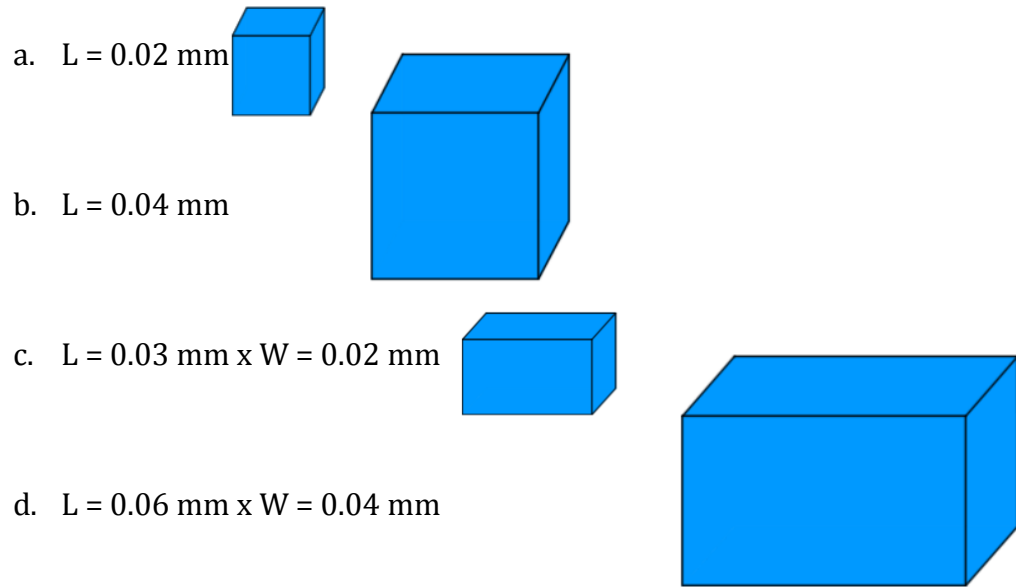


## Big Idea 2: Multiple Choice

### Big Idea 2A

1. Various materials are transported into and out of cells by simple diffusion. The rate at which these materials diffuse is related to the surface area to volume ratio of the cell. Which of the following cube-shaped cells would be most efficient at removing waste by diffusion?

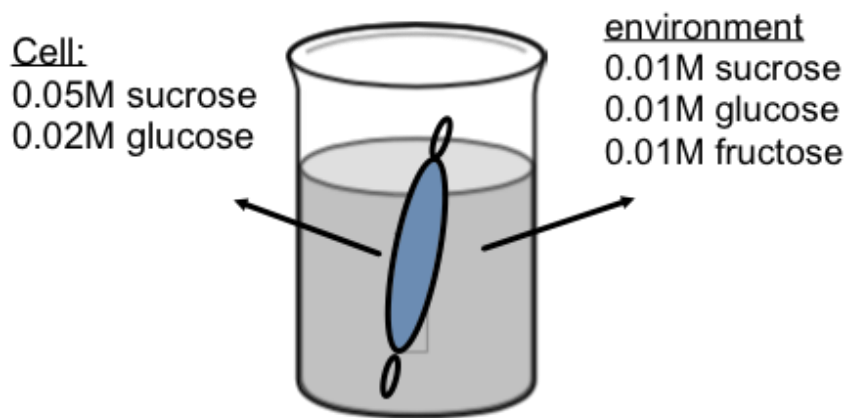


Small nonpolar molecules can pass through the phospholipid bilayer of a cell. A cell is placed in a solution containing the following compounds:

- I. KCl
  - II. Glucose
  - III.  $\text{CO}_2$
  - IV.  $\text{H}_2\text{CO}_3$
  - V.  $\text{O}_2$
2. Which compounds will diffuse across the cell membrane without the aid of integral proteins?
- a. V only
  - b. III, V
  - c. I, III, V
  - d. II, III, V
3. The cell is genetically modified to contain only integral proteins with hydrophilic side chains. Which compounds will diffuse into the cell?
- a. I, II, III
  - b. I, II, III, V
  - c. I, III, IV, V
  - d. I, II, III, IV, V

