

# USTET Science Practice Test (Sample)

## Study Guide



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## **Questions**

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- 1. What is the primary function of vascular tissues in plants?**
  - A. Photosynthesis**
  - B. Transport of water and nutrients**
  - C. Storage of genetic material**
  - D. Support and rigidity**
- 2. What do dominant alleles accomplish in the context of genetics?**
  - A. They create a recessive phenotype**
  - B. They are expressed when present**
  - C. They do not affect the appearance**
  - D. They are always passed on**
- 3. What process requires energy to move molecules against their concentration gradient?**
  - A. Diffusion**
  - B. Passive Transport**
  - C. Osmosis**
  - D. Active Transport**
- 4. Which theory, published in 1543, proposed that the Earth and the planets revolve around the sun?**
  - A. Ptolemaic Theory**
  - B. Galilean Theory**
  - C. Copernican Theory**
  - D. Einstein's Theory**
- 5. Which of the following terms is a result of two alleles that combine but neither dominant?**
  - A. Heterozygous Trait**
  - B. Homogeneous Trait**
  - C. Codominant Trait**
  - D. Recessive Trait**

- 6. What is the jellylike substance that fills the interior of a cell called?**
- A. Cytoplasm**
  - B. Nucleus**
  - C. Cell wall**
  - D. Chloroplast**
- 7. Which process is responsible for creating a complementary RNA sequence from a DNA template?**
- A. Replication**
  - B. Transcription**
  - C. Mutation**
  - D. Translation**
- 8. What characteristic best describes parenchymal cells?**
- A. Irregularly thickened walls**
  - B. Thick cell walls with lignin**
  - C. Cubical and loosely packed**
  - D. Highly specialized for reproduction**
- 9. Which of the following processes occurs first in the gene expression pathway?**
- A. Translation**
  - B. Transcription**
  - C. RNA processing**
  - D. Mutation**
- 10. Which of the following defines the atmosphere?**
- A. A layer of soil**
  - B. A solid outer part of the Earth**
  - C. A layer of gases surrounding a planetary body**
  - D. A measure of biodiversity**

## **Answers**

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1. B
2. B
3. D
4. C
5. C
6. A
7. B
8. C
9. B
10. C

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## **Explanations**

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## 1. What is the primary function of vascular tissues in plants?

- A. Photosynthesis
- B. Transport of water and nutrients**
- C. Storage of genetic material
- D. Support and rigidity

Vascular tissues in plants primarily serve the critical function of transporting water, nutrients, and sugars throughout the plant. This transport system is composed of two main types of vascular tissues: xylem and phloem. Xylem is responsible for carrying water and dissolved minerals from the roots to the rest of the plant. It operates through a system of vessels and tracheids that facilitate the upward movement of water due to processes such as transpiration, which creates a negative pressure that pulls water up from the roots. Phloem, on the other hand, transports the products of photosynthesis, primarily sugars, from the leaves where they are produced to other parts of the plant, such as roots and growing tissues. This distribution of nutrients is essential for the growth and energy balance of the plant. While other functions like photosynthesis, storage of genetic material, and providing structural support and rigidity are vital roles in plants, they do not relate directly to the primary function of vascular tissues. The emphasis on the transport capabilities highlights how vascular tissues are integral to a plant's overall functioning, influencing its growth, health, and ability to adapt to its environment.

## 2. What do dominant alleles accomplish in the context of genetics?

- A. They create a recessive phenotype
- B. They are expressed when present**
- C. They do not affect the appearance
- D. They are always passed on

In genetics, dominant alleles play a crucial role in determining phenotypes. When a dominant allele is present in an organism's genotype, it is expressed in the phenotype, meaning the physical and observable characteristics of the organism reflect that dominant trait. This occurs regardless of whether the second allele (from the paired homologous chromosome) is dominant or recessive. For example, consider a trait controlled by two alleles, one dominant (A) and one recessive (a). If an individual has the genotype AA or Aa, the dominant allele A will dictate the phenotype. Therefore, dominant alleles assert their influence over recessive alleles, which do not manifest in the phenotype when paired with a dominant allele. Understanding this concept is critical in genetics, as it lays the foundation for predicting inheritance patterns and the likelihood of certain traits appearing in offspring.

