

Name:
Teacher:

Date:
Class/Period:

- 1) What combines with sugar and a phosphate group to form a nucleotide?
- A. Amino acid
 - B. Deoxyribose
 - C. Glycerol
 - D. Nitrogenous base

2) Bacteriophages infect bacterial cells causing them to produce more bacteriophages. The Hershey-Chase experiments used radioactively labeled bacteriophages as shown in the table.

Hershey-Chase Experiments				
	Step 1	Step 2	Step 3	Results
Experiment 1	Radioactively label bacteriophage protein with ^{35}S	Allow bacteriophages to infect bacteria cells	Separate bacteriophages from bacteria	Detect ^{35}S with bacteriophages
Experiment 2	Radioactively label bacteriophage DNA with ^{32}P	Allow bacteriophages to infect bacteria cells	Separate bacteriophages from bacteria	Detect ^{32}P inside bacteria

What was the conclusion of the Hershey-Chase experiments?

- A. DNA from the bacteriophage entered the bacteria.
- B. DNA from the bacteriophage became bacterial DNA.
- C. Protein from the bacteriophage entered the bacteria.
- D. Protein from the bacteriophage became bacterial DNA.

3) DNA molecules differ from RNA molecules in which of the following ways?

- I. DNA molecules contain a different type of pentose sugar than do RNA molecules.
- II. DNA molecules contain the nitrogenous base cytosine while RNA molecules do not.
- III. RNA molecules contain the nitrogenous base uracil while DNA molecules do not.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II, and III

4) Despite the diversity of nature, most organisms contain the same 4 DNA bases. This table shows the DNA composition of 3 organisms as reported in a classic 1950s experiment.

Base Composition (percent)				
Organism	Adenine (A)	Guanine (G)	Thymine (T)	Cytosine (C)
Human	29	21	29	21
Wheat germ	27	23	27	23
<i>E. coli</i>	25	25	25	25

Based on this study, what did scientists conclude about the DNA composition of all organisms?

- A. A, G, T, and C occur in equal percentages.
- B. A and G occur in equal percentages, and T and C occur in equal percentages.
- C. A and T occur in equal percentages, and G and C occur in equal percentages.
- D. A and C occur in equal percentages, and T and G occur in equal percentages.

5) Persons A and B have similar mRNA sequences with the exception of 1 nucleotide.

Person A: AUGGUUACUAAGGGCUGA

Person B: AUGGUUACUGAGGGCUGA

Use the genetic code chart to determine how this difference affects the sequence of amino acids in the resulting protein.

1st position	2nd position				3rd position
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

- A. Lys in Person A is replaced with Glu in Person B.
- B. Phe in Person A is replaced with Leu in Person B.
- C. Persons A and B have identical amino acid sequences.
- D. A stop codon is generated in Person B and not in Person A.

Consider this mRNA codon chart.

1st position	2nd position				3rd position
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

- 6) The mRNA sequence ACU codes for the amino acid Thr. A mutation occurs, and the resulting mRNA sequence is AUU. What amino acid will replace Thr ?
- A. Val
 - B. Met
 - C. Ile
 - D. Ala
- 7) Which of the following mRNA sequences codes for valine (Val), glutamic acid (Glu), and serine (Ser), respectively?
- A. UGG-AGG-CUA
 - B. GUA-GGG-AGC
 - C. GUC-GAA-ACU
 - D. GUG-GAG-AGC
- 8) Charles Lyell's *Principles of Geology* contains information about the formation of sedimentary rock. Lyell's information supported which of Darwin's ideas regarding natural selection?
- A. Organisms compete for resources.
 - B. Tropical biodiversity takes a great deal of time.
 - C. Habitat variation makes biodiversity in the tropics possible.
 - D. Reproductive success depends on the fitness of a species.
- 9) In coho salmon, hooknose males are large and jack males are small. Average-sized males exist, but are rare. What statement best explains disruptive selection in male coho salmon?
- A. Average-sized males reach the spawning ground first.
 - B. The scent of average-sized males makes them most attractive to females.
 - C. Hooknose males produce stronger sperm than jack males or average-sized males.
 - D. The relative size of hooknose males and jack males is an advantage during mating.

- 10) Horse skeleton fossils indicate that the size of horses increased over time. Which statement best explains this fossil record?
- A. Smaller horses bred with larger horses, creating hybrids.
 - B. Smaller horses were infected by a fatal virus early in their history.
 - C. Larger horses consumed the food supply of the smaller horses.
 - D. Larger horses produced a slightly greater number of surviving offspring.
- 11) Cytochrome C is a protein used in the electron transport chain. This table shows short sections of Cytochrome C's amino acid sequences in 5 organisms, using single letter abbreviations.

