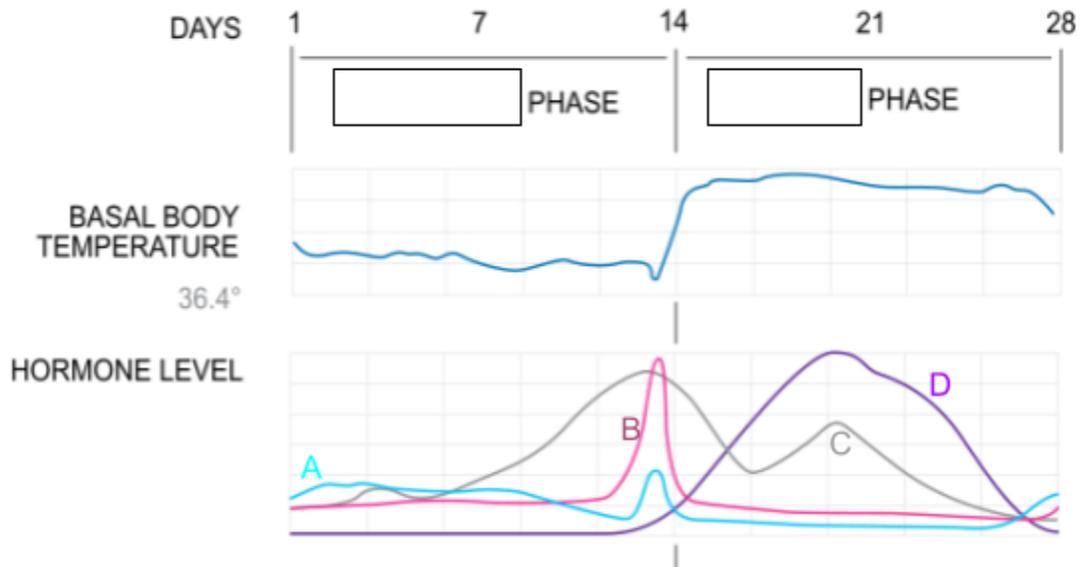


## Wave Round Exam

### Question 1:

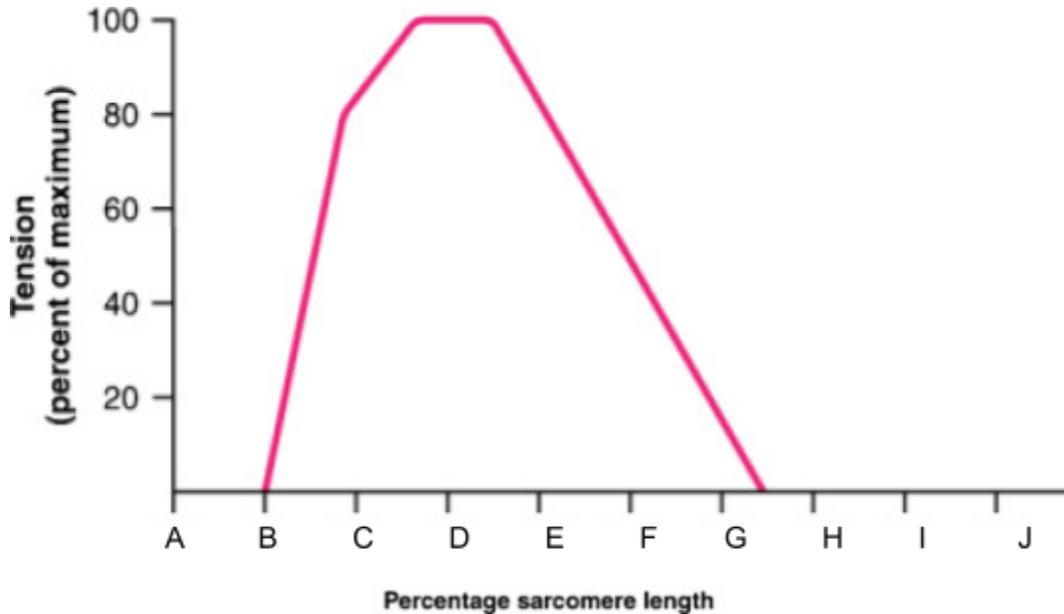
The following graphs describe the body temperature and levels of 4 hormones in a woman's body during the menstrual cycle.



