

## Exam 1.

True or False: A virus is considered a microorganism.

**False. Viruses are not living and as such are not considered microorganisms. Viruses can, however, be classified as microbes, a more general term that includes microorganisms and viruses.**

2. What is the smallest biological unit of life?

**A cell.**

3. At a generalized level, all cells are comprised of what?

**Macromolecules\***

**\*A student may also answer: Proteins, Lipids, Nucleic acids and Polysaccharides but they must answer with all four to be fully correct.**

How many different types of amino acids are available from which to make proteins?

**20**

2. Define an essential amino acid.

**An essential amino acid cannot be produced by the human body and as such must be taken in from the environment through alternative sources (i.e) food.**

## Exam Page 3

1. What are the two major types of nucleic acids and their roles?

DNA (deoxyribonucleic acid): Contains the genetic material as well as heredity characteristics found in living organisms. RNA (ribonucleic acid): its role is for decoding the sequence of heredity information found in DNA

### Answer Key

1. What are the two major types of nucleic acids and their roles?

**There are two major types of nucleic acids: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid). Nucleic acids are chemical molecules that carry genetic information within**

the cell. DNA contains a vast amount of hereditary information and is responsible for the inheritable characteristics of living organisms. RNA is responsible for deciphering the hereditary information in DNA and using it to synthesize proteins.

## Exam Page 4

### Answer Key

1. Complete the following RNA strand and indicate how many bonds are formed for each complementary pair:

3' GGUCAUCG 5'

5' CC AGC 3'

3' GGUCAUCG 5'

5' CCAGUAGC 3'

There are 2 bonds formed between A and U, and 3 bonds between G and C.

## Exam Page 5

### Answer Key

1. The plasma membrane (select all that are true):
  - A. Only restricts movement of materials into the cell
  - B. Is often a bilayer comprised of lipids
  - C. Cannot prevent essential nutrients from escaping
  - D. Contains hydrophobic tails pointing inward

**B and D**

2. Carbon, Hydrogen and Oxygen atoms come together to form what primary macromolecule? Give an example.

**Polysaccharides. Glucose, sucrose and cellulose are all acceptable answers.**

## Exam Page 6

### Answer Key

1. True or False: Eukaryotic cells do not have a nucleus

**False. Eukaryotic cells do have a nucleus (prokaryotic cells do not).**

2. True or False: Prokaryotic cells can be subdivided into Bacteria and Archaea.

**True**

3. Describe the 4 basic bacterial morphologies.

**Coccus (round/spherical), bacillus (rod), vibrio (curved rod) or spirillum (spiral/corkscrew).**

4. True or False: Archaea, a eukaryotic class of microorganisms, are capable of surviving harsh environments.

**False. Archaea are prokaryotic bacteria capable of surviving harsh environments.**

## **Exam Page 7**

**Answer Key**

1. Which of the following microorganisms are considered to be Eukarya? Select all that apply.

- A. Animalia
- B. Plantae
- C. Fungi
- D. Protista

**A,B,C,D**

2. True or False: All multicellular microorganisms classified as Animalia are heterotrophic.

**True**

3. Microorganisms classified as Plantae obtain most of their energy by converting \_\_\_\_\_ energy into \_\_\_\_\_ energy.

**Light (sunlight); chemical (sugars)**

## **Exam Page 8**

**Answer Key**

1. A defining characteristic of fungi is the presence of chitin in the cell walls. Which of following also contain chitin? Select all that apply.

- A. Mushrooms
- B. Bacteria
- C. Yeast
- D. Molds

**A, C and D all contain chitin.**

2. True or False: A defining characteristic of Protista is the inability of colonies to form tissue layers.

**True.**

## Exam Page 9

### Answer Key

1. Cell walls are found in which of the following (select all that apply):

- A. Plants
- B. Fungi
- C. Bacteria
- D. Mammalian cells
- E. Algae

**A, B, C, E**

2. The function of the ribosome is (select all that apply):

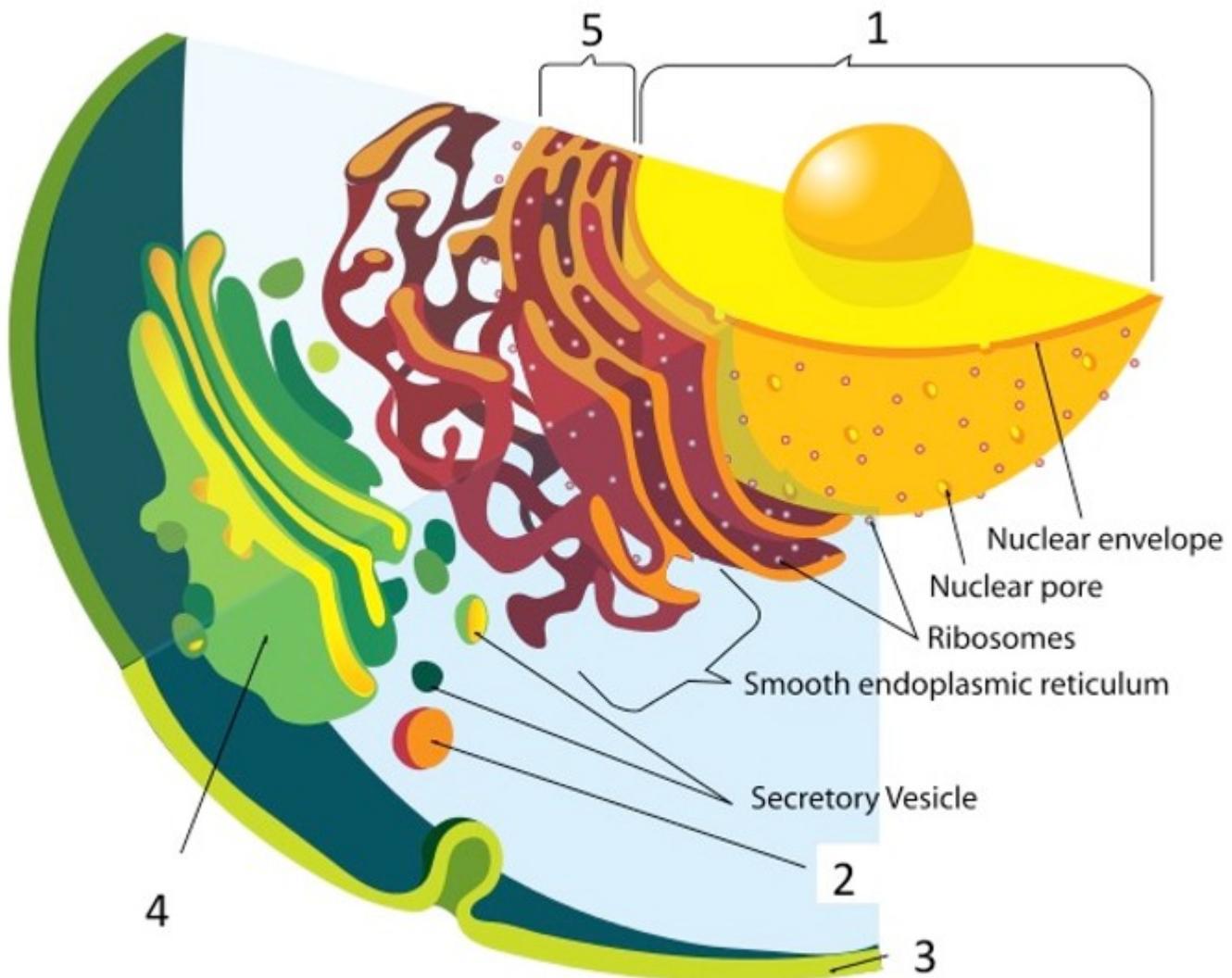
- A. Lipid synthesis
- B. Protein synthesis
- C. To produce energy (ATP)
- D. Protein modification and distribution
- E. Waste disposal via hydrolytic enzymes

