact mcat team association american medical colleges mcat resource center association american medical colleges kaplan mcat review project begin shortly release preview guide mcat 2015 exam 2nd edition thorough analysis staff psychometrician able analyze relative yield different topic mcat begin construct table content book kaplan mcat review series dedicated staff 30 writer 7 editor 32 proofreader work 5,000 combined hour produce book format book heavily influence weekly meeting kaplan learning science year book create number opportunity expansion improvement occur current edition represent culmination wisdom accumulate time frame include new feature design improve reading learning experience text book submit publication april 2022 update date visit [www.kaptest.com/retail-book-](http://www.kaptest.com/retail-book-) question content present email [kaplanmcatfeedback@kaplan.com](mailto:kaplanmcatfeedback@kaplan.com) question relate content email [booksupport@kaplan.com](mailto:booksupport@kaplan.com) book vet round review end information present book true accurate good knowledge feedback help improve prep material notify inaccuracy error book send email [kaplanmcatfeedback@kaplan.com](mailto:kaplanmcatfeedback@kaplan.com)

kaplan mcat biology review book kaplan mcat review series bring kaplan classroom experience right home convenience is book offer kaplan content review strategy practice kaplan 1 choice mcat is book design help review biology topic cover mcat understand content review matter thorough sufficient preparation mcat e mcat test science knowledge

critical reading reasoning problem- solve skill assume simply memorize content book earn high score test day maximize score improve reading test taking skill mcat style question practice test beginning section find short list objective describe skill cover section learning objective text develop conjunction kaplan learning science team design specifically focus attention task concept likely mcat ese learning objective function means guide study indicate information relationship focus section start section read learning objective carefully ey allow assess exist familiarity content provide goal orient focus studying experience mcat concept checks end section find open ended question use assess mastery material ese

mcats concept checks introduce aer numerous conversation kaplan learning science team research demonstrate repeatedly introspection self analysis improve mastery retention recall material complete mcat concept checks ensure get key point section move science mastery assessment beginning chapter find 15 mcat style practice question ese design help assess understanding chapter begin read chapter guidance provide assessment determine good way review chapter base personal strength weakness question science mastery assessments focus first scientific inquiry reasoning skills knowledge scientific concepts principles occasional question fall second fourth sirs scientific reasoning problem solving data base statistical reasoning respectively addition online resource find test like passage set cover content study ensure apply knowledge way mcat expect guide examples expert thinking embed chapter book guide example expert inking ese example locate adjacent content relate contain mcat like scientific article passage read passage real mcat refer expert inking material right clarify key information gather passage read attempt answer associate question work passage ere explanation include correct answer follow question give ese passage question design help build critical thinking experimental reasoning datum interpretation skill preparation challenge face mcat e follow guide five type sidebar find kaplan mcat biology review bridge ese sidebar create connection science topic appear multiple chapter kaplan mcat review key concept ese sidebar draw attention important takeaway give topic offer synopsis overview

complex information understand sure grasp key concepts give subject mcats expertise ese sidebar point information test mcats offer key strategy point test taking tip apply test day mnemonic ese sidebar present memory device help recall real world

ese sidebar illustrate concept text relate practice medicine world large information need know test day topic real world sidebar excellent example concept appear passage discrete stand question mcats book cover e information present kaplan mcats review series cover list official mcats content list topic list cover level detail common undergraduate postbaccalaureate class consider prerequisite mcats note premedical class include topic discuss book depth book additional exposure science content bad thing content knowledge expect walk test day cover chapter profile first page chapter represent holistic look content chapter include pie chart text information e pie chart analysis base directly datum release aamc rough estimate importance chapter relation book text portion chapter profiles include aamc content category cover chapter ese reference directly aamc mcats exam content listing available testmaker website new high yield badge scatter section chapter amino acids find proteins note terminology stereochemistry amino acid structure amino acid hydrophobic hydrophilic amino acids amino acid abbreviation acid base chemistry amino acid protonation deprotonation titration amino acid peptide bond formation hydrolysis peptide bond formation peptide bond hydrolysis primary secondary protein structure tertiary quaternary protein structure folding solvation layer 1.1 amino acid find protein chapter 1.1 able ese badge represent 100 topic test aamc word accord testmaker experience resource high yield badge mean question test day is book contain thorough glossary index easy navigation end book write margin draw diagram highlight key point necessary help high score look forward work achieve dream doctor deserve study book addition provide good practice question test strategy kaplan team learn scientist dedicate research test good method get study time tip improve retention review multiple topic study session is counterintuitive

we're practice skill time order improve skill research show weave topic lead increase learning consideration mcat oen include topic single question study integrated manner effective way prepare test customize content draw attention difficult critical content ensure overlook read read section e good way visual highlight tab use stickie work recommend highlight important difficult section text selective highlighting 10 text give chapter great emphasize part text over-highlighting opposite effect repeat topic time people try memorize concept repeat succession research show retention improve space repeat time mix order study content example try read chapter different order second time revisit practice question answer incorrectly new sequence information review recently help well understand question solution struggle past moment reflect finish read section first time stop think read jot thought margin note content important topic come mind read associate learning memory fantastic way retain information is work answer question aer answer question moment think step take arrive solution lead answer choose understand step take help good decision answer future question addition resource locate text additional online resource await [www.kaptest.com/booksonline](http://www.kaptest.com/booksonline) sure log advantage free practice access resource note access online resource limit original owner book study mcat year medical school frenzied experience student meet requirement rigorous work schedule student learn prioritize time fall hopelessly surprise mcat test specifically design predict success medical school high speed time intensive test mcat demand excellent time management skill endurance grace pressure test prepare have solid plan attack stick key give confidence structure need create study plan good time create study plan beginning mcat preparation use calendar want start purchase planner print free calendar internet use build calendar app smart device track interactive online calendar pick option practical likely use consistently calendar able start plan study schedule following step 1 fill obligation choose day write school extracurricular work obligation class

fill obligation choose day write school extracurricular work obligation class session work shift meeting attend add personal obligation appointment lunch date family social time etc make

appointment calendar hang friend go movie strange plan social activity advance help achieve balance personal professional obligation life get busy have happy balance allow focused productive come time study stay round neglect important addition schedule personal professional obligation plan time take time important study kaplan recommend take day week ideally study obligation minimum study mcat 2 add study block obligation establish calendar framework add study block obligation keep study schedule consistent possible day week study time day official test ideal promote recall possible fit study block studying efficient possible block short frequent period study time week learning perspective study hour day day week valuable study hour day week specifically kaplan recommend study long hour sitting hour block plan minute break hour use break seat quick stretch snack drink clear mind minute break 50 minute study sound like lot break allow deal distraction rest brain 50 minute study block remain fully engaged completely focused 3 add length practice test want add length practice test want test early prep spread remain length practice test evenly test date stagger test way allow form baseline comparison determine area focus right away provide realistic feedback prep perform test day plan calendar aim finish length practice test majority studying week test day allow spend final week complete final brief review know online resource find sample study calendar different test day timeline use starting point sample calendar include focus need area fit timeline test day need customize study calendar need step total time spend study week depend schedule personal prep need time test day recommend spend range 300–350 hour prepare take official mcat way break study hour day day week month

official mcat way break study hour day day week month approach study day week hour day study long period time time study week matter plan ensure complete practice feel completely comfortable mcat content good sign ready test day begin earn goal score consistently practice study mcat cover large material study test day initially daunting combat tip control studying time control content practice require mcat break content specific goal week instead attempt approach test goal want increase overall score 5 point big abstract difficult measure small

scale reasonable goal read chapter day week goal like overwhelming help break studying manageable piece book information familiar probably see content careful familiarity subject necessarily translate knowledge mastery subject assume recognize concept actually know apply quickly appropriate level passively read book instead read actively use free margin space jot important idea draw diagram chart read highlighting excellent tool use sparingly highlight sentence active reading coloring frequently stop ask question read e.g. main point fit overall scheme thing thoroughly explain make connection focus grand scheme ensure know essential content prepare level critical thinking require mcat focus area great opportunity limit have minimal time prepare test day focus big area opportunity area opportunity topic area highly test master likely will time detailed note page book instead use result practice material determine area big opportunity seek take length test sure performance report well identify area opportunity skim content matter demonstrate proficiency pause read thoroughly look unfamiliar particularly difficult begin science mastery assessment beginning chapter question correct reasonable time able quickly skim chapter question prove difficult need spend time read chapter certain subsection chapter thoroughly practice review tracking leave time review practice question length test tempt practice push ahead cover new material quickly possible fail schedule ample time review actually throw away great opportunity improve performance brain rarely remember

actually throw away great opportunity improve performance brain rarely remember see carefully review question solve explanation process retrieve information reopen reinforce connection build brain build long- term retention repeatable skill set exactly need beat review note specific reason miss question get wrong guess spreadsheet like add miss sheet wimis complete practice question periodically review wimis identify pattern consistently miss question certain content area fall testmaker trap mcat prep adjust study plan base available study time result review strength weakness likely change course prep address area important score shift focus area change help review make length test include wimis template sure check



video resource online syllabus miss chem phys 42 nuclear confuse electron absorption chem phys 47 keq miscalculation need memorize equation read answer choice slow scope forget research answer study overlook aspect study environment learning actually occur study home student choice problem arise environment chief distraction studying mentally drain process time pass distraction tempting escape route considerable willpower reason stay focused hard need instead study home head library quiet coffee shop new location possible eliminate usual distraction promote efficient studying instead study home course entire day stay library hour effective studying enjoy rest day mcat matter study practice like test day possible require official test snack chew gum study block turn music television phone practice computer online resource simulate computer base test environment complete practice question work scratch paper noteboard sheet write directly print material will option test day memory tie sense test like study environment easy test day recall information put work learn chapter 1 cell chapter 1 cell organelle cell science mastery assessment pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter

take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 hyperbaric oxygen

treatment certain type bacterial infection therapy patient place chamber partial pressure oxygen significantly increase increase partial pressure oxygen patient tissue treatment likely infection 1 obligate aerobic bacteria 2 facultative anaerobic bacteria 3 aerotolerant anaerobic bacteria 4 obligate anaerobic bacteria 2 follow describe connective tissue cell 1 account cell muscle bone tendon 2 secrete substance form extracellular matrix 3 organ tend form stroma 4 organ provide support epithelial cell 3 following type nucleic acid form genome virus 1 single stranded rna 2 double stranded dna 3 single stranded dna 1 2 ii 3 ii 4 ii iii 4 theory spontaneous generation state live organism arise nonliving material 1859 pasteur demonstrate organism emerge sterilize growth medium weaken theory spontaneous generation support tenet cell 1 live thing compose cell 2 cell basic functional unit life 3 cell arise preexist cell 4 cell carry genetic information form dna 5 mitochondrial dna 1 2 ii 3 ii 4 ii iii 6 follow function smooth endoplasmic 1 lipid synthesis 2 poison detoxification 3 protein synthesis 4 transport protein 7 main function nucleolus 1 ribosomal rna synthesis 2 dna replication 3

function nucleolus 1 ribosomal rna synthesis 2 dna replication 3 cell division 4 chromosome assembly 8 following organelle surround single 9 follow difference allow distinguish prokaryotic eukaryotic cell 1 ribosomal subunit weight 2 presence nucleus 3 presence membrane outside surface cell 4 presence membrane bind organelle 10 follow contain tubulin 11

herpes simplex virus hsv enter human body remain dormant nervous system produce outbreak exposure heat radiation stimulus follow statement correctly describe hsv 1 remain dormant nervous system virus 2 outbreak virus lysogenic cycle 3 herpes simplex virus add genetic information genetic information cell 4 herpes simplex virus contain tail sheath tail fiber 12 resistance antibiotic recognize medical problem mechanism account bacterium ability increase genetic variability adapt resist different antibiotic 1 binary fission 1 ii 2 iii 3 ii iii 4 ii iii

bacterial cell note resistant penicillin bacterium transfer colony lack fertility factor rest colony  
 resistant penicillin penicillin resistant cell start exhibit phenotypic characteristic include  
 secretion novel protein follow method bacterial recombination likely account change 4  
 infection bacteriophage 14 alzheimer disease protein call amyloid precursor protein app  
 cleave form protein call  $\beta$  amyloid protein  $\beta$  pleated sheet structure precipitate form plaque  
 brain mechanism disease similar 15 infection cell viral particle transport nucleus order  
 produce viral protein likely genomic content virus 1 double stranded dna 2 double stranded  
 rna 3 positive sense rna 4 negative sense rna chapter 1 the cell chapter 1.2 eukaryotic cell hy  
 1.3 classification structure prokaryotic cell classification bacteria shape aerobe anaerobes  
 prokaryotic cell structure 1.4 genetics growth prokaryotic cell 1.5 viruse subviral particle hy viral  
 life cycle prion viroids pie chart indicate content chapter relevant nineteen percent question  
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 assembly molecule cell group cell single cellular 2b structure growth physiology genetic  
 prokaryote virus human body contain approximately 37 trillion cell bacterial cell outnumber  
 eukaryotic cell 10 1 cell create tissue form organ cell serve purpose communicate carry  
 reaction life possible sheer number cell human body nearly impressive numerous function cell  
 perform conduction impulse nervous system allow memory learning simultaneous contraction  
 cardiac myocyte pump blood entire human body order understand human organism human  
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crude microscope look cork know characterization spring hooke law  $f = kx$  describe relationship elastic force spring constant displacement spring equilibrium hooke law appear official mcat content list relate topic elastic potential energy testable content equation form energy discuss chapter 2 mcat physics math review prior 1600

organism perceive complete inseparable small part inability small structure simple optical instrument like magnifying glass 1665 robert hooke assemble crude compound microscope test property piece cork notice honeycomb like structure compare space cork small room monastery know cell cork consist desiccate nonliving cell hooke able nucleus organelle cell membrane 1674

anton van leeuwenhoek view live cell microscope later researcher note cell separate cell distinct structure research indicate tissue cell function tissue dependent function cell tissue century later 1850 rudolph virchow demonstrate diseased cell arise normal cell normal tissue original form cell theory consist basic tenet live thing compose cell cell basic functional unit life cell arise preexist cell advance molecular biology fourth tenet add theory cell carry genetic information form deoxyribonucleic acid dna genetic material pass parent daughter cell cell theory create interesting dilemma respect virus virus small structure contain genetic material unable reproduce violate fourth tenet cell theory virion replicate invade organism use ribonucleic acid rna genetic information virus discuss later chapter consider live organism mcat concept check 1.1 assess understanding material question 1 fundamental tenet cell theory solution concept check give chapter mcat biology review find near end chapter concept check locate follow concept summary chapter 1.2 eukaryotic cell high yield chapter 1.2 able explain importance hydrogen peroxide cellular function identify predominant protein find microfilament microtubule distinguish property different cytoskeletal structure classify cell type epithelial connective tissue recall name function cellular organelle eukaryotic cell

organelle major distinction live organism compose prokaryotic eukaryotic cell prokaryotic organism single celled eukaryotic organism unicellular multicellular eukaryotic cell contain true nucleus enclose membrane prokaryotic cell contain nucleus major organelle identify eukaryotic cell cell organelle describe chapter label figure 1.1 eukaryotic cell numerous membrane bind organelle find cytoplasm eukaryotic cell high yield badge section indicate content frequently test cell membrane enclose semifluid cytosol organelle suspend eukaryotic cell organelle membrane bind allow compartmentalization function membrane eukaryotic cell consist phospholipid bilayer membrane unique surface hydrophilic electrostatically interact aqueous environment inside outside cell inner portion hydrophobic help provide highly selective barrier interior cell external environment cell membrane important topic mcat entire chapter chapter 8 mcat biochemistry review devote solely

mcat entire chapter chapter 8 mcat biochemistry review devote solely discuss structure physiology biological membrane cytosol allow diffusion molecule cell nucleus genetic material encode deoxyribonucleic acid dna organize chromosome eukaryotic cell reproduce mitosis allow formation identical daughter cell control center cell nucleus heavily test organelle mcat contain genetic material necessary replication cell nucleus surround nuclear membrane envelope double membrane maintain nuclear environment separate distinct cytoplasm nuclear pore nuclear membrane allow selective way exchange material cytoplasm nucleus nuclear envelope create distinct environment cell separate nucleus cytoplasm permit compartmentalization transcription formation hnRNA dna subsequently process form mRNA translation formation peptide mRNA process discuss chapter 7 mcat biochemistry review genetic material dna contain code region call gene linear dna wind organize protein know histone wind linear strand call chromosome location dna nucleus permit compartmentalization dna transcription separate rna translation finally subsection nucleus know nucleolus ribosomal rna rRNA synthesize nucleolus actually take approximately 25 percent volume entire nucleus identify dark spot nucleus mitochondrion show figure 1.2 call

power plant cell reference important metabolic function mitochondrion contain layer outer inner membrane outer membrane serve barrier cytosol inner environment mitochondrion inner membrane arrange numerous infolding call crista contain molecule enzyme electron transport chain crista highly convoluted structure increase surface area available electron transport chain enzyme space inner outer membrane call intermembrane space space inside inner membrane call mitochondrial matrix describe chapter 10 mcat biochemistry review pumping proton mitochondrial matrix intermembrane space establish proton motive force ultimately proton flow atp synthase generate atp oxidative phosphorylation matrix contain mitochondrial dna inner membrane molecular complex atp produce figure 1.2 mitochondrial structure serial endosymbiosis theory attempt explain formation membrane bind organelle posit organelle form engulfing prokaryote establishment symbiotic relationship addition mitochondrion chloroplast plant cell organelle motility flagella believe originate process mitochondrion different part cell semi autonomous contain gene replicate independently

mitochondrion different part cell semi autonomous contain gene replicate independently nucleus binary fission paradigmatic example cytoplasmic extranuclear inheritance transmission genetic material independent nucleus mitochondrion think originate engulfing aerobic prokaryote anaerobic prokaryote result symbiotic relationship addition keep cell alive provide energy mitochondrion capable kill cell release enzyme electron transport chain release kick start process know apoptosis program cell death lysosome membrane bind structure contain hydrolytic enzyme capable break different substrate include substance ingest endocytosis cellular waste product lysosome function conjunction endosome transport package sort cell material travel membrane endosome capable transport material trans golgi cell membrane lysosomal pathway degradation lysosomal membrane sequester enzyme prevent damage cell release enzyme occur process know autolysis like mitochondrion lysosome release hydrolytic enzyme result apoptosis case release enzyme directly lead degradation cellular component endoplasmic reticulum er series interconnect membrane

actually contiguous nuclear envelope double membrane endoplasmic reticulum fold numerous invagination create complex structure central lumen variety er smooth rough rough er rer stud ribosome permit translation protein destined secretion directly lumen hand smooth er ser lack ribosome utilize primarily lipid synthesis phospholipid cell membrane detoxification certain drug poison ser transport protein rer golgi apparatus golgi apparatus consist stack membrane bind sac material er transfer golgi apparatus vesicle inside golgi apparatus

cellular product modify addition group like carbohydrate phosphate sulfate golgi apparatus modify cellular product introduction signal sequence direct delivery product specific cellular location modification sorting golgi apparatus cellular product repackaging vesicle direct correct cellular location product destined secretion secretory vesicle merge cell membrane content release exocytosis relationship lysosome er golgi apparatus show figure 1.3 vesicle er travel golgi vesicle golgi allow secretion storage travel lysosome figure 1.3 lysosome endoplasmic reticulum golgi apparatus cell relative distribution organelle form follow function cell require lot energy locomotion sperm cell high concentration mitochondrion cell involve secretion pancreatic islet cell endocrine tissue high concentration rer golgi apparatus cell red blood cell primarily serve transport function organelle peroxisome contain hydrogen peroxide primary function peroxisome breakdown long chain fatty acid  $\beta$  oxidation peroxisome participate synthesis phospholipid contain enzyme involve pentose phosphate pathway discuss chapter 9 mcat biochemistry review cytoskeleton show figure 1.4 provide structure cell help maintain shape addition cytoskeleton provide conduit transport material cell component cytoskeleton microfilament microtubule intermediate filament structure distribution microfilament microtubule intermediate filament cell figure 1.4 cytoskeletal element rounded shape near center photograph nucleus microfilament solid polymerize rod actin actin filament organize bundle network resistant compression fracture provide protection cell actin filament use atp generate force movement interact myosin muscle contraction microfilament play role

cytokinesis division material daughter cell mitosis cleavage furrow form microfilament organize ring site division new daughter cell actin filament ring contract ring small eventually pinch connection daughter cell motor protein like kinesin dynein classic example nonenzymatic protein function bind protein cell adhesion molecule immunoglobulin ion channel motor protein travel cytoskeletal structure accomplish function nonenzymatic protein function discuss chapter 3 mcat unlike microfilament microtubule hollow polymer tubulin protein microtubule radiate cell provide primary pathway motor protein like kinesin dynein carry vesicle cilia flagella motile structure compose microtubule cilium projection cell

vesicle cilia flagella motile structure compose microtubule cilium projection cell primarily involve movement material surface cell example cilia line respiratory tract involve movement mucus flagellum structure involve movement cell movement sperm cell reproductive tract cilia flagella share structure compose pair microtubule form outer ring microtubule center show figure 1.5 know  $9 + 2$  structure see eukaryotic organelle motility bacterial flagellum different structure different chemical composition discuss later chapter cross section doublet microtubule central microtubule dynein arm plasma membrane radial spoke inner sheath nexin label figure 1.5 cilium flagellum structure microtubule organize ring 9 doublet 2 central microtubule centriole find region cell call centrosome organize center microtubule structure triplet microtubule hollow center mitosis centriole migrate opposite pole divide cell organize mitotic spindle microtubule emanate centriole attach chromosome complex call kinetochore exert force sister chromatid pull apart intermediate filament diverse group filamentous protein include keratin desmin vimentin lamins intermediate filament involve cell cell adhesion maintenance overall integrity cytoskeleton intermediate filament able withstand tremendous tension increase structural rigidity cell addition intermediate filament help anchor organelle include nucleus identity intermediate filament protein cell specific cell tissue type unique characteristic eukaryotic cell formation tissue division labor different cell tissue carry different function example heart cell participate conduction pathway cause contraction



serve supportive role like maintain structural integrity organ tissue type epithelial tissue connective tissue muscle tissue nervous tissue muscle nervous tissue consider extensively subsequent chapter explore epithelial connective tissue epithelial tissue cover body line cavity provide means protection pathogen invasion desiccation certain organ epithelial cell involve absorption secretion sensation remain cohesive unit epithelial cell tightly join underlie layer connective tissue know basement membrane epithelial cell highly diverse serve numerous function depend identity organ find organ epithelial cell constitute parenchyma functional part organ example nephron kidney compose epithelial cell hepatocyte liver acid produce cell stomach epithelial

compose epithelial cell hepatocyte liver acid produce cell stomach epithelial cell epithelial cell polarize mean face lumen hollow inside organ tube outside world interact underlie blood vessel structural cell example small intestine cell involve absorption nutrient lumen involve release nutrient circulation use rest body classify different epithelium accord number layer shape cell simple epithelium layer cell stratified epithelium multiple layer pseudostratified epithelium appear multiple layer difference cell height reality layer turn shape cell classify cuboidal columnar squamous name imply cuboidal cell cube shaped columnar cell long thin squamous cell flat connective tissue support body provide framework epithelial cell carry function epithelial cell contribute parenchyma organ connective tissue main contributor stroma support structure bone cartilage tendon ligament adipose tissue blood example connective tissue cell connective tissue produce secrete material collagen elastin form extracellular matrix mcat concept check 1.2 assess understanding material question 1 briefly describe function organelle list rough endoplasmic reticulum smooth endoplasmic reticulum 2 child diagnose enzyme deficiency prevent production hydrogen peroxide likely outcome deficiency 3 predominant protein cytoskeletal element 4 cytoskeletal structure centriole flagella differ 5 classify following cell epithelial cell connective tissue fibroblast produce collagen number organ endothelial cell line blood vessel  $\alpha$  cell produce glucagon pancreas

osteoblast produce osteoid material harden bone chondroblast produce cartilage  
1.3 classification structure prokaryotic cell chapter 1.3 able compare contrast archaea bacteria  
eukaryote identify common bacterial shape explain difference gram positive gram negative  
bacteria detail structural difference eukaryotic prokaryotic flagellum differentiate metabolic  
process aerobic anaerobic bacteria prokaryote simple organism include bacteria prokaryote  
contain membrane bind organelle genetic material organize single circular molecule dna  
concentrate area cell call nucleoid region despite simplicity prokaryote incredibly diverse  
knowledge diversity essential study medicine prokaryote cause infection fact choose  
appropriate antibiotic fight infection require knowledge basic structure bacteria cause  
overarching domain life classify archaea bacteria eukarya archaea bacteria

cause overarching domain life classify archaea bacteria eukarya archaea bacteria contain  
prokaryote initially archaea bacteria classify kingdom monera modern genetic biochemical  
technique indicate difference evolutionary pathway archaea bacteria significant domain  
eukarya archaea single celled organism visually similar bacteria contain gene metabolic  
pathway similar eukaryote bacteria historically archaea consider extremophile commonly  
isolate harsh environment extremely high temperature high salinity light recent research  
demonstrate great variety habitat organism include human body archaea notable ability use  
alternative source energy photosynthetic chemosynthetic generate energy inorganic  
compound include sulfur- nitrogen base compound ammonia similarity domain eukaryote  
hypothesize eukaryote archaea share common origin eukaryote archaea start translation  
methionine contain similar rna polymerase associate dna histone archaea contain single  
circular chromosome divide binary fission budding share similar overall structure bacteria  
interestingly archaea resistant antibiotic bacteria contain cell membrane cytoplasm flagella  
fimbria similar cilia show figure 1.6 bacteria eukaryote share analogous structure difficult  
develop medicine target bacteria case seemingly similar structure biochemical difference  
allow exclusive targeting kind organism example bacterial flagella eukaryotic flagella different

scientist able develop antibacterial vaccine specifically target bacterial flagellum antibiotic target bacterial ribosome significantly small eukaryotic ribosome bacillus long projection short projection figure 1.6 prokaryotic cell specialization flagella fimbriae bacteria perform essential function human being include production vitamin k intestine vitamin k require production plasma protein necessary blood clotting newborn infant colonize bacteria produce clotting factor put risk hemorrhage baby bear give injection vitamin k aid production clotting factor colonize bacteria approximately  $5 \times 10^{30}$  bacteria earth outnumber plant animal combine mention introduction chapter bacteria outnumber human cell body 10:1 relationship human body bacteria complex bacteria mutualistic symbiote mean human bacteria benefit relationship example include bacteria human gut produce vitamin k biotin vitamin b7 prevent overgrowth harmful bacteria bacteria pathogen parasite mean provide advantage benefit host cause disease pathogenic bacteria live intracellularly extracellularly example

benefit host cause disease pathogenic bacteria live intracellularly extracellularly example chlamydia trachomatis common sexually transmit infection live inside cell reproductive tract clostridium tetani cause tetanus live outside cell produce toxin enter bloodstream classification bacteria shape classification bacteria shape provide scientist pathologist physician specialize identification characterization disease common language talk bacteria way identify different specie bacteria bacteria exist shape show figure 1.7 spherical bacteria know cocci include common pathogen streptococcus pyogene spherical bacteria rod shaped bacteria spiral shaped bacteria figure 1.7 prokaryotic cell shape cocci staphylococcus aureus b bacilli mycobacterium tuberculosis c spirilli leptospira interrogans rod shaped bacteria like escherichia coli know bacilli finally spiral shaped bacteria know spirilli include specie treponema pallidum cause pathogenic bacteria spiral shaped common treponema pallidum cause syphilis borrelia burgdorferi cause lyme disease leptospira interrogans cause weil disease aerobes anaerobes bacteria require oxygen survival bacteria require oxygen metabolism term obligate aerobe bacteria use fermentation form cellular metabolism require

oxygen call anaerobe different type anaerobe anaerobe survive oxygen contain environment  
call obligate anaerobe presence oxygen lead production reactive oxygen contain radical  
specie lead cell death bacteria toggle metabolic process oxygen aerobic metabolism present  
switch anaerobic metabolism bacteria call facultative anaerobe finally aerotolerant anaerobe  
unable use oxygen metabolism harm presence environment bacteria require oxygen survival  
bacteria require oxygen metabolism term obligate aerobe bacteria use fermentation form  
cellular metabolism require oxygen call anaerobe different type anaerobe anaerobe survive  
oxygen contain environment call obligate anaerobe presence oxygen lead production reactive  
oxygen contain radical specie lead cell death bacteria toggle metabolic process oxygen  
aerobic metabolism present switch anaerobic metabolism bacteria call facultative anaerobe  
finally aerotolerant anaerobe unable use oxygen metabolism harm presence environment  
prokaryotic cell structure main difference prokaryote eukaryote prokaryote lack nucleus  
membrane bind organelle show figure 1.8 prokaryote single celled organism mean cell able  
perform function necessary life prokaryote

celled organism mean cell able perform function necessary life prokaryote live colony cell  
signal cell share information environment cell wall cell membrane contain ribosome dna  
nucleoid region flagellum figure 1.8 prokaryotic cell structure prokaryote form multicellular  
organism bacterium responsible protect environment cell wall form outer barrier cell layer cell  
membrane plasma membrane compose phospholipid similar eukaryote cell wall cell  
membrane know envelope cell wall provide structure control movement solute bacterium  
allow cell maintain concentration gradient relative environment bacteria main type cell wall  
gram positive gram negative type cell wall determine gram staining process crystal violet stain  
follow counterstain substance call safranin envelope absorb crystal violet stain appear deep  
purple cell say gram positive envelope absorb crystal violet stain absorb safranin counterstain  
cell appear pink red say gram negative antibiotic penicillin target enzyme catalyze cross  
linking peptidoglycan gram positive cell cross link cell wall long serve effective barrier

bacterium susceptible osmotic damage lyses bacteria develop resistance mechanism penicillin  
bacteria include streptococcus pyogenes cause strep throat skin infection treponema pallidum  
cause syphilis sensitive gram positive cell wall consist thick layer peptidoglycan polymeric  
substance amino acid sugar addition structural barrier function cell wall aid bacterial  
pathogen provide protection host organism immune system addition peptidoglycan gram  
positive cell wall contain lipoteichoic acid clear role acid serve bacterium human immune  
system activate exposure gram negative cell wall thin contain peptidoglycan small amount  
peptidoglycan cell wall bacteria adjacent cell membrane separate membrane periplasmic  
space addition cell wall cell membrane gram negative bacteria outer membrane contain  
phospholipid lipopolysaccharide interestingly lipopolysaccharide gram negative bacteria  
trigger immune response human being inflammatory response lipopolysaccharide strong  
response lipoteichoic acid bacteria contain cell wall composition different gram positive gram  
negative bacteria specific component cell wall trigger flagella long whip like structure  
propulsion bacteria flagellum depend species flagella food away toxin immune cell

bacteria flagellum depend species flagella food away toxin immune cell ability cell detect  
chemical stimulus away call chemotaxis flagellum compose filament basal body hook show  
figure 1.9 filament hollow helical structure compose flagellin basal body complex structure  
anchor flagellum cytoplasmic membrane motor flagellum rotate rate 300 hz hook connect  
filament basal body basal body rotate exert torque filament spin propel bacterium forward  
overall structure flagella

similar

gram positive gram negative bacteria slight difference different physical structure chemical  
composition envelope gram positive gram negative bacteria archaea contain flagella structure  
flagella different bacteria unlikely ask test day flagellum filament hook basal body figure 1.9

prokaryotic flagellum structure hook connect filament basal body complex structure show mention early prokaryote concentrate dna region cell know nucleoid region contain nuclear envelope prokaryotic dna carry single circular chromosome find coil histone like protein bacteria true histone find archaea addition dna acquire external source carry small circular structure know plasmid plasmid carry dna necessary survival prokaryote consider genome bacterium confer advantage antibiotic resistance prokaryote lack key organelle mitochondrion instead cell membrane electron transport chain generation atp prokaryote contain primitive cytoskeleton nearly complex find eukaryote prokaryote contain ribosome ribosome different size find eukaryote prokaryotic ribosome contain 30s 50s subunit eukaryotic ribosome contain 40s 60s subunit fact prokaryote eukaryote different sized ribosome imply carry protein synthesis slightly different way difference highlight chapter 7 mcat biochemistry review difference allow target bacterial ribosome number antibiotic include tetracycline aminoglycoside macrolide leave eukaryotic ribosome mcat concept check 1.3 assess understanding material question 1 way archaea similar bacteria way archaea similar similar bacteria similar eukaryote 2 common shape bacteria 3 compare contrast metabolism aerobic anaerobic bacteria note yes box carry aerobic carry 4 difference envelope gram positive gram negative bacteria gram positive bacteria susceptible antibiotic 5 structure eukaryotic prokaryotic flagella differ biology guide example expert thinking investigate collective resistance property bacteria co- colonization experiment conduct week old female cd1 mouse infect intratracheally chloramphenicol sensitive cms pneumococcus equivalent quantity cms chloramphenicol resistant cmr pneumococcus 1:1 hour post infection mouse treat intraperitoneal injection chloramphenicol cm concentration 75 mg kg1 follow additional dose space 5 hour apart control mouse receive vehicle injection cmr pneumococcus cm resistant expression resistance factor chloramphenicol bacteria mixture mouse

pneumococcus cm resistant expression resistance factor chloramphenicol bacteria mixture mouse ip injection vehicle vehicle stable bacterial coexistence require successful adjustment

ecological constraint limited resource antibiotic concentration well quantify bacterial behavior  
condition vitro population analysis conduct base setup resistant analysis iv control figure 1  
mixed culture experiment antibiotic stress cms cms + cmr co colonization condition b co  
colonization colony analysis cms cmr ratio figure 2 bacterial growth trajectory subject  
antibiotic stress resource competition b axis indicate co- colonization experiment parameter  
efficiency refer growth rate efficiency cmr cell dot indicate figure 1 experiment antibiotic level  
previous analysis establish cms area s cmr area r bacterial growth area n competition induce  
extinction area e cms bacteria outcompete cmr bacteria subsequently clear antibiotic density  
cmr 200 min level base adapt sorg r. a. lin l. van doorn g. s. sorg m. olson j. nize

v. veening j. w. 2016 collective resistance microbial community intracellular antibiotic  
deactivation plos biology 14(12 e2000631 consider following successful co colonization cms  
growth efficiency cmr remain constant value presence absence antibiotic stress conclusion  
valid question ask analyze conclusion validity find key term locate passage case ask growth  
efficiency find figure description figure 2b accord description growth efficiency reference  
growth rate cmr depict x axis graph conclusion give question stem state growth efficiency  
unchanged presence antibiotic determine conclusion valid need decipher graph represent  
figure description rich source crucial information accord figure 2b description area graph  
depict different outcome cms cmr co colonization ensure draw valid conclusion examine  
graph axis time analyze graph hold variable constant assume antibiotic present mean  
antibiotic stress zero look x axis zero line growth efficiency cmr decrease cms strain start  
outcompete fact growth efficiency cmr high susceptible strain cms outcompete cmr.

let hold variable different level let assume antibiotic stress high look right x axis condition  
growth susceptible strain make sense susceptible strain expect survive antibiotic x axis value  
area e slightly low cmr growth efficiency susceptible strain outcompete cmr remove  
protection succumb antibiotic fact growth efficiency cmr high bacteria successfully grow

observation observe growth efficiency cmr strain large influence co colonized strain grow  
shade area figure 2b explain figure description deduce meaning context possibility designate  
area graph base figure label successful co colonization shade area area cms cmr area figure  
description learn large dot indicate experiment conduct figure 1 condition figure 1 experiment  
demonstrate successful co- colonization conclude shade area region successful co-  
colonization strain conclusion present question stem claim growth efficiency cmr change  
antibiotic presence assess simply need compare condition antibiotic successful co-  
colonization occur growth efficiency cmr 1 growth efficiency high cms strain outcompete raise  
antibiotic level red dot growth efficiency remain 1 cmr bacteria outcompete cms bacteria  
order strain coexist antibiotic stress resistance strain growth efficiency low 1 reasonably argue  
conclusion

valid 1.4genetics growth prokaryotic cell high- chapter 1.4 able describe bacterial genetic  
recombination transformation conjugation recall phase bacterial growth curve major feature  
see prokaryotic cell differ eukaryotic cell structurally biochemically prokaryote reproduce  
asexual reproduction form binary fission addition prokaryote capable acquire genetic material  
outside cell binary fission show figure 1.10 simple form asexual reproduction see prokaryote  
circular chromosome attach cell wall replicate cell continue grow size eventually plasma  
membrane cell wall begin grow inward midline cell produce identical daughter cell binary  
fission require few event mitosis proceed rapidly fact strain e. coli replicate 20 minute ideal  
growth figure 1.10 stage binary fission single circular chromosome prokaryotic cell contain  
information necessary cell survive reproduce bacteria contain extrachromosomal  
extragenomic material know plasmid plasmid carry gene impart benefit bacterium antibiotic  
resistance mechanism show figure 1.11 plasmid carry additional virulence factor trait increase  
pathogenicity toxin production projection allow attachment certain kind cell feature allow  
evasion host immune system subset plasmid call episome capable integrate genome  
bacterium figure 1.11 mechanism antibiotic resistance bacterial genetic recombination help



increase bacterial diversity permit evolution bacterial species time recombination process include transformation conjugation transduction transformation result integration foreign genetic material host genome foreign genetic material frequently come bacteria lyse spill content vicinity bacterium capable transformation gram negative rod able carry process conjugation bacterial form mating sexual reproduction involve cell form conjugation bridge facilitate transfer genetic material transfer unidirectional donor male + recipient female bridge appendage call sex pili find donor male form pilus bacteria contain plasmid know sex factor contain necessary gene well study sex factor f fertility factor

e. coli bacteria possess plasmid term f<sup>+</sup> cell call f cell conjugation f<sup>+</sup> cell replicate f factor donate copy f cell convert f<sup>+</sup> cell enable cell obtain new plasmid transfer copy cell method genetic recombination allow rapid acquisition antibiotic resistance virulence factor colony plasmid pass conjugation bridge process conjugation illustrate figure 1.12 figure 1.12 bacterial conjugation sex factor plasmid process transformation integrate host genome case conjugation occur entire genome replicate contain sex factor donor cell attempt transfer entire copy genome recipient bridge usually break dna sequence move cell undergo change refer abbreviation hfr high frequency transduction genetic recombination process require vector virus carry genetic material bacterium virus obligate intracellular pathogen mean reproduce outside host cell bacteriophage virus infect bacteria accidentally incorporate segment host dna assembly bacteriophage infect bacterium release trap dna new host cell transfer dna integrate genome give new host additional gene process transduction show figure 1.13 figure 1.13 bacterial transduction transposon genetic element capable insert remove genome phenomenon limit prokaryote see eukaryote transposon insert code region gene gene disrupt discuss previously bacteria reproduce binary fission imply bacteria exactly local colony assume mutation genetic recombination bacteria divide fast bacteria say grow series phase show figure 1.14 new environment bacteria adapt new local condition lag phase bacteria adapt rate division increase cause exponential increase number bacteria colony

exponential phase call log phase number bacteria colony grow resource reduce reduction  
resource slow reproduction stationary phase result bacteria exceed ability environment  
support number bacteria death phase occur mark depletion resource figure 1.14 bacterial  
growth curve

big challenge doctor face patient compliance treatment especially antibiotic patient fail  
complete entire course antibiotic discontinue treatment feel well unfortunately breed  
antibiotic resistance kill bacteria nonresistant leave bacteria resistant resistant bacteria  
reproduce result recurrence infection time practice lead bacteria resistant multiple antibiotic  
make common infection difficult treat bacterial growth curve example semilog plot fact y axis  
logarithmic mean straight line see exponential phase actually represent exponential increase  
number bacteria linear increase semilog log log plot discuss chapter 12 mcat physics math  
mcat concept check 1.4 assess understanding material question 1 briefly describe mechanism  
bacterial genetic recombination 2 phase bacterial growth curve feature 1.5 virus subviral  
particle chapter 1.5 able explain virus define obligate intracellular parasite recall key virus  
terminology include retrovirus positive negative sense describe virus able produce progeny  
infection host cell compare contrast lytic lysogenic cycle describe prion viroid able cause  
disease beginning chapter discuss cell theory note virus fit definition live thing acellular virus  
small 20 nm large 300 nm reference prokaryote 1–10  $\mu\text{m}$  eukaryote time large unlike  
eukaryotic cell virus lack organelle nucleus virus compose genetic material protein coat  
envelope contain lipid genetic information circular linear single- double- stranded compose  
dna rna protein coat know capsid surround envelope compose phospholipid virus specific  
protein envelope sensitive heat detergent desiccation enveloped virus easy kill hand virus  
envelope resistant sterilization likely persist surface extended period time virus reproduce  
independently consider obligate intracellular parasite virus express replicate genetic  
information host cell lack ribosome carry protein synthesis hijack cell machinery virus replicate  
produce viral progeny call virion release infect additional cell bacteriophage virus specifically

target bacteria actually enter bacteria simply inject genetic material leave remain structure outside infected cell addition capsid bacteriophage contain tail sheath tail fiber show figure 1.15 tail sheath act like syringe inject genetic material bacterium tail fiber help bacteriophage

like syringe inject genetic material bacterium tail fiber help bacteriophage recognize connect correct host cell figure 1.15 structure bacteriophage viral genome come variety shape size gene addition viral genome single- double stranded dna rna single stranded rna virus positive sense negative sense positive sense imply genome directly translate functional protein ribosome host cell like mrna negative sense rna virus bit complicated negative sense rna strand act template synthesis complementary strand template protein synthesis negative sense rna virus carry rna replicase virion ensure complementary strand synthesize retrovirus enveloped single stranded rna virus family retroviridae usually virion contain identical rna molecule virus carry enzyme know reverse transcriptase synthesize dna single stranded rna dna integrate host cell genome replicate transcribe host cell dna clever mechanism integration genetic material host cell genome allow cell infect indefinitely way remove infection kill infected cell human immunodeficiency virus hiv retrovirus utilize life cycle characteristic hiv difficult treat show figure figure 1.16 life cycle human immunodeficiency virus hiv retrovirus transduction investigation method gene therapy theorize retroviral transduction method deliver functional version miss altered gene correct protein synthesize certain disease treat gene therapy discuss chapter 6 mcat biochemistry viral life cycle discuss virus infect host cell use host cell machinery order reproduce discuss viral life cycle detail virus infect specific set cell bind specific receptor host cell proper receptor cell essentially invisible virus virus bind correct receptor virus cell bring close proximity permit additional interaction enveloped virus fuse plasma membrane cell allow entry virion host cell host cell mistake virus bind membrane nutrient useful molecule actually bring virus cytoplasm endocytosis mention early bacteriophage use tail fiber anchor cell membrane inject genome host bacterium tail sheath tail fiber enzymatic activity allow penetration cell wall formation pore cell membrane

depend virus different portion virion insert host cell enveloped virus hiv fuse

different portion virion insert host cell enveloped virus hiv fuse membrane enter cell intact  
bacteriophage insert genetic material leave capsid outside host cell hiv bind receptor call ccr5  
white blood cell order infect people lack receptor immune hiv recently case hiv positive  
individual leukemia receive bone marrow transplant donor lack ccr5 leukemia cure patient  
experience remission hiv infection white blood cell newly acquire bone marrow susceptible hiv  
infection translation progeny assembly infection translation viral genetic material occur order  
virus reproduce require translocation genetic material correct location cell dna virus enter  
nucleus order transcribe mrna mrna go cytoplasm translate protein genetic material positive  
sense rna virus stay cytoplasm directly translate protein host cell ribosome negative sense rna  
virus require synthesis complementary rna strand rna replicase translate form protein dna  
form reverse transcription retrovirus travel nucleus integrate host genome ribosome trna  
amino acid enzyme host cell viral rna translate protein protein structural capsid protein allow  
creation new virion cytoplasm host cell viral genome replicate package capsid note viral  
genome return original form packaging example retrovirus transcribe new copy single  
stranded rna dna enter host genome single virus create hundred thousand new virion single  
host cell viral progeny release multiple way viral invasion initiate cell death result spilling viral  
progeny second host cell lyse result fill extremely large number virion lysis actually  
disadvantage virus virus long use cell carry life cycle finally virus leave cell fuse plasma  
membrane show figure 1.17 process know extrusion process keep host cell alive allow  
continue use host cell virus virus state say productive cycle figure 1.17 viral extrusion lytic  
lysogenic cycle depend growth condition specific virus bacteriophage enter lytic lysogenic life  
cycle phase similar lysis productive cycle method progeny release discuss lytic cycle  
bacteriophage maximize use cell machinery little regard survival host cell host swell new virion  
machinery little regard survival host cell host swell new virion cell lysis bacteria infect virus

lytic phase term event virus lyse bacterium integrate host genome provirus prophage initiate lysogenic cycle case virus replicate bacterium reproduce host genome virus remain integrated host genome indefinitely environmental factor radiation light chemical cause provirus leave genome revert lytic cycle mention early provirus extract bacterial gene leave genome allow transduction gene bacterium bacteriophage kill host integration phage host genome actually benefit bacterium infection strain phage generally make bacterium susceptible superinfection simultaneous infection phage provirus relatively innocuous arrangement confer evolutionary advantage lytic lysogenic cycle contrast figure 1.18 figure 1.18 lytic vs. lysogenic cycle bacteriophage prions viroids prions viroid small subviral particle cause disease certain prions infectious protein nonliving thing cause disease trigger misfolding protein usually conversion protein  $\alpha$  helical structure  $\beta$  pleated sheet drastically reduce solubility protein ability cell degrade protein eventually protein aggregate form interfere cell function prion know cause bovine spongiform encephalopathy

mad cow disease creutzfeldt jakob disease familial fatal insomnia human viroid small pathogen consist short circular single stranded rna infect plant viroid bind large number rna sequence silence gene plant genome prevent synthesis necessary protein result metabolic disruption structural damage cell viroid classically think plant pathogen example human viroid exist include hepatitis d virus hdv hdv innocuous coinfect hepatitis b virus hbv hdv able exert silence effect human hepatocyte mcat concept check 1.5 assess understanding material question 1 virus consider obligate intracellular parasite 2 coronavirus cause common cold describe enveloped single stranded positive sense rna virus indicate virus 3 briefly describe pathway retroviral nucleic acid infection host cell release viral progeny 4 difference lytic lysogenic cycle 5 prion cause disease chapter introduce basis biology cell theory live thing prokaryotic eukaryotic cell prokaryote simple contain membrane bind organelle eukaryote contain membrane bind organelle highly specialized function eukaryotic organism especially human primary focus test day understanding prokaryotic structure physiology necessary

understand infectious disease virus nonliving infectious particle invade cell order reproduce finally discuss small infectious particle prion viroid discussion focus primarily eukaryote spend significant time clinical career battle pathogen present chapter vaccine available number bacteria bacillus anthracis anthrax corynebacterium diphtheriae diphtheria haemophilus influenzae type b upper respiratory ear infection neisseria meningitidis case bacterial meningitis streptococcus pneumoniae case bacterial pneumonia clostridium tetani tetanus salmonella typhi typhoid bordetella pertussis whooping cough virus varicella zoster virus chickenpox shingles hepatitis b virus human papillomavirus hpv influenza measles mumps polio rabies rotavirus rubella yellow fever vaccine target antibiotic antiviral therapy appropriate pharmacotherapy usually depend understanding bacterial viral physiology know resistance pattern local area word principle present chapter everyday life physician discuss method cellular reproduction division bacterial cell cell binary fission eukaryotic cell replicate use different process mitosis chapter turn attention mitosis meiosis human reproduction review content test

chapter turn attention mitosis meiosis human reproduction review content test knowledge critical thinking skill complete test like passage set online cell theory basic tenet live thing compose cell cell basic functional unit life cell arise preexist cell cell carry genetic information form dna genetic material pass parent daughter cell virus consider live thing acellular reproduce assistance host cell use rna genetic eukaryote membrane bind organelle nucleus form cell membrane membrane organelle contain phospholipid organize form hydrophilic interior exterior surface hydrophobic core cytosol suspend organelle allow diffusion molecule eukaryotic organelle serve specific function nucleus contain dna organize chromosome surround nuclear membrane envelope double membrane contain nuclear pore way exchange material nucleus cytosol dna organize code region call gene nucleolus subsection nucleus ribosomal rna rrna mitochondrion contain outer inner membrane outer membrane form barrier cytosol inner membrane fold crista contain enzyme electron transport chain

membrane intermembrane space inside inner mitochondrial membrane mitochondrial matrix  
mitochondrion divide independently nucleus binary fission trigger apoptosis release  
mitochondrial enzyme cytoplasm lysosome contain hydrolytic enzyme break substance ingest  
endocytosis cellular waste product enzyme release autolysis cell occur endoplasmic reticulum  
er series interconnected membrane continuous nuclear envelope rough er rER studded with ribosome  
permit translation protein destined for secretion smooth er sER lipid synthesis detoxification golgi  
apparatus consist stack membrane bound sacs cellular product modify package direct specific  
cellular peroxisome contain hydrogen peroxide break long chain fatty acid  $\beta$  oxidation  
participate phospholipid synthesis pentose phosphate pathway cytoskeleton provide stability  
rigidity overall structure cell provide transport pathway molecule cell microfilament compose  
actin provide structural protection cell cause muscle contraction interaction myosin help form  
cleavage furrow cytokinesis mitosis microtubule compose tubulin create pathway motor  
protein like kinesin dynein carry vesicle contribute structure cilia flagella organize pair  
microtubule ring microtubule center 9 + 2 structure centriole found in centrosome involve  
microtubule organization mitotic spindle intermediate

structure centriole found in centrosome involve microtubule organization mitotic spindle  
intermediate filament involve cell cell adhesion maintenance integrity cytoskeleton help  
anchor organelle common examples include keratin desmin epithelial tissue cover body line  
cavity protect pathogen invasion desiccation epithelial cell absorb secrete substance  
participate sensation organ epithelial cell form parenchyma functional part organ epithelial  
cell polarize face lumen outside world face blood vessel structural cell epithelia classify  
number layer simple epithelium layer stratified epithelium layer pseudostratified epithelium  
appear multiple layer difference cell height actually layer epithelia classify shape cell cuboidal  
cell cube-shaped columnar cell long narrow squamous cell flat connective tissue support body  
provide framework epithelial cell organ connective tissue form stroma support structure  
secrete material form extracellular matrix bone cartilage tendon ligament adipose tissue

blood classification structure prokaryotic cells prokaryote contain membrane bind organelle contain genetic material single circular molecule dna locate nucleoid region overarching domain life prokaryote account archaea extremophile live harsh environment high temperature high salinity light use chemical source energy chemosynthesis light photosynthesis similarity eukaryote start translation methionine similar rna polymerase histone bacteria single circular chromosome divide binary fission bacteria similar structure eukaryote complex relationship human include mutualistic symbiosis eukarya non prokaryotic domain bacteria classify shape spherical bacteria call cocci rod shaped bacteria call bacilli spiral shaped bacteria call spirilli bacteria classify base metabolic process obligate aerobe require oxygen metabolism obligate anaerobe survive oxygen contain environment carry anaerobic metabolism facultative anaerobe survive environment oxygen toggle metabolic process base environment aerotolerant anaerobe use oxygen metabolism survive oxygen contain environment cell wall cell membrane bacteria form envelope control movement solute cell bacteria classify color cell wall turn gram staining crystal violet stain follow counterstain safranin gram positive bacteria turn purple gram negative bacteria turn pink- gram positive bacteria thick cell wall compose peptidoglycan gram negative bacteria thin cell wall

cell wall compose peptidoglycan gram negative bacteria thin cell wall compose peptidoglycan outer membrane contain phospholipid lipopolysaccharide bacteria flagellum generate propulsion bacterium food away immune cell move response chemical stimulus call chemotaxis bacterial flagellum contain filament compose flagellin basal body anchor rotate flagellum hook connect prokaryote carry electron transport chain cell membrane prokaryotic ribosome small eukaryotic ribosome 30s 50s 40s 60s genetics growth prokaryotic cells prokaryote multiply binary fission chromosome replicate cell grow size cell wall begin grow inward midline cell divide identical daughter cell addition single circular chromosome prokaryote extrachromosomal material carry plasmid plasmid contain antibiotic resistance gene virulence factor plasmid integrate genome call bacterial genetic recombination increase



bacterial diversity transformation occur genetic material surrounding take cell incorporate material genome conjugation transfer genetic material bacterium conjugation bridge plasmid transfer f<sup>+</sup> cell f<sup>-</sup> cell portion genome transfer hfr cell transduction transfer genetic material bacterium bacteriophage vector transposon genetic element insert remove genome bacterial growth

follow predictable pattern bacteria adapt new local condition lag phase growth increase exponentially exponential log phase resource reduce growth level stationary phase resource deplete bacteria undergo death phase virus subviral particle virus contain genetic material protein coat capsid lipid- virus obligate intracellular parasite mean survive replicate outside host cell individual virus particle call virion bacteriophage virus target bacteria addition structure contain tail sheath inject genetic material bacterium tail fiber allow bacteriophage attach host cell viral genome nucleic acid compose dna rna single- double- single stranded rna virus positive sense translate host cell negative sense require complementary strand synthesize rna replicase translation retrovirus contain single stranded rna genome complementary dna strand reverse transcriptase dna strand integrate genome virus infect cell attach specific receptor enter cell fuse plasma membrane bring endocytosis inject genome cell virus reproduce replicate translate genetic material host cell ribosome trna amino acid enzyme viral progeny release cell death lysis extrusion bacteriophage specific life cycle lytic cycle bacteriophage produce massive number new virion cell lyse bacteria lytic phase term virulent lysogenic cycle virus integrate host genome provirus prophage reproduce cell provirus remain genome indefinitely leave genome response stimulus enter lytic cycle prion infectious protein trigger misfolding protein usually convert  $\alpha$  helical structure  $\beta$  pleated sheet decrease solubility protein increase resistance degradation viroid plant pathogen small circle complementary rna turn gene result metabolic structural change potentially cell answer concept check 1 live thing cell cell basic functional unit life cell arise cell genetic information carry form deoxyribonucleic acid dna pass parent daughter cell 1 nucleus store genetic

information site transcription mitochondrion involve atp production apoptosis lysosome break cellular waste product molecule ingest endocytosis involve apoptosis rough endoplasmic reticulum synthesize protein destined secretion smooth endoplasmic reticulum involve lipid synthesis detoxification golgi apparatus package modify distribute cellular product peroxisome break long chain

apparatus package modify distribute cellular product peroxisome break long chain fatty acid synthesize lipid contribute pentose phosphate pathway 2 peroxisome dependent hydrogen peroxide function enzyme deficiency result inability form hydrogen peroxide likely result inability digest long chain fatty acid fatty acid build peroxisome displace cellular content ultimately result cell 3 microfilament compose actin microtubule compose tubulin intermediate filament differ cell type compose keratin desmin vimentin lamin 4 centriole consist triplet microtubule hollow center flagella consist doublet outside microtubule 5 endothelial cell  $\alpha$  cell epithelial cell fibroblast osteoblast chondroblast connective tissue cell 1 archaea similar bacteria single celled organism lack nucleus membrane bound organelle contain single circular chromosome divide binary fission budding similar eukaryote start translation methionine contain similar rna polymerase contain dna associate histone 2 common shape bacteria spherical coccus rod shaped bacilli spiral shaped spirilli carry aerobic carry 4 antibiotic penicillin target enzyme catalyze cross linking peptidoglycan gram positive bacteria thick layer peptidoglycan lipoteichoic acid contain outer membrane gram negative bacteria thin layer peptidoglycan outer membrane contain lipopolysaccharide phospholipid penicillin antibiotic similar function easily reach weaken peptidoglycan layer 5 eukaryotic flagellum contain microtubule compose tubulin organize 9 + 2 arrangement bacterial flagellum flagellin consist filament basal body hook 1 transformation acquisition exogenous genetic material integrate bacterial genome conjugation transfer genetic material bacterium conjugation bridge plasmid transfer  $f^+$  cell  $f^-$  cell portion genome transfer hfr cell recipient transduction transfer genetic material bacterium bacteriophage bacteria environment little growth bacteria use available

resource multiply exponential stationary phase bacterial multiplication slow resource bacteria die resource insufficient support 1 virus contain organelle ribosome order reproduce synthesize protein virus infect cell hijack 2 description indicate virus contain outer layer phospholipid inner capsid capsid single stranded rna immediately translate protein ribosome host cell 3 nucleic acid enter single stranded rna undergo reverse transcription reverse transcriptase form

enter single stranded rna undergo reverse transcription reverse transcriptase form double stranded dna dna enter host genome replicate host cell dna transcribe mrna structural protein mrna double viral genome new virion new virion assemble structural protein mrna single stranded rna genome virion release infect cell 4 lytic cycle bacteriophage replicate host cell extremely high number host cell lyse release virion lysogenic cycle bacteriophage genome enter host genome replicate host cell provirus response appropriate stimulus provirus leave host genome synthesize new virion 5 prion cause disease trigger change conformation protein  $\alpha$  helix  $\beta$  pleated sheet change reduce solubility protein make highly resistant degradation science mastery assessment explanation obligate anaerobe survive presence oxygen likely kill therapy treat infection type bacteria list survive presence oxygen infection involve bacteria likely treat therapy bone tendon compose predominantly connective tissue cell muscle tissue consider different tissue type example connective tissue include cartilage ligament adipose tissue blood connective tissue secrete substance form extracellular matrix collagen elastin eliminate b c d essentially identical eliminate organ connective tissue form support structure epithelial cell call stroma virus nucleic acid dna rna case single- double stranded type nucleic acid list viral genome make d correct answer process sterilization kill live cell lack cellular growth condition support idea cell arise preexist cell match c contrast experiment directly visualize cell analyze genetic material b d eliminate mitochondrion think evolve anaerobic prokaryote engulf aerobic prokaryote establish symbiotic relationship mitochondrial dna mdna likely similar bacterial dna mdna bacterial dna organize single

circular chromosome double stranded dna replicate binary fission statement ii correct statement iii incorrect smooth endoplasmic reticulum involve transport material cell lipid synthesis detoxification drug poison protein rough er cross smooth er secrete cytoplasmic vesicle transport golgi apparatus protein synthesis function smooth er free ribosome ribosome associate rough er c nucleolus confuse nucleus dense

ribosome ribosome associate rough er c nucleolus confuse nucleus dense structure nucleus ribosomal rna rrna synthesize correct lysosome vesicular organelle digest material hydrolytic enzyme surround single membrane mitochondrion nucleus surround double membrane eliminate b c ribosome surround membrane find eukaryote prokaryote lack membrane bind organelle eliminate d main difference prokaryote eukaryote prokaryote nucleus eukaryote eliminate b prokaryote ribosomal subunit 30s 50s eukaryote ribosomal subunit 40s 60s eliminate prokaryote membrane bind organelle eukaryote eliminate d presence membrane outer surface cell distinguish prokaryotic cell eukaryotic gram negative bacteria animal cell share feature c correct answer tubulin primary protein microtubule responsible structure movement cilia flagella eliminate b centriole organize microtubule mitotic spindle eliminate d microfilament compose tubulin actin make c correct answer virus exist lytic lysogenic cycle switch lytic cycle virus dna take control host cell genetic machinery manufacture numerous progeny end host cell burst lyse release new virion capable infect cell lysogenic cycle viral dna add host cell genome remain dormant day year spontaneously result environmental circumstance provirus reactivate enter lytic cycle b incorrect term reverse d describe feature bacteriophage virus infect bacteria human nervous system c accurately describe hsv operate lysogenic cycle make correct answer bacterial cell reproduce binary fission asexual process progeny identical parent binary fission statement increase genetic variability conjugation describe sexual mating bacteria transfer genetic material bacteria temporarily join transduction occur fragment bacterial chromosome accidentally package viral progeny produce viral infection introduce bacterium viral vector conjugation transduction statement ii

iii increase bacterial genetic variability bacterial cell rapidly cause phenotypic change rest colony likely f+ mean cell able form sex pilus conjugation make correct expression new phenotypic characteristic indicate bacterium acquire genetic material environment transformation b transduction occur bacteriophage infection c d prion infectious protein cause misfolding protein prion generally cause shift  $\beta$  pleated sheet conformation cause decrease solubility

generally cause shift  $\beta$  pleated sheet conformation cause decrease solubility increase resistance degradation ultimately lead disease mechanism similar describe alzheimer disease make c correct answer virus require transport nucleus order produce viral protein likely require use nuclear rna polymerase order create mrna translate protein dna virus need transport nucleus produce viral protein eliminate answer choice consult online resource additional practice online biochemistry chapter 3 nonenzymatic protein function protein analysis biochemistry chapter 8 biochemistry chapter 10 carbohydrate metabolism ii biology chapter 2 biology chapter 8 immune system biology chapter 12 genetics evolution chapter 2 reproduction chapter 2 reproduction gram stain cell background science mastery assessment pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept

summary end chapter 1 follow correct sequence development mature sperm cell 1 spermatid 1 ° spermatocytespermatogonium2 °