**3. What process requires energy to move molecules against their concentration gradient?**

- A. Diffusion**
- B. Passive Transport**
- C. Osmosis**
- D. Active Transport**

Active transport is the process that requires energy to move molecules against their concentration gradient. In biological systems, molecules naturally move from regions of higher concentration to regions of lower concentration through passive processes like diffusion or osmosis, which do not require energy input. However, active transport mechanisms, such as the operation of ion pumps (e.g., sodium-potassium pump), allow cells to import substances that are less abundant outside the cell (like certain ions or nutrients) compared to inside, or to expel waste products. This energy-dependent process is crucial for maintaining homeostasis within cells and allowing them to function optimally. The energy usually comes from adenosine triphosphate (ATP), which is produced during cellular respiration. Therefore, the ability of active transport to concentrate substances within the cell or remove them against the gradient plays a vital role in cellular activities.

**4. Which theory, published in 1543, proposed that the Earth and the planets revolve around the sun?**

- A. Ptolemaic Theory**
- B. Galilean Theory**
- C. Copernican Theory**
- D. Einstein's Theory**

The Copernican Theory, formulated by Nicolaus Copernicus and published in 1543, marks a significant turning point in the history of astronomy. This theory introduced a heliocentric model of the universe, asserting that the Earth and other planets revolve around the Sun. This was a revolutionary concept at a time when the prevalent belief was that the Earth was the center of the universe (geocentric model) as proposed by earlier thinkers such as Ptolemy. Copernicus's work laid the groundwork for modern astronomy by challenging established beliefs and providing observational evidence for the motion of celestial bodies. His ideas were crucial in advancing the scientific revolution, influencing subsequent astronomers like Galileo and Kepler. By recognizing the Sun's central role in the solar system, the Copernican Theory began to shift humanity's understanding of its place in the cosmos and helped to propel the development of further astronomical discoveries.

**5. Which of the following terms is a result of two alleles that combine but neither dominant?**

- A. Heterozygous Trait**
- B. Homogeneous Trait**
- C. Codominant Trait**
- D. Recessive Trait**

The correct term for a situation where two alleles combine but neither is dominant is codominant trait. In codominance, both alleles express themselves fully and independently without masking the presence of the other. This means that an organism with one allele for blood type A and another for blood type B will express both antigens on the surface of its red blood cells, resulting in a blood type of AB. This phenomenon clearly illustrates the concept of codominance, where both traits are equally expressed. In contrast, heterozygous traits simply refer to the presence of two different alleles for a single trait, without implying any specific interaction between them. Homogeneous traits (often referred to as homozygous traits) involve two identical alleles, and recessive traits are those that only manifest in the absence of a dominant allele. Thus, these terms do not capture the unique phenomenon of both alleles being equally expressed as codominance does.

**6. What is the jellylike substance that fills the interior of a cell called?**

- A. Cytoplasm**
- B. Nucleus**
- C. Cell wall**
- D. Chloroplast**

The jellylike substance that fills the interior of a cell is called cytoplasm. It is a vital component of the cell, providing a medium in which the cell's organelles are suspended and where many cellular processes occur. Cytoplasm contains water, salts, and various organic molecules, creating an environment that supports biochemical reactions and helps maintain the cell's shape. The nucleus, while an essential organelle that houses the cell's genetic material, is not the substance filling the interior; instead, it floats within the cytoplasm. The cell wall is a rigid outer layer found in plant cells and some bacteria, providing structural support, but it does not refer to the internal substance of the cell. Chloroplasts are organelles found in plant cells that are involved in photosynthesis, but they are not the jellylike substance filling the cell. Hence, cytoplasm is the correct term for the medium that fills the interior of a cell.