**B. Ribosomes are located in the cytoplasm of prokaryotic cells and in the ER of eukaryotic cells.**

## Exam Page 10

### Answer Key

1. Identify the following cellular components by matching the number with the description.



- A. Cell wall
- B. Lysosome
- C. Centriole
- D. Rough endoplasmic reticulum
- E. Plasma membrane
- F. Nucleus
- G. Golgi apparatus

**1 F**

**2 B**

**3 E**

**4 G**

**5 D**

## EXAM MODULE 2

True or False: As movement requires energy, metabolism can be defined as a controlled set of biochemical reactions that occur in only motile organisms in order to maintain life.

**False. Metabolism occurs in all living organisms, not just those that move.**

2. True or False: Enzymes slow down chemical reactions to conserve energy.

**False. Enzyme catalyze (speed up) chemical reactions.**

3. What is a cofactor? And give a general example.

**A cofactor is a small chemical component that assists an enzyme during the catalysis reactions. A cofactor is usually metal ions.**

### Answer Key

1. Define anabolism.

**Anabolism is the process of building up or biosynthesis of macromolecules from small molecular units into much larger complexes.**

2. In order to convert proteins into amino acids which metabolic process would be active?

**Catabolism would be active as proteins are made up of amino acids. Therefore the process described (proteins into amino acids) is the breakdown, or catabolism of protein.**

## Exam Page 3

### Answer Key

1. Describe the energy transfer process relative to both ATP and ADP.

**ATP has the energy (phosphate group) to donate while ADP can accept energy in the form of a phosphate group. Thus, ATP can be reduced ( $\text{ATP} \rightarrow \text{ADP} + \text{Pi}$ ) while ADP can be built into ATP ( $\text{ADP} + \text{Pi} \rightarrow \text{ATP}$ ).**

2. An organism that derives its energy (generates ATP) from photons of light is called a \_\_\_\_\_?

**Phototrophic microorganism.**

An organism that derives its energy by removing electrons from elemental sulfur would be classified as a \_\_\_\_\_?

**Lithotroph**

4. A reactive intermediate would be present in which phosphorylation process?

- A. Photophosphorylation
- B. Substrate-level phosphorylation
- C. Oxidative phosphorylation

**B. The chemical compound losing the phosphate group is referred to as the phosphorylated reactive intermediate.**

## Exam Page 4

### Answer Key

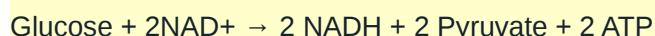
1. The catabolism of a single molecule of glucose goes through what 3 distinct transitions?

**The breakdown of glucose goes through (1) Glycolysis then (2) Fermentation or Respiration and finally through (3) the electron transport chain (ETC).**

2. What is the most energetic transition in the catabolism of glucose?

**The electron transport chain yields 34 ATP while both glycolysis and fermentation (or respiration) each yield only 2 ATP.**

3. Identify the reactants of the following chemical equation:



**The reactants are to the left of the arrow: Glucose and 2NAD<sup>+</sup>**

4. The presence of what molecule 'signals' to the cell that glycolysis is about to start?

**Glucose-6-phosphate (G6P)**

5. True or False: In the absence of oxygen fermentation produces 2 ATP.

**False. Fermentation only reduces NADH back to NAD<sup>+</sup>**

## Exam Page 5

**Answer Key**

1. What is the primary byproduct of the TCA cycle? Select all that apply.

- A. NAD<sup>+</sup>
- B. FAD
- C. NADH
- D. FADH<sub>2</sub>

**C and D. The TCA cycle produces an abundance of reduced electron carriers (NADH and FADH<sub>2</sub>).**

2. True or False. The reactants of the TCA cycle directly enter and fuel the electron transport system.

**False. The products of the TCA cycle (reduced electron carriers) enter and drive the production of ATP via the electron transport system.**

## Exam Page 6

**Answer Key**

1. In the absence of glucose, which of the following can be used as alternative energy sources?

Select all that apply.