1. Ovulation occurs on day 14. (T/F)
2. The second phase of the menstrual cycle (days 14-28) is referred to as the follicular stage. (T/F)
3. The Anterior Pituitary gland produces the hormone described by the gray line (C). (T/F)
4. The hormone described by the pink line (B) is what induces a Corpus Luteum to become a Corpus Albicans. (T/F)

**Question 2:**

The following graph describes the force-tension curve of a skeletal muscle.



1. Contraction tension is affected by sarcomere length in skeletal muscle, but not in cardiac or smooth muscle. (T/F)
2. The protein Titin acts as a compression spring to prevent Z discs from being too close together (T/F)
3. If the sarcomere length is greater than D, it would represent a preload on the muscle (T/F)
4. Gamma motor neurons are activated when this muscle is stretched beyond its optimal length. (T/F)

**Question 3:**

The following botanical illustrations depict 4 different plant species:

Fig A.



Fig B.



Fig C.



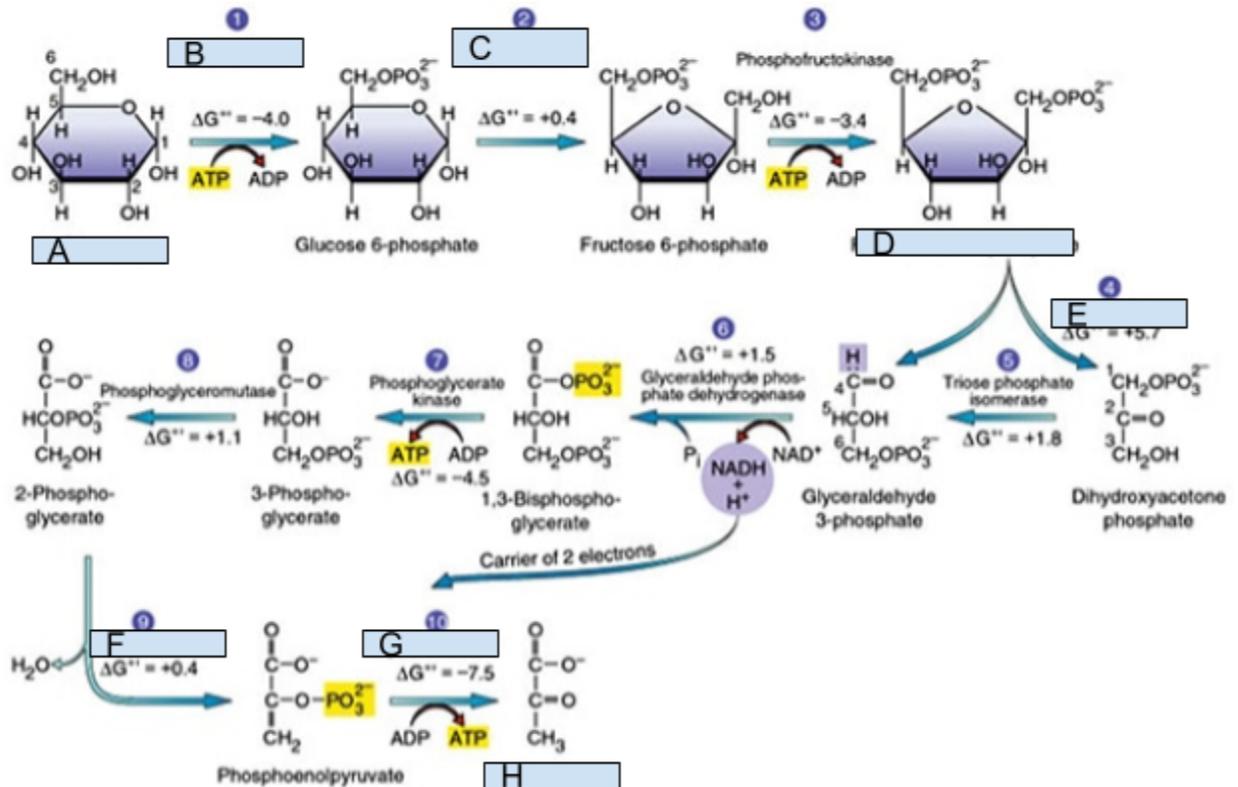
Fig D.