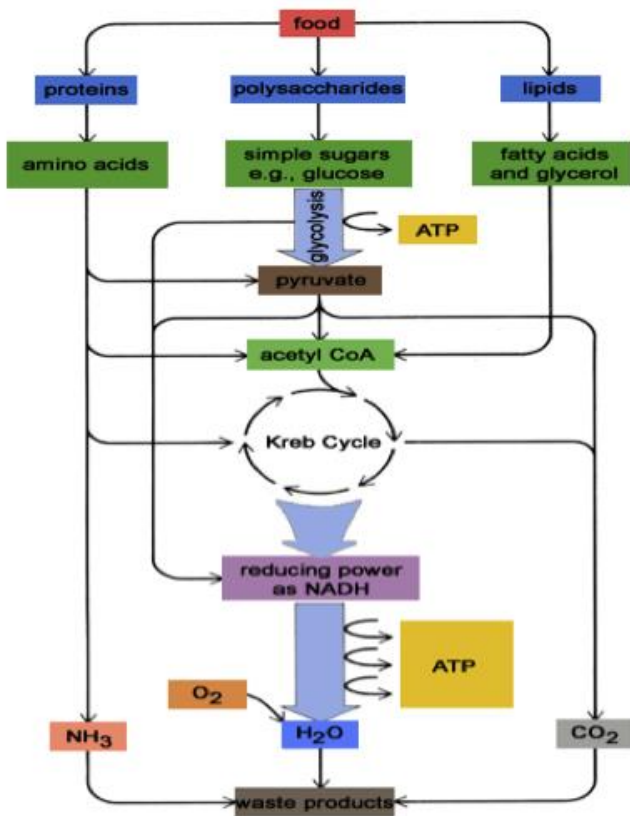
4. Bacterial cells and plants cells are less likely than animal cells to lyse in a hypotonic environment because:
  - a. The cells have mechanisms which actively transport water outside the cell
  - b. Bacteria and plant cells have plasma membranes less permeable to water than most animal cells
  - c. These cells increase their rates of photosynthesis in hypotonic environments
  - d. Bacterial cells and plants cells are surrounded by cell walls which provide support to the cell membrane under high osmotic pressure

An artificial cell consisting of an aqueous solution enclosed in a selectively permeable membrane is immersed a beaker containing a different solution. The membrane is permeable to water and the simple sugars, glucose and fructose. The membrane is impermeable to the disaccharide, sucrose.



5. Which of these experimental treatments would increase the rate of glucose transport into the cell?
  - a. Increasing extracellular glucose concentration
  - b. Decreasing extracellular pH
  - c. Increasing cytoplasmic pH
  - d. Adding an inhibitor that blocks the regeneration of ATP
6. Which of these experimental treatments would result in the most turgid cell?
  - a. Increasing the temperature of the system
  - b. Increasing the intracellular sucrose concentration
  - c. Decreasing the extracellular simple sugar concentration
  - d. Decreasing cytoplasmic pH
7. Facilitated diffusion and active transport both rely on proteins embedded in the phospholipid bilayer of the cell. Which of the following statements provides the best explanation of the differences between active transport and facilitated diffusion?

- a. Active transport is powered by ADP phosphorylation while facilitated diffusion is powered by the hydrolysis of ATP
  - b. Active transport is powered by the hydrolysis of ATP while facilitated diffusion is powered by anabolic reactions of cells
  - c. Facilitated diffusion moves molecules with their concentration gradient until equilibrium is reached; active transport moves molecules against their concentration gradient
  - d. Facilitated diffusion moves molecules from areas of high concentration to areas of low concentration; active transport uses ATP hydrolysis to move molecules from areas of low concentration to areas of high concentration
8. Choose the pair of terms that correctly completes this sentence:  
Catabolism is to \_\_\_\_\_ as \_\_\_\_\_ is to endergonic
- a. Exergonic; spontaneous
  - b. Anabolic; exergonic
  - c. Work; energy
  - d. Entropy; enthalpy
9. Living systems do not violate the second law of thermodynamics, which states the entropy increases over time. Which of the following statements supports this statement?
- a. Order is maintained in photosynthetic organisms by coupling cellular processes that increase entropy with decreases in the amount of ultraviolet radiation absorbed by the organism
  - b. Energy input must exceed free energy lost to entropy to maintain order and power cellular processes
  - c. Exergonic reactions, such as  $\text{ATP} \rightarrow \text{ADP}$  are powered by endergonic reactions
  - d. Metabolic processes are catalyzed by enzymes thus decreasing the entropy of the system
10. If an enzyme in solution is saturated with substrate. The most effective way to obtain a faster yield of products is to
- a. Add more enzyme
  - b. Heat the solution to 90C
  - c. Add more substrate
  - d. Add an allosteric inhibitor