- A. Lactose
- B. Nucleic acids
- C. Carbohydrates
- D. Lipids

**A, C, D can all be used as alternative energy sources.**

2. For the catabolism of proteins and lipids, which of the following enzymes are used? Select all that apply.

- A. Ligases
- B. Proteases
- C. Transferases
- D. Lipases

**B and D. Proteases breakdown proteins while lipases breakdown lipids.**

3. True or False. The  $\beta$ -oxidation pathway catabolizes the fatty acid chains of lipids.

True

## Exam Page 7

### Answer Key

1. True or False. Plants, algae and bacteria all contain chloroplasts.

**False. Chloroplasts are specific to algae and plants only.**

2. The process of carbon fixation begins with which of the following reactants: select all that apply.

- A. ATP
- B. Glyceraldehyde-3-phosphate
- C. CO<sub>2</sub>
- D. NADPH
- E. H<sub>2</sub>O

**A, C, D, and E. Carbon fixation uses the ATP/NADPH produced during light reactions to convert CO<sub>2</sub> and H<sub>2</sub>O into useful sources of energy (carbohydrates).**

## Exam Page 8

### Answer Key

1. What is one of the main functions of light reactions?

**Similar to the electron transport chain, one of its main functions is to generate a proton concentration gradient to generate ATP.**

2. True or False: Dark reactions can occur in the presence or absence of light.

**True. The term ‘dark reactions’ (also known as the Calvin Cycle) simply denotes the second stage in photosynthesis—dark reactions do not actually require darkness in order to occur.**

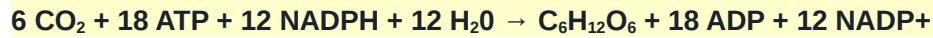
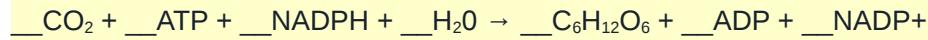
## Exam Page 9

### Answer Key

1. How many turns (or repetitions) of the Calvin Cycle are required to generate one molecule of glucose?

**Six.**

2. Complete the following equation by placing the appropriate numbers where indicated.



## Exam Page 10

### Answer Key

1. Match the following reactions to its corresponding enzyme:

1. A + B → A-B
2. A-B → A + B
3. A<sup>-</sup> + B → A + B<sup>-</sup>
4. Ab + C → A + Cb

A- Lyases

B- Transferases

C- Oxioreductases

D- Hydrolases

E- Ligases

F- Isomerases

**1E 1. A + B → A-B      Ligases**

**2A 2. A-B → A + B      Lyases**

**3C 3.  $A^- + B \rightarrow A + B^-$       Oxioreductases**

**4B 4.  $Ab + C \rightarrow A + Cb$       Transferases**

## EXAM MODULE 3

. A micrometer is defined as

- A.  $10^{-3}$
- B.  $10^{-6}$
- C.  $10^{-9}$
- D.  $10^{-12}$

**B. A micrometer is one-millionth of a meter.**

2. True or False: A nanometer is longer than a micrometer.

**False. A nanometer is 1,000 times smaller than a micrometer.**

## Exam Page 2

### Answer Key

1. Resolution and contrast are two critical factors that influence your ability to see an object. Explain each.

**Resolution refers to the distance between two objects at which the objects still can be seen as separate. Poor or low resolution means two (or more) objects may appear as one.**

**Contrast is the difference in light absorbance between two objects. Poor contrast gives a high background and makes the visualization of multiple objects difficult. For instance, trying to identify 2 dark colored objects at night (low light = low contrast) versus the same 2 objects in the middle of a sunny afternoon (bright light against 2 dark objects = high contrast).**

## Exam Page 3

### Answer Key

1. Assuming a constant (non-adjustable) light source power, identify the part of the microscope you would adjust to limit the amount of light entering the microscope.

Select all that apply.

- A. Objective
- B. Condenser
- C. Iris diaphragm
- D. Eye piece

**C. The iris controls the amount of light that passes through the sample and into the objective lens. Thus, it can be adjusted (opened or closed) to alter the amount of light.**

2. What is the total magnification (relative to your eye) of a sample imaged with a 60x objective and a 10x eyepiece? Show your math.