1. At least two of the figures above depict monocot species (T/F)
2. Figure C depicts a plant with hard woody tissue and exhibits secondary growth (T/F)
3. A majority ( $\geq 3$ ) of the plant species shown above are capable of producing fruit (T/F)
4. The fruit shown in figure D developed from a single ovary in a flower, and is therefore classified as a berry (T/F)

**Question 4:**

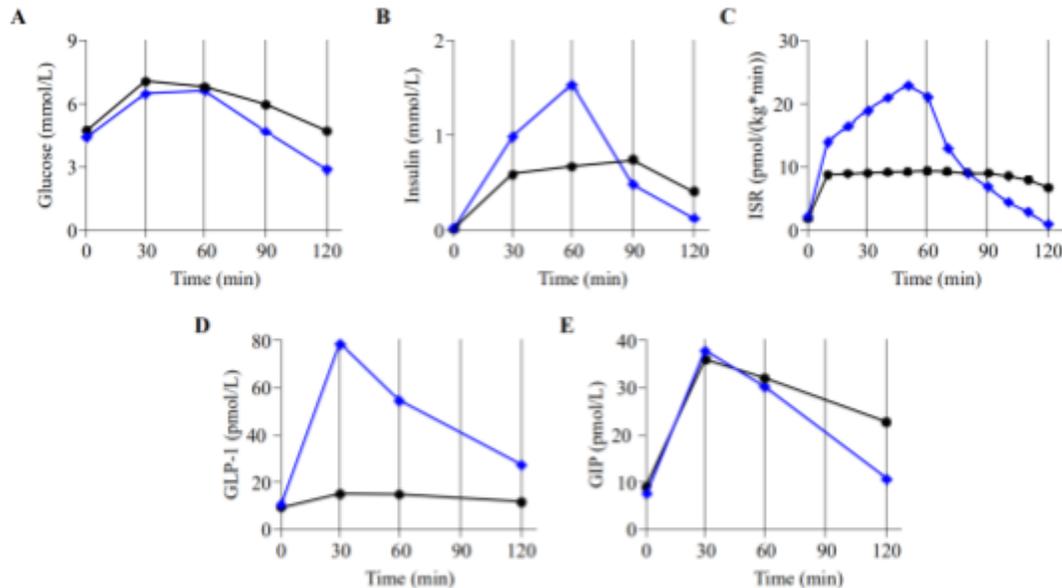
The following picture describes the glycolysis pathway



1. A is in alpha anomeric form. Also, the brain exclusively uses A molecule for energy source (T/F)
2. The reaction catalyzed by Enzyme B is a regulatory Step in Glycolysis with ATP, a potent activator (T/F)
3. Molecule H is used to undergo fermentation in aerobic conditions or enters mitochondria in anaerobic conditions (T/F)
4. Enzyme-catalyzed reaction 3 is activated directly or indirectly by insulin (T/F)

**Question 5:**

Morbid obesity may be treated by gastric bypass surgery, in which a part of the stomach is removed and the small intestine is bypassed. A group of obese patients were enrolled in a study where researchers tracked their glucose and hormone levels in response to a glucose tolerance test, before and after gastric bypass surgery.



Effects of a glucose ingestion at time = 0 on the level of various parameters. Black circles indicate levels before gastric bypass, and blue diamonds indicate levels 3 months after gastric bypass. A. glucose level; Fig. B–C, insulin concentration and its secretion rate (ISR); Fig. D, Glucagon-Like Peptide 1 (GLP-1, gut hormone); and Fig. E, Gastric Inhibitory Polypeptide (GIP, gut hormone) [from Jørgensen et al. 2013].