11. According to the flow chart to the left, which of the following is not true of catabolic reaction within the cell?

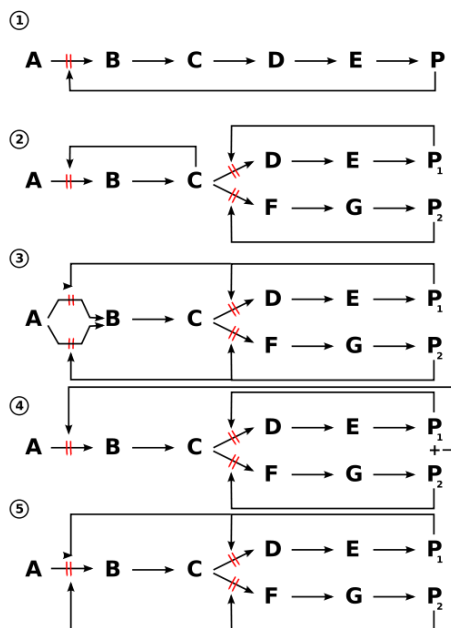
- a. The metabolism of all foods produce ammonia and carbon dioxide as waste products
- b. The metabolism of all foods produce acetyl CoA for the Krebs cycle
- c. Only simple sugars are processed through glycolysis
- d. Protein catabolism creates substrates for the pyruvate

dehydrogenase complex and the Krebs cycle

12. Using the flow chart above to determine the waste products of protein catabolism.

- a.  $\text{NH}_3$
- b.  $\text{NH}_3$ , ATP
- c.  $\text{NH}_3$ ,  $\text{H}_2\text{O}$
- d.  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{CO}_2$

13. Tryptophan can inhibit the activity of the first enzyme in metabolic pathway that builds tryptophan in the body. Which chemical pathway shown to the left illustrates this feedback mechanism?



- a. 1
- b. 2
- c. 3
- d. 5

14. Cholesterol is broken down by animal cells into bile acid. The "classical" pathway for the catabolism of cholesterol is initiated by the hydroxylation of the molecule at the 7 position.

When this pathway is inhibited, cholesterol follows an “acidic” pathway which is initiated by the hydroxylation of the molecule at the 27 position. Which chemical pathway, shown for question 13, illustrates this catabolic pathway?

- a. 1
- b. 2
- c. 3
- d. 4

15. *Thermoplasmales picrophilus* is the most acidophilic of all known organisms on Earth. These archaea can live in environments with a pH as low as 0.6. Which of the following statements is likely true about this organism?
- a. They are capable of maintain an internal pH much higher than that of the surrounding environment
  - b. Their enzymes have a low optimal pH
  - c. Their enzymes are insensitive to pH
  - d. They use molecules other than proteins as their main catalysts
16. Which of the following metabolic processes cannot occur without a net influx of energy from some other process?
- a.  $\text{ATP} + \text{H}_2\text{O} \rightarrow \text{ADP} + \text{P}_i$
  - b.  $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
  - c.  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
  - d. sucrose  $\rightarrow$  fructose + glucose