2 spermatogonium1 ° spermatocyte2 ° 3 spermatozoan1 ° spermatocyte2 ° 4 spermatogonium1 ° spermatocyte2 ° 2 follow correctly pair stage development egg cell relevant point woman life cycle 1 birth menarche prophase ii 2 ovulation metaphase 3 ovulation metaphase ii 4 fertilization prophase ii 3 study suggest patient alzheimer disease defect way spindle apparatus attach kinetochore fiber stage mitotic division expect able visualize problem 4 researcher wish incorporate radiolabeled deoxyadenine genome daughter cell arise result mitosis late stage cellular development radiolabeled deoxyadenine add achieve result 5 certain ovarian tumor call granulosa cell tumor know produce excessive level estrogen physician diagnose granulosa cell tumor look secondary cancer following part reproductive tract 1 fallopian tube 6 ovulation oocyte release 1 fallopian tube 3 abdominal cavity 7 cancer cell cell mitosis occur continuously regard quality quantity cell produce reason chemotherapy attack rapidly divide cell point(s cell cycle chemotherapy effectively prevent cancer cell 1 s stage 1 2 ii 3 ii iii 4 ii iii 8 following incorrectly pair structure male reproductive system feature structure 1 seminal vesicle produce alkaline fructose contain 2 prostate gland surround muscle raise lower 3 vas deferens tube connect epididymis ejaculatory 4 Cowper gland produce fluid clear trace urine 9 point meiotic cycle cell diploid number chromosome 1 interphase 2 telophase 3 interkinesis 4 telophase ii 10 follow likely contribute genetic 1 random fertilization egg sperm 2 random segregation homologous chromosome 3 crossing homologous chromosome meiosis 4 replication dna s stage 11 follow statement correctly identify key difference mitosis meiosis 1 metaphase mitosis replicate chromosome line single file metaphase ii meiosis replicate chromosome line opposite side metaphase plate 2 anaphase mitosis homologous chromosome separate anaphase meiosis sister chromatid separate 3 end telophase mitosis daughter cell identical end meiosis daughter cell identical parent cell 4 metaphase mitosis centromere present directly

cell identical parent cell 4 metaphase mitosis centromere present directly metaphase plate  
metaphase meiosis centromere metaphase plate 12 follow true prophase 1 chromosome  
separate opposite pole 2 spindle apparatus disappear 3 chromosome uncoil 4 nucleolus  
disappear 13 individual phenotypically female find copy disease carry recessive allele x  
chromosome demonstrate classic symptom disease geneticist determine individual genotype  
likely arise nondisjunction parent likely genotype 1 46,xx 46 chromosome xx sex chromosome  
14 phase menstrual cycle progesterone 1 follicular phase 3 luteal phase 15 following see  
pregnancy 1 high level hcg trimester 2 high level progesterone pregnancy 3 low level fsh  
trimester 4 high level gnrh pregnancy chapter 2.1 the cell cycle mitosis by cell cycle control cell  
cycle 2.3 the reproductive system by male reproductive anatomy female reproductive anatomy  
menstrual cycle pie chart indicate content chapter relevant percent question biology mcat  
content chapter relevant 9 question biology mcat chapter cover material following aamc  
content category 1c transmission heritable information generation generation process  
increase genetic diversity 2c process cell division differentiation specialization 3b structure  
integrative function main organ system mammal share certain characteristic milk produce  
mammary gland bone middle ear lower jaw fur hair heterodont dentition different kind tooth  
sebaceous oil produce sudoriferous sweat gland placenta formation embryonic development  
characteristic human explore chapter 3 mcat biology review group mammal birth young bit  
differently break proto-therian line

metatherian prototherian monotreme include duckbilled platypus echidna spiny anteater  
encase develop embryo hard shelled amniotic egg lay hatch like reptile method development  
refer oviparity metatherians marsupial include koala kangaroo typical metatherian fetus joey  
undergo development mother uterus climb birth canal marsupium pouch bit strange essential  
reproduction different mammalian specie fact wide variety reproductive scheme nature  
organism reproduce sexual partner reproduce sexually asexually depend environmental

condition chapter 1 mcat biology review explore bacteria virus reproduce chapter explore eukaryotic female 2.1 the cell cycle mitosis high yield chapter 2.1 able describe phase mitosis major event phase identify stage cell cycle major event animal autosomal cell say diploid  $2n$  mean contain copy chromosome germ cell haploid  $n$  contain copy chromosome human number 46 23 respectively inherit 23 chromosome parent eukaryotic cell replicate cell cycle specific series phase cell grow synthesize dna divide derangement cell cycle lead unchecked cell division responsible formation cancer cell cycle cell cycle show figure 2.1 perennial mcat favorite actively divide cell cell cycle consist stage  $G_1$  s  $G_2$  m. stage  $G_1$  s  $G_2$  know collectively interphase interphase long cell cycle actively divide cell spend 90 percent time interphase cell divide spend time offshoot  $G_1$  call  $G_0$   $G_0$  stage cell simply live carry function preparation division pie chart  $G_1$  s  $G_2$  m.  $G_0$  show offshoot  $G_1$  show consist  $G_1$  s  $G_2$  combine figure 2.1 cell cycle interphase individual chromosome visible light microscopy condensed form know chromatin dna available rna polymerase gene transcribe mitosis preferable condense dna tightly coil chromosome avoid lose genetic material cell division  $G_1$  stage presynthetic gap  $G_1$  stage cell create organelle energy protein production mitochondrion ribosome endoplasmic reticulum increase size addition passage s synthesis stage govern restriction point certain criterion contain proper complement dna meet cell pass restriction point enter synthesis s stage synthesis dna s stage

restriction point enter synthesis s stage synthesis dna s stage cell replicate genetic material daughter cell identical copy replication chromosome consist identical chromatid bind specialized region know centromere show figure 2.2 note ploidy cell change number chromatid double word human stage 46 chromosome 92 chromatid present cell enter  $G_2$  twice dna cell  $G_1$  chromatid replicate form sister chromatid hold centromere figure 2.2 chromosome replication single chromatid replicate form sister chromatid chromatid compose complete double stranded molecule dna sister chromatid identical copy term chromosome refer single chromatid s phase pair chromatid attach centromere s phase  $G_2$  stage



postsynthetic gap g2 stage cell pass quality control checkpoint dna duplicate cell check ensure organelle cytoplasm daughter cell furthermore cell check sure dna replication proceed correctly avoid pass error daughter cell pass error progeny m stage mitosis m stage consist mitosis cytokinesis mitosis divide phase prophase metaphase anaphase telophase feature phase discuss section cytokinesis splitting cytoplasm organelle daughter cell autosomal cell division result genetically identical daughter cell germ cell daughter cell equivalent control cell cycle cell cycle control checkpoint notably g1 s phase g2 m phase g1 s checkpoint cell determine condition dna good synthesis mention previously checkpoint know restriction point damage dna cell cycle go arrest dna repair main protein control p53 g2 m checkpoint cell mainly concern ensure achieve adequate size organelle properly replicate support daughter cell p53 play role g2 m checkpoint molecule responsible cell cycle know cyclin cyclindependent kinase cdk order activate cdk require presence right cyclin cell cycle concentration cyclin increase decrease specific stage cyclin bind cdk create activate cdk cyclin complex complex phosphorylate transcription factor transcription factor promote transcription gene require stage cell cycle cell cycle control essential ensure cell damage inadequately size divide cell cycle control deranged damage cell allow undergo mitosis cancer result common mutation find

damage cell allow undergo mitosis cancer result common mutation find cancer mutation gene produce p53 call tp53 gene mutate cell cycle stop repair damage dna allow mutation accumulate eventually result cancerous cell divide continuously regard quality quantity new cell produce cancer cell undergo rapid cell division create tumor eventually cell begin produce right factor protease digest basement membrane factor encourage blood vessel formation damage cell able reach tissue include local invasion distant spread cancerous cell bloodstream lymphatic system result know metastasis cancer cause gene classify oncogene gene mutate actively promote cell division tumor suppressor gene gene mutate lose ability regulate arrest cell cycle different cancer type associate specific mutation oncogene tumor suppressor gene

biochemistry gene discuss chapter 6 mcat biochemistry review mitosis show figure 2.3 process identical daughter cell create single cell mitosis consist distinct phase prophase metaphase anaphase telophase occur somatic cell cell involve sexual reproduction diagram mitosis describe subsequently chapter figure 2.3 mitosis mitosis result identical daughter cell prophase phase mitosis step prophase involve condensation chromatin chromosome centriole pair separate opposite pole cell pair cylindrical organelle show figure 2.4 locate outside nucleus region know centrosome responsible correct division dna centriole migrate opposite pole cell begin form spindle fiber microtubule establish centrosome microtubule organize center cell basal body flagellum cilium fiber radiate outward centriole microtubule form aster anchor centriole cell membrane extend middle cell nuclear membrane dissolve prophase allow spindle fiber contact chromosome nucleolus distinct disappear completely kinetochore appear centrosome protein structure locate centromere serve attachment point specific fiber spindle apparatus appropriately call kinetochore fiber centrosome centriole compose triplet microtubule figure 2.4 centrosome centrosome contain tubulin- base centriole responsible proper movement chromosome phase mitosis prophase chromosome condense spindle form anaphase sister chromatid separate telophase new nuclear membrane form metaphase centriole pair opposite end cell kinetochore fiber interact fiber spindle

centriole pair opposite end cell kinetochore fiber interact fiber spindle apparatus align chromosome metaphase plate equatorial plate equidistant pole cell anaphase centromere split chromatid distinct centromere allow sister chromatid separate sister chromatid pull opposite pole cell shorten kinetochore fiber telophase cytokinesis telophase essentially reverse prophase spindle apparatus disappear nuclear membrane reform set chromosome nucleolus reappear chromosome uncoil resume interphase form new nucleus receive complete copy genome identical original genome cytokinesis occur end telophase separation cytoplasm organelle give daughter cell material survive cell undergo finite number division program death human somatic cell usually 20 50 cell long divide continuously biology guide

example expert thinking p53 tumor suppressor pathway heavily explore potential treatment patient cancer p53 pathway induce growth arrest apoptosis response cellular stress mutation pathway think nearly universal human cancer researcher explore retro inverse p53c peptide term ri tatp53c therapeutically effective means activate p53 tumor suppressor pathway preclinical model terminal metastatic cancer ri tatp53c contain protein transduction domain ptd capable traverse plasma membrane functional sequence p53 c terminus non functional ri tatp53c develop mutate functional residue peptide researcher expose ta3 st mammary carcinoma cell wild type ri- tatp53c mutant peptide ri tatp53c cell dna content analyze test cell cycle arrest occur go researcher explore dependency ri tatp53c induction growth arrest endogenous p53 cell figure 2 ta3 st h1299 cancer cell line

second experiment ask ri- tatp53c depend endogenous p53 probably go manipulate endogenous p53 iv measure ri- tatp53c effect dv iv cancer w/ endogenous p53 ta3 st cancer w/ p53 h1299 wt mut peptide concentration dv cell untreated trend wt peptide group produce low number cell mutin ta3 st difference h1299 effect change adapt snyder el meade br saenz cc dowdy sf 2004 treatment terminal peritoneal carcinomatosis transducible p53 activate peptide stage cell cycle ri tatp53c arrest cell ri- tatp53c'-induced cell arrest require endogenous p53 answer question need determine relationship ri- tatp53c' cell cycle relationship ri tatp53c' endogenous p53 depth question worth consider big picture ensure understand concept experiment passage start context experiment state paragraph 1 2 p53 tumor suppress pathway researcher hope activate treatment cancer experiment distinct explore activation pathway keep mind independent dependent variable experiment identify read identify experiment answer question prompt experiment condition vehicle wt mut vehicle condition recognize bio talk treatment condition treatment negative control wt condition accord second sentence paragraph 2 functional ri tatp53c'. treatment group hypothesis start 2nd paragraph correct interesting datum mut condition describe second sentence

paragraph 2 non functional mutant ri- tatp53c'. condition proportion cell low medium high  
dna content measure accord sentence paragraph 2 determine cell cycle arrest occur point  
know exp 1 relate ri tatp53c' iv cell cycle dv answer question prompt let analyze datum  
experiment look figure 1 notice vehicle mutant condition identical wt treatment condition  
differ greatly specifically ri tatp53c' treatment wt result large portion cell have dna consider  
background knowledge cell cycle phase relative dna content deduce g1 low dna content g1  
occur division decrease dna s phase increase dna conclude ri tatp53c' arrest cell g1 order  
answer second question relationship ri tatp53c' functionality endogenous p53 determine align  
pretty paragraph 3 description experiment 2 solid indication need analyze figure 2 look title  
graph different cancerous cell culture ta3 st p53 + /+ h1299 p53 differ expression p53  
independent variable analyze graph additional independent variable wt light blue vs. mut dark  
blue peptide concentration peptide dependent variable figure 2 cell untreated word number  
cancerous cell unarrested cancerous peptide understanding variable let look datum figure 2  
graph striking difference wt ri tatp53c' treatment p53 + /+ cancerous cell result drastic drop  
untreated cancerous cell light blue 1st graph p53 condition wt ri- tatp53c' cancerous cell level  
remain constant light blue

2nd graph show ability wt ri tatp53c induce cell cycle arrest dependent endogenous p53  
addition p53 + /+ p53 condition expose mutant ri tatp53c non functional drop cancerous cell  
second point expect worth note show unexpected occur experiment give datum figure 2  
conclude order ri tatp53c induce cell arrest require endogenous p53 tumor overall figure 1  
show wt ri tatp53c' induce cell arrest base increase proportion cell low dna content induce cell  
arrest g1 figure 2 able determine ri tatp53c' require functional p53 pathway order induce cell  
arrest loss ri tatp53c' functionality p53 condition mcat concept check 2.1 assess understanding  
material 1 stage cell cycle happen stage cell cycle stage features 2 phase mitosis happen  
phase mitotic phase features chapter 2.2 able predict ploidy daughter cell end mitosis meiosis

differentiate homologous chromosome sister chromatid compare contrast mitosis meiosis explain importance cross event relation genetic mitosis occur somatic tissue result identical daughter cell meiosis occur gametocyte germ cell result nonidentical sex cell gamete meiosis share similarity mitosis process instance genetic material duplicate chromatin condense form chromosome microtubule emanate centriole involve divide genetic material mcat tend ask difference process contrast mitosis consist round replication division meiosis consist round replication follow round division show figure 2.5 meiosis result homologous chromosome separate generate haploid daughter cell know reductional division meiosis ii similar mitosis result separation sister chromatid change ploidy know diagram meiosis describe subsequently chapter figure 2.5 meiosis meiosis result nonidentical daughter human genome compose 23 homologous pair chromosome homologue contain chromosome inherit parent bring important note terminology homologous pair consider separate chromosome maternal chromosome 15 paternal chromosome 15 sister chromatid identical strand dna connect centromere s phase 92 chromatid organize 46 chromosome organize 23 homologous pair prophase chromatin condense chromosome spindle apparatus form nucleolus nuclear membrane disappear major difference meiosis mitosis occur point

nucleolus nuclear membrane disappear major difference meiosis mitosis occur point homologous chromosome come intertwine process call synapsis point chromosome consist sister chromatid synaptic pair contain chromatid refer tetrad homologous chromosome hold group protein call synaptonemal complex chromatid homologous chromosome break point contact call chiasma plural chiasmata exchange equivalent piece dna show figure 2.6 process call cross characterize number crossover event occur strand dna include single crossover double crossover note cross occur homologous chromosome sister chromatid chromosome identical cross produce change chromatid involve leave altered structurally complete set gene genetic recombination unlink link gene increase variety genetic combination produce gametogenesis linkage refer tendency gene inherit gene locate far physically likely inherit

likely undergo crossing relative oppose asexual reproduction produce identical offspring  
sexual reproduction provide advantage great genetic diversity believe increase ability species  
evolve adapt change environment homologous chromosome align form tetrad cross occur  
chiasma form recombinant chromosome figure 2.6 synapsis prophase homologous  
chromosome exchange genetic material cross rate gene unlinking map difference gene  
chromosome far apart gene likely unlinked cross statistic determine distance gene  
chromosome measure unit cross daughter cell unique pool allele gene code alternative form  
give trait random mixture maternal paternal origin classical genetic cross explain mendel  
second law independent assortment state inheritance allele effect likelihood inherit certain  
allele gene metaphase homologous pair tetrad align metaphase plate pair attach separate  
spindle fiber kinetochore note difference mitosis mitosis chromosome line metaphase plate  
spindle fiber pole meiosis homologous chromosome line metaphase plate hold spindle fiber  
anaphase homologous pair separate pull opposite pole cell process call disjunction account  
mendel law segregation disjunction chromosome paternal origin separate disjoin homologue  
maternal origin chromosome end daughter cell distribution homologous chromosome  
intermediate daughter cell random respect parental origin separating homologous  
chromosome refer segregation critical understand meiosis different mitosis chromosome  
number halve reductional division meiosis daughter cell

different mitosis chromosome number halve reductional division meiosis daughter cell  
haploid number chromosome 23 human meiosis ii similar mitosis sister chromatid separate  
change ploidy observe telophase nuclear membrane form new nucleus point chromosome  
consist sister chromatid join centromere cell haploid homologous chromosome separate n  
chromosome find daughter cell 23 human cell divide daughter cell cytokinesis cell division  
short rest period interkinesi chromosome partially anaphase ii meiosis homologous  
chromosome anaphase sister chromatid anaphase ii fail separate result gamete copy  
particular chromosome gamete subsequently fertilization result zygote copy chromosome

nondisjunction affect autosomal chromosome trisomy 21 result syndrome sex chromosome  
klinefelter turner syndrome meiosis ii similar mitosis sister chromatid homologue separate  
prophase ii nuclear envelope dissolve nucleolus disappear centriole migrate opposite pole  
spindle apparatus begin form metaphase ii chromosome line metaphase plate anaphase ii  
centromere divide separate chromosome sister chromatid chromatid pull opposite pole  
spindle fiber  $2n$   $2n$   $2n$   $n$  occur divide cell occurs sex cell pair homologous chromosome  
align opposite side metaphase plate crossing cross occur telophase ii nuclear membrane form  
new nucleus cytokinesis follow daughter cell form completion meiosis ii haploid daughter cell  
produce gametocyte use phrase oogenesis discuss later chapter result few cell egg remain  
unfertilized ovulation mcat concept check 2.2 assess understanding material 1 number ploidy  
daughter cell produce meiosis meiosis ii 2 difference homologous chromosome sister 3 phase  
meiosis list difference analogous phase mitosis meiotic phase difference mitotic phase 2.3  
reproductive system high yield chapter 2.3 able recall function interstitial cell leydig sertoli cell  
identify phase meiosis primary secondary oocyte describe acrosome differentiate male female  
sex organ development recall phase menstrual cycle include key feature relative hormone  
level phase ovarian cycle chromosomal sex determine 23rd pair chromosome xx female  
xy male ova carry x chromosome sperm carry x y chromosome x chromosome carry sizeable

chromosome sperm carry x y chromosome x chromosome carry sizeable genetic information  
mutation gene cause sex- link x link disorder male term hemizygous respect gene x  
chromosome copy male disease cause allele unpaired x chromosome necessarily express  
allele female hand homozygous heterozygous respect gene x chromosome x link disorder  
recessively inherit female express disorder far frequently male female carry diseased allele x  
chromosome exhibit disease say carrier sex link x link comparatively y chromosome contain  
little genetic information notable gene y chromosome sry sex determine region y code  
transcription factor initiate testis differentiation formation male gonad absence y  
chromosome zygote female presence y chromosome zygote actually handful y link disease

result reduce fertility father pass y link disease son assume fertility lose disease extremely rare include official mcat content list male reproductive anatomy male reproductive system show figure 2.7 label ureter urinary bladder vas deferens seminal vesicle ejaculatory duct prostate gland bulbourethral gland urethra figure 2.7 male reproductive system pathway sperm male reproductive system serve(n vas deferens call ductus deferens male primitive gonad develop testis testis functional component seminiferous tubule interstitial cell leydig sperm produce highly coiled seminiferous tubule nourish sertoli cell cell leydig secrete testosterone male sex hormone androgen testis locate scrotum external pouch hang penis position allow maintain temperature  $2^{\circ}\text{C}$   $4^{\circ}\text{C}$  low body fat layer muscle vas deferens ductus deferens raise lower testis maintain proper temperature sperm development sperm form pass epididymis flagella gain motility store ejaculation ejaculation sperm travel vas deferens enter ejaculatory duct posterior edge prostate gland ejaculatory duct fuse form urethra carry sperm penis exit body male reproductive urinary system share common pathway case female prostate enlarge age frequently cause problem old male include condition call benign prostatic hyperplasia prostate surround urethra classic symptom condition include urinary frequency urgency nighttime awakening

urethra classic symptom condition include urinary frequency urgency nighttime awakening use bathroom sperm pass reproductive tract mix seminal fluid produce combine effort seminal vesicle prostate gland bulbourethral gland seminal vesicle contribute fructose nourish sperm seminal vesicle prostate gland fluid mildly alkaline property sperm survive relative acidity female reproductive tract bulbourethral cowper gland produce clear viscous fluid clean remnant urine lubricate urethra sexual arousal combination sperm seminal fluid know mention spermatogenesis formation haploid sperm meiosis occur seminiferous tubule male diploid stem cell know spermatogonia replicate genetic material s stage develop diploid primary spermatocyte meiotic division result haploid secondary spermatocyte undergo meiosis ii generate haploid spermatid finally spermatid undergo maturation mature



spermatozoon spermatogenesis result functional sperm spermatogonium mature sperm compact consist head contain genetic material midpiece generate atp fructose flagellum motility show figure 2.8 midpiece fill mitochondrion generate energy swim female reproductive tract reach ovum fallopian tube sperm head cover cap know acrosome structure derive golgi apparatus necessary penetrate ovum male reach sexual maturity puberty approximately 3 million sperm produce day typically continue course individual lifespan label head acrosome nucleus midpiece centriole mitochondria tail axial filament end piece figure 2.8 structure mature sperm female reproductive anatomy female reproductive organ primarily internal show figure 2.9 gonad know ovary produce estrogen progesterone ovary locate pelvic cavity consist thousand follicle multilayered sac contain nourish protect immature ova egg puberty menopause egg month ovulate peritoneal sac line abdominal cavity draw fallopian tube oviduct line cilia propel egg forward fallopian tube connect muscular uterus site fetal development lower end uterus know cervix connect vaginal canal sperm deposit intercourse vagina passageway childbirth occur external part female genital organ know collectively vulva mention early female separate excretory reproductive tract label ovary fallopian tube uterus endometrium cervix vagina figure 2.9 female reproductive system production female gamete know oogenesis gametocyte undergo

female reproductive system production female gamete know oogenesis gametocyte undergo meiotic process female male significant difference unending supply stem cell analogous spermatogonia female oogonia female form fetal development birth oogonia undergo dna replication consider primary oocyte cell  $2n$  like primary spermatocyte actually arrest prophase i.

menarche menstrual cycle

primary oocyte month complete meiosis produce secondary oocyte polar body division

characterize unequal cytokinesis distribute ample cytoplasm daughter cell secondary oocyte  
nearly polar body polar body generally divide produce functional gamete secondary oocyte  
hand remain arrest metaphase ii complete remainder meiosis ii oocyte surround layer zona  
pellucida corona radiata zona pellucida surround oocyte acellular mixture glycoprotein protect  
oocyte contain compound necessary sperm cell binding corona radiata lie outside zona  
pellucida layer cell adhere oocyte ovulation meiosis ii trigger sperm cell penetrate layer help  
acrosomal enzyme secondary oocyte undergo second meiotic division split mature ovum polar  
body eventually break mature ovum large cell consist large quantity cytoplasm organelle  
ovum contribute nearly zygote half dna cytoplasm organelle include mitochondrion rna early  
cellular process sperm contribute half dna completion meiosis ii haploid pronucleus sperm  
ovum join create diploid zygote ability reproduce hormonal control prior puberty  
hypothalamus restrict production gonadotropin release hormone gnrh start puberty  
restriction lift hypothalamus release pulse gnrh trigger anterior pituitary gland synthesize  
release follicle stimulate hormone fsh luteinize hormone lh hormone trigger production sex  
hormone develop maintain reproductive system male sexual development fetal period week  
fertilization birth presence y chromosome lead production androgen result male sexual  
differentiation duration infancy childhood androgen production low testosterone produce  
testis increase dramatically puberty sperm production begin order achieve delicate interplay  
fsh lh stimulation cell type testis fsh stimulate sertoli cell trigger sperm maturation lh cause  
interstitial cell produce testosterone testosterone develop maintain male reproductive system  
result development secondary sexual characteristic facial axillary hair deepening voice  
increase muscle bone mass testosterone production remain high adulthood decline age  
hormone exert negative feedback hypothalamus anterior pituitary production keep receptor  
testosterone absent defective exert effect result condition call androgen insensitivity  
syndrome ais chromosomal male xy female secondary sexual characteristic complete  
androgen insensitivity chromosomal male appear female birth oftentimes

characteristic complete androgen insensitivity chromosomal male appear female birth oftentimes diagnosis ais puberty amenorrhea failure menstruate manifest female sexual development ovary derive embryonic structure testis control fsh lh secrete anterior pituitary ovary produce estrogen progesterone estrogen secrete response fsh result development maintenance female reproductive system female secondary sexual characteristic breast growth widening hip change fat distribution embryo estrogen stimulate development reproductive tract adult estrogen lead thickening lining uterus endometrium month preparation implantation zygote estrogen establish progesterone protect endometrium progesterone secrete corpus luteum remain ovarian follicle follow ovulation response lh interestingly progesterone involve development maintenance endometrium initial thickening endometrium role estrogen mean estrogen progesterone require generation development maintenance endometrium capable support zygote end trimester pregnancy progesterone supply placenta corpus luteum atrophy cease function menstrual cycle reproductive year menarche menopause estrogen progesterone level rise fall cyclic pattern response endometrial lining grow shed know menstrual cycle divide event show figure 2.10 follicular phase ovulation luteal phase menstruation figure 2.10 menstrual cycle follicle stimulate hormone fsh facilitate maturation single ovum b peak luteinize hormone lh day 14 mark ovulation release oocyte follicle c endometrial lining uterus reach peak luteal phase shed beginning mcat like test ability identify graph blood concentration fsh lh estrogen progesterone menstrual cycle sure know peak study figure 2.10 follicular phase begin menstrual flow shed uterine lining previous cycle begin gnRH secretion hypothalamus increase response decrease concentration estrogen progesterone fall end cycle high concentration gnRH cause increase secretion fsh lh hormone work concert develop ovarian follicle follicle begin produce estrogen negative feedback effect cause gnRH lh fsh concentration level estrogen stimulate regrowth endometrial lining stimulate vascularization glandularization estrogen interesting negative positive feedback effect late follicular phase develop follicle secrete high high concentration estrogen eventually estrogen concentration reach threshold

paradoxically result positive feedback gnrh lh fsh level spike surge lh important induce

feedback gnrh lh fsh level spike surge lh important induce ovulation release ovum ovary abdominal peritoneal cavity oral contraceptive pill ocps simply estrogen progesterone progesterone preparation block conception inhibit lh fsh release negative feedback inhibit ovulation take placebo pill end month withdrawal menstruation occur estrogen progesterone level drop egg pass ovulation lh cause ruptured follicle form corpus luteum secrete progesterone remember estrogen help regenerate uterine lining progesterone maintain implantation progesterone level begin rise estrogen level remain high high level progesterone cause negative feedback gnrh fsh lh prevent ovulation multiple assume implantation occur corpus luteum lose stimulation lh progesterone level decline uterine lining slough loss high level estrogen progesterone remove block gnrh cycle begin follicle mature follicular phase fsh lh lh surge midcycle trigger ovulation rupture follicle corpus luteum secrete estrogen progesterone build uterine lining preparation implantation lh fsh inhibit fertilization occur corpus luteum atrophy progesterone estrogen level decrease menses occur lh fsh level begin hand fertilization occur result zygote develop blastocyst implant uterine lining secrete human chorionic gonadotropin hcg analog lh look similar chemically stimulate lh receptor maintain corpus luteum hcg critical trimester development estrogen progesterone secrete corpus luteum uterine lining place second trimester hcg level decline placenta grow sufficient size secrete progesterone estrogen high level estrogen progesterone continue serve negative feedback aging ovary sensitive fsh lh result ovarian atrophy estrogen progesterone level drop endometrium atrophy menstruation stop negative feedback fsh lh remove blood level hormone rise call menopause profound physical physiological change usually accompany process include flushing hot flash bloating headache menopause usually occur age 45 55 mcat concept check 2.3 assess understanding material 1 function interstitial cell leydig sertoli cell interstitial cell leydig 2 phase meiosis primary oocyte arrest phase meiosis secondary oocyte arrest 3 acrosome organelle form acrosome 4 hormone key sexual differentiation fetus xy

genotype describe

acrosome 4 hormone key sexual differentiation fetus xy genotype describe expect phenotype  
receptor hormone 5 phase menstrual cycle feature relative hormone concentration phase  
note draw symbol signify level hormone = phase key feature fsh lh estrogen progesterone  
chapter explore key tenet cell theory cell produce copy examine mitosis result genetically  
identical diploid daughter cell move meiosis result genetically nonidentical haploid daughter  
cell gamete look male female reproductive system form gamete contain half normal  
complement genetic information finally explore basic reproductive endocrinology see  
testosterone estrogen key development reproductive system secondary sex characteristic  
develop puberty formation gamete half story course serve good species form sex cell cell  
interact form human ultimately gamete accomplish purpose pass gene instruction life  
generation turn attention chapter step fertilization embryogenesis birth union egg sperm  
human planet today beginning human race come review content test knowledge critical  
thinking skill complete test like passage set online cell cycle mitosis diploid  $2n$  cell copy  
chromosome haploid  $n$  cell copy cell cycle contain stage  $g_1$  s  $g_2$  stage collectively call  
interphase dna uncoil form  $g_1$  stage presynthetic gap cell create organelle energy protein  
production increase size restriction point dna check quality pass cell s stage s stage synthesis  
dna replicate strand dna call chromatid hold centromere  $g_2$  stage postsynthetic gap cell  
growth replication organelle preparation mitosis quality checkpoint pass cell enter mitosis m  
stage mitosis mitosis cytokinesi occur  $g_0$  stage cell perform function prepare p53 play role  
major checkpoint cell cycle  $g_1$  s  $g_2$  m cyclin cyclin dependent kinase cdk rise fall cell cycle  
cyclin bind cdk phosphorylate activate transcription factor stage cell cycle cancer occur cell  
cycle control deranged allow damage cell undergo mitosis regard quality quantity new cell  
produce cancerous cell begin produce factor allow delocalize invade adjacent tissue  
metastasize mitosis produce genetically identical diploid daughter cell

adjacent tissue metastasize mitosis produce genetically identical diploid daughter cell single cell occur somatic cell mitosis phase prophase chromosome condense nuclear membrane dissolve nucleolus disappear centriole migrate opposite side cell spindle apparatus begin form kinetochore chromosome contact spindle fiber metaphase chromosome line metaphase plate anaphase sister chromatid separate pull opposite telophase nuclear membrane reform spindle apparatus disappear cytosol organelle split daughter cell cytokinesis meiosis occur gametocyte germ cell produce nonidentical haploid sex cell gamete meiosis round replication round division reductional equational division meiosis homologous pair chromosome homologue separate homologue chromosome give number opposite parental origin prophase event occur prophase mitosis homologue come intertwine process call synapsis chromatid refer tetrad cross exchange genetic material chromatid material chromatid homologous chromosome account mendel second law independent assortment metaphase homologous chromosome line opposite side metaphase plate anaphase homologous chromosome pull opposite pole cell account mendel law segregation telophase chromosome fully decondense cell enter interkinesi cytokinesis meiosis ii sister chromatid separate process functionally identical mitosis sister chromatid copy dna hold centromere reproductive system chromosomal sex determine 23rd pair chromosome human xx female xy male x chromosome carry sizeable genetic information mutation x link gene cause sex link disorder male hemizygous respect unpaired gene x chromosome express sex link disorder recessive disease carry allele female copy affected allele call carrier y chromosome carry little genetic information contain sry sex determine region y gene cause gonad differentiate testis male reproductive system contain internal external structure sperm develop seminiferous tubule testis nourish sertoli cell interstitial cell leydig testis secrete testosterone male sex hormone androgen testis locate scrotum hang outside abdominal cavity temperature  $2^{\circ}\text{C}$   $4^{\circ}\text{C}$  low rest body form sperm gain motility epididymis store ejaculation ejaculation sperm travel vas deferen ejaculatory duct urethra penis seminal vesicle contribute fructose nourish sperm produce prostate gland produce alkaline

vesicle contribute fructose nourish sperm produce prostate gland produce alkaline fluid bulbourethral gland produce clear viscous fluid clean remnant urine lubricate urethra sexual arousal semen compose sperm seminal fluid gland spermatogenesis haploid sperm produce stage germ cell call primary spermatocyte meiosis germ cell call secondary spermatocyte meiosis ii germ cell call spermatid maturation germ cell call spermatozoa sperm contain head midpiece flagellum head contain genetic material cover acrosome modify golgi apparatus contain enzyme help sperm fuse penetrate ovum midpiece generate atp fructose contain flagellum promote motility female reproductive system primarily contain internal structure ova egg produce follicle ovary month egg ovulate peritoneal sac draw fallopian tube oviduct fallopian tube connect uterus lower end cervix vaginal canal lie cervix site sperm deposit intercourse vaginal canal site childbirth external part female genital organ collectively know vulva oogenesis haploid ovum variable number polar body form oogonium birth oogonia undergo replication consider primary oocyte arrest prophase i. ovulate egg month secondary oocyte arrest metaphase ii oocyte fertilize complete meiosis ii true cytokinesis uneven oogenesis cell receive little cytoplasm organelle call polar body oocyte surround zona pellucida acellular mixture glycoprotein protect oocyte contain compound necessary sperm bind corona radiata layer cell adhere oocyte ovulation gonadotropin release hormone gnrh hypothalamus cause release follicle stimulate hormone fsh luteinize hormone lh function depend sex individual male fsh stimulate sertoli cell trigger spermatogenesis lh cause interstitial cell produce testosterone testosterone responsible maintenance development male reproductive system male secondary sex characteristic facial axillary hair deepening voice increase bone female fsh stimulate development ovarian follicle lh cause ovulation hormone stimulate production estrogen progesterone menstrual cycle periodic growth shedding endometrial follicular phase gnrh secretion stimulate fsh lh secretion promote follicle development estrogen release stimulate vascularization glandularization decidua ovulation stimulate sudden surge lh surge trigger estrogen level reach threshold switch negative

positive

lh surge trigger estrogen level reach threshold switch negative positive feedback effect luteal phase lh cause ruptured follicle corpus luteum secrete progesterone maintain uterine lining high estrogen progesterone level cause negative feedback gnrh lh fsh menstruation occur fertilization estrogen progesterone level drop endometrial lining slough block gnrh production remove fertilization occur blastula produce human chorionic gonadotropin hcg lh analog maintain corpus luteum near end trimester hcg level drop placenta take progesterone production menopause occur ovary stop produce estrogen progesterone usually age 45 55 menstruation stop fsh lh level rise physical physiological change accompany menopause include flushing hot flash bloating headache answer concept checks cell grow perform normal function dna examine dna replicate cell continue grow replicate organelle preparation mitosis cell continue perform normal function mitosis cell division occur cell perform normal function prepare chromosome condense nuclear membrane dissolve nucleolus disappear centriole migrate opposite pole begin form spindle apparatus metaphase chromosome gather metaphase plate center cell guidance spindle apparatus sister chromatid separate copy chromosome migrate opposite pole chromosome decondense nuclear membrane reform nucleolus reappear spindle apparatus break cell divide identical daughter cell 1 meiosis haploid daughter cell meiosis ii haploid gamete 2 homologous chromosome related chromosome opposite parental origin maternal chromosome 15 paternal chromosome 15 male x y chromosome sister chromatid identical copy dna hold centromere s phase cell contain 92 chromatid 46 chromosome 23 homologous pair difference mitotic phase prophase homologous chromosome come tetrad synapsis cross homologous chromosome line opposite side metaphase plate individual chromosome line metaphase plate homologous chromosome separate centromere break chromatin decondense interkinesis occur cell prepare meiosis ii 1 interstitial cell leydig secrete testosterone male sex hormone androgen sertoli cell nourish sperm development 2 primary oocyte arrest prophase secondary oocyte



arrest metaphase ii 3 acrosome contain enzyme capable penetrate corona radiata zona pellucida ovum permit fertilization occur

capable penetrate corona radiata zona pellucida ovum permit fertilization occur modify golgi apparatus 4 androgen testosterone lead male sexual differentiation absence androgen receptor condition know androgen insensitivity syndrome lead xy genotype phenotypically female fsh lh estrogen progesterone egg develop endometrial lining vascularized ovulation egg release follicle peritoneal cavity corpus luteum produce progesterone maintain shedding endometrial science mastery assessment explanation

diploid cell call spermatogonia differentiate primary spermatocyte undergo meiotic division yield haploid secondary spermatocyte undergo second meiotic division immature spermatid spermatid undergo series change lead production mature sperm spermatozoa time birth shortly ovulation egg cell arrest prophase stage meiosis i. cell refer primary oocyte ovulation egg cell complete meiosis arrest metaphase ii haploid cell call secondary oocyte sperm penetrate outer layer secondary oocyte complete meiosis ii mature ovum spindle apparatus interact kinetochore fiber near end prophase spindle apparatus align chromosome equatorial plate metaphase b initial connection microtubule kinetochore occur prophase ensure label deoxyadenine incorporate dna daughter cell insert nucleotide dna replication complete replication occur s stage introduce deoxyadenine g1 s stage g1 precede s late point deoxyadenine add estrogen know cause growth endometrial lining follicular phase menstrual cycle level stay high luteal phase promote vascularization glandularization tissue excessive level estrogen provide strong signal cell growth promote tumor formation cancer tissue list question require estrogen development strongly dependent estrogen growth subtle point ovulation miss student remain hard believe organ examine anatomy class medical school rupture ovarian follicle release oocyte abdominal cavity close entrance fallopian tube aid beat cilia oocyte draw fallopian tube travel reach uterus fertilize fallopian tube implant uterine wall

fertilization occur expel uterine lining menstruation question ask determine point cell cycle prevent lower number cell undergo mitosis idea prevent dna synthesis s stage cell cycle dna replicate viable daughter cell form idea prevent mitotic cycle form altogether prophase prevent spindle apparatus formation prevent nuclear membrane dissolve interfere process phase similarly treatment act cell metaphase stage cell cycle interfere mitotic cycle solution present viable prostate gland seminal vesicle bulbourethral gland secrete seminal fluid combine sperm produce semen cremaster muscle surround testis raise lower testis response change temperature meiotic division reductional division pull homologous chromosome opposite pole cell anaphase i.

near end telophase cytokinesis occur result haploid n daughter cell interkinesis anaphase ii daughter cell haploid eliminate c d cell diploid interphase remain diploid end telophase i. safe way answer question correctly answer choice eliminate one contribute genetic variability random fertilization egg sperm random segregation homologous chromosome anaphase crossing homologous chromosome prophase contribute genetic variability sexual reproduction result novel combination genetic material eliminate b c s stage d cause increase genetic variability dna copy precisely error mean strand dna key difference mitosis meiosis primarily appear meiosis i.

note synapsis crossing occur prophase homologous chromosome separate meiosis sister chromatid mitosis location centromere relative metaphase plate trivial representative fact homologous chromosome line opposite side equatorial plate meiosis contrast positioning chromosome directly metaphase plate mitosis prophase chromatin condense chromosome spindle apparatus form nucleoli nuclear membrane disappear describe anaphase b c describe telophase nondisjunction refer incorrect segregation homologous chromosome anaphase sister chromatid anaphase ii case daughter cell end copy related genetic material receive zero immediately eliminate b normal complement chromosome 46 individual recessive disease

carry allele express disease likely dominant allele give trait see male hemizygous x link gene  
see female turner syndrome 45,x x chromosome c answer progesterone peak luteal phase  
support endometrium potential implantation blastula progesterone level relatively low  
follicular phase ovulation eliminate b withdrawal progesterone actually cause menses eliminate  
d trimester pregnancy corpus luteum preserve human chorionic gonadotropin hcg  
progesterone secretion corpus luteum maintain trimester eliminate second trimester hcg level  
decline progesterone level rise hormone secrete placenta eliminate b high level progesterone  
estrogen inhibit gnRH secretion prevent fsh lh secretion onset new menstrual cycle eliminate c  
validate d online consult online resource additional practice behavioral science chapter 1  
biology behavior biochemistry chapter 6 dna biotechnology biology chapter 1 biology chapter  
3 embryogenesis development biology chapter 5 endocrine system biology chapter 12  
genetics evolution embryogenesis development pre med know feeling content know mcats  
know first important high yield badge book help identify important topic science mastery  
assessment tool mcats prep arsenal is quiz take online resource guidance help ensure spend  
appropriate time chapter base personal strength weakness worry skip mean study later prep  
complete length test uncover specific piece content need review come chapter appropriate  
use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow  
review quiz question ensure understand solve answer 8–11 question correctly

review quiz question ensure understand solve answer 8–11 question correctly spend 20–40  
minute review quiz question begin question miss read note correspond subchapter question  
answer correctly ensure thinking match explanation understand choice correct incorrect  
answer 12–15 question correctly spend 20 minute review question quiz miss include quick  
read correspond subchapter relevant content subchapter question review question answer  
correctly ensure thinking match explanation review concept summary end chapter 1 following  
signaling molecule coordinate uterine contraction a. oxytocin prolactin b. progesterone  
prostaglandin c. oxytocin progesterone d. oxytocin prostaglandin 2 follow association primary

germ layer adult organ a. endoderm cardiac muscle b. endoderm lens eye d. mesoderm lining digestive tract 3 following layer notochord form 4 influence specific group cell differentiation group cell call 5 follow likely find blood person pregnant a. immunoglobulin produce fetus b. fetal hemoglobin release fetal red blood cell c. progesterone produce placental cell d. carbon dioxide exhale fetal lung 6 cell release substance diffuse environment result differentiation nearby cell example type cell cell 7 cancer cell remove patient culture cell culture able divide indefinitely cellular senescence protein likely activate cell account characteristic a. epidermal growth factor b. sonic hedgehog c. transform growth factor beta 8 anencephaly rare physiological abnormality cerebrum fail develop trimester pregnancy disorder manifest a. trimester b. second trimester c. trimester d. trimester 9 follow false regard adult stem cell a. retain inherent pluripotency harvest select organ b. controversial embryonic stem cell c. require treatment transcription factor d. reduce risk rejection patient stem cell 10 child bear imperforate anus anal canal fail form correctly rectum connect outside world pathology likely account failure a. cell differentiation b. cell determination 11 follow myocardial infarction heart heal creation scar fibroblast example a. complete regeneration b. incomplete regeneration 12 neurofibromatosis type von recklinghausen disease disorder cause formation tumor multiple nervous

type von recklinghausen disease disorder cause formation tumor multiple nervous system structure skin cell carry mutation chromosome 17 selective transcription genome appear cause significant tumorigenesis follow primary germ tissue layer 13 follow show correct order early developmental milestone a. blastula gastrula morula b. morula gastrula blastula c. morula blastula gastrula d. gastrula blastula morula 14 woman pregnant accidentally give single dose teratogenic drug late trimester baby bear day later follow likely outcome a. complete failure organ development death fetus b. partial failure organ development survival fetus c. disfigurement fetus d. respiratory distress

birth long term effect 15 follow statement fetal circulation false a. umbilical cord artery vein b. foramen ovale shunt connect chamber heart c. blood flow ductus arteriosus aorta pulmonary artery d. ductus venosus shunt bypass liver chapter 3 embryogenesis development chapter 3.1 early developmental stage problem early development 3.2 mechanism development by cell migration cell death regeneration senescence aging 3.4 gestation birth pie chart indicate content chapter relevant

percent question biology mcat content chapter relevant 5 question biology mcat chapter cover material following aamc content 1b transmission genetic information gene protein 2c process cell division differentiation specialization 3b structure integrative function main organ system 7a individual influence behavior ultrasonography radiographic technique perform place probe emit high frequency sound wave near tissue examine pregnancy probe transduce image computer screen determine gestational age screen multiple pregnancy anomaly identify baby phenotypical sex typically determine 16 17 week blood test ultrasonography equipment high resolution chapter continue discussion chapter 2 begin fertilization formation diploid zygote union sperm ovum follow development point birth autonomously breathe baby examine cell develop human divide differentiate explore specific system difference exist develop fetus adult present overview stage pregnancy childbirth 3.1 early developmental stage chapter 3.1 able distinguish determinate indeterminate cleavage zygote describe process implantation stage development connect ectoderm mesoderm neural crest endoderm organ form describe induction influence development recall stage embryonic development gastrula early stage embryonic gastrulation section explore development formation diploid zygote neurulation formation neural tube differentiate nervous system discuss chapter 2 mcat biology review secondary oocyte ovulate follicle approximately day 14 menstrual cycle secondary oocyte travel fallopian tube fertilize 24 hour ovulation fertilization show figure 3.1 usually occur wide fallopian tube call ampulla sperm meet secondary oocyte fallopian tube bind oocyte release acrosomal enzyme enable head sperm penetrate corona radiata zona pellucida sperm come

direct contact secondary oocyte cell membrane form tube like structure know acrosomal apparatus extend penetrate cell membrane pronucleu freely enter oocyte meiosis ii come sperm attach egg inject pronucleu acrosomal apparatus cortical reaction figure 3.1 fertilization penetration sperm cell membrane cortical reaction release calcium ion occur calcium ion depolarize membrane ovum serve purpose depolarization prevent fertilization ovum multiple sperm cell increase calcium concentration increase metabolic rate newly form diploid zygote depolarized impenetrable membrane

increase metabolic rate newly form diploid zygote depolarized impenetrable membrane call fertilization membrane twinning occur different mechanism dizygotic fraternal twin form fertilization different egg release ovulatory cycle different sperm zygote implant uterine wall develop placenta chorion amnion structure discuss later chapter zygote implant close placenta grow fraternal twin genetically similar pair sibling monozygotic identical twin form single zygote split genetic material identical genome offspring division incomplete conjoined twin result offspring physically attach monozygotic twin classify number structure share monochorionic monoamniotic twin share amnion chorion monochorionic diamniotic twin amnion share chorion dichorionic diamniotic twin amnion chorion type twinning occur result separation occur gestational structure share risk fetus grow develop fertilization fallopian tube zygote travel uterus implantation arrive late long endometrium capable support embryo move uterus implantation zygote undergo rapid mitotic cell division process call cleavage cleavage officially create embryo nullify zygote define characteristic unicellularity round mitosis occur total size embryo remain unchanged division show figure 3.2 divide progressively small cell cell increase ratio nuclear cytoplasmic n c ratio surface area- volume ratio cell achieve increase area gas nutrient exchange relative overall volume 8 cell embryo fertilization membrane stabilize pipette figure 3.2 8 cell embryo embryo undergo cleavage event point type cleavage indeterminate determinate indeterminate cleavage result cell develop complete organism fact monozygotic twin identical genome originate indeterminately

cleave cell embryo determinate cleavage result cell fate term imply determine word cell commit differentiate certain type cell division later embryo solid mass cell know morula show figure 3.3 term come latin word mulberry help grasp embryo stage look like cell appear partially fuse figure 3.3 morula morula solid ball cell morula form undergo blastulation form blastula hollow ball cell fluid fill inner cavity know blastocoel mammalian blastula know blastocyst consist noteworthy cell group trophoblast inner cell mass show figure 3.4

trophoblast cell surround blastocoel rise chorion later placenta inner cell mass protrude blastocoel give rise organism hollow ball trophoblast cell protrude inner cell mass figure 3.4 blastula blastula contain fluid fill cavity call remember blastula embryo blast cavity blastula move fallopian tube uterus burrow endometrium trophoblast cell specialize create interface maternal blood supply develop embryo trophoblastic cell rise chorion extraembryonic membrane develop placenta trophoblast form chorionic villus microscopic finger like projection penetrate endometrium chorionic villus develop placenta support maternal fetal gas exchange embryo connect placenta umbilical cord consist artery vein encase gelatinous substance vein carry freshly oxygenate blood rich nutrient placenta embryo umbilical artery carry deoxygenate blood waste placenta exchange blastula implant outside uterus situation know ectopic pregnancy 95

ectopic pregnancy occur fallopian tube ectopic pregnancy generally viable narrow fallopian tube environment embryo properly grow embryo spontaneously abort tube rupture considerable hemorrhaging result fact suspect ectopic pregnancy placenta functional embryo support yolk sac site early blood cell development extraembryonic membrane require discussion allantois amnion allantois involve early fluid exchange embryo yolk sac ultimately umbilical cord form remnant yolk sac allantois allantois surround amnion thin tough membrane fill amniotic fluid fluid serve shock absorber pregnancy lessen impact maternal motion develop embryo addition form placenta chorion form outer membrane amnion add

additional level protection anatomy structure show figure 3.5 fetus connect placenta umbilical cord yolk sac amnion chorion chorionic villi label figure 3.5 anatomy pregnancy amniocentesis process aspirate amniotic fluid insert thin needle amniotic sac amniotic fluid contain fetal cell examine chromosomal abnormality sex determination amniocentesis recommend people 35 pregnant early screen test blood test ultrasound indicate high chance chromosomal abnormality fetus individual age group high rate meiotic nondisjunction result genetic deviation syndrome cell mass implant begin developmental process gastrulation generation distinct cell layer early developmental process point show figure 3.6 today understanding development come study organism vary degree similarity human development sea urchin gastrulation begin small invagination blastula cell continue move invagination result elimination blastocoel visualize imagine inflate balloon poke finger keep push eventually rubber balloon come contact membrane merge occur development create tube middle balloon live thing result process call gastrula membrane invagination blastocoel call archenteron later develop gut opening archenteron call blastopore deuterostome human blastopore develop anus protostome develop fertilize egg cleave 16 cell stage morula blastula gastrula blastopore archenteron figure 3.6 early stage embryonic development remember blastopore fate protostome vs. deuterostome think adult talk toddler deuterostome start deu look like duo mean deuterostome develop anus orifice associate number two"—from blastopore protostome start end mouth primary germ layer

number two"—from blastopore protostome start end mouth primary germ layer eventually cell migrate remain blastocoel establish layer cell call primary germ layer outermost layer call ectoderm give rise integument include epidermis hair nail epithelia nose mouth low anal canal lens eye nervous system include adrenal medulla inner ear derive ectoderm middle layer call mesoderm develop different system include musculoskeletal circulatory excretory system mesoderm give rise gonad muscular connective tissue layer digestive respiratory system adrenal innermost layer call endoderm form epithelial lining digestive respiratory tract include



lung pancreas thyroid bladder distal urinary tract part liver derive primary germ layer  
ectoderm—"attracto"derm thing attract cosmetic feature smart mesoderm—"means"oderm  
mean get organism bone muscle mean get body circulatory system mean get gonad  
endoderm lining endernal internal organ digestive respiratory tract accessory organ attach  
system cell gene able develop distinctly different cell type highly specialized function primarily  
selective transcription genome word gene need particular cell type transcribe pancreatic islet  
cell gene produce specific hormone insulin glucagon somatostatin turn gene turn cell type  
selective transcription relate concept induction ability group cell influence fate nearby cell  
process mediate chemical substance call inducer diffuse organize cell responsive cell chemical  
responsible process guidance neuronal axon induction ensure proximity different cell type  
work organ mcat like test dual embryonic origin adrenal gland adrenal cortex derive  
mesoderm adrenal medulla derive ectoderm adrenal medulla contain nervous tissue germ  
layer form neurulation development nervous system begin remember nervous system derive  
ectoderm cell originate surface embryo ectoderm end inside final organism rod mesodermal  
cell know notochord form long axis organism like primitive spine fact remnant notochord  
persist intervertebral disc vertebra notochord induce group overlying ectodermal cell slide  
inward form neural fold surround neural groove show figure 3.7 neural fold grow fuse neural  
tube give rise central nervous system tip neural fold neural crest cell

rise central nervous system tip neural fold neural crest cell cell migrate outward form  
peripheral nervous system include sensory ganglia autonomic ganglion adrenal medulla  
schwann cell specific cell type tissue calcitonin produce cell thyroid melanocyte skin finally  
ectodermal cell migrate neural tube crest cover rudimentary nervous system neural plate  
overlie notochord invaginate form neural fold neural groove form neural tube neural crest  
figure 3.7 formation neural tube failure neural tube close result spina bifida spinal cord  
expose outside world anencephaly brain fail develop skull leave open severity spina bifida  
effect range significant distress death anencephaly universally fatal individual likely pregnant

encourage folate folic acid prevent complication furthermore recommend individual pregnant supplement diet folate neurulation occur pregnancy detect problem early development early development highly sensitive time stage germ layer form organogenesis production organ begin teratogen far reach highly detrimental effect teratogen substance interfere development cause defect death develop embryo teratogen effect embryo fetus believe unique genetic embryo influence effect teratogen addition genetic route exposure length exposure rate placental transmission teratogen exact identity teratogen affect outcome common teratogen include alcohol prescription drug virus bacteria environmental chemical include polycyclic aromatic hydrocarbon addition teratogen maternal health influence development certain condition cause change overall physiology person pregnant result overexposure underexposure embryo fetus certain chemical example pregnant individual diabetes hyperglycemia high blood glucose poor birth outcome overexposure sugar utero lead fetus large deliver hypoglycemic soon birth synthesize high level insulin compensate maternal folic acid deficiency prevent complete closure neural tube result spina bifida part nervous system expose outside world cover thin membrane anencephaly brain fail develop like teratogen maternal health issue variable effect develop embryo fetus spina bifida severe result profound disability completely asymptomatic detect tuft hair overlie area overall trend association certainly find environmental condition gene development outcome somewhat unpredictable highly mcat concept check 3.1

gene development outcome somewhat unpredictable highly mcat concept check 3.1 assess understanding material 1 difference determinate indeterminate cleavage 2 zygote gastrula stage development 3 stage development implantation occur 4 primary germ layer organ form germ layer organ 5 induction influence development 6 tissue neural crest cell develop 3.2 mechanism development high yield chapter 3.2 able explain difference determination differentiation connect totipotency pluripotency multipotency respective level differentiation recall type cell cell communication distinguish apoptosis necrosis describe early cell undergo

determinate cleavage commit particular cell line inducer communication group differentiate cell section specific look biochemical property developmental mechanism adult human compose approximately 37 trillion cell cell organize tissue form organ organ system order create organism complex human cell perform specialized function addition cell organ organize organ function properly example pancreas create digestive enzyme trypsin carboxypeptidases b pancreatic lipase endocrine hormone insulin glucagon somatostatin cell synthesize digestive enzyme locate cell product enter duct ultimately duodenum likewise cell synthesize endocrine hormone locate near blood vessel product systemic circulation order accomplish cell stage specification determination differentiation initial stage cell specialization specification cell reversibly designate specific cell type follow determination previously define commitment cell particular function future prior determination cell cell type go specification determination cell irreversibly commit specific lineage multiple pathway determination occur cleavage exist mrna protein parent cell asymmetrically distribute daughter cell presence specific mrna protein molecule result determination determination occur secretion specific molecule nearby cell molecule call morphogen cause neighboring cell follow particular developmental pathway determination commitment particular cell type note cell actually produce need carry function cell type goal differentiation cell fate determine cell begin undertake change cause cell develop determine cell type include change structure function biochemistry cell match cell type process call differentiation cell determine commit particular cell lineage cell differentiate assume structure function biochemistry cell cell differentiate rise cell differentiate

assume structure function biochemistry cell cell differentiate rise cell differentiate know stem cell stem cell exist embryonic tissue adult tissue tissue particular stem cell differentiate determine potency cell great potency call totipotent include embryonic stem cell totipotent cell differentiate cell type fetus placental structure 16 cell stage cell morula begin differentiate group inner cell mass trophoblast cycle cell division totipotent cell start differentiate germ cell

layer stage cell say pluripotent cell differentiate cell type find placental structure finally cell continue specialized say multipotent stem cell differentiate multiple type cell particular group example hematopoietic stem cell capable differentiate cell find blood include type white blood cell red blood cell platelet skin cell neuron muscle cell use different term describe potency important recognize potency spectrum series strict definition note stem cell exist embryo adult stem cell rise skin blood epithelial lining digestive tract stem cell able differentiate different cell type potency stem cell determine different cell type stem cell cell differentiated potency cell decrease totipotent pluripotent multipotent decade stem cell research hotly contest issue harvesting embryonic stem cell highlight figure 3.8 ultimately result termination embryo think cell regenerate human tissue include spinal cord follow injury heart follow heart attack immunologic concern transplantation stem cell different genetic makeup evoke immune response result rejection addition implant pluripotent cell necessarily differentiate desire tissue structure blastocyst cell type inner cell mass label colony es cell figure 3.8 embryonic stem cell stem cell cornerstone biotechnology gene study perform introduce alter embryonic stem cell contain transgene mice stem cell lack particular gene create knockout mice process discuss chapter 6 mcat biochemistry review order address controversy researcher begin investigate adult stem cell well cell multipotent able differentiate different cell type researcher adult stem cell use transcription factor increase potency cell potential advantage approach stem cell take patient usually blood

cell potential advantage approach stem cell take patient usually blood bone marrow adipose tissue induce different tissue type implant patient offer reduce risk rejection foreign tissue challenge induce differentiation correct cell type organ complex structure depend number different cell type require different signal research ongoing hold promise despite limited success biology guide example expert thinking role

microrna-29b control differentiation neuroectoderm cell neural tube epithelial cell nte neural

neural crest cell ncc remain unclear study impact mir-29b researcher engineer mir-29b sponge contain multiple tandem bind site target mir-29b competitively bind mir-29b addition sponge researcher engineer mir-29b overexpress cell insert mir-29b sequence embryonic stem cell genome drive cag promoter insert rosa26 site clarify role sound like pick 29b figure 1 neural tube epithelial cell differentiation experiment result expression level mir-29b sponge verify qpcr b qpcr result nte marker gene zfp521 expression level mir-29b sponge condition c expression level mir-29b verify qpcr d qpcr result nte marker gene zfp521 mir-29b overexpression condition low d show oe high figure 2 neural crest cell differentiation experiment result qpcr result ncc marker p75 snail2 expression mir-29b overexpression condition b qpcr result ncc marker p75 snail3 expression mir-29b sponge show oe sponge adapt xi j. wu y. li g. ma l. feng k. guo x. kang j. 2017 mir-29b mediate neural tube versus neural crest fate decision embryonic stem cell neural differentiation stem cell reports 9(2) 571–586 mir-29b influence differentiation neuroectoderm cell neural epithelial cell neural crest cell respectively question ask draw conclusion base datum provide start want define term question stem sure clear exactly ask tell paragraph neuroectoderm cell differentiate type cell neural epithelial cell neural crest cell tell mir-29b influence process know impact differentiation parse target mir-29b manipulate change alter neuroectoderm cell differentiation researcher create experimental condition mir-29b sponge mir-29b overexpression recall mir-29b work bind complementary site mrna block translation mechanism prevent synthesis gene product state passage mir-29b sponge site complementary mir-29b act like sponge grab mir-29b cell result mir-29b bind sponge instead bind local rna mean functionally mir-29b bind rna compare normal word opposite overexpress condition know action differentiation condition overexpression inhibition analyze datum figure 1 show neural epithelial cell

overexpression inhibition analyze datum figure 1 show neural epithelial cell result mir-29b sponge condition differentiation level reduce compare control mir-29b overexpression

condition differentiation level increase imply microRNA-29b critical differentiation neuroectoderm cell neural look figure 2 oppose effect microRNA sponge condition differentiation neural crest cell increase compare control microRNA overexpression condition differentiation neural crest cell reduce datum infer microRNA suppress neuroectoderm cell differentiation neural crest cell conclusion presence microRNA-29b important neuroectoderm cell differentiation neural epithelial cell presence microRNA-29b suppress differentiation neural crest cell determination differentiation cell depend location cell identity surround cell develop cell receive signal organize cell secrete signaling molecule discuss previously surround tissue induce develop cell particular cell type inducer term inducer refer cell secrete signal cell induce call responder responsive cell induce responder competent able respond induce signal cell cell communication occur autocrine paracrine juxtacrine endocrine signal autocrine signal act cell secrete signal place paracrine signal act cell local area juxtacrine signal usually involve diffusion involve cell directly stimulate receptor adjacent cell finally endocrine signal involve secrete hormone travel bloodstream distant target tissue inducer growth factor peptide promote differentiation mitosis certain tissue growth factor function specific cell type certain area determine competence cell way certain growth factor code particular tissue example pax6 express ectoderm head location optic vesicle approach overlying ectoderm produce factor development lens eye induce interestingly induction way pathway end differentiation lens trigger optic vesicle form optic cup ultimately retina know reciprocal development tissue expose multiple inducer course development development eye lateral outpocketing brain optic vesicle grow touch overlying ectoderm optic vesicle induce ectoderm form lens placode lens placode turn induce optic vesicle create optic cup optic cup induce lens placode develop cornea lens experiment frog embryo ectoderm subsequently transplant trunk optic vesicle grow lens develop trunk ectoderm transplant outgrowth optic vesicle main method signaling occur

trunk ectoderm transplant outgrowth optic vesicle main method signaling occur use gradient

morphogen molecule cause determination cell diffuse organism location close origin morphogen expose high concentration area away exposure multiple morphogen secrete simultaneously result unique combination morphogen exposure organism induce differentiation specific cell type common morphogen include transform growth factor beta  $\text{tgf } \beta$  sonic hedgehog  $\text{shh}$  epidermal growth factor  $\text{egf}$  cell migration cell death regeneration induction differentiation lead creation different type cell cell right location carry function sculpting anatomic structure require differentiation death cell certain organ ability recreate injure surgically remove portion tissue cell able disconnect adjacent structure migrate correct location example anterior pituitary gland originate segment oral ectoderm migrate mouth final location hypothalamus neural crest cell undergo extensive migration cell form edge neural fold neurulation migrate body form different structure include sensory ganglia autonomic ganglia adrenal medulla schwann cell specific cell type tissue calcitonin produce cell thyroid melanocyte skin apoptosis program cell death occur time development example finger originally web development hand cell webbing later undergo apoptosis result separation individual finger toe apoptosis occur apoptotic signal process apoptosis cell undergo change morphology divide self contain protrusion call apoptotic bleb break apart apoptotic body digest cell show figure 3.9 allow recycling material bleb contain membrane prevent release potentially harmful substance extracellular environment different necrosis process cell death cell die result injury necrosis internal substance leak cause irritation nearby tissue immune cell darken small disintegrate small vesicle figure 3.9 apoptosis apoptotic cell disintegrate absorb digest cell regenerative capacity ability organism regrow certain part body vary species species specie salamander newt enhance capacity regenerate retain extensive cluster stem cell body regeneration require stem cell migrate appropriate body initiate regrowth specie say undergo complete regeneration lose damage tissue replace identical tissue contrast incomplete regeneration imply newly form tissue identical structure function tissue injure

regeneration imply newly form tissue identical structure function tissue injure lose human typically exhibit incomplete regeneration response injury human regenerative capacity vary tissue type liver tissue high regenerative capacity able undergo extensive regeneration follow injury loss example live donor able donate 50 percent liver tissue liver regenerate miss portion unfortunately heart little regenerative capacity scarring result follow injury event heart attack kidney moderate regenerative capacity able repair nephron injury tubule regenerative capacity easily overwhelm kidney failure result senescence aging organism age change occur molecular cellular structure result disruption metabolism eventually death organism senescence biological aging occur cellular organismal level change accumulate cellular level senescence result failure cell divide normally approximately 50 division vitro research demonstrate shorten telomere end chromosome telomere reduce loss genetic information end chromosome help prevent dna unravel high concentration guanine cytosine enable telomere knot end chromosome telomere difficult replicate shorten round dna synthesis eventually telomere short cell long able replicate cell include germ cell fetal cell tumor cell express enzyme know telomerase enzyme reverse transcriptase able synthesize end chromosome prevent senescence telomerase allow cell divide indefinitely play role survival cancer cell organismal level senescence represent change body ability respond change environment aging complex involve cellular senescence accumulation chemical environmental damage time mcat concept check 3.2 assess understanding material 1 difference determination differentiation 2 type potency lineage cell type type potency cell lineage 3 type cell cell communication 4 difference apoptosis necrosis chapter 3.3 able recall oxygenation status blood umbilical artery umbilical identify fetal shunt location organ bypass recall placenta show figure 3.10 organ nutrient gas waste exchange occur crucial maternal fetal blood mix different blood type simple method nutrient waste product diffusion prefer method water glucose amino acid inorganic salt diffusion require gradient imply high partial pressure oxygen maternal blood fetal blood enhance transfer oxygen maternal fetal



oxygen maternal blood fetal blood enhance transfer oxygen maternal fetal circulation fetal blood cell contain fetal hemoglobin hbf great affinity oxygen adult hemoglobin primarily hba assist transfer retention oxygen fetal circulatory system waste material carbon dioxide opposite direction figure 3.10 placental structure embryo obtain nutrient oxygen person pregnant actual mixing blood instead placenta depend close proximity embryonic maternal bloodstream facilitate diffusion remember gas exchange fetus occur placenta fetal lung function birth placental barrier serve function immunity fetus immunologically naïve expose pathogen accidental exposure happen utero crossing antibody placental membrane serve protective function placenta qualify endocrine organ produce progesterone estrogen human chorionic gonadotropin hcg essential pathogen large cross placental barrier diffusion set pathogen call torches infection cross barrier cause significant birth defect screen immunization infection recommend pregnancy torches stand toxoplasma gondii rubella cytomegalovirus herpes hiv syphilis umbilical vessel commonly test mcat demonstrate need understand proper biological definition artery vein like artery carry blood away heart umbilical artery carry blood away fetus placenta like vein carry blood heart umbilical vein carry blood fetus placenta remember oxygenation occur placenta fetal lung umbilical artery carry deoxygenated blood umbilical vein carry oxygenate blood unlike artery umbilical artery carry deoxygenated blood waste product unlike vein umbilical vein carry oxygenated blood nutrient key difference fetal adult circulation demonstrate important characteristic develop organism lung liver serve significant function prior birth gas exchange occur lung placenta detoxification metabolism primarily control mother liver nutrient waste exchange occur placenta fetus depend lung liver notably organ underdeveloped sensitive high blood pressure receive postnatal life fetus construct shunt actively direct blood away organ develop show figure 3.11 figure 3.11 fetal circulation systemic fetal circulation b enlarged view fetal circulation

highlight

fetal shunt different shunt reroute blood lung call foramen ovale way valve connect right atrium left atrium allow blood enter right atrium inferior vena cava flow left atrium instead right ventricle pump aorta systemic circulation directly unlike adult circulation right heart high pressure develop fetus left push blood opening birth pressure differential reverse shut foramen ovale second ductus arteriosus shunt leftover blood pulmonary artery aorta pressure differential right left side heart push blood opening systemic circulation liver bypass ductus venosus shunt blood return placenta umbilical vein directly inferior vena cava liver receive blood supply small hepatic artery systemic mcat concept check 3.3 assess understanding material 1 oxygenation status blood umbilical artery 2 fetal shunt vessel heart chamber connect organ shunt bypass shunt connect vessel chamber organ bypassed 3.4 gestation birth chapter 3.4 able identify major developmental feature trimester describe stage birth recall key concept term birth process include parturition prostaglandin oxytocin afterbirth human gestation last estimate 280 day divide trimester general rule large animal long gestational period few offspring pregnancy example elephant usually calf gestate 22 month contrast mouse 10 12 offspring litter gestate 20 day need know detail gestation mcat key developmental event trimester familiar major organ begin develop week heart begin beat approximately 22 day soon afterward eye gonad limb liver start form week embryo 10 mm length week grow 15 mm cartilaginous skeleton begin harden bone seventh week end week organ form brain fairly develop embryo know fetus end month fetus 9 cm long second trimester fetus undergo tremendous growth begin amniotic fluid face take human appearance toe finger elongate end sixth month fetus measure 30 36 cm long seventh eighth month characterize continue rapid growth brain development antibody transport highly selective active transport pregnant individual fetus protection foreign agent preparation life outside womb transfer begin early pregnancy

foreign agent preparation life outside womb transfer begin early pregnancy high ninth month

birth growth rate slow fetus active room advance medicine allow premature baby bear early 24 week survive far short normal 40 week neonate survive severe complication fetal development complete 24 week problem apparent respiratory gastrointestinal nervous system vaginal childbirth parturition accomplish rhythmic contraction uterine smooth muscle coordinate prostaglandin peptide hormone oxytocin birth consist basic phase cervix thin amniotic sac rupture commonly call water break strong uterine contraction result birth fetus finally placenta umbilical cord expel refer afterbirth mcat concept check 3.4 assess understanding material 1 key developmental feature trimester 2 occur phase birth chapter see fertilize ovum zygote embryo organ develop body organize complex organ system embryo turn newborn baby development certainly stop human nurture young year decade undergo physical cognitive sexual development embryonic development extremely important lay foundation development proceed correctly time process go exactly plan case medical school study wide spectrum teratology study birth defect adult structure arise embryonic germ layer special importance commonly test mcat remainder embryology cleavage event uterine contraction focus main terminology highlight stage addition difference fetal adult physiology see organ system derive begin survey anatomy physiology chapter chapter 4 11 mcat biology review explore cell tissue organ interaction major organ system discussion begin nervous system review content test knowledge critical thinking skill complete test like passage set online early developmental stages fertilization joining sperm ovum usually occur ampulla fallopian tube sperm use acrosomal enzyme penetrate corona radiata contact oocyte plasma membrane sperm establish acrosomal apparatus inject pronucleus sperm penetrate cause release calcium ion prevent additional sperm fertilize egg increase metabolic rate result diploid zygote call fraternal dizygotic twin result fertilization egg different sperm identical monozygotic twin result splitting zygote monozygotic twin classify placental structure share mono- vs. diamniotic mono- vs. dichorionic

classify placental structure share mono- vs. diamniotic mono- vs. dichorionic cleavage refer

early division cell embryo mitotic division result large number small cell overall volume change  
zygote embryo cleavage indeterminate cleavage result cell capable cell organism determinate  
cleavage result cell commit differentiate specific cell type morula solid mass cell see early  
development

blastula blastocyst fluid fill center call blastocoel

different structure trophoblast placental structure inner cell mass develop blastula implant  
endometrial lining form placenta chorion contain chorionic villus penetrate endometrium  
create interface maternal fetal blood placenta establish embryo support yolk allantois involve  
early fluid exchange embryo yolk sac amnion lie inside chorion produce amniotic fluid develop  
organism connect placenta umbilical gastrulation archenteron form blastopore end  
archenteron grow blastocoel contact opposite establish primary germ layer ectoderm  
epidermis hair nail epithelia nose mouth anal canal nervous system include adrenal medulla  
lens eye mesoderm musculoskeletal circulatory excretory system mesoderm give rise gonad  
muscular connective tissue layer digestive respiratory system adrenal cortex endoderm  
epithelial lining respiratory digestive tract part pancreas thyroid bladder distal urinary tract  
neurulation development nervous system begin formation germ layer notochord induce  
group overlying ectodermal cell form neural fold surround neural groove neural fold fuse  
form neural tube central nervous system tip neural fold contain neural crest cell peripheral  
nervous system sensory ganglia autonomic ganglia adrenal medulla schwann cell specific cell  
type tissue calcitonin produce cell thyroid melanocyte skin teratogen substance interfere  
development cause defect death develop embryo teratogen include alcohol certain  
prescription drug virus bacteria environmental chemical maternal condition affect  
development include diabetes increase fetal size hypoglycemia birth folic acid deficiency  
neural mechanisms development cell specialization occur result determination differentiation  
determination commitment specific cell lineage accomplish uneven segregation cellular

material mitosis morphogen promote development specific cell line respond specific morphogen cell differentiation refer change cell undergo selective transcription characteristic appropriate cell line stem cell cell capable develop cell type classify potency totipotent cell able differentiate cell type include germ layer placental structure pluripotent cell able differentiate germ layer derivative multipotent cell able differentiate specific subset cell communicate number different signaling method inducer release factor promote differentiation competent autocrine signal act cell release signal paracrine signal act local cell juxtacrine

act cell release signal paracrine signal act local cell juxtacrine signal act direct stimulation adjacent cell endocrine signal act distant tissue travel growth factor peptide promote differentiation mitosis certain tissue tissue induce differentiation signaling occur gradient cell need migrate arrive correct location apoptosis program cell death formation apoptotic bleb subsequently absorb digest cell apoptosis sculpt certain anatomical structure remove webbing digit regenerative capacity ability organism regrow certain part body liver high regenerative capacity heart low senescence result multiple molecular metabolic process notably shortening telomere cell division nutrient gas waste exchange occur placenta oxygen carbon dioxide passively exchange concentration fetal hemoglobin hbf high affinity oxygen adult hemoglobin primarily hba affinity assist transfer retention oxygen fetal circulatory system placental barrier serve immune protection pathogen antibody transfer pregnant individual placenta serve endocrine function secrete estrogen progesterone human chorionic gonadotropin hcg umbilical artery carry deoxygenated blood fetus placenta umbilical vein carry oxygenate blood placenta fetus fetal circulatory system differ adult version have foramen ovale connect right atrium left atrium bypass lung ductus arteriosus connect pulmonary artery aorta bypass lung ductus venosus connect umbilical vein inferior vena cava bypass liver gestation birth trimester organogenesis occur development heart eye gonad limb liver brain second trimester tremendous growth occur movement begin face distinctly human digit elongate trimester rapid growth brain development continue transfer antibody fetus

birth cervix thin amniotic sac rupture uterine contraction coordinate prostaglandin oxytocin result birth fetus finally placenta umbilical cord expel answer concept check 1 determinate cleavage refer cell division result cell have definitive lineage daughter cell program differentiate particular cell type indeterminate cleavage refer cell division result cell differentiate cell type 2 zygote 2- 4- 8- 16 cell embryo morula blastula blastocyst 3 implantation occur blastula blastocyst stage integument include epidermis hair nail epithelia nose mouth anal canal lens eye

epidermis hair nail epithelia nose mouth anal canal lens eye nervous system include adrenal medulla inner ear musculoskeletal system circulatory system excretory system gonad muscular connective tissue layer digestive respiratory system adrenal cortex epithelial lining digestive respiratory tract part liver pancreas thyroid bladder distal urinary 5 induction process nearby cell influence differentiation adjacent cell ensure proper spatial location orientation cell share function complementary function 6 neural crest cell peripheral nervous system include sensory ganglia autonomic ganglia adrenal medulla schwann cell specific cell type tissue calcitonin produce cell thyroid melanocyte skin 1 determination commitment cell particular lineage differentiation refer actual change occur order cell assume structure function determine cell type cell type develop embryo primary germ layer extraembryonic tissue amnion chorion pluripotency cell type develop embryo primary germ multipotency cell type particular lineage example hematopoietic stem cell 3 autocrine signal act cell secrete paracrine signal act local cell juxtacrine cell trigger adjacent cell direct receptor stimulation endocrine signal travel bloodstream act cell distant site 4 apoptosis program cell death result contain bleb dead cell pick digest cell necrosis cell death injury result spilling cytoplasmic content 1 umbilical artery carry deoxygenate blood umbilical vein carry connected vessels chambers right atrium left atrium ductus arteriosus pulmonary artery aorta umbilical vein inferior vena cava liver 1 trimester organogenesis occur development heart eye gonad limb liver brain second trimester tremendous growth occur movement begin face distinctly human

digit elongate trimester rapid growth brain development continue transfer antibody fetus 2 phase birth cervix thin amniotic sac rupture second phase uterine contraction coordinate prostaglandin oxytocin result birth fetus phase placenta umbilical cord expel science mastery assessment explanations prostaglandin promote cervical dilation onset contraction oxytocin promote uterine contraction positive feedback loop oxytocin involve milk letdown help uterus contract shrink follow delivery factor lead d right answer contrast prolactin

shrink follow delivery factor lead d right answer contrast prolactin promote milk production produce follow childbirth eliminate progesterone maintain pregnancy actually inhibit uterine contraction eliminate b answer question useful review quickly embryonic layer ectoderm give rise integument epidermis hair nail epithelia nose mouth anal canal lens eye nervous system include adrenal medulla endoderm give rise epithelial lining digestive respiratory tract part liver pancreas thyroid bladder finally mesoderm give rise musculoskeletal system circulatory system excretory system gonad adrenal cortex correct association find c fingernail derive ectoderm rod mesodermal cell call notochord develop longitudinal axis dorsal layer ectoderm inductive effect notochord overlie ectoderm start bend inward form groove dorsal surface embryo dorsal ectoderm eventually pinch develop spinal cord brain neural tube form ectoderm notochord influence specific group cell differentiation group cell term induction example eye form reciprocal induction brain ectoderm competence refer ability cell respond give inducer influence group organize cell eliminate senescence term biological aging eliminate b determination result induction term refer general concept effect group cell differentiation group cell pregnancy placenta produce estrogen progesterone maintain endometrium hormone necessary proper gestation fetus measurable maternal blood act maternal organ prior birth fetus immunologically naïve produce immunoglobulin eliminate worth note maternal immunoglobulin cross placenta enter fetal blood fetal hemoglobin large protein easily cross placenta red blood cell large cross barrier eliminate b carbon dioxide fetal metabolism find maternal blood fetal lung nonfunctional prior birth fetus suspend amniotic

fluid carbon dioxide transfer placenta directly fetal bloodstream question stem state cell release substance diffuse environment cause differentiation nearby cell cell act nearby cell molecule spread diffusion example paracrine signaling autocrine signaling occur molecule secrete cell act cell juxtacrine signaling b occur adjacent cell signal spread diffusion endocrine signaling d molecule secrete travel bloodstream distant target cell able divide indefinitely senescence exhibit normal cell behavior normally

cell able divide indefinitely senescence exhibit normal cell behavior normally somatic cell divide limited number time telomere short effective protector genomic material occur cell stop divide case cell continue divide indefinitely likely enzyme telomerase activate allow synthesis telomere counteract shortening dna replication organogenesis primarily occur trimester pregnancy 8 week gestation brain fairly develop organ form severity anencephaly suggest defect early fetal development lead correct answer

second trimester mark significant growth development defect stage cause structural abnormality absence organ unlikely embryonic stem cell controversial require termination embryo harvest eliminate b adult stem cell significantly controversial require treatment transcription factor order increase level potency eliminate c rejection concern foreign cell introduce individual stem cell remove risk eliminate d adult stem cell naturally pluripotent pluripotency induce strategic use transcription factor correct answer development program cell death occur multiple location order ensure development correct adult structure place occur finger toe digestive tract central lumen form apoptosis occur correctly digestive tract imperforate anus result failure determination differentiation likely result absence anorectal structure altogether eliminate b failure neurulation lead absence nervous system compatible life eliminate d injury healing occur sort regenerative process human tissue liver capable regenerate tissue function structure original tissue heart capable sort regeneration form fibrous scar area injury example incomplete regeneration newly form tissue identical structure



function tissue injure lose mutation affect skin nervous system derive ectoderm germ tissue layer lead skin nervous system formation eliminate b c notochord actually primary germ tissue layer answer question eliminate d cell division occur embryo consist solid ball cell know morula hollow center form create blastula finally cell begin differentiate germ layer embryo consider gastrula c correct answer question stem state woman give drug day baby bear important remember organogenesis occur trimester structure fully functional lung organ largely form prior administration teratogenic drug likely major effect development organ result exposure teratogen eliminate b c lung tissue sensitive mature late likely infant respiratory distress birth blood flow ductus arteriosus pulmonary artery aorta direction flow determine pressure differential right heart pulmonary circulation left heart systemic circulation unlike adult right heart high pressure prenatal life left blood shunt pulmonary circulation systemic circulation foramen ovale ductus arteriosus consult online resource additional practice online behavioral science

ductus arteriosus consult online resource additional practice online behavioral science chapter 1 biology behavior biochemistry chapter 3 nonenzymatic protein function protein analysis biochemistry chapter 6 dna biotechnology biology chapter 1 biology chapter 2 biology chapter 5 endocrine system chapter 4 nervous system chapter 4 nervous system neuron background science mastery assessment pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question

correctly spend 20 minute review question quiz miss include quick read correspond  
subchapter relevant content subchapter question review question answer correctly ensure  
thinking match explanation review concept summary end chapter 1 rest membrane potential  
depend 1 differential distribution ion axon membrane 2 opening voltage gate calcium channel  
3 active transport ion membrane 1 2 ii 3 iii 4 ii iii 2 follow associate myelin sheath 1 fast  
conduction nerve impulse 2 node ranvier form gap axon 3 increased magnitude potential  
difference action 4 saltatory conduction action potential 3 follow true regard action potential 1  
hyperpolarized stimulus carry axon terminal decrease size 2 size action potential proportional  
size stimulus produce 3 increase intensity depolarization increase size 4 action potential  
trigger impulse give magnitude speed produce 4 follow correctly describe difference nerve  
tract 1 nerve see central nervous system tract see peripheral nervous