1. Gastric bypasses result in a shorter and stronger insulin response to raised glucose levels (T/F)
2. From this data, GIP is expected to induce insulin secretion (T/F)
3. Change in GLP-1 level after gastric bypass may explain the faster increase in ISR (T/F)
4. Based on this study, decreasing GLP-1 secretion may be an effective treatment for Type 2 Diabetes (T/F)



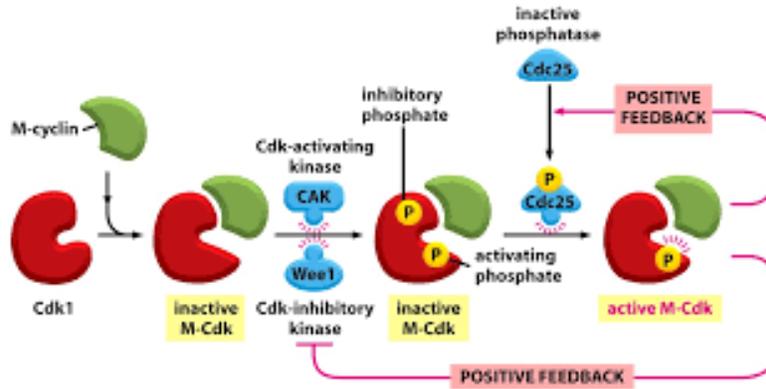
**Question 6:**

When somatic cells are transformed into cancerous cells, many mutations disrupt cellular processes such as the regulation of replication. These cells may also undergo dedifferentiation, and lose the ability to perform their normal cellular duties. During dedifferentiation, the fine-tuned control of gene expression required for normal healthy function may be lost, and cancerous cells may display abnormal expression of genes and proteins.

1. The presence of proteins in the glomerular filtrate is therefore indicative of a tumor (T/F)
2. Scientists may identify cells with abnormal expression profiles by examining MHC class 1 molecules expressed on the plasma membrane (T/F)
3. All lymphocytes are tested for self-reactivity as a part of normal immunological development, so that lymphocytes in circulation are non-reactive to any proteins expressed in one's body. (T/F)
4. Dendritic cells are unable to detect tumor cells by abnormal expression profiles alone because the proteins are still endogenous in nature and therefore not seen as foreign (T/F)

**Question 7:**

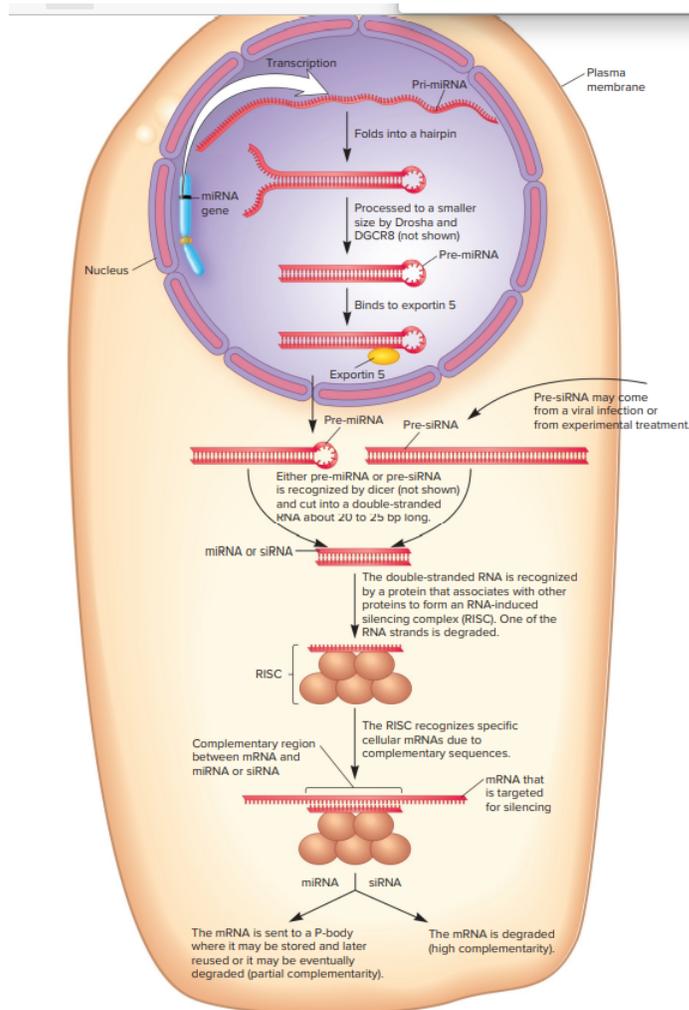
M-Cdk is a key protein involved in regulating the transition from G<sub>2</sub> to M phase of the cell cycle. The activation of M-Cdk is controlled by several other proteins, including CAK, Wee1, and Cdc25.