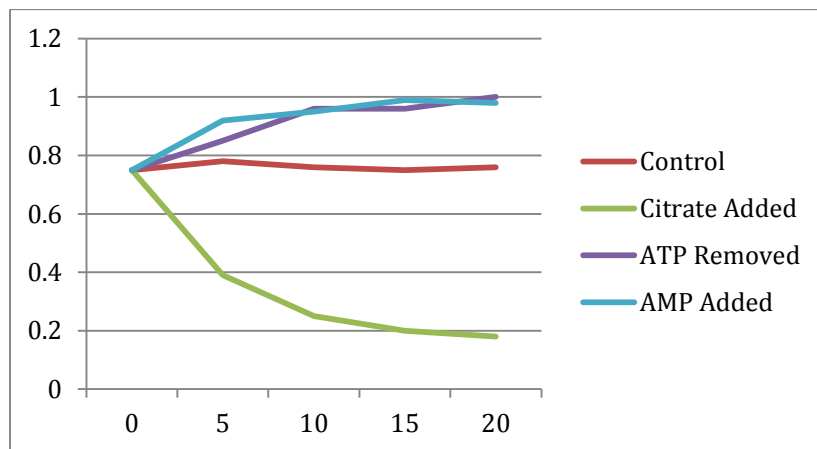
### Big Idea 2B

17. Which of the following statements is a correct distinction between cyclic and noncyclic photophosphorylation?
- a. Only noncyclic photophosphorylation produces ATP
  - b. In addition to ATP, noncyclic photophosphorylation also produces  $\text{O}_2$  and NADPH
  - c. Chemiosmosis is unique to noncyclic photophosphorylation
  - d. Only cyclic photophosphorylation can operate in the absence of photosystem II
18. Which of the following correctly sequences the steps of non-cyclic electron transport?
- a. Chlorophyll molecules absorb UV radiation exciting electrons which flow through photosystem I, returning to the chlorophyll molecules
  - b. Electrons donated from water molecules pass through photosystem I then photosystem II before returning to the chlorophyll molecules, generating ATP in the process
  - c. The ATP and NADPH generated by the reactions of photosystem II and photosystem I are utilized by the Calvin Cycle to build high energy glucose molecules

- d. Water is oxidized by the capture of light energy; these excited electrons are passed through the dark reactions, returning to chlorophyll during the final light reactions

19. Prokaryotic photosynthetic pathways were the foundation of eukaryotic pathways. All of the following support this statement except:
- a. Chloroplasts are surrounded by a double membrane
  - b. The genetic material of chloroplasts replicates independently of the host cell
  - c. Photosynthetic prokaryotes contain structures similar to photosystem I and photosystem II
  - d. Photosynthetic eukaryotes use chlorophyll to excite electrons, while cyanobacteria use phycobilins to perform the same function

An experiment was conducted to determine the factors affecting aerobic respiration in a facultative aerobe. Under aerobic conditions, the rate of carbon dioxide production was determined at 5 minute intervals. A graph of the results is shown below.



20. Which of the following best explains the above results?
- a. ATP and citrate are allosteric inhibitors in the cellular respiration process, while the presence of AMP stimulates respiration
  - b. ATP and AMP stimulate respiration, while citrate inhibits this process
  - c. Citrate stimulates the production of CO<sub>2</sub> by stimulating fermentation in the bacterial cells
  - d. The presence of ATP and AMP have little effect on the process of cellular respiration

