CELLS/ ORGANELLES

What part of the cell produces ATP for the blueberry plant to grow?

A. Mitochondrion  
B. Cytoplasm  
C. Ribosome  
D. Nucleus

The plasma membrane contains which of the following?

A. phospholipids  
B. cholesterol molecules  
C. many proteins  
D. all of the above

Which of the following is true of the nucleus?

A. The nucleus is considered the control center of the cell. 
B. The nucleus contains the cell’s DNA.  
C. Most cells have a nucleus.  
D. all of the above

Match the vocabulary word with the proper definition.

Definitions

1. the arrangement of phospholipids in the plasma membrane
2. helps make and transport proteins and lipids
3. stores and transports protein and lipid molecules
4. helps the cell maintain its shape and holds cell organelles in place within the cytoplasm
5. layer that surrounds the plasma membrane of a plant cell
6. help organize the chromosomes before cell division
7. organelle that processes proteins and prepares them for use both inside and outside the cell
8. larger of the sac-like organelles that store and transport materials in the cell
9. describes the formation of eukaryotic cells
10. energy-carrying molecule
11. stores substances such as water, enzymes, and salts in plant cells
12. “power plant” of the cell

Terms

a. ATP 
b. cell wall 
c. central vacuole 
d. centriole 
e. cytoskeleton 
f. endoplasmic reticulum 
g. endosymbiotic theory 
h. Golgi apparatus 
i. mitochondria 
j. phospholipid bilayer 
k. vacuole 
l. vesicle

MITOSIS/ MEIOSIS/ PUNNETT SQUARES

Students need to be able to:

1. Identify the product of mitosis as two new cells with identical copies and the same number of chromosomes as the original cell; and
2. identify the product of meiosis as cells with a unique combination of genetic information and half the chromosomes of the original cell.
Why is it necessary for the DNA to replicate prior to cell division?
A. so that each daughter cell will have 23 chromosomes
B. so that each daughter cell will have a complete copy of the genetic material
C. so that each daughter cell will have 46 homologous chromosomes
D. so that each daughter cell will have 2 sister chromatids

The correct order of phases during mitosis is
A. telophase→prophase→metaphase→anaphase
B. prophase→anaphase→metaphase→telophase
C. prophase→metaphase→telophase→anaphase
D. prophase→metaphase→anaphase→telophase

How many chromosomes are in a normal human cell?
A. 23
B. 32
C. 46
D. 64

In some species of moths, large wings are dominant over small wings, and yellow wings are dominant over white wings. What percent of the offspring of two moths with small white wings will also have small white wings?
A. 0%
B. 25%
C. 75%
D. 100%

Why are the offspring of flowering plants genetically different from the parent plants?
A. Sexual reproduction produces offspring with new combinations of genes.
B. Sexual reproduction produces offspring with half the number of genes.
C. Asexual reproduction produces offspring with twice as many genes.
D. Asexual reproduction produces offspring with a variety of genes.

**DNA**
Students need to be able to:
1. Describe how the structure of DNA allows the nucleus to regulate cell activity.
2. Identify that mutations can be neutral, harmful or helpful to the survival of offspring. MUTATIONS ARE RANDOM!!

A strand of DNA contains the sequence GGC-CAT. What is the complementary strand of mRNA for this sequence?

If one strand of DNA is CAGGTTACG, the opposite strand is
A. GTCCAATGC
B. GTCCTTAGC
C. CAGGTTACG
D. GTCCTTAGC
Which of the following statements concerning DNA is correct? (1) DNA contains instructions for all the proteins your body makes. (2) The shape of DNA is a double helix. (3) The central dogma of molecular biology states RNA → DNA → Protein.
   A. 1 only
   B. 1 and 2
   C. 2 and 3
   D. 1, 2, and 3

**PROTEIN SYNTHESIS**

The green pepper plant has proteins that control the process of making glucose. How does the plant obtain these proteins?
   A. The plant makes the proteins using the instructions in DNA.
   B. The proteins are absorbed from the soil by the roots of the plant.
   C. The light energy changes molecules in the plant cell into proteins.
   D. The proteins are all present in the seed before germination occurs.

The two processes of protein synthesis are
   A. gene expression and protein expression.
   B. transcription and translation.
   C. replication and translation.
   D. transcription and the genetic code.

Which of the following statements is correct?
   A. Translation occurs in a ribosome when the codons on the mRNA are “read.”
   B. Translation occurs in a ribosome when the anticodons on the mRNA are “read.”
   C. Translation occurs in a ribosome when the codons on the rRNA are “read.”
   D. Transcription occurs in a ribosome when the codons on the mRNA are “read.”