1. The inhibitory phosphate is added to M-Cdk by CAK. (T/F)
2. Cdc25 removes the phosphate added by Cdk-activating kinase. (T/F)
3. M-Cdk exerts positive feedback on both Cdc25 and Wee1 by phosphorylating these enzymes. (T/F)
4. M-cyclin expression fluctuates during the cell cycle while Cdk1 levels stay the same throughout the cell cycle. (T/F)

### Question 8:

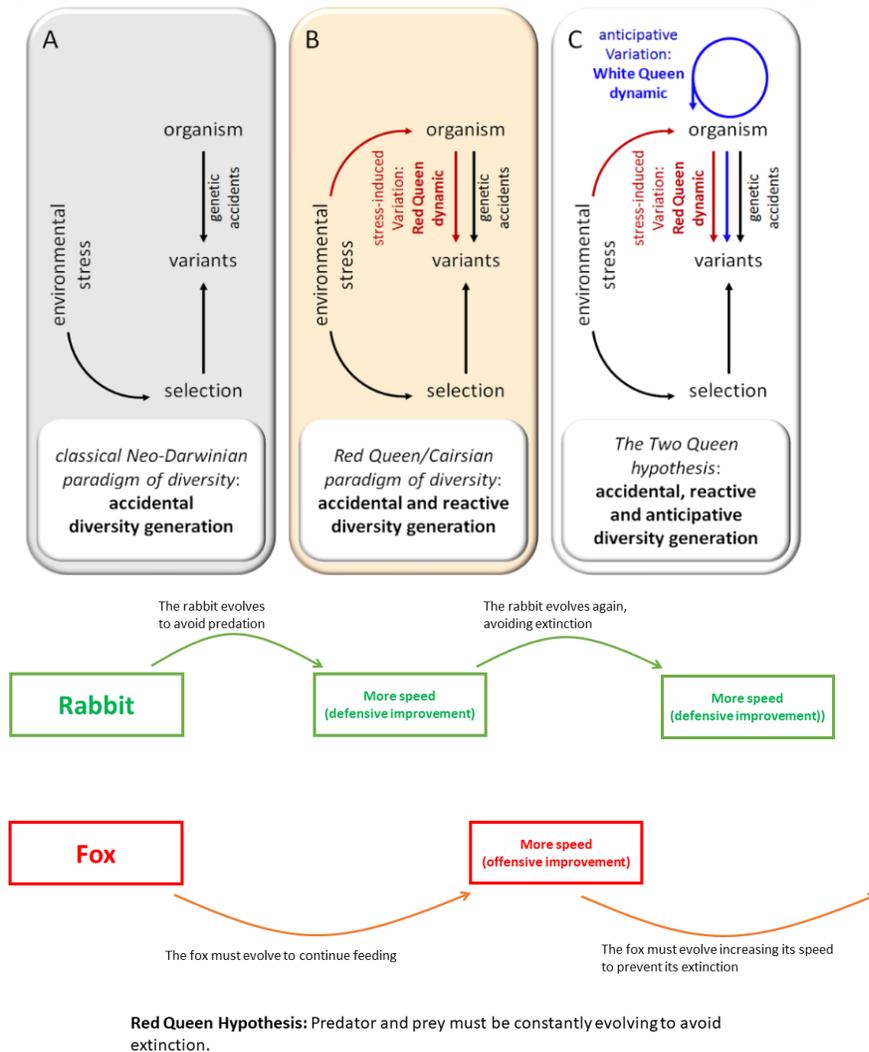
The year is 730 CE, and you are a budding philosopher working to understand the mysteries of the world around you. A strange individual approaches you in the middle of the night and hands you a top secret envelope as they leave in their “Delorean”. Intrigued, you notice that the papers deal with all of the history of biology. Studying this very intently, you reach the section regarding RNA interference, in which ncRNAs known as microRNAs and Small-interfering RNAs form RNA-induced silencing complexes. Answer the following questions below.