21. Oxygen is removed from the environment. Which of the following would most likely occur?

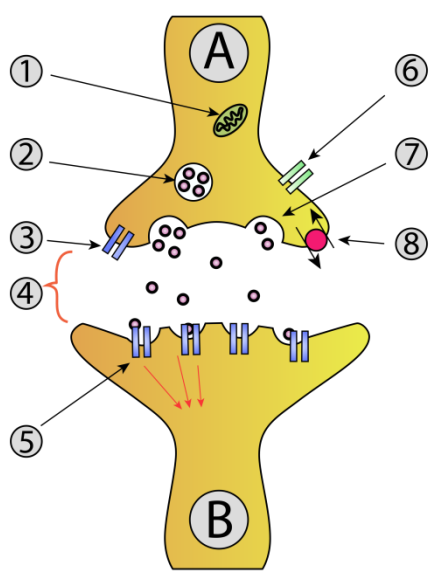
- a. The production of carbon dioxide in the “AMP added” system would increase
  - b. The production of carbon dioxide in the “ATP removed” system would increase
  - c. The production of carbon dioxide in the “control” system would decrease and level off
  - d. The production of carbon dioxide in the “control” system would increase and level off
22. Most CO<sub>2</sub> from catabolism is released during?
- a. Glycolysis
  - b. The Krebs Cycle
  - c. The Calvin Cycle
  - d. The light dependent reactions
23. Photosynthesis and aerobic cellular respiration both rely on electron transport chains to generate ATP. Which of the following does not correctly identify similarities and differences in the ETCs of these processes?
- a. Electrons delivered to the ETC are used to generate a proton gradient across the membrane
  - b. In photosynthesis, electrons are delivered to the ETC by NADPH; in cellular respiration, electrons are delivered to the ETC by NADH and FADH<sub>2</sub>
  - c. In prokaryotes, active transport moves protons across the cell’s plasma membrane during photosynthesis and cellular respiration
  - d. In photosynthesis, the facilitated diffusion of protons across the membrane generates ATP and glucose molecules; in cellular respiration, this process generates ATP
24. Chemosynthetic autotrophs and photosynthetic autotrophs are similar in that they both capture free energy to produce organic compounds. The balanced chemical equation for hydrogen sulfide chemosynthesis is as follows:  $\text{CO}_2 + \text{O}_2 + 4\text{H}_2\text{S} \rightarrow \text{CH}_2\text{O} + 4\text{S} + 3\text{H}_2\text{O}$ . Which of following correctly contrasts photosynthesis and chemosynthesis?
- a. In photosynthesis oxygen gas is the final electron acceptor, while in chemosynthesis hydrogen sulfide is the final electron acceptor
  - b. In chemosynthesis water is a final product, while in photosynthesis carbon dioxide is a final product
  - c. Photosynthetic organisms rely on free energy from sunlight to build organic compounds, while chemosynthetic organisms produce organic compounds using heat energy
  - d. Chemosynthetic organisms capture energy from inorganic molecules, such as hydrogen sulfide, while photosynthetic organisms capture energy present in sunlight

25. When making wine, yeast is added to grape juice. As time passes, the yeast uses up all of the oxygen in the flask, but continues to thrive and produce alcohol. Which of the following statements best explains this process?
- Yeast has evolved the ability to use other electron acceptors in the absence of oxygen
  - Yeast is a facultative anaerobe, able to switch to fermentation in the absence of oxygen
  - In the absence of oxygen, yeast participates in a symbiotic relationship with anaerobic bacteria
  - Fructose stimulates alcohol production in yeast

**Big Idea 2C**

26. The metabolic requirements of cells impose upper limits on the size that is practical for a single cell. Eukaryotic cells have increased this upper limit by all of the following except:
- Possessing extensive and elaborate internal membranes
  - Compartmentalizing chemical reactions in organelles
  - Evolving double membranes in the organelles of the cell
  - Embedding enzymes directly into membranes to facilitate local metabolic reactions
27. Cyanide binds with at least one of the molecules involved in the production of ATP. Following exposure to cyanide, the cyanide would accumulate which part of the cell?
- Mitochondria
  - Ribosomes
  - Lysosomes
  - Endoplasmic reticulum
28. Bacteria and archaea generally lack internal membranes and have a cell wall. Which of the following statements is incorrect?
- Protein catalysts are embedded in the cell wall to speed up metabolic reactions
  - The upper size limit of bacteria and archaea is generally lower than that of plant and animal cells
  - To perform aerobic cellular respiration, prokaryotes pump ions into the space between the plasma membrane and the cell wall
  - All metabolic reactions in these cells occur in the cytoplasm





The diagram to the left illustrates Neuron A transmitting a signal to Neuron B.

29. Which of the following correctly describes the transport of neurotransmitter out of Neuron A?
- The vesicle (2) fuses to the membrane (7) emptying its contents into the synaptic cleft (4) in a process called exocytosis
  - Using endocytosis, Neuron A passively transports the chemicals into the synaptic cleft (4)
  - The vesicle (2) facilitates diffusion of the neurotransmitter through the channel protein (3)
  - Simple diffusion occurs at the membrane (7) moving the neurotransmitter with its concentration gradient
30. Referring to the diagram above, for signal transduction to occur Neuron B must uptake ions from the synaptic cleft (4). Which of the following correctly describes the transport of these ions into Neuron B?
- Ions diffuse directly across the phospholipid bilayer
  - The ions must be actively transported through the integral proteins (5)
  - The neurotransmitter activates the integral proteins (5) opening channels to ion flow
  - The ions enter Neuron B through endocytosis

The vulva is the opening through which the nematode lays its eggs. Precursor cells in the larvae required a series of inductions initiated by a chemical signal from a nearby cell called an anchor cell. The binding of this first inducer to receptors on the nearest vulval precursor cells signals these cells to develop into the inner vulva. In addition, this binding triggers a signal-induction pathway leading to the synthesis of a second inducer molecule. This inducer, in turn, binds to specific receptors on to adjacent vulval precursor cells signaling these cells to develop the outer vulva.