Which of the following statements is correct? (1) Translation always begins with an UAG start codon. (2) The start codon establishes the reading frame of mRNA. (3) The mRNA molecule is read one codon at a time until a stop codon is reached.
   A. 1 only
   B. 2 only
   C. 2 and 3
   D. 1, 2, and 3

*Fill in the blank with the appropriate term.*
1. Transcription takes place in the ____________ of the cell.
3. A group of three bases in the mRNA is a ____________.
4. Transcription takes place in three steps: initiation, elongation, and ____________.
6. ____________ is the second part of the central dogma of molecular biology: RNA → Protein.
8. AUG is the start codon and it codes for the amino acid ____________.
10. The mRNA molecule is read, codon by codon, until a ____________ codon is reached.
11. An ____________ of the tRNA is complementary to the codon.
12. Transcription is the transfer of genetic instructions in DNA to ____________.
PHOTOSYNTHESIS / CELL RESPIRATION

Students need to be able to:
1. Describe the inputs and outputs of matter and energy in photosynthesis, cellular respiration and combustion.

Which of the following statements is true about glucose and ATP?
(1) Glucose is made during photosynthesis. (2) The energy in sunlight is temporarily stored in glucose before it is transferred to ATP. (3) ATP is the energy-carrying molecule that cells use for energy. (4) The processes that make ATP and glucose also recycle oxygen in Earth's atmosphere.
A. statement 1 only
B. statements 2 and 3 only
C. statements 1, 2, and 3 only
D. All 4 statements are correct.

Which of the following statements is true?
A. The products of photosynthesis are the reactants of cellular respiration.
B. The products of cellular respiration are the reactants of photosynthesis.
C. Both statements are true.
D. Neither statement is true.

The correct chemical formula for photosynthesis (in the presence of sunlight) is
A. \(6\text{CO}_2 + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}\).
B. \(6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2\).
C. \(\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}\)
D. \(\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2 \rightarrow 6\text{O}_2 + 6\text{H}_2\text{O}\)

The correct sequence of events in the light reactions is
A. absorption of sunlight, electrons flow down the electron transport chain, ATP is made, NADPH is made.
B. absorption of sunlight, splitting of water, electrons flow down the electron transport chain, ATP is made.
C. electrons flow down the electron transport chain, NADPH is made, ATP is made, water is split.
D. absorption of sunlight, electrons flow down the electron transport chain, NADPH is made, water is split.

The chemical formula of cellular respiration is
A. \(6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2\).
B. \(\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}\).
C. \(\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2\).
D. \(\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}\).

Photosynthesis
A. uses the energy in sunlight to make food.
B. uses the glucose in sunlight to make food.
C. uses the energy in sunlight to make ATP.
D. breaks down glucose to form ATP.
How do tussock moths obtain energy in cellular respiration?
A. By taking in water
B. By releasing oxygen
C. By breaking down glucose
D. By inhaling carbon dioxide

Coyotes eat proteins in food. The proteins break down due to enzymes produced in the stomach of the coyote. The production of these enzymes then causes more enzymes to be released in the stomach. Which process does this describe?
A. Meiosis
B. Diffusion
C. Feedback
D. Respiration

What is one purpose of ATP molecules in plant and animal cells?
A. To increase the rate of diffusion across cell membranes
B. To decrease the rate of chemical reactions
C. To store energy used for cell processes
D. To pass genetic traits to offspring

What is the role of cellular respiration in plants?
A. To absorb carbon dioxide
B. To release oxygen
C. To produce ATP
D. To form glucose