1. One would not expect a mammalian brain cell to naturally produce siRNA molecules (T/F)
2. The remaining single-stranded miRNA in a RISC is perfectly complementary to the specific mRNA that will be silenced (T/F)
3. If the targeted miRNA is sent to a P body, the inhibition of translation is not temporary (T/F)
4. RNAi mediated by siRNA is likely important in defending against viral infections (T/F)

**Question 9:**

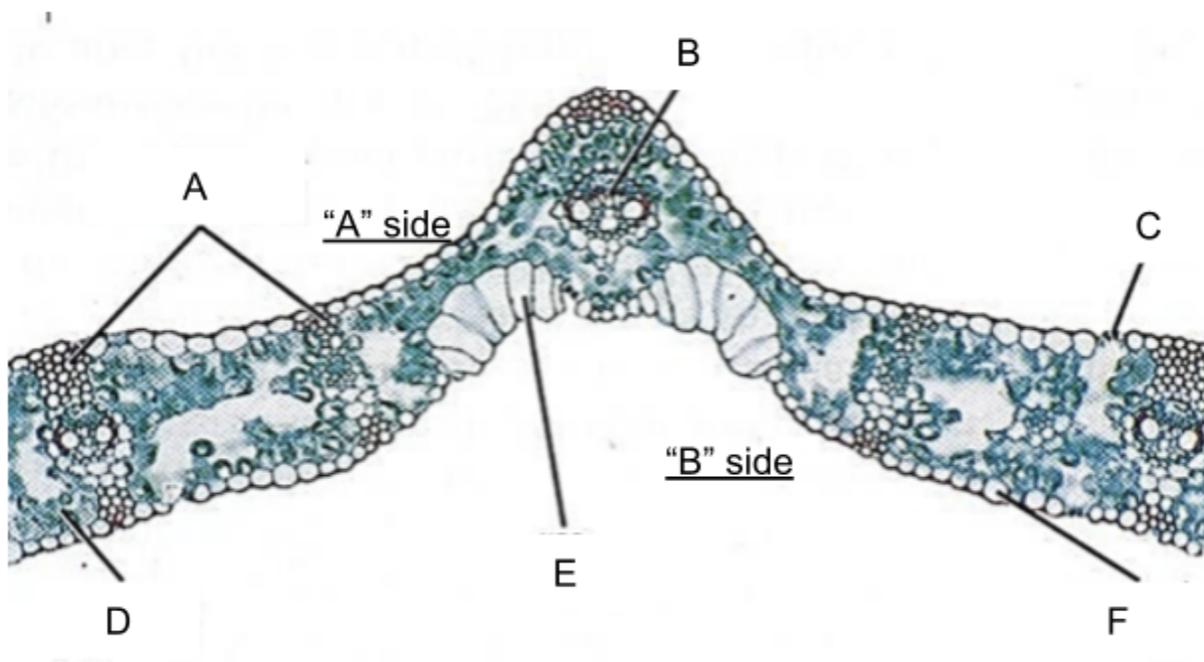
Traditionally, biologists believe that diversity is caused by random mutations (classical neo-Darwinian paradigm). However, evidence in recent years has supported other methods of producing diversity.



1. The relationship between the length of butterflies' proboscis and the location of nectar in a flower is an example of the red queen hypothesis. (T/F)
2. The red queen hypothesis provides support for why asexual reproduction might be favorable over sexual reproduction in some cases. (T/F)
3. The millions of unique antibodies created by V(D)J recombination is an example of the White Queen dynamic. (T/F)
4. The offspring of an organism that lacks DNA glycosylase would most likely be more affected by accidental diversity generation than the offspring of an organism that has DNA glycosylase.

**Question 10:**

A cross-section of a leaf is shown below. Structures of interest are labeled A-F.



1. The "A" side is the adaxial side of the leaf (T/F)
2. Structure F allows the plant to perform gas exchange (T/F)
3. This leaf has been taken from a monocot species (T/F)
4. Structure E is responsible for nyctinasty (drooping of the leaf during night) (T/F)