31. All vulval precursor cells have receptors for both the first and second inducer molecules. Which of the following likely determines the effect of inducer molecules on the cell?
- Competitive inhibition by cofactors
  - Concentration of inducer molecules in the environment
  - Genetic regulation of coenzymes
  - Concentration of repressor molecules in the environment

32. Scientists are able to initiate the synthesis of the second inducer molecule artificially. Predict the outcome of the development of the vulva in this nematode.
- No vulva will develop
  - A normal vulva will develop
  - A inner vulva will develop with no outer vulval cells
  - Outer vulva cells will develop but the inner vulva will fail to develop
33. Which of the following physiological responses is an example of positive feedback?
- The body's production of red blood cells, which transport oxygen from the lungs to other organs, is stimulated by low concentrations of oxygen
  - A high concentration of glucose in the blood causes deeper, more rapid breathing, which expels carbon dioxide
  - Pressure of the baby's head near the opening of the uterus stimulates uterine contractions which cause greater pressure against the uterine opening
  - Heightening body temperature induces sweating which disposes of metabolic heat and cools the body
34. Diabetes is a disease that affects a feedback regulation pathway of the cell, specifically the cell's ability to lower the blood glucose level. Which of the following is not an accurate statement regarding this disease?
- Diabetics fail to produce or respond to insulin, a hormone that decreases blood glucose levels
  - Synthetic insulin can replace regular insulin in the feedback mechanism
  - Diabetics experience a positive rather than negative feedback regulation of glucose levels
  - In people without diabetes, increases in glucose intake initiate the production of insulin
35. Chemotaxis is the movement of cells in response to chemicals in their environment. Which of the following is not an example of this process?
- Bacteria use flagella to move toward the highest concentration of glucose
  - Leaves move in response to light sources
  - Sperm moving toward an egg during fertilization
  - Cells moving away from poisons introduced to the system

