



# Understanding Life Science

## Final Exam

2021 Spring

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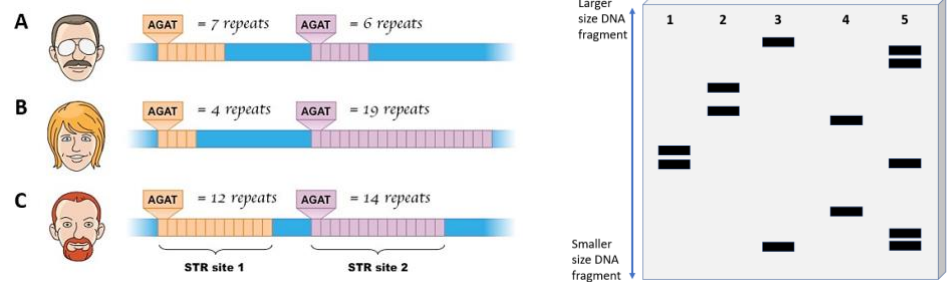
### \* Multiple Choice Questions (1.5 point each)

1. Recently, the intermittent fasting has been under spotlight as a possible means of achieving healthier lifestyle and delaying ageing. If the claimed benefit of the intermittent fasting is indeed true, probably it must require the function of the ...
  - a. mitochondria
  - b. Golgi apparatus
  - c. rough endoplasmic reticulum
  - d. smooth endoplasmic reticulum
  - e. lysosome**
2. Which of the following cellular activities would be least affected by defect in the electron transport chain function of the mitochondria?
  - a. Transport of CFTR protein to the cell membrane
  - b. Synthesis of DNA chain from nucleotides
  - c. Acidification of lysosome lumen
  - d. Contraction of muscle
  - e. Import of cholesterol through receptor mediated endocytosis**
3. Which of the following sequences would be cut by a restriction enzyme? Assume that all the sequences are in double stranded form.
  - a. GCCACT
  - b. TTTCCC
  - c. GAAUUC
  - d. GATCGGCCGATC
  - e. How am I supposed to know this?**
4. The reason why the non-aerobic exercise is much less effective than the cardio exercise in burning fats is because...
  - a. fats require mitochondria for their oxidation.**
  - b. fats are more resistant to the catabolic breakdown in the mitochondria.
  - c. glucose generates more energy than fats.
  - d. fats cannot be metabolized through the process of aerobic respiration.
  - e. fats are catabolized by the enzymes in the glycolysis.
5. A pioneering breakthrough in recombinant DNA technology was that human insulin gene being inserted into a plasmid vector and successfully expressed in bacteria to produce insulin protein. Which of the followings is NOT a correct account for the event?
  - a. Availability of the restriction enzymes that can cut the boundary of the insulin gene properly would have been essential for the project's success.
  - b. It means that bacteria use basically the same genetic codes as the eukaryotes do.

- c. The property of plasmid as small, independently replicating extrachromosomal DNA was instrumental in the success of the project.
  - d.** If the insulin gene contained introns, the project would have failed.
  - e. The insulin gene in the plasmid vector must also have its native human promoter sequence.
6. Which of the following is the best account for the smooth endoplasmic reticulum (SER) being more abundant than the rough endoplasmic reticulum (RER) in the liver tissues?
- a. It is the same reason why SER is more abundant than RER in the small intestine and brain.
  - b. Liver is the major organ of the lipid metabolism.
  - c. To facilitate the detoxification function of the liver
  - d.** For its function of calcium storage
  - e. For its function of secreting many digestive enzymes
7. Which of the followings is a correct account for the antibiotic resistance genes of “super bacteria”?
- a. The genes conferring resistance mechanism are usually present on the bacterial chromosome.
  - b. Normal bacteria cannot acquire the resistance gene spontaneously through genetic mutation.
  - c. The only way to keep the “super bacteria” from spreading is to use antibiotics more frequently.
  - d. The resistance genes cannot be transferred to another bacteria.
  - e.** Normal bacteria usually outcompete the “super bacteria” in their natural habitats.
8. Quinolones are specific type of antibiotics that inhibit bacterial DNA polymerase, the enzyme catalyzing bacterial DNA replication. Which of the following mechanisms cannot possibly a way of developing resistance against the quinolones?
- a. Having a mutant enzyme that destroys quinolones inside the bacteria.
  - b.** Mutation in bacterial DNA that makes the DNA polymerase unable to perform its catalytic activity on the DNA.
  - c. Having a mutant DNA polymerase that is not recognized by quinolones.
  - d. Having a mutation that make the bacterial cell membrane less permeable to the quinolones.
  - e. All of the above.
9. On chromosome, only certain regions are defined as genes. These areas are different from the rest of the chromosomal regions in that...
- a.** they have more histone proteins associated with the DNA.
  - b. they are usually located in the central area of each chromosome.
  - c. chromosomes in these areas are more condensed.
  - d. chromosomes in these areas are ~~more condensed~~ contain the promoters. (문제오류)
  - e. these areas form heterochromatin.
10. Choose a statement that best describes the nature of alleles of a gene.
- a.** They are different version of a same gene present on different loci.
  - b. A given human can have as many different alleles as possible for a gene.
  - c. Different allele of a gene arises through mutations occurring only in the coding region of the gene.
  - d. In some cases, an allele of a gene can be responsible for multiple different phenotypes.
  - e. A dominant allele of a gene is functionally superior to a recessive allele.      불완전우성?

