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Question: 1

Which of the following do certain bacteria and green plants have in common?

- A. photosynthesis
- B. mitochondrial electron transport
- C. the ability to live in the absence of molecular oxygen
- D. all of the above

Answer: D

Explanation:

Similar to green plants, certain bacteria are capable of using carbon dioxide (CO₂) and water (H₂O) to synthesize carbohydrates. The pigments used by bacteria are more varied than the types of chlorophyll used by green plants. Bacterial photosynthesis does not take place in a chloroplast as it does in green plants. As is the case for all prokaryotes, bacteria lack internal membrane-bound structures, or organelles, such as chloroplasts or mitochondria. Thus, while many types of bacteria can carry out electron transport reactions to capture energy as part of the process of respiration, they do not do so in mitochondria. In contrast, some bacteria can, and some actually must, grow in the absence of molecular oxygen. Plants always require the presence of oxygen in order to capture energy from aerobic respiration.

Question: 2

Which of the following is a consistent difference between prokaryotes and eukaryotes?

- A. the presence of a nucleus
- B. the presence of a cell wall
- C. motility
- D. multicellularity

Answer: A

Explanation:

Eukaryotes are distinguished from prokaryotes primarily by the presence of a discrete intracellular compartment, the nucleus, which contains the cellular genetic material. The term “karyote” comes from the Greek “karyon” meaning kernel, referring to the nucleus. The prefix “pro-” means “before,” and the prefix “eu-” means “good” or “true.” Both groups, however, have examples of multi- and unicellular organisms, such as certain bacteria, which aggregate to form complex structures, or yeast, a unicellular eukaryote. Similarly, there are both eukaryotes (plants) and prokaryotes (most, but not all bacteria), which have cell walls. Motility is a common feature of the cells of organisms within both groups.

Question: 3

Choose the set of terms that does not correspond to a monomer and the polymer built from it.

- A. fatty acids; lipid
- B. amino acids; protein
- C. nucleotides; RNA
- D. sucrose; glycogen

Answer: D

Explanation:

Glycogen is a polymer formed of repeating units of the monosaccharide glucose, which is commonly used by mammals to store energy. Sucrose, or table sugar, is a disaccharide—thus, not a monomer—derived from glucose and fructose; it must be converted to glucose monomers to be metabolized for energy or stored as glycogen. RNA is an information-carrying polymer composed of nucleotides (adenine, guanine, cytosine, and uracil). Proteins are polymers composed of a mixture of twenty amino acids arranged in such a way that the particular amino acid sequence and composition dictates the structure and function of the protein. In a similar way, lipids are complex polymers made up of mixtures of fatty acids, and the biological functions of lipids depend on their particular composition.

Question: 4

Which of the following diseases is a neural tube defect?

- A. amyotrophic lateral sclerosis
- B. spina bifida
- C. Alzheimer's disease
- D. multiple sclerosis

Answer: B

Explanation:

Spina bifida is a birth defect that occurs when, during development, the neural tube fails to close and develop into a functional spinal cord. This leads to neuromuscular defects whose severity depends upon the extent of the closure defect. Multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS or Lou Gehrig's disease) generally occur in adulthood and involve the loss of the ability of neurons within the brain and spinal cord to cause muscle contraction (MS) or to control muscular movement (ALS). Alzheimer's disease is seen later in life and involves characteristic lesions of the brain.

Question: 5

Which of the following disease pairs are most closely related?

- A. chicken pox and shingles
- B. measles and diabetes
- C. *Staphylococcus aureus* and pneumonia
- D. herpes and cervical cancer

Answer: A

Explanation:

Chicken pox, which used to be a common disease of childhood, is caused by the herpes virus, varicella zoster (VZ). Individuals who have had chicken pox can develop the painful disease shingles later in life, which involves the active infection of a spinal nerve tract with VZ. This disease pair is related by cause-and-effect: only VZ causes shingles. In contrast, although there is evidence that measles is associated with juvenile-onset (type 1) diabetes, there are other putative causes of this disease. In a similar way, although *Staphylococcus aureus* is the infectious agent in a small fraction of cases of pneumonia, it is by no means the most common, let alone the sole, cause of pneumonia. Finally, although it was once believed that genital herpes infections could lead to cervical cancer, it has subsequently been determined that the two conditions are unrelated.