1 nerve see central nervous system tract see peripheral nervous system 2 nerve cell body  
nucleus tract cell body 3 nerve carry type information tract carry type information 4 nerve  
contain neuron tract contain neuron 5 follow accurately describe sensory neuron 1 sensory  
neuron afferent enter spinal cord 2 sensory neuron efferent enter spinal cord 3 sensory  
neuron afferent enter spinal cord 4 sensory neuron efferent enter spinal cord 6 sensory  
neuron receive stimulus bring threshold following 1 depolarized 2 transduce stimulus action  
potential 3 inhibit spread action potential sensory neuron 4 cause release neurotransmitter  
cell central 7 potential axon membrane negative normal resting potential neuron say state 8  
follow statement concern somatic division peripheral nervous system incorrect 1 pathway  
innervate skeletal muscle 2 pathway usually voluntary 3 pathway refer reflex arc 4 pathway  
involve neuron 9 follow function parasympathetic nervous 1 increase blood sugar period  
stress 2 dilate pupil enhance vision 3 increase oxygen delivery muscle 4 decrease heart rate  
blood pressure 10 following neurotransmitter ganglia sympathetic parasympathetic nervous  
system 11 neural structure ribosome primarily locate 3 axon hillock 12 autoimmune disease  
attack voltage gate calcium channel synaptic terminal excitatory neuron likely symptom

condition 1 spastic paralysis inability relax muscle 2 flaccid paralysis inability contract muscle 3 inability reuptake neurotransmitter release 4 retrograde flow action potential 13 neuron fire action potential multiple presynaptic cell release neurotransmitter dendrite neuron 1 saltatory conduction 3 feedback loop 4 inhibitory transmission 14 disease result death schwann cell portion nervous system likely affect 1 central nervous system 2 somatic nervous system 3 autonomic nervous system 4 parasympathetic nervous system 15 surgeon accidentally clip dorsal root ganglion spinal surgery likely consequence error 1 loss reflex level 2 loss sensation level 3 loss cognitive function 1 2 ii 3 ii 4 ii iii chapter 4 nervous

2 ii 3 ii 4 ii iii chapter 4 nervous system chapter 4.1 cells nervous system hy cell nervous system 4.2 transmission neural impulse hy action potential 4.3 organization human nervous system hy central peripheral nervous systems autonomic nervous system pie chart

indicate content chapter relevant thirteen percent question biology mcat content chapter relevant 12 question biology mcat chapter cover material following aamc content 2a assembly molecule cell group cell single cellular multicellular organism 3a structure function nervous endocrine system way system coordinate organ system 4c electrochemistry electrical circuit element 6a sense environment generation indigenous people south america blow dart lace paralytic plant extract hunt prey 1800 english physician interact

indigenous south americans recognize possible use paralytic agent know tubocurarine anesthetic agent surgery physician notice animal influence tubocurarine temporarily immobilized recover period paralysis accord physician anesthetic agent revolutionize surgery test effectiveness new drug physician volunteer demonstrate effectiveness test pain perception influence tubocurarine drug effective paralyze agent effect sensory receptor body feel test able express organism sense pain temperature aspect environment nervous system coordinate sensory information respond stimulus specifically nervous system responsible

control muscular movement neuromuscular reflex glandular secretion salivation lacrimation  
addition nervous system responsible high level thinking mental function despite complex  
function nervous system operate basic electrical chemical signal biomedical scientist discover  
nervous system anatomical functional division nature action potential histological feature  
microscope know inspirational challenge future physician realize brain continue vast frontier  
human exploration discovery 4.1 cells nervous system high yield chapter 4.1 able recall  
different term myelin produce cell peripheral central nervous system identify function main  
category glial cell describe purpose major structure neuron neuron specialize cell capable  
transmit electrical impulse translate electrical impulse chemical signal section consider  
structure neuron neuron communicate part nervous system neuron shape match function  
dictate cell neuron interact variety different type neuron body share specific feature axon  
carry neural signal away soma dendrite carry signal anatomy neuron show figure 4.1 like cell  
mature red blood cell neuron nucleus nucleus locate cell body call soma soma location  
endoplasmic reticulum ribosome cell appendage emanate directly soma call dendrite receive  
incoming message cell information receive dendrite transmit cell body reach axon hillock  
integrate incoming signal axon hillock play important role action potential transmission  
electrical impulse axon signal arrive dendrite excitatory inhibitory axon hillock sum signal  
result excitatory reach threshold discuss later chapter initiate action potential axon long  
appendage terminate close proximity target structure muscle gland neuron mammalian nerve  
fiber insulate myelin fatty membrane prevent signal loss crossing

nerve fiber insulate myelin fatty membrane prevent signal loss crossing signal like insulation  
prevent wire accidentally discharge myelin sheath maintain electrical signal neuron addition  
myelin increase speed conduction axon myelin produce oligodendrocyte central nervous  
system schwann cell peripheral nervous system certain interval axon small break myelin  
sheath expose area axon membrane call node ranvier explore discussion action potential  
follow node ranvier critical rapid signal conduction finally end axon nerve terminal synaptic

bouton knob structure enlarge flatten maximize transmission signal neuron ensure proper release neurotransmitter chemical transmit information neuron label cell body axon hillock schwann cell oligodendrocyte cns node

ranvier myelin sheath axon nerve terminal figure 4.1 structure neuron body mount immune response myelin lead destruction insulate substance demyelination myelin speed conduction impulse neuron absence myelin slow information transfer common demyelinating disorder multiple sclerosis ms ms myelin brain spinal cord selectively target different kind neuron demyelinate patient ms experience wide variety symptom include weakness lack balance vision problem incontinence neuron physically connect neuron small space terminal portion axon release neurotransmitter bind dendrite adjacent neuron postsynaptic neuron space know synaptic cleft nerve terminal synaptic cleft postsynaptic membrane know synapse neurotransmitter release axon terminal traverse synaptic cleft bind receptor postsynaptic neuron multiple neuron bundle form nerve peripheral nervous system nerve sensory motor mixed refer type(s information carry mix nerve carry sensory motor information cell body neuron type cluster central nervous system axon bundle form tract unlike nerve tract carry type information cell body neuron tract group nucleus biology guide example expert thinking huntington disease hd devastating neurodegenerative condition cause expansion cag repeat exon 1 it15 encode protein huntingtin huntingtin widely express hd associate neurodegeneration striatal medium spiny neuron particular vulnerability hypothesize result transcriptional dysregulation camp creb signaling cascade neuron potential treatment target phosphodiesterase pde inactivate camp creb cascade test hypothesis potential therapeutic approach researcher investigate administration tp-10 highly specific phosphodiesterase inhibitor alleviate neurological deficit highly utilize hd model system r6/2 mouse loss reflex loss body weight increase instance clasping behavior mice monitor tp-10 intervention group vehicle control group righting reflex assess lay mouse monitor ability upright position clasping behavior correlate camp creb lead = want model system hd = mice behavior axon cover

extension oligodendrocyte loose association astrocyte lose reflex trend wild type wt gain weight end experiment r6/2 trend vehicle group develop clasp treatment adapt giampà c. laurenti d. anzilotti s. bernardi g. menniti f. s. fusco f. r.

2010 inhibition striatal specific phosphodiesterase pde10a ameliorate striatal cortical pathology r6/2 mouse model tp-10 treatment alleviate neurological deficit associate question ask result associate study go use information article result figure order answer article say tp-10 possible treatment huntington disease hd second paragraph describe dependent variable measure success experiment appear figure associate dependent variable need evaluate result figure reach conclusion base label axis graph figure 1a show age mouse lose righting reflex specifically r6/2 tp-10 red retain righting reflex long r6/2 vehicle black accord passage loss righting reflex indicate neurodegeneration tp-10 appear alleviate particular symptom figure 1b show mouse hd genetic condition lose weight treatment vehicle condition mean tp-10 appear help weight maintenance finally figure 1c show clasping occur readily r6/2 vehicle r6/2 tp-10 term clasping imply positive negative effect brain article tell clasping sign neurodegeneration datum show r6/2 tp-10 treat mouse later onset clasping demonstrate neurological deficit overall figure 1a 1c indicate tp-10 potential treat neurological deficit associate huntington disease figure 1b indicate treatment address aspect disease cell nervous system neurons cell nervous system neuron support myelinate cell cell call glial cell neuroglia glial cell play structural supportive role show figure 4.2 glial cell astrocyte oligodendrocyte detailed knowledge cell type necessary mcat familiarity basic function suffice astrocyte nourish neuron form blood brain barrier control transmission solute bloodstream nervous ependymal cell line

ventricle brain produce cerebrospinal fluid physically support brain serve shock absorber microglia phagocytic cell ingest break waste product pathogen central nervous system oligodendrocyte cns schwann cell pns produce myelin mcat concept check 4.1 assess

understanding material 1 following neuron structure provide brief description 2 collection cell body call cns pns 3 type glial cell properly function individual susceptible cns infection 4 guillain barré syndrome gbs autoimmune disease cause demyelination peripheral nervous system type glial cell target gbs 4.2transmission neural impulse high yield chapter 4.2 able explain ion channel regulatory step involve process initiate propagate terminate action potential describe rest membrane potential maintain differentiate temporal spatial summation identify ion responsible fusion neurotransmitter contain vesicle nerve terminal membrane recall main method block action neurotransmitter identify ion channel change occur shift voltage associate action potential graph membrane potential versus time action potential discuss basic anatomy neuron turn physiology underlie neuronal signaling action potential neuron use message call action potential relay electrical impulse axon synaptic bouton explore follow section action potential ultimately cause release neurotransmitter synaptic cleft cell rest membrane potential net electric potential difference exist cell membrane create movement charge molecule membrane neuron potential 70 mv inside neuron negative relative outside important ion involve generate maintain rest potential potassium  $K^+$  sodium  $Na^+$  potassium concentration inside cell average 140 mm compare 4 mm outside cell concentration difference make favorable potassium outside cell facilitate outward movement potassium cell membrane transmembrane potassium leak channel allow slow leak potassium cell potassium continually leak cell cell lose small positive charge leave small negative charge make outside cell slightly positively charged negative charge build inside cell potassium draw cell attraction positive potassium ion negative potential build inside cell potential difference continue grow potassium strongly draw cell certain potential potassium cation push concentration gradient match potassium cation pull electric potential cation push concentration gradient match potassium cation pull electric potential point net movement ion cell equilibrium respect potassium potential difference represent potassium equilibrium call equilibrium potential potassium potassium equilibrium potential -90 mv.

negative sign assign convention positive ion potassium leave cell think influx efflux big event small potassium need exit cell result electrostatic force equal force concentration gradient fact action potential change potassium intracellular concentration small accurately measure current device action potential reliant local voltage change membrane overall lack change intracellular ion concentration impact transmission reason membrane potential report unit voltage easily measurable instead concentration change negligible little potassium need exit equilibrium potential respect potassium establish instantly let consider isolation important ion sodium sodium concentration gradient reverse potassium concentration 12 mm inside 145 mm outside cell mean drive force push sodium cell movement facilitate sodium leak channel slow leak sodium cell cause buildup electric potential equilibrium potential sodium 60 mv positive sodium move cell live system sodium potassium flow cell membrane time potassium concentration gradient cause potassium leak cell potassium leak channel time sodium move opposite direction opposite effect certain sense sodium undo effect potassium movement rest potential tug of- war potassium movement pull cell potential 90 mv sodium movement pull cell potential opposite way +60 mv. ion win tug war instead balance effect reach 70 mv average nerve cell see figure 4.3 balance net effect sodium potassium equilibrium potential rest membrane potential rest potential significantly close potassium equilibrium potential cell permeable potassium ion able establish equilibrium ion continue leak cell membrane sodium potassium pump move 3 sodium ion 2 potassium ion hydrolyze atp passive sodium potassium leak figure 4.3 maintenance rest membrane potential action  $\text{Na}^+/\text{K}^+$  atpase  $\text{Na}^+$  leak channel  $\text{K}^+$  leak channel create maintain rest membrane potential 70 mv. rest membrane potential dependent intra- extracellular ion concentration relative permeability

rest membrane potential dependent intra- extracellular ion concentration relative permeability membrane different ion charge ion goldman hodgkin katz voltage equation bring different factor equation predict rest membrane potential equation discuss chapter 8 mcat give continual ion leaking membrane means move sodium potassium ion gradient rest



potential maintain  $\text{Na}^+/\text{K}^+$  atpase continually pump sodium potassium start potassium cell sodium cell maintain respective gradient fact person body atp spend  $\text{Na}^+/\text{K}^+$  atpase maintain gradient single purpose remember direction ion movement  $\text{Na}^+/\text{K}^+$  atpase think pumpkin axon hillock neurons receive excitatory inhibitory input excitatory input cause depolarization raise membrane potential  $V_m$  rest potential make neuron likely fire action potential inhibitory input cause hyperpolarization lower membrane potential rest potential make neuron likely fire action potential axon hillock receive excitatory input depolarize threshold value usually range 55 mv 40 mv action potential imply stimulus necessarily generate response small excitatory signal sufficient bring axon hillock threshold postsynaptic neuron receive information different presynaptic neuron excitatory inhibitory additive effect multiple signal know summation type summation temporal spatial temporal summation multiple signal integrate relatively short period time number small excitatory signal fire nearly moment bring postsynaptic cell threshold enable action potential spatial summation additive effect base number location incoming signal large number inhibitory signal fire directly soma cause profound hyperpolarization axon hillock depolarization cause excitatory signal fire dendrite ion channel membrane potential graph membrane potential vs. time action potential show graph start -70 mv increase  $\text{Na}^+$  influx +35 drop during  $\text{K}^+$  efflux -70 mv hyperpolarization bring -70 mv  $\text{Na}^+$   $\text{K}^+$  pump threshold show -50 mv figure 4.4 action potential generation sufficient depolarization cell membrane threshold lead generation action potential follow repolarization hyperpolarization return rest membrane potential cell bring threshold voltage gate sodium channel open membrane imply ion channel open response change potential membrane depolarization permit passage sodium ion strong electrochemical gradient promote

membrane depolarization permit passage sodium ion strong electrochemical gradient promote migration sodium cell electrical standpoint interior cell negative exterior cell favor movement positively charge sodium cation cell chemical standpoint high concentration

sodium outside cell inside favor movement sodium cell sodium pass ion channel membrane potential positive cell rapidly depolarize sodium channel open response change membrane potential inactivate  $v_m$  approach +35 mv sodium channel inactivate bring near rest potential deinactivate sodium channel exist state closed cell reach threshold inactivation reverse open threshold approximately +35 mv inactive approximately +35 mv rest potential  $Na^+$  want cell cell negative inside electrical gradient low concentration  $Na^+$  inside chemical gradient positive potential inside cell trigger voltage gate sodium channel inactivate trigger voltage gate potassium channel open sodium depolarize cell electrochemical gradient favor efflux potassium neuron positively charge potassium cation drive cell restoration negative membrane potential call repolarization efflux  $K^+$  cause overshoot rest membrane potential hyperpolarize neuron hyperpolarization serve important function make neuron refractory action potential type refractory period absolute refractory period stimulation cause action potential occur relative refractory period great normal stimulation cause action potential membrane start potential negative rest value action potential rely electrical chemical gradient neuron start rest potential 70 mv.

rest potential potassium high inside cell low outside cell sodium high outside cell low inside cell cell reach threshold sodium channel open sodium flood cell make positive inside depolarization sodium channel inactivate potassium channel open allow potassium flow cell bring potential negative range repolarization actually overshoot rest potential hyperpolarization  $Na^+/K^+$  atpase work restore rest potential  $Na^+/K^+$  atpase act restore rest potential sodium potassium gradient partially dissipate action far discuss movement ion small segment axon signal convey neuron action potential travel axon initiate neurotransmitter release movement call impulse propagation show figure 4.5 sodium rush segment axon cause depolarization surround region axon depolarization bring subsequent segment axon threshold open sodium channel segment segment continue rest action potential wave like fashion action potential reach nerve terminal action potential fire segment axon segment

momentarily refractory describe previously functional consequence information flow direction  
action potential move left right follow closely refractory segment axon figure 4.5 action  
potential propagation action potential propagate axon proximal sodium channel open  
depolarize membrane induce distal sodium channel open refractory character channel action  
potential direction toxin call tetrodotoxin ttx find pufferfish delicacy part world ttx block  
voltage gate  $\text{Na}^+$  channel block neuronal transmission rapidly cause death phrenic nerve  
innervate diaphragm long depolarize lead paralysis muscle cessation breathing reason chef  
prepare pufferfish specially train license local anesthetic work block voltage gate  $\text{Na}^+$  channel  
drug work particularly sensory neuron block transmission pain favor pain neuron neuron  
small axonal diameter little myelin allow easy access sodium channel anesthetic concentration  
keep sufficiently low block pain neuron significant effect sensory modality motor function  
speed action potential depend length cross-sectional area axon increase length axon result  
high resistance slow conduction great cross sectional area allow fast propagation decrease  
resistance effect cross sectional area significant effect length order maximize speed  
transmission mammal myelin myelin extraordinarily good insulator

order maximize speed transmission mammal myelin myelin extraordinarily good insulator  
prevent dissipation electric signal insulation effective membrane permeable ion movement  
node ranvier signal hop node node call saltatory conduction saltatory conduction recall think  
spanish verb saltar important note action potential type neuron potential difference  
depolarization increased intensity stimulus result increase potential difference action potential  
increase frequency firing insulation myelin extremely effective human spinal cord thickness  
finger insulation cord wide telephone pole prevent signal loss discuss previously neuron  
actually direct physical contact small space neuron call synaptic cleft neurotransmitter secrete  
show figure 4.6 clarify terminology neuron precede synaptic cleft call presynaptic neuron  
neuron synaptic cleft call postsynaptic neuron neuron signal gland muscle neuron  
postsynaptic cell term effector synapsis chemical nature use small molecule refer

neurotransmitter send message cell action potential cause synaptic vesicle fuse terminal membrane diffuse neurotransmitter cleft receptor dendrite postsynaptic cell figure 4.6 synapse synaptic vesicle release presynaptic neuron diffuse synaptic cleft activate receptor postsynaptic neuron gland muscle prior release neurotransmitter molecule store membrane bind vesicle nerve terminal action potential reach nerve terminal voltage gate calcium channel open allow calcium flow cell sudden increase intracellular calcium trigger fusion membrane bind vesicle cell membrane synapse cause exocytosis neurotransmitter critical understand difference electrical chemical transmission neuron electricity pass signal length axon neuron chemical neurotransmitter pass signal subsequent neuron gland muscle release synapse neurotransmitter molecule diffuse cleft bind receptor postsynaptic membrane allow message pass neuron state early neuron excitatory inhibitory distinction truly come level neurotransmitter receptor receptor ligand gate ion channel postsynaptic cell depolarize hyperpolarize g protein- couple receptor cause change level cyclic amp camp influx calcium note physiology receptor discuss chapter 3 mcat biochemistry review neurotransmission regulate circumstance constant signaling postsynaptic cell desirable neurotransmitter remove synaptic cleft main mechanism accomplish goal neurotransmitter break enzymatic reaction breakdown acetylcholine ach acetylcholinesterase ache show

neurotransmitter break enzymatic reaction breakdown acetylcholine ach acetylcholinesterase ache show figure 4.7 classic example acetylcholine remove acetylcholine receptor break figure 4.7 breakdown neurotransmitter enzyme acetylcholine ach break acetylcholinesterase second neurotransmitter bring presynaptic neuron reuptake carrier reuptake serotonin 5 ht show figure 4.8 classic example mechanism dopamine da norepinephrine ne use reuptake carrier serotonin release synapse act postsynaptic receptor stop production receptor presynaptic cell reuptake transporter bring serotonin cell figure 4.8 reuptake neurotransmitter serotonin 5 ht take presynaptic cell autoreceptor signal presynaptic cell stop release serotonin start reuptake common drug modify process occur synapse instance cocaine act block neuronal reuptake

carrier prolong action neurotransmitter synapse clinically useful drug treat alzheimer disease  
glaucoma myasthenia gravi inhibit acetylcholinesterase elevate synaptic level acetylcholine  
nerve gas warfare terrorism extremely potent acetylcholinesterase inhibitor nerve gas cause  
rapid death prevent relaxation skeletal muscle importantly diaphragm lead respiratory arrest  
neurotransmitter simply diffuse synaptic cleft nitric oxide gaseous signaling molecule fit  
category mcat concept check 4.2 assess understanding material 1 neural structure initiate  
action potential 2 entity maintain rest membrane potential approximate voltage rest  
membrane potential 3 difference temporal spatial summation 4 action potential ion channel  
open ion channel regulate effect opening channel polarization cell effect polarization 5 action  
potential ion channel open second ion channel regulate effect opening channel polarization  
cell effect polarization 6 difference absolute relative refractory period absolute refractory  
period relative refractory period 7 ion primarily responsible fusion neurotransmitter- contain  
vesicle nerve terminal membrane 8 main method neurotransmitter action 4.3 organization  
human nervous system chapter 4.3 able classify element nervous system component central  
nervous system peripheral nervous system differentiate afferent efferent neuron describe  
function somatic autonomic nervous system recall physiological effect activate sympathetic  
nervous system parasympathetic nervous system distinguish neural pathway monosynaptic  
nervous system remarkable collection cell govern involuntary voluntary behavior maintain  
homeostasis function nervous system include

govern involuntary voluntary behavior maintain homeostasis function nervous system include  
sensation perception cognition thinking problem solving executive function planning  
language comprehension creation emotion emotional expression balance coordination  
regulation endocrine organ regulation heart rate breathing rate vascular resistance  
temperature human nervous system complex web 100 billion cell communicate coordinate  
regulate signal rest body action occur body react external stimulus nervous system section  
look nervous system basic organization note information contain section discuss chapter 1

mcats behavioral sciences review central peripheral nervous systems generally speak kind nerve cell nervous system sensory neuron motor neuron interneuron sensory neuron know afferent neuron transmit sensory information sensory receptor spinal cord brain motor neuron know efferent neuron transmit motor information brain spinal cord muscle gland interneuron find neuron numerous type interneuron locate predominantly brain spinal cord link reflexive behavior afferent neuron ascend spinal cord brain efferent neuron exit spinal cord way rest body different type information require different type processing processing stimulus response generation happen level spinal cord require input brainstem cerebral cortex reflex discuss later section require processing level spinal cord example reflex hammer hit patellar tendon sensory information go spinal cord motor signal send quadriceps muscle cause leg jerk forward knee input brain require scenario require input brain brainstem happen supraspinal circuit let turn overall structure human nervous system diagram figure 4.9 flowchart organization description give subsequent text figure 4.9 major division nervous system nervous system broadly divide primary component central peripheral nervous system central nervous system cns compose brain spinal cord brain consist white matter grey matter white matter consist axon encase myelin sheath grey matter consist unmyelinated cell body dendrite brain white matter lie deeply grey matter base brain brainstem largely responsible basic life function breathing note lobe brain major brain structure discuss chapter 1 mcats behavioral sciences review spinal cord extend

discuss chapter 1 mcats behavioral sciences review spinal cord extend downward brainstem divide region cervical thoracic lumbar sacral structure neck receive sensory motor innervation spinal cord spinal cord protect vertebral column transmit nerve space adjacent vertebra like brain spinal cord consist white grey matter white matter lie outside cord grey matter deep axon motor sensory neuron spinal cord sensory neuron bring information periphery enter dorsal spinal cord cell body sensory neuron find dorsal root ganglia motor neuron exit spinal cord ventrally close body structure spinal cord see figure 4.10 figure 4.10 spinal cord sensory

neuron transmit information pain temperature vibration brain cell body dorsal root ganglia spinal cord motor neuron run brain opposite spinal cord ventral root control movement skeletal muscle glandular secretion peripheral nervous system pns contrast nerve tissue fiber outside brain spinal cord include 31 pair spinal nerve 10 12 pair cranial nerve olfactory optic nerve technically outgrowth central nervous system pns connect cns rest body subdivide somatic autonomic nervous system somatic nervous system consist sensory motor neuron distribute skin joint muscle sensory neuron transmit information afferent fiber motor impulse contrast travel efferent fiber autonomic nervous system ans generally regulate heartbeat respiration digestion glandular secretion word ans manage involuntary muscle associate internal organ gland ans help regulate body temperature activate sweating piloerection depend hot cold respectively main thing understand function automatic independent conscious control note similarity word autonomic automatic association make easy remember autonomic nervous system manage automatic function heartbeat respiration digestion temperature control primary difference somatic autonomic nervous system peripheral component autonomic nervous system contain neuron contrast motor neuron somatic nervous system go directly spinal cord muscle synapse autonomic nervous system neuron work series transmit message spinal cord neuron know preganglionic neuron second postganglionic neuron soma preganglionic neuron cns axon travel ganglion pns synapse cell body postganglionic

neuron cns axon travel ganglion pns synapse cell body postganglionic neuron stimulate target tissue autonomic nervous system ans subdivision sympathetic nervous system parasympathetic nervous system branch act opposition mean antagonistic example sympathetic nervous system act accelerate heart rate inhibit digestion parasympathetic nervous system decelerate heart rate promote digestion neuron autonomic nervous system call preganglionic neuron second neuron postganglionic neuron main role parasympathetic nervous system conserve energy associate rest sleep state act reduce heart rate constrict

bronchi parasympathetic nervous system responsible manage digestion increase peristalsis exocrine secretion acetylcholine neurotransmitter responsible parasympathetic response body release preganglionic postganglionic neuron vagus nerve cranial nerve x responsible parasympathetic innervation thoracic abdominal cavity function parasympathetic nervous system summarize figure 4.11 figure 4.11 function parasympathetic nervous system contrast sympathetic nervous system activate stress include mild stressor keep school work deadline emergency mean difference life death sympathetic nervous system closely associate rage fear reaction know fight flight reaction activate sympathetic nervous system sympathetic parasympathetic nervous system increase heart rate redistributes blood muscle locomotion increase blood glucose concentration relax bronchi decrease digestion peristalsis dilate eye maximize light intake release epinephrine bloodstream function sympathetic nervous system summarize figure 4.12 sympathetic nervous system preganglionic neuron release acetylcholine postganglionic neuron release norepinephrine figure 4.12 function sympathetic nervous system neural circuit call reflex arc control reflexive behavior example consider occur step nail receptor foot detect pain pain signal transmit sensory neuron spinal cord point sensory neuron connect interneuron relay pain impulse brain wait brain send signal interneuron spinal cord send signal muscle leg directly cause individual withdraw foot pain support foot original sensory information make way brain time arrive muscle respond pain thank reflex arc type reflex arc monosynaptic polysynaptic consider purpose reflex amusing watch leg jump doctor test knee jerk reflex functional reason response occur stretch patellar tendon make body think muscle

reason response occur stretch patellar tendon make body think muscle getting overstretch response muscle contract order prevent injury monosynaptic reflex arc single synapse sensory neuron receive stimulus motor neuron respond classic example knee jerk reflex show figure 4.13 patellar tendon stretch information travel sensory afferent presynaptic neuron spinal cord interface motor efferent postsynaptic neuron cause contraction quadriceps muscle net



result extension leg lessen tension patellar tendon note reflex simply feedback loop response potential injury patellar tendon quadriceps muscle stretch far tear damage knee joint reflex serve protect muscle figure 4.13 knee jerk reflex knee jerk knee extension reflex elicit swiftly stretch patellar tendon polysynaptic reflex arc interneuron sensory motor neuron real life example reaction step nail describe early involve withdrawal reflex extremity step nail stimulate flex hip muscle hamstring muscle pull foot away nail monosynaptic reflex similar knee jerk reflex describe previously person maintain balance foot plant firmly ground occur motor neuron control quadricep muscle opposite limb stimulate extend interneuron spinal cord provide connection incoming sensory information motor neuron support limb mcat concept check 4.3 assess understanding material 1 part nervous system central nervous system cns peripheral nervous system pns 2 afferent neuron efferent neuron 3 function accomplish somatic nervous system autonomic nervous system 4 effect sympathetic nervous system parasympathetic nervous system 5 pathway neural impulse monosynaptic reflex nervous system fascinating complex system human body million million cell allow appropriate interaction everyday world seat personality ultimately system make medical school course neuroscience astounding detail nervous system include circuit govern sensation pain temperature circuit allow body function chapter explore nervous system cellular organizational level neuron primary cell nervous system propagate impulse electrical chemical mean action potential synaptic transmission respectively neuron group form nerve primary organizational structure major branch nervous system peripheral nervous system central nervous system consist brain spinal cord peripheral

nervous system central nervous system consist brain spinal cord peripheral nervous system subdivide somatic autonomic nervous system subdivide

sympathetic parasympathetic nervous system nervous system heavily test mcat play role function major organ system neuron cause muscle digestive structure carry food peristalsis

regulate breathing rate heart rate glandular secretion nervous system system profound effect  
body endocrine system explore chapter serve similar role chemical messenger carry blood call  
review content test knowledge critical thinking skill complete test like passage set online cells  
nervous system neurons highly specialized cell responsible conduction neurons communicate  
electrical chemical form electrical communication occur ion exchange generation membrane  
potential length axon chemical communication occur

neurotransmitter release presynaptic cell binding neurotransmitter neuron consist different  
part dendrite appendage receive signal cell cell body soma location nucleus organelle  
endoplasmic reticulum ribosome axon hillock cell body transition axon action potential initiate  
axon long appendage action potential travel nerve terminal synaptic bouton end axon  
neurotransmitter release node ranvier expose area myelinated axon permit synapse consist  
nerve terminal presynaptic neuron membrane postsynaptic cell space call synaptic cleft axon  
coat myelin insulate substance prevent myelin create oligodendrocyte central nervous system  
schwann cell peripheral nervous system myelin prevent dissipation neural impulse crossing  
neural impulse adjacent neuron individual axon bundle nerve tract single nerve carry multiple  
type information include sensory motor tract contain type information cell body neuron type  
nerve cluster ganglia peripheral nervous system cell body individual neuron tract cluster  
nucleus central nervous system neuroglia glial cell cell nervous system addition astrocyte  
nourish neuron form blood brain barrier control transmission solute bloodstream nervous  
ependymal cell line ventricle brain produce cerebrospinal fluid physically support brain serve  
microglia phagocytic cell ingest break waste product pathogen central nervous system  
oligodendrocyte cns schwann cell pns produce myelin transmission neural impulse neuron  
exhibit rest membrane potential approximately 70 rest potential maintain selective  
permeability ion  $\text{Na}^+/\text{K}^+$  atpase  $\text{Na}^+/\text{K}^+$  atpase pump sodium ion cell potassium ion pump  
income signal excitatory inhibitory excitatory signal cause depolarization neuron inhibitory  
signal cause hyperpolarization neuron temporal summation refer integration multiple signal

near time spatial summation refer addition multiple signal near space action potential propagate signal axon excitatory stimulation occur cell depolarize threshold voltage voltage gate sodium channel open sodium flow neuron strong electrochemical gradient continue depolarize neuron peak action potential approximately +35 mv sodium channel inactivate potassium channel open potassium flow neuron strong electrochemical gradient repolarize cell potassium channel stay open long overshoot rest potential result hyperpolarize neuron potassium channel close  $\text{Na}^+/\text{K}^+$  atpase

rest potential result hyperpolarize neuron potassium channel close  $\text{Na}^+/\text{K}^+$  atpase bring neuron rest potential restore sodium potassium gradient axon hyperpolarize refractory period absolute refractory period cell unable fire action potential relative refractory period cell require large normal stimulus fire action potential impulse propagate length axon influx sodium segment axon bring subsequent segment axon threshold fact precede segment axon refractory period mean action potential travel direction nerve terminal neurotransmitter release synapse action potential arrive nerve terminal voltage gate calcium channel open influx calcium cause fusion vesicle fill neurotransmitter presynaptic membrane result exocytosis neurotransmitter synaptic cleft neurotransmitter bind receptor postsynaptic cell ligand gate ion channel g protein couple receptor neurotransmitter clear postsynaptic receptor stop propagation signal way happen neurotransmitter enzymatically break neurotransmitter absorb presynaptic cell neurotransmitter diffuse synaptic cleft organization human nervous system type neuron nervous system motor efferent neuron interneuron sensory afferent neuron nervous system central nervous system cns brain spinal cord peripheral nervous system pns cranial spinal cns white matter consist myelinated axon grey matter consist unmyelinated cell body dendrite brain white matter deep grey matter spinal cord grey matter deep white matter pns divide somatic voluntary autonomic automatic nervous system autonomic nervous system divide parasympathetic rest digest sympathetic fight flight reflex arc use ability interneuron spinal cord relay information source stimulus

simultaneously route monosynaptic reflex arc sensory afferent presynaptic neuron fire directly motor efferent postsynaptic neuron polysynaptic reflex arc sensory neuron fire motor neuron interneuron fire motor neuron answer concept check 1 axon transmit electrical signal action potential soma synaptic knob axon hillock integrate excitatory inhibitory signal dendrite fire action potential excitatory signal strong reach threshold dendrite receive incoming signal carry soma myelin sheath act insulation axon speed conduction soma cell body contain nucleus endoplasmic reticulum ribosome synaptic bouton lie end axon release neurotransmitter 2 collection cell body central

lie end axon release neurotransmitter 2 collection cell body central nervous system call nucleus peripheral nervous system call ganglion 3 astrocyte nourish neuron form blood brain barrier help protect brain foreign pathogen gain entrance microglia ingest break waste product pathogen disruption mechanism increase susceptibility cns infection 4 oligodendrocyte produce myelin central nervous system schwann cell produce myelin peripheral nervous system gbs cause demyelination pns infer schwann cell target immune destruction 1 action potential initiate axon hillock 2 rest membrane potential maintain  $\text{Na}^+/\text{K}^+\text{ATPase}$  approximately 70 mv.

3 temporal summation integration multiple signal close time spatial summation integration multiple signal close space 4 sodium channel open threshold 50 mv regulate inactivation occur +35 mv. inactivation reverse repolarize cell opening sodium channel cause 5 potassium channel open second approximately +35 mv. regulate close low potential slightly 70 mv opening potassium channel cause repolarization eventually 6 absolute refractory period cell unable fire action potential regardless intensity stimulus relative refractory period cell fire action potential stimulus strong normal 7 calcium responsible fusion neurotransmitter vesicle nerve 8 neurotransmitter action stop enzymatic degradation reuptake diffusion 1 central nervous system include brain spinal cord peripheral nervous system include cranial spinal

nerve sensory 2 afferent sensory neuron bring signal sensor central nervous system efferent motor neuron bring signal central nervous system effector 3 somatic nervous system responsible voluntary action notably move muscle autonomic nervous system responsible involuntary process like heart rate bronchial dilation dilation pupil exocrine gland function peristalsis 4 sympathetic nervous system promote fight flight response increase heart rate bronchial dilation redistribution blood locomotor muscle dilation pupil slowing digestive urinary function parasympathetic nervous system promote rest and- digest function slow heart rate constrict bronchi redistribute blood gut promote exocrine secretion constrict pupil promote peristalsis urinary function 5

monosynaptic reflex sensory afferent presynaptic neuron fire directly motor efferent postsynaptic neuron polysynaptic reflex sensory neuron fire directly motor neuron interneuron interneuron fire motor science mastery assessment explanation polarization neuron rest result uneven distribution ion inside outside cell difference achieve active pumping ion neuron  $\text{Na}^+/\text{K}^+$  atpase voltage gate calcium channel important nerve terminal influx calcium trigger fusion vesicle contain neurotransmitter membrane maintain rest membrane potential myelin white lipid contain material surround axon neuron central peripheral nervous system arrange axon discontinuously gap segment myelin call node ranvier eliminate b myelin increase conduction velocity insulate segment axon membrane permeable ion node ranvier eliminate action potential jump node node process know saltatory conduction eliminate d action potential describe or- magnitude potential difference action potential fix regardless intensity stimulus myelin affect magnitude potential difference action potential make c correct answer previous question action potential describe all- response mean threshold membrane potential reach action potential consistent size duration produce neuronal information code frequency number action potential size action potential eliminate b c make d correct answer hyperpolarize inhibitory signal transmit nerve terminal eliminate nerve collection neuron peripheral nervous system contain multiple type information sensory

motor contain cell body ganglia tract collection neuron central nervous system contain type information contain cell body sensory neuron consider afferent carry signal periphery central nervous system enter spinal cord dorsal motor neuron consider efferent carry signal central nervous system periphery exit spinal cord ventral sensory neuron receive signal strong bring threshold assume receptor depolarized allow transduce stimulus action potential action potential carry sensory neuron central nervous system cell release neurotransmitter give choice incorrect statement find c receptor stimulate promote spread action potential postsynaptic sensory neuron spinal cord send signal brain potential axon membrane negative normal rest potential neuron refer hyperpolarize hyperpolarization occur right action potential cause excess potassium exit neuron

hyperpolarization occur right action potential cause excess potassium exit neuron somatic division peripheral nervous system innervate skeletal muscle responsible voluntary movement pathway nervous system reflex arc reflexive response certain stimulus involve sensory motor neuron neuron synapse spinal cord require signal brain pathway somatic division involve neuron depend type signal correct answer parasympathetic nervous system govern rest digest response parasympathetic nervous system slow heart rate decrease blood pressure promote bloodflow gi tract constrict pupil function sympathetic nervous system govern fight-flight response include increase heart rate blood pressure decrease bloodflow digestive tract increase bloodflow muscle d answer choice represent function parasympathetic nervous system acetylcholine neurotransmitter release preganglionic neuron sympathetic parasympathetic nervous system postganglionic neuron sympathetic nervous system usually release norepinephrine postganglionic neuron parasympathetic nervous system release acetylcholine neuron contain specialized structure include dendrite axon axon hillock neuron cell carry cellular function include protein synthesis cell body soma contain nucleus endoplasmic reticulum ribosome consider function voltage gate calcium channel nerve terminal depolarize voltage gate calcium channel open allow influx calcium influx calcium

trigger fusion synaptic vesicle contain neurotransmitter membrane neuron nerve terminal  
allow exocytosis neurotransmitter synapse disease block influx calcium release  
neurotransmitter lack neurotransmitter mean neuron send excitatory signal symptom result  
disease inability neuron transmit excitatory signal muscle neuron communicate flaccid  
paralysis result neuron require multiple instance excitatory transmission bring threshold  
excitatory signal close time temporal space spatial way pattern excitation schwann cell  
responsible myelination cell peripheral nervous system central nervous system unlikely affect  
peripheral nervous system include somatic nervous system autonomic nervous system  
autonomic nervous system compose parasympathetic sympathetic nervous system dorsal  
root ganglion contain cell body sensory neuron dorsal root ganglion disrupt certain level loss  
sensation level furthermore reflex rely sensory afferent dorsal root ganglion result reflex arc  
online consult online resource additional practice behavioral science chapter 1 biology  
behavior

online resource additional practice behavioral science chapter 1 biology behavior behavioral  
science chapter 2 sensation perception biochemistry chapter 3 nonenzymatic protein function  
protein analysis biochemistry chapter 8 biology chapter 11 musculoskeletal system general  
chemistry chapter 12 endocrine system pre med know feeling content know mcat know first  
important high yield badge book help identify important topic science mastery assessment  
tool mcat prep arsenal is quiz take online resource guidance help ensure spend appropriate  
time chapter base personal strength weakness worry skip mean study later prep complete  
length test uncover specific piece content need review come chapter appropriate use  
assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow  
review quiz question ensure understand solve answer 8–11 question correctly spend 20–40  
minute review quiz question begin question miss read note correspond subchapter question  
answer correctly ensure thinking match explanation understand choice correct incorrect  
answer 12–15 question correctly spend 20 minute review question quiz miss include quick

read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 following association hormone category b. testosterone cortical sex hormone 2 following hormone directly stimulate target tissue 3 increased synthetic activity parathyroid gland lead a. increase renal calcium reabsorption b. decrease rate bone resorption c. decrease basal metabolic rate d. decrease blood glucose concentration 4 follow well describe structure mechanism action a. cholesterol derivative bind receptor cell surface b.

chain amino acid signal second messenger c. chain amino acid directly bind dna alter gene expression d. cholesterol derivative bind intracellular receptor alter gene 5 iodine deficiency result 6 patient high tsh level follow cause high a. autoimmune destruction thyroid cell produce t3 t4 b. tumor hypothalamus secrete high level trh c. high level t4 thyroid replacement medication d. cancerous growth parafollicular cell thyroid destroy cell type organ 7 testing novel hormone indicate nuclear localization composition carbon hydrogen oxygen base finding hormone likely classify a. peptide hormone b. steroid hormone c. amino acid derivative d. direct hormone 8 follow true pancreatic somatostatin a. secretion increase low blood glucose b. inhibitory c. regulate cortisol level d. stimulate insulin glucagon secretion 9 destruction  $\beta$  cell pancreas cause a. glucagon secretion stop increase blood glucose concentration b. glucagon secretion stop decrease blood glucose concentration c. insulin secretion stop increase blood glucose concentration d. insulin secretion stop decrease blood glucose concentration 10 follow false aldosterone regulation a. renin convert plasma protein angiotensinogen angiotensin i. b. angiotensin ii stimulate adrenal cortex secrete aldosterone c. angiotensin convert angiotensin ii angiotensin convert enzyme d. decrease blood oxygen concentration stimulate renin production 11 scientist discover new hormone relatively large size trigger conversion atp camp following well describe type hormone discover a. amino acid derivative hormone b. peptide hormone c. steroid hormone d. tropic hormone 12 patient present muscle weakness slow movement calcium deposit tissue blood test reveal low calcium



level blood administration following appropriate treatment blood test b. parathyroid hormone  
13 oxytocin antidiuretic hormone a. peptide hormone produce release pituitary b. steroid  
hormone produce release pituitary c. peptide hormone produce hypothalamus release  
pituitary d. steroid hormone produce hypothalamus release pituitary 14

excessive level dopamine brain associate psychosis accordingly antipsychotic medication block  
dopamine receptor following effect see individual take antipsychotic a. increase secretion  
growth hormone b. decrease secretion growth hormone c. increase secretion prolactin d.  
decrease secretion prolactin 15 genotypically female infant bear ambiguous genitalia soon  
birth infant suffer hyponatremia low blood concentration sodium endocrine organ likely affect  
d. adrenal cortex

endocrine system chapter mechanism hormone action classification hormone chemical  
structure classification hormone target tissue endocrine organ hormone content chapter  
relevant 9 question biology mcat chapter cover material following aamc content category 3a  
structure function nervous endocrine system way system coordinate organ system 3b  
structure integrative function main organ system e human body consist trillion cell work  
sustain life order work effectively fuel resource conserve appropriately respond stressful  
situation addition organ able communicate brain cause change behavior physiology maintain  
homeostasis messenger endocrine system hormone play essential role communication  
example pancreas produce insulin glucagon insulin induce transport glucose organ storage  
excess glucose blood glucose concentration high conversely glucagon trigger release sugar  
store raise blood glucose concentration work hormone ensure adequate level glucose organ  
function glucose level high cause damage organ system diabetes mellitus common disease  
united states major cause morbidity mortality type 1 diabetes mellitus autoimmune disease  
insulin produce cell islet langerhans destroy type 2 diabetes mellitus cause end organ  
insensitivity insulin case blood glucose concentration rise dangerous level time normal

concentration cause significant damage organ include retina eye glomerulus kidney coronary vessel heart cerebral vessel brain peripheral nerve le untreated frank treat case diabetes lead blindness kidney failure heart attack stroke limb amputation regardless field enter spend significant time work diabetic patient think effect disease condition treatment chapter explore different type hormone work survey endocrine organ discuss hormone produce is extremely high yield chapter mcat frequently test makeup endocrine system hormone function process endocrine system feedback loop regulation return chapter frequently thorough knowledge system definitely pay off test day mechanism hormone action chapter 5.1 able compare contrast trait action peptide vs. steroid hormone recall process synthesize amino acid derivative hormone distinguish direct tropic hormone e endocrine system consist organ know gland secrete hormone hormone signal molecule secrete directly bloodstream distant target

secrete hormone hormone signal molecule secrete directly bloodstream distant target tissue target tissue hormone bind receptor induce change gene expression cellular functioning hormone share structure function order understand hormone function first important understand basic classification hormone chemical structure hormone subdivide category base different criterion hormone classifie chemical identity hormone peptide steroid amino acid derivative peptide hormone amino acid range size small anti diuretic hormone adh relatively large insulin peptide hormone derive large precursor polypeptide cleave posttranslational modification ese small unit transport golgi apparatus modification activate hormone direct correct location cell hormone release exocytosis aer package vesicle peptide hormone charge pass plasma membrane bind extracellular receptor e peptide hormone consider first messenger bind receptor trigger transmission second signal know second messenger ere different receptor subtype type receptor determine happen hormone stimulate e connection hormone surface effect bring second messenger cell know signaling cascade step possibility amplification example hormone molecule bind multiple receptor degrade receptor activate

multiple enzyme trigger production large quantity second messenger us step result increase signal intensity common second messenger cyclic adenosine monophosphate camp inositol triphosphate ip3 calcium e activation g protein couple receptor show figure 5.1 system binding peptide hormone trigger receptor activate inhibit enzyme call adenylate cyclase raise lower level camp accordingly camp bind intracellular target protein kinase phosphorylate transcription factor like camp response element bind protein creb exert hormone ultimate effect mind protein kinase modify enzyme transcription factor rapid slow effect cell figure 5.1 mechanism action peptide hormone peptide hormone bind membrane bind receptor initiate signal cascade second messenger like e effect peptide hormone usually rapid short live hormone act second messenger cascade transient quick turn off compare steroid hormone effect relatively constant peptide generally water soluble peptide hormone travel freely bloodstream usually require carrier is stark contrast steroid hormone lipid soluble peptide hormone surface receptor

stark contrast steroid hormone lipid soluble peptide hormone surface receptor act second messenger system steroid hormone bind intracellular receptor function bind dna alter gene steroid hormone derive cholesterol produce primarily gonad adrenal cortex steroid hormone derive nonpolar molecule easily cross cell membrane receptor usually intracellular cytosol intranuclear nucleus bind receptor steroid hormone receptor complex undergo conformational change e receptor bind directly dna result increased decrease transcription particular gene depend identity hormone show figure 5.2 common form conformational change dimerization pairing receptor hormone complex e effect steroid hormone slow long live peptide hormone steroid hormone participate gene regulation cause alteration mrna protein present cell direct action dna figure 5.2 mechanism action steroid hormone estrogen like steroid hormone influence cell behavior modify transcription steroid hormone water soluble carry protein bloodstream travel body protein specific carry hormone sex hormone bind globulin protein nonspecific albumin note hormone generally inactive attach carrier

protein dissociate carrier function erefore level carrier protein change level active hormone  
example condition increase quantity protein carry thyroid hormone thyroxine- bind globulin  
tbg is cause body perceive low level thyroid hormone increase quantity tbg bind large  
proportion hormone mean free hormone available insulin peptide hormone release meal  
order active fast onset short act like peptide hormone estrogen testosterone steroid hormone  
promote sexual maturation slow long last change true steroid hormone amino acid derivative  
hormone finally amino acid derivative hormone common peptide steroid hormone include  
important hormone discuss chapter include epinephrine norepinephrine triiodothyronine  
thyroxine ese hormone derive amino acid usually additional modification example thyroid  
hormone tyrosine modifie addition iodine atom e chemistry family hormone considerably  
predictable instance overt memorization good strategy instance catecholamine epinephrine  
norepinephrine bind g protein couple receptor thyroid hormone bind intracellularly  
pregnancy high level estrogen progesterone cause increase production tbg thyroxine bind  
globulin order compensate people pregnant secrete high level

thyroxine bind globulin order compensate people pregnant secrete high level thyroid  
hormone order diagnose thyroid disease pregnancy different reference value classification  
hormone target tissue hormone know direct hormone secrete act directly target tissue  
example insulin release pancreas cause increase uptake glucose muscle hormone know tropic  
hormone require intermediary act example discuss chapter 2 mcat biology review  
gonadotropin release hormone gnrh hypothalamus stimulate release luteinize hormone lh  
follicle stimulate hormone fsh lh act gonad stimulate testosterone production male estrogen  
production female gnrh lh cause direct change physiology muscle bone hair follicle stimulate  
production hormone endocrine gland act target tissue tropic hormone usually originate brain  
anterior pituitary gland allow coordination multiple process body mechanism action amino  
acid derivative hormone memorize unpredictable epinephrine norepinephrine extremely fast  
onset short live like peptide hormone think adrenaline rush thyroxine triiodothyronine hand

slow onset long duration like steroid hormone regulate metabolic rate long period time  
peptide amino acid derivative hormone name end in insulin vasopressin thyroxine  
triiodothyronine steroid hormone name end in testosterone aldosterone mineralocorticoid  
cortisol glucocorticoid is exhaustive help identify chemistry hormone test day mcats concept  
check 5.1 assess understanding material 1 compare contrast peptide steroid hormone base  
following location receptor mechanism action method travel bloodstream speed onset  
duration action 2 amino acid derivative hormone synthesize 3 difference direct tropic  
hormone endocrine organs hormones chapter 5.2 able recall hormone involve calcium  
homeostasis impact blood identify tissue synthesize catecholamine major catecholamine list  
pancreatic hormone regulator impact blood glucose recall detail hormone involve water  
homeostasis include production action ultimate impact blood volume osmolarity recall release  
hormone produce hypothalamus pituitary target end result signaling pathway final target  
organ e hypothalamus pituitary thyroid parathyroid gland adrenal gland pancreas gonad  
testis ovary pineal gland endocrine gland show figure 5.3 organ capable synthesize secrete  
hormone furthermore collection cell organ kidney gastrointestinal

capable synthesize secrete hormone furthermore collection cell organ kidney gastrointestinal  
gland heart thymus serve important endocrine role e organ second group traditionally call  
endocrine organ hormone production main function figure 5.3 organ endocrine system  
endocrine organ produce hormone secrete bloodstream act distant target tissue discuss  
mechanism hormone act classification discuss individual endocrine organ hormone secrete let  
begin hypothalamus bridge nervous endocrine system regulate pituitary gland tropic  
hormone hypothalamus capable have organism wide effect e hypothalamus locate forebrain  
directly pituitary gland thalamus hypothalamus hypothalamus pituitary close hypothalamus  
control pituitary paracrine release hormone portal system directly connect organ e

hypothalamus

receive input wide variety source example hypothalamus call suprachiasmatic nucleus receive light input retinae help control sleep wake cycle part hypothalamus respond increase blood osmolarity part hypothalamus regulate appetite satiety hypothalamus contain number nucleus section call lateral ventromedial anterior hypothalamus nucleus play role emotional experience aggressive behavior sexual behavior metabolism temperature regulation water balance part hypothalamus discuss chapter 1 mcat behavioral e release hormone hypothalamus regulate negative feedback negative feedback occur hormone product later pathway inhibit hormone enzyme early pathway is type feedback maintain homeostasis conserve energy restrict production substance present sufficient quantity e hypothalamus pituitary gland inextricably link e pituitary gland anterior posterior component unique interaction hypothalamus discuss turn interaction anterior pituitary e hypothalamus secrete compound hypophyseal portal system blood vessel system directly connect hypothalamus anterior pituitary show figure 5.4 us hormone release hypothalamus travel directly anterior pituitary find appreciable concentration systemic circulation note hypophysis alternative term pituitary hormone release hypothalamus portal bloodstream travel pituitary stalk bind receptor anterior pituitary stimulate release hormone figure 5.4 hypophyseal portal system system blood vessel connect hypothalamus pituitary e hypothalamus secrete different tropic hormone e following indicate hormone release hypothalamus hormone(s release anterior pituitary response gonadotropin release hormone gnrh follicle stimulate hormone fsh luteinize hormone lh growth hormone release hormone ghrh growth hormone yroid release hormone trh thyroid stimulate hormone corticotropin release factor crf adrenocorticotropin hormone ere exception pattern prolactin inhibit factor pif actually dopamine release hypothalamus cause decrease prolactin secretion anterior pituitary power endocrine system control hypothalamus locate directly hormone anterior pituitary require factor hypothalamus release prolactin exception long hypothalamus release pif actually dopamine prolactin release absence pif allow prolactin release tropic hormone cause release

hormone endocrine gland negative feedback effect example release crf hypothalamus stimulate anterior pituitary secrete acth acth cause adrenal cortex increase level cortisol secrete

secrete acth acth cause adrenal cortex increase level cortisol secrete blood cortisol detrimental level high prevent excess cortisol secretion cortisol inhibit hypothalamus anterior pituitary release crf acth respectively show figure 5.5 is make sense crf acth accomplish desire effect get cortisol blood mean term receptor hypothalamus pituitary cortisol receptor present organ able recognize cortisol level increase ree organ system like commonly refer axis example hypothalamic pituitary adrenal hpa axis hypothalamic pituitary ovarian hpo axis figure 5.5 hypothalamic negative feedback mechanism interactions posterior pituitary e posterior pituitary receive tropic hormone hypophyseal portal system neuron hypothalamus send axon pituitary stalk directly posterior pituitary release oxytocin antidiuretic hormone oxytocin stimulate uterine contraction labor milk letdown lactation ere evidence oxytocin involve bonding behavior antidiuretic hormone adh call vasopressin increase reabsorption water collect duct kidney adh secrete response increase plasma osmolarity increase concentration solute blood tumor pituitary gland result compression portal system connect pituitary hypothalamus block ability pif reach pituitary exert effect prolactin release result lactation galactorrhea male milk production male nonpregnant female lead physician suspect presence pituitary tumor describe early pituitary gland divide anterior posterior section distinction cover discussion pituitary gland focus hormone release e anterior pituitary synthesize secrete seven different product tropic hormone direct go mention tropic hormone briefly

ese hormone work

cause release hormone organ level us discuss tropic hormone tandem endocrine organ act

e release follicle stimulate hormone fsh luteinize hormone lh stimulate gonadotropin release hormone gnrh hypothalamus ese hormone act gonad testis ovary e release adrenocorticotrophic hormone acth stimulate corticotropin- release factor crf hypothalamus acth act adrenal cortex e release thyroid stimulate hormone tsh stimulate thyroid release hormone trh hypothalamus tsh act product anterior pituitary follicle stimulate hormone fsh luteinize hormone lh adrenocorticotrophic hormone acth thyroid stimulate hormone tsh growth hormone gh additionally hormone flat tropic hormone hormone peg direct hormone prolactin important female male stimulate milk production mammary gland milk production male pathologic pregnancy estrogen progesterone level high addition prolactin hormone increase milk production secrete anterior pituitary prolactin unusual hormone release dopamine hypothalamus decrease secretion e high level estrogen progesterone allow development milk duct preparation lactation shortly aer expulsion placenta estrogen progesterone dopamine level drop block milk production remove lactation actually milk ejection occur newborn infant latch breast nipple stimulation cause activation hypothalamus result different reaction oxytocin release posterior pituitary result contraction smooth muscle breast ejection milk nipple second hypothalamus stop release dopamine anterior pituitary allow prolactin release cause production milk regulation milk supply endorphin decrease perception pain example aer complete marathon people endorphin high rush endorphin mask pain having run 26.2 mile induce sense euphoria pharmaceutical agent morphine mimic effect naturally occur painkiller growth hormone gh name exactly promote growth bone muscle is sort growth energetically expensive require large quantity glucose growth hormone prevent glucose uptake certain tissue grow stimulate breakdown fatty acid is increase availability glucose overall allow muscle bone use gh release stimulate growth hormone release hormone ghrh hypothalamus bone growth originate special region bone know epiphyseal plate seal shut puberty excess gh release childhood closure cause gigantism deficit result dwarfism adult situation slightly different



closure cause gigantism deficit result dwarfism adult situation slightly different long bone seal  
gh effect primarily small bone e result

medical condition know acromegaly e bone commonly affected hand foot head patient  
acromegaly tend seek medical help buy large shoe wear ring long fit hat e posterior pituitary  
contain nerve terminal neuron cell body hypothalamus mention early posterior pituitary  
receive store hormone produce hypothalamus adh adh secrete response low blood volume  
sense baroreceptor increase blood osmolarity sense osmoreceptor show figure 5.6 action  
level collect duct increase permeability duct water is increase reabsorption water filtrate  
nephron is result great retention water result increase blood volume high figure 5.6  
antidiuretic hormone adh hormone release posterior pituitary actually synthesize  
hypothalamus simply release posterior pituitary gland posterior pituitary synthesize hormone  
oxytocin secrete childbirth allow coordinated contraction uterine smooth muscle secretion  
stimulate suckling promote milk ejection contraction smooth muscle breast finally oxytocin  
involve bonding behavior oxytocin unusual positive feedback loop release oxytocin promote  
uterine contraction promote oxytocin release promote strong uterine contraction positive  
feedback loop usually identify spiral forward scheme usually definitive endpoint case delivery  
e thyroid control thyroid stimulate hormone anterior pituitary e thyroid surface trachea  
palpate feel organ near base neck move swallow e thyroid major function set basal metabolic  
rate promote calcium homeostasis mediate first effect release triiodothyronine t3 thyroxine t4  
carry second effect release calcitonin triiodothyronine thyroxine triiodothyronine t3 thyroxine  
t4 produce iodination amino acid tyrosine follicular cell thyroid e number 3 4 refer number  
iodine atom attach tyrosine yroid hormone capable reset basal metabolic rate body make  
energy production efficient alter utilization glucose fatty acid increased amount t3 t4 lead  
increase cellular respiration is lead increase protein fatty acid turnover speed synthesis  
degradation compound high plasma level thyroid hormone lead decrease tsh trh synthesis  
negative feedback prevent excessive secretion t3 t4 show figure 5.7

hypothalamus secrete trh stimulate anterior pituitary secrete tsh stimulate thyroid gland release t3 t4 decrease trh tsh secretion figure 5.7 thyroid hormone negative feedback deficiency iodine inflammation thyroid result hypothyroidism thyroid hormone secrete insufficient amount e condition characterize lethargy decrease body temperature slow respiratory heart rate cold intolerance weight gain yroid hormone require appropriate neurological physical development child child test birth appropriate level deficiency result intellectual disability developmental delay cretinism excess thyroid hormone result tumor thyroid stimulation call hyperthyroidism predict clinical course syndrome consider opposite effect see hypothyroidism heighten activity level increase body temperature increase respiratory heart rate heat intolerance examine thyroid tissue light microscope distinct cell population gland follicular cell produce thyroid hormone c cell call parafollicular cell produce calcitonin calcitonin decrease plasma calcium level way increase calcium excretion kidney decrease calcium absorption gut increase storage calcium bone high level calcium blood stimulate secretion calcitonin calcitonin tone calcium level blood calcium exceptionally important ion critically important function calcium bone structure strength release neurotransmitter neuron regulation muscle contraction clotting blood calcium cofactor addition calcium play role cell movement exocytosis cellular material e parathyroid

small pea sized structure sit posterior surface thyroid e hormone produce parathyroid gland aptly name parathyroid hormone pth pth serve antagonistic hormone calcitonin raise blood calcium level specifically decrease excretion calcium kidney increase absorption calcium gut vitamin d increase bone resorption free calcium show figure 5.8 like hormone see pth subject feedback inhibition level plasma calcium rise pth secretion decrease parathyroid hormone promote phosphorus homeostasis increase resorption phosphate bone reduce reabsorption phosphate kidney promote excretion urine plasma calcium inhibit pth pth increase calcium mobilization bone renal reabsorption converstion vitamin d active form decrease renal

phosphate reabsorption vitamin d increase gi absorption calcium figure 5.8 calcium phosphorus homeostasis pth activate vitamin d require absorption calcium phosphate gut e overall effect parathyroid hormone significant increase blood calcium level little effect phosphate absorption phosphate gut excretion kidney somewhat cancel like glucagon insulin pth calcitonin antagonistic think hormone pair primary function regulate calcium level blood pth increase serum calcium level calcitonin decrease calcium biology guide example expert thinking patient mutation thra thyroid hormone receptor alpha gene exhibit classical feature hypothyroidism researcher

create topic hypothyroidism outside knowledge mouse express mutate tra1 denote pv thra1pv/+ mouse faithfully reproduce classical hypothyroidism see patient tra1pv dominant negative mutant bind t3 researcher render thra1pv/+ mouse hypothyroidic treat propylthiouracil ptu ptu medication treat hyperthyroidism inhibit enzyme thyroperoxidase ptu treat mouse treat t3 induce symptom hyperthyroidism result summarize figure 1 finding consistent early report feedback loop pituitary thyroid axis affect express tra1pv mutant endocrine system specific mutation thra bind t3 mice mutation ptu medicine treat hyperthyroidism induce hypothyroidism mice finding consistent idea feedback loop figure 1 thyroid experiment result eu = iv eu hypo hyper dvs t3 t4 tsh trend euthyroid mean thyroid keep normal control change t3 t4 tsh pretty consistent condition eu hypo hyper wt pv/+ adapt park s. han c. r. park j. w. zhao l. zhu x. willingham m. cheng s. y. 2017

defective erythropoiesi cause mutation thyroid hormone receptor  $\alpha$  gene plos genetics 13(9 e1006991 tsh level elevated mouse give propylthiouracil ptu question like ask explain underlie biological cause observe phenomenon e mcat oen test ability reason concept mechanism familiar question state change system propylthiouracil effect observe elevated tsh level job determine relate want identify information need passage science background mcat question oen intentionally include term familiar e key answer question familiar phenomenon

describe find relevant information passage information conjunction scientific understanding  
solve problem identified change system question application ptu accord passage ptu  
medication inhibit thyroperoxidase treat hyperthyroidism experiment ptu render[ed ra1pv/+  
mouse hypothyroidic look figure 1a t3 t4 graph hypothyroid gray bar significantly small  
euthyroid black bar sure euthyroid refer infer give category graph hypothyroid hyperthyroid  
wild type normal function base datum context passage reasonable infer ptu drug function  
lower production thyroid hormone t3 t4 consider have low thyroid hormone relate elevated  
tsh level tsh tropic hormone release anterior pituitary regulate negative feedback mechanism  
involve thyroid hormone specifically know hypothalamus release thyroid release hormone trh  
cause anterior pituitary release thyroid stimulate hormone tsh tsh act thyroid stimulate  
release thyroid hormone triiodothyronine t3 thyroxine t4 t3 t4 act negative feedback  
hypothalamus pituitary gland lower trh tsh level reason t3 t4 level low trh tsh continuously  
produce inhibit presence t3 e mouse experiment normally function endocrine gland

prior treatment assume case passage explicitly state subject assume normal healthy individual  
normal hormone level ptu administer thyroid hormone level mouse decrease result thyroid  
hormone circulation predict little negative feedback hypothalamus anterior pituitary gland trh  
tsh level mouse elevate result lack feedback normally work create t3 t4 case mouse influence  
ptu despite tsh stimulation thyroid able produce t3 t4 e cycle continue trh tsh short reason  
tsh level elevated mouse administer ptu t3 t4 activate negative feedback mechanism tsh trh  
trick brain secrete tsh trh e

adrenal gland locate kidney adrenal actually translate near kidney adrenal gland consist  
cortex medulla is distinction anatomical gland responsible secretion different hormone e  
adrenal cortex secrete corticosteroid ese steroid hormone divide functional class  
glucocorticoid mineralocorticoid cortical sex hormone glucocorticoid steroid hormone  
regulate glucose level addition hormone affect protein metabolism e glucocorticoid likely

test mcat cortisol cortisone est hormone raise blood glucose increase gluconeogenesis decrease protein synthesis cortisol cortisone decrease inflammation immunologic response cortisol know stress hormone release time physical emotional stress is increase blood sugar provide ready source fuel case body react quickly dangerous stimulus people suffer joint pain treat glucocorticoid injection joint space decrease inflammation addition glucocorticoid treat systemic inflammation cause allergic reaction autoimmune disease glucocorticoid release control adrenocorticotrophic hormone acth describe early corticotropin release factor crf hypothalamus promote release adrenocorticotrophic hormone acth anterior pituitary promote release glucocorticoid adrenal cortex mineralocorticoid salt water homeostasis profound effect kidney e noteworthy mineralocorticoid aldosterone increase sodium reabsorption distal convoluted tubule collect duct nephron water follow sodium cation bloodstream increase blood volume pressure water sodium ion flow plasma osmolarity remain unchanged contrast adh increase water reabsorption decrease plasma osmolarity aldosterone decrease reabsorption potassium hydrogen ion segment nephron promote excretion urine addition stimulate secretion aldosterone increase blood volume blood pressure angiotensin ii increase blood pressure directly powerful vasoconstrictive effect increase heart rate angiotensin convert enzyme ace inhibitor block conversion angiotensin angiotensin ii inhibit vasoconstriction ace inhibitor frequently prescribe treatment high blood pressure congestive heart failure case vasodilation help reduce vascular resistance decrease pressure fail heart pump ace inhibitor generic name end pril lisinopril enalapril ramipril unlike glucocorticoid aldosterone primarily control renin angiotensin aldosterone system show figure 5.9 decreased blood pressure cause juxtaglomerular cell kidney secrete renin cleave inactive plasma protein angiotensinogen active form angiotensin i.