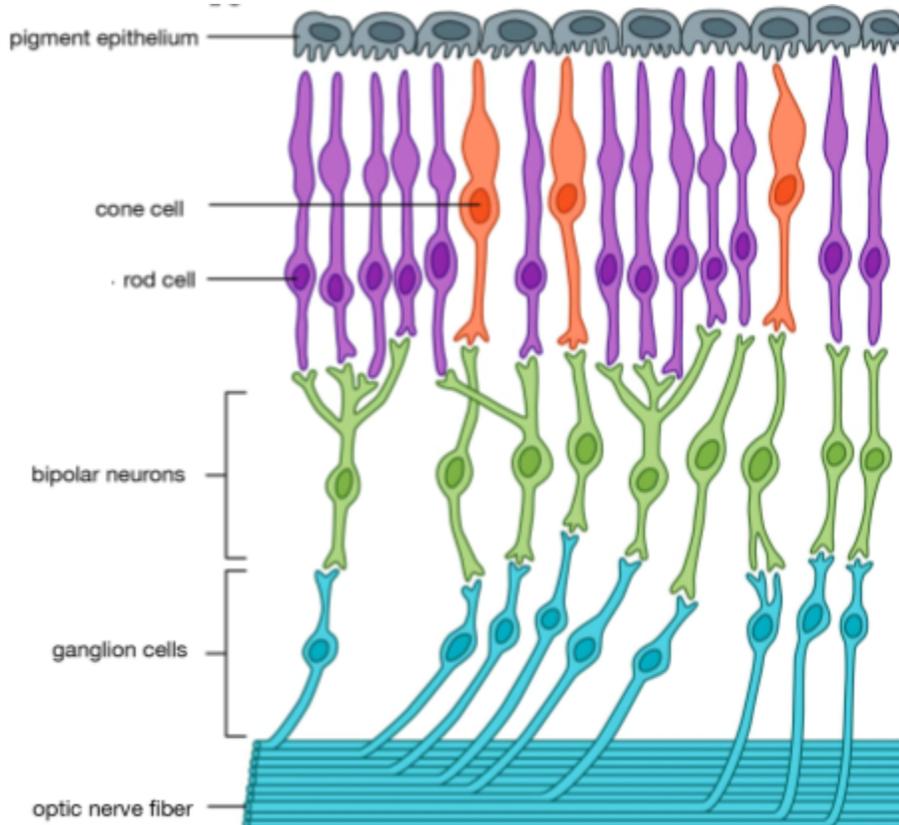
**Question 11:**

Which of the following statements about animal phylogeny are true?

1. Radial symmetry has independently evolved multiple times (T/F)
2. Bilateral symmetry independently evolved multiple times (T/F)
3. Bony jaws are a derived trait of the osteichthyes (T/F)
4. On a macroevolutionary scale, there has been a trend towards having more identical duplicates of body parts or segments. (T/F)

**Question 12:**

The following is a diagram of the structure of the human retina.



1. The bottom end of this diagram is located closer to the pupil compared to the top end of this diagram. (T/F)
2. The detection of light is mediated by a conversion of retinal between two constitutional isomers (T/F)
3. Intensity of light is encoded by the amplitude of post-synaptic action potentials (T/F)
4. The wavelength of perceived light is encoded by the frequency of post-synaptic action potentials (T/F)



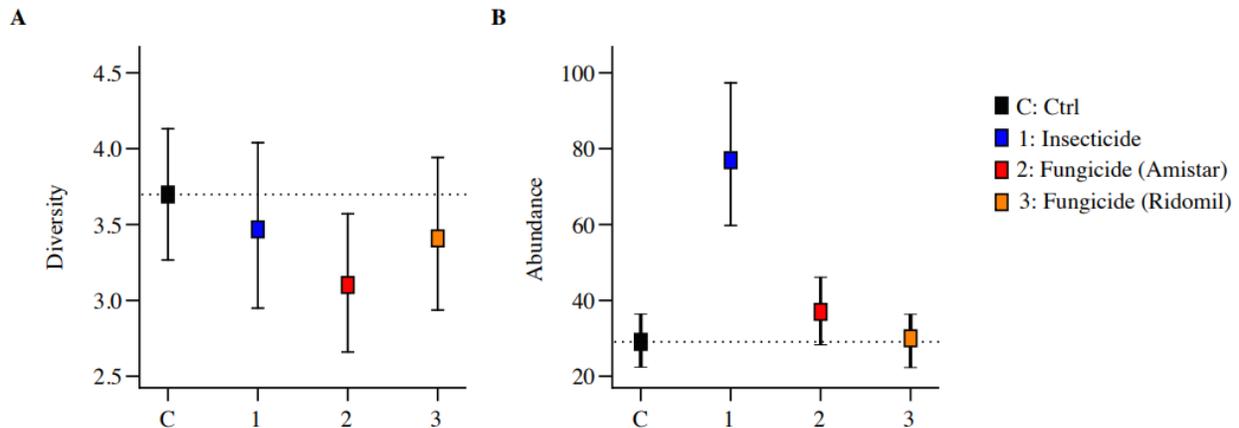
**Question 13:**

While plants are often thought of as being stationary and unmoving, many plant species exhibit movement in response to certain stimuli.