Organism	Amino acid sequence
Organism 1	...QAGYSTDK...
Organism 2	...MAQFSTDK...
Organism 3	...QAYPSTDK...
Organism 4	...QAPFTTDK...
Human	...QAPYSTAK...

Use this data to determine which organism most likely shares the most recent common ancestor with humans.

- A. Organism 1
 - B. Organism 2
 - C. Organism 3
 - D. Organism 4
- 12) For biological evolution to occur by way of natural selection, the trait being selected for need NOT:
- A. be heritable.
 - B. vary among individuals.
 - C. increase an individual's life span.
 - D. increase an individual's reproductive success.

13) A biologist hypothesizes that biological evolution is occurring in a certain population of freshwater fish she is studying. To support this hypothesis, the biologist would need to document a change in which of the following?

- A.** Size of individual fish over their lifetime
- B.** Size of the population of fish over the course of her study
- C.** Frequency of alleles in the population over the course of her study
- D.** Frequency of predation on members of the population over the course of her study

14) According to the biological species concept, when comparing 2 populations (Population 1 and Population 2), which of the following most likely indicates that Population 1 and Population 2 are the same species?

- A.** Individuals from Population 1 are the same color as individuals from Population 2.
- B.** Individuals from Population 1 consume the same species of prey as individuals from Population 2.
- C.** Population 1 actually interbreeds with or has the potential to interbreed with Population 2.
- D.** Population 1 inhabits the same general area as Population 2.

15) According to fossil evidence, whales evolved from 4-legged ancestors. The modern baleen whale has forelimbs, but inspection of its skeleton reveals only tiny vestigial hind limbs. What is the best explanation for this loss of hind limbs in the baleen whale?

- A.** The hind limbs adapted into flippers to help the whale swim faster.
- B.** Random chance and genetic drift led to the reduction in size of hind limbs.
- C.** Whales with shorter hind limbs swam faster than those with longer hind limbs.
- D.** Some whales lost longer hind limbs to predators and passed that trait to their offspring.

16) A homeowner applied a pesticide to a home infested with cockroaches. After 1 day she found many dead cockroaches. Several days later, she observed a few live cockroaches. The homeowner reapplied the pesticide, but she continued to see some live cockroaches. Which of the following is the most likely explanation for why some of the cockroaches were able to survive repeated exposure to the pesticide? Some of the cockroaches:

- A. experienced a mutation as a direct result of the first exposure that conferred resistance to the pesticide.
- B. were able to alter their genotypes to ones that conferred resistance to the pesticide.
- C. developed pesticide resistance through contact with other species of resistant insects.
- D. had an allele that conferred resistance to the pesticide prior to their first exposure.

17) Which of the following is most likely an example of an innate behavior?

- A. A monkey washing its food in a stream after watching another monkey do the same
- B. A young coyote avoiding porcupines after the porcupine sticks the coyote with its quills
- C. A sea turtle hatchling orienting itself toward the ocean upon emerging from its underground nest
- D. A chimpanzee stacking boxes to reach bananas hanging from the ceiling of its enclosure

- 18)** Dinosaur extinction coincided with a massive asteroid's collision with Earth. The extreme heat of the impact killed many organisms. The resulting dust cloud prevented photosynthesis for a long period of time, killing many other organisms. Which scenario most likely explains how life survived on Earth after the asteroid impact?
- A.** The large number of dead organisms supplied an abundant food source for surviving carnivores.
 - B.** Some organisms survived the initial impact and adapted to new food sources and habitats.
 - C.** Microscopic organisms survived and evolved into modern forms of terrestrial and aquatic life.
 - D.** The dust cloud affected terrestrial organisms, but did not affect aquatic organisms.
- 19)** The mode of natural selection that favors extreme phenotypes rather than intermediate phenotypes is best described as:
- A.** directional selection.
 - B.** disruptive selection.
 - C.** random selection.
 - D.** stabilizing selection.

20) Dr. Romero is raising 3 types of damselfishes in separate aquariums: 2 from the Atlantic Ocean and 1 from the Pacific Ocean. This table summarizes the information she gathered through observations and breeding experiments.

Fish type and origin	Length of adults (cm)	Number of dorsal fin rays	Color of adults	Pairs mated and offspring produced	Offspring of pairs successfully reproduced
A. Atlantic	5.0–6.6	14–18	solid brown	A & B yes A & C yes	A × B no A × C yes
B. Atlantic	5.5–8.0	16–20	brown with small white spots	B & A yes B & C no	B × A no
C. Pacific	6.4–9.2	17–21	mottled brown and yellow	C & A yes C & B no	C × A yes

Based on the most commonly accepted definition of a species, how many different species of damselfishes is Dr. Romero raising, and which fish are they?