angiotensin convert angiotensin ii angiotensin convert enzyme ace lung angiotensin ii stimulate adrenal cortex secrete aldosterone blood pressure restore decrease drive stimulate renin release serve negative feedback mechanism system pathway flowchart describe

previous paragraph figure 5.9 renin angiotensin aldosterone system cortical sex hormones e  
adrenal gland cortical sex hormone androgen estrogen testis secrete large quantity androgen  
adrenal testosterone play relatively small role male physiology ovary secrete far small amount  
androgen female sensitive disorder cortical sex hormone production example certain enzyme  
deficiencie synthetic pathway adrenal cortex hormone result excess androgen production  
adrenal cortex deficiency result obvious phenotypic effect male fetus genotypic female bear  
ambiguous masculinized genitalia presence excess cortical sex hormone male affecte similar  
disorder lead excessive production estrogen function corticosteroid 3 s sex cortical sex  
hormone nestle inside adrenal cortex adrenal medulla derivative nervous system organ  
responsible production sympathetic hormone epinephrine norepinephrine e specialized  
nerve cell medulla capable secrete compound directly bloodstream epinephrine  
norepinephrine amino acid derivative hormone belong large class molecule know like  
sympathetic component autonomic nervous system hormone release adrenal medulla diverse  
system wide effect center fight or-flight response epinephrine increase breakdown glycogen  
glucose glycogenolysis liver muscle increase basal metabolic rate epinephrine norepinephrine  
increase heart rate dilate bronchi shunt blood flow system sympathetic response at  
vasodilation blood vessel lead increase bloodflow skeletal muscle heart lung brain  
concurrently vasoconstriction decrease bloodflow gut kidney skin note stress response involve  
cortisol epinephrine classically cortisol understand mediate long term slow stress response  
catecholamine understand control short term fast stress response fact cortisol actually  
increase synthesis catecholamine result increase catecholamine release e pancreas exocrine  
endocrine function exocrine tissue secrete substance directly duct pancreas produce number  
digestive enzyme discuss chapter 9 mcat biology review endocrine standpoint small cluster  
hormone produce cell group islet langerhans pancreas show figure 5.10

islet contain distinct type cell alpha  $\alpha$  beta  $\beta$  delta  $\delta$  cell cell type secrete different hormone  $\alpha$ -  
cell secrete glucagon  $\beta$  cell secrete insulin  $\delta$  cell secrete gross anatomy pancrea pancreatic

duct accessory pancreatic duct common bile duct duodenal papilla duodenum microscopic acini exocrine islet endocrine figure 5.10 anatomy pancreas islets langerhans scatter pancreas carry endocrine function organ glucagon secrete time fasting glucose level low glucagon increase glucose production trigger glycogenolysis gluconeogenesis degradation protein fat addition low blood glucose concentration certain gastrointestinal hormone cholecystikinin gastrin increase glucagon release  $\alpha$  cell blood glucose concentration high glucagon release inhibit glucagon level high glucose go insulin antagonistic glucagon secrete blood glucose level high show figure 5.11 insulin induce muscle liver cell glucose store glycogen later use addition active glucose level high insulin stimulate anabolic process fat protein synthesis description

give caption figure 5.11 insulin direct relationship blood glucose concentration blood glucose level high insulin level rise cause cell glucose blood blood glucose level low insulin level remain low excess insulin cause hypoglycemia characterize low blood glucose concentration underproduction insufficient secretion insensitivity insulin result diabetes mellitus clinically characterize hyperglycemia excess glucose blood kidney excessive glucose filtrate overwhelm nephron ability reabsorb glucose result presence urine osmotically active particle readily cross cell membrane presence glucose filtrate lead excess excretion water increase dramatic urine volume erefore patient diabetic oen report polyuria increase frequency urination polydipsia increase thirst ere type diabetes mellitus type insulin dependent diabetes mellitus cause autoimmune destruction  $\beta$  cell pancreas result low absent insulin production people haww type diabetic require regular injection insulin prevent hyperglycemia permit uptake glucose cell type ii non insulin dependent diabetes mellitus result receptor level resistance effect insulin type ii diabetes mellitus partially inherit partially environmental factor high carbohydrate diet obesity certain pharmaceutical agent take orally help body effectively use insulin produce ese individual require insulin body long control glucose level aid medication insulin decrease plasma glucose glucagon increase plasma glucose growth hormone

glucocorticoid epinephrine capable increase plasma glucose hormone raise blood glucose level commonly call counterregulatory hormone somatostatin inhibitor insulin glucagon secretion high blood glucose amino acid concentration stimulate secretion somatostatin produce hypothalamus decrease growth hormone secretion addition effect insulin glucagon reproductive endocrinology discuss detail chapter 2 mcat biology review offer brief overview chapter e testis secrete testosterone response stimulation gonadotropin lh fsh testosterone cause sexual differentiation male gestation promote development maintenance secondary sex characteristic male axillary pubic hair deepening voice muscle growth e ovary secrete estrogen progesterone response gonadotropin estrogen involve development female reproductive system gestation promote development maintenance secondary sex characteristic female axillary pubic hair breast growth body fat redistribution ese steroid hormone govern

hair breast growth body fat redistribution ese steroid hormone govern menstrual cycle pregnancy e pineal gland locate deep brain secrete hormone melatonin e precise mechanism hormone unclear demonstrate involve circadian rhythm blood level melatonin partially responsible sensation sleepiness e pineal gland receive projection directly retina involve vision hypothesize pineal gland respond decrease light intensity release melatonin melatonin enjoy somewhat wonder drug status past decade tout remedy jet lag aging certainly effect melatonin cause profound drowsiness use reset daily rhythm melatonin available counter health food store long term effect melatonin therapy currently unknown addition organ list specific cell tissue organ exhibit endocrine function gastrointestinal tract endocrine tissue find stomach intestine gastrointestinal peptide identify important one include secretin gastrin cholecystokinin e specific function hormone discuss chapter 9 mcat biology review expect digestive system stimulus release peptide presence e kidney play role water balance mention early adh increase water permeability collect duct renin angiotensin aldosterone system increase sodium water reabsorption distal convoluted tubule collect duct



the kidney produce erythropoietin stimulate bone marrow increase production erythrocyte red blood cell secrete response low oxygen level blood the heart release atrial natriuretic peptide and help regulate salt water balance cell atria stretch excess blood volume release and is hormone promote excretion sodium increase urine volume is effect functionally antagonistic aldosterone lower blood volume pressure effect blood osmolarity

the thymus locate directly sternum release thymosin important proper t cell development differentiation the thymus atrophy adulthood thymosin level drop accordingly the function t cell discuss chapter 8 mcat biology review list hormone action find table 5.1 stimulate follicle maturation female spermatogenesis male stimulate ovulation female testosterone synthesis male stimulate adrenal cortex synthesize secrete stimulate thyroid produce stimulate milk production decrease sensation pain stimulate bone muscle growth raise blood glucose level stimulate water reabsorption kidney increase permeability stimulate uterine contraction labor milk secretion lactation promote t3 thyroxine stimulate metabolic activity c cell decrease blood calcium increase blood calcium increase blood glucose concentration decrease protein increase water reabsorption kidney increase sodium reabsorption promote potassium hydrogen ion excretion increase blood glucose concentration heart rate dilate bronchi alter blood flow pattern stimulate glycogen breakdown glycogenolysis increase blood lower blood glucose concentration promote anabolic process suppress secretion glucagon induce development maintenance male reproductive system male secondary sex induce development maintenance female reproductive system female secondary sex promote maintenance involve circadian rhythm stimulate bone marrow produce promote salt water excretion stimulate t cell development table 5.1 major hormone human mcat concept check 5.2 assess understanding material 1 hypothalamic release hormone list hormone( affect anterior pituitary organ pituitary hormone act hormone(s release target organ hormone(s release growth hormone release 2 hormone primarily involve calcium homeostasis come effect blood calcium 3 endocrine tissue synthesize catecholamine main catecholamine

produce 4 pancreatic hormone major driver glucose homeostasis come effect blood glucose 5 hormone primarily involve water homeostasis come effect blood volume e endocrine system unique organ anatomically related hormone produce wide variety location far reach effect entire organism

e endocrine system allow integration execution homeostatic parameter necessary ensure proper functioning body example learn calcium level maintain narrow concentration range plasma antagonistic action calcitonin parathyroid hormone vitamin d hormone manipulate steady state organism continue study human body

find endocrine system effect system body regulate fuel metabolism blood flow growth development section chapter small note erythropoietin hormone stimulate production red blood cell bone marrow interpret brief mention indication relatively unimportant fact cell body red blood cell need constant supply oxygen accomplish function body oxygen respiratory system distribute oxygen tissue circulatory system chapter explore system separately recognize division artificial like body respiratory circulatory system inseparable serve common function provide oxygen work cell body review content test knowledge critical thinking skill complete test like passage set online mechanisms hormone action endocrine signaling involve secretion hormone directly bloodstream e hormone travel distant target tissue bind receptor induce change gene expression cell peptide hormone compose amino acid derive large precursor protein cleave posttranslational peptide hormone polar pass plasma ese hormone bind extracellular receptor trigger transmission second messenger step signaling cascade induce amplification peptide hormone exert effect usually rapid onset ese hormone water soluble travel freely bloodstream require special carrier steroid hormone derive cholesterol steroid hormone minimally polar pass ese hormone bind promote conformational change cytosolic intranuclear receptor hormone receptor complex bind dna alter transcription particular gene steroid hormone exert effect usually slow onset hormone lipid soluble dissolve

bloodstream carry specific protein amino acid derivative hormone modified amino acid eir  
chemistry share feature peptide hormone feature steroid hormone different amino acid  
derivative hormone share different feature hormone class common example epinephrine  
norepinephrine triiodothyronine thyroxine hormone classifie target tissue direct hormone  
major effect non endocrine tissue tropic hormone major effect endocrine tissue endocrine  
organs hormones e hypothalamus bridge nervous endocrine e release hormone  
hypothalamus mediate number factor include projection part brain chemo baroreceptor  
blood vessel negative feedback hormone negative feedback final hormone product pathway  
inhibit hormone enzyme early pathway maintain e hypothalamus stimulate anterior pituitary  
gland paracrine release hormone hypophyseal portal system directly connect

pituitary gland paracrine release hormone hypophyseal portal system directly connect organ  
gonadotropin release hormone gnrh promote release follicle stimulate hormone fsh luteinize  
hormone lh growth hormone release hormone ghrh promote release growth hormone yroid  
release hormone trh promote release thyroid- stimulate hormone tsh corticotropin release  
factor crf promote release adrenocorticotrophic hormone acth prolactin inhibit factor pif  
dopamine inhibit release interaction posterior pituitary occur axon nerve project  
hypothalamus antidiuretic hormone adh vasopressin oxytocin synthesize hypothalamus travel  
axon posterior pituitary release bloodstream e anterior pituitary release hormone response  
stimulation hypothalamus fsh lh acth tsh tropic hormone prolactin endorphin growth  
hormone direct hormone follicle stimulate hormone fsh promote development ovarian follicle  
female spermatogenesis male luteinize hormone lh promote ovulation female testosterone  
production male adrenocorticotrophic hormone acth promote synthesis release glucocorticoid  
adrenal cortex yroid stimulate hormone tsh promote synthesis release triiodothyronine  
thyroxine thyroid prolactin promote milk production endorphin decrease perception pain  
produce euphoria growth hormone gh promote growth bone muscle shunt glucose tissue  
raise blood glucose concentration e posterior pituitary release hormone produce antidiuretic

hormone adh vasopressin secrete response low blood volume increase blood osmolarity increase reabsorption water collect duct nephron increase blood volume decrease blood osmolarity oxytocin secrete childbirth promote uterine contraction promote milk ejection involve bonding behavior unusual positive feedback loop negative

thyroid locate base neck trachea produce key hormone triiodothyronine t3 thyroxine t4 produce follicular cell contain iodine ey increase basal metabolic rate alter utilization glucose fatty acid thyroid hormone require proper neurological physical development calcitonin produce parafollicular c cell decrease plasma calcium concentration promote calcium excretion kidney decrease calcium absorption gut promote calcium storage bone thyroid parathyroid gland release parathyroid hormone pth increase blood calcium concentration pth decrease excretion calcium kidney increase bone resorption directly increase blood calcium concentration pth activate vitamin d necessary calcium phosphate absorption gut pth promote resorption phosphate bone reduce reabsorption phosphate kidney vitamin d promote absorption phosphate gut effect phosphate concentration somewhat cancel thyroid adrenal cortex produce class steroid hormone glucocorticoid cortisol cortisone increase blood glucose concentration reduce protein synthesis inhibit immune system participate stress response glucocorticoid release stimulate acth mineralocorticoid aldosterone promote sodium reabsorption distal convoluted tubule collect duct increase water reabsorption aldosterone increase potassium hydrogen ion excretion aldosterone activity regulate renin angiotensin aldosterone system acth cortical sex hormone include androgen like testosterone estrogen male female thyroid adrenal medulla derive nervous system secrete catecholamine bloodstream catecholamine include epinephrine norepinephrine involve fight or-flight sympathetic response epinephrine hormone promote glycogenolysis increase basal metabolic rate increase heart rate dilate bronchi alter blood pressure endocrine pancreas produce hormone regulate glucose glucagon produce  $\alpha$  cell raise blood glucose level stimulate protein fat degradation glycogenolysis insulin produce  $\beta$  cell lower blood glucose level stimulate glucose

uptake cell promote anabolic process like glycogen fat protein synthesis somatostatin produce  $\delta$  cell inhibit insulin  $\epsilon$  gonad produce hormone involve development maintenance reproductive system secondary sex  $\epsilon$  testis secrete testosterone  $\epsilon$  ovary secrete estrogen progesterone  $\epsilon$  pineal gland release melatonin help regulate circadian organ release hormone primarily consider endocrine system cell stomach intestine produce hormone like secretin gastrin cholecystokinin  $\epsilon$

kidney secrete erythropoietin stimulate bone marrow produce erythrocyte red blood cell response low oxygen level blood  $\epsilon$  atrium heart secrete atrial natriuretic peptide anp promote excretion salt water kidney response stretching atrium high blood volume  $\epsilon$  thymus secrete thymosin important proper t cell development differentiation answer concept check amino acid polypeptide extracellular cell membrane intracellular intranuclear stimulate receptor usually g protein couple receptor affect level second messenger commonly camp initiate bind receptor induce conformational change regulate transcription level dna travel dissolves travel freely bind carrier protein 2 amino acid derivative hormone modify amino acid addition iodine tyrosine thyroid hormone 3 direct hormone secrete bloodstream travel target tissue direct effect tropic hormone cause secretion hormone travel target tissue cause effect hormone(s anterior hormone(s release fsh luteinize testosterone testis note decrease dopamine hypothalamus promote prolactin secretion 2 calcitonin parafollicular c- cell thyroid decrease blood calcium concentration parathyroid hormone parathyroid gland increase blood calcium concentration

3  $\epsilon$  adrenal medulla synthesize catecholamine include epinephrine 4 glucagon  $\alpha$  cell pancreas increase blood glucose concentration insulin  $\beta$  cell pancreas decrease blood 5 antidiuretic hormone adh vasopressin hypothalamus release posterior pituitary increase blood volume decrease blood osmolarity aldosterone adrenal cortex increase blood volume effect blood osmolarity atrial natriuretic peptide anp heart decrease blood volume effect

blood osmolarity science mastery assessment explanation unlike hormone list adh secrete adrenal cortex corticoid adh peptide hormone produce hypothalamus release posterior pituitary promote water reabsorption e association correct hormone directly stimulate non endocrine target tissue refer direct hormone glance answer choice notice hormone secrete anterior pituitary gland e direct hormone secrete anterior pituitary prolactin endorphin growth hormone gh answer choice tropic hormone e tropic hormone anterior pituitary include follicle stimulate hormone fsh luteinizing hormone lh adrenocorticotrophic hormone acth thyroid stimulate e parathyroid gland secrete parathyroid hormone pth hormone function increase blood calcium level increase synthetic activity parathyroid gland lead increase pth increase blood calcium level mechanism increase calcium reabsorption kidney decrease excretion increase bone resorption increase absorption calcium gut activation vitamin peptide hormone compose chain amino acid vary size generally large charged polar cross cell membrane instead hormone bind extracellular receptor rely second messenger mediate effect observation justify b inflammation thyroid iodine deficiency cause hypothyroidism thyroid hormone undersecrete secrete hypothyroidism newborn infant cause cretinism characterize poor neurological physical development include intellectual disability short stature coarse facial feature iodine deficiency result swelling thyroid gland call goiter see cause hyperthyroidism iodine deficiency cause hyperthyroidism eliminate d galactorrhea associate prolactin gigantism c associate growth hormone e hypothalamic pituitary thyroid axis include secretion thyroid release hormone trh hypothalamus trigger secretion thyroid stimulate hormone tsh anterior pituitary stimulate secretion triiodothyronine t3 thyroxine t4 thyroid overproduction trh promote overproduction tsh eliminate b destruction

follicular cell produce t3 t4 remove negative feedback allow tsh level rise eliminate d high level t4 cause negative feedback lower tsh level make c correct answer steroid hormone nonpolar cholesterol derivative bind internal receptor importantly cholesterol derivative hormone generally lack nitrogen compose primarily carbon hydrogen oxygen factor support b right

answer

contrast eliminate peptide hormone localize cell surface amino acid derivative signal like steroid hormone c eliminate chemical composition give question stem indicate lack nitrogen d eliminate term direct refer hormone target datum target hormone give question stem pancreatic somatostatin secretion increase high blood glucose amino acid level lead decrease insulin glucagon secretion eliminate d somatostatin inhibitory hormone confirme b e stimulus somatostatin release include high blood glucose amino acid mention high level certain gastrointestinal hormone discuss chapter 9 mcat biology review cortisol eliminate c  $\beta$  cell responsible insulin production e function insulin lower blood glucose level promote influx glucose cell stimulate anabolic process glycogenesis fat protein synthesis us destruction  $\beta$  cell result cessation insulin production lead hyperglycemia high blood glucose e stimulus renin production low blood pressure cause juxtaglomerular cell kidney produce renin enzyme convert plasma protein angiotensinogen angiotensin i. angiotensin convert angiotensin ii enzyme lung angiotensin ii stimulate adrenal cortex secrete aldosterone aldosterone help restore blood volume increase sodium reabsorption kidney lead increase water reabsorption is remove initial stimulus renin production us b c correctly describe renin angiotensin aldosterone system d describe stimulus erythropoietin secretion e question stem indicate newly discover hormone function first messenger stimulate conversion atp camp camp function second messenger trigger signal cascade cell hormone act second messenger relatively large size short peptide complex polypeptide peptide hormone is hormone tropic hormone entirely possible direct hormone d regardless cause low level calcium blood require treatment therapy frequently treat hypocalcemia low blood calcium level calcium gluconate calcium chloride administration parathyroid hormone raise blood calcium concentration calcitonin poor choice case hormone lower blood calcium concentration eliminate aldosterone thymosin play role calcium homeostasis eliminate c d oxytocin vasopressin antidiuretic hormone end suffix hint peptide amino acid derivative hormone ese

hormone synthesize hypothalamus release

posterior pituitary remember posterior pituitary actually synthesize hormone contain axon originate cell hypothalamus site release dopamine number neurological system relevant endocrine system fact dopamine secretion prevent prolactin release us individual take medication block dopamine receptor lose inhibition prolactin release elevate prolactin level e question stem state infant genotypically female bear ambiguous genitalia mean genitalia appear specifically female specifically male genotypic female indicate infant expose androgen fetal period addition infant lose sodium cause hyponatremia is indicate issue excess androgen lack aldosterone hormone require proper reuptake sodium kidney hormone synthesize adrenal cortex make d correct answer note hormone regulate hypothalamic pituitary adrenal axis eliminate b consult online resource additional practice behavioral science chapter 5 motivation emotion stress biochemistry chapter 3 nonenzymatic protein function protein analysis biochemistry chapter 8 biochemistry chapter 12 bioenergetic regulation metabolism biology chapter 4 e nervous system biology chapter 10 chapter 6 respiratory system chapter 6 respiratory system x ray lung science mastery assessment pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept



summary end chapter 1 following facilitate gas exchange lung 1

summary end chapter 1 following facilitate gas exchange lung 1 thin alveolar wall 2 multiple subdivision respiratory tree 3 difference partial pressure  $O_2$  and  $CO_2$  4 active transporter alveolar cell 2 following association correctly pair stage respiration muscle action occur stage 1 inhalation diaphragm relax 2 inhalation internal intercostal muscle contract 3 exhalation diaphragm contract 4 exhalation external intercostal muscle relax 3 total lung capacity equal vital capacity plus 1 tidal volume 2 expiratory reserve volume 3 residual volume 4 inspiratory reserve volume 4 intrapleural pressure necessarily low atmospheric 1 inhalation expansion chest cavity cause compression intrapleural space decrease pressure 2 inhalation expansion chest cavity cause expansion intrapleural space decrease pressure 3 exhalation compression chest cavity cause compression intrapleural space decrease pressure 4 exhalation compression chest cavity cause expansion intrapleural space decrease pressure 5 patient present emergency room stab wound left chest chest x ray blood note collect chest cavity cause collapse lobe left lung blood likely locate 1 parietal pleura chest wall 2 parietal pleura visceral pleura 3 visceral pleura lung 4 alveolar wall lung surface 6 following statement anatomy respiratory system true 1 epiglottis cover glottis swallowing ensure food enter trachea 2 trachea bronchi line ciliated epithelial cell 3 pharynx contain vocal cord control skeletal muscle cartilage 4 nares line vibrissae help filter particulate matter inhale air 7 follow correct sequence passageway air travel inhalation 1 pharynx trachea bronchiole bronchi alveoli 2 pharynx trachea larynx bronchi alveoli 3 larynx pharynx trachea bronchi alveoli 4 pharynx larynx trachea bronchi alveoli 8

idiopathic pulmonary fibrosis ipf disease scar tissue form alveolar wall make lung tissue significantly stiff following finding likely detect spirometry patient ipf 1 decrease total lung capacity 2 decrease inspiratory reserve volume 3 increase residual volume 1 2 ii 3 ii 4 ii iii 9 study indicate premature baby deficient lysozyme possible consequence deficiency 1

respiratory distress alveolar collapse shortly birth 2 increase susceptibility certain infection 3 inability humidify air pass nasal cavity 4 slowing respiratory rate response acidemia 10 form pneumonia cause excess fluid mucus pus build entire lobe lung affect diffusion gas affect area 1 carbon dioxide diffuse oxygen able enter blood 2 oxygen diffuse blood carbon dioxide 3 change diffusion occur 4 diffusion occur affect area 11 people anxiety disorder respond stress hyperventilate recommend breathe paper bag rebreathe air treatment appropriate 1 hyperventilation cause increase blood carbon dioxide breathe air bag help readjust blood level 2 hyperventilation cause decrease blood carbon dioxide breathe air bag help readjust blood level 3 hyperventilation cause increase blood oxygen breathe air bag help readjust blood level 4 hyperventilation cause decrease blood oxygen breathe air bag help readjust blood level 12 patient present emergency room asthma attack patient hyperventilate past hour blood ph 7.52 patient give treatment appear respond subsequent blood ph reading 7.41 normal blood ph reassure sign 1 patient kidney compensate alkalemia 2 normal blood ph reading likely inaccurate 3 patient descend respiratory failure 4 patient blood ideally acidemic time compensate alkalemia 13 premature infant respiratory distress place ventilator ventilator set provide positive end- expiratory pressure setting useful premature 1 premature infant lack surfactant 2 premature infant lack lysozyme 3 premature infant thermoregulate 4 premature infant unable control ph. 14 emphysema alveolar wall destroy decrease recoil lung tissue following change see patient emphysema 1 increase residual volume 2 decrease total lung capacity 3 increase blood concentration oxygen 4 decrease blood concentration carbon dioxide 15

allergic reaction occur overactive immune response substance cell respiratory tract play large role generation allergic reaction 1 alveolar epithelial cell 3 mast cell 4 ciliated epithelial cell respiratory system chapter anatomy mechanism breathe lung capacity volume regulation breathing function respiratory system control ph content chapter relevant 3 question biology

mcats chapter cover material following aamc content category 3b structure integrative function  
main organ system coughing fever shortness of breath hypoxia symptom number pulmonary  
disease flareup chronic obstructive pulmonary disease copd streptococcus pneumoniae  
pneumococcal pneumonia type hypersensitivity pneumonitis know extrinsic allergic alveolitis  
eaa is example bit esoteric bring hypersensitivity dry grass rat urine mold grow hot tub call  
hot tub lung case hot tub lung severe certainly enjoyable eye oen misdiagnose asthma  
bronchitis treat steroid quell immune system reduce inflammation hot tub lung potentially  
away antibiotic therapy recommend physician end simply have tell patient good way avoid hot  
tub lung sure tub clean properly routinely use e lesson avoid hot tub lung essential sensitive  
organ delicate membrane protect type stressor pathogen particle chemical irritate cause  
respiratory distress

chapter look structure lung microanatomy respiration talk mechanic breathing overall  
function lung surprise low percentage question associate chapter give chapter touch classic  
mcats topic include pressure gas equilibrium question mcats relate work air lung example  
question depend general knowledge work energy gas regardless context knowledge  
respiratory system specifically anatomy mechanism breathing chapter 6.1 able identify muscle  
involve inhalation exhalation explain purpose function surfactant recall mathematical  
relationship vital capacity inspiratory reserve volume expiratory reserve volume tidal volume  
predict brain alter respiratory rate response change blood level o<sub>2</sub> co<sub>2</sub> order structure  
pathway air use enter body naris alveoli e lung locate thoracic cavity structure specially  
design perform breathing e anatomy respiratory system summarize figure 6.1 gas exchange  
occur lung air enter respiratory tract external naris nose pass nasal cavity filter mucous  
membrane nasal hair vibrissa figure 6.1 anatomy respiratory system nose mouth serve  
important role breathing remove dirt particulate matter air warm humidify reach lung air pass  
pharynx larynx e pharynx reside nasal cavity mouth common pathway air destined lung food  
destined esophagus contrast larynx lie pharynx pathway air food respiratory tract opening

larynx glottis cover epiglottis swallowing & larynx contain vocal cord maneuver skeletal muscle cartilage larynx air pass cartilaginous trachea mainstem bronchi & bronchi trachea contain ciliated epithelial cell catch material past mucous membrane nose mouth lung bronchus continue divide small structure know bronchiole divide end tiny balloon like structure gas exchange occur alveoli alveolus coat surfactant detergent lower surface tension prevent alveolus collapse network capillary surround alveolus carry oxygen carbon dioxide & branching minute size alveoli allow exceptionally large surface area gas exchange approximately 100 m<sup>2</sup> total left lung small indentation make slightly small right lung contain lobe right lung contain position heart thoracic cavity & lung contain thoracic cavity contain heart & chest wall form outside thoracic cavity

cavity contain heart & chest wall form outside thoracic cavity membrane know pleura surround lung show figure 6.2 & pleura form close sac lung expand & surface adjacent lung visceral pleura outer parietal figure

6.2 lung membranes & lung fill passively require skeletal muscle generate negative pressure expansion & important muscle diaphragm thin muscular structure divide thoracic chest cavity abdominal cavity & diaphragm somatic control breathing autonomic control addition muscle chest wall neck participate breathing especially breathing labored pathologic condition discuss breathing worth take close look relationship pleura lung imagine large partially deflated balloon imagine take fist push balloon balloon come surround hand is analogous lung pleura fist lung balloon

represent pleural layer & directly touch fist visceral pleura outer layer parietal pleura associate chest wall real life & space sac refer intrapleural space contain thin layer fluid is pleural fluid help lubricate pleural surface & pressure differential create pleura ultimately drive breathing explore section intrapleural space example potential space space normally

collapsed pathologic state potential space expand fluid air accumulate pleural layer example pleural effusion fluid accumulate intrapleural space pneumothorax air collect state disturb normal mechanic breathing apparatus cause atelectasis lung collapse let turn mechanic ventilation ground physics discuss chapter 2 3 mcat physics math review use pressure useful work system use pressure differential intrapleural space lung drive air inhalation active process use diaphragm external intercostal muscle layer muscle rib expand thoracic cavity show figure 6.3 diaphragm flatten chest wall expand outward intrathoracic volume volume chest cavity increase specifically intrapleural space closely abut chest wall volume increase first predict happen intrapleural pressure understanding boyle law increase intrapleural volume lead decrease figure 6.3 stage ventilation diaphragm contract inhalation relax exhalation boyle law state constant temperature pressure volume gas inversely relate principle underlie negative pressure breathing chest wall expand pressure lung drop air draw lung low pressure intrapleural space inside lung e gas lung initially atmospheric pressure high pressure intrapleural space e lung expand intrapleural space pressure lung drop air suck high pressure environment outside world is mechanism refer negative pressure breathing drive force low relatively negative pressure intrapleural space compare lung unlike inhalation exhalation active process simple relaxation external intercostal muscle reverse process discuss paragraph diaphragm external intercostal relax chest cavity decrease volume happen pressure intrapleural space explain boyle law pressure intrapleural space high lung atmospheric pressure us air push result exhalation active task speed process internal intercostal muscle abdominal muscle oppose external intercostal pull rib cage is actively decrease

muscle oppose external intercostal pull rib cage is actively decrease volume thoracic cavity finally recall surfactant prevent complete collapse alveoli exhalation reduce surface tension inhalation exhalation require different amount energy expenditure muscle contraction require create negative pressure thoracic cavity force air lung inspiration expiration calm state entirely

elastic recoil lung musculature active state muscle force air speed process ventilation remember balloon analogy e lung resilient elastic quality attach pleurae chest wall e chest wall expand inhalation pull lung create pressure differential require inhalation chest wall relax lung recoil intrinsic elastic quality lung surface tension alveoli accentuate relaxation process lung recoil volume small pressure increase pressure inside lung high outside pressure exhalation occur note indirect connection lung chest wall prevent collapse completely recoil like surfactant emphysema disease characterize destruction alveolar wall result reduce elastic recoil lung make process exhalation extremely difficult case emphysema cause cigarette smoking lung capacity volume pulmonology medical field associate lung breathing frequently assess lung capacity volume instrument measure quantity spirometer spirometer measure air remain lung aer complete exhalation residual volume provide number measure useful commonly test lung volume include total lung capacity tlc e maximum volume air lung inhale completely usually 6 7 liter residual volume rv e volume air remain lung exhale completely vital capacity vc e difference minimum maximum volume air lung tlc rv tidal volume tv e volume air inhale exhale normal expiratory reserve volume erv e volume additional air forcibly exhale aer normal exhalation inspiratory reserve volume irv e volume additional air forcibly inhale aer normal inhalation ese different lung volume capacity see figure 6.4 figure 6.4 lung volumes regulation breathing breathing require input nervous control center ventilation primarily regulate collection neuron medulla oblongata call ventilation center fire rhythmically cause regular contraction respiratory muscle ese neuron contain chemoreceptor primarily sensitive carbon dioxide concentration

muscle ese neuron contain chemoreceptor primarily sensitive carbon dioxide concentration partial pressure carbon dioxide blood rise hypercarbia hypercapnia respiratory rate increase carbon dioxide exhale cause carbon dioxide level blood fall ese cell respond change oxygen concentration tend significance period significant hypoxemia low oxygen concentration limited extent control breathing consciously choose breathe rapidly slowly extended period

hypoventilation lead increase carbon dioxide level override medulla oblongata jump start breathing e opposite process hyperventilation blow off carbon dioxide ultimately inhibit ventilation mcat concept check 6.1 assess understanding material 1 list structure respiratory pathway air enter naris 2 muscle( involve inhalation exhalation 3 purpose surfactant 4 mathematical relationship vital capacity vc inspiratory reserve volume irv expiratory reserve volume erv tidal volume tv 5 blood level co2 low brain alter respiratory rate maintain homeostasis function respiratory system chapter 6.2 able describe mechanism respiratory system prevent infection recall chemical equation bicarbonate buffer system predict blood ph change response change concentration o2 organ system function e lung function gas exchange respiratory story e lung line tremendous number capillary thermoregulation e lung represent pathway body serve immune function prevent invader gain access bloodstream finally lung allow control blood ph control carbon dioxide concentration erefore lung integrate body system include cardiovascular immune renal nervous gas exchange course primary function lung alveolus surround network capillary e capillary bring deoxygenated blood pulmonary artery originate right ventricle heart e wall alveoli cell thick facilitate diffusion

carbon dioxide blood lung oxygen blood e oxygenate blood return le atrium heart pulmonary vein diffusion gas occur thin membrane alveolus capillary certain disease cause fibrosis scarring membrane result effective diffusion disease cause limitation ventilation gas flow perfusion blood flow lung mechanism cause hypoxia low blood oxygen level accomplish end result different e drive force gas exchange pressure differential gas initially arrive alveoli blood relatively low partial pressure oxygen relatively high partial pressure carbon dioxide facilitate transfer respective concentration gradient show figure 6.5 gradient blood air lung present blood enter lung energy require gas transfer figure 6.5 gas exchange alveolus o2 alveoli flow partial pressure gradient alveoli pulmonary capillary bind hemoglobin transport co2 flow partial pressure gradient capillary alveoli expiration respiratory system adjust move

high altitude oxygen available breathe rapidly try avoid hypoxia second bind dynamic hemoglobin oxygen alter facilitate unloading oxygen tissue discuss chapter 7 mcat biology review natural response hemoglobin decrease carbon dioxide concentration environment actually decrease unloading oxygen tissue mechanism counteract override phenomenon short term body red blood cell ensure adequate delivery oxygen long term body develop blood vessel vascularization facilitate distribution oxygen tissue order maximize gas exchange tremendous surface area alveoli capillary interact entire respiratory tract highly vascular thermoregulation regulation body temperature heat transfer thermal energy regulate body surface vasodilation vasoconstriction capillary expand blood pass vessel large thermal energy dissipate capillary contract blood pass conserve thermal energy nasal tracheal capillary frequently purpose respiratory system capillary bed provide mechanism thermoregulation human predominantly regulate temperature capillary sweat gland skin rapid muscle contraction shivering e respiratory system transfer heat environment evaporation water mucous secretion animal dog advantage cooling mechanism pant mention lung provide large interface body interact outside world

important gas exchange thermoregulation come potential risk pathogen bacteria virus fungus cause infection lung gain access body rich vascularity alveolar membrane necessity lung able fight off potential invader e first line defense nasal cavity small hair vibrissa help trap particulate matter potentially infectious particle e nasal cavity contain enzyme call lysozyme find tear saliva lysozyme able attack peptidoglycan wall gram positive bacteria e internal airway line mucus trap particulate matter large invader underlying cilium propel mucus respiratory tract oral cavity expel swallow mechanism call mucociliary escalator division science largely artificial mcat contain question integrate multiple science discipline question locate biological biochemical foundations living systems section require knowledge general chemistry fact 10 section chemistry 5 general chemistry 5 organic chemistry pneumonia infection lung cause bacteria virus atypical pneumonia commonly call walking pneumonia



infection require hospitalization leave patient bedridden cause small bacterium call mycoplasma pneumoniae bacterium cause prolonged cough damage epithelial cell line lung paralyze cilia line respiratory tract lack cilia make difficult clear mucus lung cough last respiratory epithelial cell recover cilia functional e lung especially alveoli contain numerous immune cell include macrophage macrophage engulf digest pathogen signal rest immune system invader mucosal surface contain iga antibody help protect pathogen contact mucous membrane finally mast cell populate lung ese cell preform antibody surface right substance attach antibody mast cell release inflammatory chemical surround area promote immune response unfortunately antibody oen reactive substance pollen mold mast cell provide inflammatory chemical mediate allergic reaction control ph e respiratory system play role ph balance bicarbonate buffer system blood metabolic acidosis condition excess acid mechanism hypoventilation common occurrence medicine anaerobic respiration generate lactic acid individual type 1 diabetes mellitus produce ketoacid hypoinsulinemic certain poison like methanol formaldehyde produce organic acid case primary method compensation increase question bicarbonate buffer system mcat favorite likely form test day

is equation represent opportunity mcat test understanding basic chemistry concept le châtelier principle disturbance ph affect respiration e body attempt maintain ph 7.35 7.45 ph low hydrogen ion concentration high acidemia acid sense chemoreceptor outside blood brain barrier send signal brain increase respiratory rate increase hydrogen ion concentration cause shi bicarbonate buffer system generate additional carbon dioxide describe early respiratory center brain sensitive increase partial pressure carbon dioxide promote increase respiratory rate respiratory rate increase carbon dioxide blow off. is push buffer equation le notice difference shi le previous paragraph cause increase hydrogen ion concentration elevate concentration carbon dioxide removal carbon dioxide cause shi le allow hydrogen ion concentration drop normal  $\text{h}^+$  acid base increase yield constant ph reason  $\text{h}^+$  strong acid weak base like titration discuss chapter 10 mcat general chemistry review combination shift

ph solution acidic range blood basic alkalemia body seek increase acidity lung contribute respiratory rate slow carbon dioxide retain shie buffer equation right produce hydrogen ion bicarbonate ion is result low ph. equation essential test day success likely test biological biochemical foundations living systems chemical physical foundations biological systems section overall lung play role immediate adjustment carbon dioxide level extension hydrogen ion level lung work maintain proper ph. e kidney play role modulate secretion reabsorption acid base nephron is slow response represent long term compensation information kidney function homeostasis chapter 10 mcat biology review biology guide example expert thinking chronic inhalation crystalline silica show result silicosis

pulmonary fibrosis play role development pulmonary hypertension mechanism pathology develop clearly understand oxidant antioxidant imbalance suggest extracellular superoxide dismutase sod3 abundant antioxidant enzyme pulmonary vasculature study role sod3 development silica mediate pathology scientist inject crystalline silica suspension trachea wt sod3-/- mouse 28 day later pressure catheter insert right ventricle jugular vein measure right ventricular systolic pressure rvsp figure 1 elevated rvsp associate pulmonary hypertension follow rvsp measurement mouse sacrifice mrna extract lung tissue assay sod3 background info silica damage lung maybe researcher thought process enzyme prevalent blood vessel lung let test experimental set compare silica induce lung pathology wt sod3-/- exp 1 measure rvsp high rvsp = pulmonary hypertension exp 2 measure sod3 gene expression figure 2 lung section stain mason trichrome visualize collagen marker pulmonary fibrosis figure 3 exp 3 quantify collagen content lung increase collagen lung = fibrosis figure iv = silica treatment presence absence sod3 figure 1 dv rvsp trend rvsp appear high sod3 ko mouse treat silica dv sod3 expression trend silica treatment decrease sod3 expression normal mouse dv collagen lung trend high sod3 ko mouse treat silica adapt zelko i. n. zhu j. roman j. 2018 role sod3 silica relate lung fibrosis pulmonary vascular remodeling respiratory research 19(1 221 base finding study sod3 protect exacerbate crystalline silica induce pathology is question test

understanding

presence absence sod3 affect development silica induce lung pathology find answer require strong understanding experimental design careful analysis datum let start experimental design paragraph 2 tell experimental group normal mouse treat silica normal mouse treat silica sod3 knockout ko mouse treat silica e normal mouse lack treatment serve negative control normal mouse treat silica serve positive control paragraph 1 tell crystalline silica show cause pulmonary fibrosis silicosis expect indicator pathology normal mouse treat silica untreated mouse sod3 protective role delete lead increase lung damage sod3 exacerbate silica induce lung damage delete lead decrease lung damage time analyze datum figure 1 show normal mouse exposure silica lead increase rvsp indicate potential role silica development pulmonary hypertension furthermore deletion sod3 lead great elevation rvsp suggest sod3 protective role figure 2

show expression sod3 transcript lung tissue e sod3 ko mouse expression consistent gene knockout note silica exposure lead decrease sod3 expression figure 3 show elevation collagen content lung silica treat mouse compare untreated mouse is elevation significantly high sod3 ko mouse take result suggest sod3 protect silica induce pulmonary fibrosis pulmonary hypertension knockout sod3 lead increase pulmonary fibrosis pulmonary hypertension aer exposure crystalline silica sod3 likely serve protective role lung silica- mcat concept check 6.2 assess understanding material 1 mechanism respiratory system prevent 2 chemical equation bicarbonate buffer system 3 respiratory failure refer inadequate ventilation provide oxygen tissue ph change respiratory failure learn human body easy reduce complex varied function lung breathe provide supply oxygen e lung perform gas exchange rely difference partial pressure gas alveoli blood oxygen take blood carbon dioxide release exhalation inhalation exhalation require pressure differential create anatomical structure chest wall diaphragm pleura lung bag air gas exchange function respiratory system e respiratory system serve

essential role thermoregulation immunity pH regulation individual system human body special  
note system integrate system clear connection binding oxygen hemoglobin lung rest  
circulatory system concept expand chapter effect altitude pH chemical review content test  
knowledge critical thinking skill complete test like passage set online anatomy mechanism  
breathe air draw naris nasal cavity pharynx warm humidify filter nasal hair vibrissa mucous  
membrane enter larynx follow trachea & trachea divide mainstem bronchus divide  
bronchiole divide continually small passage reach alveoli alveolus small sac interface  
pulmonary capillary allow gas diffuse cell thick membrane surfactant alveoli reduce surface  
tension liquid gas interface prevent collapse & pleura cover lung line chest wall & visceral  
pleura lie adjacent lung & parietal pleura line chest wall & intrapleural space lie layer contain  
thin layer fluid lubricate pleural surface & diaphragm thin skeletal muscle help create  
pressure differential require breathing

diaphragm thin skeletal muscle help create pressure differential require breathing inhalation  
active process & diaphragm external intercostal muscle expand thoracic cavity increase  
volume intrapleural space is decrease intrapleural pressure is pressure differential  
ultimately expand lung drop pressure draw air environment is mechanism term negative  
pressure breathing exhalation passive active passive exhalation relaxation muscle inspiration  
elastic recoil lung allow chest cavity decrease volume reverse pressure differential see  
inhalation active exhalation internal intercostal muscle abdominal muscle forcibly decrease  
volume thoracic cavity push air spirometer measure lung capacity volume total lung capacity  
TLC maximum volume air lung inhale completely residual volume RV volume air remain lung  
exhale completely vital capacity VC difference minimum maximum volume air lung tidal  
volume TV volume air inhale exhale expiratory reserve volume ERV volume additional air  
forcibly exhale after normal exhalation inspiratory reserve volume IRV volume additional air  
forcibly inhale after normal inhalation ventilation regulate ventilation center collection neuron  
medulla oblongata chemoreceptor respond carbon dioxide concentration increase respiratory

rate high concentration carbon dioxide blood hypercarbia hypercapnia e ventilation center respond low oxygen concentration blood hypoxemia increase ventilation rate ventilation control

consciously cerebrum medulla oblongata override cerebrum extended period hypo-hyperventilation function respiratory system e lung perform gas exchange blood simple diffusion concentration gradient deoxygenated blood high carbon dioxide concentration bring lung pulmonary artery oxygenated blood low carbon dioxide concentration leave lung pulmonary vein e large surface area interaction alveoli capillary allow respiratory system assist thermoregulation vasodilation vasoconstriction capillary bed e respiratory system protect potential pathogen multiple mechanism include vibrissa mucous membrane mucociliary escalator help filter incoming air trap lysozyme nasal cavity saliva attack peptidoglycan cell wall gram positive bacteria macrophage engulf digest pathogen signal rest immune system invader mucosal surface cover iga antibody mast cell antibody surface trigger promote release inflammatory chemical mast cell oen involve allergic reaction e respiratory system involve ph control bicarbonate buffer system blood ph decrease respiration rate increase compensate blow off carbon dioxide is cause le shi buffer equation reduce hydrogen ion concentration blood ph increase respiration rate decrease compensate trap carbon dioxide is cause right shi buffer equation increase hydrogen ion concentration answer concept check 1 naris nasal cavity pharynx larynx trachea bronchi bronchiole alveoli 2 inhalation use diaphragm external intercostal muscle labored breathing muscle neck involve passive exhalation use recoil muscle active exhalation use internal intercostal muscle abdominal muscle 3 surfactant reduce surface tension air liquid interface alveoli is prevent collapse 4 vital capacity sum inspiratory reserve volume expiratory reserve volume tidal volume  $vc = irv + erv + tv$  5 co2 level low brain decrease respiratory rate order raise co2 level 1 immune mechanism respiratory system include vibrissae naris lysozyme mucous membrane mucociliary escalator macrophage lung mucosal iga antibody mast cell 3

respiratory failure ventilation slow carbon dioxide blow off.

occur buffer equation shift right hydrogen ion generate is result low pH blood science mastery assessment explanations gas exchange lung rely passive diffusion oxygen carbon dioxide is accomplish easily difference partial pressure gas subdivision respiratory tree create large surface area interaction alveoli circulatory system addition thin alveolar wall allow fast diffusion gas exchange therefore b c eliminate d correct answer active transport gas exchange process lung e muscle involve ventilation diaphragm separate thoracic cavity abdominal cavity intercostal muscle inhalation diaphragm contract flatten external intercostal muscle contract pull rib cage these action cause overall increase volume thoracic cavity exhalation diaphragm external intercostal relax cause decrease volume thoracic cavity recoil tissue force exhalation internal intercostal abdominal muscle contract force air out correct association give answer d total lung capacity equal vital capacity maximum volume air forcibly inhale exhale lung plus residual volume air remain lung prevent alveoli collapse inhalation chest cavity expand cause expansion intrapleural space accord Boyle law increase volume constant temperature accompany decrease pressure intrapleural pressure extension alveolar pressure atmospheric pressure air enter lung exhalation pressure gradient reverse exhalation intrapleural pressure high atmospheric pressure low e intrapleural space bound parietal visceral pleura potential space normally collapse contain small fluid introduction fluid air intrapleural space fill space cause collapse lung e option list firmly appose permit blood collect space e pharynx lie nasal cavity oral cavity common pathway food enter digestive system air enter respiratory system larynx contain vocal cord pharynx air enter respiratory tract external naris nostril travel nasal cavity pass pharynx larynx ingest food pass pharynx way esophagus ensure food accidentally enter larynx epiglottis cover larynx swallowing aer larynx air go trachea eventually divide bronchus lung e bronchi branch small bronchiole terminate cluster alveoli give sequence d

correctly describe sequence passage air travel patient ipf increase stiffness lung likely decrease volume air individual inhale decrease total lung capacity inspiratory reserve volume spirometry measure total lung capacity accurately determine residual volume volume air le lung individual maximally exhale residual volume make portion total lung capacity total lung capacity = vital capacity + residual volume spirometer determine total lung capacity erefore statement true statement individual ipf appear answer choice finally increase stiffness lung expect decrease residual volume increase residual volume describe measure spirometer lysozyme enzyme present nasal cavity saliva tear degrade peptidoglycan prevent infection gram positive bacteria us premature infant lack lysozyme likely suffer infection organism area lung filled mucus inflammatory cell area able participate gas exchange air enter leave area concentration gradient long exist oxygen carbon dioxide able diffuse alveolar wall people hyperventilate respiratory rate increase respiratory rate increase carbon dioxide blow off. is cause shi le bicarbonate buffer equation blood alkaline breathe bag allow carbon dioxide return bloodstream order maintain proper ph.

patient asthma attack respond treatment hyperventilate hour patient fatigued able maintain hyperventilation case patient breathing rate start decrease patient fail receive adequate oxygen extension carbon dioxide trap blood ph begin drop despite fact ph normal moment patient crash start demonstrate acidemia near future kidney compensate alkalemia slow process normalize blood ph hour adequate compensation kidney actually reassure sign eliminate ere evidence suggest measurement inaccurate eliminate b finally aer treatment patient return normal blood ph adequate ventilation expect overcompensate acidemic is question require different level thinking e question stem state premature infant oen require ventilation positive end expiratory pressure expect know ventilator setting mcat able decode phrase mean end expiration ventilator provide high pressure normal force extra air alveoli is pressure prevent alveolar collapse remind surfactant serve purpose reduce surface tension us make sense premature baby lack surfactant provide extra air pressure end expiration

beneficial e intrinsic elastic property lung important exhalation passive recoil lung tissue help decrease lung volume decrease recoil patient difficulty exhale completely increase residual volume e total lung capacity expect increase case recoil oppose inhalation eliminate b decrease alveolar surface area expect decrease gas exchange decrease blood concentration oxygen increase blood concentration carbon dioxide eliminate c d allergic reaction occur substance bind antibody promote overactive immune response inflammatory chemical e antibody attach mast cell us substance bind antibody mast cell release inflammatory mediator cause allergic reaction

consult online resource additional practice biology chapter 7 e cardiovascular system biology chapter 10 general chemistry chapter 6 general chemistry chapter 8 e gas phase general chemistry chapter 10 acid basis physics math chapter 3 chapter 7 cardiovascular system science mastery assessment pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 follow false statement erythrocyte 1 erythrocyte contain hemoglobin 2 erythrocyte anaerobic 3 nucleus erythrocyte locate middle 4 erythrocyte phagocytize spleen liver certain period time 2 follow correct sequence cardiac impulse



1 sa node av node purkinje fiber bundle 2 av node bundle purkinje fiber ventricle  
3 sa node atria av node bundle purkinje fiber 4 sa node av node atria bundle  
purkinje fiber 3 hemoglobin affinity o<sub>2</sub> 1 increase exercise muscle tissue 2 decrease blood  
paco<sub>2</sub> decrease 3 decrease blood ph decrease 4 high maternal blood fetal blood 4 following  
correctly trace circulatory pathway 1 superior vena cava right atrium right ventricle  
pulmonary artery lung pulmonary vein left atrium left ventricle aorta 2 superior vena  
cava left atrium left ventricle pulmonary artery lung pulmonary vein right atrium  
right ventricle aorta 3 aorta right atrium right ventricle pulmonary artery lung  
pulmonary vein left atrium left ventricle superior vena cava 4 superior vena cava right  
atrium right ventricle pulmonary vein lung pulmonary artery left atrium left  
ventricle aorta 5 venous end capillary bed osmotic pressure 1 great hydrostatic pressure 2  
result net outflow fluid 3 significantly high osmotic pressure arterial 4 cause protein enter  
interstitium 6 patient chart indicate cardiac output 7500 ml minute stroke volume 50 ml.  
patient pulse beat 7 unconscious patient rush emergency room need immediate blood  
transfusion time check patient medical history determine blood type type blood patient  
receive 8 follow true artery vein 1 artery thin walled muscular elastic vein thick walled inelastic  
2 artery conduct oxygenate blood vein carry deoxygenated blood 3 blood pressure aorta high  
pressure superior vena cava 4 artery facilitate blood transport skeletal muscle contraction vein  
use pumping heart push blood 9 give time

blood venous system arterial system following feature vein allow 1 relative lack smooth  
muscle wall 2 presence valve 3 proximity vein lymphatic vessel 4 thin endothelial lining 10  
follow involve body primary blood- 1 fluid intake 2 absorption nutrient gastrointestinal system  
3 carbon dioxide produce metabolism 4 hormone release kidney 11 kidney disease person  
lose albumin urine effect likely capillary 1 increase oncotic pressure 2 increase hydrostatic  
pressure 3 decrease oncotic pressure 4 decrease hydrostatic pressure 12 tricuspid valve

prevent backflow blood 1 left ventricle left atrium 2 aorta left ventricle 3 pulmonary artery right ventricle 4 right ventricle right atrium 13 world record long hold breath 22 minute 0 second sample take individual minute breath holding follow observe 1 increase hemoglobin affinity oxygen 2 decrease  $paco_2$  3 increase hematocrit 4 decrease pH 14 person heart attack primarily affect wall ventricle portion electrical conduction system likely affect 1 av node 2 sa node 3 bundle 4 left ventricular muscle 15 vascular structure create resistance blood flow cardiovascular system chapter anatomy cardiovascular system physiology cardiovascular system gas solute exchange content chapter relevant 6 question biology mcat chapter cover material following aamc content category 3b structure integrative function main organ system late 19th century physician adhere doctrine health know humoralism is theory develop greek roman physician philosopher adopt islamic physician remain dominant medical thought practice displace modern medical research 1800 e theory humoralism

hold human body compose fluid substance call humor black bile yellow bile phlegm blood healthy state humor balance excess deficiency cause illness disease maladaptive personality characteristic course lifetime level humor rise fall accordance diet activity result malady reflective imbalance treatment intend restore balance know treatment associate humoralism practice bloodletting disease associate excess blood physician withdraw significant amount blood patient restore balance humor method bloodletting dramatic include draw blood major vein arm neck puncture artery device know scarificator develop cut superficial vessel famously leech especially early 19th century draw excess blood fact early decade 1800 hundred million leech european physician 1830s france import 40 million leech year medical treatment humoral theory completely discredit modern science practice associate humoralism albeit base different medical understanding different purpose example new research show medicinal leech effectively microsurgery help prevent blood coagulation reconstructive surgery stimulate circulation reattache tissue e cardiovascular system commonly test organ system mcat serve variety function include movement respiratory gas nutrient waste review

structure functional anatomy cardiovascular system discuss blood functional component trace pathway create electrically excitable cell initiate spread contraction heart quick recap genetic inheritance help explain consequence ABO Rh antigen addition binding oxygen carbon dioxide hemoglobin discuss detail anatomy cardiovascular system chapter 7.1 able recall name chamber valve heart describe chain event conduction system heart lead identify autonomic input heart effect distinguish artery capillary vein explain right heart muscular left trace flow blood heart & cardiovascular system consist muscular chambered heart blood vessel blood show figure 7.1 & heart act pump distribute blood vasculature & vasculature consist artery capillary vein & blood travel vein return right heart pump lung reoxygenate & oxygenate blood return to heart pump rest body figure 7.1 anatomy cardiovascular system & heart chambered structure

compose predominantly cardiac muscle & speak heart pump support single circulatory system heart actually compose pump support different circulation series & right heart accept deoxygenated blood return body move lung way pulmonary artery constitute first pump pulmonary circulation & second pump to heart receive oxygenated blood lung way pulmonary vein force body aorta systemic circulation heart consist atrium ventricle & atrium thin walled structure blood receive venae cavae deoxygenated blood enter right heart pulmonary vein oxygenated blood enter to heart & atrium contract push blood ventricle & ventricle fill contract send blood lung right ventricle systemic circulation to ventricle note ventricle far muscular atrium allow powerful contraction necessary push blood rest body & atrium separate ventricle atrioventricular valve likewise ventricle separate vasculature semilunar valve & valve allow heart muscle create pressure ventricle necessary propel blood forward circulation prevent backflow blood & valve right atrium right ventricle know tricuspid valve leaflet valve to atrium to ventricle know mitral bicuspid valve leaflet & valve separate right ventricle pulmonary circulation know pulmonary valve valve separate to ventricle aorta know aortic valve semilunar valve leaflet atrioventricular valve lab rat left

atrium = bicuspid right atrium = tricuspid central theme biology touch previous chapter structure function relate e right le side heart different pump right heart pump blood lung le heart pump blood systemic circulation blood leave le heart travel considerable distance blood pressure maintain far away foot us le heart muscular right heart fact right heart muscular le pump blood forcefully damage lung electrical conduction heart e coordinated rhythmic contraction cardiac muscle originate electrical impulse generate travel pathway form electrically excitable structure

show figure 7.2 is commonly test pathway consist order excitation sinoatrial sa node atrioventricular av node bundle av bundle branch purkinje fiber impulse initiation occur sa node generate 60–100 signal minute require neurological input is small collection cell locate wall right atrium depolarization wave spread sa node cause atrium contract simultaneously ventricular filling passive blood move atria ventricle base solely ventricular relaxation atrial systole contraction result increase atrial pressure force little blood ventricle is additional volume blood call atrial kick account 5–30 percent cardiac output signal reach av node sit junction atria ventricle e signal delay allow ventricle fill completely contract e signal travel bundle branch embed interventricular septum wall purkinje fiber distribute electrical signal ventricular muscle e muscle cell connect intercalate disc contain gap junction directly connect cytoplasm adjacent cell is allow coordinated figure 7.2 electrical conduction system heart electrical impulse travel sa node av node bundle finally purkinje fiber cardiac muscle myogenic activity mean contract neurological input sa node generate 60–100 beat minute innervation heart cut neurological input heart important speed slow rate contraction generate place heart electrical impulse detect body surface place electrode skin opposite side heart recording current call electrocardiogram ecg ekg k way reflect german spelling electrocardiogram incredibly powerful tool assess status patient heart normal ekg show depolarization precede cardiac muscle contraction electrical spike ekg occur cardiac contractile event p wave occur immediately atria contract qrs complex occur ventricle contract

t wave represent ventricular repolarization e sa node intrinsic rhythm 60–100 signal minute  
normal human heart rate 60–100 beat minute highly condition athlete heart rate significantly  
low 60 range 40 50 beat minute stress exercise excitement surprise danger cause heart rate  
rise significantly 100 e circulatory system autonomic control e autonomic system consist  
sympathetic fight or-flight parasympathetic rest- digest branch control heart affect  
vasculature sympathetic

or-flight parasympathetic rest- digest branch control heart affect vasculature sympathetic  
signal speed heart rate increase contractility cardiac muscle parasympathetic signal provide  
vagus nerve slow heart rate e heart muscle contract order blood heartbeat compose phase  
know systole diastole systole ventricular contraction closure av valve occur blood pump  
ventricle diastole ventricle relax semilunar valve close blood atria fill ventricle contraction  
ventricle generate high pressure systole relaxation diastole cause pressure decrease e  
elasticity wall large artery stretch receive volume blood heart allow vessel maintain sufficient  
pressure ventricular muscle relax fact elasticity large artery diastolic blood pressure plummet  
zero e normal event heartbeat include pressure le atrium le ventricle aorta le ventricular  
volume normal pathologic heart sound ekg

show figure 7.3 figure 7.3 cardiac cycle mcat expect thorough understanding detail diagram  
important change valve open closed pressure volume relate measure aware cardiac output  
total blood volume pump ventricle minute matter ventricle choose mention previously pump  
connect series volume blood pass like electrical current resistor series cardiac output co  
product heart rate hr beat minute stroke volume sv volume blood pump beat  $co = hr \times sv$   
rhythmic impulse hear listen heart stethoscope lub dub refer heart sound sound s1 produce  
av valve close start systole prevent backflow atria second sound s2 produce semilunar valve  
close end systole prevent backflow ventricle extra heart sound s3 s4 result stiffness heart  
muscle high blood pressure heart murmur loud audible stethoscope arise valve malfunction

narrow stiff wide floppy result abnormal flow pattern valve limit fast heart beat pump blood effectively heart fill blood relax diastole fast beat time blood enter heart relaxation fast heartbeat mean diminish return term blood supply body dangerous condition call ventricular tachycardia abbreviate v tach feature rapid rate ventricular contraction heart v tach properly fill blood paradoxically stop pump blood despite fast rate systemic pressure drop precipitously death result heart force abnormal rhythm human cardiac output 5 liter minute period exercise rest autonomic nervous system increase sympathetic decrease parasympathetic cardiac output respectively biology guide example expert thinking investigate effect atorvastatin post myocardial infarction recovery left ventricular myocardial infarction artificially induce rat rat randomly assign atorvastatin vehicle treatment week left ventricle rat examine result summarize figure article result fairly common vehicle mean base lot time saline serve ivs vehicle lvedp ees volume range ees prsw figure 1 representative pressure volume cardiac cycle loop vehicle treat rat atorvastatin treat rat b record preload manipulation brief period inferior vena cava occlusion panel c f illustrate quantitative analysis hemodynamic variable rat include