**60 x 10 = 600x magnification**

## Exam Page 4

### Answer Key

1. True or False: A cell that is adherent, flat (thin) and unstained is easily identified using bright field microscopy.

**False. Adherent, flat cells are almost invisible due to the limits on both resolution and contrast.**

2. Which of the following could be seen clearly by the unaided eye? Select all that apply.

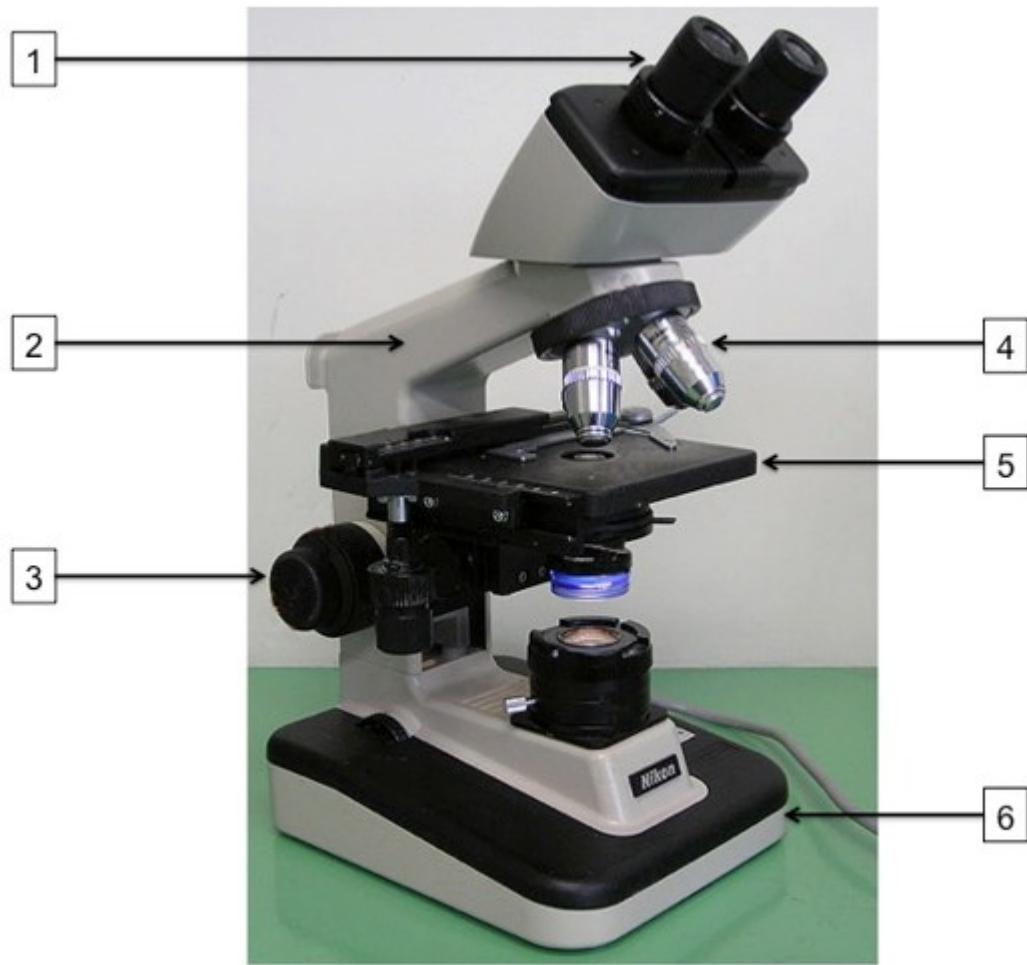
- A. Bacteria with diameter of 24  $\mu\text{m}$
- B. Protozoa with diameter of 150  $\mu\text{m}$
- C. Virus with a diameter of 0.2  $\mu\text{m}$
- D. Skin cell with diameter of 1500  $\mu\text{m}$

**B and D. The unaided eye can, on average, clearly resolve objects > 100  $\mu\text{m}$**

## Exam Page 5

### Answer Key

1. Label the following unmarked microscope components (numbered arrows) by matching it with the components provided (letters).



- A. Stage
- B. Fine Adjustment Knob
- C. Iris Diaphragm
- D. Neck
- E. Condenser Lens
- F. Eyepiece
- G. Objective
- H. Base
- I. Coaxial Controls

**1F**

**2D**

**3B**

**4G**

**5A**

**6H**

## Exam Page 6

### Answer Key

1. For each of the following questions select from the list below the single best answer:

Phase-Contrast

Dark Field

Fluorescence

Confocal

This type of microscope is best suited for visualizing GFP, RFP and YFP proteins.

**Fluorescence**

2. This type of microscope can provide detailed images of live cells without staining.

**Phase-Contrast**

3. This type of microscope is used to greatly increase the contrast between samples and background by reflecting light off of the specimen.

**Dark Field**

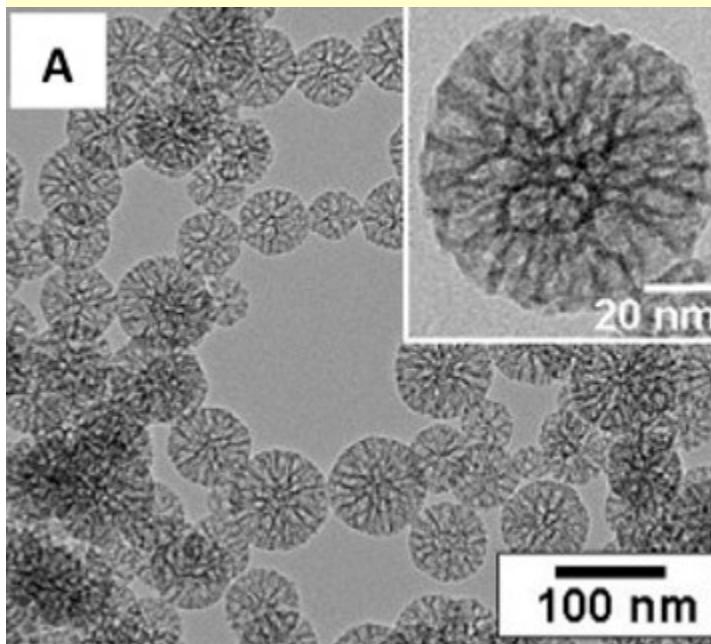
4. This type of microscope is capable of capturing images in multiple focal planes, rendering a specimen in 3D

**Confocal**

## Exam Page 7

### Answer Key

1. Identify what type of electron microscope was used to capture the following image and explain your choice.



The above image is captured via a Transmission Electron Microscope (TEM). Even at 20nm resolution (inset image), subcellular substructures are still visible. The image lacks the outside 'shell' only appearance of SEM.

## Exam Page 8

### Answer Key

1. Gram-Positive cells appear \_\_\_\_\_ in color due to a \_\_\_\_\_ peptidoglycan layer in the cell wall.

Purple; Thick

2. Gram-Negative cells appear \_\_\_\_\_ in color due to a \_\_\_\_\_ peptidoglycan layer in the cell wall.

Pink; Thin

## Exam Page 9

### Answer Key

1. True or False: The distinguishing characteristic of Gram-Negative bacteria is the presence of LPS in the outer membrane.

**True.**

2. True or False: If you wish to study the motility of an organism you cannot heat fix, but you can chemically fix the specimen.

**False. Both heat and chemical fixation strategies will kill the cell, making motility observations impossible.**

## Exam Page 10

### Answer Key

1. You want to observe the size and shape of a cell. What is the easiest staining technique that you could perform? Name at least one dye you would use during this process.

**Simple stain. You could use any of the following: methylene blue, crystal violet, safranin or fuschin.**

2. You suspect a patient may have TB. Once a sample has been obtained it is sent off to the lab for an acid-fast stain. If the patient were infected with TB, describe what you would expect to see on the stained slide.

**You would expect to see red cells (TB+) on a blue background (TB negative).**

3. True or False: If a patient is suspected of having malaria, a Giemsa stain would be an appropriate differential test to perform.