**Match the vocabulary word with the proper definition.**

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ 1. the process in which glucose is broken down and ATP is made</td>
<td>a. ATP</td>
</tr>
<tr>
<td>____ 2. organism at the end of a food chain</td>
<td>b. autotroph</td>
</tr>
<tr>
<td>____ 3. shows how energy and matter flow from producers to consumers</td>
<td>c. cellular respiration</td>
</tr>
<tr>
<td>____ 4. also known as autotrophs</td>
<td>d. consumer</td>
</tr>
<tr>
<td>____ 5. the ability to do work</td>
<td>e. decomposer</td>
</tr>
<tr>
<td>____ 6. stores chemical energy in a concentrated, stable form</td>
<td>f. energy</td>
</tr>
<tr>
<td>____ 7. the energy-carrying molecule that cells use for energy</td>
<td>g. food</td>
</tr>
<tr>
<td>____ 8. process that stores energy from sunlight in the chemical bonds of glucose</td>
<td>h. food chain</td>
</tr>
<tr>
<td>____ 9. organisms that make their own food</td>
<td>i. glucose</td>
</tr>
<tr>
<td>____ 10. all animals and fungi and many single-celled organisms</td>
<td>j. heterotroph</td>
</tr>
<tr>
<td>____ 11. organisms that must eat</td>
<td>k. photosynthesis</td>
</tr>
<tr>
<td>____ 12. organic molecules that store energy in their chemical bonds</td>
<td>l. producer</td>
</tr>
</tbody>
</table>
**Fill in the blank with the appropriate term.**

1. Heterotrophs are living things that cannot make their own ______________.
2. ______________ and ______________ are the two types of molecules organisms use for chemical energy.
3. Glucose and ______________ are the products of photosynthesis.
4. ______________, water, and energy are the products of cellular respiration.
5. Photosynthesis is the process in which energy from ______________ is transferred to glucose.
6. ______________ is the process in which energy from glucose is transferred to ATP.
7. Without photosynthesis, there would be no ______________ in the atmosphere.
8. All organisms burn glucose to form ______________ during cellular respiration.
9. The chemical formula of glucose is ______________.
10. Photosynthesis occurs in the ______________, and cellular respiration occurs in the ______________.
11. ______________ make their own food, whereas ______________ get food by eating other living things.
12. Living organisms get their ______________ from food.

**EVOLUTION/ INHERITANCE**

STUDENTS need to be able to:

1. Predict changes in populations due to natural selection caused by differences in genetic variability or environmental pressures.
2. Infer relationships among organisms given physical characteristics, functional characteristics and/or genetic information.
3. Explain how biological evolution is the result of interactions among populations, inherited variability, resources available and/or natural selection.

The traits of populations in the forest ecosystem have changed over time. What caused the traits to change?

A. Natural selection  
B. Lack of mutations  
C. Unlimited resources  
D. Asexual reproduction

Why do frogs and fish in the stream have similar genes?

A. Frogs and fish are made of molecules.  
B. Frogs and fish share a common ancestor.  
C. Frogs and fish get nutrients from the stream.  
D. Frogs and fish compete in the stream ecosystem.

Which scientific evidence would show that two species of birds are closely related?

A. The two bird species have similar DNA sequences  
B. The two bird species eat many of the same insects  
C. The two bird species are found in the same area  
D. The two bird species have similar feather colors
The traits of populations in the forest ecosystem have changed over time. What caused the traits to change?

A. Natural selection  
B. Lack of mutations  
C. Unlimited resources  
D. Asexual reproduction

Examples of analogous structures are

A. the tails of mice and rats.  
B. the limbs of humans and apes.  
C. the wings of bats and birds.  
D. all of the above

The strongest evidence for evolution from a common ancestor is

A. similar DNA sequences.  
B. similar body structures.  
C. similar embryological structures.  
D. similar fossils.

*Fill in the blank with the appropriate term.*

1. Humans and apes are evolutionarily closely related, based on analysis of their __________ sequences.

2. Wings of bats and birds serve the same function and are __________ structures.

3. Comparative __________ is the study of the similarities and differences in the structures of different species.

4. The human tail bone and appendix are __________ structures.

5. __________ structures are structures that are similar in related organisms because they were inherited from a common ancestor.

6. Comparative __________ is the study of the similarities and differences in the embryos of different species.

7. The term __________ refers to an organism’s ability to survive and produce fertile offspring.

8. Darwin proposed that __________ selects the variations in organisms that are most useful.

**ECOLOGY**

Students need to be able to:

1. Identify living and nonliving factors that promote or limit population growth.

Plants use nitrogen to make proteins. What is present in the soil that makes nitrogen directly available to plants?

A. Air  
B. Water  
C. Sugars  
D. Bacteria
Most autotrophs make “food” through the process of
   A. cellular respiration.
   B. chemosynthesis.
   C. homeostasis.
   D. photosynthesis.

In the food chain grass → grasshopper → snake → hawk, which organism(s) are the heterotrophs?
   A. the grass
   B. the grass and grasshopper
   C. the hawk
   D. the grasshopper, snake, and hawk

Which statement best describes the relationship between a consumer and a producer?
   A. A lion eating an antelope.
   B. A caterpillar eating a leaf.
   C. A snake eating a rat.
   D. A flower absorbing sunlight.