panel c f illustrate quantitative analysis hemodynamic variable rat include dp dt c lv end diastolic pressure d end- systolic elastance e preload recruitable stroke work f adapt tang x l sanganalmath sk sato h bi q hunt g vincent rj et al 2011 atorvastatin therapy peri infarct period attenuate le ventricular dysfunction remodeling aer myocardial infarction plos 6(9 e25320 treatment condition correlate great stroke volume rat follow myocardial infarction is question ask interpret give figure order determine condition associate particular outcome e mcat require bring testable content knowledge expect know use logical reasoning analyze experiment e first step think question ask analyze give passage figure know outside content knowledge stroke volume define volume blood pump heartbeat simply speak need identify information figure relate volume blood pump sure good place start look unit graph figure novel figure unit serve great clue figure look stroke volume look unit volume like liter cm<sup>3</sup> part

c f unit pressure second pressure pressure volume look need refer image b unit volume x axis  
accord

figure label graph show vehicle

treat rat graph b show atorvastatin treat rat e label tell graph pressure volume cardiac cycle  
loop rat condition relate graph stroke volume remember stroke volume volume blood pump  
heartbeat word blood pump aer cardiac cycle pressure volume graph cardiac cycle see  
rectangular loop height width loop represent pressure change volume change respectively  
look graph figure compare change volume loop condition explicitly measure dimension  
atorvastatin graph wide loop great stroke volume base part b figure 1 reasonably conclude  
treatment atorvastatin correlate great stroke volume rat post infarction compare control  
vehicle artery carry blood away heart order deliver blood entire body circulatory system utilize  
vessel different size e major type vessel artery vein capillary blood travel away heart artery  
large aorta systemic circulation major artery common carotid subclavian renal artery branch  
off aorta distribute bloodflow different peripheral tissue artery undergo division change divert  
blood specific tissue organ reach target branch arteriole ultimately lead capillary perfuse  
tissue ere set coronary artery base aorta send blood perfuse heart musculature venous  
capillary network capillary join venule join form vein venous blood empty superior inferior  
venae cavae entry right heart blood vessel line endothelial cell is special type cell help  
maintain vessel release chemical aid vasodilation vasoconstriction addition endothelial cell  
allow white blood cell pass vessel wall tissue inflammatory response finally endothelial cell  
release certain chemical damage involve formation blood clot repair vessel stop bleed heart  
attack myocardial infarction cause lack bloodflow coronary artery result decrease oxygen  
delivery cardiac muscle anaerobic respiration produce atp demand muscle tissue begin die  
person suffer heart attack give  $\beta$  blocker block sympathetic stimulation heart result low heart  
rate low contractility  $\beta$  blocker heart work hard oxygen demand diminish help prevent

damage cardiac tissue cross section different blood vessel show figure 7.4 worry name layer simply able recognize type cell

figure 7.4 worry name layer simply able recognize type cell comprise different vessel artery smooth muscle vein figure 7.4 structure blood vessels artery blood away heart lung part body artery contain oxygenate blood fact pulmonary artery umbilical artery contain deoxygenated blood small muscular artery know arteriole artery highly muscular elastic create tremendous resistance flow blood is reason le heart generate high pressure overcome resistance cause systemic artery aer artery fille blood elastic recoil wall maintain high pressure force blood forward capillary vessel single endothelial cell layer small red blood cell pass capillary single-file line e thin wall capillary allow easy diffusion gas  $O_2$   $CO_2$  nutrient notably glucose waste ammonia urea capillary interface communication circulatory system tissue remember blood carry hormone capillary allow endocrine signal arrive target capillary delicate capillary damage blood leave capillary enter interstitial space occur close space result bruise vein thin walled inelastic vessel transport blood heart pulmonary umbilical vein vein carry deoxygenate blood venule small venous structure connect capillary large vein body e small smooth muscle wall vein give recoil artery furthermore vein able stretch accommodate large quantity blood fourth total blood volume venous circulation time note volume arterial blood normally volume venous blood total volume pass heart unit time

cardiac output give heart locate chest bloodflow vein upward low body heart gravity inferior vena cava translate large blood vertical column e pressure venous column large vein leg high fact exceed systolic pressure 120 mmhg go high 200 mmhg us vein structure push blood forward prevent backflow large vein contain valve blood flow forward vein valve open blood try backward valve slam shut failure venous valve result formation varicose vein distended blood pool people pregnant especially susceptible formation varicose vein increase total blood volume pregnancy compression inferior vena cava fetus blood clot form deep vein leg result



injury inactivity blood stasis hypercoagulable state tendency blood clot excessively clot dislodge travel right atrium right ventricle pulmonary artery lung clot call pulmonary emboli specifically thromboemboli block segment pulmonary artery produce rapid labored breathing chest pain death occur thromboemboli large patient immobile follow surgical procedure long hospital stay introduce threat dvt pulmonary emboli undesirable complication sick hospital special wrap place leg contract rhythmically order prevent pooling blood formation blood clot addition patient receive medication like heparin warfarin prevent formation clot addition high pressure lower extremity small smooth muscle create challenge propel blood forward us vein rely external force generate pressure push blood heart vein surround skeletal muscle squeeze vein muscle contract force blood gravity way squeeze tube toothpaste cause content expel tube is sit motionless long period time cramped middle seat long transoceanic flight aer surgery increase risk blood clot formation vein leg pelvis blood pool lower extremity sluggish blood coagulate easily clot deep vein leg call deep vein thrombosis dvt is clot dislodged travel right heart lung cause life threaten condition call pulmonary embolus circulation definition circular let return anatomy heart vasculature show figure 7.1 trace flow blood body closeup bloodflow heart show figure 7.5 begin return blood right atrium blood return

show figure 7.5 begin return blood right atrium blood return heart body venae cavae divide superior vena cava svc inferior vena cava ivc e superior vena cava return blood portion body heart inferior vena cava return blood portion body heart deoxygenated blood enter right atrium travel tricuspid valve enter right ventricle contraction blood right ventricle pass pulmonary valve enter pulmonary artery travel lung break continuously small vessel blood reach capillary line alveoli participate gas exchange carbon dioxide leave blood oxygen enter blood e blood travel pulmonary venule pulmonary vein carry blood le heart oxygenated blood enter le atrium travel mitral valve enter le ventricle contraction blood le ventricle pass aortic valve enter aorta aorta blood enter artery arteriole capillary aer gas nutrient

exchange occur capillary blood enter venule lead large vein e vein svc ivc return right heart  
figure 7.5 bloodflow heart bicuspid valve acceptable alternative mitral valve rarely medicine  
practitioner refer valve letter abbreviation m mitral mitral refer miter ceremonial headdress  
wear religious leader large leaflet mitral valve somewhat resemble write shorthand pathway  
appear like case blood pass capillary bed return heart portal system body blood pass capillary  
bed series return heart hepatic portal system blood leave capillary bed wall gut pass hepatic  
portal vein reach capillary bed liver hypophyseal portal system blood leave capillary bed  
hypothalamus travel capillary bed anterior pituitary allow paracrine secretion release  
hormone renal portal system blood leave glomerulus travel efferent arteriole surround  
nephron capillary network call vasa recta mcat concept check 7.1 assess understanding  
material 1 start enter heart venae cavae chamber blood pass heart valve prevent backflow  
chamber valve prevent backflow 2 start site impulse initiation structure conduction system  
heart 3 compare contrast artery capillary vein carry blood 4 right heart contain cardiac muscle  
left 5

autonomic input heart cut happen chapter 7.2 able recall component plasma predict  
compatible blood type give blood type identify purpose hematocrit measurement relevant  
unit recognize different type leukocyte function describe platelet produce distinguish cell type  
blood contain contain examine pump pipe blood travel let look fluid pathology lab frequently  
study composition blood centrifuge spin blood rapid rate separate complex fluid component  
base density volume blood 55 liquid 45 cell show figure 7.6 plasma liquid portion blood  
aqueous mixture nutrient salt respiratory gas hormone blood protein plasma refine removal  
clotting factor serum e cellular portion blood consist major category erythrocyte leukocyte  
platelet blood cell form hematopoietic stem cell originate bone figure 7.6 composition blood  
serum

plural sera variety medical testing procedure antibody testing blood typing serum consider

preferable plasma application lack clotting factor fibrinogen erythrocyte red blood cell body oxygen nutrient deliver peripheral tissue carbon dioxide waste hydrogen ion ammonia pick peripheral tissue deliver organ process waste lung liver kidney e erythrocyte red blood cell specialized cell design oxygen transport oxygen simply dissolve cytoplasm red blood cell remember molecular oxygen nonpolar low solubility aqueous environment erythrocyte contain 250 million molecule hemoglobin bind molecule oxygen erefore red blood cell carry approximately 1 billion molecule red blood cell unique number way modification reflect special role play human body red blood cell biconcave indent side serve dual purpose shape assist travel tiny capillary second increase cell surface area increase gas exchange red blood cell unique mature nucleus mitochondrion membrane bind organelle lose e loss organelle make space molecule hemoglobin addition loss mitochondrion particular mean red blood cell consume oxygen carry deliver peripheral tissue word red blood cell carry oxidative phosphorylation generate atp rely entirely glycolysis atp lactic acid arise fermentation main byproduct red blood cell lack nucleus unable divide erythrocyte live 120 day bloodstream cell liver spleen phagocytize senescent old red blood cell recycle part medicine complete blood count measure quantity cell type blood red blood cell commonly give measure hemoglobin hematocrit hemoglobin course measure quantity hemoglobin blood give result gram deciliter hematocrit measure blood sample consist red blood cell give percentage normal hemoglobin consider 13.5 17.5 phenotypical male 12.0 16.0 phenotypical female normal hematocrit consider 41 53 male 36 46 female example patient hemoglobin 13.8 hematocrit 41.2 leukocyte white blood cells

leukocyte white blood cell usually comprise 1 percent total blood volume is translate 4,500–11,000 leukocyte microliter blood small number relative erythrocyte concentration is number massively increase certain condition need white blood cell notably infection white blood cell crucial immune system act defender pathogen foreign cell cancer material recognize self let briefly discuss five basic type leukocyte categorize class granulocyte

agranulocyte e granular leukocyte granulocyte neutrophil eosinophil basophil name contain cytoplasmic granule visible microscopy ese granule contain variety compound toxic invade microbe compound release exocytosis granular leukocyte involve inflammatory reaction allergy pus formation destruction bacteria parasite e specific function granulocyte discuss chapter 8 mcat biology review e agranulocyte contain granule release exocytosis consist lymphocyte monocyte lymphocyte important specific immune response body target fight particular pathogen virus bacteria lymphocyte act primary responder infection function maintain long term memory bank pathogen recognition ese cell real sense help body learn experience prepare mount fast response repeat exposure familiar pathogen vaccine work train cell rough exposure weaken pathogen antigenic protein protein recognize immune system pathogen memory cell create example child united states receive varicella chickenpox vaccine include live weaken strain varicella zoster virus cause chickenpox vaccine administer virus recognize foreign immune response activate process certain immune cell form memory virus word body learn remember virus prepare ward off virus appear later life lymphocyte maturation take place location lymphocyte mature bone marrow refer b cell mature thymus call t cell b cell responsible antibody generation t cell kill virally infect cell activate immune cell e detail component specific immune response discuss chapter 8 mcat biology review e agranulocyte monocyte phagocytize foreign matter bacteria organ body contain collection phagocytic cell leave bloodstream enter organ monocyte rename macrophage organ macrophage population specific central nervous system example call microglia skin call langerhans cell bone call osteoclast rombocyte platelet cell

skin call langerhans cell bone call osteoclast rombocyte platelet cell fragment shard release cell bone marrow know megakaryocyte eir function assist blood clotting present high concentration 150,000–400,000 microliter blood e enzymatic reaction involve formation clot clotting cascade discuss shortly mention cellular element blood originate bone marrow e production blood cell platelet call hematopoiesis trigger number hormone growth factor

cytokine e notable erythropoietin secrete kidney stimulate mainly red blood cell development thrombopoietin secrete liver kidney stimulate mainly platelet development e hematopoietic pathway

show figure 7.7 hematopoietic stem cell form lymphoid myeloid stem cell lymphoid form nk t-b- plasma cell myeloid form dendritic cell monocyte macrophage neutrophil eosinophil mast cell basophil platelet erythrocyte figure 7.7 hematopoiesis red blood cell express surface protein call antigen general antigen specific target usually protein immune system react e major antigen family relevant blood group abo antigen rh factor e abo system comprise allele blood type particular class erythrocyte cell surface protein b allele codominant mean person express abo antigen allele ia simply present chromosome b allele ib b present chromosome express person blood type ab e o allele o recessive b allele people type o blood express variant b antigen protein homozygous recessive genotype e naming system blood type base presence absence protein variant e blood type b ab o. b allele dominant genotype iaia iai genotype b ibib different way write abo allele ia ib b o. comfortable system mcat system common medical practice e abo classification important implication medical practice critical match blood type transfusion exaggeration blood type matching life death matter give severe hemolysis result donor blood antigen recognize foreign recipient immune system example person type blood recognize type protein self type b protein foreign antibody type b ab type o blood cell express antigen variant initiate immune response regardless recipient actual blood type people type o blood consider universal donor blood cause abo relate hemolysis recipient recipient type o produce anti anti b antibody receive type o blood hand people type ab blood consider universal recipient receive blood blood type blood antigen foreign individual ab blood adverse reaction occur transfusion thorough description blood type give table 7.1 note blood give transfusion pack red blood cell plasma generally give us care donor red blood cell antigen plasma antibody determine hemolysis occur donate receive

blood cell antigen plasma antibody determine hemolysis occur donate receive b b ab o b ab o  
table 7.1 abo blood type guarantee question blood group test day critical learn system work ia  
ib codominant recessive important point need antibody antibody create response antigen  
specifically target antigen expect antibody ebola virus expose is true rh factor individual rh  
negative anti rh antibody prior exposure rh positive blood individual lack allele automatically  
anti antibody e reason lie gut research demonstrate e. coli inhabit colon protein match b  
allele is serve source exposure allow develop anti anti b antibody prior exposure person  
blood is abo compatibility important blood transfusion give wrong abo blood type lead rapid  
hemolysis antigen stimulus b cell antibody exposure b cell specific antigen cell antibody  
produce factory common blood type united states o+ common ab- e rh factor name first  
describe rhesus monkey surface protein express red blood cell time think single antigen find  
exist variant le unmodified rh positive rh+ rh negative rh- refer presence absence specific  
allele call d.

e presence absence d indicate plus minus superscript abo blood type o+ ab- rh positivity  
follow autosomal dominant inheritance positive allele protein blood bank pathology rh factor  
refer d. note b d protein important blood typing dozen antigen match include c e kell lewis  
duffy antigen correctly match low probability hemolysis e rh factor status particularly  
important obstetric medicine exposure small fetal blood childbirth inevitable matter good  
obstetrician person pregnant rh fetus rh+ person sensitized rh factor person immune system  
begin make antibody is problem first child time person start produce antibody child bear  
subsequent pregnancy fetus rh+ present problem maternal anti rh antibody cross placenta  
attack fetal blood cell result hemolysis fetal cell is condition know erythroblastosis fetalis  
fatal fetus today use medicine prevent condition ere concern maternal fetal abo  
mismatching antibody ab antigen class call igm readily cross placenta unlike anti rh igg  
antibody person rh pregnant rh+ fetus risk erythroblastosis fetali subsequent rh mismatch  
pregnancy usually avoid give rh parent rh immunoglobulin rhogam pregnancy immediately

delivery administration immunoglobulin type passive immunization absorb fetus rh+ cell prevent production anti rh antibody parent mcat concept check 7.2 assess understanding material 1 component plasma 2 individual b+ blood automobile accident require blood transfusion blood type person receive recovery individual thankful transfusion decide donate blood blood type person donate receive donate 3 hematocrit measure unit hematocrit 4 type leukocyte involve specific immune response 5 platelet come 6 cell type(s blood contain nucleus contain nucleus physiology cardiovascular system chapter 7.3 able predict impact change bloodflow artery capillary vein blood pressure heart function recall bicarbonate buffer chemical equation include catalyze enzyme explain oxyhemoglobin dissociation curve shift left recall series event compound coagulation cascade identify region body associate different part oxyhemoglobin dissociation curve e cardiovascular system transport compound include gas nutrient waste product body

cardiovascular system transport compound include gas nutrient waste product body tissue red blood cell plasma furthermore serve important role immunity specialized cell leukocyte help body fight localized systemic pathogen capillary body dilate constrict maintain proper body temperature addition circulatory system mediate formation blood clot repair damage vessel ese function reflect important job cardiovascular system include maintenance blood pressure gas solute exchange coagulation thermoregulation discuss gas solute exchange important recognize circulatory system serve predominant function blood pressure keep sufficiently high propel blood forward blood pressure provide healthcare professional information health circulatory system addition high blood pressure hypertension pathological state result damage blood vessel organ blood pressure measure force unit area exert wall blood vessel measure sphygmomanometer sphygmomanometer measure gauge pressure systemic circulation pressure atmospheric pressure 760 mmhg sea level discuss chapter 4 mcat physics math review blood pressure express ratio systolic ventricular contraction diastolic ventricular relaxation pressure pressure gradually drop arterial venous circulation

large drop occur arteriole show figure 7.8 normal blood pressure consider 90/60 120/80 figure 7.8 mean arterial pressure different location cardiovascular system large drop blood pressure occur arteriole critical capillary thin walled unable withstand pressure arterial analogy draw circulation electric circuit like electromotive force voltage drive current give electrical resistance pressure gradient circulatory system drive cardiac output give vascular resistance is analogy important remember equation electric circuit apply cardiovascular system example ohm law  $v = ir$  translate following equation circulation  $\delta p = co \times tpr$   $\delta p$  pressure differential circulation  $co$  cardiac output  $tpr$  total peripheral vascular resistance important note arteriole capillary act like resistor circuit electricity travel wire wire provide intrinsic level resistance limit flow electricity resistance base factor resistivity length cross-sectional area resistivity obvious correlate physiology factor certainly e long blood vessel resistance offer e large cross sectional area blood vessel resistance offer addition artery highly muscular able expand contract need change vascular resistance maintain blood pressure arteriole contract limit blood enter give capillary bed like increase resistance decrease current flow give branch circuit finally exception portal system systemic capillary bed parallel erefore open capillary bed decrease vascular resistance like add resistor parallel assume body compensate increase cardiac output vital sign include temperature heart rate respiratory rate blood pressure provide quick snapshot person condition give moment high blood pressure indicate clinical hypertension anxiety catecholamineproducing tumor stimulant use low blood pressure indicate hemorrhage heart attack sepsis severe bloodstream infection neurological damage broad differential diagnosis vital sign combine quick clinical history provide way clinician identify patient require immediate intervention blood pressure regulate baroreceptor wall vasculature baroreceptor specialized neuron detect change mechanical force wall vessel blood pressure low stimulate sympathetic nervous system cause vasoconstriction increase blood pressure addition chemoreceptor sense osmolarity blood high indicate dehydration is promote release antidiuretic hormone adh



blood high indicate dehydration is promote release antidiuretic hormone adh vasopressin peptide hormone hypothalamus store posterior pituitary increase reabsorption water increase blood volume pressure dilute blood low perfusion juxtaglomerular cell kidney stimulate aldosterone release renin angiotensin aldosterone system aldosterone increase reabsorption sodium extension water increase blood volume pressure blood pressure high neurologically sympathetic impulse decrease permit relaxation vasculature concurrent drop blood pressure heart specialized atrial cell able secrete hormone call atrial natriuretic peptide anp is hormone aid loss salt nephron act natural diuretic loss fluid interestingly anp fairly weak diuretic fluid lose oen counter effect high salt diet blood pressure human body different way raise blood pressure way lower gas solute exchange blood pressure ensure sufficient forward flow blood system happen blood reach capillary oxygen nutrient diffuse blood tissue waste product like carbon dioxide hydrogen ion urea ammonia diffuse blood addition hormone secrete capillary travel circulation diffuse target tissue ion fluid return blood ensure area swollen fluid regardless substance exchange fundamental concept consider process concentration gradient case capillary wall high concentration give substance is allow movement gas solute oxygen carry primarily hemoglobin blood hemoglobin protein compose cooperative subunit prosthetic heme group bind oxygen molecule e binding oxygen occur heme group central iron atom undergo change oxidation state e binding releasing oxygen iron atom heme group oxidation reduction reaction important note oxygen diffuse blood dissolve plasma negligible compare quantity oxygen bind hemoglobin e level oxygen blood oen measure partial pressure  $O_2$  blood  $p_{aO_2}$  normal  $p_{aO_2}$  approximately 70–100 mmhg take measurement inconvenient involve take sample blood artery contrast oxygen saturation percentage hemoglobin molecule carry oxygen easily measure finger probe healthy oxygen saturation level 97 percent lung oxygen diffuse alveolar capillary first oxygen bind heme group induce conformational shi shape hemoglobin taut relaxed is shi increase hemoglobin affinity oxygen make easy subsequent molecule

is this increase hemoglobin affinity oxygen make easy subsequent molecule oxygen bind remain unoccupied heme group heme group acquire oxygen molecule affinity continue increase create positive feedback like spiral forward mechanism hemoglobin subunit bind oxygen removal molecule oxygen induce conformational shift decrease overall affinity oxygen make easy molecule oxygen leave heme group is positive feedback process oxygen molecule leave hemoglobin progressively easy oxygen remove is phenomenon form allosteric regulation refer cooperative binding result classic sigmoidal s shaped oxyhemoglobin dissociation curve show figure 7.9 figure 7.9 oxyhemoglobin dissociation curve look shift curve let sure understand mean accord curve blood 100 percent saturated lung partial pressure 100 mmHg  $O_2$  in tissue low partial pressure oxygen 40 mmHg rest low partial pressure hemoglobin approximately 80 percent saturated therefore  $100 - 80 = 20$  oxygen release hemoglobin oxygen tissue course exercise partial pressure oxygen tissue low 20 mmHg low partial pressure hemoglobin approximately 30 percent saturated therefore  $100 - 30 = 70$  oxygen release tissue reality unloading oxygen facilitate shift hemoglobin curve occur exercise describe later deliver oxygen tissue job transport respiratory gas remove carbon dioxide gas  $CO_2$  primary waste product cellular respiration important carbon dioxide gas like oxygen gas nonpolar low solubility aqueous plasma small percentage total  $CO_2$  transport blood lung dissolve plasma carbon dioxide carry hemoglobin hemoglobin low affinity carbon dioxide oxygen is vast majority  $CO_2$  exist blood bicarbonate ion  $CO_2$  enter red blood cell encounter enzyme carbonic anhydrase catalyze combination reaction carbon dioxide water form carbonic acid  $H_2CO_3$  carbonic acid weak acid dissociate proton bicarbonate anion is hydrogen ion proton bicarbonate ion high solubility water make effective method transport metabolic waste product lung excretion reach alveolar capillary lung reaction lead formation proton bicarbonate anion reverse allow breathe carbon dioxide is chemical reaction important provide effective mean rid body tissue carbon dioxide gas concentration

provide effective mean rid body tissue carbon dioxide gas concentration free proton blood affect ph ph turn allosteric effect oxyhemoglobin dissociation curve increased carbon dioxide production cause right shi bicarbonate buffer equation result increase  $\text{h}^+$  decrease

ph ese proton bind hemoglobin reduce hemoglobin affinity oxygen is decrease affinity see oxyhemoglobin curve shi right know bohr effect note trigger right shi increase  $\text{paco}_2$  increase  $\text{h}^+$  decrease ph oen associate oxygen demand high rate cellular metabolism result increase carbon dioxide production accumulation lactic acid decrease ph. is decrease affinity allow oxygen unload tissue show figure 7.10 look red green line hemoglobin nearly 100 percent saturated lung partial pressure 100 mmhg  $\text{o}_2$  line green line significantly low red reach partial pressure 20 mmhg  $\text{o}_2$  exercise muscle erefore right shi represent great unloading oxygen tissue figure 7.10 shift oxyhemoglobin dissociation cause right shift oxyhemoglobin curve exercise right thing following occur exercise increase  $\text{h}^+$  decrease ph fetal hemoglobin high affinity oxygen adult hemoglobin left shifted curve compare adult hemoglobin cause right shi oxyhemoglobin curve include increase temperature increase 2,3 biphosphoglycerate 2,3 bpg product glycolysis red blood cell le shi like blue line figure 7.10 occur decrease  $\text{paco}_2$  decrease  $\text{h}^+$  increase ph decrease temperature decrease 2,3 bpg addition fetal hemoglobin hbf high affinity oxygen adult hemoglobin hba is sense fetal red blood cell literally pull oxygen off maternal hemoglobin fetal hemoglobin e bicarbonate buffer system important link respiratory renal system disturbance system lead change ph blood example individual hyperventilate excess  $\text{co}_2$  blow off shie bicarbonate buffer system le decrease concentration proton is lead increase ph know respiratory alkalosis e kidney compensate change increase excretion bicarbonate bring ph normal contrast renal tubular acidosis type kidney unable excrete acid effectively is lead buildup proton blood metabolic acidosis cause buffer system shi le.

e excess  $\text{co}_2$  form process exhale person increase respiratory rate compensate bring ph

normal nutrient waste hormone addition respiratory gas blood carry nutrient waste product hormone appropriate location use disposal discuss early concentration gradient guide movement substance tissue carbohydrate amino acid absorb capillary small intestine enter systemic circulation hepatic portal system fat absorb lacteal small intestine bypass hepatic portal circulation enter systemic circulation thoracic duct release intestinal cell fat package lipoprotein water soluble e absorption nutrient cover extensively chapter 9 mcat biology review waste carbon dioxide ammonia urea enter bloodstream travel respective concentration gradient tissue capillary e blood eventually travel kidney waste product filtere secrete elimination body hormone enter circulation near organ hormone produce is usually occur exocytosis allow secretion hormone bloodstream certain hormone carry protein blood release specific condition hormone reach target tissue activate cell surface receptor peptide hormone diffuse cell activate intracellular intranuclear receptor steroid hormone bloodstream pressure gradient essential maintain proper balance fluid volume solute concentration blood interstitium cell surround blood vessel ese opposing related hydrostatic osmotic oncotic pressure hydrostatic pressure force unit area blood exert vessel wall is generate contraction heart elasticity artery measure upstream large artery blood pressure hydrostatic pressure push fluid bloodstream interstitium capillary wall somewhat leaky design osmotic pressure hand suck pressure generate solute attempt draw water bloodstream osmotic pressure attributable plasma protein usually call oncotic pressure arteriole end capillary bed hydrostatic pressure push fluid large oncotic pressure draw fluid net efflux water circulation show figure 7.11 fluid move vessel hydrostatic pressure drop significantly osmotic pressure stay erefore venule end capillary bed hydrostatic pressure push fluid drop oncotic pressure draw fluid net influx water circulation figure 7.11

starling force capillary bed hydrostatic pressure push fluid vessel dependent blood pressure generate heart elastic artery osmotic pressure pull fluid vessel dependent number particle dissolve plasma protein refer oncotic pressure e balance oppose pressure call starle force

essential maintain proper fluid volume solute concentration inside outside vasculature  
imbalance pressure result little fluid tissue example accumulation excess fluid interstitium  
result condition call edema note interstitial fluid take lymphatic system lymphatic fluid lymph  
return central circulatory system way channel call thoracic duct blockage lymph node infection  
surgery result edema need learn memorize starling equation quantifie net filtration rate fluid  
compartment understand movement solute fluid capillary level govern pressure differential  
like movement carbon dioxide oxygen lung certain genetic disease hemophilia cause  
malfunction cascade clotting reaction increase risk life threaten blood loss relatively minor  
injury hemophilia common form sex link trait far common genotypical male genotypical  
female cover function red blood cell plasma briefly touch white blood cell explore extensively  
chapter 8 mcat biology review is leave platelet protect vascular system event damage form  
clot clot compose coagulation factor protein platelet prevent minimize blood loss endothelium  
blood vessel damage expose underlie connective tissue contain collagen protein call tissue  
factor platelet come contact expose collagen sense evidence injury response release content  
begin aggregate clump simultaneously coagulation factor secrete liver sense tissue factor  
initiate complex activation cascade detail coagulation cascade scope mcat important know  
endpoint cascade activation prothrombin form thrombin thromboplastin rombin convert  
fibrinogen fibrin fibrin ultimately form small fiber aggregate cross link weave structure like net  
capture red blood cell platelet form stable clot area damage

show figure 7.12 clot form surface vessel cut call scab figure 7.12 thrombus clot formation  
rombus formation blood clotting occur blood vessel injure e process begin platelet attach  
matrix expose endothelial cell line blood vessel disrupt is attachment activate quiescent  
 $\alpha_{IIb}\beta_3$  integrin molecule cause adhere circulate protein include fibrinogen form bridge  
additional platelet cell protein ultimately form network cell fiber dense plug injury prevent  
blood loss wound repair ultimately clot break is task accomplish predominantly plasmin  
generate plasminogen mcat concept check 7.3 assess understanding material 1 bacterial

sepsis overwhelming bloodstream infection number capillary bed body open simultaneously  
effect blood pressure risk infection sepsis dangerous heart 2 chemical equation bicarbonate  
buffer system enzyme catalyze reaction 3 look oxyhemoglobin dissociation curve determine  
oxygen deliver tissue 4 direction oxyhemoglobin dissociation curve shift result exercise  
physiological change cause shift 5 exposure subendothelial compound start coagulation  
cascade protein help stabilize clot start cascade stabilize clot e

cardiovascular system commonly test mcat topic familiar basic structure system pump series  
e right ventricle pump blood pulmonary circulation le ventricle pump blood systemic  
circulation discuss myogenic activity cardiac muscle pathway electricity follow heart sa node  
av node bundle purkinje fiber e movement blood vascular system result heart pump  
generate pressure blood pressure measure blood force unit area vessel wall record gauge  
pressure pressure atmospheric pressure discuss difference structure artery capillary vein  
anatomical difference reflective different function review composition blood major blood cell  
type examine abo rh antigen system frequently appear mcat widespread clinical relevance e  
blood ability carry oxygen carbon dioxide describe recall carbon dioxide primarily carry  
bicarbonate ion blood e conversion carbon dioxide ion accomplish enzyme carbonic  
anhydrase chapter focus function red blood cell plasma platelet briefly examine immune  
system primarily drive action white blood cell product immunology consider challenging  
course medical school learn dozen cytokine cluster differentiation cd specialized cell type  
chapter focus basic immunology discuss major component innate nonspecific adaptive  
specific immune response review content test knowledge critical thinking skill complete test  
like passage set online anatomy cardiovascular system e cardiovascular system consist  
muscular chambered heart blood vessel blood e heart compose cardiac muscle support  
different circulation pulmonary circulation systemic circulation heart consist atrium ventricle  
e atrium separate ventricle atrioventricular valve tricuspid right bicuspid mitral le e  
ventricle separate vasculature semilunar valve pulmonary right aortic le e pathway blood

right atrium pulmonary artery lung pulmonary vein left atrium aorta artery arteriole  
capillary venule vein venae cavae right atrium and left heart contain muscle right  
systemic circulation high resistance electrical conduction heart starts sinoatrial SA node goes  
atrioventricular AV node

AV node electrical impulse travels bundle travels Purkinje fiber systole refers period ventricular  
contraction AV valve closes diastole heart relaxs semilunar valve closes and cardiac output product  
heart rate stroke volume and sympathetic nervous system increase heart rate contractility and  
parasympathetic nervous system decrease heart and vasculature consists artery vein capillary  
artery thick highly muscular structure elastic quality is allow recoil help propel blood forward  
system

small muscular artery arteriole control flow capillary bed capillary wall cell thick make narrow  
red blood cell travel single file capillary site gas solute exchange vein inelastic thin walled  
structure transport blood heart is able stretch order accommodate large volume blood  
recoil capability vein compress surround skeletal muscle valve maintain way flow small vein  
call venule portal system blood pass capillary bed series hepatic portal system blood travel gut  
capillary bed liver capillary bed hepatic portal vein hypophyseal portal system blood travel  
capillary bed hypothalamus capillary bed anterior pituitary renal portal system blood travel  
glomerulus vasa recta efferent arteriole blood compose cell plasma aqueous mixture nutrient  
salt respiratory gas hormone blood protein erythrocyte red blood cell lack mitochondrion  
nucleus organelle order room hemoglobin protein carry oxygen common measurement  
include hemoglobin concentration hematocrit percentage blood compose leukocyte white  
blood cell form bone marrow is crucial immune system granular leukocyte neutrophil  
eosinophil basophil play role nonspecific immunity agranulocyte include lymphocyte  
monocyte play role immunity lymphocyte play large role specific thrombocyte platelet cell  
fragment megakaryocyte require coagulation blood antigen include surface antigen B and Rh

ia ib b allele codominant o allele recessive people antibody ab allele positive rh factor dominant rh negative individual create anti rh antibody after exposure rh positive blood physiology cardiovascular system blood pressure refer force unit area exert wall blood vessel blood divide systolic diastolic high overcome resistance create arteriole capillary low avoid damage vasculature surround structure measure sphygmomanometer blood pressure maintain baroreceptor chemoreceptor reflexes low blood pressure promote aldosterone antidiuretic hormone adh vasopressin release high blood osmolarity promote adh release high blood pressure promote atrial natriuretic peptide anp release gas solute exchange occur level capillary rely existence concentration gradient facilitate diffusion capillary wall capillary leaky aid transport gas solute starle force consist hydrostatic pressure osmotic oncotic

transport gas solute starle force consist hydrostatic pressure osmotic oncotic pressure hydrostatic pressure pressure fluid blood vessel osmotic pressure suck pressure draw water solute oncotic pressure osmotic pressure protein hydrostatic pressure force fluid arteriolar end capillary bed oncotic pressure draw venule end oxygen carry hemoglobin exhibit cooperative binding lung high partial pressure oxygen result loading oxygen hemoglobin tissue low partial pressure oxygen result unloading cooperative binding successive oxygen bind hemoglobin increase affinity subunit successive oxygen release decrease affinity subunit

carbon dioxide largely carry blood form carbonic acid bicarbonate hydrogen ion carbon dioxide nonpolar particularly soluble bicarbonate hydrogen ion carbonic acid polar highly soluble high  $paco_2$  high  $h^+$  low ph high temperature high concentration 2,3 bpg cause right shi oxyhemoglobin dissociation curve reflect decrease affinity addition opposite cause right shi le shi see dissociation curve fetal hemoglobin compare adult hemoglobin nutrient waste hormone carry bloodstream tissue use disposal coagulation result activation cascade endothelial lining blood vessel damage collagen tissue factor underlie endothelial cell expose is result cascade event know coagulation cascade ultimately result formation clot platelet



bind collagen stabilize fibrin activate thrombin clot break plasmin answer concept check valve  
at prevent backflow mitral bicuspid valve 2 sinoatrial sa node atrioventricular av node  
bundle av bundle branch purkinje fibers carry blood away heart yes lot arteriole thin yes  
little 4 e right heart pump blood low resistance circuit low pressure require muscle e le  
heart pump blood high resistance circuit high pressure require muscle 5 autonomic  
innervation heart lose heart continue beat intrinsic rate pacemaker sa node e individual  
unable modify heart rate sympathetic parasympathetic nervous system heart stop beat 1  
plasma aqueous mixture nutrient salt respiratory gas hormone blood protein clotting protein  
immunoglobulin 2 person b+ blood receive b+ b o+ o blood person b+ blood donate people b+  
ab+ blood 3 hematocrit measure percentage blood sample occupy red blood cell measure  
percentage point 4 lymphocyte involve specific immune defense 5 platelet cellular fragment  
shard give off megakaryocyte bone marrow 6 leukocyte include neutrophil eosinophil basophil  
monocyte macrophage lymphocyte contain nucleus erythrocyte platelet 1 open capillary bed  
parallel decrease overall resistance circuit e cardiac output increase attempt maintain  
constant blood pressure is risk heart increase demand heart eventually tire lead heart attack  
precipitous drop blood pressure 2

eventually tire lead heart attack precipitous drop blood pressure 2 e bicarbonate buffer  
system equation e combining carbon dioxide water catalyze carbonic 3 e oxygen delivery  
see drop y value percent hemoglobin saturation oxyhemoglobin dissociation curve example  
blood 100 saturate lung 100 mmhg o<sub>2</sub> 80 saturate tissue 40 mmhg o<sub>2</sub> 20 oxygen release  
tissue 4 e oxyhemoglobin curve shi right exercise response increase arterial co<sub>2</sub> increase h<sup>+</sup>  
decrease ph increase temperature is right shi represent hemoglobin decrease affinity  
oxygen allow oxygen unload tissue 5 e coagulation cascade start exposure collagen tissue  
factor platelet coagulation factor e clot stabilize science mastery assessment explanations

erythrocytes red blood cell produce red bone marrow circulate blood 120 day aer

phagocytize spleen liver eliminate d red blood cell disc like shape lose membranous organelle like mitochondrion nucleus maturation is make c correct answer erythrocyte fill hemoglobin lack mitochondrion make metabolism solely anaerobic eliminate b ordinary cardiac contraction originate regulate sinoatrial sa node e impulse travel atrium stimulate contract simultaneously e impulse arrive atrioventricular av node momentarily slow conduction allow completion atrial contraction ventricular filling e impulse carry bundle branch purkinje fiber wall ventricle generate strong contraction accord bohr effect decrease ph blood decrease hemoglobin affinity o<sub>2</sub> is make c correct answer e affinity generally lower exercise muscle facilitate unloading oxygen tissue eliminate decrease paco<sub>2</sub> cause decrease h<sup>+</sup> increase ph increase hemoglobin affinity o<sub>2</sub> eliminate b finally d incorrect hemoglobin affinity o<sub>2</sub> high fetal blood blood drain superior inferior venae cavae right atrium pass tricuspid valve right ventricle pulmonary valve pulmonary artery lead lung oxygenated blood return le atrium pulmonary vein flow mitral valve le ventricle le ventricle pump aortic valve aorta distribution body e exchange fluid greatly influence difference hydrostatic osmotic pressure blood tissue e osmotic oncotic pressure remain relatively constant hydrostatic pressure arterial end great hydrostatic pressure venous end result fluid move capillary arterial end venous end fluid reabsorb venous end osmotic pressure exceed hydrostatic pressure protein cross capillary wall normal circumstance e first step solve problem define cardiac output cardiac output = heart rate × stroke volume divide cardiac output stroke volume determine note heart rate actually pathologically fast normal heart rate consider 60 100 beat minute know patient blood type type transfusion safely o-.

people o blood consider universal donor blood cell contain surface antigen erefore o blood give potentially life- threaten consequence abo rh incompatibility e answer choice correctly describe artery vein c pressure aorta usually range 120 80 mmhg depend heart systole diastole pressure superior vena cava near zero incorrect artery thick walled vein thin wall b incorrect relationship reverse pulmonary umbilical circulation d reverse artery use pumping

heart snapping elastic wall transport blood venous blood propel skeletal muscle contraction  
e relative lack smooth muscle venous wall allow stretching store blood body valve vein allow  
way flow blood heart stretch artery vein close lymphatic vessel bearing relative difference  
volume artery vein single cell endothelial lining carbon dioxide byproduct metabolism cell  
later combine water form bicarbonate reaction catalyze carbonic anhydrase is system blood  
plasma important buffer system food fluid absorption significant source buffering eliminate b  
kidney involve acid base balance carry function filtration secretion reabsorption mechanism  
hormone release eliminate d circulation plasma protein play important role generate osmotic  
oncotic pressure is allow water displace arterial end capillary bed hydrostatic pressure  
reabsorb venule end loss plasma protein cause decrease plasma osmotic oncotic pressure e  
atrioventricular valve locate atria ventricle side heart eir role prevent backflow blood atria e  
valve right heart cusp call tricuspid valve prevent backflow blood right ventricle right atrium  
hold breath prolonged period result drop oxygenation increase  $paco_2$  e increased carbon  
dioxide associate water form carbonic acid dissociate proton bicarbonate anion low oxygen  
saturation eventually lead anaerobic metabolism tissue cause increase lactic acid ese lead  
decrease ph. e cardiac conduction system start sa node locate near right atrium continue av  
node locate av valve e bundle locate wall ventricle likely affecte wall ventricle damage heart  
attack is affect le ventricle le ventricular muscle cardiac conduction system e great  
resistance

provide arteriole arteriole highly muscular ability contract dilate order regulate blood pressure  
consult online resource additional practice equation remember 7.1 cardiac output  $co = hr \times sv$   
7.2 ohm law apply circulation  $\delta p = co \times tpr$  biochemistry chapter 9 carbohydrate metabolism  
biology chapter 6 e respiratory system biology chapter 8 e immune system general  
chemistry chapter 12 physics math chapter 4 physics math chapter 6 chapter 8 e immune  
system red white blood cell background pre med know feeling content know mcat know first  
important high yield badge book help identify important topic science mastery assessment

tool mcat prep arsenal is quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 digeorge syndrome thymus completely absent absence thymus leave individual unable mount specific defense following type pathogen 2

follow involve cell mediate immunity a. memory cell b. plasma cell c. cytotoxic cell d. suppressor cell 3 lymphatic system a. transport hormone body b. transport chylomicron circulatory system c. cause extravasation fluid tissue d. site mast cell activation 4 follow involve antibody production a. plasma cell b. memory cell c. helper t cell d. cytotoxic cell 5 follow true innate immune system a. include macrophage mediate inflammation b. active infection c. recognize unique feature pathogen d. contain cell derive hematopoietic stem cell 6 follow example adaptive immunity a. prr recognize pathogen invasive parasite eosinophil recruit area b. complement activate cause osmotic instability bacterium c. memory b cell generate vaccination activate antigen d. dendritic cell sample bacteria laceration travel lymph node present antigen 7 follow true passive active immunity a. active immunity require week build passive immunity acquire b. active immunity short live passive immunity long live c. active immunity acquire pregnancy placenta d. passive immunity acquire vaccination 8

self reactive t cell eliminate b. lymph node c. bone marrow 9 response immune system

downregulation mhc molecule a. b cell activate antibody release b. t cell activate result cytotoxic response c. natural killer cell induce apoptosis affected cell d. macrophage engulf pathogen display antigen 10 follow correctly indicate response cd8 + t cell a. secretion cytotoxic chemical b. cause isotype switching c. presentation antigen d. activation b cell 11 lymphoma cancer cell lymphoid lineage cell reside lymph node type cell likely cause lymphoma a. cd8 + t cell d. th1 cell 12 encounter antigen t cell specific t cell receptor activate example a. innate immunity b. cytotoxic t cell response c. humoral immunity d. clonal selection 13 cell type phagocyte attack bacterial pathogen bloodstream d. dendritic cell 14 type immunity likely affect removal spleen a. cytotoxic immunity b. humoral immunity c. innate immunity d. passive immunity 15 follow example nonspecific defense mechanism a. skin provide physical barrier invasion b. macrophage engulf destroy foreign particle c. inflammatory response initiate response physical damage d. cytotoxic t cell destroy cell display foreign antigen immune system chapter structure immune system innate adaptive immunity innate immune system noncellular nonspecific defenses cells innate immune system adaptive immune system cells adaptive immune system activation adaptive immune system recognition self nonself lymphatic system pie chart indicate content chapter relevant percent question biology content chapter relevant 6 question biology mcat chapter cover material following aamc content category 3b structure integrative function main organ system past decade public imagination capture alarming report flesh eat bacteria

disease bacteria actually eat flesh dangerous flesh- eat bacteria cause condition call necrotizing fasciitis disease require aggressive medical surgical treatment include intravenous antibiotic surgical debridement removal necrotic tissue amputation different type bacteria include group streptococcus clostridium perfringen methicillin- resistant staphylococcus aureus mrsa cause necrotize fasciitis e massive destruction skin muscle connective tissue release bacterial toxin call superantigen life threaten ese superantigen cause immune system nonspecifically overactivated necrotize fasciitis dangerous bacteria subsequent

inflammatory response destruction skin nonspecific immune defense leave body susceptible superinfection infection pathogen chapter consider type nonspecific defense specific immune defense e human body rely interaction innate nonspecific adaptive specific immune system order protect disease immune system perfect response immune system nonspecifically overactivated case necrotizing fasciitis activated human suppose protect discuss individual part immune system part work protect disease addition discuss concept autoimmunity disease result immune attack oneself briefly touch vaccine advantage understanding immune system protect life threaten infection e immune system largely integrate lymphatic system discuss chapter structure immune system chapter 8.1 able distinguish innate adaptive immunity draw comparison b- t cell include development maturation function specificity control mechanism identify immune cell granulocyte agranulocyte day human body expose numerous bacteria virus fungus parasite body able protect infection time sick immune system usually able contain eliminate infection immune system topic cell biology biochemistry anatomy biology interact topic allow mcat ask question integrate topic discuss complex idea focus big picture create mental image help concept plug detail approach foster ability associate structure function think critically topic test day innate adaptive immunity order fight infection human body different division immune system innate adaptive immunity compare figure 8.1 innate immunity compose defense active infection lack ability target specific invader reason call nonspecific immunity adaptive specific immunity refer defense target specific pathogen is system slow act maintain immunological memory infection mount fast attack

system slow act maintain immunological memory infection mount fast attack subsequent infection mammalian immune system overarching division innate left act near entry point body ready fail contain pathogen adaptive division right kick mount later highly target attack specific innate immune system dendritic cell monocyte macrophage neutrophil release cytokine inflammatory protein adaptive immune system b cell plasma cell make antibody t cell attack infected cell innate immune system system include component antimicrobial molecule

phagocyte cell ingest destroy pathogen cell dendritic cell macrophage activate inflammatory response secrete protein call cytokine trigger influx immune cell blood recruit phagocyte notably monocyte mature macrophage adaptive immune system system feature b cell t cell activate b cell secrete antibody molecule bind antigen specific component unique give invader destroy invader directly mark attack t cell recognize antigen display cell t cell help activate b cell t cell show t cell directly attack infected cell t- b cell spawn memory cell promptly eliminate invader encounter figure 8.1 division immune system e immune system house single organ show figure 8.2 e structure component serve nonspecific defense oen serve function organ system e bone marrow produce leukocyte white blood cell participate immune system process hematopoiesis discuss chapter 7 mcat biology review e spleen location blood storage activation b- cell turn plasma cell produce antibody adaptive immunity note b cell leave bone marrow consider mature naïve expose antigen antibody dissolve act blood cell division adaptive immunity call humoral immunity t cell class adaptive immune cell mature thymus small gland pericardium sac protect heart t cell agent cell mediate immunity coordinate immune system directly kill virally infected cell finally lymph node major component lymphatic system provide place immune cell communicate mount attack b cell activate immune tissue find close proximity digestive system site potential invasion pathogen ese tissue commonly call gut associate

site potential invasion pathogen ese tissue commonly call gut associate lymphoid tissue galt include tonsil adenoid head peyer patch small intestine lymphoid aggregate appendix label adenoid tonsil lymph node thymus spleen peyer patch small intestine lymphatic vessel appendix bone figure 8.2 anatomy immune lymphatic system lay people involve medicine gland swollen feel sensation fullness throat biological standpoint lymph node gland secrete product bloodstream endocrine duct exocrine actually experience know medically lymphadenopathy swelling lymph node occur activation immune system organ immune system lymph node filter lymph site immune response mount bone marrow site immune cell

production thymus site t cell maturation spleen act storage area white blood cell platelet recycling center red blood cell filter blood lymph immune system leukocyte produce bone marrow hematopoiesis show figure 8.3 note is image show figure 7.7 copy convenience leukocyte divide group cell granulocyte agranulocyte ese name refer presence absence granule cytoplasm ese granule contain toxic enzyme chemical release exocytosis particularly effective bacterial fungal parasitic pathogen granulocyte agranulocyte come common precursor hematopoietic stem cell remember chapter 7 mcat biology review hematopoietic stem cell cell type give rise red blood cell platelet granulocyte include cell neutrophil eosinophil basophil e name cell actually refer way cell appear aer stain certain chemical agranulocyte include lymphocyte responsible antibody production immune system modulation target killing infected cell monocyte phagocytic cell bloodstream consider agranulocyte ey macrophage tissue tissue resident population macrophage specific name microglia central nervous system langerhans cell skin osteoclast bone hematopoietic stem cell form lymphoid myeloid stem cell lymphoid form nk t- b- plasma cell myeloid form dendritic cell monocyte macrophage neutrophil eosinophil mast cell basophil platelet erythrocyte figure 8.3 hematopoiesis test order physician know complete blood count cbc test count number red blood cell platelet white blood cell cbc order differential mean type white blood cell count cell

cbc order differential mean type white blood cell count cell population abnormal indicate particular type infection give right clinical condition example 90 percent white blood cell neutrophil possible bacterial infection present 20 percent white blood cell eosinophil possible invasive parasitic infection present innate immunity refer response cell carry learn reason know nonspecific immune response conversely adaptive immunity develop immune cell learn recognize respond particular antigen oen aptly refer specific immune response divide specific immune system humoral immunity drive b cell antibody cell- mediate immunity drive t cell mcat concept check 8.1 assess understanding material 1 difference innate adaptive immunity 2 compare contrast b- t cell humoral cell- 3 cell consider granulocyte consider



agranulocyte innate immune system chapter 8.2 able describe immunologic function  
noncellular nonspecific immune defense include defensin mucus identify immune cell type  
antigen presentation differentiate mhc mhc ii recall stimulus require activate natural killer cell  
neutrophil eosinophil basophil mast cell e innate immune system consist cell structure offer  
noncellular nonspecific defenses first line defense skin integument chapter 10 mcat biology  
review discuss specific homeostatic function skin focus skin protect body e skin provide  
physical barrier outside world internal organ prevent bacteria virus fungus parasite enter  
body additionally antibacterial enzyme call defensin find skin sweat antimicrobial property e  
skin important first line defense cut abrasion skin provide entry point pathogen body deep  
wound allow pathogen penetrate deeply body discuss chapter 6 mcat biology review  
respiratory system mechanism prevent pathogen enter body e respiratory passage mucous  
membrane line cilia trap particulate matter push oropharynx swallow expel mucus help trap  
particulate like smoke dirt help prevent bacteria virus gain access lung tissue mucous  
membrane include eye oral cavity produce nonspecific bacterial enzyme call lysozyme secrete  
tear saliva respectively gastrointestinal tract e gastrointestinal tract play role nonspecific  
immunity stomach secrete acid result elimination

tract play role nonspecific immunity stomach secrete acid result elimination pathogen  
addition gut colonize bacteria bacteria lack necessary characteristic cause infection large  
bacterial population gut potential invader able compete keep bay antibiotic reduce population  
gut flora provide opportunity growth pathogen resistant gi tract newborn baby particularly  
susceptible infection newborn immune system underdeveloped gi tract colonize breast milk  
contain family antibody particularly effective mucosal surface help defend newborn baby  
gastrointestinal infection

e complement system consist

number protein blood act nonspecific defense bacteria complement activate classical pathway  
require binding antibody pathogen alternative pathway require antibody e complement  
protein punch hole cell wall bacteria make osmotically unstable despite association antibody  
complement consider nonspecific defense modifie target specific organism protect virus cell  
infect virus produce interferon protein prevent viral replication dispersion interferon cause  
nearby cell decrease production viral cellular protein ey decrease permeability cell make  
hard virus infect addition interferon upregulate mhc class class ii molecule result increase  
antigen presentation well detection infected cell immune system describe section interferon  
responsible flu like symptom occur viral infection include malaise tiredness muscle soreness  
fever cell innate immune system happen bacteria virus fungus parasite breach noncellular  
defense e cell innate immune system poise ready attack macrophage type agranulocyte  
reside tissue ese cell derive blood bear monocyte resident population tissue permanent  
transient cell group tissue resident macrophage highlight mcat biology review include  
microglia central nervous system langerhans cell skin osteoclast bone bacterial invader enter  
tissue macrophage activated e activate macrophage thing phagocytize invader endocytosis  
en digest invader enzyme finally present little piece invader peptide cell protein call major  
histocompatibility complex mhc mhc bind pathogenic peptide call antigen carry cell surface  
recognize cell adaptive immune system addition macrophage release cytokine chemical  
substance stimulate inflammation recruit additional immune cell area mhc molecule come  
main class class class ii nucleated cell body display mhc class molecule protein produce cell  
load mhc present surface cell show figure 8.4 is allow immune system monitor health cell  
detect cell infect virus intracellular pathogen cell infect expect present unfamiliar nonself  
protein surface erefore mhc pathway oen call endogenous pathway bind antigen come  
inside cell cell invade intracellular pathogen kill certain group t cell cytotoxic t lymphocyte  
prevent infection cell virion break antigenic peptide load mhc rough er present cell

virion break antigenic peptide load mhc rough er present cell surface figure 8.4 endogenous

pathway antigen presentation mhc class mhc exist nucleate cell mhc molecule highly variable human usually divide particular subtype people certain mhc subtype different susceptibility disease individual certain subtype considerably susceptible autoimmune disease important match mhc type donor recipient closely possible transplant avoid rejection major histocompatibility complex molecule join antigen mhc antigen complex go cell surface display antigen allow immune system monitor health cell mhc nucleate cell present endogenous antigen mhc ii antigen present cell present exogenous antigen mhc class ii molecule mainly display professional antigen- present cell like macrophage show figure 8.5 remember phagocytic cell pick pathogen environment process present mhc ii antigen substance usually pathogenic protein target antibody antibody production domain adaptive immune system important understand cell innate immune system present antigen antigen originate outside cell mhc ii pathway oen call exogenous pathway e presentation antigen immune cell result activation innate adaptive immune system professional antigen present cell include macrophage dendritic cell skin b cell certain activate antigen pick break load mhc ii golgi bring cell surface recognition figure 8.5 exogenous pathway antigen presentation mhc class ii mhc ii exist professional antigen- present cell like macrophage dendritic cell b- cell activate epithelial cell major histocompatibility complex molecule join antigen mhc antigen complex go cell surface display antigen allow immune system monitor health cell mhc nucleated cell present endogenous antigen mhc ii antigen present cell present exogenous antigen innate immune cell nonspecific form line defense immune defender engulf consume pathogen cell release histamine chemical promote inflammation cell type tiny granule interior neutrophil eosinophil basophil participate inflammatory response present antigen fragment protein molecule pathogen cancer cell adaptive immune cell induce attack bearer display antigen natural killer cell cell destroy body cell infect pathogen go cancer cell macrophage

cell destroy body cell infect pathogen go cancer cell macrophage dendritic cell special receptor know pattern recognition receptor prr well describe toll- like receptor tlr prr able recognize

category invader bacterium virus fungus parasite is allow production appropriate cytokine recruit right type immune cell immune cell different weapon target particular group natural killer cells arm race human immune system pathogen pathogen find way avoid certain defense example virus cause downregulation mhc molecule make hard t- cell recognize presence infection natural killer nk cell type nonspecific lymphocyte able detect downregulation mhc induce apoptosis virally infect cell cancer cell downregulate mhc production nk cell offer protection growth cancer addition macrophage granulocyte include neutrophil eosinophil basophil closely related mast cell involve nonspecific defense neutrophil populous leukocyte blood short lived bit five day

ese cell phagocytic like macrophage target bacteria neutrophil follow bacteria chemotaxis movement organism accord chemical stimulus case neutrophil sense product give off bacteria move concentration gradient source neutrophil detect bacteria opsonize mark antibody b cell cell like natural killer cell macrophage monocyte eosinophil contain receptor antibody attack opsonized bacteria dead neutrophil collection responsible formation pus infection eosinophil contain bright red orange granule primarily involved allergic reaction invasive parasitic infection activation eosinophil release large amount histamine inflammatory mediator is result vasodilation increase leakiness blood vessel allow additional immune cell especially macrophage neutrophil bloodstream tissue inflammation particularly useful extracellular pathogen include bacteria fungus histamine cause inflammation induce vasodilation movement fluid cell bloodstream tissue finally basophil contain large purple granule involve allergic response ey populous leukocyte bloodstream normal condition mast cell closely related basophil small granule exist tissue mucosa epithelium basophil mast cell release large amount histamine response allergen lead inflammatory response mcat concept check 8.2 assess understanding material 1 noncellular nonspecific immune defense list provide brief description immunologic function normal gastrointestinal flora 2 cell professional antigen present cell 3 difference mhc mhc ii 4 stimulus activate following type cell natural killer cell

basophil mast cell adaptive immune system chapter 8.3 able recall major class lymphocyte function describe main effect circulate antibody describe effect positive negative selection t cell maturation explain secondary response pathogen efficient differentiate passive active immunity explain antibody specific give antigen e adaptive immune system identify specific invader mount attack pathogen e response variable depend identity pathogen e adaptive immune system divide division humoral immunity cell mediate cytotoxic immunity involve identification specific pathogen organization appropriate immune response cell adaptive immune system e adaptive immune system consist mainly type lymphocyte b cell t cell b cell govern humoral response t cell mount cell mediate response cell immune system create bone marrow

mount cell mediate response cell immune system create bone marrow b- t cell mature different location b cell mature bone marrow spleen b originally stand bursa fabricius organ find bird t- cell mature thymus expose pathogen day physical symptom relieve is occur adaptive immune response take time form specific defense b cell mature bone marrow t cell mature thymus humoral immunity involve production antibody long week fully effective aer initial infection ese antibody specific antigen invade microbe antibody produce b cell lymphocyte originate mature bone marrow activate spleen lymph node adaptive immune cell target invader great specificity respond slow replicate response antigen antigen stimulate cell divide produce antibody neutralize invader tag kill killer t cell destroy infected cell detect presence antigen t- cell helper regulatory type coordinate immune response antibody call immunoglobulin ig carry different job body antigen display surface cell float freely blood chyle lymphatic fluid air antibody present surface cell secrete body fluid antibody bind antigen response depend location antibody secrete body fluid main possibility first bind specific antigen antibody attract leukocyte phagocytize antigen immediately is call opsonization describe early second antibody cause pathogen clump agglutinate form large insoluble complex phagocytize ird antibody block ability pathogen invade tissue essentially neutralize

cell surface antibody binding antigen b cell cause activation cell result proliferation formation plasma memory cell describe later chapter contrast antigen bind antibody surface mast cell cause degranulation exocytosis granule content release histamine cause inflammatory allergic reaction antibody y shape molecule identical heavy chain identical light chain show figure 8.6 disulfide linkage noncovalent interaction hold heavy light chain antibody antigen bind region end call variable region domain tip y. region specific polypeptide sequence bind specific antigenic sequence reason take long initiate antibody response b cell undergo hypermutation antigen bind region try find good match antigen b cell bind

bind region try find good match antigen b cell bind antigen high affinity survive provide mechanism generate specificity call clonal selection e remain antibody molecule know constant region domain region cell natural killer cell macrophage monocyte eosinophil receptor initiate complement cascade b cell make type antibody b- cell immune system recognize antigen antibody come five different isotype igm igd igg ige iga specific purpose antibody isotype outside scope mcat know different type different time adaptive immune response different type pathogen different location body cell change isotype antibody produce stimulate specific cytokine process call isotype switching heavy chain constant join diversity variable region light chain constant joining variable region link figure 8.6 structure antibody molecule b cell generate actively constantly produce antibody antibody production energetically expensive process reason expend energy produce antibody need instead naïve b cell expose antigen wait lymph node particular antigen come exposure correct antigen b cell proliferate produce type daughter cell plasma cell produce large amount antibody memory b cell stay lymph node await reexposure antigen is initial activation take approximately seven day know primary response e plasma cell eventually die memory cell lifetime organism microbe encounter memory cell rapidly proliferate differentiate plasma cell produce antibody specific pathogen is immune response call secondary response rapid robust e development last memory cell basis efficacy vaccination humoral immunity base activity b cell cell mediate

immunity involve t cell t cell mature thymus undergo positive negative selection positive selection refer allow maturation cell respond presentation antigen mhc cell respond mhc undergo apoptosis able respond periphery negative selection refer cause apoptosis cell self reactive activate protein produce organism e maturation t cell facilitate thymosin peptide hormone secrete thymic cell t cell le thymus mature naïve exposure antigen t cell undergo clonal selection high affinity give antigen proliferate cd immunology stand cluster

selection high affinity give antigen proliferate cd immunology stand cluster differentiation include cell surface marker detect lab technique call flow cytometry marker indication type leukocyte investigation present state maturity ere major type t cell helper t cell suppressor t cell killer cytotoxic t cell helper t cell th call cd4 + t cell coordinate immune response secrete chemical know lymphokine ese molecule capable recruit immune cell plasma cell cytotoxic t cell macrophage increase activity e loss cell occur human immunodeficiency virus hiv infection prevent immune system mount adequate response infection advanced hiv infection call acquire immunodeficiency syndrome aids weak pathogen cause devastating consequence opportunistic infection cd4 + t cell respond antigen present mhc ii molecule mhc ii present exogenous antigen cd4 + t cell effective bacterial fungal parasitic infection cd4 + t cell well fight extracellular infection cd8 + t cell well target intracellular infection cytotoxic t cell tc ctl cytotoxic t lymphocyte call cd8 + t cell capable directly kill virally infect cell inject toxic chemical promote apoptosis infected cell cd8 + t cell respond antigen present mhc molecule mhc present endogenous antigen cd8 + t cell effective viral intracellular bacterial fungal infection  $cd \times mhc = 8$  cd4 + cell respond mhc ii  $4 \times 2 = 8$ ) cd8 + cell respond mhc  $8 \times 1 = 8$ ) suppressor regulatory t cell treg express cd4 differentiate helper t cell express protein call foxp3 ese cell help tone immune response infection adequately contain ese cell turn off self reactive lymphocyte prevent autoimmune disease term self tolerance finally memory t cell generate similar memory b cell cell lie wait exposure antigen activate carry robust rapid response suppressor t cell self reactive t cell turn suppressor t cell inactivate lymphocyte target

destruction promote conversion suppressor t cell summary different type lymphocyte

destruction promote conversion suppressor t cell summary different type lymphocyte  
adaptive specific immunity show figure 8.7 t lymphocyte cell mediate immunity memory  
cytotoxic suppressor helper b lymphocyte humoral immunity memory plasma igm igd igg ige  
iga figure 8.7 lymphocyte specific immunity diagram show differentiation lymphocyte  
precursor cell type involve specific immunity activation adaptive immune system important  
note innate adaptive immune system disparate entity function separately e proper  
functioning entire immune system depend interaction system ere five type infectious  
pathogen bacteria virus fungus parasite include protozoan worm insect prion immune  
defense immune system response depend specific identity pathogen present

classic example bacterial extracellular pathogen infection viral intracellular pathogen infection  
mind categorization imperfect example bacteria like mycobacterium tuberculosis listeria  
monocytogene actually intracellular pathogen bacterial extracellular pathogen infection  
macrophage like sentinel human body lookout potential invader let person suffer laceration  
bacteria introduce body laceration macrophage antigen present cell engulf bacteria  
subsequently release inflammatory mediator ese cell digest bacteria present antigen  
pathogen surface conjunction mhc ii e cytokine attract inflammatory cell include neutrophil  
additional macrophage mast cell activate inflammation degranulate result histamine release  
increase leakiness capillary is augment ability immune cell leave bloodstream travel affected  
tissue e dendritic cell leave affected tissue travel near lymph node present antigen b cell b  
cell produce correct antibody proliferate clonal selection create plasma cell memory cell  
antibody travel bloodstream affected tissue tag bacteria destruction time dendritic cell  
present antigen t cell activate t cell response particular cd4 + t cell activate ese cell come type  
call th1 th2 th1 cell release interferon gamma ifn  $\gamma$  activate macrophage increase ability kill  
bacteria th2 cell help activate b cell common aer pathogen eliminate plasma cell die memory



b- t cell remain ese memory cell allow fast secondary response exposure pathogen later time  
viral intracellular pathogen infection viral infection virally infect cell begin produce interferon  
reduce permeability nearby cell decrease ability virus infect cell reduce rate transcription  
translation cell decrease ability virus multiply cause systemic symptom malaise muscle aching  
fever ese infect cell present intracellular protein surface conjunction mhc virally infect cell  
intracellular protein viral protein cd8 + t cell recognize mhc antigen complex foreign inject  
toxin cell promote apoptosis way infection shut able spread nearby cell event virus  
downregulate production presentation mhc molecule natural killer cell recognize absence  
mhc accordingly cause apoptosis cell pathogen clear memory t cell generate allow fast  
response mount recognition self nonself self

cell generate allow fast response mount recognition self nonself self antigen protein  
carbohydrate present surface cell body normal circumstance self antigen signal immune cell  
cell foreign attack immune system fail distinction self foreign attack cell express particular self  
antigen condition know autoimmunity note autoimmunity potential problem immune  
functioning problem arise immune system misidentifie foreign antigen dangerous fact pet  
dander pollen peanut inherently threatening human life people immune system  
hypersensitive antigen overactivated antigen encounter is call allergic reaction allergy  
autoimmunity family immune reaction classifie hypersensitivity reaction autoimmune disease  
result destruction tissue cause deficiency type diabetes mellitus result autoimmune  
destruction  $\beta$  cell pancreas result inability produce insulin characterize high blood sugar  
excessive utilization fat protein energy example autoimmune disease include multiple  
sclerosis myasthenia gravis psoriasis systemic lupus erythematosus rheumatoid arthritis  
graves disease guillain barré syndrome e

human body strive prevent autoimmune reaction early t- cell b cell maturation process t cell  
educate thymus education involve elimination t cell respond self- antigen call negative

selection immature b cell respond self- antigen eliminate leave bone marrow process perfect  
occasionally cell respond self antigen allow survive autoimmune disease treat number therapy  
common example administration glucocorticoid modified version cortisol potent  
immunosuppressive oen disease significant long term consequence infection poliovirus  
example cause permanent paralysis polio widespread illness today hardly hear outbreak polio  
highly effective vaccination program lead elimination polio part world immunization achieve  
active passive fashion active immunity immune system stimulate produce antibody specific  
pathogen e mean expose pathogen natural artificial rough natural exposure antibody  
generate b cell individual infected artificial exposure vaccine result production antibody  
individual experience true infection instead individual receive injection intranasal spray  
contain antigen activate b cell produce antibody fight specific infection e antigen weaken kill  
form microbe microbe protein structure 1998 paper publish lancet claim find link vaccine  
autism paper withdraw lancet demonstrate primary author undisclosed conflict interest result  
scientifically inaccurate fact design scientific study show link exist reporting unsubstantiated  
connection lay medium influence parent guardian avoid immunize child 1998 outbreak  
measles mumps united states industrialize nation raise concern resurgence illness previously  
think eliminate country vaccine carry risk include rare case encephalitis brain inflammation  
guillain barré syndrome autoimmune disease myelin peripheral nerve attack pathogen  
vaccine protect immunization achieve passively passive immunity result transfer antibody  
individual e immunity transient antibody plasma cell produce give individual natural example  
transfer antibody placenta pregnancy protect fetus transfer antibody mother nurse infant  
breast milk case exposure rabies virus tetanus intravenous immunoglobulin give prevent  
pathogen spread biology guide example expert thinking development immune mediate liver  
failure viral hepatitis recently link action cd8 + t cell effector mechanism identify preclinical  
model include cytokine