**True. Giemsa stains are often used in the clinical setting to aid in the diagnosis of blood parasites.**

## EXAM MODULE 4

True or False: Growth media is best suited for distinguishing between two similar species of bacteria.

**False. Growth media is designed to simply support (and not restrict) microbial growth.**

2. A researcher is asked to determine which of two vials contains E coli and which contains Salmonella. Knowing both are Gram-Negative while only one of them is capable of fermenting lactose, which type of media would be best suited:

- A. Growth media
- B. Differential media
- C. Selective media
- D. Selective and Differential media

**B. Differential media distinguishes between two, often related, microbes.**

3. What are the requirements of a fastidious microbe?

**A fastidious microbe is an organism with complex growth requirements such that if absent it will not grow. Enriched medias thus contain these specific and essential nutrients required for the growth of a particular subset of microorganisms.**

## Exam Page 2

Answer Key

1. True or False: LB agar is classified as a selective, non-differential media.

**False. LB agar is the most basic type of agar and like LB media supports the growth of virtually all microbes without restriction.**

2. What is agar used for in microbiology?

**Agar is used to create a solid, smooth surface on which microbes can grow.**

## Exam Page 3

Answer Key

1. Match the following hemolytic class with its description of activity.

1. Alpha hemolysis

**B** A. No hemolytic activity

2. Beta hemolysis

**C** B. Incomplete hemolytic activity

3. Gamma hemolysis

A

C. Complete hemolytic activity

## Exam Page 4

### Answer Key

1. Columbia CNA agar is most closely related to which media:

- A. Trypticase Soy Agar
- B. MacConkey Agar
- C. Blood agar
- D. EMB agar

**C. CNA agar is similar to BAP as it is also enriched with blood and allows for differentiation based on hemolytic patterns.**

2. True or False: Chocolate agar gets its brown color from cocoa to produce an enriched media.

**False. Chocolate (cocoa) is never added to the media. The name is derived simply based on the color that actually comes from the presence of 'cooked' (lysed) red blood cells in the media.**

3. A researcher is studying a strain of E. coli currently growing on a MacConkey plate. However, the researcher can't remember if E. coli is Gram-Positive or Gram-Negative. Would a Gram stain be necessary to confirm? Why or why not?

**No. A Gram stain would not be necessary, as only Gram-Negative microbes will grow on MacConkey agar. Thus, E. coli is a Gram-Negative microbe.**

## Exam Page 5

### Answer Key

1. In an attempt to detect the presence of the pathogenic strain of E. coli O157:H7, a researcher spread a culture onto a MacConkey agar with failed results. What type of agar should they (correctly) try next? Why?

**The microbe should be plated on SMAC (Sorbitol-MacConkey agar) as it is specifically formulated to detect O157:H7. Pathogenic E. coli (O157:H7) cannot ferment sorbitol while**

**non-pathogenic E. coli can ferment both sorbitol and lactose. Therefore, colonies that ferment (acidic conditions; non-pathogenic) can be differentiated from non-fermenters (neutral to basic conditions; pathogenic).**

## Exam Page 6

### Answer Key

1. What is the Gram status (Positive or Negative) of microbes growing on Eosin Methylene Blue (EMB) agar plates?

**Gram-Negative. EMB plates specifically restrict the growth of Gram-Positive bacteria.**

2. Mannitol salt agar will turn what color in the presence of the pathogenic strain Staphylococcus aureus?

**Yellow. Pathogenic Staph aureus will turn the agar from red to yellow.**

## Exam Page 7

### Answer Key

1. What is the process of spreading a bacterial culture onto a petri dish?

**Plating.**

2. In order to visual individual colonies of bacteria would you culture your sample in a liquid media or on a solid (agar) media? Why?

**Solid (agar) media. The primary advantage is that cells are held into place. When grown in a nutrient broth, bacterial cells can multiply but are free to move around in solution. When grown on agar within a petri dish the fixed in such as way as to form colonies.**

3. True or False? The visualization of colonies on a petri dish represents bacterial cells that have often multiplied a million times over.

**True. To form a bacterial colony the initial cell must have multiplied many times over, often greater than a million, in order for the naked eye to resolve it.**

## Exam Page 8

## Answer Key

1. True or False. The purpose of a quadrant streak is to expand a bacterial population.

**False. The purpose of the quadrant streak is to generate individual colonies such that a single (pure) bacterial sample can be isolated.**

2. To be considered a 'pure' culture, the sample (1) can be traced back to a single cell and (2)\_\_\_\_\_ ?

**The culture must also be free from external contaminants. Simply put, a pure sample would never contain multiple bacterial species (ie) Strep and Staph.**

3. When performing a quadrant streak, the sample is spread across the plate in such a way as to form what?

**A dilution gradient is formed. The resulting gradient should always contain within it the growth of individual colonies.**

4. In what phase of a dilution streak would you expect to find the lowest concentration of bacteria, P2 or P4?

**P4 (Phase 4) would contain the lowest concentration of bacteria. The phases rank (from highest to lowest), P1 > P2 > P3 > P4.**

## Exam Page 9

### Answer Key

1. True or False. When performing a dilution streak a new (or sterilized) loop must be used for each phase.

**True. Failure to do so would prevent the establishment of a dilution gradient, as the same bacterial concentration would be spread across both phase regions.**

2. In order to encourage growth of a slow growing microbe what might a researcher do during a phase dilution streak?

**A researcher may either (1) opt to perform only a 3-phase dilution streak or (2) pass the loop through the previous phase multiple times (as opposed to only once).**

3. True or False. To restrict the growth of a pathogenic microbe a researcher might decrease an incubator from 37°C to 25°C.

**True. Pathogenic strains of bacteria tend to grow faster than non-pathogenic strains at 37°C, so researchers may set incubators at 25°C to restrict its growth.**

## Exam Page 10

### Answer Key

1. When given an unknown bacterial sample the first step is to expand the current bacterial population. Which form of media best suites this need? Why?