**7. Which process is responsible for creating a complementary RNA sequence from a DNA template?**

**A. Replication**

**B. Transcription**

**C. Mutation**

**D. Translation**

Transcription is the process through which a complementary RNA sequence is synthesized from a DNA template. During transcription, the enzyme RNA polymerase binds to a specific region of the DNA strand, known as the promoter, and unwinds the DNA helix. It then reads the nucleotide sequence of the DNA and synthesizes a single-stranded RNA molecule by pairing the DNA bases with their complementary RNA bases. For instance, if the DNA template has an adenine (A), the RNA will have a uracil (U) instead of thymine (T), pairing it with cytosine (C), guanine (G), or thymine (T) appropriately. This process is crucial for gene expression, as it produces messenger RNA (mRNA) which carries the genetic information needed for protein synthesis. Other processes such as replication involve copying the entire DNA molecule to ensure accurate duplication prior to cell division, mutation refers to changes in the DNA sequence which may affect function, and translation is the process by which the RNA sequence is used to synthesize proteins. Each of these processes has its distinct role in genetics and cellular function, but only transcription specifically creates RNA from a DNA template.

**8. What characteristic best describes parenchymal cells?**

**A. Irregularly thickened walls**

**B. Thick cell walls with lignin**

**C. Cubical and loosely packed**

**D. Highly specialized for reproduction**

Parenchymal cells are best described as cubical and loosely packed due to their fundamental role in plant tissues. These cells are characterized by their thin cell walls and ability to divide and differentiate into various types of cells. Their loose packing provides ample space for air and intercellular substance, allowing for processes like gas exchange and storage of nutrients and water. This structure makes them versatile, as they serve functions such as photosynthesis, storage of carbohydrates, and secretion. Their shape and arrangement enhance their ability to fulfill these essential roles in plant physiology. In contrast, other options present characteristics not typically associated with parenchymal cells; for instance, thickened or lignified walls are attributes of other cell types involved in structural support, not parenchyma, which emphasizes its multifunctional and supportive roles in plant biology.

**9. Which of the following processes occurs first in the gene expression pathway?**

**A. Translation**

**B. Transcription**

**C. RNA processing**

**D. Mutation**

In the gene expression pathway, transcription is the first process that occurs. During transcription, a specific segment of DNA is transcribed to produce messenger RNA (mRNA). This step is crucial as it involves the copying of genetic information from DNA, which can then be translated into proteins. After transcription, the mRNA undergoes processing, which includes modifications like adding a 5' cap and a poly-A tail, and splicing out introns. Translation, the following step, is where ribosomes synthesize proteins based on the sequence of the mRNA. Mutation, while it can affect gene expression and produce changes to DNA, is not a step in the gene expression pathway itself. Understanding these distinctions helps clarify the sequence and function of each part of the gene expression process.

**10. Which of the following defines the atmosphere?**

**A. A layer of soil**

**B. A solid outer part of the Earth**

**C. A layer of gases surrounding a planetary body**

**D. A measure of biodiversity**

The atmosphere is defined as a layer of gases surrounding a planetary body, which is precisely what makes option C the correct choice. This layer is made up of various gases, including nitrogen, oxygen, carbon dioxide, and trace amounts of others, which are crucial to maintaining life on Earth by providing the necessary elements for respiration, weather patterns, and even protection from harmful solar radiation. The atmosphere plays an essential role in regulating temperature through the greenhouse effect, allowing Earth to sustain life. Furthermore, it is essential for weather and climate systems, which are vital for the ecosystems and human activities on the planet. This definition directly relates to how the atmosphere functions and its significance in environmental science. In contrast, the other options define different aspects of Earth's systems; a layer of soil relates to the lithosphere, while a solid outer part of the Earth corresponds to the crust. The last option, a measure of biodiversity, pertains to the variety of life forms in ecosystems, which is a separate concept not directly linked to the definition of the atmosphere.