11. Three people having different STR repeats loci are shown in the figure. Choose the one correctly matches each person to the DNA profile on the right side of the figure.

- a. A-2, B-5, C-4
- b. A-3, B-1, C-2
- c. A-5, B-2, C-1
- d. A-1, B-3, C-2**
- e. A-3, B-2, C-5



12. If a tRNA gene with an anticodon sequence of 5'-UUU-3' had a mutation that changes the anticodon sequence into 5'-UUA-3', what would be the most likely result out of this?

- a. Genes that have AAA codon would have a frame-shift mutation.
- b. Genes with UAA stop codons would produce larger size of proteins.
- c. Gens that have UUU codon would have a non-sense mutation with premature stop.
- d. Genes having AAA codon in their exon region would have a frame-shift mutation.**
- e. Due to the codon redundancy, no significant effect of this mutation would be present.

13. Which of the followings is NOT a common feature that is shared by microtubule, microfilament, and intermediate filament?

- a. Component of the cytoskeleton
- b. Polymer assembled from specific monomers**
- c. Found only in the eukaryotic cells
- d. Maintains specific cell shapes
- e. Controls cell division

14. Which of the following is NOT an outcome of differential gene expression?

- a. Expression of hemoglobin gene only in the red blood cells
- b. Expression of crystalline gene only in the lens cells
- c. Expression of albumin gene only in the liver cells
- d. Development of tissues and organs**
- e. Synthesis of more than 100,000 human proteins from only about 23,000 genes by alternative splicing

15. If the "primary" transcript for a given mRNA of eukaryotic gene consists of sections that we can distinguish as A-B-C-D-E-F...

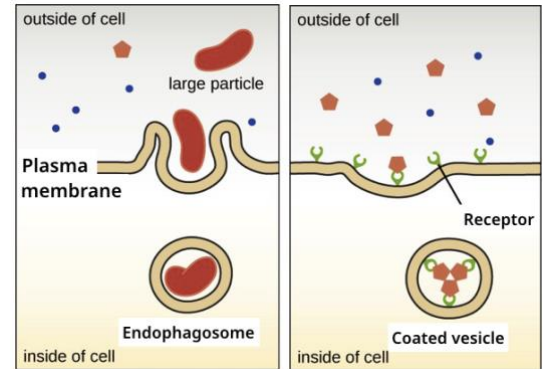
- a. mature mRNA of the gene should also contain A-B-C-D-E.
- b. all these sections contain codons.
- c. these sections also include promoter region.
- d. it is possible to produce several different versions of mature mRNA, such as A-C-D, A-B-D-E, etc.**

- e. these sections are part of exon.
16. Which of the following statements about “DNA profiling” is NOT correct?
- a. Each individual’s unique DNA sequence profile, similar to the fingerprints, can be identified through DNA profiling.
  - b. Tandem repeat sequences, such as VNTR, SSR, and satellite DNAs, are used to distinguish the different individuals.
  - c. These DNA repeats are usually located on centromeric and telomeric region of the chromosomes.
  - d.** The profiles between identical twins are usually expected to be identical.
  - e. The profile between spouses will be at least 50% more similar to each other than to that of a total stranger.
17. One lesson we learned from the case of Progeria is that...
- a. materials entering the nucleus have to go through their respective specific transporters present on the nuclear envelop.
  - b. the nuclear envelops are not as discriminatory as the cell membrane in controlling the material transport.
  - c. the nuclear envelop was originated by “invagination” of the cell membrane during the course of eukaryote evolution.
  - d. chromosome in the nucleus normally exist as a less condensed form called “chromatin”.
  - e.** the relative position of each chromosome region in the nucleus is critical in coordinating the gene expression activity of the region.
18. Rotenone, commonly known as rat poison, is a drug blocking the electron transport chain of the aerobic respiration. As a result, no accumulation of hydrogen ions occurs in the space between the inner and outer mitochondrial membranes. If yeast cells were treated with rotenone...
- a. they will also die like rats.
  - b. it will have no effect at all because yeasts are single celled eukaryotes.
  - c.** they will start producing alcohol.
  - d. they cannot metabolize glucose.
  - e. they cannot survive under anaerobic (= no oxygen) condition.
19. Which of the following features of the cystic fibrosis is most directly related with what makes the mutation recessive?
- a. It is a non-sense mutation.
  - b.** It is a mutation caused by deletion of three nucleotides.
  - c. The mutant protein gets to be misfolded.
  - d. The mutant protein is degraded in the rough ER
  - e. It causes thick mucus build-up on the respiratory tract making it more vulnerable to the infections.
20. The reason why probes are needed to identify the RFLP patterns of the DNA fingerprinting analyses is because...
- a. the probe would reveal the exact size of the target DNA fragment.