+ t cell effector mechanism identify preclinical model include cytokine interferon ifn tumor

necrosis factor tnfr apoptosis induce molecule fas ligand fasl perforin-1 prf1 well study factor mouse model acute hepatitis develop immunize mice ova epitope short peptide sequence derive protein ovalbumin infect recombinant adenovirus express ova peptide 30 day later acute liver damage observe mark increase serum alanine aminotransferase salt marker liver damage decrease body topic cd8 + t cell hepatitis component immune system lead immune mediate liver failure new model study immune- mediate liver damage damage liver = elevate salt decrease body weight study contribution fasl tnfr liver pathology mouse inject anti fasl anti tnfr igg control antibody adenovirus challenge researcher measure salt level body weight day post challenge figure 1 well elucidate role perforin-1 ova specific t cell ot-1 cell wt perforin perforin-1 ko ot-1 x prf1-/- cell inject naive mouse prior exp 1 test fasl tnfr contribution antibody add prevent factor exert normal biological function exp 2 test role perforin-1 add t cell perforin- 1

measure salt body mass adenovirus challenge serum alt weight measurement take follow infection figure 2 figure 1 = antibody study iv antibody treatment dv salt level loss trend graph group overlapping error figure 2 = cell transfer study iv presence absence dvs previous trend mouse give perforin-1 knockout cell increase salt lose weight compare control adapt welz m. eickhoff s. abdullah z. trebicka j. gartlan k. h. spicer j. a. kastenmüller w. 2018 perforin inhibition protect lethal endothelial damage fulminant viral hepatitis nature communications 9(1 4805 base result parameter test fas ligand tumor necrosis factor perforin likely involve destruction liver tissue acute infection is question test understanding experimental design comprehension result let start experimental design paragraph 1 tell main factor believe involve immune mediate liver damage fasl tnfr perforin-1 inf test involvement factor researcher design new experimental model ey first inject mouse ova peptide induce primary immune response development memory cell irty day later researcher infect mice adenovirus express ova is result activation memory cell secondary immune response researcher show able induce immune control liver damage first experiment mouse inject antibody fasl tnfr prior

adenovirus infection and antibody bind fasl tnfr render unable function similar knock gene significantly cheap develop transgenic mouse figure 1 show result notice significant difference salt level body weight loss mouse treat control antibody mouse treat fasl tnfr antibody increase salt decrease weight loss indicate remove tnfr fasl function prevent liver damage is suggest factor require immune- mediate liver damage

second experiment test involvement perforin-1 the experimental setup slightly different instead inject ova peptide ova specific t cell inject mice different type cell normal perforin-1 knockout mouse infect adenovirus is enable examine contribution perforin-1 liver damage figure 2 show result experiment note significant difference salt level control perforin-1 knockout ko cell are elevation salt knockout cell increase control cell is suggest perforin-1 contribute liver damage furthermore mouse give perforin-1 ko cell lose weight compare mouse give control cell knockout perforin-1 gene lead decrease immune mediate liver damage mouse perforin-1 play important role immune mediate liver damage result significant difference control tnfr fasl antibody treat mouse tnfr fasl play role immune mediate liver damage statistically significant difference control perforin-1 knockout cell observe indicate role perforin-1 immune mediate liver damage mcq concept check 8.3 assess understanding material 1 lymphocyte list main function suppressor regulatory t cell 2 main effect circulating antibody pathogen 3 antibody specific give antigen 4 t cell appropriately pass positive selection inappropriately pass negative selection t cell reactive 5 cell account fact secondary response pathogen rapid robust primary response 6 difference active passive immunity lymphatic system chapter 8.4 able predict blockage flow lymph node impact lymphatic system body describe factor structure link lymphatic cardiovascular and immune system lymphatic system intimately related b cell proliferate develop lymphatic system especially lymph node is system serve function body and lymphatic system cardiovascular system type circulatory system way vessel large center body and vessel carry lymphatic fluid lymph join form large thoracic duct posterior chest deliver fluid to subclavian vein near heart certain cancer

especially breast cancer prone spread lymphatic channel mastectomy surgery remove breast treatment breast cancer order ensure cancer remove local lymph node remove time lymph node small bean shaped structure lymphatic vessel lymph node contain lymphatic channel artery vein

structure lymphatic vessel lymph node contain lymphatic channel artery vein e lymph node provide space cell immune system expose possible pathogen e lymphatic system serve different purpose body provide secondary system circulation equalization fluid distribution capillary fluid leave bloodstream go tissue e quantity fluid leave tissue arterial end capillary bed depend hydrostatic oncotic pressure starle force remember oncotic pressure blood draw water vessel venule end hydrostatic pressure decrease net pressure draw fluid venule end slightly net pressure push fluid arterial end small fluid remain tissue lymphatic vessel drain tissue subsequently return fluid

bloodstream e lymphatic offer protection pathology example blood

low concentration albumin key plasma protein oncotic pressure blood decrease water drive bloodstream venule end us fluid collect tissue provide lymphatic channel block fluid eventually return bloodstream lymphatic lymphatic overwhelm edema occur swelling fluid collect tissue transportation biomolecule e lymphatic system transport fat digestive system bloodstream lacteal small lymphatic vessel locate center villus small intestine fat package chylomicron intestinal mucosal cell enter lacteal transport lymphatic fluid carry chylomicron take milky white appearance call state previously chapter lymph node place antigen- present cell lymphocyte interact b cell proliferate mature lymph node collection call germinal center mcat concept check 8.4 assess understanding material 1 filariasis infection member certain group parasite notably wuchereria bancrofti parasite reside lymph node cause blockage flow individual w. bancrofti infection lymph node thigh likely happen 2 structure primarily

responsible return material lymphatic circulation cardiovascular system e ability fend off microbial invasion critical survival e immune system body involve multiple different organ cell type nonspecific mechanism intact skin mucous membrane defensin lysozyme complement interferon natural killer cell neutrophil eosinophil basophil monocyte macrophage constitute complex first line defense mechanism comprise innate immune system capable immediate response target specific pathogen maintain immunologic memory e adaptive immune system comprise b- t cell lymphocyte allow immune system target specific pathogen learn past exposure us infect certain strain virus activation specific immunity confer long term protection particular virus advantage secondary response immunization problem specificity self antigen label foreign lead autoimmune disease immune system focus destroy pathogen include bacteria interesting transition chapter go sterilization system bacterial colonization norm oral flora normal gut bacteria ability digest absorb nutrient intimately link symbiotic bacteria digestive tract chapter explore anatomy physiology digestive system provide raw material generate energy build protein carry activity daily living review content test knowledge critical thinking skill complete test like passage set online structure immune

thinking skill complete test like passage set online structure immune system e immune system divide innate adaptive immunity innate immunity compose defense active target specific invader maintain immunologic memory call nonspecific immunity adaptive immunity compose defense time activate target specific invader maintain immunologic memory call specific immunity e immune system disperse body immune cell come bone marrow e spleen lymph node site immune response mount b cell activate e thymus site t cell maturation gut associate lymphoid tissue galt include tonsil leukocytes white blood cell involve immune defense innate immune system nonspecific defense noncellular e skin act physical barrier secrete antimicrobial compound like defensin mucus mucous membrane trap pathogen respiratory system mucus propel upward cilia swallow tear saliva contain lysozyme

antibacterial compound e stomach produce acid kill pathogen colonization gut help prevent overgrowth pathogenic bacteria e complement system punch hole cell wall bacteria make osmotically unstable interferon give off virally infect cell help prevent viral replication dispersion nearby cell nonspecific defense cellular macrophage ingest pathogen present major histocompatibility complex mhc molecule ey secrete mhc class mhc present nucleate cell display endogenous antigen protein cell cytotoxic t- cell cd8 + cell mhc class ii mhc ii present professional antigen present cell macrophage dendritic cell b cell certain activate epithelial cell display exogenous antigen protein outside cell helper t cell cd4 + cell dendritic cell antigen present cell skin natural killer cell attack cell present mhc molecule include virally infect cell cancer cell granulocyte include neutrophil eosinophil basophil neutrophil ingest bacteria particularly opsonize bacteria mark antibody ey follow bacteria chemotaxis eosinophil allergic reaction invasive parasitic infection ey release histamine cause inflammatory basophil allergic reaction mast cell related cell find skin adaptive immune system humoral immunity center antibody production plasma cell activate b cell antibody target particular antigen ey contain heavy chain light

cell antibody target particular antigen ey contain heavy chain light chain ey constant region variable region tip variable region antigen bind activate antigen bind region undergo hypermutation improve specificity antibody produce cell give signal switch isotype antibody igm igd igg ige iga circulate antibody opsonize pathogen mark destruction cause agglutination clumping insoluble complex ingest phagocyte neutralize pathogen cell surface antibody activate immune cell mediate allergic memory b cell lie wait second exposure pathogen mount rapid vigorous immune response cell mediated cytotoxic immunity center function t cell undergo maturation

thymus positive selection select t cell react antigen present mhc negative selection cause apoptosis self reactive t- cell e peptide hormone thymosin promote t cell development helper

t cell th cd4 + respond antigen mhc ii coordinate rest immune system secrete lymphokine activate arm immune defense th1 cell secrete interferon gamma activate macrophage th2 cell activate b cell primarily parasitic infection cytotoxic t cell tc ctl cd8 + respond antigen mhc kill virally infect cell suppressor regulatory t cell treg tone immune response aer infection promote self tolerance memory t cell serve similar function memory b cell autoimmune condition self antigen identifie foreign immune system attack body cell allergic reaction nonthreatening exposure incite inflammatory immunization method induce active immunity activation b cell produce antibody antigen prior exposure passive immunity transfer antibody individual lymphatic system e lymphatic system circulatory system consist way vessel intermittent lymph node e lymphatic system connect cardiovascular system thoracic duct posterior chest e lymphatic system equalize fluid distribution transport fat fat soluble compound chylomicron provide site mount immune response answer concept check 1 innate immunity consist defense active pathogen capable target specific invader take long mount response adaptive immunity response target specific pathogen maintain immunologic memory infection mount fast response subsequent infection bone marrow activate spleen lymph directly kill 3 granulocyte include neutrophil eosinophil basophil agranulocyte include b- t cell lymphocyte monocyte 1 skin provide physical barrier secrete antimicrobial enzyme defensin example antibacterial enzyme skin lysozyme antimicrobial present tear saliva mucus present mucous membrane trap incoming pathogen respiratory system cilium propel mucus upward swallow expel stomach acid antimicrobial substance digestive system e normal gastrointestinal flora provide competition make hard pathogenic bacteria grow gut complement set protein blood create hole bacteria 2 professional antigen present cell include macrophage dendritic cell skin b cell certain activate epithelial cell 3

dendritic cell skin b cell certain activate epithelial cell 3 mhc find nucleated cell present piece protein peptide create cell endogenous antigen allow detection cell infect intracellular pathogen especially virus mhc ii find antigen present cell present protein result digestion



extracellular pathogen bring endocytosis exogenous antigen 4 natural killer cell activate cell present mhc virally infect cell cancer cell neutrophil activate bacteria especially opsonize tag antibody surface eosinophil activate invasive parasite allergen basophil mast cell activate 1 plasma cell form b cell expose antigen produce antibody memory b cell form b cell expose antigen lie wait second exposure give antigen mount rapid robust response helper t cell coordinate immune system lymphokine respond antigen bind mhc ii cytotoxic t cell directly kill virally infected cell respond antigen bind mhc i. suppressor regulatory t cell quell immune response aer pathogen clear promote self- tolerance memory t cell like memory b cell lie wait second exposure pathogen mount rapid robust response 2 circulate antibody mark pathogen destruction phagocytic cell opsonization cause agglutination pathogen insoluble complex take phagocytic cell neutralize pathogen prevent invade tissue 3 b cell originally mature bone marrow specificity point antibody respond give antigen undergo hypermutation rapid mutation antigen bind site b cell high affinity antigen survive proliferate increase specificity antigen 4 positive selection occur t cell thymus able respond antigen present mhc allow survive respond undergo apoptosis negative selection occur t cell respond self antigen undergo apoptosis leave thymus t cell appropriately pass positive selection inappropriately pass negative selection reactive self antigen 5 memory cell allow immune system carry rapid robust secondary response 6 active immunity refer stimulation immune system produce antibody pathogen passive immunity refer transfer antibody prevent infection stimulation plasma cell produce antibody 1 fluid unable return lower leg edema result is infection lead elephantiasis severe swelling limb

leg edema result is infection lead elephantiasis severe swelling limb thickening skin 2 e thoracic duct carry lymphatic fluid le subclavian vein science mastery assessment explanations t lymphocyte mature thymus specific defense intracellular pathogen bacteria fungus parasite live intracellularly virus definition replicate cell e absence t cell leave individual unable fight viral infection specific defense e lymphocyte involve cell mediate

immunity t lymphocyte t cell are type t cell play different role cell mediate immunity cytotoxic t- cell helper t cell memory t cell suppressor t cell us answer choice cell involve cell mediate immunity plasma cell differentiated immunoglobulin secrete b lymphocyte involve humoral immunity b e main function lymphatic system collect excess interstitial fluid return circulatory system maintain balance body fluid answer choice addition lymphatic system accept chylomicron small intestine deliver cardiovascular circulation transport hormone function cardiovascular system eliminate e lymphatic system absorb fluid push tissue cause extravasation fluid eliminate c mast cell reside activate skin mucous membrane eliminate d antibody produce plasma cell derive b lymphocyte e cell type t lymphocyte memory b cell exist secondary antigen exposure memory b cell rapidly proliferate differentiate plasma cell produce antibody memory b cell directly produce antibody question true statement eliminate e innate immune system include phagocyte like macrophage activate inflammatory response recruit additional immune cell eliminate e innate immune system act near entry point body active eliminate b furthermore blood cell include cell immune system derive hematopoietic stem cell bone marrow eliminate d contrast innate immune system recognize specific antigen pathogen make c correct adaptive immunity involve activation b cell t cell specific encounter antigen choice conform paradigm correct c indicate b cell activate pattern recognition receptor prrs recognize pattern common certain pathogen identify specific pathogen complement example blood bear nonspecific defense bacteria eliminate b dendritic cell travel lymph node

nonspecific defense bacteria eliminate b dendritic cell travel lymph node d interaction innate adaptive immune system dendritic cell nonspecific active immunity refer production antibody immune response active immunity confer individual vaccination individual inject weakened inactive modified form particular antigen stimulate immune system produce antibody active immunity require week build passive immunity hand involve transfer antibody example breast milk example passive immunity pregnancy maternal antibody cross placenta enter fetal

circulation confer passive immunity fetus passive immunity acquire immediately short live last long antibody circulate blood t cell mature thymus educate is education involve elimination t cell improper bind mhc antigen complex positive selection self reactive t cell negative selection us self reactive t cell eliminate healthy cell exhibit mhc class molecule natural killer cell monitor expression mhc molecule surface cell viral infection cancer oen cause reduction expression mhc class molecule cell surface natural killer cell detect lack mhc induce apoptosis affected cell cd8 + t cell largely responsible cytotoxic immune response release toxic chemical virally infect cell cd8 + t cell able kill cell effort contain viral infection isotype switching refer change isotype antibody produce cause cd8 + cell eliminate b antigen present macrophage dendritic cell certain epithelial cell b cell eliminate c b cell activate cytotoxic t lymphocyte eliminate d lymphocyte arise lymphoid lineage include b cell t cell us type b- t cell capable cause lymphoma macrophage lymphocyte likely cause lymphoma adaptive immune system encounter antigen cell antibody t- cell receptor specific antigen activate is know clonal selection t- cell response cytotoxic response activation helper t cell plus explain specificity response eliminate b e phagocyte attack bacteria list neutrophil dendritic cell dendritic cell able sample present type material reside skin neutrophil hand present bloodstream attack bacteria present tissue eosinophil basophil involve development allergy eosinophil defend parasite e spleen location

basophil involve development allergy eosinophil defend parasite e spleen location b cell mature proliferate erefore removal spleen likely result reduction humoral immunity fact people receive vaccination prior removal spleen order bolster immunity e body employ number nonspecific defense mechanism foreign invasion e skin mucous membrane provide physical barrier bacterial invasion addition sweat contain enzyme attack bacterial cell wall certain passage respiratory tract line ciliate mucus coat epithelium filter trap foreign particle macrophage engulf destroy foreign particle e inflammatory response initiate response physical damage e choice nonspecific defense mechanism d correct answer cytotoxic t cell

involve specific cell mediate immunity consult online resource additional practice biochemistry chapter 3 nonenzymatic protein function protein analysis biology chapter 1 biology chapter 6 e respiratory system biology chapter 7 e cardiovascular system biology chapter 9 e digestive system biology chapter 10 pre med know feeling content know mcat know first important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal is quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 following association correctly match gastric cell compound b.

chief cell pepsinogen c. parietal cell alkaline mucus d. mucous cell intrinsic factor 2 follow small intestine 3 experiment enteropeptidase secretion block direct result level following active enzyme likely affect d. carboxypeptidase a. 4 following incorrectly pair digestive enzyme function a. trypsin hydrolyze specific peptide bond b. lactase hydrolyze lactose glucose galactose c. pancreatic amylase hydrolyze starch maltose d. lipase emulsify fat 5 follow correctly list organ protein digest a. mouth stomach b. stomach large intestine c. stomach small intestine d. small intestine large intestine 6 follow choice incorrectly pair digestive enzyme site a. sucrase salivary gland 7 week old infant bring emergency room infant caregiver report infant unable milk shortly nurse infant sudden projectile vomiting exam olive shaped mass feel infant upper abdomen determine constriction digestive system prevent food reach

small intestine stomach structure likely site problem a. cardiac sphincter b. pyloric sphincter c. ileocecal valve d. internal anal sphincter 8 medication anticholinergic effect block activity parasympathetic neuron body individual old medication simultaneously exacerbate effect following expect individual take medication a. dry mouth c. slow gastric emptying d. decrease gastric acid production 9 graph relative activity enzyme solution vary ph. following choice correctly identify enzyme a. 1 chymotrypsin 2 pepsin b. 1 pepsin 2 carboxypeptidase b c. 1 lactase 2 aminopeptidase d. 1 enteropeptidase 2 amylase 10 following likely lead elevated level bilirubin a. cholangiocarcinoma cancer bile duct ultimately lead occlusion duct lumen b. autoimmune hemolytic anemia disease red blood cell attack antibody lyse c. ménétrier disease ruga thicken overlying gland lose secretory d. acetaminophen tylenol overdose accumulation toxic metabolite cause rapid liver failure 11 follow correctly pair molecule primary site absorption b. amino acid large intestine c. vitamin e stomach d. cholesterol ascend colon 12

cleavage fat glycerol fatty acid catalyze lipase lumen duodenum well describe a. mechanical digestion b. chemical digestion c. intracellular digestion 13 following biomolecule drain liver arrive right heart a. cholecalciferol vitamin d b. threonine amino acid c. fructose monosaccharide d. pantothenic acid vitamin b5 14 following hormone increase feeding behavior 15 following likely see patient liver failure a. high concentration urea blood b. high concentration albumin blood c. low concentration ammonia blood d.

low concentration clotting factor blood digestive system chapter anatomy digestive system ingestion digestion accessory organs digestion absorption defecation jejunum ileum pie chart indicate content chapter relevant percent question biology content chapter relevant 4 question biology mcat chapter cover material following aamc content category 3b structure integrative function main organ system continue survey organ system come digestive system previous review organ system start basic anatomical overview organ digestion include

accessory organ discuss organ function provide nutrition individual e food eat complex incorporate meat grain vegetable fruit dairy product nut e job digestive system complex food compose polysaccharide fat protein turn large macromolecule small simple monosaccharide fatty acid amino acid order cleave bond body require complex system mechanical chemical agent ese compound absorb gut transport tissue circulatory system cell chapter consider organ digestive system process food eat fuel need energy growth development maintenance essential activity anatomy digestive system chapter 9.1 able describe mechanical chemical digestion differentiate identify interaction sympathetic parasympathetic nervous system digestive system trace path food body name major organ valve ere type digestion occur intracellular digestion metabolism involve oxidation glucose fatty acid energy diet consist pure glucose fatty acid substance extract food e process nutrient obtain food occur lumen alimentary canal know extracellular digestion is technically outside body lumen gastrointestinal tract communicate directly outside world e alimentary canal run mouth anus section off sphincter circular smooth muscle canal contract allow compartmentalization function e human digestive tract specialized section different functional role e basic functional distinction digestion absorption digestion involve breakdown food constituent organic molecule starch carbohydrate monosaccharide lipid fat free fatty acid glycerol protein amino acid digestion subdivide mechanical chemical process mechanical digestion physical breakdown large food particle small food particle involve break chemical bond chemical digestion enzymatic cleavage chemical bond peptide bond protein glycosidic bond starch absorption involve transport

bond peptide bond protein glycosidic bond starch absorption involve transport product digestion digestive tract circulatory system distribution body tissue cell e digestive tract show figure 9.1 begin oral cavity mouth follow pharynx share pathway food enter digestive system air enter respiratory system pharynx food enter esophagus transport stomach stomach food travel small intestine large intestine finally waste product digestion enter rectum feces store

appropriate time release addition digestive tract salivary gland pancreas liver gallbladder help provide enzyme lubrication necessary aid digestion food label mouth salivary gland pharynx esophagus stomach small intestine liver gallbladder pancreas ascending transverse descend sigmoid colon appendix rectum anus figure 9.1 anatomy digestive system e enteric nervous system collection million neuron govern function gastrointestinal system

ese neuron present wall digestive tract trigger peristalsis rhythmic contraction gut tube order material system is system function independently brain spinal cord heavily regulate autonomic nervous system e parasympathetic division involve stimulation digestive activity increase secretion exocrine gland promote peristalsis e sympathetic division involve inhibition activity e fact oen feel sleepy lethargic aer eat big meal oen call food coma colloquially parasympathetic activity hand period high sympathetic activity bloodflow decrease digestive tract gut motility slow significantly gland body sweat gland innervate parasympathetic biology guide example expert think bile acid crucial intestinal absorption dietary fatty acid cholesterol fat soluble vitamin determine interruption enterohepatic circulation bile acid alter triglyceride glucose metabolism researcher test ileal background purpose determine remove bile acid change sodium dependent bile acid transporter slc10a2 ko mouse 95 intestinal bile acid absorb return liver knock slc10a2 dramatically reduce total pool bile acid body approx 80 reduction addition mouse feed sucrose rich sr diet simulate metabolic stress unhealthy diet new abbreviation ko sentence say knock know stand knock detail iv normal vs reduce bile acid regular vs figure 1 expression sterol regulatory element-bind protein 1 srebp1 protein immunoblot srebp1c crucial optimal activation gene fatty acid wt wild type ko sr diet iv srebp1 wt ko dv expression precursor trend wt mice sr increase level protein noticeable change ko mice sr test new protein involve fatty acid synthesis gluconeogenesis metabolic figure 2 hepatic mrna glucokinase gk liver pyruvate kinase ivs gk lpk wt ko diet sr dv relative mrna expression trend lpk significantly low ko mouse diet significantly high ko mouse diet adapt

lundåsen t andersson e m snaith m lindmark h lundberg j östlund lindqvist m et al 2012  
inhibition intestinal bile acid transporter slc10a2 improve triglyceride metabolism normalize  
elevated plasma glucose reduce total pool bile acid good strategy combat  
hypertriglyceridemia diabetes induce unhealthy diet is question ask action reduce total pool  
bile acid specified impact condition hypertriglyceridemia diabetes answer question assess  
datum give article change bile acid quantity affect trait outcome associate start make sure  
comfortable term question rely article critical thinking skill fill knowledge gap  
hypertriglyceridemia condition blood triglyceride level high diabetes condition blood glucose  
level high information

give passage entirely scope test day figure need know answer question know know mouse  
feed food simulate unhealthy diet supply sugar recognize diabetes metabolic disorder link  
sugar metabolism recognize triglyceride fat probably condition involve fat metabolism us  
assume action lower blood triglyceride relate hypertriglyceridemia blood glucose relate  
diabetes constitute potentially beneficial therapy condition look datum experimental mouse  
compare control look change relate metabolic pathway determine possible treatment  
implication reduce bile salt concentration order treat accord passage knockout mouse bile  
acid transporter mean pool available bile acid system significantly low ere second variable  
diet simulate mouse experience metabolic stressor sucrose rich condition compare normal  
metabolic function figure 1 show concentration protein involve fatty acid synthesis ko mouse  
versus wild- type mouse normal sucrose rich diet wild type mouse addition metabolically  
stressful high- sugar diet lane 3 lead big increase production protein compare regular diet  
lane 1 knockout mouse perceivable change regular diet lane 2 sucrose rich diet lane 4 is true  
actual protein precursor mean ko mouse transcribe metabolic protein e lamin lane like  
control protein expression look pretty board ignore datum analysis base figure metabolic  
protein fatty acid synthesis chain look like knockout mouse experience metabolic stress try



turn extra sucrose fatty acid base piece datum look like reduce bile acid way relieve metabolic stress associate hypertriglyceridemia worth investigation move figure 2 show condition measure mrna production different protein glucokinase pyruvate kinase exactly sure enzyme glucose pyruvate name sound like probably involve sugar metabolism pathway look figure first pair column wild type mouse express mrna protein ko mice aer metabolic stress add look like pyruvate kinase production specifically spike ko mouse at indicate mouse respond metabolic stress great extent term lpk wild type mouse directly measure level blood glucose determine increase metabolic response represent positive negative trend unlike datum figure

increase metabolic response represent positive negative trend unlike datum figure 1 look like bile salt reduction good treatment option diabetic individual need reevaluate truly helpful triglyceridemia energetic processing fat consider fully separate processing sugar overall takeaway mix result figure 1 reduction bile salt look like promising treatment triglyceridemia figure 2 indicate reduce bile salt effective treat diabete conclude data need assess therapy effect sugar lipid mcat concept check 9.1 assess understanding material 1 difference mechanical chemical digestion 2 trace path food body start ingestion end excretion fece 3 effect parasympathetic nervous system digestive system effect sympathetic nervous system parasympathetic nervous system sympathetic nervous system ingestion digestion chapter 9.2 able identify secretory cell digestive tract secretion function secretion explain bile pancreatic lipase work digest fat recall key digestive enzyme hormone produce saliva stomach intestine summarize function supply body nutrient ingest eat food hormone involve feeding behavior include antidiuretic hormone adh vasopressin aldosterone glucagon ghrelin leptin cholecystokinin adh aldosterone trigger sensation thirst encourage behavior fluid consumption glucagon secrete pancrea ghrelin secrete stomach pancreas stimulate feeling hunger leptin cholecystokinin opposite stimulate feeling satiety digestion begin oral cavity continue stomach first small intestine know duodenum e oral cavity play role mechanical chemical digestion food mechanical digestion mouth involve breaking large food particle

small particle tooth tongue lip is process call mastication chewing chewing help increase surface area volume ratio food create surface area enzymatic digestion pass gut tube moderate size food particle enter lumen alimentary canal food particle large create obstruction risk tract chemical digestion carbohydrate occur mouth small intestine amylase target complementary starch salivary amylase active mouth high specificity rapidly soluble starch pancreatic amylase active small intestine high specificity soluble nonpolar starch chemical digestion breakdown chemical bond macromolecule food

is rely enzyme saliva produce pair salivary gland saliva aid mechanical digestion moisten lubricate food e salivary gland like gland digestive tract innervate parasympathetic nervous system e presence food oral cavity trigger neural circuit ultimately lead increase parasympathetic stimulation gland salivation trigger signal food near smell sight saliva contain salivary amylase know ptyalin lipase salivary amylase capable hydrolyze starch small sugar maltose dextrin lipase catalyze hydrolysis lipid e chemical digestion occur mouth minimal food stay mouth long muscular tongue form food bolus force pharynx pair major salivary gland parotid submandibular sublingual gland microscopic salivary gland scatter upper digestive system parasympathetic nervous system responsible promote salivation sympathetic nervous system input gland sympathetic nervous system increase viscosity saliva dry mouth tacky sensation mouth occur fight flight response e pharynx cavity lead mouth posterior nasal cavity esophagus e pharynx connect esophagus larynx respiratory tract e pharynx divide part nasopharynx nasal cavity oropharynx mouth laryngopharynx vocal cord food prevent enter larynx swallowing epiglottis cartilaginous structure fold cover laryngeal inlet failure mechanism lead aspiration food choking e esophagus muscular tube connect pharynx stomach e esophagus compose skeletal muscle compose smooth muscle

middle mix mean term nervous control esophagus somatic voluntary motor control rest gastrointestinal tract matter autonomic involuntary nervous control e rhythmic contraction

smooth muscle propel food stomach call peristalsis normal circumstance peristalsis proceed digestive tract certain factor exposure chemical infectious agent physical stimulation posterior pharynx cognitive stimulation lead reversal peristalsis process emesis vomiting swallowing initiate muscle oropharynx constitute upper esophageal sphincter peristalsis squeeze push propel bolus stomach bolus approach stomach muscular ring know lower esophageal sphincter cardiac sphincter relax open allow passage food weakness lower esophageal sphincter key feature gastroesophageal reflux disease gerd cause classic heartburn symptom eat food acid reflux lower esophagus irritate protect mucosa stimulate pain receptor receptor localize pain poorly general burning sensation feel lower chest lead common term heartburn ere main energy source carbohydrate fat protein mention early chemical digestion carbohydrate fat initiate mouth mechanical chemical digestion take place esophagus continued enzymatic activity initiate mouth salivary enzyme us digestion occur prior entrance bolus stomach minimal compare digestion occur stomach small intestine e stomach highly muscular organ capacity approximately liter human stomach locate upper le quadrant abdominal cavity underneath diaphragm is organ use hydrochloric acid enzyme digest food create fairly harsh environment erefore mucosa thick prevent autodigestion e stomach divide main anatomical division show figure 9.2 fundus body contain gastric gland antrum pylorus contain pyloric gland e internal curvature stomach call less curvature external curvature call great curvature e lining stomach throw fold call ruga label esophagus fundus body pylorus antrum pyloric sphincter duodenum less great curvature angular notch figure 9.2 anatomy stomach nonsteroidal

anti inflammatory drug nsoids ibuprofen naproxen aspirin common drug drug effect effect disruption mucus production stomach leave mucosa stomach unprotected irritation result irritation form gastritis inflammation mucosa stomach gastric ulcer deep wound lining e mucosa stomach contain gastric gland pyloric gland e gastric gland respond signal vagus nerve parasympathetic nervous system activate brain response sight taste smell food gastric

gland different cell type mucous cell chief cell parietal cell mucous cell produce bicarbonate rich mucus protect muscular wall harshly acidic  $\text{pH} = 2$  proteolytic environment stomach stomach secrete product 1 hcl kill microbe denature protein convert pepsinogen pepsin 2 pepsinogen cleave stomach pepsin enzyme partially digest 3 mucus protect mucosa 4 bicarbonate protect mucosa 5 water dissolve dilute ingest material 6 intrinsic factor require normal absorption vitamin b12 gastric juice combination secretion cell type gastric gland chief cell parietal cell e chief cell secrete pepsinogen is inactive zymogen form pepsin proteolytic enzyme hydrogen ion stomach secrete parietal cell hydrochloric acid cleave pepsinogen pepsin pepsin digest protein cleave peptide bond near aromatic amino acid result short peptide fragment pepsin activate acidic environment follow pepsin active low  $\text{pH}$ . is unique characteristic human enzyme human enzyme active physiological  $\text{pH}$ . stomach acid kill harmful bacteria exception helicobacter pylori infection usually asymptomatic cause inflammation ulcer certain gastric cancer e acidic environment help denature protein break intramolecular bond hold food addition hcl parietal cell secrete intrinsic factor glycoprotein involve proper absorption vitamin b12 e pyloric gland contain g cell secrete gastrin peptide hormone gastrin induce parietal cell stomach secrete hcl signal stomach contract mix content e digestion solid food stomach result acidic semifluid mixture know chyme e combined mechanical chemical digestive activity stomach result significant increase surface area unrecognizable food particle chyme reach small intestine absorption nutrient maximize

ere substance absorb directly stomach alcohol aspirin stomach mainly organ digestion zollinger ellison syndrome rare disease result gastrin secrete tumor gastrinoma typically tumor find pancreas excess gastrin lead excessive hcl production parietal cell surprisingly common sign zollinger ellison syndrome presence intractable ulcer disease e small intestine consist segment duodenum jejunum ileum e small intestine long seven meter e duodenum responsible majority chemical digestion minor involvement absorption absorption small intestine take place jejunum ileum food leave stomach pyloric sphincter enter duodenum e

presence chyme duodenum cause release brush border enzyme like disaccharidase maltase isomaltase lactase sucrase peptidase include dipeptidase brush border enzyme present luminal surface cell line duodenum break dimer trimer biomolecule absorbable monomer e duodenum secrete enteropeptidase involve activation digestive enzyme accessory organ digestion finally secrete hormone like secretin cholecystokinin cck e disaccharidase digest disaccharide maltase digest maltose isomaltase digest isomaltose lactase digest lactose sucrase digest sucrose lack particular disaccharidase cause inability break correspond disaccharide en bacteria intestine able hydrolyze disaccharide produce methane gas byproduct addition undigested disaccharide osmotic effect pull water stool cause diarrhea is people lactose intolerant symptom bloating flatulence

possibly diarrhea aer ingest dairy product peptidase break protein peptide imply aminopeptidase peptidase secrete gland duodenum remove n terminal amino acid peptide dipeptidase cleave peptide bond dipeptide release free amino acid unlike carbohydrate break monosaccharide absorption protein break di- tripeptide absorb small intestine wall celiac disease result immune reaction gluten protein find grain especially wheat condition immune system develop antibody certain component gluten antibody cross react element small intestine cause damage mucosa result diarrhea discomfort condition result malabsorptive syndrome include inability absorb fat fat soluble vitamin contrary popular belief celiac disease gluten sensitivity immune condition true allergy enteropeptidase call enterokinase enzyme critical activation trypsinogen pancreatic protease trypsin trypsin initiate activation cascade describe later chapter enteropeptidase activate procarboxypeptidases b secretin peptide hormone cause pancreatic enzyme release duodenum regulate ph digestive tract reduce hcl secretion parietal cell increase bicarbonate secretion pancreas secretin enterogastrone hormone slow motility digestive tract slowing motility allow increase time digestive enzyme act chyme especially fat finally cholecystokinin cck secrete response entry chyme specifically amino acid fat chyme duodenum is peptide hormone stimulate release bile pancreatic juice

act brain promote satiety bile complex fluid compose bile salt pigment cholesterol bile salt derive cholesterol by enzyme directly perform chemical digestion enzymatic cleavage chemical bond bile salt serve important role mechanical digestion fat ultimately facilitate chemical digestion lipid bile salt hydrophobic hydrophilic region allow serve bridge aqueous lipid environment fact bile salt like common soap detergent use wash hand clothes dish small intestine bile salt emulsify fat cholesterol micelle bile fat spontaneously separate aqueous mixture

duodenum accessible pancreatic lipase water soluble addition micelle increase surface area fat increase rate lipase act ultimately proper fat digestion depend bile lipase bile get fat solution increase surface area place micelle mechanical digestion and lipase come hydrolyze ester bond hold lipid chemical digestion cck promote secretion pancreatic juice duodenum show figure 9.3 pancreatic juice complex mixture enzyme bicarbonate rich alkaline solution is bicarbonate help neutralize acidic chyme provide ideal working environment digestive enzyme active pH 8.5 pancreatic juice contain enzyme digest type nutrient carbohydrate fat protein and identify function enzyme discuss section chapter cck stimulate duodenal fat amino acid parasympathetic innervation cause enzyme release pancreas secretin stimulate duodenal acid cause bicarbonate fluid release pancreas figure 9.3 hormonal control exocrine pancreas acidic environment stomach basic environment duodenum point important correlation

pH enzyme activity pepsin active stomach work well pH 2 pancreatic enzyme active duodenum work well pH 8.5 pH temperature salinity affect enzyme function highlight chapter 2 mcat biochemistry review mcat concept check 9.2 assess understanding material 1 main enzyme find saliva enzyme 2 cell type list major secretion cell function secretion 3 following substance determine digestive enzyme hormone briefly summarize function enzyme hormone 4 bile pancreatic lipase work digest fat accessory organs digestion chapter 9.3 able recall pancreatic enzyme molecule help digest describe significance function bile include production

component release list major function liver associate accessory organ digestion germ layer origin digestion complex process require release enzyme cell directly line alimentary canal pancreas liver gallbladder collectively organ originate outgrowth endoderm gut tube development call accessory organ digestion e pancreas serve different role body reflecte exocrine endocrine function discuss chapter 5 mcat biology review endocrine function pancreas include release insulin glucagon somatostatin peptide hormone necessary maintenance proper blood sugar level e hormonal function pancreas limit cell reside islet langerhans scatter organ e bulk pancreas exocrine cell call acinar cell produce pancreatic juice mention early pancreatic juice bicarbonate rich alkaline secretion contain digestive enzyme work class biomolecule pancreatic amylase break large polysaccharide small disaccharide responsible carbohydrate digestion e pancreatic peptidase trypsinogen chymotrypsinogen carboxypeptidase b release zymogen form activate responsible protein digestion enteropeptidase produce duodenum master switch convert trypsinogen trypsin activate zymogen activate procarboxypeptidase b. finally pancreas secrete pancreatic lipase capable break fat free fatty acid pancreatitis inflammation

pancreas usually cause gallstone excessive consumption alcohol regardless cause pancreatitis result premature activation pancreatic enzyme autodigestion pancreatic tissue painful condition result long hospital stay long term consequence diabetes reduce digestion protein fat pancreatic juice transfer duodenum duct system run middle pancreas show figure 9.4 like exocrine cell acinar cell secrete product duct ese duct duodenum major minor duodenal labeled head body tail lobule pancreatic accessory pancreatic duct gallbladder bile duct major minor duodenal papilla duodenum figure 9.4 anatomy pancreas function liver include processing synthesis nutrient glycogenesis glycogenolysis storage mobilization fat gluconeogenesis production urea detoxification chemical production bile synthesis albumin clotting factor e liver locate upper right quadrant abdomen contain unique structure communicate digestive system bile duct connect liver gallbladder small intestine bile produce

liver travel bile duct store gallbladder secrete duodenum & liver receive blood drain abdominal portion digestive tract hepatic portal vein is nutrient rich blood process liver drain inferior vena cava way right heart example liver take excess sugar create glycogen storage form glucose store fat triacylglycerol & liver reverse process produce glucose rest body glycogenolysis gluconeogenesis mobilize fat lipoprotein & liver detoxify endogenous compound body exogenous compound bring environment example liver convert ammonia toxic waste product amino acid metabolism urea excrete kidney & liver detoxify metabolize alcohol medication drug actually require activation enzyme liver addition drug take orally modification drug liver render inactive major component bile bile salt emulsify fat pigment especially bilirubin breakdown hemoglobin cholesterol bile production significant job liver vis à vis digestive system mention early bile compose bile salt pigment cholesterol bile salt amphipathic molecule emulsify fat digestive system & major pigment bile bilirubin byproduct breakdown hemoglobin bilirubin travel liver conjugate attach protein secrete bile excretion liver unable process excrete bilirubin liver damage excessive red blood cell destruction blockage bile duct jaundice yellowing skin

red blood cell destruction blockage bile duct jaundice yellowing skin occur addition bile production processing nutrient detoxification drug metabolism liver synthesize certain protein necessary proper body function these protein include albumin protein maintain plasma oncotic pressure serve carrier drug hormone clotting factor blood coagulation cirrhosis liver result different process include chronic alcohol consumption hepatitis c infection autoimmune hepatitis fatty liver disease outcome cirrhosis scarring liver scar tissue build create increase resistance portal vein result portal hypertension cause backup fluid portal system result swollen vein digestive system especially esophagus rupture cause life threaten bleeding manifest hematemesis vomiting blood cirrhosis cause bleeding disorder production clotting factor disrupt inability properly dispose ammonia result increase ammonia blood affect mentation finally cirrhosis cause hepatocellular carcinoma cancer hepatocyte stone formation



precipitation solid concentration reach  $K_{sp}$  compound particularly common gallbladder bile concentrate solubility  $K_{sp}$  discuss chapter 9 mcat general e gallbladder locate beneath liver store concentrate bile release cck gallbladder contract push bile biliary tree e bile duct system merge pancreatic duct show figure 9.4 early empty e gallbladder common site cholesterol bilirubin stone formation is painful condition cause inflammation gallbladder e stone travel bile duct stick biliary tree case stone catch enter duodenum result blockage biliary tree pancreatic duct cause e function digestive enzyme bile summarize hydrolyze starch maltose dextrin hydrolyze starch maltose dextrin hydrolyze maltose glucose molecule glucose hydrolyze sucrose glucose fructose hydrolyze lactose glucose galactose peptide bond activate peptide bond convert peptide bond activate peptide bond carboxy end activate peptide bond amino hydrolyze pair converts trypsinogen b note bile enzyme involve mechanical digestion fat table 9.1 digestive enzymes summary digestion major class biomolecule provide figure 9.5 triacylglycerol lipase mouth pancreas bile micelle gallbladder carbohydrate amylase mouth pancreas sucrase lactase maltase isomaltase intestinal brush border protein pepsin stomach trypsin chymotrypsin carboxypeptidase b pancreas dipeptidase aminopeptidase

protein pepsin stomach trypsin chymotrypsin carboxypeptidase b pancreas dipeptidase aminopeptidase intestinal brush border figure 9.5 summary digestive process mcat concept check 9.3 assess understanding material 1 list pancreatic enzyme digest major class 2 main component bile 3 bile synthesize bile store bile carry carry function 4 list function liver 5 accessory organ digestion originate primary germ layer absorption defecation chapter 9.4 able recall fat soluble vitamin order section small intestine section large predict portion gut impact disease give digestive symptom watery stool identify biomolecule typically absorb vessel villus structure villus absorption nutrient primarily occur small intestine especially jejunum ileum e large intestine largely absorb water jejunum ileum e small intestine consist segment duodenum jejunum ileum discuss previously duodenum primarily involve digestion e jejunum ileum involve absorption nutrient e small intestine line villus small finger like

projection epithelial lining show figure 9.6 villus microvilli drastically increase surface area available absorption addition middle villus capillary bed absorption water soluble nutrient lacteal lymphatic channel take fat transport lymphatic system label villus microvilli lacteal capillary lymphatic vessel figure 9.6

structure villus segment small intestine do jones industrial simple sugar glucose fructose galactose amino acid absorb secondary active transport facilitate diffusion epithelial cell line small intestine show figure 9.7 in substance epithelial cell membrane intestinal capillary blood constantly pass epithelial cell carry carbohydrate amino acid molecule away is create concentration gradient blood low concentration monosaccharide amino acid inside epithelial cell use simple carbohydrate amino acid diffuse epithelial cell capillary and absorb molecule liver hepatic nutrient bring couple sodium and/or hydrogen ion peptide break inside cell monosaccharide amino acid bring blood facilitate diffusion figure 9.7 absorption carbohydrate amino acid small intestine fat short chain fatty acid follow process carbohydrate amino acid diffuse directly intestinal capillary and fatty acid require transporter nonpolar easily traverse cellular membrane large fat glycerol cholesterol separately intestinal cell reform triglyceride show figure 9.8 and triglyceride esterified cholesterol molecule package chylomicron enter bloodstream chylomicron enter lymphatic circulation lacteal small vessel form beginning lymphatic system and lacteal converge enter venous circulation thoracic duct base neck empty left subclavian fatty acid 2 monoacylglycerol phospholipid cholesterol fat soluble vitamin micelle bring mucosal cell package chylomicron lymph short chain fatty acid bile salt travel blood figure 9.8 absorption lipid vitamin absorb small intestine vitamin categorize fat soluble water soluble fat soluble vitamin d e k easily memorize vitamin b complex c water soluble fat soluble vitamin dissolve directly chylomicron enter lymphatic circulation failure digest absorb fat properly pathology liver gallbladder pancreas small intestine lead deficiency fat soluble vitamin e water soluble vitamin take water amino acid carbohydrate endothelial cell small intestine pass directly plasma addition fat carbohydrate amino acid vitamin small

intestine absorb water water chyme actually result secretion e

average person consume liter fluid day secretion upper gastrointestinal tract total seven liter fluid day order maintain proper fluid level body fluid reabsorb osmosis solute absorb bloodstream water draw eventually reach capillary water pass transcellularly cell membrane paracellularly squeeze cell reach blood e final gastrointestinal tract large intestine primarily involve water absorption e large intestine large diameter short length small intestine divide major section cecum colon rectum e cecum simply outpocketing accept fluid exit small intestine ileocecal valve site attachment appendix e appendix small finger like projection think vestigial recent evidence suggest role ward off certain bacterial infection repopulate large intestine normal flora aer episode diarrhea inflammation appendix appendicitis surgical emergency fact common reason unscheduled surgery united states e colon divide ascending transverse descending sigmoid colon main function absorb water salt sodium chloride undigested material le small intestine e small intestine actually absorb water colon colon primarily concentrate remain material form feces little water absorption cause diarrhea finally rectum serve storage site feces consist indigestible material water bacteria e. coli

certain digestive secretion reabsorb enzyme bile e anus opening waste eliminate consist sphincter internal external anal sphincter e external sphincter voluntary control somatic internal sphincter involuntary control autonomic note similarity muscle control voiding urine feces case internal sphincter autonomic control internal urethral sphincter internal anal sphincter external sphincter somatic control external urethral sphincter external anal sphincter urination discuss chapter 10 mcat e large intestine small intestine home different species bacteria fact 30 percent dry matter stool consist bacteria bacteria anaerobe cecum home aerobic bacteria e presence bacteria colon represent symbiotic relationship bacteria provide steady source food byproduct produce bacteria beneficial human example bacteria gut produce vitamin k essential production clotting factor biotin vitamin b7 coenzyme

metabolic enzyme mcat concept check 9.4 assess understanding material 1 circulatory vessel villus biomolecule absorb 2 fat soluble vitamin 3 section small intestine order section large intestine order small intestine large intestine 4 vibrio cholera cause severe infection intestine lead massive volume watery diarrhea 20 liter day give symptom cholera likely impact small intestine large intestine chapter review lot information digestive system use advantage test day begin overview anatomy keep mind system design carry extracellular digestion consider foodstuff fat protein carbohydrate compound break simple molecular form absorb distribute tissue cell body move gastrointestinal tract discuss organ site absorption digestion spend good bit time discuss enzyme involve digestion specific purpose digestion occur primarily oral cavity stomach duodenum absorption occur primarily jejunum ileum method transport circulatory system slightly different depend compound finally discuss segment large intestine role water salt absorption temporary storage waste product information digestive system overwhelming underlie concept

relatively straightforward systematic approach chart table flashcard help manage content end digestive system main purpose break energy- contain compound circulation rest body equally important system body getting rid compound blood buildup waste product like ammonia urea potassium hydrogen ion lead pathology instance hyperammonemia buildup ammonia blood lead severe permanent neurological damage hyperkalemia buildup potassium blood quickly cause fatal heart attack temperature regulation similarly important hyperthermia hypothermia lead organ dysfunction ultimately death chapter turn attention regulatory system renal system skin review content test knowledge critical thinking skill complete test like passage set online anatomy digestive system intracellular digestion involve oxidation glucose fatty acid energy extracellular digestion occur lumen alimentary canal mechanical digestion physical breakdown large food particle small food particle chemical digestion enzymatic cleavage chemical bond peptide bond protein glycosidic bond e pathway digestive tract oral cavity pharynx esophagus stomach small intestine large intestine rectum

e accessory organ digestion salivary gland pancreas liver gallbladder e enteric nervous system wall alimentary canal control peristalsis activity upregulate parasympathetic nervous system downregulate sympathetic nervous system ingestion digestion multiple hormone regulate feeding behavior include antidiuretic hormone adh vasopressin aldosterone promote thirst glucagon ghrelin promote hunger leptin cholecystokinin promote satiety oral cavity mastication start mechanical digestion food salivary amylase lipase start chemical digestion food food form bolus swallow e pharynx connect mouth posterior nasal cavity e esophagus propel food stomach peristalsis food enter stomach lower esophageal cardiac sphincter e stomach part fundus body antrum pylorus e stomach less great curvature throw fold call ruga numerous secretory cell line stomach mucous cell produce bicarbonate rich mucus protect chief cell secrete pepsinogen protease activate acidic environment stomach parietal cell secrete hydrochloric acid intrinsic factor need vitamin b12 absorption g cell secrete gastrin peptide hormone increase hcl secretion gastric motility aer mechanical chemical

peptide hormone increase hcl secretion gastric motility aer mechanical chemical digestion stomach food particle call chyme food pass duodenum pyloric sphincter e

duodenum first small intestine primarily involve chemical digestion disaccharidase brush border enzyme break maltose isomaltose lactose sucrose monosaccharide brush border peptidase include aminopeptidase dipeptidases enteropeptidase activate trypsinogen procarboxypeptidase initiate activation cascade secretin stimulate release pancreatic juice digestive tract slow motility cholecystokinin stimulate bile release gallbladder release pancreatic juice satiety accessory organs digestion acinar cell pancreas produce pancreatic juice contain bicarbonate pancreatic amylase pancreatic peptidase trypsinogen chymotrypsinogen carboxypeptidases b pancreatic e liver synthesize bile store gallbladder secrete duodenum directly bile emulsifie fat make soluble increase surface e main component bile bile salt pigment especially bilirubin breakdown hemoglobin cholesterol e

liver process nutrient glycogenesis glycogenolysis storage mobilization fat gluconeogenesis produce urea detoxify chemical activate inactivate medication produce bile synthesize albumin clotting & gallbladder store concentrate bile absorption defecation & jejunum ileum small intestine primarily involve & small intestine line villus cover microvilli increase surface area available absorption villus contain capillary bed lacteal vessel lymphatic water soluble compound monosaccharide amino acid water soluble vitamin small fatty acid water enter fat soluble compound fat cholesterol fat soluble vitamin enter lacteal & large intestine absorb water salt form semisolid feces & cecum outpocketing accept fluid small intestine ileocecal valve site attachment & colon divide ascending transverse descend & rectum store feces excrete anus gut bacteria produce vitamin K biotin vitamin B7

answer concept check 1 mechanical digestion chewing physically break food small pieces chemical digestion involve hydrolysis bond breakdown food small biomolecules 2 oral cavity mouth pharynx esophagus stomach small intestine large intestine rectum anus 3 & parasympathetic nervous system increase secretion gland digestive system promote peristalsis & sympathetic nervous system slow peristalsis 1 saliva contain salivary amylase ptyalin digest starch small sugar maltose dextrin lipase digest fat protect lining stomach increase pH bicarbonate digest protein activate  $H^+$  HCl decrease pH kill microbe denature protein carry chemical digestion intrinsic factor absorption vitamin B12 increase HCl production increase gastric motility brush border enzyme break sucrose increase pancreatic secretion especially bicarbonate reduce HCl secretion decrease motility brush border enzyme break dipeptide free recruit secretion gallbladder pancreas activate trypsinogen initiate activation 4 bile accomplish mechanical digestion fat emulsify increase surface area pancreatic lipase accomplish chemical digestion fat break ester bond 1 carbohydrate pancreatic amylase protein trypsin chymotrypsin carboxypeptidases b fat pancreatic lipase 2 bile compose bile salt amphipathic molecule derive cholesterol emulsify fat pigment especially bilirubin breakdown hemoglobin cholesterol 3 bile synthesize liver store gallbladder serve function

duodenum 4 e liver process nutrient glycogenesis glycogenolysis storage mobilization fat gluconeogenesis produce urea detoxify chemical activate inactivate medication produce bile synthesize albumin clotting factor 5 outgrowth gut tube accessory organ digestion arise embryonic endoderm 1 e circulatory vessel capillary lacteal e capillary absorb water soluble nutrient like monosaccharide amino acid short chain fatty acid water soluble vitamin water e lacteal absorb fat soluble nutrient like fat cholesterol fat soluble 2 e fat soluble vitamin d e k. 3 e small intestine consist duodenum jejunum ileum e large intestine consist cecum colon rectum 4 large intestine main function absorb water

small intestine actually absorb large volume water us massive volume watery diarrhea likely arise infection small intestine large intestine science mastery assessment explanation chief cell secrete pepsinogen protease secrete zymogen activate acidic environment stomach g cell secrete gastrin parietal cell secrete hydrochloric acid intrinsic factor mucous cell secrete alkaline mucus eliminate answer choice e small intestine divide section duodenum jejunum ileum e cecum large intestine make b correct answer aminopeptidase brush border peptidase secrete cell line duodenum require enteropeptidase activation trypsinogen procarboxypeptidase b activate enteropeptidase eliminate d activate trypsin activate chymotrypsinogen trypsinogen activate chymotrypsinogen activate eliminate c lipase involve digestion fat function emulsify fat job bile lipase chemically digest fat duodenum allow bring duodenal cell package chylomicron e association give protein digestion begin stomach pepsin secrete pepsinogen hydrolyze specific peptide bond protein digestion continue small intestine trypsin secrete trypsinogen chymotrypsin secrete chymotrypsinogen carboxypeptidase b secrete procarboxypeptidases b aminopeptidase dipeptidase hydrolyze specific part peptide protein digestion occur mouth large intestine sucrase brush border enzyme find duodenal cell secrete salivary gland is enzyme hydrolyze sucrose disaccharide form glucose fructose monosaccharide e association correct e question basically ask identify structure lie stomach small intestine is pyloric sphincter presentation give question

classic example call pyloric stenosis pyloric sphincter thicken relax permit chyme e cardiac sphincter lie esophagus stomach e ileocecal valve c lie ileum small intestine cecum large intestine e internal anal sphincter d lie end e parasympathetic nervous system role digestive system promote motility gut tube secretion gland erefore block parasympathetic nervous system likely result dry mouth reduce secretion saliva slow gastric emptying decrease peristalsis decrease gastric acid production reduce hcl secretion parietal cell gastric gland eliminate c d b correct answer

expect constipation individual diarrhea slow motility colon lead increase water reabsorption make fece firm cause constipation e first graph show maximal activity acidic ph imply enzyme act stomach e second graph show maximal activity ph 8.5 imply enzyme act duodenum e choice match first graph stomach enzyme pepsin second duodenal enzyme carboxypeptidase b b elevated bilirubin imply blockage bile flow increased production bilirubin massive hemoglobin release inability liver produce bile bile duct occlude bile able flow digestive tract build increase bilirubin level blood red blood cell lyse b bilirubin level rise accordance increase hemoglobin release liver failure occur d liver unable produce bile bilirubin build c refer pathology stomach key word give ruga fold stomach wall lack gastric function effect bilirubin level make correct choice chylomicron contain triacylglycerol cholesteryl ester fat soluble vitamin secrete intestinal cell lacteal amino acid fat soluble vitamin like vitamin e cholesterol absorb small intestine e cleavage fat describe question stem refer breakdown triacylglycerides hydrolysis reaction water add ester linkage fatty acid glycerol backbone break bond reason chemical digestion b correct note location reaction occur lumen digestive organ reaction classifie extracellular reaction is observation important eliminate c capillary intestine come form portal vein drain liver lacteal come form thoracic duct drain directly le subclavian vein erefore fat soluble compound pass liver reach right heart vitamin d fat soluble ghrelin promote sensation hunger increase feeding behavior leptin cholecystokinin promote satiety decrease feeding behavior eliminate b gastrin increase acid



production gastric motility significant relationship feeding behavior eliminate d e liver serve function include carry metabolic process glycogenesis glycogenolysis fat storage gluconeogenesis detoxification activation medication synthesis bile germane question role convert ammonia urea urea cycle synthesis protein include albumin clotting factor patient liver failure able convert ammonia urea high concentration ammonia low concentration urea blood eliminate c decrease synthetic

concentration ammonia low concentration urea blood eliminate c decrease synthetic activity albumin clotting factor concentration low eliminate b make d correct answer consult online resource additional practice biochemistry chapter 2 biochemistry chapter 9 carbohydrate metabolism biochemistry chapter 11 lipid amino acid metabolism biology chapter 5 e endocrine system biology chapter 7 e cardiovascular system biology chapter 8 e immune system pre med know feeling content know mcat know first important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal is quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter 1 follow likely filter glomerulus 2 follow segment nephron sodium actively transport nephron a.

proximal convoluted tubule b. thin portion ascend limb loop henle c. distal convoluted tubule

d. thick portion ascend limb loop henle 3 region kidney low solute concentration normal b. outer medulla c. inner medulla d. renal pelvis 4 follow sequence correctly show passage blood vessel kidney a. renal artery afferent arteriole glomerulus efferent arteriole vasa recta renal vein b. afferent arteriole renal artery glomerulus vasa recta renal vein c. glomerulus renal artery afferent arteriole efferent arteriole renal vein vasa recta d. renal vein efferent arteriole glomerulus afferent arteriole vasa recta renal artery 5 following statement false a. adh increase water reabsorption kidney b. aldosterone indirectly increase water reabsorption kidney c. adh act directly proximal convoluted tubule d. aldosterone stimulate reabsorption sodium collect duct 6 nephron amino acid enter vasa recta process 7 cold day person wait hour bus stop following structure help person body set maintain normal temperature c. posterior pituitary 8 glucose reabsorption nephron occur a. loop henle b. distal convoluted tubule c. proximal convoluted tubule d. collect duct 9 normal physiological circumstance primary function nephron create urine a. hypertonic blood b. hypotonic blood c. isotonic filtrate d. hypotonic vasa recta 10 diabetic nephropathy commonly detect find protein urine patient disease likely defect nephron b. proximal convoluted tubule c. loop henle d. collecting duct 11 laceration cut layer loose connective tissue skin layer skin a. stratum corneum b. stratum lucidum c. papillary layer d.

reticular layer 12 ph blood high substance likely excrete large quantity urine c. hydrogen ion d. bicarbonate ion 13 layer skin stem cell keratinocyte find a. stratum lucidum b. stratum granulosum c. stratum basale d. stratum corneum 14 drug prevent conversion angiotensin angiotensin ii likely effect drug a. increase sodium reabsorption b. increase potassium reabsorption c. increase blood pressure d. increase blood ph 15 sarin potent organophosphate chemical warfare inhibitor acetylcholinesterase sarin cause excessive buildup acetylcholine synapsis neurotransmitter following symptom likely see individual sarin poisoning a. increase urination increase sweating b. increase urination decrease sweating c. decrease urination increase sweating d. decrease urination decrease sweating chapter

excretory system anatomy excretory system function excretory system content chapter relevant 7 question biology mcat chapter cover material following aamc content category 3b structure integrative function main organ system headache ibuprofen backache work ibuprofen 50 year relatively inexpensive counter nonsteroidal anti inflammatory drug nsaid ibuprofen know analgesic pain reliever moderation ibuprofen carry relatively little risk take multiple dose year profoundly affect kidney year analgesic use usually self therapy lead kidney failure know analgesic nephropathy untreated kidney failure universally fatal kidney failure detect dialysis kidney transplant save individual life dialysis save patient kidney failure dialyze fluid solute blood strategic concentration keep separate blood semipermeable membrane blood filtere dialysis machine fluid solute diffuse concentration gradient limit size determine membrane e dialysis machine perform filtration purify blood excrete waste crucial function kidney normally perform chapter learn filtration reabsorption secretion ese process collectively responsible osmoregulation osmoregulation mechanism body use maintain homeostasis fluid tissue discuss skin play significant role temperature homeostasis thermoregulation excretory system chapter 10.1 able list structure secretory pathway order vessel renal vascular pathway identify nervous system component control detrusor muscle describe process component kidney able exchange solute filtrate blood identify function(s segment nephron e excretory system

solute filtrate blood identify function(s segment nephron e excretory system serve function include regulation blood pressure blood osmolarity acid base balance removal nitrogenous waste e kidney play essential role function anatomy excretory system e excretory system consist kidney ureter bladder urethra show figure 10.1 e kidney bean shaped structure locate digestive organ level

rib e functional unit kidney nephron kidney approximately 1 million nephron nephron eventually renal pelvis narrow form ureter urine travel ureter bladder bladder urine transport

urethra exit figure 10.1 excretory system leave kidney urine move ureter store urinary bladder excrete urethra kidney subdivide cortex medulla show figure 10.2 e cortex kidney outermost layer medulla kidney sit cortex kidney renal hilum deep slit center medial surface e wide ureter renal pelvis span entire width renal hilum e renal artery renal vein ureter enter exit renal hilum figure 10.2 gross anatomy kidney portal system kidney major portal system body hypophyseal portal system connect hypothalamus anterior pituitary discuss chapter 5 mcat biology review hepatic portal system connect gut tube liver discuss chapter 9 mcat biology review case blood pass capillary bed return e kidney portal system body portal system consist capillary bed series blood travel return heart e renal artery branch pass medulla enter cortex afferent arteriole e highly convoluted capillary tu derive afferent arteriole know glomerulus aer blood pass glomerulus efferent arteriole form second capillary bed ese capillary surround loop henle know vasa recta e renal vascular system show figure 10.3 microanatomy renal vascular system nephron visible figure 10.3 structure nephron glomerulus cup like structure know bowman capsule bowman capsule lead long tubule distinct area order proximal convoluted tubule descend ascend limb loop henle distal convoluted tubule collect duct e kidney ability excrete waste intricately tie specific placement structure physiology discussion neuron chapter 4 mcat biology review term describe organization

blood vessel kidney afferent neuron carry sensory information central nervous system afferent arteriole carry blood glomeruli efferent neuron relay signal away central nervous system efferent arteriole carry blood away glomerulus e bladder muscular lining know detrusor muscle parasympathetic activity cause detrusor muscle contract order leave body urine pass sphincter internal external urethral sphincter e internal urethral sphincter consist smooth muscle contract normal state internal sphincter smooth muscle involuntary control e external urethral sphincter consist skeletal muscle voluntary control bladder stretch receptor convey nervous system bladder require empty is cause parasympathetic neuron fire detrusor

muscle contract is contraction cause internal sphincter relax is reflex know micturition reflex e step individual e person choose relax external sphincter urinate maintain tone external sphincter prevent urination is cause moment discomfort reflex usually dissipate minute bladder empty process begin anew shortly thereafter urination facilitate contraction abdominal musculature increase pressure abdominal cavity result compression bladder increase urine flow rate e kidney filter blood form urine e composition quantity urine determine present state body example blood volume low blood osmolarity high beneficial body maximally retain water is result low volume highly concentrated urine likewise patient receive large amount intravenous fluid likely produce large volume concentrated urine us primary job kidney regulate blood volume osmolarity order kidney function divide different process filtration secretion reabsorption e nephron first function filtration kidney approximately 20 percent blood pass glomerulus filter e fluid bowman space e collect fluid know filtrate e movement fluid bowman space govern starle force account pressure differential hydrostatic oncotic pressure blood bowman space show figure 10.4 e hydrostatic pressure glomerulus significantly high bowman space cause fluid nephron hand osmolarity blood high bowman space result pressure oppose movement fluid nephron hydrostatic pressure large oncotic pressure net flow

blood nephron figure 10.4 starle force relative hydrostatic oncotic pressure gradient determine direction rate like electromotive force discuss chapter 6 mcat physics math review starle force misnomer force pressure differential cause net movement fluid glomerulus bowman space pressure discuss chapter 4 mcat physics math review circumstance fluid flow glomerulus bowman space pathology cause derangement flow consider happen ureter obstruct kidney stone obstruction result buildup urine stone eventually fluid build cause distention renal pelvis nephron happen filtration case e hydrostatic pressure bowman space increase point filtration long occur excessive pressure oppose movement fluid nephron e filtrate similar composition blood contain cell protein filter ability select base size word

molecule cell large glomerular pore remain blood describe early blood remain glomerulus travel efferent arteriole vasa recta e filtrate isotonic blood capsule capillary swell kidney filter 180 liter day approximately 36 time blood volume is mean entire volume person blood filtere 40 minute imagine glomerulus like sieve colander small molecule dissolve blood pass tiny pore glucose later reabsorb large molecule protein blood cell blood cell protein find urine indicate health problem level glomerulus addition filtere blood nephron able secrete salt acid basis urea directly tubule active passive transport e quantity identity substance secrete nephron directly relate need body time example diet heavy meat result intake large amount protein contain significant nitrogen ammonia  $\text{nh}_3$  byproduct metabolism nitrogen contain compound base disturb ph blood cell e liver convert ammonia urea neutral compound travel kidney secrete nephron excretion urine e kidney capable eliminate ion substance present relative excess blood potassium cation hydrogen ion metabolite medication secretion mechanism excrete waste simply large pass glomerular pore filtration movement solute blood filtrate bowman capsule secretion movement solute blood filtrate bowman reabsorption movement solute filtrate

blood compound filtere secrete take use reabsorption certain substance reabsorb glucose amino acid vitamin addition hormone antidiuretic hormone adh vasopressin aldosterone alter quantity water reabsorb kidney order maintain blood e kidney use mechanism filtration secretion reabsorption produce urine regulate blood volume osmolarity function nephron simple fact

renal physiology oen consider difficult topic cover medical order simplify topic important understand kidney main goal body need lose concentrate urine conserve water e kidney allow human body reabsorb certain material reuse selectively eliminate waste example glucose amino acid usually present urine kidney able reabsorb substance later use contrary waste product like hydrogen potassium ion ammonia urea remain filtrate excrete finally water

reabsorb large quantity order maintain blood pressure make filtrate reabsorb lose body order understand complex organ study nephron piece- piece discuss exactly occur segment follow nephron diagram show figure 10.5 theme note segment horizontal diagram bowman capsule proximal convoluted tubule distal convoluted tubule primarily focus identity particle urine body need lose contrast segment vertical diagram loop henle collect duct primarily focus volume concentration urine concentrate urine conserve figure 10.5 reabsorption secretion nephron proximal convoluted tubule e filtrate first enter proximal convoluted tubule pct region amino acid glucose water soluble vitamin majority salt reabsorb water 70 percent filtered sodium reabsorb filtrate remain isotonic interstitium solute large volume water reabsorb solute enter interstitium connective tissue surround nephron pick vasa recta return bloodstream reuse body e pct site secretion number waste product include hydrogen ion potassium ion ammonia urea major waste product excrete urine dump hunk loop henle filtrate proximal convoluted tubule enter descend limb loop henle dive deep medulla turn ascend limb loop henle e descend limb permeable water medulla increase osmolarity descend limb travel deeply ink moment affect flow water descend limb traverse deeply medulla increase interstitial concentration favor outflow water descend limb reabsorb e kidney capable alter osmolarity interstitium is create gradient couple selective permeability nephron allow maximal reabsorption conservation water normal physiological state osmolarity cortex approximately blood remain level deeply medulla osmolarity interstitium range isotonic blood

try excrete water time concentrated try conserve water concentration tubule interstitium drive force gradient water lose urine interstitium concentrated water tubule interstitium eventually blood vasa recta nephron create countercurrent multipli system is mean flow filtrate loop henle opposite direction flow blood vasa recta flowe direction quickly reach equilibrium kidney unable reabsorb water make flow opposite direction filtrate constantly expose hypertonic blood allow maximal reabsorption water descend limb transition ascend limb loop henle

change permeability occur e ascend limb permeable salt impermeable water descend limb maximize water reabsorption take advantage increase medullary osmolarity ascend limb maximize salt reabsorption take advantage decrease medullary osmolarity transition inner outer medulla loop henle thick term dilute segment is lumen tube enlarge cell line tube large ese cell contain large amount mitochondrion allow reabsorption sodium chloride active transport salt reabsorb water stick nephron filtrate actually hypotonic compare interstitium tend focus concentrate ability nephron segment noteworthy portion nephron produce urine dilute blood is important period overhydration provide mechanism eliminate excess water beginning loop henle filtrate isotonic interstitium us beginning loop henle end

slight degree dilution far important fact volume filtrate significantly reduce demonstrate net reabsorption large volume water distal convolute tubule filtrate enter distal convoluted tubule dct e dct respond aldosterone promote sodium reabsorption sodium ion osmotically active particle water follow sodium concentrate urine decrease volume e dct site waste product secretion like pct certain condition congestive heart failure body accumulate excess fluid lung peripheral tissue edema judicious use diuretic drug help body rid excess fluid diuretic typically inhibit reabsorption sodium region nephron increase sodium excretion osmotically active particle sodium pull water relieve body excess fluid e final concentration urine depend largely permeability collect duct responsive aldosterone antidiuretic hormone adh vasopressin permeability collect duct increase water reabsorption result concentration urine e reabsorb water enter interstitium make way vasa recta reenter bloodstream plasma e collect duct reabsorb water variable body hydrated collect duct fairly impermeable salt water conservation mode adh aldosterone act increase reabsorption water collect duct allow great water retention concentrated urine output ultimately reabsorb tubule end collect duct excrete collect duct point return aer opportunity reabsorption filtrate leave tubule collect renal pelvis e fluid carry urea uric acid excess ion sodium potassium magnesium calcium flow ureter bladder store functions excretory system e kidney use osmolarity gradient selective



permeability filter secrete reabsorb material process make urine process large implication human body e selective elimination water solute allow kidney conjunction endocrine cardiovascular respiratory system control blood pressure blood osmolarity acid base balance chapter 5 mcat biology review discuss hormone important maintenance proper blood pressure aldosterone antidiuretic hormone adh vasopressin aldosterone increase blood pressure increase reabsorption sodium medicine exploit characteristic drug actually block angiotensin- convert enzyme angiotensin ii receptor chapter 5 mcat biology review mention ace inhibitor end pril angiotensin ii receptor blocker end sartan losartan valsartan irbesartan block receptor limit aldosterone release limit

sartan losartan valsartan irbesartan block receptor limit aldosterone release limit salt water reabsorption result lower blood pressure aldosterone steroid hormone secrete adrenal cortex response decrease blood pressure decreased blood pressure stimulate release renin juxtaglomerular cell kidney renin cleave angiotensinogen liver protein form angiotensin i.