- A. 1 species: Fish A, B, and C are all members of a single species.
- B. 2 species: Fish A and B are a single species; Fish C is a separate species.
- C. 2 species: Fish A and C are a single species; Fish B is a separate species.
- D. 3 species: Fish A, B, and C are all members of separate species.

21) Suppose a population of land-dwelling snakes is split into 2 separate populations when a river changes course, cutting right down the middle of their habitat and preventing them from interbreeding. What type of isolating mechanism is described in this scenario?

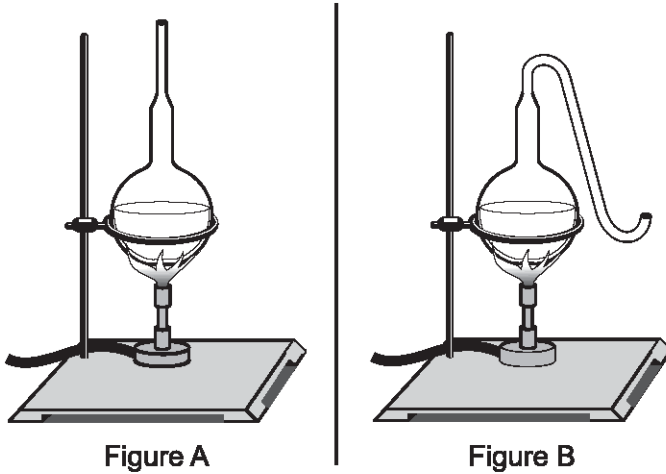
- A. Temporal isolation
- B. Geographic isolation
- C. Behavioral isolation
- D. Habitat isolation

22) Much of the genetic diversity existing in modern multicellular organisms is most likely a result of:

- A. DNA mutations originating in gametes.
- B. DNA mutations originating in somatic cells.
- C. protein mutations originating in gametes.
- D. protein mutations originating in somatic cells.

- 23)** Lazzaro Spallanzani and Louis Pasteur both performed experiments hoping to disprove the hypothesis that organisms can form by spontaneous generation. Which of the following flasks was included in Pasteur's experiment that was NOT included in Spallanzani's?
- A.** A flask that allowed air to enter but did not allow microorganisms to enter
 - B.** A flask that did not allow air to enter but did allow microorganisms to enter
 - C.** A flask that allowed neither air to enter nor microorganisms to enter
 - D.** A flask that allowed both air to enter and microorganisms to enter
- 24)** John Needham performed an experiment testing spontaneous generation. He boiled chicken broth, placed it in a sterile flask, and then sealed the flask. After a few days, Needham observed microorganisms in the flask. Based on current understanding, how was his experiment flawed?
- A.** Boiling activated dormant microorganisms present in the broth.
 - B.** Boiling the broth did not kill all microorganisms present.
 - C.** Microorganisms entered the broth from the flask itself after the flask was sealed.
 - D.** After Needham boiled the broth, microorganisms entered from the air.
- 25)** Who helped disprove the idea of spontaneous generation by demonstrating that maggots come from fly eggs and NOT from meat?
- A.** Francesco Redi
 - B.** John Needham
 - C.** Lazzaro Spallanzani
 - D.** Louis Pasteur

- 26) In an experiment, a scientist filled 2 open flasks, as shown in the figures, with broth and boiled the broth until it became clear. He then left the flasks open for several days.



Which results showed that spontaneous generation did NOT occur?

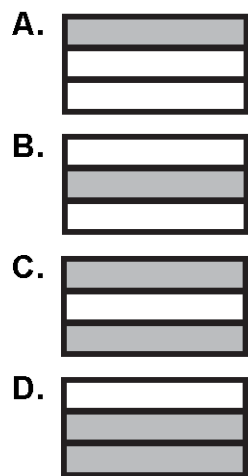
- A. The broth in both Flasks A and B remained clear.
 - B. The broth in both Flasks A and B became cloudy.
 - C. The broth in Flask A remained clear, and the broth in Flask B became cloudy.
 - D. The broth in Flask A became cloudy, and the broth in Flask B remained clear.
- 27) What characteristic of early autotrophs gave them an advantage over early heterotrophs?
- A. They ate heterotrophs.
 - B. They produced spores.
 - C. They made their own food.
 - D. They reproduced asexually.
- 28) The presence of which of the following structures in a cell would indicate that the cell is NOT a photosynthetic bacterium?
- A. Cell wall
 - B. Chloroplast
 - C. DNA
 - D. Ribosome