- A. MSA agar
- B. LB media
- C. MacConkey agar
- D. Columbia CNA agar

**B. LB media.** All other options (A, C and D) are all forms of selective media, meaning they may potentially inhibit the growth of the unknown sample. The culture should be first expanded and then place onto selective/differential agar plates.

## EXAM MODULE 5

. Define the concept of universal precautions.

**Universal precautions means any and all samples, whether known or unknown, are to be treated as potentially hazardous (or pathogenic) materials.**

2. List at least 3 observations a researcher would be sure to note while assessing an unknown microbial sample.

**A lab researcher would be certain to note:**

- 1. Size and shape
- 2. Any observable motility
- 3. Gram status (positive or negative)
- 4. The presence of any chemical reactions

5. Changes in color localized to the organism or the surrounding media
6. Capture (or draw) images of any of the characteristics described above

## Exam Page 2

### Answer Key

1. While observing an unknown sample of limited amounts, a researcher must determine the following observations: (1) the presence of any motility and (2) its Gram status using the same sample—the liquid sample cannot be divided. Which would you determine first and why?

You must determine motility before determining the Gram status. Motility requires a wet mount, while Gram staining requires heat fixing the sample. If one were to begin with the Gram stain the heat fixation process would kill the organism, making any observations regarding motility impossible. The correct approach would be to place the liquid culture on a glass slide and determine its motility status. Next, the same liquid culture can be heat fixed and Gram stained.

2. A facultative anaerobe is a microorganism capable of growth under what conditions?

A facultative anaerobe is capable of growth under aerobic (with oxygen) and anaerobic (without oxygen) conditions.

## Exam Page 3

### Answer Key

1. True or False. The Lancefield groups are used to subdivide antigenic groups of alpha-hemolytic Streptococcus.

**False. The Lancefield groupings are used to subdivide beta-hemolytic Strep.**

2. The distinctions for Lancefield subgroupings lie in its: (select all that apply)
  - A. Catalase activity
  - B. Carbohydrate composition of antigens
  - C. Hemolytic activity
  - D. All of the above

**B. Carbohydrate composition of antigens present in the cell wall determines the Lancefield groupings (A, B, C, etc). Note, ALL strep under Lancefield groupings are (by definition) catalase negative and beta-hemolytic. Thus, answers A and C cannot be used to subdivide streptococcal species.**

3. Rheumatic fever displays \_\_\_\_\_ hemolytic activity and occurs when \_\_\_\_\_ is left untreated.

- A. Beta; Strep. Pharyngitis
- B. Gamma; Strep. Septicemia
- C. Beta; Rheumatic fever
- D. Alpha; Strep. Pharyngitis

**A. Strep throat (also known as strep. Pharyngitis) can lead to Rheumatic fever if left untreated and displays beta-hemolytic activity.**

## Exam Page 4

### Answer Key

1. True or False. Under most circumstances, staphylococcus can be found in ~80% of human population where it remains non-symptomatic.

**False. Staphylococcus is only found (non-symptomatic) in ~30% of the human population.**

2. Define commensal bacteria.

**The bacterium neither harms nor benefits from the host from which it obtains nutrients.**

3. How can Staphylococcus be differentially tested?

**Staphylococcus species are capable of growth in the presence of bile salts.**

## Exam Page 5

### Answer Key

1. Match the following symptoms with their respective diseases:

1. Folliculitis  
**D** A. Childhood skin disease near mouth/nose
2. Scalded-skin syndrome  
**E** B. Infection of thin, transparent scleral tissue
3. Impetigo  
**A** C. Infection occurs at time of birth
4. Conjunctivitis  
**B** D. Pus-filled lesions on skin or hair
5. Ophthalmia Neonatorum  
**C** E. Ruptured pustules; treated with Penicillin

2. True or False. The causative agent of conjunctivitis can be either bacterial or viral.

**True. There are bacterial (staph) and viral forms of conjunctivitis, both resulting in the inflammation of the conjunctiva and 'pink eye.'**

## Exam Page 6

### Answer Key

1. True or False. Tuberculosis is best identified by a Gram stain.

**False. Mycobacterium show poor Gram staining and show be screened via an acid-fast stain.**

2. True or False. You can become infected with TB simply by sharing a drink with someone who is currently infected with TB.

**False. As per the Center for Disease Control (CDC) guidelines, simply shaking someone's hand, sharing a drink or even kissing cannot spread TB.**

3. Identify the disease based on the following (select all that apply):

It is a small, acid-fast rod usually remaining asymptomatic for up to 20 years. It affects the skin, nerves, upper respiratory tract and eyes of infected individuals.

- A. Tuberculosis
- B. Leprosy
- C. Scalded-skin syndrome
- D. Hansen's disease
- E. Bacterial conjunctivitis

**B and D. Hansen's disease is simply another name for Leprosy. Leprosy is characterized by its ability to remain dormant for up to 20 years as well as the effects observed relative to the patients skin, nerves, lungs and eyes.**

## Exam Page 7

### Answer Key

1. Only directly ingesting the pre-formed Clostridium toxin (neither the bacteria nor its spores) will cause disease in adults.

**True. The mature (adult) microbiota is capable of killing the bacteria/spores.**

2. While visiting his grandparents, a 10-year-old child has green beans for dinner that were harvested from his grandparents' garden and canned the previous year. Severe illness sets in and the child is taken to the hospital. Botulism is suspected, but what form? Explain your answer.

**Foodborne botulism. The child is too old (> 6 months) to be considered for infant botulism and wounds were not present. The green beans were likely improperly canned and under the low-acidic, anaerobic conditions, bacterial growth was encouraged.**

## Exam Page 8

### Answer Key

1. True or False. Although there is no cure for tetanus, it can be prevented through vaccination.

**True. There is no cure for tetanus. However, tetanus is entirely preventable through vaccination.**

2. Describe the symptoms and treatment regimen for someone infected with Clostridium perfringens.

**Clostridium perfringens** (also known as Gas gangrene) presents with muscle necrosis, swelling of infected areas, fever and intense gas production. Treatment entails removal of all infected tissue, often resulting in amputation of the affected areas, in conjunction with heavy antibiotic therapies.