is peptide metabolize angiotensin convert enzyme lung form angiotensin ii promote release aldosterone adrenal adh govern water reabsorption result low blood osmolarity aldosterone cause salt water reabsorption change blood aldosterone work alter ability distal convoluted tubule collect duct reabsorb sodium remember water travel osmolarity gradient us reabsorb sodium water flow is reabsorption isotonic fluid net effect increase blood volume blood pressure aldosterone increase potassium hydrogen ion excretion antidiuretic hormone adh know vasopressin peptide hormone synthesize hypothalamus release posterior pituitary response high blood osmolarity directly alter permeability collect duct allow water reabsorb make cell junction duct leaky increased concentration interstitium hypertonic filtrate cause reabsorption water tubule alcohol caffeine inhibit adh release lead frequent excretion dilute urine addition kidney cardiovascular system regulate blood pressure specifically vasoconstrict vasodilate order maintain blood pressure constriction afferent arteriole lead

low pressure blood reach glomerulus adjacent juxtaglomerular cell erefore vasoconstriction secondarily lead renin release help raise blood pressure e osmolarity blood tightly control ensure correct oncotic pressure vasculature note terminology osmotic pressure suck pressure draw water vasculature cause dissolve particle oncotic pressure hand osmotic pressure attributable dissolve protein specifically blood osmolarity usually maintain approximately 290 milliosmole mosm liter describe early kidney control osmolarity modulate reabsorption water filtere secrete dissolve particle blood osmolarity low excess water excrete solute reabsorb high concentration contrast blood osmolarity high water reabsorption increase solute excretion e bicarbonate buffer system major regulator blood ph. remind buffer equation chapter 6 mcat biology review talk respiratory system contribute acid base balance increase decrease respiratory rate blood ph low increase respiratory rate blow off co2 favor conversion  $\text{h}^+$  carbon dioxide increase ph. blood ph high decrease respiratory rate cause opposite effect e respiratory system react derangement ph quickly excretory system contribute e

kidney able selectively increase decrease secretion hydrogen ion bicarbonate blood ph low kidney excrete hydrogen ion increase reabsorption bicarbonate result high ph. likewise blood ph high kidney excrete bicarbonate increase reabsorption hydrogen ion is slow respiratory response highly effective way body maintain acid base balance biology guide example expert thinking carbonic anhydrase group zinc metalloenzyme catalyze reversible hydration carbon dioxide carbonic acid solution rapidly dissociate bicarbonate proton second isoform carbonic anhydrase ii caii soluble express tissue include red blood cell osteoclast kidney caii physically functionally interact = enzyme catalyze co2 bicarbonate ion caii isoform express aquaporin-1 aqp1 increase permeability aqp1 water aqp1 express lumen face interstitium face membrane proximal tubule thin descend limb tdl loop henle observation caii augment water flux aqp1 lead posit caii contribute water reabsorption consequently urinary concentrating ability test hypothesis examine water homeostasis caii deficient caii def mouse mouse find polydipsic high water intake polyuric high urine volume analysis osmolarity urine see figure 1 measure

following property interstitium renal cortex inner strip outer medulla isom lie cortex medulla inner medulla im osmolarity figure 2 sodium ion concentration figure 3 represent  $p < 0.05$  caii interact aqp1 aqp1 find proximal convoluted tubule descending limb loop henle hypothesis caii help water resorption concentrating knock caii mice look water homeostasis caii def mouse drink lot water high volume urine fig 1 urine osmolarity look different kidney area cortex cortex medulla medulla fig 2 osmolarity kidney fig 3 sodium ion concentration kidney region iv wild type caii def mouse dv urine osmolarity trend caii def mouse significantly low urine iv region kidney type mouse wt caii def dv interstitium osmolarity trend inner medulla kidney interstitium significantly low osmolarity caii def

mice compare wt iv region kidney type mouse wt caii def dv interstitium sodium trend inner medulla kidney interstitium significantly low sodium concentration caii def mouse compare wt adapt krishnan d. pan w. beggs m. r. trepiccione f. chambrey r. eladari d. cordat e. dimke h. alexander r. t. 2018 deficiency carbonic anhydrase ii result urinary concentrating defect frontiers physiology 8 1108 accord datum lack caii great impact portion nephron question ask use datum pinpoint specific area nephron affecte important understand experimental setup result prepare use outside content knowledge e researcher goal well understand role caii play water resorption interaction aqp1 know content background aquaporin aqp water specific membrane channel find part nephron aqp availability membrane allow movement water filtrate body give information caii enzyme responsible create bicarbonate ion tell interact aqp1 increase water permeability create mouse deficient caii researcher look change osmolarity urine kidney tell paragraph 2 caii deficient mouse high urine volume high water intake support hypothesis mouse reabsorb water instead excrete urine figure 1 support conclusion show urine dilute caii deficient mouse wild type control data answer question specifically nephron lack caii have great impact figure 2 3 information specific part kidney answer go come recall cortex refer outer region organ medulla refer inner give additional area call isom boundary cortex medulla figure osmolarity interstitium inner medulla im

significantly low normal mouse indicate nephron exist inner medulla problem area paragraph 1 state aqp1 find proximal tubule thin descending limb loop henle e proximal tubule outer kidney cortex thin descend limb deep kidney move inner medulla make descend limb nephron affecte satisfie requirement question bring issue water reabsorb interstitium result osmolarity expect result high osmolarity is ultimately

come nephron work concentrate urine lack water reabsorb thin descend limb result decrease ion passively reabsorb ascend limb give drop osmolarity result datum conclude caii deficient mouse impact reduce efficacy aqp1 thin descend limb loop henle mcat concept check 10.1 assess understanding material 1 list structure excretory pathway filtrate enter nephron excretion urine body 2 list vessel renal vascular pathway start renal artery end renal vein 3 arm nervous system responsible contraction detrusor 4 process solute exchange filtrate blood happen process 5 segment nephron list major function proximal convoluted tubule descend limb loop henle ascend limb loop henle distal convoluted tubule chapter 10.2 able recall predominant cell type epidermis order layer epidermis dermis describe mechanism body use regulate temperature weight size skin integument large organ body make 16 percent total body weight average skin major component nonspecific immune defense protect exposure element invasion pathogen e skin layer start deep layer work outward layer hypodermis subcutaneous layer dermis epidermis show figure 10.6 skin derive ectoderm figure 10.6 anatomy skin subcutaneous tissue e epidermis subdivide layer call stratum deep layer outward stratum basale stratum spinosum stratum granulosum stratum lucidum stratum corneum show figure 10.7 e stratum basale contain stem cell responsible proliferation keratinocyte predominant cell skin produce keratin stratum spinosum cell connect layer site langerhans cell describe stratum granulosum keratinocyte die lose nucleus e stratum lucidum present thick hairless skin skin sole foot palm nearly transparent finally stratum corneum contain dozen layer flattene keratinocyte form barrier prevent invasion pathogen help prevent loss fluid salt hair project skin opening sweat sebaceous gland figure 10.7 layer

epidermis cell epidermis epidermis main cell keratinocyte keratin mention resistant damage provide protection injury water pathogen callus form excessive keratin deposition area repeat strain friction provide protection avoid damage future fingernail hair form keratin produce specialized cell skin

damage future fingernail hair form keratin produce specialized cell skin layer skin superficial deep come let sun burn melanocyte cell type derive neural crest cell find stratum basale these cell produce melanin pigment serve protect skin dna damage cause ultraviolet radiation produce pigment transfer keratinocyte human actually comparable number melanocyte skin color cause vary level activity melanocyte active melanocyte result dark skin tone exposure ultraviolet radiation melanocyte increase activity result dark skin color people albinism suffer genetic metabolic disorder characterize inability synthesize melanin typically albinism inherit autosomal recessive fashion expect patient albinism extremely sensitive harmful effect sun depigmentation occur vitiligo autoimmune disorder melanocyte kill individual immune system langerhans cell actually special macrophage reside stratum spinosum these cell capable present antigen t cell order activate immune system the dermis consist multiple layers the upper layer right epidermis papillary layer consist loose connective tissue papillary layer dense reticular layer sweat gland blood vessel hair follicle originate dermis evaporation endothermic process substance absorb energy surrounding undergo phase change presence dissolve solute sweat increase boiling point sweat slightly comparison pure water allow absorption heat energy boil point elevation colligative property discuss chapter 9 mcat general chemistry review sensory receptor locate dermis merkel cell disc example sensory receptor present epidermal dermal junction these cell connect sensory neuron responsible deep pressure texture sensation skin sensory organ skin include free nerve ending respond pain meissner corpuscle respond light touch ruffini ending respond stretch pacinian corpuscle respond deep pressure vibration finally hypodermis layer connective tissue connect skin rest body is layer contain fat fibrous tissue mention skin protect element microbe function include ultraviolet

protection melanin transduction sensory information outside world section look function skin thermoregulation thermoregulation achieve sweating piloerection vasodilation vasoconstriction sweating excellent cooling mechanism control autonomic nervous system body temperature rise set point determine hypothalamus thermoregulation process

system body temperature rise set point determine hypothalamus thermoregulation process occur order rid body heat postganglionic sympathetic neuron utilize acetylcholine innervate sweat gland promote secretion water certain ion skin heat absorb body water molecule undergo phase change evaporate e production sweat main mechanism cooling evaporation water skin absorb body heat time arteriolar vasodilation occur maximize heat loss is bring large quantity blood skin accelerate evaporation sweat maximize heat energy available liquid gas phase change neuron innervate sweat gland actually unusual unlike postganglionic sympathetic neuron neuron cholinergic noradrenergic release acetylcholine norepinephrine preganglionic neuron autonomic nervous system postganglionic neuron parasympathetic nervous system cholinergic neuron discuss chapter 4 mcat biology cold condition arrector pili muscle contract cause hair skin stand end piloerection is help trap layer heated air near skin e arteriole feed capillary skin constrict limit quantity blood reach skin skeletal muscle begin contract rapidly cause shivering shivering require sizeable atp significant portion energy atp convert thermal energy addition mechanism human possess layer fat skin is fat help insulate body addition fat call white fat brown fat present especially infant brown fat efficient electron transport chain mean heat energy release fuel e skin help maintain osmolarity body is skin relatively impermeable water is prevent entrance water skin loss water tissue is important case burn large loss skin dehydration tissue real threat survival mcat concept check 10.2 assess understanding material 1 predominant cell type epidermis 2 layer epidermis superficial deep 3 layer dermis superficial deep 4 mechanism body use cool mechanism body use retain heat main organ system discuss chapter excretory system skin system play essential role

homeostasis chapter demonstrate mcat worthy concept system work multiple system participate homeostasis kidney major player salt water acid base balance function depend endocrine system circulatory system respiratory system skin important immune organ function thermoregulatory organ dependent nervous system send sensory signal nervous system organ system chapter musculoskeletal system notice system interact system order produce fully function organism e mcat far focused conceptualize big picture detail memorize study focus understand system system influence rest body review content test knowledge critical thinking skill complete test like passage set online excretory system e

excretory system serve function include regulation blood pressure blood osmolarity acid base balance removal e kidney produce urine flow ureter renal pelvis urine collect bladder excrete urethra e kidney contain cortex medulla kidney hilum contain renal artery renal vein ureter e kidney contain portal system capillary bed series blood renal artery flow afferent arteriole form glomerulus bowman capsule first capillary bed blood flow efferent arteriole vasa recta second capillary bed surround nephron leave kidney renal vein e bladder muscular lining know detrusor muscle parasympathetic control muscular e internal urethral sphincter consist smooth muscle involuntary parasympathetic control e external urethral sphincter consist skeletal muscle voluntary control e kidney participate solute movement process filtration movement solute blood filtrate bowman capsule e direction rate filtration determine starle force account hydrostatic oncotic pressure differential glomerulus bowman space secretion movement solute blood filtrate bowman capsule reabsorption movement solute filtrate blood segment nephron specific function e proximal convoluted tubule pct site bulk reabsorption glucose amino acid soluble vitamin salt water site secretion hydrogen ion potassium ion ammonia urea e descending limb loop henle permeable water salt filtrate move osmotically concentrated renal medulla water reabsorb filtrate e vasa recta nephron flow opposite direction create countercurrent multipli system allow maximal reabsorption e ascend limb loop henle permeable salt water salt reabsorb passively actively e dilute

segment outer medulla salt actively reabsorb site filtrate actually hypotonic compare blood e distal convoluted tubule dct responsive aldosterone site salt reabsorption waste product excretion like e collect duct responsive aldosterone antidiuretic hormone variable permeability allow reabsorption right water depend body e kidney hormonal control blood pressure volume low different hormonal system activate aldosterone steroid hormone regulate renin angiotensin aldosterone system increase sodium reabsorption distal convoluted tubule collect duct increase water reabsorption is result increase blood volume pressure change blood osmolarity antidiuretic hormone

result increase blood volume pressure change blood osmolarity antidiuretic hormone adh vasopressin peptide hormone synthesize hypothalamus release posterior pituitary release stimulate low blood volume high blood osmolarity increase permeability collect duct water increase water reabsorption is result increase blood volume pressure decrease blood e kidney regulate ph selective reabsorption secretion bicarbonate hydrogen ion e skin act barrier protect element invasion e skin compose major layer hypodermis subcutaneous layer dermis epidermis e epidermis compose five layer stratum basale stratum spinosum stratum granulosum stratum lucidum stratum corneum e stratum basale contain stem cell proliferate form keratinocyte keratinocyte nucleus lose stratum granulosum thin layer form stratum melanocyte produce melanin protect skin dna damage cause ultraviolet radiation melanin pass langerhans cell special macrophage serve antigen- present cell skin e dermis compose layer papillary layer sensory cell locate dermis include merkel cell deep pressure texture free nerve ending pain meissner corpuscle light touch ruffini ending stretch pacinian corpuscle deep pressure vibration e hypodermis contain fat connective tissue connect skin rest body e skin important thermoregulation maintenance constant internal temperature cooling mechanism include sweating draw heat body evaporation water sweat vasodilation sweat gland innervate postganglionic cholinergic warming mechanism include piloerection arrector pili muscle contract cause hair stand end trap layer warmed air skin vasoconstriction shivering



insulation provide fat e skin prevent dehydration salt loss body answer concept check 1  
bowman space proximal convoluted tubule descend limb loop henle ascending limb loop  
henle distal convoluted tubule collect duct renal pelvis ureter bladder urethra 2  
renal artery afferent arteriole glomerulus efferent arteriole vasa recta renal vein 3 e  
parasympathetic nervous system cause contraction detrusor 4 filtration movement solute  
blood filtrate bowman capsule secretion movement solute blood filtrate bowman capsule  
reabsorption movement solute filtrate blood

solute blood filtrate bowman capsule reabsorption movement solute filtrate blood 5 bowman  
capsule site filtration water ion amino acid vitamin glucose pass essentially cell protein e  
proximal convoluted tubule control solute identity reabsorb vitamin amino acid glucose  
secrete potassium hydrogen ion ammonia urea e descend limb loop henle important water  
reabsorption use medullary concentration gradient e ascend limb loop henle important salt  
reabsorption dilution urine dilute segment e distal convoluted tubule like pct important  
solute identity reabsorb salt secrete potassium hydrogen ion ammonia urea e collect duct  
important urine concentration variable permeability allow water reabsorb base need body 1  
keratinocyte primary cell epidermis 2 stratum corneum stratum lucidum stratum granulosum  
stratum spinosum stratum basale 3 e papillary layer reticular layer 4 e body cool sweating  
vasodilation e body warm vasoconstriction piloerection shivering science mastery  
assessment explanation e glomerulus function like sieve small molecule dissolve fluid pass  
glomerulus include glucose later reabsorb large molecule protein cell erythrocyte platelet able  
pass glomerular sodium actively transport nephron proximal distal convoluted tubule  
concentration sodium outside nephron high inside energy require transport sodium molecule  
concentration gradient eliminate c inner medulla sodium ion chloride diffuse passively  
concentration gradient thin ascending limb loop henle make b correct answer e thick  
ascending limb loop henle thick cell contain mitochondrion produce atp need active transport  
sodium chloride filtrate eliminate d e region kidney low solute concentration cortex proximal

convoluted tubule distal convoluted tubule find e solute concentration increase descend medulla concentrated urine find renal pelvis blood enter kidney renal artery divide afferent arteriole run medulla cortex afferent arteriole branch convoluted network capillary call glomerulus converge directly vein capillary converge efferent arteriole divide fine capillary network know vasa recta e vasa recta capillary envelop nephron tubule reabsorb ion converge renal vein e arrangement tandem capillary bed know portal system answer

vein e arrangement tandem capillary bed know portal system answer choice describe adh aldosterone ese hormone ultimately act increase water reabsorption kidney respective mechanism action different adh increase water reabsorption increase permeability collect duct water aldosterone stimulate reabsorption sodium distal convoluted tubule collect duct knowledge evaluate answer choice c correct answer adh act proximal convoluted tubule collect duct essential substance glucose salt amino acid water reabsorb filtrate return blood vasa recta general reabsorption refer movement solute filtrate blood e hypothalamus function thermostat regulate body temperature cold outside nervous stimulation blood vessel skin increase cause vessel constrict is constriction diminish blood flow skin surface prevent heat loss sweat gland turn off prevent heat loss evaporation skeletal muscle stimulate shiver rapidly contract increase metabolic rate produce heat e hypothalamus involve process include release endocrine hormone regulation appetite circadian rhythm e filtrate enter bowman capsule flow proximal convoluted tubule virtually glucose amino acid important organic molecule reabsorb e kidney function eliminate waste urea reabsorb important substance glucose amino acid reuse body generation solute concentration gradient cortex medulla allow considerable water reabsorb excretion concentrated urine serve limit water loss body help preserve blood volume us primary function nephron create urine hypertonic blood make correct answer eliminate b d water reabsorb filtrate urine hypertonic filtrate e glomerulus likely location pathology large protein detect urine is large protein able pass filter glomerulus first place large protein filtrate nephron structure reabsorb us likely source

protein urine glomerular pathology e layer skin predominantly loose connective tissue  
papillary layer dermis e stratum corneum stratum lucidum b contain dead keratinocyte  
reticular layer d consist dense connective tissue ph blood high indicate blood alkalemic order  
correct ph blood kidney increase excretion base bicarbonate excretion urea little effect ph  
eliminate ammonia base toxic generally convert urea excretion eliminate b excretion  
hydrogen ion

toxic generally convert urea excretion eliminate b excretion hydrogen ion exacerbate  
alkalemia eliminate c e stratum basale contain stem cell proliferate form keratinocyte ascend  
layer skin shed stratum corneum normally angiotensin ii

cause secretion aldosterone adrenal cortex aldosterone serve increase reabsorption sodium  
promote excretion potassium hydrogen ion us block release aldosterone result decrease  
reabsorption sodium decrease excretion potassium hydrogen ion is eliminate d make b  
correct answer absence aldosterone sodium reabsorption occur lead water reabsorption  
eliminate c excess acetylcholine lead activation parasympathetic neuron preganglionic  
sympathetic neuron postganglionic sympathetic neuron innervate sweat gland  
parasympathetic nervous system cause contraction bladder expect increase urination e  
increased activation sweat gland lead increase sweating consult online resource additional  
practice behavioral science chapter 2 sensation perception biochemistry chapter 8 biology  
chapter 6 e respiratory system biology chapter 7 e cardiovascular system biology chapter 8  
e immune system general chemistry chapter 9 musculoskeletal system pre med know feeling  
content know mcat know first important high yield badge book help identify important topic  
science mastery assessment tool mcat prep arsenal is quiz take online resource guidance  
help ensure spend appropriate time chapter base personal strength weakness worry skip  
mean study later prep complete length test uncover specific piece content need review come  
chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter

limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question answer correctly ensure thinking match explanation review concept summary end chapter question 1 2 3 base following diagram 1 muscle contraction following region decrease( length a. 1 b. 1 2 c. 3 4 d. 2 3 4 2 region 1 refer a. thick filament b. thin filament c. band

d. band 3 region represent sarcomere 4 following molecule  $Ca^{2+}$  + bind release sarcoplasmic reticulum regulate muscle contraction 5 following cell correctly couple definition a. osteoblast bone cell involve secretion bone matrix b. osteoclast immature bone cell c. osteocyte polynucleated cell actively involved bone resorption d. chondrocyte undifferentiated bone marrow cell 6 x ray right femur child show short opposite femur average length child age region bone likely cause abnormality 7 following incorrectly pair type muscle fiber characteristic fiber a. red fiber rich mitochondria b. red fiber high level myoglobin c. white fiber fast twitch d. white fiber predominantly use aerobic respiration 8 knee move forth walking prevent surface leg bone rub a. articular cartilage c. synovial fluid d. smooth muscle 9 type(s) muscle multinucleated i. cardiac muscle ii skeletal muscle iii smooth muscle a. b. ii c. iii d. ii 10 type(s) muscle myogenic activity i. cardiac muscle ii skeletal muscle iii smooth muscle a. b. ii c. iii d. iii 11 red bone marrow involve erythrocyte formation contrast yellow bone a. involve leukocyte formation b. responsible drainage lymph c. cause formation spicule d. contain predominantly adipose tissue 12 following statement periosteum incorrect a. periosteum serve site attachment bone muscle b. cell periosteum differentiate osteoblast c. periosteum fibrous sheath surround long bone d. periosteum secrete fluid joint cavity 13 following bone appendicular skeleton a. triquetrum carpal bone b. calcaneus form heel c.

ischium fuse pelvic bone d. sternum breastbone 14 facilitate process birth infant head somewhat flexible flexibility fontanelle soft spot connective tissue infant skull time fontanelle close process know a. endochondral ossification b. intramembranous ossification c.

bone resorption d. longitudinal growth 15 young patient present emergency room break hip patient deny recent history trauma joint blood test reveal calcium concentration 11.5 normal 8.4–10.2 tissue likely responsible d. smooth muscle musculoskeletal system chapter muscular system type muscle microscopic structure skeletal muscle stimulation summation muscle fatigue skeletal system joint movement content chapter relevant 8 question biology mcat chapter cover material following aamc content category 3b structure integrative function main organ system large disaster traumatic event like war earthquake deeply affect health population impact practice medicine lead discovery new medical condition world war ii nazi germany bomb london 57 consecutive day beginning come know blitzkrieg month lightning war victim blitz know london include affliction specific set symptom pain swelling accompany effect deplete blood volume shock weakness low blood pressure decrease urine output obvious acute kidney failure lead quickly death if untreated cause blitz victim suffer symptom extreme physical trauma muscle compression destroy skeletal muscle tissue is condition call rhabdomyolysis rhabdo refer striation myo muscle lysis breakdown e product skeletal muscle destruction toxic circulate blood filter creatine kinase product fact rhabdomyolysis diagnose creatine kinase level five time

normal upper limit myoglobin like hemoglobin myoglobin use heme carry oxygen house red blood cell as erythrocyte free urine sample test positive heme point compellingly rhabdomyolysis myoglobin oxygen reserve specialized feature muscle chapter skeletal muscle able exert effect body move bony structure joint skeletal muscle form muscle body smooth muscle play role cardiovascular respiratory reproductive digestive system cardiac muscle comprise contractile tissue heart bone simply support structure provide protection internal

organ serve storage reserve calcium mineral site hematopoiesis chapter explore biology tissue complete tour system anatomy physiology muscular system chapter 11.1 able categorize muscle skeletal smooth cardiac base innervation order series event muscular contraction explain relationship atp binding muscular contraction recall meaning term summation simple twitch tetanus identify zone band sarcomere predict length change e muscular system compose skeletal muscle smooth muscle cardiac muscle skeletal muscle essential support body facilitate movement e contraction skeletal muscle compress venous structure help propel blood low pressure venous system heart lymph lymphatic system rapid muscle contraction lead shivering important thermoregulation smooth muscle responsible involuntary movement rhythmic contraction smooth muscle digestive system call peristalsis smooth muscle aid regulation blood pressure constrict relax vasculature cardiac muscle special type muscle able maintain rhythmic contraction heart nervous system input section discuss type muscle physiology muscle type muscle muscle divide different subtype skeletal muscle smooth muscle cardiac muscle muscle type perform specific function share similarity muscle capable contraction rely calcium ion muscle innervate nervous system innervate muscle ability muscle contract nervous input vary type type skeletal muscle responsible voluntary movement innervate somatic nervous system arrangement actin myosin repeat unit call sarcomere appear stripe striate view microscopically skeletal muscle multinucleated form individual muscle cell fuse long rod poultry provide great example difference red white fiber muscle support thigh consider dark meat contain high concentration red fiber pectoral muscle breast meat

meat contain high concentration red fiber pectoral muscle breast meat poultry short burst flight consider white meat high concentration white ere multiple different type fiber skeletal muscle red fiber know slow twitch fiber high myoglobin content primarily derive energy aerobically myoglobin oxygen carrier use iron heme group bind oxygen impart red color red fiber contain mitochondrion carry oxidative phosphorylation white fiber know fast twitch fiber

contain myoglobin myoglobin iron color light ese type fiber mix muscle muscle contract slowly sustain activity muscle support posture contain predominance red fiber muscle contract rapidly fatigue quickly contain white smooth muscle responsible involuntary action us smooth muscle control autonomic nervous system find respiratory tree digestive tract bladder uterus blood vessel wall location smooth muscle cell single nucleus locate center cell like skeletal muscle smooth muscle cell contain actin myosin fiber organize striation see compare skeletal muscle smooth muscle capable sustained contraction constant state low level contraction see blood vessel call tonus smooth muscle actually contract nervous system input know myogenic activity case muscle cell contract directly response stretch stimulus mcat love test fact smooth cardiac muscle exhibit myogenic activity muscle cell respond nervous input require external signal undergo contraction cardiac muscle characteristic smooth skeletal muscle type cardiac muscle primarily uninucleated cell contain nucleus like smooth muscle cardiac muscle contraction involuntary innervate autonomic nervous system unlike smooth muscle cardiac muscle appear striate like skeletal unique characteristic cardiac muscle cardiac myocyte communicate cardiac muscle cell connect intercalate disc contain gap junction ese gap junction connection cytoplasm adjacent cell allow flow ion directly cell is allow rapid coordinated depolarization muscle cell efficient contraction cardiac muscle cardiac muscle cell able define maintain rhythm term myogenic activity start sinoatrial sa node depolarization spread conduction pathway atrioventricular av node depolarization spread bundle branch purkinje fiber e gap junction allow progressive

spread bundle branch purkinje fiber e gap junction allow progressive depolarization spread ion flow gap junction cell e nervous endocrine system play role regulation cardiac muscle contraction e vagus nerve provide parasympathetic outflow heart slow heart rate

norepinephrine sympathetic neuron epinephrine adrenal medulla bind adrenergic receptor heart cause increase heart rate great contractility way epinephrine increase intracellular

calcium level cardiac myocyte ultimately cardiac contraction like type muscle rely e main characteristic muscle type summarize table 11.1 nucleus cell 1–2 nucleus cell 1 nucleus cell  $Ca^{2+}$  + require  $Ca^{2+}$  + require  $Ca^{2+}$  + require table 11.1 type muscle microscopic structure skeletal muscle type muscle specific microscopic structure mcat tend focus contractile element microscopic structure skeletal muscle order accurately answer question test day let moment discuss skeletal muscle detail e sarcomere basic contractile unit skeletal muscle sarcomere thick thin filament e thick filament organize bundle myosin thin filament actin protein troponin tropomyosin ese protein help regulate interaction actin myosin filament protein titin act spring anchor actin myosin filament prevent excessive stretching muscle remember filament associate troponin tropomyosin remember actin t sarcomere divide different line zone band show figure 11.1 z line define boundary sarcomere e m line run center sarcomere middle myosin filament e band region contain exclusively thin filament h zone contain thick filament e band contain thick filament entirety include overlap thin filament contraction h zone band distance z line distance m line small band size figure 11.1 sarcomere sarcomeres functional unit striated muscle remember thin thick filament remember actin actin filament thin myosin filament thick gross structure myocytes sarcomeres attach end end form myofibril myofibril surround covering know sarcoplasmic reticulum sr modified endoplasmic reticulum contain high concentration  $Ca^{2+}$  ion e sarcoplasm modified cytoplasm locate outside sarcoplasmic reticulum e cell membrane myocyte know sarcolemma e sarcolemma capable propagate action potential distribute action potential sarcomere muscle system transverse tubule t tubule orient perpendicularly myofibril show figure 11.2

myocyte muscle cell contain myofibril arrange parallel call muscle fiber e nucleus usually find periphery cell finally myocyte parallel form muscle figure 11.2 architecture skeletal muscle muscle compose parallel myocyte muscle fiber compose parallel myofibril part sarcomere z z end alphabet end sarcomere m middle myosin filament thin letter thin filament h h thick letter thick filament thick filament overlap sarcoplasmic reticulum fancy specialized endoplasmic



reticulum muscle cell myofibril arrangement sarcomere series muscle fiber myocyte muscle cell contain myofibril arrange parallel muscle parallel muscle fiber name similar pay careful attention terminology read muscle structure contraction muscle require series coordinated step repeat induce shortening is process depend atp contraction start neuromuscular junction nervous system communicate muscle motor efferent neuron is signal travel neuron reach nerve terminal synaptic bouton acetylcholine release synapse case neuromuscular junction nerve terminal call motor end plate acetylcholine bind receptor sarcolemma cause depolarization nerve terminal control group myocyte nerve terminal myocyte constitute motor unit depolarization trigger action potential spread sarcolemma t tubule e action potential travel t- tubule muscle tissue sarcoplasmic reticulum action potential reach sarcoplasmic reticulum  $Ca^{2+}$  ultimately release e calcium ion bind regulatory subunit troponin trigger change confirmation tropomyosin troponin bind is change expose myosin bind site actin thin filament show figure 11.3 figure 11.3 regulation contraction calcium calcium bind troponin lead conformational change tropomyosin expose myosin bind site actin shortening sarcomere e free globular head myosin molecule bind expose site actin e newly form actin myosin cross bridge allow myosin pull actin draw thin filament m line result shortening sarcomere e actin myosin cross bridge cycle illustrate figure 11.4 figure 11.4 actin myosin cross bridge cycle calcium atp essential muscle contraction start diagram

myosin carry hydrolyze atp adp inorganic phosphate pi able bind myosin bind site e release inorganic phosphate adp rapid succession provide energy powerstroke result sliding actin filament myosin filament en atp bind myosin

head release actin is atp hydrolyze adp pi recock myosin head position initiate cross- bridge cycle e repetitive binding releasing myosin head actin filament allow thin filament slide thick filament cause sequential shortening sarcomere is know slide filament model show figure 11.5 figure 11.5 sarcomere contraction sarcomere contract h zone band shorten a- band

unchanged dissociation adp pi myosin responsible powerstroke hydrolysis atp binding atp require release myosin head acetylcholine degrade synapse enzyme know acetylcholinesterase is result termination signal neuromuscular junction allow sarcolemma repolarize signal decay calcium release cease sr take calcium sarcoplasm e sr tightly control intracellular calcium concentration muscle contract necessary atp bind myosin head free actin myosin actin disconnect sarcomere return original width calcium myosin- bind site cover tropomyosin contraction prevent death atp production cease myosin head detach actin make impossible muscle relax lengthen condition know rigor mortis stimulation summation muscle fatigue muscle cell like neuron exhibit response respond completely stimulus muscle cell respond stimulus reach threshold value e strength response muscle cell change option erefore nerve control overall force number motor unit recruit respond maximal response occur fiber muscle stimulate contract simultaneously muscle fiber contract fashion innervate neuron deliver signal action potential phenomenon action potential discuss chapter 4 mcat biology review simple twitch response single muscle fiber brief stimulus threshold show figure 11.6a consist latent period contraction period relaxation period e latent period time reach threshold onset contraction time action potential spread muscle allow calcium release sarcoplasmic reticulum e muscle contract assume calcium clear sarcoplasm figure 11.6 force muscle contraction simple twitch tetanus simple twitch contraction b summation frequent simple twitch lead tetanus summation tetanus muscle fiber expose frequent prolong stimulation insufficient time relax e contraction combine strong prolonged is know frequency summation show figure 11.6b contraction frequent muscle unable relax know tetanus prolonged tetanus result

contraction frequent muscle unable relax know tetanus prolonged tetanus result muscle fatigue explain note tetanus disease include tetanus physiological phenomenon primary clinical feature tetanic physiology occur normal circumstance multiple simple twitch succession disease tetanus cause bacterium call clostridium tetani release toxin

tetanus tetanus block release gaba neuron inhibit motor neuron make motor neuron overexcitable lead constant contraction muscle strong fracture bone tetanus usually prevent exposure administration tetanus immunoglobulin biology guide example expert thinking previous research

show muscle tension generation influence dv muscle tension generation temperature muscle fiber establish connection temperature interact muscle tension generation researcher measure rate tension rise temperature specifically researcher establish change rate tension rise different high temperature  $25^{\circ}\text{C}$   $35^{\circ}\text{C}$  low temperature  $20^{\circ}\text{C}$   $10^{\circ}\text{C}$  experiment try test connection temperature figure 1 tension generation rate versus trend tension generation rate low slope line steep low temperature study conduct investigate relationship tetanic tension response temperature type muscle fiber experiment researcher directly observe tension generation muscle plot time study passage mcat likely ask comparison iv temperature dv tetanic tension response tetanic type trend temperature decrease curve flatten i.e. change tension remain low figure 2 tetanic tension response obtain intact fiber bundle different temperature suitable stimulation frequency duration adapt ranatunga k. w. 2018 temperature effect force actinmyosin interaction muscle look experimental finding international study 2 datum conflict study 1 datum is question ask set datum conflict analyze relationship need draw proper conclusion datum set data set relate conflict data set reveal relationship validate similar datum set directly contradict similar datum set start want sure understand datum set separately e first study seek investigate temperature affect rate tension generation muscle tissue e result experiment display line graph first thing look analyze figure axis label correspond unit y axis rate tension rise high value axis mean muscle generate tension fast word high rate x axis thing bit confusing e axis display temperature way technically reciprocal temperature fortunately graph label corresponding real temperature location reciprocal high temperature find close le temperature decrease go right complication graph show pretty straightforward relationship high temperature close physiological temperature

rate tension rise high drop rate  $35^{\circ}\text{C}$   $25^{\circ}\text{C}$  relatively minor low temperature rate tension rise low change rate temperature decrease

dramatic study 2 examine similar relationship temperature muscle tension graph show visual representation tension generate muscle shape curve appear measurement stimulation tension rise quickly taper off. graph quick observation high temperature max tension generate high time require reach peak tension temperature lower muscle tension generation drop significantly evaluate study 2 datum conflict study 1 datum need compare assess data set relate graph temperature independent variable look data set demonstrate change temperature study 1 show rise rate tension study 2 report rate tension rise explicitly tension time essentially rate  $35^{\circ}\text{C}$   $25^{\circ}\text{C}$  slope tension increase sharp mean rate tension increase high low temperature slope gentle tension generation take significantly long is mean study 2 corroborate study 1 datum high temperature correlate high rate low temperature correlate low change rate visualize study 1 show change rate tension rise high temperature mild change rate low temperature study 2 graph  $35^{\circ}\text{C}$   $25^{\circ}\text{C}$  change slope rate tension small change slope  $15^{\circ}\text{C}$   $5^{\circ}\text{C}$  dramatic know slope represent rate tension rise change slope represent change rate us study 2 conflict study 1 fact study corroborate oxygen debt muscle fatigue muscle require atp function slow twitch red muscle fiber high level mitochondrion use oxidative phosphorylation atp mean high concentration oxygen require generate large amount atp muscle cell need ere supplemental energy reserve muscle creatine phosphate create transfer phosphate group atp creatine time rest is reaction reverse muscle use quickly generate atp  $\text{adp} + \text{creatine} \rightarrow \text{atp} + \text{creatine phosphate}$  muscle contain myoglobin bind oxygen high affinity exercise muscle run oxygen use myoglobin reserve aerobic metabolism go fast twitch white muscle fiber few mitochondrion rely glycolysis fermentation atp circumstance person exercise heart rate respiratory rate increase order oxygen actively respire muscle e

oxyhemoglobin dissociation curve undergo right shift presence increase carbon dioxide concentration increase hydrogen ion concentration decrease pH increase temperature adaptation muscle use quickly overwhelm ability body deliver oxygen

red muscle fiber switch anaerobic metabolism produce lactic acid point muscle begin fatigue  
the difference oxygen need muscle actual present call oxygen debt after cessation strenuous  
exercise body metabolize lactic acid produce lactic acid convert pyruvate enter citric acid cycle  
this process require oxygen oxygen require recover strenuous exercise equal oxygen  
concept check 11.1 assess understanding material 1 type(s) muscle skeletal smooth cardiac  
following describe note circle correct response(s) item skeletal smooth cardiac skeletal smooth  
cardiac skeletal smooth cardiac skeletal smooth cardiac innervate autonomic nervous system  
skeletal smooth cardiac exhibit myogenic activity skeletal smooth cardiac 2 zone band  
sarcomere change length muscle 3 event initiate muscle contraction order start  
neurotransmitter release trace pathway point myosin bind 4 role binding ATP myosin head  
play cross bridge cycle dissociation ADP inorganic phosphate binding ATP dissociation ADP  
inorganic phosphate 5 tetanus physiological phenomenon disease skeletal system chapter  
11.2 able distinguish compact spongy bone identify structural part bone relative contribution  
recall major chemical component bone describe function(s) osteoblast osteoclast chondrocyte  
substance lubricate movable joint produce ere type skeleton exoskeleton endoskeleton  
exoskeleton encase organism usually find arthropod crustacean insect vertebrate include  
human endoskeleton endoskeleton internal able protect soft tissue structure exoskeleton  
exoskeleton shed regrown accommodate growth endoskeleton well able accommodate  
growth large organism the component skeletal system divide axial appendicular skeleton the  
axial skeleton consist skull vertebral column rib cage hyoid bone small bone anterior neck  
swallow provide basic central framework body the appendicular skeleton consist bone limb  
humerus radius ulna carpal metacarpal phalanx upper limb femur tibia fibula tarsal  
metatarsal phalanx lower limb pectoral girdle scapula clavicle pelvis skeleton type cover

structure muscle connective tissue vasculature e structure skeleton show figure 11.7 bone label individual bone label red figure 11.7 anatomy human skeleton adult human 206 bone 100 hand foot e skeleton create

adult human 206 bone 100 hand foot e skeleton create major component bone cartilage bone connective tissue derive embryonic mesoderm bone hard cartilage relatively lightweight macroscopic bone structure e structure bone see figure 11.8 figure 11.8 anatomy long bone humerus bone characteristic strength come specifically compact bone live dense strong e type bone structure spongy cancellous bone e lattice structure spongy bone visible microscopy consist bony spicule point know trabecula e cavity trabecula fille bone marrow red yellow red marrow fille hematopoietic stem cell responsible generation cell blood yellow marrow compose primarily fat relatively inactive bone appendicular skeleton typically long bone characterize cylindrical sha call diaphysis swell end form metaphyse terminate epiphysis e outermost portion bone compose compact bone internal core spongy bone long bone diaphysis metaphyse bone marrow e epiphysis hand use spongy core effective dispersion force pressure joint internal edge epiphysis epiphyseal growth plate cartilaginous structure site longitudinal growth prior adulthood epiphyseal plate fille mitotic cell contribute growth puberty epiphyseal plate close vertical growth halt finally fibrous sheath call periosteum surround long bone protect serve site muscle attachment periosteal cell capable differentiate bone form cell healthy periosteum necessary bone growth repair root lig come latin mean tie bind think dna ligase discuss chapter 6 mcat biochemistry review think ligand complex ion discuss chapter 9 mcat general chemistry review case ligament tie bone stabilize joint structure musculoskeletal system hold dense connective tissue tendon attach muscle bone ligament hold bone joint microscopic bone structure e strength compact bone come bone matrix organic inorganic component e organic component include collagen glycoprotein peptide e inorganic component include calcium phosphate hydroxide ion harden form hydroxyapatite crystal  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$  mineral sodium magnesium potassium

store bone strong bone require uniform distribution organic inorganic material e bony matrix order structural unit know osteon haversian system show figure

matrix order structural unit know osteon haversian system show figure 11.9 osteon contain concentric circle bony matrix call lamella surround central microscopic channel longitudinal channel axis parallel bone know haversian canal transverse channel axis perpendicular bone know volkmann canal ese canal contain blood vessel nerve fiber lymph vessel maintain health bone lamellar ring small space call lacuna house mature bone cell know osteocyte e lacuna interconnect tiny channel call canaliculus allow exchange nutrient waste osteocyte haversian volkmann canal figure 11.9

bone matrix cross sectional longitudinal view highlight haversian system bone appear rigid static actually dynamic vascular innervated hurt break bone addition bone remain vigorous equilibrium construction destruction know bone remodeling cell type largely responsible build maintain strong bone osteoblast osteoclast osteoblast build bone osteoclast polynucleate resident macrophage bone resorb ese process contribute constant turnover bone show figure 11.10 bone formation essential ingredient calcium phosphate obtain blood bone resorption ion release bloodstream bone remodeling occur response stress bone actually remodel way accommodate repetitive stress face body endocrine hormone affect bone metabolism parathyroid hormone peptide hormone release parathyroid gland response low blood calcium promote resorption bone increase concentration calcium phosphate blood vitamin d activate parathyroid hormone promote resorption bone is counterintuitive first isn't vitamin d promote bone growth resorption bone response vitamin d actually encourage growth new strong bone overcompensate effect resorb bone first place finally calcitonin peptide hormone release parafollicular cell thyroid response high blood calcium promote bone formation lower blood calcium level figure 11.10 bone remodeling osteoporosis

common bone disease united states think result increase osteoclast resorption concomitant slowing bone formation lead loss bone mass estrogen believe help prevent osteoporosis stimulate osteoblast activity osteoblast build bone osteoclast chew bone cartilage soer flexible bone cartilage consist firm elastic matrix call chondrin secrete cell call chondrocyte fetal skeleton cartilage is advantageous fetus grow develop confined environment traverse birth canal adult cartilage body part need little extra flexibility cushioning external ear nose wall larynx trachea intervertebral disc joint cartilage differ bone avascular blood lymphatic vessel innervate bone body create hardening cartilage bone is process know endochondral ossification responsible formation long bone body bone form intramembranous ossification undifferentiated embryonic connective tissue mesenchymal tissue transform replace bone is occur bone skull joint movement like bone cartilage joint connective tissue come major variety immovable movable immovable joint consist bone fuse form suture similar fibrous joint ese joint find primarily head anchor bone movable joint structure show figure 11.11 include hinge joint like elbow knee ball socket joint like shoulder hip ey permit bone shi relative movable joint strengthen ligament piece fibrous tissue connect bone consist synovial capsule enclose actual joint cavity articular cavity layer so tissue call synovium secrete synovial fluid lubricate movement structure joint space e articular cartilage contribute joint coat articular surface bone impact restrict lubricate joint cartilage bone figure 11.11 structure movable joint degradation articular cartilage cartilage joint lead medical issue like osteoarthritis osteoarthritis arthritis lay population painful lack cartilage joint lead bone rub directly muscle attach bone contraction cause bone e end muscle large attachment bone usually proximal connection call origin e end small attachment bone usually distal connection call insertion oen muscle work antagonistic pair relax contract case arm biceps brachii triceps brachii work antagonistically show figure 11.12 biceps contract triceps relax elbow flexe triceps contract biceps relax

biceps contract triceps relax elbow flexe triceps contract biceps relax elbow extend muscle



synergistic work accomplish function figure 11.12 antagonistic muscle pair bicep brachii triceps brachii example muscle pair work antagonistically contraction cause elongate muscle classifie type movement coordinate flexor muscle decrease angle joint like biceps brachii extensor increase straighten angle like triceps brachii abductor move body away midline like deltoid adductor move body midline like pectoralis major medial lateral rotation describe motion occur limb medial rotator rotate axis limb midline like subscapularis lateral rotator rotate axis limb away midline like infraspinatus mcat concept check 11.2 assess understanding material 1 difference compact spongy bone 2 structural part bone contribute 3 chemical form inorganic component bone 4 function osteoblast osteoclast chondrocyte 5 liquid provide lubrication movable joint tissue produce concept emphasize past chapter anatomy physiology notion organ system work order achieve desire effect e musculoskeletal system different usually think musculoskeletal system responsible movement limit musculoskeletal system function shortsighted e bone reservoir calcium mineral release hormonal signaling ey protect internal organ provide support body muscle tissue move bone pump blood body key function number system include respiration digestion blood pressure vascular tone reproduction childbirth review anatomy physiology master fundamental organ system sure pay special attention organ system interact mcat expect understand individual organ system challenge ask think critically system impact spend time study look interaction step ahead test day

final chapter mcat biology review switch gear look transfer information generation generation is pick discussion first chapter book explore organization cell genetic material reproduction embryogenesis development chapter describe classical mendelian inheritance conclude note gene pool change time topic evolution review content test knowledge critical thinking skill complete test like passage set online muscular system ere main type muscle skeletal muscle smooth muscle cardiac muscle skeletal muscle involve support movement propulsion blood venous system thermoregulation appear striate

voluntary somatic control polynucleated divide red slow twitch fiber carry oxidative phosphorylation white fast twitch fiber rely smooth muscle respiratory reproductive cardiovascular digestive system appear nonstriated involuntary autonomic control uninucleated display myogenic activity contraction neural input cardiac muscle comprise contractile tissue heart appear striate involuntary autonomic control uninucleated binucleated display myogenic activity cell connect intercalate disc contain gap e sarcomere basic contractile unit striated muscle sarcomere thick myosin thin actin filament troponin tropomyosin find thin filament regulate actin myosin interaction e sarcomere divide different line zone band e boundary sarcomere define z line e m line locate middle sarcomere e band contain thin filament e h zone consist thick filament e band contain thick filament entirety sarcomere maintain constant size sarcomeres attach end end myofibril myocyte muscle cell muscle fiber contain myofibril myofibril surround sarcoplasmic reticulum calcium contain modified endoplasmic reticulum cell membrane myocyte know sarcolemma system t tubule connect sarcolemma orient perpendicularly myofibril allow action potential reach part muscle muscle contraction begin neuromuscular junction motor neuron release acetylcholine bind receptor sarcolemma cause depolarization is depolarization spread sarcolemma t tubule trigger release calcium ion calcium bind troponin cause shi tropomyosin exposure myosin bind site actin thin filament shortening sarcomere occur myosin head bind expose site actin form cross bridge pull actin filament thick filament result contraction is know slide filament model e muscle relax acetylcholine degrade acetylcholinesterase terminate signal allow calcium bring sr atp bind myosin head allow release actin muscle cell exhibit response call simple twitch addition multiple simple twitch muscle opportunity fully relax call frequency summation simple twitch occur frequently let muscle relax lead tetanus prolonged strong contraction muscle cell additional energy reserve reduce oxygen debt difference oxygen need present forestall fatigue creatine phosphate transfer phosphate group adp form myoglobin heme contain protein muscular oxygen skeletal system internal

form myoglobin heme contain protein muscular oxygen skeletal system internal skeleton like human call endoskeleton external skeleton like arthropod call exoskeleton e human skeletal system divide axial appendicular e axial skeleton consist structure midline skull vertebral column rib cage hyoid bone e appendicular skeleton consist bone limb pectoral girdle pelvis bone derive embryonic mesoderm include compact spongy cancellous type compact bone provide strength dense spongy cancellous bone lattice like structure consist bony spicule know trabecula e cavity fille bone long bone contain sha call diaphysis flare form metaphyse terminate epiphysis e epiphysis contain epiphyseal growth plate cause linear growth bone bone surround layer connective tissue call periosteum bone attach muscle tendon bone matrix organic component like collagen glycoprotein peptide inorganic component like bone organize concentric ring call lamella central haversian volkmann canal is structural unit call osteon haversian system lamellar ring lacuna osteocyte reside connect canaliculus allow nutrient waste bone remodeling carry osteoblast osteoclast osteoblast build bone osteoclast resorb bone parathyroid hormone increase resorption bone increase calcium phosphate concentration blood vitamin d increase resorption bone lead increase turnover subsequently production strong bone calcitonin increase bone formation decrease calcium concentration blood cartilage firm elastic material secrete chondrocyte matrix call chondrin cartilage usually find area require flexibility cartilage avascular innervated fetal life bone form cartilage endochondral ossification bone especially skull form directly undifferentiated tissue mesenchyme intramembranous joint classifie immovable movable immovable joint fuse form suture similar movable joint usually strengthen ligament contain synovial fluid secrete synovium aid motion lubricate joint bone joint coat articular cartilage aid movement provide cushioning muscle serve opposite function come antagonistic pair muscle contract lengthen answer concept check 1 skeletal cardiac muscle striate smooth muscle uninucleated skeletal muscle polynucleated skeletal muscle voluntary smooth cardiac muscle innervate autonomic nervous system smooth cardiac muscle exhibit myogenic activity 2 e band

system smooth cardiac muscle exhibit myogenic activity 2 e band change length muscle contraction entire length myosin filament

e filament change length slide band remain constant length contraction 3 release acetylcholine motor neuron activation acetylcholine receptor sarcolemma depolarization sarcolemma spreading signal t tubule release calcium sarcoplasmic reticulum sr binding calcium troponin conformational shi tropomyosin exposure myosin bind site myosin bind actin 4 atp binding allow myosin filament disconnect actin dissociation adp inorganic phosphate myosin cause 5 tetanus summation multiple simple twitch occur quickly muscle relax is lead strong prolonged contraction muscle 1 compact bone dense strength form outer layer bone spongy cancellous bone space bony spicule call trabecula site marrow production find interior core bone help distribute force pressure bone 2 e part bone diaphysis metaphysis epiphysis growth plate find epiphysis contribute linear growth 3 inorganic bone compose hydroxyapatite crystal 4 osteoblast build bone osteoclast chew bone break chondrocyte form cartilage 5 synovial fluid produce synovium lubricate movable joint science mastery assessment explanation give diagram sarcomere ask determine region shorten muscle contraction band zone sarcomere shorten contraction band length thick filament diagram region 1 us remain region shorten make d correct answer region 2 represent band region 3 represent h zone region 4 length sarcomere region 1 contain thick thin filament overlap is region refer band measure end thick filament is portion sarcomere change length muscle contraction e sarcomere contractile unit striate muscle cell sarcomere represent area vertical line refer z line addition z line anchor thin filament diagram sarcomere define region 4

calcium release sarcoplasmic reticulum sarcoplasm bind troponin molecule thin filament cause strand tropomyosin shi expose myosin bind site thin filament let quickly define cell

discuss answer choice osteoblast bone cell involve secretion bone matrix state osteoclast large polynucleated cell involved bone resorption osteocyte mature bone cell eventually surround matrix primary role bone maintenance finally chondrocyte cell secrete chondrin elastic matrix make cartilage is question essentially ask longitudinal growth occur bone e likely site abnormality child femur epiphyseal plate disc cartilaginous cell internal border epiphysis epiphyseal plate site longitudinal growth damage epiphysis metaphysis involvement imply damage epiphyseal plate red fiber slow twitch fiber high level myoglobin mitochondrion ey derive energy aerobic respiration capable sustained vigorous activity is eliminate b white fiber hand fast twitch fiber contain low level myoglobin few mitochondrion composition derive energy anaerobically fatigue easily is eliminate c make d correct answer e articular surface bone cover layer smooth articular cartilage e epiphysis portion bone eliminate b synovial fluid lubricate movement joint space stop bone contact job articular cartilage eliminate c ere appreciable function smooth muscle joint space eliminate d e type muscle multinucleated skeletal muscle make b correct answer cardiac muscle contain centrally locate nucleus statement incorrect smooth muscle hand centrally locate nucleus myogenic activity refer ability muscle contract nervous stimulation response stimulus like stretching smooth cardiac muscle possess yellow marrow largely inactive infiltrate adipose tissue make d correct e periosteum fibrous sheath surround long bone site attachment muscle tissue periosteum cell capable differentiate bone form cell call osteoblast is eliminate b c synovium secrete fluid joint cavity joint space periosteum make d correct answer e axial skeleton include skull vertebral column rib cage hyoid bone e sternum point attachment rib cage axial appendicular skeleton e limb bone pectoral girdle pelvis appendicular skeleton bone form way endochondral ossification

pectoral girdle pelvis appendicular skeleton bone form way endochondral ossification intramembranous ossification endochondral ossification replacement cartilage bone occur long bone eliminate intramembranous ossification formation bone undifferentiated

connective tissue cell mesenchyme occur skull make b correct answer bone resorption  
breakdown bone formation eliminate c longitudinal growth occur long bone responsible  
increase height time play role fontanelle ossification eliminate d unprovoked fracture hip  
normal finding person young give patient high calcium level likely patient increase level bone  
resorption cause bone fragile parathyroid hormone cause calcium release bone patient  
overactive parathyroid gland cancer gland likely calcium resorb bone blood calcium level high  
consult online resource additional practice biology chapter 4 e nervous system biology  
chapter 5 e endocrine system biology chapter 6 e respiratory system biology chapter 7 e  
cardiovascular system general chemistry chapter 9 physics math chapter 1 kinematic dynamic  
genetics evolution pre med know feeling content know mcat know first important high yield  
badge book help identify important topic science mastery assessment tool mcat prep arsenal  
is quiz take online resource guidance help ensure spend appropriate time chapter base  
personal strength weakness worry skip mean study later prep complete length test uncover  
specific piece content need review come chapter appropriate use assessment answer 0–7  
question correctly spend 1 hour read chapter limited note follow review quiz question ensure  
understand solve answer 8–11 question correctly spend 20–40 minute review quiz question  
begin question miss read note correspond subchapter question answer correctly ensure  
thinking match explanation understand choice correct incorrect answer 12–15 question  
correctly spend 20 minute review question quiz miss include quick read correspond  
subchapter relevant content subchapter question review question answer correctly ensure  
thinking match explanation review concept summary end chapter 1 gene order link gene m n  
o p give follow 2 suppose mammalian species allele black hair b dominant

follow 2 suppose mammalian species allele black hair b dominant allele brown hair b allele  
curly hair c dominant allele straight hair c organism unknown genotype cross straight brown  
hair phenotypic ratio follow i. 25 curly black hair ii 25 straight black hair iii 25 curly brown hair  
iv 25 straight brown hair genotype unknown parent 3 genotypical male hemophilia xhy cross

genotypical female carrier color blindness hemophilia  $x c x h$  probability genotypically female child bear condition 4 test cross species plant reveal appearance recessive phenotype offspring true phenotypically dominant parent a. genotypically heterozygous b. genotypically homozygous c. genotypically heterozygous homozygous d. genotype test cross control parent 5 following definition false a. penetrance percentage individual population carry allele actually express phenotype associate b. expressivity percentage

individual population carry allele express phenotype associate c. incomplete dominance occur phenotype heterozygote intermediate phenotype homozygote d. codominance occur multiple allele exist give gene dominant 6 species plant homozygous red flower  $rr$  cross homozygous yellow flower  $rr$  f1 generation self cross f2 generation phenotypic ratio red orange yellow 1:2:1 characteristic account b. incomplete dominance 7 following statement incorrect inheritance trait accord modern synthesis model a. mutation excessive amount ultraviolet light occur unfertilized egg affect child bear egg b. muscular strength gain weight lifter lifetime inherit weight lifter child c. green feathered bird survive predator forest pass green feather gene offspring d. flower tasty nectar eat butterfly likely pass gene pollen spread butterfly flower desirable nectar 8 follow statement false base darwin theory natural a. natural selection drive force evolution b. favorable genetic variation common individual life c. natural selection drive organism live group ultimately distinct d. fitness measure reproductive success 9 follow necessary condition hardy weinberg equilibrium a. large population size b. mutation c. monogamous mating partner d. migration population 10 climate cold ice age particular species mammal evolve thick layer fur kind selection occur population a. stabilize selection b. directional selection c. disruptive selection d. speciation selection 11 point population descend ancestral stock consider separate specie a. long produce viable fertile offspring b. look significantly different c. interbreed successfully produce offspring d. habitat separate significantly large distance 12 nonevolving population allele  $r$   $r$  code trait frequency  $r$  30 percent frequency possible a. 49  $rr$  42  $rr$  9  $rr$  b. 30  $rr$  21  $rr$  49  $rr$  c. 0.09  $rr$  0.42  $rr$  0.49  $rr$  d.