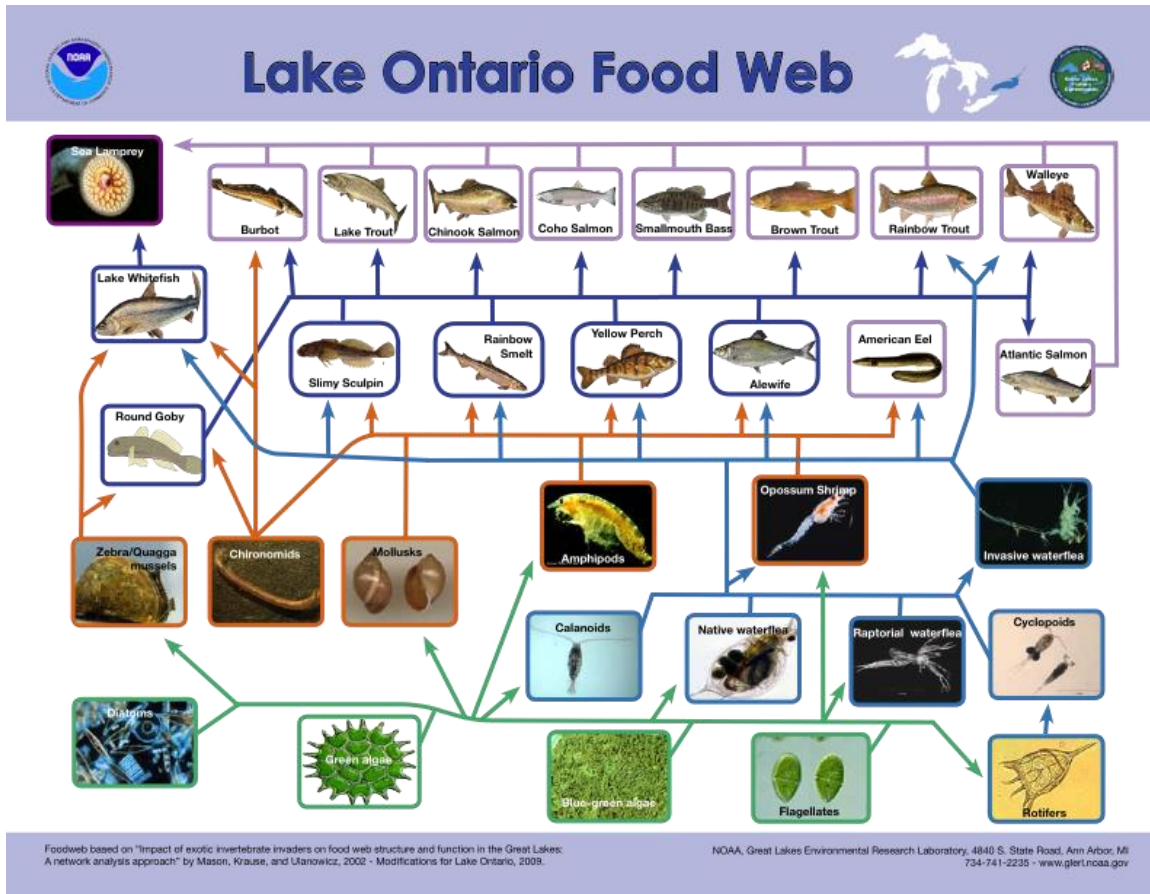
## Big idea 2D

36. The type of mature cell that a particular embryonic plant cell will become is determined by all of the following except:
- The cell's age
  - Regulation of the cell's gene expression
  - The cell's final position in a developing organ
  - The presence of tissue specific proteins

In plants, resistance to disease is based on gene-for-gene recognition. A plant has many *R* genes (for resistance), and each pathogen has a set of *Avr* genes (for avirulence, meaning not virulent). The plant is resistant to a pathogen if any one of the plants' *R* genes is a dominant allele that corresponds to a dominant *Avr* allele in the pathogen.

37. In which of the situations below would the pathogen be avirulent?
- $AVR_D - R_d$
  - $AVR_E - R_G$
  - $AVR_M - R_M$
  - $AVR_e - R_E$
38. The most likely explanation of this type of immunity is:
- The *R* gene from the plant interacts directly with the *Avr* gene of the pathogen, turning off transcription of virulent factors
  - The dominant *R* allele creates an enzyme which hydrolyzes all foreign DNA entering the cell
  - The *R* gene codes for a specific receptor protein which recognizes the DNA sequence of the dominant *Avr* allele
  - The *Avr* gene codes for a specific signal protein which binds to a receptor protein coded for by the *R* gene of the plant
39. Allergies are exaggerated immune responses to certain environmental antigens, such as pollen. Which of the following best explains this immune response?
- The allergen binds to an antibody embedded in the connective tissue of the animal, signaling the cell to release histamine
  - The allergen binds to an antibody specific to that allergen, signaling the cell to release histamine
  - When first exposed to the allergen, plasma cells recreate an antibody specific for that antigen; some of these antibodies remain attached to the connective tissue cells to respond to later exposures
  - When first exposed to the allergen, cells release histamine; histamine signals plasma cells to release antibodies specific to the antigen

40. Which of the following is not a normal response to dehydration in humans?
- Increased permeability of the collecting ducts to water
  - Production of more dilute urine
  - Increased thirst
  - Reduced urine production



41. The sea lamprey attaches itself to a variety of salt- and fresh-water fish. It injects an anticoagulant into the prey, feeding off its blood. One in seven of these fish survive. This relationship is best described as:
- Mutualism
  - Commensalism
  - Parasitism
  - Predator-prey
42. Which of the following would be most affected by the removal of Zebra mussels from the local environment?
- Slimy Sculpin
  - Round Goby
  - Lake Trout
  - Coho Salmon

43. Which property of water is responsible for all the others?
- Cohesion
  - Adhesion
  - Polarity
  - High specific heat