Question: 6

An injury to which of the following anatomic structures could lead to cellulitis?

- A. bone
- B. skin
- C. lungs
- D. heart

Answer: B

Explanation:

Cellulitis is an infection of the skin usually caused by staphylococcal or streptococcal bacteria. Generally, these bacteria are found on the skin but can enter the underlying tissue through small cracks or other wounds. These infections do not involve bone or internal organs, although one complication of untreated cellulitis can be osteomyelitis, in which bone adjacent to the affected tissue becomes infected.

Question: 7

Which of the following organelles are involved in the generation of metabolic energy in the form of ATP?

- A. nuclei
- B. chloroplasts
- C. mitochondria
- D. the endoplasmic reticulum

Answer: C

Explanation:

Electron transport, which occurs in the mitochondria, is a process in which the metabolic energy derived from the oxidation of glucose or other sugars is captured in ATP molecules. In contrast, the chloroplast is the organelle where photosynthesis, which uses light as a source of energy and a related set of energy transport molecules, leads to the synthesis of sugars using carbon dioxide as a carbon source. Neither the nucleus nor the endoplasmic reticulum is involved in the generation of metabolic energy. Rather, they are the sites where ATP and other high-energy compounds are utilized in the synthesis of DNA/RNA and proteins, respectively.

Question: 8

Identify the feature of protein synthesis that differs between prokaryotic and eukaryotic cells.

- A. the amino acids used
- B. the structure and composition of the ribosomes
- C. the code that specifies which amino acid should be added to a growing protein chain
- D. a requirement for the expenditure of metabolic energy

Answer: B

Explanation:

A major difference between prokaryotic cells and eukaryotic cells are the proteins and RNA molecules that make up the ribosome. Eukaryotic ribosomes are termed 80S ribosomes to distinguish them from the smaller 70S ribosomes found in bacteria and other prokaryotes. The difference between 70S and 80S ribosomes is significant and is the basis by which a number of antibiotics can kill bacteria without affecting animal cells. In contrast, the other aspects of protein synthesis are very similar among all living things: protein synthesis is an energy-requiring process using a universal genetic code to assemble the same 20 amino acids into functional proteins.

Question: 9

Which of the following processes does not involve molecular oxygen?

- A. fermentation
- B. release of carbon dioxide from hemoglobin
- C. photosynthesis
- D. aerobic respiration

Answer: A

Explanation:

Fermentation refers to the metabolism of glucose to yield some energy in the form of ATP in the absence of molecular oxygen. This process provides significantly fewer ATP molecules per glucose

molecule than are recovered through electron transport with oxygen as a final electron acceptor, the process termed aerobic respiration. Photosynthesis uses carbon dioxide and light energy to synthesize glucose, and it liberates oxygen as an end product. Finally, the release of carbon dioxide in the lungs occurs when oxygen displaces carbon dioxide from hemoglobin molecules in the blood.

Question: 10

A deficiency in which of the following vitamins leads to the disease scurvy?

- A. vitamin C
- B. vitamin D
- C. vitamin A
- D. vitamin B12

Answer: A

Explanation:

Scurvy, a disease in which collagen synthesis does not occur normally, results from a lack of vitamin C, also called ascorbic acid. Humans cannot synthesize vitamin C, but it is available from plant sources, including citrus fruits. The symptoms of scurvy include pale spotty skin, bleeding gums, and soft, spongy flesh, and were especially apparent in sailors and others who were deprived of fresh fruits and vegetables for a long time. The recognition that the inclusion of citrus fruits in the diet of men at sea lead to British sailors becoming termed “limeys.” Vitamin A deficiency, which is not common, results in night blindness, as well as other systemic problems. Inadequate intake of vitamin B12 has been associated with anemia, as well as neurological and behavioral abnormalities. Inadequate levels of vitamin D, the “sunshine vitamin,” can cause weakness and abnormalities in teeth and bones, including rickets in children, which is characterized by soft and malformed bones.

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