What caused the increase in the average beak size of the finch population after the 1977 drought?
   A. Finches’ beaks grew bigger because of the lack of water.
   B. Finches with small beaks were able to grow bigger beaks.
   C. Finches with bigger beaks were unable to leave the island.
   D. Finches with bigger beaks were able to survive and reproduce.

Which change to the forest ecosystem could limit the growth of the tussock moth population?
   A. Decrease in competition
   B. Reduction in disease
   C. Fewer predators
   D. Loss of habitat

How would a fish population affect the stream ecosystem?
   A. Fish would lower the water temperature.
   B. Fish would produce oxygen from the water.
   C. Fish would block sunlight, increasing plant growth.
   D. Fish would produce waste, providing nutrients to plants.

Paige and Logan counted a total of 480 plants in 12 square meters. What was the population density of these plants?
   A. 80 plants per square meter
   B. 40 plants per square meter
   C. 4 plants per square meter
   D. 5,760 plants per square meter
People often build homes near streams. Which action represents sustainable use of resources in the construction of new homes?
A. Installing furnaces that burn fossil fuels
B. Installing refrigerators made in another country
C. Using materials from old buildings for new homes
D. Using wood from old-growth forests for new homes

Scientists must be careful that their activities in an ecosystem do not introduce any new organisms into that ecosystem. What might be an effect on the finch population of Daphne Major if a new bird species were brought to the island?
A. The finch population would decline due to reproduction.
B. The finch population would increase due to adaptation.
C. The finch population would decline due to competition.
D. The finch population would increase due to predation.

Students asked the following question:
Question: What is the effect of the size of a moth population on the growth of trees in an ecosystem?
Which reason describes why this question is scientifically testable?
A. All moths require trees for food.
B. Many different ecosystems include trees.
C. Annual data can be collected because trees grow slowly.
D. Both tree height and moth population size can be measured.

Which is a role of the tussock moth larvae in the forest ecosystem carbon cycle?
A. The larvae eat food and release oxygen
B. The larvae eat food and release carbon dioxide
C. The larvae breathe in oxygen and produce glucose
D. The larvae breathe in carbon dioxide and produce water

Before the drought, Daphne Major had 720 finches living on 80 acres of land. What was the population density of finches on Daphne Major?____________________________

Examples of biotic factors include
A. grass, flowers, and sunlight
B. grass, trees, bees, and ants.
C. grass, trees, soil, and water.
D. all of the above

Components of an ecosystem include
A. soil, sunlight, water, and weather.
B. grass, trees, bees, and ants.
C. all the biotic and abiotic factors in an area.
D. all of the above.
Which describes the possible flow of energy in an ecosystem?
A. snakes to frogs to caterpillars to trees  
B. trees to frogs to snakes to caterpillars  
C. trees to caterpillars to frogs to snakes  
D. caterpillars to trees to frogs to snakes

The relationship between autotrophs and producers is
A. that autotrophs make the food the producers eat.  
B. that producers make the food the autotrophs eat.  
C. that autotrophs eat producers.  
D. that they are the same organisms.

Which statement best describes a trophic level?
A. A trophic level is the feeding position of an organism in a food chain or web.  
B. A trophic level is the position of an organism in an ecosystem.  
C. A trophic level is the niche of an organism in an ecosystem.  
D. A trophic level is the feeding role of an organism in an ecosystem.

Examples of decomposers include
A. algae and cyanobacteria.  
B. earthworms, dung beetles, and spiders.  
C. vultures and raccoons.  
D. all of the above.

Fill in the blank with the appropriate term.
1. Abiotic factors are the _______ aspects of the environment.
2. ________ are organisms that produce food for themselves and other organisms.
3. Scavengers consume the soft tissues of ________ animals.
4. ________ levels are the positions in a food chain or food web.
5. Ecosystems require constant inputs of ________ from sunlight or chemicals.
6. Omnivores consume both ________ and animals.
7. The competitive ________ principle states that two different species cannot occupy the same niche.
8. Producers are also called ________.
9. ________ feed on dead leaves and animal feces, among other debris.
10. Examples of ________ are lions, polar bears, and hawks.
11. ________ are organisms that depend on other organisms for food.
12. An ________ consists of all the biotic and abiotic factors in an area and their interactions.