- b. many different DNA fragments of same size will appear on the same position on the electrophoresis gel.
  - c.** different repeat numbers of the target DNA have to be distinguished by different sizes.
  - d. the DNA samples on the gel electrophoresis are run as single strands.
  - e. SNP (single nucleotide polymorphism) present on the DNA fingerprinting samples can be easily detected by probes.
21. On eukaryotic chromosome, the area defined as gene should always include...
- a. promoter
  - b. enhancer
  - c.** coding region
  - d. introns
  - e. exons
22. DNP (dinitrophenol) is a chemical known to act as an uncoupler in the electron transport chain of the aerobic respiration by making hydrogen ions leak out of the space between the out- and inner membranes of the mitochondria. Which of the followings is a correct account for the effect of the DNP on the aerobic respiration?
- a. Glucose will not be oxidized into carbon dioxide.
  - b. ATP will be still produced by the electron transport chain.
  - c. NADH and FADH<sub>2</sub> will not be oxidized.
  - d. Oxygen will still be reduced into water.
  - e.** The aerobic respiration will stop at the end of the glycolysis, generating lots of heat.
23. Which of the following descriptions about epigenetics is NOT correct?
- a. It generally does not involve any changes in DNA sequence of the genes.
  - b.** Its effects are on the level of gene expressions only; it does not make any different proteins.
  - c. Different degrees of chromatin condensations are the main mechanism through which its effect is mediated.
  - d. Methylation and acetylation are the two major chemical modifications associated with the control of chromatin condensation involved in it.
  - e. It is always induced by environmental conditions but transmitted into next generations.
24. Albumin is a protein that are made only in the liver cells and secreted into the blood. Which of the followings is a correct description about the albumin protein and its gene expression?
- a. It is a glycoprotein (= having carbohydrates attached to it).
  - b.** Its gene in other tissues does not have the same enhancer as in the liver tissue.
  - c. Its gene in other tissues does not have the promoter.
  - d. Its gene expression is mediated by different RNA polymerase in other tissues.
  - e. Different kind of transcription factors are required to activate its gene expression in other tissues.

## Essay Questions

1. Briefly compare and contrast the two processes shown in the figure. Why would both be negatively affected by a defect in the function of the rough ER? (4 points)



2. Explain why the overall process of photosynthesis is an anabolic reaction. What is the role of water and oxygen, respectively, in the process? (4 points)

광합성이 동화작용인 이유

동화작용이란 작은 분자를 합쳐 큰 분자를 합성하는 반응작용이다.

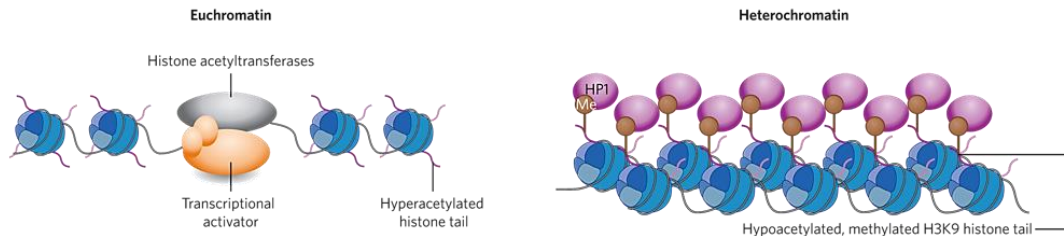
식물이 (( 빛에너지+CO<sub>2</sub>+H<sub>2</sub>O -> O<sub>2</sub>+C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> ))과 같은 물질대사를 하는 것을 광합성이라고 한다. 이산화탄소와 물을 합쳐 산소를 배출하고 포도당과 같은 큰 분자를 합성하므로 동화작용이다. (+흡열작용)

광합성 반응에서 물은 포도당을 합성하는 데에 수소분자를 제공하고 산소는 광합성 작용 후 배출되는 역할이다.

3. Explain why the intrinsic heterochromatin areas of the human chromosomes, such as centromere and telomere, show much higher DNA sequence variation among different individuals. (4 points)

짧은 염기서열이 많이 반복되어 나타나기 때문에 일부만 있어도 금방 복제시켜 복구할 수 있기 때문이다.

4. Concisely explain the role of transcription activator in operation epigenetics according to this figure. (2 points)



transcription(전사): DNA → RNA

Euchromatin(진정염색질): 비교적 낮은 밀도로 존재하는 염색질 구조, 히스톤의 acetylation이 작용하며 밀도가 낮기 때문에 전사가 활발하게 이루어지고 있다.

Heterochromatin(이질염색질): 비교적 높은 밀도로 존재하는 염색질 구조, 히스톤의 methylation이 작용하며 밀도가 높아 전사가 비교적 활발하지 못하다.

5. In this figure, explain why the growing peptides has to be transferred from A to B, rather than B to A. (2 points)