- 29)** An organelle found in a liver cell would best be identified as a lysosome if its primary function was which of the following?
- A.** Processing and packaging of cellular materials prior to export
 - B.** Harvesting of light energy to produce carbohydrates
 - C.** Detoxification of poisonous molecules within the cell
 - D.** Digestion of macromolecules and old organelles
- 30)** Naomi adds cycloheximide to cells grown in a test tube. Within minutes, she identifies short incomplete segments of proteins in the cells. On which organelle does cycloheximide act?
- A.** Endoplasmic reticulum
 - B.** Golgi apparatus
 - C.** Nucleus
 - D.** Ribosome
- 31)** After Tyler adds a chemical to normally functioning cells, proteins begin to accumulate in the cells' endoplasmic reticula. This chemical most likely prevents movement of proteins from the endoplasmic reticulum to which organelle?
- A.** Golgi apparatus
 - B.** Lysosome
 - C.** Mitochondrion
 - D.** Ribosome
- 32)** A scientist adds an antibody specific to the actin protein to a prepared culture of macrophages. The macrophages exhibit active movement before, but not after, treatment. What is the most accurate conclusion about the function of actin?
- A.** Actin depolymerizes microtubular arrays.
 - B.** Actin plays a role in the function of pseudopodia.
 - C.** Actin disrupts cellular activities in the cytoskeleton.
 - D.** Actin guides the movement of chromosomes in macrophages.

- 33) Biochemists have created an artificial cell membrane that they hope to insert into artificial red blood cells for future dehydration and transportation into outer space.

When scientists stain natural cell membranes with a heavy metal, they can view the membranes with an electron microscope. The heavy metal stains the polar hydrophilic heads of phospholipid membranes. If the artificial membranes resemble natural membranes, what area(s), when viewed under a microscope, would appear stained?

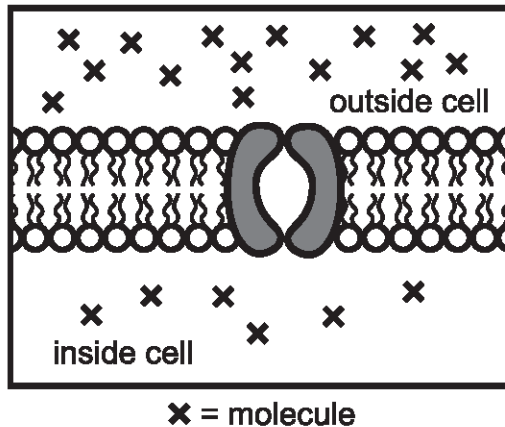
(Note: Shading represents stains.)



- 34) A scientist places a cell in a solution, and over time the cell gains mass and swells. What is the most likely explanation for the cell's gain in mass?
- A. The solution is hypertonic to the cell.
 - B. The solution is hypotonic to the cell.
 - C. The solution and the cell have equal concentrations of solutes.
 - D. The solution and the cell have equal concentrations of water.

- 35)** A paramecium lives in a relatively hypotonic environment. Which of these structures does the paramecium use to maintain homeostasis under these conditions, and how does it do so?
- A.** Contractile vacuole; by expelling water from the intracellular space into the extracellular space
 - B.** Contractile vacuole; by absorbing water from the extracellular space into the intracellular space
 - C.** Lysosome; by expelling water from the intracellular space into the extracellular space
 - D.** Lysosome; by absorbing water from the extracellular space into the intracellular space
- 36)** The cytoplasm of red blood cells has a higher concentration of Na^+ than does pure water. Suppose a biologist places a red blood cell in pure water. Is there a net flow of water molecules into or out of the red blood cell, and by which process does this net flow of water occur?
- A.** Out of the cell; osmosis
 - B.** Into the cell; osmosis
 - C.** Out of the cell; active transport
 - D.** Into the cell; active transport

37) The diagram shows a cell membrane composed of a phospholipid bilayer with a channel protein. Each **x** represents the same type of molecule inside or outside the cell. Facilitated diffusion moves these molecules across the cell membrane.



In what direction do these molecules move and through which structure?

- A. Into the cell through the channel protein
- B. Into the cell through the phospholipid bilayer
- C. Out of the cell through the channel protein
- D. Out of the cell through the phospholipid bilayer

Answer Key

- 1) D
- 2) A
- 3) B
- 4) C
- 5) A
- 6) C
- 7) C
- 8) B
- 9) D
- 10) D
- 11) A
- 12) C
- 13) C
- 14) C
- 15) C
- 16) D
- 17) C
- 18) B
- 19) B
- 20) C
- 21) B
- 22) A
- 23) A
- 24) D
- 25) A
- 26) D
- 27) C
- 28) B
- 29) D
- 30) D
- 31) A
- 32) B
- 33) C
- 34) B
- 35) A
- 36) B
- 37) A