9 rr 42 rr 49 rr 13 particular hardy weinberg population eye color brown blue population 36 blue eye recessive trait percentage population heterozygous 14 tay sachs disease autosomal recessive disorder characterize defective hexosaminidase a. proteomic analysis cell affect condition reveal shorten protein abnormal amino acid sequence c terminus base information mutation likely a. silent mutation b. missense mutation c. nonsense mutation d. frameshift mutation 15 child bear number rare phenotypic feature genetic testing perform child determine partial trisomy 21 copy segment dna chromosome 21 partial monosomy 4 copy segment dna chromosome 4 follow mutation occur parental gamete development explain finding genetics evolution chapter fundamental concept genetics pattern dominance penetrance expressivity dna genetic material change gene pool analytical approach genetics measure evolutionary time content chapter relevant 13 question biology mcat chapter cover material following aamc content category 1c transmission heritable information generation generation process increase genetic diversity generation european royal family practice know royal intermarriage purpose establish continue political alliance maintain bloodline purity smooth diplomatic relation marriage royal family arrange result interweaving bloodline eventually european royalty genetically related marriage union lead severe restriction gene pool allele represent royal family line offspring parent relate blood lineage consanguinity come great similarity genotype certain allele frequent phenotypic expression hallmark royal descent e house habsburg rule number european kingdom

11th century late 18th century infamous inbreeding practice member royal family bear unmistakable mark restricted gene jaw malformation come know habsburg lip medically term prognathism greek forward jaw condition misalignment mandible maxilla e habsburg family portrait present individual prominent forward thrust low jaw chin characteristic mandibular prognathism e genetic condition aesthetic implication lead disfigurement disability charles ii spain suffere bad case habsburg lip record lower tooth protrude far upper tooth able chew



food chapter explore concept classical genetic originally describe mid-1800 consider chapter tandem discussion molecular genetic chapter 6 7 mcat biochemistry review en explore change gene pool occur time discussion evolution quantify genetic population undergo evolution hardy fundamental concepts genetics chapter 12.1 able recall trait allele dominant recessive differentiate homozygous heterozygous hemizygous genotype compare contrast complete dominance codominance incomplete explain difference penetrance expressivity connect mendel law phase meiosis closely blood type individual carry antigen erythrocyte circulate anti b antibody blood type b individual carry b antigen erythrocyte circulate anti antibody type ab antigen antibody type o antigen antibody make type o individual universal donor type ab individual universal recipient blood typing discuss chapter 7 mcat biology review e

physical biochemical characteristic live organism determine gene dna sequence code heritable trait pass generation take gene large supply noncode dna organize chromosome ensure genetic material pass easily daughter cell mitosis meiosis gene alternative form call allele explore abo blood antigen example allele gene ia ib e genetic combination possess individual know genotype manifestation give genotype observable trait know phenotype human being typically possess copy chromosome call homologue exception sex chromosome genotypical male x chromosome y chromosome gene particular locus location specific chromosome e normal locus particular gene consistent human being gene describe location chromosome homologous pair person inherit allele gene male sex chromosome allele categorize base expression copy allele need express give phenotype allele say dominant usually represent capital letter copy need allele say recessive usually represent lowercase letter allele give gene individual say homozygous genotype allele different individual heterozygous genotype hemizygous genotype describe situation allele present give gene case part x chromosome genotypical male pattern dominance dominant recessive allele exist give gene say complete dominance case presence dominant allele mask recessive allele present dominant allele exist

give gene codominance example person allele blood antigen allele b blood antigen express antigen simultaneously finally incomplete dominance occur heterozygote express phenotype intermediate homozygous genotype classic example incomplete dominance mating certain flower red flower cross white flower result pink flower show figure 12.1 incomplete dominance snapdragon display incomplete dominance allele dominant heterozygous phenotype mixture penetrance expressivity penetrance expressivity reveal complex interplay gene environment penetrance population measure define proportion individual population carry allele actually express phenotype word probability give particular genotype person express phenotype allele classify degree penetrance huntington disease cause expansion repetitive sequence huntingtin gene classic example individual 40 sequence repeat penetrance—100 percent individual allele symptom huntington disease individual few sequence repeat high penetrance allele symptom disease few sequence repeat gene come reduced

penetrance allele symptom disease few sequence repeat gene come reduced penetrance low penetrance nonpenetrance penetrance proportion population give genotype actually express phenotype expressivity different manifestation genotype related distinct concept expressivity define vary phenotype despite identical genotype expressivity constant individual give genotype express phenotype expressivity variable individual genotype different phenotype penetrance population parameter percentage individual give genotype express phenotype expressivity reflect gray area expression commonly consider individual level example disease neurofibromatosis type ii autosomal dominant disease result mutation gene nf2 merlin interestingly range phenotype associate carry defective allele patient debilitating tumor vestibulocochlear nerve need hearing balance cataract tumor skin call neuroma spinal lesion small proportion population nonpenetrant e disease show variable expressivity presentation range clinical effect severe disability gregor mendel augustinian friar develop tenet genetic 1860 base work pea plant study genetic come long way pedigree analysis dna probe genome sequencing mendel original idea hold mendel law law segregation ere basic tenet modern

interpretation mendel first law segregation discuss gene exist alternative form allele organism allele gene inherit e allele segregate meiosis result gamete carry allele inherit trait allele organism different fully express silent e express allele say dominant silent allele recessive mind codominance incomplete dominance exception rule e key cellular correlate draw separation homologous chromosome anaphase meiosis separate segregate chromosome different cell gamete carry allele give trait mendel second law law independent assortment mendel second law independent assortment state inheritance gene affect inheritance gene remember chapter 2 mcat biology review spermatogonia oogonia undergo genome replication meiosis i. e daughter dna strand hold parent strand centromere dna strand know sister chromatid prophase meiosis homologous chromosome pair form tetrad derive chromatid involve chromatid homologous chromosome small segment genetic material swap chromatid homologous chromosome result novel combination allele present original chromosome recombination is allow inheritance gene independent inheritance mendel second law complicate discovery

allow inheritance gene independent inheritance mendel second law complicate discovery link gene discuss nonindependent assortment linkage later chapter section analytical approach genetic segregation homologous chromosome independent assortment allele increase genetic diversity gamete subsequently genetic diversity offspring is demonstrate improve ability species evolve adapt environmental stress segregation independent assortment allow great genetic diversity offspring dna genetic material mendel notice certain pattern inheritance know dna genetic material transfer offspring gene dna fact scientific community reject mendel

initial paper inheritance early 1900s work rediscover early mid-1900 largely believe protein heritable material mid-1900 experiment conduct largely point dna role genetic 1920 frederick griffith scientist work british government study streptococcus pneumoniae bacteria cause

pneumonia strain *S. pneumoniae* identify virulent disease cause strain nonvirulent strain successive trial griffith expose mouse strain bacteria different condition observe mouse live die show figure 12.2 e virulent *S. pneumoniae* smooth capsule help bacterium evade immune system cause disease inject strain mouse result death mice naturally virulent bacteria kill prior injection disease result likewise exposure mouse nonvirulent strain rough capsule cause disease dead virulent bacteria live nonvirulent bacteria inject mouse mouse die live bacteria smooth capsule find mice theorize live nonvirulent bacteria acquire ability form smooth capsule dead virulent bacteria is know transform principle figure 12.2 griffith experiment transform principle describe griffith experiment bacterial transformation discuss chapter 1 mcat biology review remember transformation main way bacteria increase genetic variability conjugation transduction researcher rockefeller institute confirm transformation principle ree american scientist oswald avery colin macleod maclyn mccarty attempt identify exact material underlie transformation principle ese scientist purify large quantity heat kill virulent *S. pneumoniae* bacteria separate subcellular component bacteria different extract note addition particular extract nonvirulent *S. pneumoniae* transform bacteria enable kill mouse inject substance treat enzyme know degrade dna bacteria transform mouse live substance treat enzyme know degrade protein bacteria transform mouse die us group conclude transform substance dna radiolabel sulfur appropriate choice tag protein hershey chase experiment recall chapter 1 mcat biochemistry review amino acid cysteine methionine contain sulfur r group nucleotide contain 1952 year description watson crick model alfred hershey martha chase work confirm idea dna independently carry genetic information

ese scientist create bacteriophage radiolabel dna protein group bacteriophage contain radiolabel sulfur find protein dna group contain radiolabel phosphorus find dna protein bacteriophage permit infect group nonlabeled bacteria recall chapter 1 mcat biology review bacteriophage infect bacterium inject genetic material cell leave capsid outside aer phage bacteria incubate sample centrifuge separate material remain outside cell bacterial cell

determine radiolabeled protein enter cell radiolabeled dna know virus enter cell cause disease replicate experiment help confirm dna heritable genetic material mcat concept check 12.1 assess understanding material 1 mean allele dominant recessive 2 mean genotype homozygous heterozygous 3 difference complete dominance codominance 4 difference penetrance expressivity 5 phase meiosis mendel law closely correlate mendel law mendel second law change gene pool chapter 12.2 able identify main type point mutation genetic change recall main type frameshift mutation explain genetic leakage increase century describe relationship genetic drift small population founder identify main type chromosomal mutation impact allele exist species know gene pool mutation genetic leakage occur new gene introduce gene pool genetic variability essential survival species allow evolve adapt change environmental stress certain trait desirable confer selective advantage allow individual produce viable fertile offspring section consider genetic diversity mutation leakage genetic dri cause change allele frequency mutation change dna sequence result mutant allele mutant allele contrast wild type counterpart allele consider normal natural ubiquitous study population new mutation introduce variety way ionize radiation ultraviolet ray sun chemical exposure damage dna substance cause mutation call mutagen dna polymerase subject make mistake dna replication albeit low rate proofreading mechanism help prevent mutation occur mechanism element know transposon insert remove genome transposon insert middle code sequence mutation disrupt gene flawed protein arise way underlie change dna sequence incorrect pairing nucleotide transcription translation trna molecule charge incorrect amino acid anticodon result derangement normal amino acid e major type

acid anticodon result derangement normal amino acid e major type nucleotide level mutation discuss great detail chapter 7 mcat biochemistry review offer brief overview type mutation occur level single nucleotide small number nucleotide ese mutation show figure 12.3 figure 12.3 common nucleotide level mutation point mutation occur nucleotide dna c t g swap ese subcategorize silent missense silent mutation occur change nucleotide effect final

protein synthesis gene is commonly occur change nucleotide transcribe nucleotide codon degeneracy wobble missense mutation occur change nucleotide result substitute amino acid final protein nonsense mutation occur change nucleotide result substitute stop codon amino acid final protein frameshift mutation occur nucleotide insert delete genome mrna transcribe dna read letter sequence call codon insertion deletion nucleotide shift reading frame usually result change amino acid sequence premature truncation protein generation nonsense mutation etc subcategorize insertion chromosomal mutation large scale mutation large segment dna affected demonstrate figure 12.4 figure 12.4 common chromosomal mutation deletion mutation occur large segment dna lose chromosome small deletion mutation consider frameshift mutation describe previously duplication mutation occur segment dna copy multiple times genome inversion mutation occur segment dna reverse chromosome insertion mutation occur segment dna move chromosome small insertion mutation include insert dna chromosome consider frameshift mutation describe previously translocation mutation occur segment dna chromosome swap segment dna consequence mutations mutations different consequence mutation advantageous confer positive selective advantage allow organism produce fitter offspring example sickle cell disease single nucleotide mutation cause sickle hemoglobin disease detrimental life heterozygote sickle cell disease usually minor symptom natural resistance malaria red blood cell slightly short lifespan short parasitic plasmodium species cause malaria reproduce us heterozygote sickle cell disease selective advantage likely die malaria hand mutation detrimental deleterious example xeroderma pigmentosum xp inherit defect nucleotide excision repair mechanism patient xp dna damage ultraviolet radiation repair appropriately ultraviolet radiation

patient xp dna damage ultraviolet radiation repair appropriately ultraviolet radiation introduce cancer cause mutation lack repair mechanism patient xp frequently diagnose malignancy especially skin important class deleterious mutation know inborn error metabolism etc deficiencies gene require metabolism child bear deficient gene often require

early intervention order prevent permanent damage buildup metabolite pathway example phenylketonuria pku enzyme phenylalanine hydrolase complete metabolism amino acid phenylalanine defective absence enzyme toxic metabolite phenylalanine accumulate cause seizure impairment cerebral function learning disability musty odor bodily secretion disease discover shortly after birth dietary phenylalanine eliminate treatment administer aid metabolize remain phenylalanine genetic leakage flow gene species case individual different closely relate species mate produce hybrid offspring hybrid offspring mule hybrid male horse female donkey able reproduce odd number chromosome horse 64 chromosome donkey 62 mule 63 chromosome undergo normal homologous pairing meiosis form gamete case hybrid reproduce member species beefalo cross cattle american bison e hybrid carry gene parent species result net flow gene species genetic drift refer change composition gene pool chance genetic drift tend pronounced small population e founder effect extreme case genetic drift small population species find reproductive isolation population result natural barrier catastrophic event bottleneck drastically suddenly reduce size population available breeding breeding group small inbreeding mating genetically relate individual occur later generation inbreeding encourage homozygosity increase prevalence homozygous dominant recessive genotype ultimately genetic drift founder effect inbreeding cause reduction genetic diversity one reason small population increase prevalence certain trait disease example branched chain ketoacid dehydrogenase deficiency call maple syrup urine disease especially common mennonite community imply common origin mutation small original population is loss genetic variation cause reduce fitness population condition know inbreeding depression opposite end spectrum breeding outcrossing introduction unrelated individual breeding group theoretically result increase variation gene pool increase fitness mcat concept check 12.2 assess understanding material 1 main

fitness mcat concept check 12.2 assess understanding material 1 main type point mutation change occur 2 main type frameshift mutation 3 main type chromosomal mutation share type

frameshift mutation change occur 4 genetic leakage animal rare prior century 5 genetic drift common small population relationship founder effect analytical approaches genetics chapter 12.3 able predict phenotype ratio offspring cross  $aabb \times aabb$  order gene chromosome give recombination frequency recall criterion hardy weinberg principle underlie population characteristic imply solve calculation problem require use hardy weinberg equation  $p + q = 1$   $p^2 + 2pq + q^2 = 1$  genetics field number biometric technique quantitative approach biological datum develop ese range punnett square mapping chromosome recombinant frequency hardy weinberg equilibrium punnett square diagram predict relative genotypic phenotypic frequency result crossing individual e allele

parent arrange square genotype progeny represent intersection allele e genotype progeny product parental pedigree family tree analysis mainstay mcat passage question topic long appear exam appear medical school genetic study symbology pedigree analysis complex intricate great deal information glean draw pedigree genetic problem include mcat dominant allele assign capital letter recessive allele assign lowercase letter copy allele individual say homozygous different individual heterozygous cross trait study say monohybrid e parent p generation refer individual cross offspring filial f generation multiple generation denote f generation numeric subscript think grandparent p generation parent f1 generation f2 generation mendel work pea plant purple white flower cross different plant group contain homozygote subsequent experimentation reveal allele purple color dominant p allele white color recessive p us cross homozygous purple flower white flower cross  $pp \times pp$  result f1 generation contain 100 percent pp heterozygote show figure 12.5 flower generation purple p dominant allele figure 12.5 punnett square homozygous parent member f1 generation cross result offspring f2 generation genotypically phenotypically diverse parent cross plant genotype  $pp$  result 25 percent  $pp$  50 percent  $pp$  25 percent  $pp$  offspring show figure 12.6 phenotypically 3:1 distribution homozygous dominant heterozygous dominant offspring purple-flowere plant us cross heterozygote case complete dominance result



1:2:1 distribution genotype homozygous dominant heterozygous dominant homozygous recessive 3:1 distribution phenotype dominant recessive

ese ratio course theoretical probability hold true especially small population offspring usually offspring parent close phenotypic ratio expect ratio figure 12.6 punnett square heterozygous parent cross heterozygote trait complete dominance result 1:2:1 ratio genotype 3:1 ratio phenotype know ratio cold test day ability create read punnett square quickly test day useful skill question involve mendelian inheritance entire passage biological biochemical foundations living systems section devote classical molecular genetic require use punnett square test cross determine unknown genotype show figure 12.7 test cross organism unknown genotype cross organism know homozygous recessive offspring 100 percent dominant phenotype unknown genotype likely homozygous dominant 1:1 distribution dominant recessive phenotype unknown genotype likely heterozygous test cross determine genotype parent base phenotype offspring test cross

call cross figure 12.7 test cross organism unknown genotype cross homozygous recessive organism identify unknown genotype phenotype result offspring extend punnett square account inheritance different gene dihybrid cross remember accord mendel second law independent assortment inheritance gene independent inheritance is hold true unlinked gene complicated link gene describe later chapter expand previous cross consider flower color plant height create  $4 \times 4$  punnett square show figure 12.8 remember purple dominant p white recessive p similarly tall dominant t short dwarf recessive t cross plant heterozygous trait offspring

phenotypic ratio 9:3:3:1 9 tall purple:3 tall white:3 dwarf purple:1 dwarf white note 3:1 phenotypic ratio hold trait 12 tall:4 dwarf 12 purple:4 white reflecte mendel second figure 12.8 dihybrid cross 3:1 phenotypic ratio monohybrid cross worth memorize consider sex link x link trait slightly different system symbolize allele genotypical female x chromosome homozygous heterozygous condition carry x chromosome genotypical male x chromosome y chromosome

hemizygous gene carry x chromosome is sex link trait common genotypical male have recessive allele sufficient expression recessive phenotype mcat sex link x link y link disease exist exceedingly rare tell assume sex link trait recessive write genotype sex link trait use x y symbolize normal x y chromosome x chromosome carry defective allele commonly give subscript xh indicate presence disease carry allele hemophilia particularly common example sex link trait punnett square heterozygous carrier female unaffected normal male affected hemophiliac male show figure 12.9 figure 12.9 sex linked cross state assume sex link trait mcat x link egg necessarily carry x chromosome sperm determine chromosomal genotypical sex child follow genotypical male sex- link trait genotypically female offspring carry trait express genotypically male offspring x chromosome egg contain affected allele case express gene organize linear fashion chromosome discuss early cross prophase meiosis cause allele swap homologous chromosome support mendel second law independent assortment gene locate close chromosome likely separate cross word apart gene likely point cross call chiasma e likelihood allele separate cross call recombination frequency  $\theta$  roughly proportional distance gene chromosome describe strength linkage gene base recombination frequency tightly link gene recombination frequency close 0 percent weakly link gene recombination frequency approach 50 percent expect independent analyze recombination frequency genetic map represent relative distance gene chromosome construct convention map unit centimorgan correspond 1 percent chance recombination occur gene us gene 25 map unit apart expect

recombination occur gene us gene 25 map unit apart expect 25 percent total gamete examine recombination gene recombination frequency add crude approximation determine order gene chromosome show figure 12.10 figure 12.10 genetic map recombination frequency recombination frequency know deduce order gene chromosome map unit roughly additive oen allele appear population know allele frequency example take cell sample 50 mendel plant collect 100 copy allele flower color cell 75 allele dominant allele allele frequency

$p = \frac{75}{100} = 0.75$  note indicate flower contain allele flower homozygous heterozygous tell representation allele chromosome population evolution result change gene frequency reproduce population time gene frequency population change gene pool stable evolution ostensibly occur & follow five criterion mandatory possible & population large genetic drift mutation affect gene pool mating individual population random sexual & migration individual population & gene population equally successful provide condition meet population say hardy weinberg equilibrium pair equation predict allelic phenotypic frequency let define particular gene have possible allele  $t$   $T$ . define  $p$  frequency dominant allele  $T$   $q$  frequency recessive allele  $t$ . choice gene locus  $p + q = 1$

at combine allele frequency  $T$   $t$  equal 100 percent square side equation  $(p + q)^2 = p^2 + 2pq + q^2 = 1$   $p^2$  frequency  $TT$  homozygous dominant genotype  $2pq$  frequency  $Tt$  heterozygous dominant genotype  $q^2$  frequency  $tt$  homozygous recessive genotype note sum  $p^2 + 2pq + q^2$  represent frequency dominant phenotype homozygous heterozygous dominant genotype need know solve mcat hardy weinberg problem value  $p$   $p^2$   $q$   $q^2$  calculate  $p + q = 1$   $p^2 + 2pq + q^2 = 1$  test day know key hardy weinberg equation  $p + q = 1$   $p^2 + 2pq + q^2 = 1$  equation provide different information & first

tell frequency allele population second provide information frequency genotype phenotype hardy weinberg equation allow find piece information relative frequency allele population second frequency give genotype phenotype population remember twice allele individual population individual autosomal copy gene & equation demonstrate evolution occur population assume condition list early meet allele frequency remain constant generation generation example imagine population mendel pea plant frequency tall allele  $T$  0.80 is value represent  $p$ . is mean  $q$  short allele  $t$  0.20 subtraction set  $F_1$  cross heterozygote result filial generation contain 64 percent homozygous tall 32 percent heterozygous tall 4 percent homozygous short plant & genotypic frequency determine allele frequency generation

follow notice allele frequency unchanged compare parent generation  $t = 0.80$  to  $t = 0.20$  population  
hardy weinberg equilibrium exhibit property mcat concept check 12.3 assess understanding  
material 1 cross phenotypic ratio see offspring  $bb \times bb$   $aa \times aa$   $ddee \times ddee$   $xqx \times xy$   $xrx \times xry$   
2 gene  $q$   $r$  recombination frequency 2 gene  $r$   $s$  recombination frequency 6 gene  $s$   $t$   
recombination frequency 23 gene  $q$   $t$  recombination frequency 19 order gene chromosome 3  
criterion hardy weinberg principle require imply characteristic study population 4 assume  
population hardy weinberg equilibrium 9 population homozygous dominant solve follow  
frequency dominant allele frequency recessive allele portion population heterozygous portion  
population homozygous recessive genotype portion population dominant phenotype chapter  
12.4 able describe key tenet major theory evolution include punctuate equilibrium natural  
selection inclusive fitness modern synthesis model identify pattern selection change create  
recall pattern evolution specie outcome recall biological definition species evolutionary  
thought relatively short history first theory suggest new specie arise old one propose 19th  
century significant alteration initial theory natural selection call survival fitt theory certain  
characteristic trait possess individual species help individual great reproductive success pass  
trait offspring is theory originally propose charles darwin 1859 publication origin

offspring is theory originally propose charles darwin 1859 publication origin species theory  
build basic tenet organism produce offspring survive reproductive chance variation individual  
population heritable variation organism slight survival advantage variation term favorable  
individual great preponderance favorable variation likely survive reproductive age produce  
offspring overall result increase trait future generation is level reproductive success term  
fitness organism fitness directly relate relative genetic contribution

individual generation darwin theory ultimately prove correct way completely 20th century  
modern genetic lead development currently accept theory e modern synthesis model call  
neo darwinism add knowledge genetic inheritance change gene pool darwin original theory

scientist show inheritance occur passing gene parent child gene ultimately change mutation recombination darwin theory update current form mutation recombination result change favorable organism reproductive success change likely pass generation e opposite true is process term differential reproduction time trait pass successful organism ubiquitous gene pool gene pool change time important note population evolve evolution equivalent natural selection mcat like test ability understand natural selection simply mechanism evolution natural selection equivalent survival fit germane modernization darwin theory shi scope focus inclusive fitness fitness individual organism inclusive fitness measure organism success population base number offspring success support offspring ability offspring support early description evolutionary success like darwin base solely number viable offspring organism contemporary theory account benefit certain behavior population large example existence altruism support observation close relative individual share gene promote reproduction survival related similar individual lead genetic success specie example inclusive fitness protect offspring group large endanger protect young organism ensure passing gene future generation inclusive fitness promote idea altruistic behavior improve fitness success species final theory

consider propose result research fossil record examination discover little evolution occur lineage related lifeform long period time follow explosion evolutionary change nils eldredge stephen jay Gould propose theory punctuate equilibrium explain 1972 contrast darwin theory punctuate equilibrium suggest change specie occur rapid burst evenly time mode natural selection natural selection occur stabilize selection directional selection disruptive selection show figure 12.11 figure 12.11 mode natural selection stabilize selection keep phenotype specific range select extreme instance human birth weight maintain narrow band stabilize selection fetus weigh little healthy survive fetus weigh experience trauma delivery relatively narrow birth canal addition large fetus maternal resource require reason fitness advantage keep birth weight narrow range adaptive pressure lead emergence dominance initially

extreme phenotype directional selection example heterogeneous plate bacteria resistance antibiotic plate treat ampicillin antibiotic colony exhibit resistance antibiotic survive new standard phenotype emerge result differential survivorship natural selection history differential survivorship time e emergence mosquito resistant dichlorodiphenyltrichloroethane ddt type pesticide attribute directional selection disruptive selection extreme phenotype select norm darwin study finche galapagos islands note specie specie arguably common ancestor give similar appearance compare beak size large small show figure 12.12 animal exhibit intermediate phenotype medium size beak darwin hypothesize size seed island finche food lead effect seed large fairly small require large small beak respectively us original ancestor medium size beak time animal slightly large small beak select disruptive selection facilitate existence polymorphism naturally occur difference form member population light dark coloration species butterfly adaptive radiation related concept describe rapid rise number different specie common ancestor e benefit adaptive radiation allow specie occupy different niche niche specific environment include habitat available resource predator species specifically adapt adaptive radiation favor environmental change isolation small group ancestral species figure 12.12

darwin finch image darwin finch draw john gould species define large group organism capable breed form fertile offspring formation new species evolution call speciation take population species separate geographically long period time different evolutionary pressure lead different adaptive change time pass change sufficient lead isolation mean progeny population long freely interbreed consider group separate specie reproductive isolation occur prezygotically postzygotically prezygotic mechanism prevent formation zygote completely postzygotic mechanism allow gamete fusion yield nonviable sterile offspring example prezygotic mechanism include temporal isolation breed different time ecological isolation live different niche territory behavioral isolation lack attraction member specie difference pheromone courtship display reproductive isolation incompatibility reproductive anatomy

gametic isolation intercourse occur fertilization postzygotic mechanism include hybrid inviability formation zygote develop term hybrid sterility form hybrid offspring reproduce hybrid breakdown form first generation hybrid offspring viable fertile second generation hybrid offspring inviable infertile describe early chapter mule example postzygotic hybrid sterility horse donkey produce viable mule mule sterile unable establish self perpetuate mule lineage pattern evolution look similarity specie careful determine similarity share common ancestor share common environment evolutionary pressure analyze specie way pattern evolution emerge divergent evolution parallel evolution convergent evolution show figure 12.13 figure 12.13 pattern evolution divergent evolution refer independent development dissimilar characteristic lineage share common ancestor example seal cat mammal order carnivora differ markedly general appearance ese specie live different environment adapt different selection pressure parallel evolution refer process related specie evolve similar way long period time response analogous environmental selection pressure convergent evolution refer independent development similar characteristic lineage share recent common ancestor example fish dolphin come resemble physically belong different class vertebrate ey evolve certain similar feature adapt condition aquatic life measure evolutionary time evolution slow process feature change environment subsequent change genotype phenotype population time e rate evolution measure rate change genotype period time relate severity

rate evolution measure rate change genotype period time relate severity evolutionary pressure specie word species perfectly suited habitat change condition live rate evolution exceedingly slow small base rate genetic mutation hand organism live rapidly change environment rate evolution great selection certain trait actively occur compare dna sequence different specie scientist quantify degree similarity organism example chimpanzee share 95 percent genome human mouse share 70 percent specie taxonomically distant proportion share genome decrease molecular evolutionist correlate degree genomic similarity time specie split off common ancestor similar genome recently specie separate is call molecular

clock model mcat concept check 12.4 assess understanding material 1 key tenet following theory evolution modern synthesis model 2 pattern selection change create pattern selection change population phenotype 3 pattern evolution specie outcome pattern evolution 4 biological definition species biology guide example expert thinking genus *saccharomyces* well know model industrial yeast *s. cerevisiae* include closely relate additional specie repeat isolation *s. cerevisiae* wine beer ferment beverage difficulty find truly natural habitat lead common view species product domestication unusual degree share physiological characteristic *saccharomyces* specie recent isolation *s. cerevisiae* natural environment suggest *s. cerevisiae* result natural evolution present work comparative genomics approach publicly available complete genome sequence *saccharomyces* specie search protein exhibit molecular pattern evolution  $d_n/d_s$  ratio rate nonsynonymous substitution nonsynonymous site  $d_n$ /rate synonymous substitution synonymous site  $d_s$  complete *saccharomyces* orfeomes measure protein divergence correct phylogenetic distance datum create phylogenetic tree

show figure 1 search gene associate divergence identify gene previously associate adaptation growth suboptimal temperature prompt examine catabolic flux different temperature *saccharomyces* specie different growth temperature preference figure 1 depict schematically phylogenetic relationship specie genus *saccharomyces* assign thermotolerant cryotolerant *saccharomyces* 9 relate issue formation *s. cerevisiae* domestication natural evolution lot technical jargon rephrase key takeaway researcher comparative genomics create phylogenetic tree create tree researcher see optimal growth temperature pattern correspond trend maximum growth temperature high tree generally descend order adapt gonçalves p. valério e. correia c. de almeida j. m. sampaio j. p. 2011 evidence divergent evolution growth temperature preference sympatric *saccharomyces* specie plos 6(6 e20739

base information provide temperature provide selective pressure divergent evolution *saccharomyces* specie e question ask support passage figure hypothesis temperature



explain divergence saccharomyces specie phylogenetic tree notice phrasing question ask proof evolution temperature selection is analysis retrospective way verify relationship growth temperature lead speciation causal paragraph 2 researcher fairly complex technique analyze genome saccharomyces specie arrange phylogenetic tree need understand detail method e takeaway phylogeny generate prior analysis optimal growth temperature e researcher search gene associate divergence notice gene correspond adaptation growth nonideal temperature finally analysis optimal growth temperature list saccharomyces specie give workable pattern specie close tree similar optimal growth temperature know content background change environment definitely apply selection pressure strong lead speciation formation new specie recall divergent evolution development specie different characteristic despite share temperature environmental factor base give information plausible evidence support temperature provide selection pressure divergent evolution saccharomyces specie genetics mechanism evolution increasingly important medicine unintentionally breed strain highly resistant bacteria antibiotic stewardship use appropriate antibiotic necessary important medical community seek preserve effectiveness antibiotic order understand apply concept antibiotic stewardship understand create environmental pressure lead directional selection microorganism increase frequency resistant phenotype chapter cover genetic mutation evolution give tool analyze biometric statistical genetic use punnett square recombinant frequency hardy weinberg equation fitting complete book discussion evolution spend hundred page hour prepare mcat learn basic cell biology embryogenesis development anatomy physiology genetic evolution understanding topic rely generation generation scientist come pass knowledge book letter article lecture recently television film popular medium science field constantly evolve beginning medical school student oen tell 25 percent learn first year remain true time enter practice sure statistic actually hold speak importance stay late research medical student practitioner day new discovery human body practice medicine soon make discovery bring practice improve patient life end provider attend physician researcher pass knowledge future generation physician

end provider attend physician researcher pass knowledge future generation physician help medical science evolve improve the human body astoundingly complex moment genuinely think human body astoundingly complex here learn medical school future await review content test knowledge critical thinking skill complete test like passage set online fundamental concepts genetics chromosome contain gene linear sequence allele alternative form gene dominant allele require copy express recessive allele require copy express genotype combination allele given genetic have allele term homozygous have different allele term heterozygous have allele term hemizygous male sex phenotype observable manifestation genotype are different pattern dominance complete dominance occur effect allele completely mask effect codominance dominant allele incomplete dominance dominant allele heterozygote penetrance proportion population give genotype express phenotype expressivity refer vary phenotypic manifestation give a modern interpretation mendel law help explain inheritance gene parent offspring mendel first law segregation state organism allele gene segregate meiosis result gamete carry allele trait mendel second law independent assortment state inheritance allele influence probability inherit allele different trait support dna genetic material come number 2 griffith experiment demonstrate transform principle convert nonvirulent live bacteria virulent bacteria exposure heat kill virulent bacteria avery macleod mccarty experiment demonstrate dna genetic material degradation dna lead cessation bacterial transformation a hershey chase experiment confirm dna genetic material radiolabeled dna find changes gene pool allele give population constitute gene pool mutation change dna sequence nucleotide mutation include point mutation substituting nucleotide frameshift mutation move three- letter transcriptional reading frame silent mutation effect protein missense mutation result substitution amino acid nonsense mutation result substitution stop codon amino acid insertion deletion result shift reading frame lead change downstream amino acid chromosomal mutation include large scale mutation affect a segment dna deletion mutation occur large segment dna lose duplication mutation occur

segment dna copy inversion mutation occur segment dna reverse insertion

segment dna copy inversion mutation occur segment dna reverse insertion mutation occur  
segment dna move chromosome translocation mutation occur segment dna swap segment  
dna chromosome genetic leakage flow gene specie hybrid genetic dri occur composition  
gene pool change result chance e founder effect result bottleneck suddenly isolate small  
population lead inbreeding increase prevalence certain homozygous genotype analytical  
approaches genetics punnett square visually represent crossing gamete parent relative  
genotypic phenotypic frequency e parent generation represent p filial offspring generation  
represent f1 f2 sequence monohybrid cross account gene dihybrid cross account gene sex link  
crosse sex chromosome usually indicate sex genotype e recombination frequency  $\theta$   
likelihood allele separate cross meiosis genetic map recombination frequency scale  
centimorgan e hardy weinberg principle state population meet certain criterion aim lack  
evolution allele frequency remain constant hardy weinberg equilibrium natural selection state  
chance variation exist individual advantageous variation increase individual fitness survival  
adaptation environment afford opportunity reproductive success e modern synthesis model  
neo darwinism account mutation recombination mechanism variation consider differential  
reproduction mechanism reproductive inclusive fitness consider organism success base  
number offspring success support offspring ability offspring support survival offspring  
relative ensure appearance gene subsequent generation punctuated equilibrium consider  
evolution slow process intermittent rapid burst evolutionary activity different type selection  
lead change phenotype stabilize selection keep phenotype narrow range exclude directional  
selection move average phenotype disruptive selection move population different phenotype  
extreme lead speciation adaptive radiation rapid emergence multiple specie common  
ancestor occupy ecological niche species large group organism capable breed form fertile  
offspring specie reproductively isolate pre- postzygotic mechanism specie evolve different  
relationship pattern divergent evolution occur specie share common ancestor different

parallel evolution occur specie share common ancestor evolve similar way analogous selection pressure convergent evolution occur specie share recent ancestor evolve similar analogous selection accord molecular clock model degree difference genome specie relate

selection accord molecular clock model degree difference genome specie relate time specie break off common ancestor answer concept check 1 dominant allele require copy expression recessive allele require copy expression 2 homozygous genotype allele heterozygous genotype allele different hemizygous genotype allele present give gene part x chromosome male 3 complete dominance occur allele dominant completely mask expression recessive codominance occur gene dominant allele different dominant allele express simultaneously incomplete dominance occur gene dominant allele heterozygote phenotype intermediate 4 penetrance describe proportion population express phenotype give particular genotype expressivity describe difference expression severity location phenotype 5 mendel first law segregation align anaphase meiosis mendel second law independent assortment align prophase meiosis 1 silent point mutation occur nucleotide change change protein code dna sequence redundancy genetic code missense mutation occur nucleotide change amino acid substitute final protein nonsense mutation occur nucleotide change stop codon substitute amino acid final protein 2 e type frameshi mutation insertion deletion 3 duplication mutation occur segment dna copy multiple time genome inversion mutation occur segment dna reverse genome translocation mutation occur segment dna chromosome swap segment dna chromosome 4 genetic leakage require formation hybrid organism mate member parent species hybrid exist historically especially mule fertile hybrid certainly rare modern understanding genetic commercial financial academic impetus exist create 5 genetic dri occur chance effect pronounced small sample size small population e founder effect occur small group reproductively isolate large population allow certain allele high prevalence group rest population  $bb \times bb$  3 dominant:1 recessive  $aa \times aa$  1 dominant:1 recessive  $ddee \times ddee$  1 dominant d)/dominant e 1 recessive d)/dominant e  $xqx \times xy$  female unaffected male 1

unaffected:1 affected  $xrx \times xry$  male female 1 unaffected:1 affected 2 e gene order sqrt 3 e  
criterion hardy weinberg principle imply study population undergo evolution allele frequency  
remain stable

principle imply study population undergo evolution allele frequency remain stable time 4 e  
frequency dominant allele  $p$  0.3 e frequency recessive allele  $q$  0.7 e fraction population  
heterozygous genotype  $2pq$   $2 \times 0.3 \times 0.7 = 0.42$  42 e fraction population homozygous  
recessive genotype  $q^2$   $(0.7)^2 = 0.49$  49

e fraction population dominant phenotype  $p^2 + 2pq$   $0.09 + 0.42 = 0.51 = 51$  1

natural selection state certain trait arise chance favorable reproductive success give  
environment trait pass future generation e modern synthesis model take natural selection  
explain selection specific allele pass future generation formation gamete allele favorable trait  
arise mutation inclusive fitness explain reproductive success organism number offspring  
create ability care young care explain change individual level change base survival species  
individual allele species include related individual punctuate equilibrium state specie little  
evolution occur long period interrupt rapid burst evolutionary change change population  
phenotype loss extreme maintenance phenotype small window movement extreme  
movement extreme loss norm speciation specie common ancestor similar different  
evolutionary pressure specie common ancestor remain similar similar specie recent common  
ancestor similar similar evolutionary pressure 4 species define large group organism capable  
breed form fertile offspring science mastery assessment explanations is gene mapping  
problem correlation frequency recombination distance gene chromosome give frequency  
determine gene order remember map unit equal 1 percent recombination frequency e easy  
way begin determine gene farthest apart case n o recombine frequency 18 18 map unit apart  
chromosome n p recombine 1 frequency p o recombine 17 frequency p n o finally m p

recombine 5 frequency m o recombine 12 frequency m p o dihybrid problem doubly recessive individual cross individual unknown genotype know test cross e straight- brown haired organism genotype bbcc produce gamete carry bc look f1 offspring 1:1:1:1 phenotypic ratio e fact dominant recessive trait present offspring mean unknown parental genotype contain dominant recessive allele trait e unknown parental genotype bbcc want double check answer work punnett square cross bbcc  $\times$  bbcc e female example carrier sex link trait base genotype affected allele find different x chromosome draw punnett square 25 offspring female hemophiliac xh<sub>1</sub>xh<sub>2</sub> 25 female carrier allele xc<sub>1</sub>xh<sub>2</sub> is question ask percentage female phenotype hemophilia color blindness half female carrier

ask percentage female phenotype hemophilia color blindness half female carrier trait e control parent test cross recessive erefore test parent phenotypically dominant provide recessive allele evidence presence recessive child parent dominant recessive allele erefore test parent heterozygous e definition give expressivity well match defining penetrance minus penetrance expressivity refer variable manifestation give genotype different phenotype degree phenotype express definition give accurate progeny second generation apparently blend parental phenotype e orange color result combine effect red yellow allele allele incompletely dominant phenotype heterozygote intermediate phenotype homozygote find correct answer

read choice eliminate one fit modern day theory inheritance state gene organism fit environment pass offspring is see c d demonstrate organism improve fitness pass gene offspring mention gamete expose mutagen zygote create gamete contain mutation present egg affecte us b correct answer acquire characteristic encode genome pass offspring accord modern synthesis model darwin theory natural selection argue chance variation organism help certain organism survive reproductive age produce offspring transmit variation generation us natural selection drive process evolution forward enable persistence

characteristic impart advantage environment eliminate darwin theory fitness measure term reproductive success d state rough natural selection organism separate group depend environmental pressure group eventually separate point distinct specie eliminate c b correct answer theory natural selection apply population organism particular individual favorable genetic variation common generation generation lifetime individual hardy weinberg equilibrium exist certain ideal condition satisfie allow calculate gene frequency population e hardy weinberg equation apply five condition 1 population large 2 mutation affect gene pool 3 mating individual population random 4 migration individual population 5 gene population equally successful reproduce us give choice c false monogamy necessary condition hardy weinberg equilibrium e situation describe question

stem example directional selection directional selection phenotypic norm particular species shi extreme adapt selective pressure increasingly cold environment individual thick layer fur able survive ice age shiing species define large group organism interbreed produce viable fertile offspring erefore population consider separate specie long let use information provide question stem set equation tell frequency r equal 30  $p = 0.30$  e frequency recessive gene  $r = 100 - 30 = 70$   $q = 0.70$  e frequency genotype accord hardy weinberg equilibrium give  $p^2 = rr$   $2pq = rr$   $q^2 = rr$  erefore frequency genotype  $(0.3)^2 = 0.09 = 9$   $rr$   $2 \times 0.3 \times 0.7 = 0.42 = 42$   $rr$   $(0.7)^2 = 0.49 = 49$  information give

question stem determine percentage population blue eye genotype  $bb = 36 = 0.36 = q^2$   $q = 0.6$  hardy weinberg population assume  $p + q = 1$   $p = 1 - 0.6 = 0.4$  e frequency heterozygous brown eye  $2pq = 2 \times 0.4 \times 0.6 = 0.48 = 48$  frameshi mutation include insertion deletion nucleotide change triplet reading frame mutation amino acid sequence precede mutation normal yield normal n terminal end triplet reading frame aer mutation change yield drastically different c terminal sequence oen include premature stop codon ese factor support d correct answer note nonsense mutation introduce premature stop codon c

eliminate nonsense mutation create stop codon directly change identity amino acid stop codon is scenario deletion dna duplication dna consistent translocation chromosome 4 21 development egg sperm chromosome 21 swap chromosome 4 gamete result meiosis cell result daughter cell copy dna 21 copy dna 4 erefore aer fertilization partial trisomy 21 partial monosomy 4 deletion insertion explain finding explain eliminate b inversion lead partial trisomy partial monosomy dna simply reverse eliminate d consult online resource additional practice equation remember  $p + q = 1$   $p^2 + 2pq + q^2 = 1$  behavioral science chapter 10 biochemistry chapter 6 dna biotechnology biochemistry chapter 7 rna genetic code biology chapter 1 physics math chapter 11 reasoning design execution research physics math chapter 12 data base statistical reasoning muscle move limb away center body e process substance take neurotransmitter find nervous system somatic motor neuron preganglionic parasympathetic sympathetic nerve postganglionic parasympathetic neuron metabolize e large vesicle head sperm cell contain enzyme degrade ovum cell membrane allow fertilization protein find cytoskeleton muscle cell principal constituent thin filament microfilament abrupt change membrane potential nerve muscle cause change membrane ionic permeability result conduction impulse nerve contraction muscle immune response antibody production cellular immunity

impulse nerve contraction muscle immune response antibody production cellular immunity acquire response exposure antigen substrate bind region enzyme adenosine triphosphate atp afferent sensory neuron e development characteristic enable organism survive reproduce habitat highly specific form immunity retain chemical memory invader encounter able tailor immune response specific pathogen e evolutionary process species give rise specie specialize different niche muscle move limb center body purine base present dna rna form hydrogen bond thymine uracil nucleotide molecule consist adenine ribose phosphate moiety outer phosphate bind high energy bond refer fatty tissue fat store tissue fat cell refer biological process occur presence molecular oxygen  $O_2$  organism live molecular oxygen neuron pick



impulse sensory receptor transmit central nervous system type leukocyte contain cytoplasmic granule include lymphocyte monocyte protein synthesize liver maintain oncotic pressure blood serve carrier drug hormone embryonic membrane contain grow embryo waste product alternative form gene code particular trait allele segregate meiosis type autoimmunity person immune system activate common substance environment basic functional unit lung tiny sac specialize passive gas exchange lung blood e building block protein contain amino group carboxylic acid group chain r group attach  $\alpha$ - e innermost fluid-filled embryonic membrane form protective sac surround embryo bird reptile mammal characteristic signaling cascade binding single peptide hormone membrane bind receptor result signal increase strength signaling cascade refer biological process occur oxygen organism live molecular oxygen e stage mitosis meiosis characterize migration chromatid homologous chromosome opposite pole divide male sex hormone testosterone substance kill inhibit growth bacteria fungus usually disrupt cell wall assembly bind ribosome inhibit protein synthesis immune protective protein synthesis induce presence foreign substance antigen body antibody bind specific antigen immune response call immunoglobulin substance bind antibody foreign self- portion antibody specific particular antigen area antibody antigen bind semilunar valve separate le ventricle process cell undergo program cell death highly organize

le ventricle process cell undergo program cell death highly organize manner response external internal signal peripheral portion skeleton consist arm leg pelvic pectoral girdle e central cavity gastrula stage embryological development line endoderm ultimately give rise adult small arterial structure link artery capillary ick wall muscular blood vessel generally carry blood away heart cartilaginous coating end bone provide smooth surface articulation bone joint reproductive process involve fusion gamete budding star shaped structure form centrosome pair structure heart blood return body right atrium lung le form cell cell communication cell release substance bind membrane release cell inhibit activate cellular activity autonomic nervous system inappropriate immune response target self antigen

subdivision peripheral nervous system responsible involuntary activity subdivide  
parasympathetic sympathetic nervous system chromosome sex chromosome midline  
structure skeleton include skull vertebral column rib cage provide central framework body e  
long fiber neuron conduct impulse away cell body synapse transition point cell body soma  
axon neuron site action potential initiation virus invade bacteria use bacterial rna ribosome  
self replicate type granulocytic leukocyte largely participate allergic reaction local  
inflammation solution salt pigment cholesterol produce liver store gallbladder emulsifie large  
fat droplet secrete small intestine bile duct product breakdown hemoglobin modifie soluble  
form liver type asexual reproduction characteristic prokaryote equal nuclear cytoplasmic  
division e fluid-filled central cavity blastula mammalian blastula consist trophoblastic cell  
inner cell opening archenteron external environment gastrula stage embryonic development  
e early embryonic stage embryo hollow fluid-filled sphere undifferentiated cell process solid  
mass early embryonic cell know morula blastula hollow fluid-filled sphere changes affinity  
hemoglobin oxygen cause change environment ph low increase concentration hydrogen ion  
oxyhemoglobin dissociation curve shi right indicate decrease

affinity hemoglobin oxygen efficient off-loading oxygen hemoglobin initial dose medication  
digestive system chew food leave mouth travel esophagus enter central portion bone  
especially long bone contain fat develop blood cell include erythrocyte leukocyte organic  
inorganic mineral provide strength compact bone organic component include collagen  
glycoprotein peptide inorganic component include calcium phosphate hydroxide ion  
hydroxyapatite e cup like structure nephron collect glomerular filtrate channel proximal  
convoluted tubule tube like passage air connect trachea bronchiole bundle passageway air  
start bronchi divide continuously small passageway eventually lead alveoli gas exchange  
group enzyme present luminal surface cell line duodenum break large biomolecule monomer  
able absorb conduction system heart carry impulse av node ventricle area excessive  
deposition keratin response repeat strain friction small canal connect lacuna bone matrix

haversian canal allow flow nutrient waste small thin walled blood vessel gas nutrient waste exchange occur blood tissue protein coat surround virus total blood volume pump le ventricle minute find multiply heart rate stroke volume firm elastic translucent connective tissue produce cell e chemical breakdown complex substance macromolecule yield simple substance energy e first large intestine accept material flowe ileocecal valve point attachment appendix portion neuron nucleus endoplasmic reticulum ribosome locate know soma central nervous system cns foundational belief modern biology live thing compose cell cell basic functional unit life cell arise preexist cell dna genetic material type immunity use cytotoxic chemical release cell cause death cell infect virus e brain spinal cord small organelle cytoplasm animal cell organize spindle apparatus mitosis meiosis e area chromosome sister chromatid join point attachment spindle fiber mitosis meiosis paired cylindrical organelle locate cytoplasm contain centriole e section mammalian hindbrain control muscle coordination equilibrium e

outer layer forebrain consist grey matter site high cognitive function human lower end uterus mark transition vagina uterus enzymatic cleavage chemical bond foodstuff result small molecule movement cell away chemical site cross occur homologous chromosome meiosis cell stomach secrete pepsinogen zymogen convert active form pepsin acidic environment elastic cartilage matrix substance secrete chondrocyte differentiated cartilage cell synthesize cartilaginous chromosomal strand form dna replication s phase cell cycle hold centromere filamentous body find

nucleus eukaryotic cell nucleoid region prokaryotic cell compose dna soluble lipid molecule consist triglyceride esterified cholesterol molecule absorb lacteal digestive tract aqueous mixture food secretion leave stomach enter duodenum projection cell involve movement material outside cell behavioral pattern base 24 hour cycle relate cycling hormone cortisol melatonin series mitotic division zygote immediately follow fertilization result progressively

small cell increase nucleus- phenomenon b- t cell specific particular pathogen activate  
spherically shaped bacterium genetic effect phenotype heterozygote distinct reflection allele  
particular locus describe cell capable respond induction signal cyclic adenosine  
monophosphate camp e temporary joining organism tube call pilus genetic material  
exchange form sexual reproduction bacteria animal tissue compose cell lie extracellular  
proteinaceous network support connect surround organ structure body portion antibody  
molecule variable participate binding immune modulator e process unrelated organism live  
similar environment develop analogous structure layer cell surround oocyte aid development  
ovum e remnant ovarian follicle aer ovulation continue secrete progesterone degeneration  
lead menstruation maintain uterine lining pregnancy e external layer find organ body  
include brain adrenal gland kidney release calcium ion ovum aer fertilization result creation  
fertilization membrane structure prevent fertilization ovum multiple sperm cell steroid  
hormone produce adrenal cortex include glucocorticoid cortisol mineralocorticoid aldosterone  
cortical sex e exchange genetic material homologous chromosome meiosis intracellular  
second messenger signaling cascade initiate peptide hormone synthesize atp chemical  
substance stimulate inflammation recruit additional immune cell specific area e division  
distribution parent cell cytoplasm daughter cell mitotic meiotic cell division e fluid solute cell  
membrane external nucleus cellular organelle t cell seek infected cell induce apoptosis cell  
prevent spread pathogen type genetic mutation variable dna e portion neuron receive  
stimulus convey cell body e layer skin cell epidermis contain sweat gland hair follicle fat  
blood vessel rapid mitotic division occur embryo result cell predetermine fate cell capable  
differentiate certain kind tissue organism

cell predetermine fate cell capable differentiate certain kind tissue organism designation cell  
embryo have particular in muscular structure divide thorax abdomen provide drive force  
inhalation cylindrical sha long bone e period relaxation cardiac muscle atrioventricular valve  
open ventricle fill blood e process unspecialized cell specialized involve selective transcription

genome & breakdown macromolecular nutrient material mechanical chemical mean simple molecular building block have chromosome type cell symbolize  $2n$  substance secrete bloodstream cause change physiological activity cell require intermediary selective pressure favor development extreme phenotype provide selective advantage phenotype emerge primary phenotype time type selection selective pressure favor extreme phenotype norm process change organism common ancestor evolve dissimilar structure dolphin flipper human refer allele require copy expression fetal structure shunt blood pulmonary artery aorta bypass develop lung shunt umbilical vein inferior vena cava allow oxygenate blood return placenta bypass liver enter systemic circulation segment small intestine content stomach pancreatic bile duct site digestion outermost embryonic germ layer give rise skin nervous system inner ear lens eye structure efferent motor neuron enteric nervous system organ muscle gland organism respond neuron transmit nervous impulse central nervous system effector organism early developmental stage human term refer first week after fertilization form cell cell communication involve secretion hormone bloodstream ductless gland hormone travel distant location organism cause change cellular innermost embryonic germ layer later give rise lining alimentary canal digestive respiratory organ uterine lining regenerate month preparation implantation embryo absence embryo result sloughing off endometrium process know menstruation membrane bind channel cytoplasm transport protein lipid part cell lining blood vessel consist endothelial cell collection neuron gastrointestinal tract govern peristalsis type granulocytic leukocyte largely participate immune response parasite involve pathogenesis & outermost layer skin & coil tube sperm gain motility store after production testis & small flap cartilage cover glottis swallowing prevent food enter larynx hormone synthesize

cartilage cover glottis swallowing prevent food enter larynx hormone synthesize adrenal medulla stimulate fight or flight response neurotransmitter sympathetic nervous cartilaginous structure epiphysis growth occur dilate end long bone specialized subset plasmid capable

integrate genome bacteria specific circumstance e cellular layer cover internal external surface body structure cavity red blood cell biconcave disc shaped cell contain hemoglobin nucleus portion alimentary canal connect pharynx unicellular multicellular organism compose cell contain membrane bind nucleus membrane bind e change gene pool generation cause mutation nonrandom mating natural selection genetic dri. gland release secretion duct part liver sweat gland vary expression disease symptom despite identical muscle straightening limb prokaryote exist oxygen fusion gamete structure create cortical reaction aer fertilization ovum sperm cell prevent fertilization ovum multiple sperm cell develop organism pass early developmental stage human term refer embryo ninth week aer fertilization birth e insoluble protein form bulk blood clot offspring genetic cross supplement subscript generation parent nephron process blood plasma force high pressure glomerulus bowman capsule reproductive success

individual measure increase number survival offspring microscopic whip like filament function locomotion sperm cell unicellular organism compose microtubule muscle bending limb e set cell surround develop mature ovum secrete nutrient estrogen atrophy corpus luteum aer ovulation shunt fetal heart right le atrium allow circulation largely bypass develop lung organ liver store bile contract response stimulation cholecystokinin result release bile biliary system eventually duodenum sperm ovum cell half number chromosome somatic cell haploid fuse gamete form zygote mass neuron cell body outside central nervous system e embryonic stage characterize presence ectoderm mesoderm endoderm e basic unit heredity region chromosome code allele gene individual give variation gene pool cause chance diagrammatic representation chromosome indicate distance gene chromosome determine organism complete set chromosome e genetic composition entire organism reference e network capillary encapsulate bowman capsule act filter blood enter nephron e opening trachea organelle play role packaging secretion protein molecule produce intracellularly ovary testis reproductive organ gamete process stain bacterial cell cell contain large amount

peptidoglycan cell wall stain purple cell peptidoglycan cell wall appear pink red aer type leukocyte cytoplasmic granule visible microscope neutrophil basophil eosinophil region central nervous system consist largely neuron cell body dendrite synapsis substance cause induction embryonic development ensure development correct structure have type chromosome cell symbolize states gene ratio allelic frequency remain constant generation non evolving population central channel osteon haversian system contain blood vessel nerve fiber lymph vessel type chain peptide create antibody antibody consist heavy chain light chain type t cell secrete lymphokine specific combination lymphokine secrete determine nature immune response activation th1 cell result cytotoxic response th2 response rely b cell measurement blood sample consist red blood cell express percentage iron contain protein find red blood cell bind o2 transport body have different allele particular trait area organ large vessel structure enter exit renal

particular trait area organ large vessel structure enter exit renal hilum renal artery enter kidney renal vein leave kidney ureter exit kidney transport urine inflammatory mediator cause vasodilation result increase movement fluid cell blood vessel maintenance stable internal physiological environment chromosome diploid cell carry correspond gene trait correspond loci have identical allele give trait chemical messenger secrete cell body carry bloodstream cell body regulate biochemical activity form adaptive immunity take place body fluid drive b cell antibody e resultant offspring cross mate different gene type different specie subcutaneous layer beneath dermis skin e region vertebrate forebrain control autonomic nervous system control center hunger thirst body temperature visceral function secrete factor stimulate inhibit pituitary secretion e terminal portion small intestine movement action potential axon result neurotransmitter release synaptic bouton transmission inborn error metabolism impulse target neuron organ genetic mutation cause change enzyme require metabolism early intervention necessary prevent development life threaten condition inborn error metabolism ultimately incompatible life genetic effect phenotype heterozygote mixture

parental phenotype unlinked gene primary germ cell separate randomly gametogenesis rapid mitotic division result cell individually capable complete organism chemical substance pass organize cell responsive cell result differentiation responsive cell e initiation cell differentiation develop embryo influence cell form immunity nonspecific require e outer layer body skin provide function thermoregulation innate immunity collection fiber help maintain overall integrity cytoskeleton neuron cell body nerve terminal confine specific area oen involved spinal reflexe e stage successive nuclear division divide g1 s g2 stage cell growth dna replication occur oxidation fatty acid glucose energy cell fluid-filled potential space parietal visceral pleura lubricate pleural surface allow pressure differential intrapleural space lung chromosomal mutation section chromosome break off flip reattache original spot mechanism prevent genetic exchange individual different specie population e middle portion small intestine space bone joint enclose maintain form cell cell

small intestine space bone joint enclose maintain form cell cell communication cell release substance bind receptor cell directly adjacent release protein present outermost layer skin largely responsible prevent loss fluid salt entry foreign substance body present intermediate filament cell epidermis produce keratin vertebrate organ regulate water salt concentration blood responsible urine formation protein structure locate centromere provide place spindle fiber attach chromosome small lymphatic vessel run center villi small intestine site lipid absorption lymphatic system small space bone matrix osteocyte reside loop henle lower esophageal sphincter concentric circle bony matrix haversian system specialized macrophage reside skin tube like structure short wide small intestine largely responsible resorption water formation semisolid fece consist cecum ascend colon transverse colon descend colon sigmoid colon rectum pathway air pharynx trachea e epiglottis close prevent food enter larynx e short interval application stimulus muscle contraction muscle flow gene closely relate specie white blood cell subdivide granulocyte connective tissue join bone type chain peptide create antibody antibody consist heavy chain light chain tendency certain allele inherit proximity



chromosome enzyme specifically cleave bond lipid genetic area region chromosome e u shaped section mammalian nephron ring shaped muscular structure separate esophagus stomach know cardiac sphincter e space tube sac clear fluid derive blood plasma transport lymph vessel lymphatic duct circulatory small bean shaped structure provide location antigen presentation mounting attack adaptive immune system type white blood cell involve organism specific bacteriophage infection involve integration viral dna bacterial genome disrupt destroy host e virus subsequently reemerge enter lytic cycle membrane bind organelle store hydrolytic enzyme bacteriophage infection involve destruction lysis host phagocytic white blood cell unit denote 1 percent recombination frequency gene create genetic map correspond centimorgan granulocyte release histamine cause inflammation break large food particle tooth tongue relate individual pregnant text imply gender identity pregnant individual physical breakdown large

pregnant text imply gender identity pregnant individual physical breakdown large food particle small e internal section organ adrenal gland kidney generally refer medulla oblongata mammalian hindbrain e brainstem close spinal cord control vital function breathing heartbeat precursor cell give off platelet process cell division successive nuclear division produce haploid gamete diploid germ cell skin pigment produce melanocyte protect skin uv radiation provide color skin melanin produce cell skin lymphocyte b- t cell lineage remain aer infection go order recognize previous invader rapidly induce humoral immune response e shedding uterine lining occur week phenotypically female individual presently pregnant capable pregnant e middle embryonic germ layer give rise muscular skeletal urogenital circulatory system e sum biochemical reaction occur organism e stage mitosis meiosis single chromosome tetrad line central axis divide cell attach spindle fiber small polymerize rod actin participate muscle contraction movement material cellular membrane phagocytic white blood cell reside central nervous system small hollow tube compose type protein subunit serve numerous function cell comprise internal structure cilia flagella allow

vesicle movement cell type mutation result substitution amino acid membrane bind cellular organelle reaction aerobic respiration atp synthesis occur cellular division result formation daughter cell genetically identical parent cell e atrioventricular valve separate le atrium le nerve carry afferent sensory efferent motor white blood cell transform macrophage dendritic cell enter tissue cross member species seek study trait sugar consist monomer glucose fructose molecule cause nearby cell proceed specific developmental pathway embryonic development e solid ball cell result early stage cleavage e type epithelial tissue line moist body cavity mucous type epithelial cell secrete mucus stem cell able differentiate cell agent chemical physical cause mutation change dna sequence e white lipid contain material surround axon neuron central peripheral nervous system ability muscle cell contract input nervous system find smooth cardiac muscle type heme

contract input nervous system find smooth cardiac muscle type heme contain protein bind molecular oxygen muscle protein find muscle cell function muscle contraction myosin fiber call thick filament ongoing evolutionary process result change gene frequency lead differential development phenotype describe genome rna virus contain rna sequence complementary actual transcript viral protein e functional unit vertebrate kidney bundle neuron e self propagate change electrical potential end axon neurotransmitter molecule release call synaptic bouton neural crest cell node ranvier cell originate tip neural fold migrate outward form peripheral nervous system melanocyte c- cell thyroid group ectodermal cell slide create fold later neural tube embryonic hollow tube subsequently give rise central support cell neuron responsible function hold neuron place supply neuron oxygen nutrient insulate neuron neuron destroy pathogen remove dead cell conduct electrical impulse functional unit chemical agent release synaptic cle synaptic bouton neuron bind receptor site postsynaptic neuron effector membrane alter activity type granulocytic leukocyte largely participate nonspecific immune response bacteria e specific way life occupy give organism environment include interaction organism point myelinate axon cover myelin failure homologous

chromosome separate change nucleotide sequence dna result premature stop codon mrna sequence hormone synthesize adrenal medulla stimulate fight or- flight response neurotransmitter sympathetic nervous system supportive rod run ventral neural tube vertebrate embryo induce neurulation double membrane envelop nucleus interrupt periodically pore find eukaryotic cell know small hole nuclear membrane allow way exchange material cytoplasm nucleus location prokaryotic cell chromosome find dense body visible nondividing nucleus site ribosomal rna e eukaryotic membrane bind organelle contain cell chromosome neuroscience collection cell body central myelin produce cell central nervous system undifferentiated cell undergo meiosis produce egg cell gametogenesis ovary lead formation mature ova suck pressure generate presence solute draw water bone cell responsible generation new bone bone remodeling storage mineral bone matrix bone cell responsible

bone bone remodeling storage mineral bone matrix bone cell responsible resorption bone bone remodeling mobilization mineral bone matrix parasympathetic nervous system mature bone cell house bone matrix e female egg produce gonad e tube lead ovary uterus generally site fertilization call fallopian tube e release mature ovum ovarian follicle e female gamete egg cell e oxygen need reconvert lactic acid pyruvate follow strenuous exercise difference oxygen need tissue oxygen available gland secrete digestive enzyme duodenum duct synthesize secrete hormone insulin glucagon somatostatin locate stomach duodenum upper layer dermis right epidermis consist loose connective tissue form cell cell communication cell release substance extracellular fluid substance bind receptor nearby cell cause change cellular activity e subdivision autonomic nervous system involve rest homeostasis generally antagonistic sympathetic nervous system pair gland locate thyroid secrete hormone regulate calcium phosphorous metabolism cell stomach responsible secretion acid lumen stomach immunity confer transfer injection previously pattern recognition receptor peripheral nervous system infectious disease cause agent include

bacteria virus fungus parasite prion type receptor macrophage dendritic cell able recognize nature invader bacteria virus fungus release appropriate cytokine attract right immune cell percent individual particular genotype actually express associate phenotype enzyme cleave peptide bond fibrous sheath surround long bone include neuron outside central nervous system include sensory motor neuron subdivide somatic autonomic nervous system rhythmic wave muscular contraction substance tube commonly food digestive tract organelle contain hydrogen peroxide participate breakdown long chain fatty acid pathway food mouth esophagus air nose mouth larynx e physical manifestation organism genotype structure brain secrete melatonin hormone aid regulation sleep wake cycle e bilobed endocrine gland lie hypothalamus hormone regulate endocrine gland know master gland e structure form wall uterus chorion embryo contain network capillary exchange maternal fetal circulation occur e fluid component blood contain dissolve solute minus derive b lymphocyte ability produce small circular

dissolve solute minus derive b lymphocyte ability produce small circular ring extrachromosomal dna find bacteria small enucleate disc shaped shard blood cell play important role clotting connective tissue surround lung aid provide attachment lung chest wall parietal pleura lie chest wall visceral pleura adherent lung stem cell undergo gastrulation able differentiate cell type primary germ layer small nonfunctional haploid cell create oogenesis group organism specie live give circuit blood capillary bed tandem connect artery vein example include hypophyseal hepatic renal portal system describe genome rna virus contain rna serve directly transcript viral protein production term describe ability inability stem cell differentiate different cell type humoral immune response invader first encounter take seven day effective infectious protein cause disease cause change three- dimensional structure protein  $\alpha$  helices  $\beta$  pleated sheet cell lack nuclear membrane membrane bind organelle bacterium e stage mitosis meiosis dna strand condense form visible chromosome prophase meiosis homologous chromosome align gland phenotypically male mammal secrete

alkaline semilunar valve separate right ventricle pulmonary artery e terminal fiber heart  
conduction system locate wall ventricle e valve regulate flow chyme stomach small intestine  
allele require copy express new gene combination achieve sexual reproduction crossing  
eukaryote transformation transduction conjugation prokaryote measurement oen gene  
recombine different combination gene close low terminal portion large intestine fece store  
involuntary nervous pathway consist sensory neuron interneuron motor neuron effector occur  
response e period time follow action potential neuron incapable depolarization protein  
synthesize secrete hypothalamus stimulate pituitary synthesize release hormone know tropic  
hormone e wide ureter locate kidney location collect duct eventually hormonal pathway  
function raise blood pressure restoration rest membrane potential neuron depolarize active  
passive process biochemistry series oxygen require biochemical reaction lead atp synthesis  
physiology inhalation exhalation gas exchange lung embryonic cell undergo induction e  
electrical potential cell rest approximately -70 mv excitable cell point

electrical potential cell rest approximately -70 mv excitable cell point cell cycle prevent cell  
enter portion cell cycle certain criterion meet lower layer dermis consist dense connective  
tissue rna virus contain enzyme reverse transcriptase transcribe rna dna rough endoplasmic  
reticulum antigen red blood cell presence absence indicate + respectively blood type notation  
call d organelle compose rna protein translate mrna protein synthesis portion endoplasmic  
reticulum appear rough microscopically presence ribosome attach outer surface site protein  
synthesis protein destine membrane bind secrete process electrical signal jump node ranvier  
travel axon muscle cell membrane capable propagate action potential e functional  
contractile unit striate muscle e endoplasmic reticulum muscle cell envelop myelin produce  
cell peripheral nervous system substance mobilize cell aer binding hormone receptor  
humoral immune response previously encounter invader result activation memory cell fluid  
release ejaculation consist sperm cell suspend seminal fluid gland find phenotypically male  
mammal produce smooth endoplasmic reticulum somatic nervous system specific immune

response plasmid contain genetic material formation sex pili require appendage extend donor male + bacterial cell recipient female allow formation cytoplasmic bridge transfer genetic material gene locate sex chromosome x chromosome gene exhibit different inheritance pattern genotypical male genotypical female reproductive process involve fusion gamete result passage combine genetic information change nucleotide result change protein degenerative nature genetic code multiple codon code amino acid long tube like structure long narrow large intestine largely responsible chemical digestion foodstuff absorption nutrient consist duodenum jejunum ileum portion endoplasmic reticulum lack ribosome surface location lipid synthesis detoxification drug poison cell body germ cell gamete subdivision peripheral nervous system govern voluntary action e large group organism capable mate produce viable organism target fight specific pathogen antibody cytotoxic immunity e mature male gamete sex cell immature haploid sperm cell gametogenesis testis lead sperm formation diploid stem cell male eventually rise sperm mature

sperm formation diploid stem cell male eventually rise sperm mature haploid sperm cell ring shape muscle close open tube device measure blood pressure consist inflatable cuff gauge measure pressure structure divide cell compose microtubule involve separation chromosome mitosis meiosis highly vascular organ le upper quadrant abdomen serve location disposal age red blood cell presentation antigen b cell selective pressure result elimination extreme sum force generate hydrostatic osmotic pressure result great attraction fluid membrane blood eject ventricle heartbeat process occur postsynaptic neuron target organ require stimulation multiple presynaptic neuron order respond stimulus spatial temporal sympathetic nervous system know regulatory t cell treg t cell limit immune response prevent detrimental immune reaction autoimmunity detergent lower surface tension prevent collapse organism live closely host engage mutually e subdivision autonomic nervous system produce fight or-flight response e junction neuron neurotransmitter e pairing homologous chromosome prophase fluid-filled space bone joint enclose fibrous tissue synovial fluid lubricate joint e

period cardiac cycle ventricle contract pump blood aorta pulmonary artery type leukocyte mature thymus participate e final stage mitosis meiosis chromosome uncoil nuclear membrane reform cytokinesis occur fibrous connective tissue connect bone muscle cross organism show dominant trait organism show recessive trait determine organism homozygous heterozygous trait e sperm produce organ secrete testosterone sustained muscle contraction result continuous pair homologous chromosome synapse prophase meiosis chromosome consist sister chromatid tetrad consist chromatid process organism regulate internal temperature respiratory integumentary circulatory e main lymphatic vessel empty lymph e low magnitude stimulus strength induce enzyme participate blood clotting convert fibrinogen fibrin ductless gland upper chest region vertebrate function development immune system vertebrate endocrine gland locate neck synthesize triiodothyronine thyroxine calcitonin mass similar cell support structure organize continuous state low level muscle contraction type stem cell potency describe cell able differentiate cell type organism e tube connect pharynx bronchi e transposition

cell type organism e tube connect pharynx bronchi e transposition genetic material organism virus uptake incorporation dna environment recipient bacterial cell genetic element capable insert remove atrioventricular valve separate right atrium right ventricle embryonic cell line blastocoel rise chorion placenta hormone secrete travel target cell organ trigger release hormone cause change physiological activity target cell protein constituent microtubule person o- blood blood able give type induce immune response person ab+ blood able receive blood type undergo immune response nitrogenous waste product produce liver ammonia e tube carry urine kidney bladder e tube carry urine bladder exterior liquid waste result filtration reabsorption secretion

filtrate nephron organ mammalian female reproductive system site embryonic development solution fractionate dead attenuate live pathogenic material introduce individual purpose

stimulate primary immune response boost previously produce passageway childbirth occur location sperm deposit sexual intercourse e tenth cranial nerve innervate palate pharynx larynx heart lung abdominal viscera responsible maintain homeostatic activity parasympathetic response e tube carry sperm testis urethra phenotypically male mammal second capillary bed kidney remove substance interstitium kidney return systemic in wall blood vessel carry blood heart large vein superior inferior return deoxygenate blood periphery right atrium heart group neuron medulla oblongata regulate e chamber heart pump blood pulmonary small venous structure link capillary vein refer organ limb apparent function functional time organism evolutionary past small projection wall small intestine increase surface area digestion absorption small plant pathogen consist short circular single strand rna tiny organism like particle compose protein encase nucleic acid virus obligate parasite organic nutrient organism produce require organism small amount aid proper metabolic functioning vitamin oen function cofactor enzyme e portion central nervous system consist primarily layer cell surround oocyte e diploid  $2n$  cell result fusion haploid  $n$  inactive enzyme precursor convert active note material figure table indicate italic f t aer page number band 420 423f abdominal cavity ovulation 77–78 81 abo antigen 274–275 454 carbohydrate vs. peptide 353 celiac disease 353 digestion vs. 345 epithelial cell 16 jejunum ileum 352 361–364 362f large intestine 364–365 ace angiotensin convert enzyme acetylcholine ach 157–158 163–164 401 422 acetylcholinesterase ache 157 158 422 acid base balance 234 236–237 270 279 282 366 384 390–391 394–395

ph acid reflux disease 351 acinar cell 355–356 356f 358 t acrosome 77–79 77f 100 ath adrenocorticotrophic hormone cleavage furrow 14 cytoskeleton 14 myosin bind site 422–423 422f skeletal muscle 419 smooth muscle 419 150 424 axon hillock 144 152–153 impulse propagation 154–155 155f ion channel 153–154 153f 155 muscle sarcolemma 421 422 node ranvier 145 resting potential 150–152 152f 154 active transport 124 151 152f 362 391f 392 adaptation 457 461 478 480 activation 319–320 cell mediate immunity 306 307 315 318 319f



cell 315–319 316f 317f 319f humoral immunity 305 307 316–317 319f innate immunity vs. 303  
304 307 mhc macrophage 310–311 plasma cell antibody 305 317 adaptive radiation 478  
adenosine triphosphate atp adenylate cyclase 185 adh antidiuretic hormone androgen source  
202 corticosteroid source 186 200–201 201f 206 t 207 t endocrine 189 190f 200–201 201f 206 t  
207 t hypothalamus feedback 191 192f mesoderm origin 105 renin angiotensin aldosterone  
system 200 201f 279 393 adrenal gland 105 189 190f 200 adrenal medulla 105 116 189 190f  
200 202 adrenocorticotrophic hormone acth 190–193 200 206 t adult hemoglobin hba 282  
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