3. Why does the alpha toxin (perfringolysin) produced during an infection of gas gangrene cause cell death?

The toxin perforates the membrane. It forms pores in the plasma membrane of host cells resulting in uncontrolled ion fluxes and eventually cell lysis and death.

## Exam Page 9

### Answer Key

1. You develop a fever, chills and pneumonia after recently using a warm mist vaporizer in an attempt to open your sinuses. What bacterial disease would a doctor suspect is causing your symptoms? Would the doctor suspect you contracted it from touching (potentially) contaminated doorknobs?

**Legionnaires.** No—legionella cannot be spread simply by direct contact between people. Legionella can only be transmitted through droplets small enough to be breathed in.

2. True or False. Bubonic plague is often characterized by painfully swollen lymph nodes.

True.

3. Which form of the plague is highly virulent? What does it target?

Pneumonic plague is highly virulent and targets the respiratory (lungs) system.

## Exam Page 10

### Answer Key

1. Identify the following disease:



- A. Tetanus
- B. Anthrax
- C. Gas gangrene
- D. Frost bite

**B. Anthrax—the distinct black center at the site of infection is a hallmark of anthrax infection.**

2. Gonorrhea is caused by:

- A. Diplococcal bacteria
- B. Staphylococcus bacteria
- C. Gram-Negative spirochete
- D. RNA virus

**A. Diplococcal bacteria.**

3. True or False. Chlamydia trachomatis can be grown on an agar plate alone.

**False. Chlamydia is an obligate parasite and requires a host (viable cells) for its growth.**

4. Match the following diseases with their respective symptoms if left untreated:

Gonorrhea

**C**

Syphilis

**A**

Chlamydia

**E**

- A. Paralysis, blindness and dementia
- B. Painfully swollen lymph nodes
- C. Cardiac and neurological complications
- D. Respiratory failure associated with lock-jaw
- E. Infertility and pelvic inflammatory disease.
- F. Sore throat, ocular discharge and fever

## EXAM MODULE 6

. True or False. Because the genome is contained within an enclosed space, (much like the nucleus of a cell) viruses are classified as eukaryotic.

**False. Viruses are neither eukaryotic nor prokaryotic.**

2. Describe the two basic components of a virus.

**A virus has (1) genomic material comprised of either DNA or RNA and (2) a capsid, a membrane-like protective structure that contains the genetic material, similar to the nucleus of a eukaryotic cell.**

## Exam Page 2

### Answer Key

1. The \_\_\_\_\_ surrounds the capsid of some viruses.

**Envelope.**

2. True or False. You would expect to see a viral envelope on a virus infecting a plant cell.

**False. The overwhelming majority of animal viruses are enveloped whereas the majority of plant or bacteria-infecting viruses are not.**

3. Rank the following viruses based on their size from largest to smallest:

Orthomyxovirus  
Poliovirus  
Variolavirus

**Variolavirus (~200nm) > Orthomyxovirus (100-150nm) > Poliovirus (~30nm)**

## Exam Page 3

Attachment: The virus receptors binds to the host protein outside the cell  
Entry: The virus joins with the membrane of host & enters cell  
Uncoating: The viral capsid is pulled apart where applicable.  
Replication: The viral genome makes copies of itself  
Exit: Old virus leaves the cell & new viruses are produced  
New infection: New viruses produced leaves the host cell & go infect new cells. This process restarts

#### Answer Key

1. True or False: Viral replication occurs after it attaches and enters the host cell.  
True. The viral genome is never replicated before attachment and entry.

**True. The viral genome is never replicated before attachment and entry.**

2. Place the following viral life cycle steps in order beginning with viral attachment and provide a description of each step.

Uncoating:

Release:

Replication:

Attachment:

Entry:

New infection:

**3- Uncoating: the viral capsid disassembles**

**5-Release: New virus particles are produced and leave the cell**

**4-Replication: the viral genome is the 'blueprint' to make copies of itself**

**1-Attachment: viral receptors bind to host proteins on the surface of the cell**

**2-Entry: the virus fuses with the host membrane and enters the cell**

**6-New infection: newly produced viruses that left the host cell now go on to infect new cells.**

## Exam Page 4

#### Answer Key

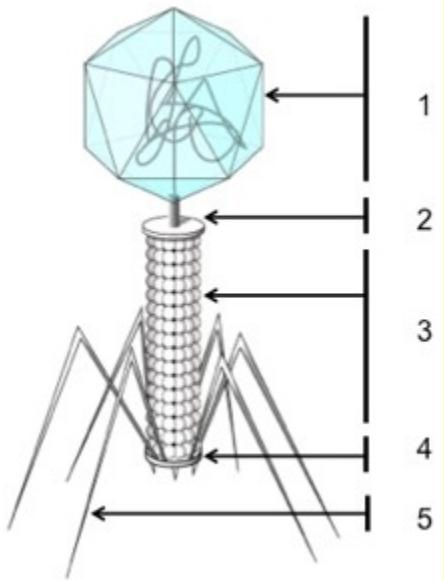
1. A virus that infects bacteria is called a \_\_\_\_\_ and contains a \_\_\_\_-side polygon capsid.

**Bacteriophage; 20-sided**

2. True or False. Structurally, bacteriophages are similar to viruses that infect animals.

**False. Bacteriophages have a distinct composition and structure.**

3. Identify the following components of a bacteriophage.



- 1-Capsid (or Head)  
2-Collar  
3-Tail (sheath)  
4-Base plate  
5-Tail fibers

## Exam Page 5

### Answer Key

1. Describe the main differences between lytic and temperate phages.

Lytic bacteriophages replicate within the host bacteria until it ruptures, whereas temperate (or lysogenic) phages primarily exist in a non-replicative state that does not kill the host cell.

Lytic phages replicate all viral proteins needed for the assembly of new virus particles whereas lysogenic phage genomes are integrated into the host genome but production of viral proteins is suppressed.

2. Based on the following image, would you expect the viral titer to be high or low? Why?



**Low.** As turbidity is a function of the number of intact bacterial cells present in the media, the amount of virus contained within the above tube must be low. As the lytic cycle continues more and more bacterial cells will be destroyed, effectively clearing the media.