**Big Idea 2E**

44. A toxin is introduced into Lake Ontario. After several years, the highest concentration of this toxin will be found in?
- A flagellate
  - A rainbow smelt
  - An Atlantic salmon
  - A sea lamprey
45. What do the typhlosole (internal fold of the intestine) of an earthworm, the spiral valve (coiled lower portion of the intestine) of a shark, and the villi (finger-like projections of the intestinal wall) of a mammal all have in common?
- All are adaptations for the efficient digestion and absorption of meat
  - They are all microscopic structures
  - All increase the absorptive surface area of the intestine
  - They are all homologous structures
46. Animals can excrete nitrogenous waste in various forms. Some excrete it as ammonia, a highly toxic substance when found in high concentrations. Some excrete these wastes as urea, a substance 100,000 times less toxic than ammonia. The remaining animals excrete nitrogenous waste as uric acid; an insoluble substance that allows these animals to conserve water. Which of the following illustrates the relationship of these compounds with the type of animals which produce them?
- Most aquatic animals – ammonia; mammals and most amphibians – urea; birds, insects, and many reptiles – uric acid
  - Most aquatic animals – urea; mammals and most amphibians – uric acid; birds, insects, and many reptile – ammonia
  - Most aquatic animals – uric acid; mammals and most amphibians – urea; birds, insects, and many reptiles – ammonia
  - Most aquatic animals – ammonia; mammals and most amphibians – uric acid; birds, insects, and many reptiles – urea
47. Which of the following animals generally has the lowest volume of urine production?
- A frog in a pond
  - A shark inhabiting a freshwater lake
  - A salmon in the ocean
  - A freshwater trout

48. In July 2012, a private company conducted a geoengineering project by dumping 100 tons of iron sulfate off the coast of British Columbia. By August a plankton bloom was covering 10,000 km<sup>2</sup> was visible in the area. Which of the following statements is false regarding this experiment?
- Iron was the limiting nutrient in the local environment
  - Carbon dioxide concentration in the atmosphere will decrease
  - Dissolved oxygen in the water in this area will increase
  - The plankton bloom will likely create a “dead zone” in the area surrounding the experiment

In 1996, a development company has purchased a large area of prairie and woodland to create a retail and housing development. The following data was collected on the local population of coyotes.

Year	Number of Coyotes in the Local Area
1990	103
1995	98
2000	46

49. Which of the following is the most likely explanation for the decrease in the coyote population after the development project?
- The development project decreased the free energy available to the autotrophs in the area
  - The development project decreased the number of producers converting solar energy to chemical energy
  - The development project allowed invasive species to move in, outcompeting the coyote population
  - The small mammals consumed by the coyotes were trapped and exterminated by humans
50. Which of the following conclusions does not explain the differences in carbon dioxide production observed below?

Carbon Dioxide Production (mL)					
Time (min)	0	10	20	30	40
Germinating seeds 22° C	0.0	8.8	16.0	23.7	32.0
Dry seeds (non-germinating) 22° C	0.0	0.2	0.1	0.0	0.1
Germinating seeds 10° C	0.0	2.9	6.2	9.4	12.5
Dry seeds (non-germinating) 10° C	0.0	0.0	0.2	0.1	0.2

- Temperature increases cause increased activity and respiration in germinating seeds
- The dry seeds may be dormant and metabolizing stored energy very slowly
- The type of seed used has an optimum germinating temperature of 10° C
- Germinating seeds have increased respiration of non-germinating seeds due to increased energy demands.

Answers

- |       |       |
|-------|-------|
| 1. a  | 26. c |
| 2. b  | 27. a |
| 3. c  | 28. a |
| 4. d  | 29. a |
| 5. a  | 30. c |
| 6. b  | 31. b |
| 7. d  | 32. d |
| 8. b  | 33. c |
| 9. b  | 34. c |
| 10. a | 35. b |
| 11. a | 36. a |
| 12. d | 37. b |
| 13. a | 38. d |
| 14. c | 39. c |
| 15. b | 40. b |
| 16. c | 41. c |
| 17. d | 42. b |
| 18. c | 43. c |
| 19. d | 44. c |
| 20. a | 45. c |
| 21. c | 46. a |
| 22. b | 47. c |
| 23. d | 48. c |
| 24. d | 49. b |
| 25. b | 50. c |