**CYCLES/ FEEDBACK**

People sweat to help maintain body temperature. What type of feedback happens when sweating regulates body temperature?
A. Positive feedback, because sweating can increase body temperature  
B. Positive feedback, because sweating can decrease body temperature  
C. Negative feedback, because sweating can decrease body temperature  
D. Negative feedback, because sweating can increase body temperature
Blueberries contain sugars like glucose. What is the source of carbon for the glucose in blueberries?
   A. Carbon atoms in fertilizer
   B. Carbon dioxide gas in air
   C. Carbon dissolved in water
   D. Carbon molecules in the soil

Which statement best describes a biogeochemical cycle?
   A. A cycle that recycles chemical elements and water.
   B. A cycle that continuously cycles chemical elements and water.
   C. A cycle that continuously cycles chemical elements and water that are needed by organisms.
   D. A cycle that continuously cycles chemical elements and water that are needed by organisms through an ecosystem.

An example of an exchange pool is
   A. the atmosphere for water.
   B. the ocean for water.
   C. the Earth for carbon.
   D. all of the above.

The relationship between condensation and precipitation is that
   A. precipitation needs to occur prior to condensation.
   B. condensation needs to occur prior to precipitation.
   C. both are parts of the water cycle.
   D. both b and c describe the relationship.

The best description of the relationship between runoff and groundwater is that
   A. runoff turns into groundwater.
   B. groundwater turns into runoff.
   C. both result from precipitation and may end up in bodies of water.
   D. none of the above

Nitrogen fixation
   A. is the process of changing nitrogen gas to nitrates.
   B. is the process of changing nitrates to nitrogen gas.
   C. is carried out by nitrogen-fixing plants.
   D. naturally occurs in the atmosphere.

In terms of carbon and the atmosphere, autotrophs
   A. remove carbon through photosynthesis and release carbon by cellular respiration.
   B. remove carbon through cellular respiration and release carbon by photosynthesis.
   C. remove oxygen through photosynthesis but release carbon by cellular respiration.
   D. only remove carbon through photosynthesis.
Which statement is correct?
A. Nitrogen must cycle through an ecosystem because it is used to make proteins and nucleic acids.
B. Nitrogen makes up most of Earth’s atmosphere.
C. Nitrogen gas from the atmosphere cannot be used by plants to make organic compounds.
D. all of the above

APPLICATION

If the tussock moth population increases rapidly, trees that people want to use can be damaged. One solution is to use an insecticide that kills moths to keep the moths from damaging trees.

Describe two possible unintended consequences of using insecticides.

In your description, be sure to:
1. Describe two effects of insecticide use on the forest ecosystem other than the intended reduction of moths to protect the trees.
2. Describe how each effect causes a change in another part of the forest ecosystem.

One unintended consequence:

Another unintended consequence:

Students used a greenhouse as a model of a forest ecosystem to predict the effects of air temperature changes on tussock moths in a forest.

Describe two ways the greenhouse model may lead to unreliable predictions about the effects of air temperature changes on a moth population in a forest ecosystem.

In your description, be sure to:
1. Describe two differences that make a forest ecosystem more complex than the greenhouse.
2. Describe how each of the differences could cause the students’ predictions about a moth population in a forest ecosystem to be unreliable.

One way:
Another way:

The high flow line can move if the amount of water in a stream changes. Based on Paige and Logan’s results, what would happen to the plants if the high flow line moved farther from the stream?

A. The number of plants four meters from the stream would decrease.
B. The mass of the plants two meters from the stream would increase.
C. The height of the plants six meters from the stream would decrease.
D. The reproduction rate of plants four meters from the stream would increase.

Becky and Juan want to increase the mass of food produced in the school garden. Which of the following questions could lead to a possible solution to this problem?

A. How much carbon dioxide do plants require?
B. Which mineral nutrients do plants need?
C. Which plants provide the most protein?
D. Which plant seeds are largest?

Jose and Tasha want to improve the soil in the garden by increasing the population of worms in the soil. Describe how to begin solving this problem.

**Problem: Increase the population of worms in the soil**

Be sure to describe the following stages in your design process:

Research the Problem: Describe any scientific information needed to solve the problem and how to collect that information.

Explore Ideas: Describe several possible solutions to the problem, including any useful scientific concepts.
PROCEDURES

Plan a field study to answer the question in the box. You may use any materials and equipment in your procedure.

Be sure your procedure includes:
- logical steps to do the field study
- conditions to be compared
- data to be collected
- method for collecting data
- how often data should be collected and recorded
- environmental conditions to be recorded

Field Study Question: How does water depth affect the temperature of water in a stream?

CONCLUSIONS