## Exam Page 6

### Answer Key

1. Which of the following cannot be spread via airborne particles:

- A. Measles
- B. Mumps
- C. Rubella
- D. A and B
- E. None of the above

**E. Measles, mumps and rubella can all be spread via airborne particles formed while coughing, sneezing, etc.**

2. True or False. A patient infected with Rubella is considered infectious one week before and after the appearance of the trademark rash.

**True**

3. Which of the following diseases does a linear, double-stranded DNA virus cause?

- A. Measles
- B. Mumps
- C. Rubella
- D. B and C
- E. None of the above

**E. Measles, mumps and rubella are all linear, single-stranded RNA viruses**

4. What disease displays as a secondary characteristic swelling of the testes/ovaries and pancreas?

**Mumps.** A patient infected with mumps (aka epidemic parotitis) has primary swelling in the parotid (salivary glands) located in the neck but also may have secondary swelling in the testes/ovaries and pancreas.

5. A patient diagnosed with German measles may additionally experience what disease? Select all that apply.

- A. Impetigo
- B. Conjunctivitis
- C. Rheumatic fever
- D. Influenza-like symptoms

**B and D.** A patient may experience a combination of symptoms such as fever, flu-like symptoms (influenza), cough, conjunctivitis, and a red blotchy skin rash.

## Exam Page 7

### Answer Key

1. You go to visit a friend who has chickenpox. While visiting what are 2 things you will be sure to avoid so that you don't also become infected?

**(1) You would want to be sure to keep a distance especially if your friend is coughing or sneezing as chickenpox can be transmitted through air-borne droplets (sneezing/coughs). (2) You would also be absolutely certain to avoid direct contact with the blisters of an infected individual.**

2. True or False. Someone who had chickenpox as a child is likely to develop shingles while in college, where the median age of college students is 18-22 years old.

**False. The most common age for VZV reactivation and shingle diagnosis tends to occur in people greater than 60 years of age.**

3. True or False. Similar to chickenpox, the blisters that appear with Shingles can cover the entire body.

**False. Unlike chickenpox blisters, which can form anywhere, the blisters associated with shingles are localized and limited to small areas.**

4. A person who has neither previously had chickenpox nor been administered the VZV vaccine is exposed to someone with an active VZV (shingles) outbreak and becomes infected. Explain why (or why not) the person will only develop shingles.

**The infected individual will not develop shingles, but will develop chickenpox. Unvaccinated and unexposed individuals must first develop chickenpox, as shingles is the reactivation of the dormant VZV virus from the chickenpox infection.**

## Exam Page 8

### Answer Key

1. While traveling abroad, should you be worried about coming into contact with either the Variola major or Variola minor viruses?

**No. Both viruses are variants of smallpox and were eradicated in 1977. You would not need to worry about coming into contact with the virus.**

2. What small (~30nm) single-stranded, non-enveloped RNA virus causes temporary or permanent paralysis by infiltrating (infecting) motor neurons within the spinal cord, brain stem or motor cortex?

**Polio, also known as poliomyelitis.**

3. Described the main underlining differences between the Salk and Sabin polio vaccine.

**The Salk vaccine contained an inactivated form of the virus and was injected while the Sabin vaccine contained a live attenuated (weakened) form of the virus and was administered orally.**

4. Which subtype of Influenza is the most virulent?

**Influenza A**

## Exam Page 9

1. A drug company is trying to develop a new drug that will inhibit the release of newly produced viral particles. Would the drug company target hemagglutinin proteins or neuraminidase proteins? Why?

Neuraminidase because it involves the budding & release of viral particles from the host cell

2. Explain why the flu shot given each year may not be 100% effective at preventing the flu?

Because you may be exposed to a viral strain that is not included in the making of the vaccine of the flu shot that you took.

## Answer Key

1. A drug company is trying to develop a new drug that will inhibit the release of newly produced viral particles. Would the drug company target hemagglutinin proteins or neuraminidase proteins? Why?

**Neuraminidase (N) proteins are directly involved in the budding and release of new viral particles and would thus be the correct target. Hemagglutinin (HA) proteins would not be advisable targets as they are directly involved in viral attachment and entry into the host cell.**

2. Explain why the flu shot given each year may not be 100% effective at preventing the flu?

**It is possible to receive a flu vaccine and yet (unfortunately) still get the flu in the same season if you are exposed to a viral strain that was not included in the vaccine. There are a large number of variants and the flu vaccine is unable to vaccinate against all subtypes. Medical researchers predict and then distribute flu vaccines based current trends and the available data relative to the most common circulating strains. Unfortunately, this model is not always 100% accurate.**

## Exam Page 10

Once HIV enters the cell, the capsid is degraded, & the HIV protein reverses transcription & makes 2 RNA copies, generating DNA strand which is then transported into the nucleus where it integrates the host genome. The virus is then replicated & new viruses are formed. Anti-retroviral medication helps to fight the ability of the virus to reproduce

### Answer Key

- True or False. The viral capsid of HIV is dumbbell shaped and contains ~2,000 copies of the viral protein p24.

**False. The HIV capsid is conical (cone) shaped.**

- The HIV surface glycoprotein gp120 binds what host cellular receptor?

- A. CD3
- B. CXCR4
- C. CCR5
- D. CD4

**D. HIV gp120 binds to CD4.**

- An individual infected with HIV is placed on anti-retroviral medication. Describe how the medication will affect the virus.

As the name suggests, anti-retrovirals are intended to inhibit (anti) the process of reverse-transcription (retro). Once the virus enters the cell and uncoating is complete, the viral enzyme reverse transcriptase (RT) acts on the two RNA copies, creating a complementary DNA strand. Anti-retrovirals attempt to block this step. In the absence of anti-retroviral medications, the now double-stranded DNA is transported to the nucleus where it can integrate into the host genome and begin replicating. By inhibiting the process of RT, anti-retroviral medications effectively block the production of new viruses by preventing its integration and replication.