1. As opposed to animals, movement in plants is induced by changes in turgor pressure within cells. (T/F)
2. Roots display positive gravitropism, while shoots exhibit negative gravitropism. (T/F)
3. In roots, gravitropism is mediated by positive feedback loops, while gravitropism is mediated by negative feedback loops in the shoot. (T/F)
4. De-etiolation is a phototropic response that causes seedlings to bend towards light. (T/F)

**Question 14:**

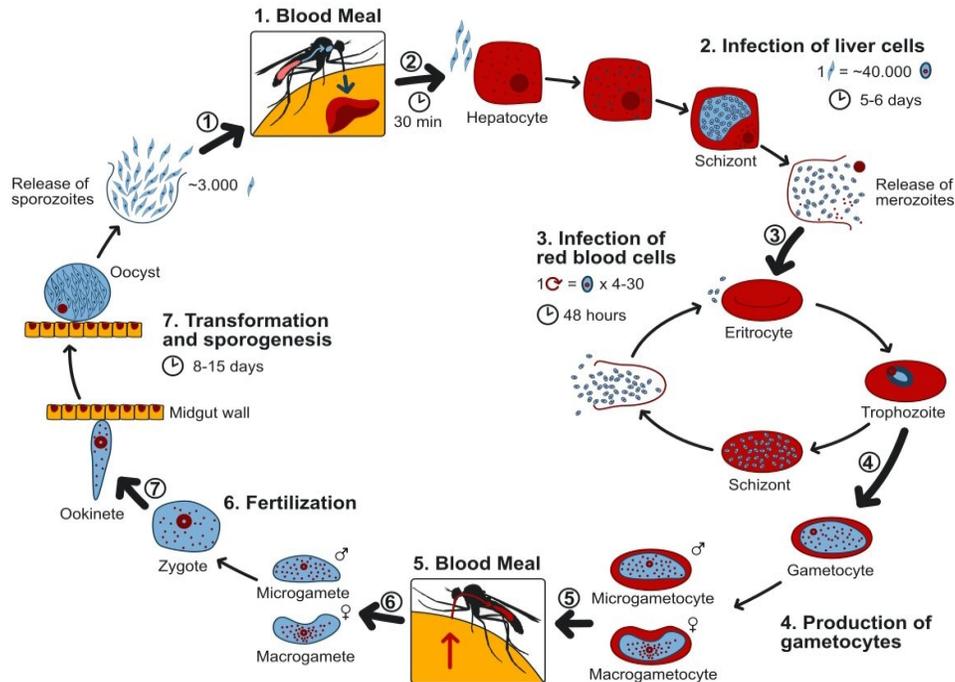
Tropical rainforest communities are very diverse, and likely hold the vast majority of all species on Earth. The Janzen-Connell hypothesis proposes that insect herbivores and pathogens are drivers of plant diversity. This was tested in a rainforest by excluding native herbivores and pathogens using pesticides and observing the effect on plant diversity and abundance.



1. In the study area, most insects were predators (T/F)
2. Application of insecticide had a statistically significant effect upon seedling diversity (T/F)
3. Ridomil is more effective at killing fungi than Amistar (T/F)
4. The results of this study can be used as evidence in support of the Janzen-Connell hypothesis (T/F)

**Question 15:**

Malaria is a disease caused by Plasmodium parasites, transmitted through mosquito bites. The following diagram shows the pathogenic life cycle of malaria transmission.



1. The relationship between Plasmodium and vector mosquitos is closest to amensalism (T/F)
2. Theoretically, people with anemia would be more susceptible to malaria (T/F)
3. Plasmodium can be found in the human body in either a haploid and diploid state (T/F)
4. Malaria can also be transmitted via direct contact with the blood of someone infected. (T/F)