Mrs. Respers
Summer Science Packet
Grade 7

Student Name: _____

Grade: _____

Date: _____

Mrs. Respers, Middle Science Teacher/ Middle School Science Fair Coordinator

Greetings, Parents and Scholars,

I am glad summer break is finally here!

As we reflect on this academic year and segue into the summer; science is all around us. I have prepared the Middle School Science packets so that learning may continue during summer break. This packet includes a study guide and review questions. Completed packets are due on or before September 10, 2021.

We will conduct a Science Fair check-in on September 09, 2021. Students are to complete his/her Science Fair Project Proposal prior to this date. For the 2021-2022 academic year, students in sixth, seventh, and eighth grade will concentrate on engineering and the following areas, respectively: Earth's Place in the Universe, Earth's Systems, Earth and Human Activity; Structure and Function of Organisms, Inheritance and Variation of Traits, Ecosystems: Interactions, and Dynamics; Matter and its Interactions, Motion and Forces, and Energy and Waves.

If you have any questions or concerns, please feel free to contact me via email at starrerespers@gmail.com.

I wish you a safe and fun summer!

Sincerely,

Mrs. Respers,
Middle School Science Teacher
Middle School Science Fair Coordinator
starrerespers@gmail.com

Experimental Variables

Experiments are important because they help people solve problems and answer questions. Most experiments follow a similar structure with key components. The subjects of the experiments are called samples, and any condition, item, or event that could affect the outcome of the experiment is called a variable. Students should understand dependent, independent, and controlled variables in experiments.

In a given experiment, some variables are held constant, or made to stay the same, while some variables must change so that the scientist can see how the samples react. Simple experiments usually test only one variable that the scientist is changing or observing in order to get an answer to a question. This variable is called an independent, or manipulated, variable. All other variables should be controlled, or remain constant, so that they do not affect the outcome of the experiment. The only variable that should change is the independent variable on which the experiment is based. When the independent variable changes throughout the experiment, it can affect the samples in different ways. The changes observed in the samples are called dependent, or responding, variables. These are the variables that are being observed. In a sense, the independent variable is the "cause," and the dependent variable is the "effect."

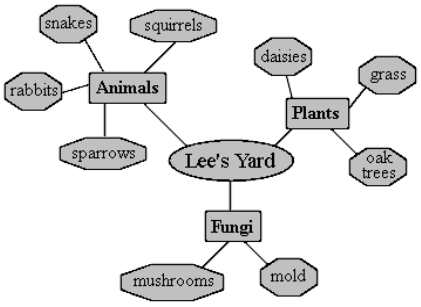
For instance, an experiment was conducted to determine if popcorn pops better at higher temperatures. Five bags of popcorn were used in ovens set at different temperatures. The popcorn in the oven with the highest temperature had the most popped kernels. Observing the number of kernels that popped at the various temperatures is very important in this experiment. The changing temperature is the independent variable. It must be changed in order to find an answer in this experiment. However, other factors could also affect the experiment, whether the scientist wants them to or not. If, in the same experiment, different types of popcorn are used each time, if the temperature is measured using different thermometers each time, or if the source of heat is different for each batch of popcorn, then the setup of the experiment is allowing changes to happen that will affect the outcome. These variables need to be held constant so they don't affect the outcome. The different temperatures affect the number of kernels of popcorn that popped. Since the temperature is the independent variable, then the factor that changes as a result of the temperature difference is the dependent variable. Here, the dependent variable is the number of kernels of popcorn that popped.

To help students understand dependent, independent, and controlled variables, have them find several experiments in their textbooks, on the Internet, or in books. For each experiment, have them write down the independent variable, dependent variable, and any other variables that should be controlled. Also, students can create and test their own experiment, again writing down the different types of variables.

Interpreting Concept Maps and Diagrams

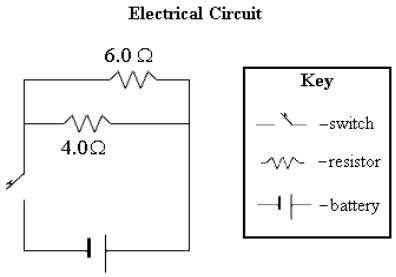
In many subject areas, including science, visual representations, such as concept maps, models, drawings, blueprints, and other diagrams, are often used to convey or explain information. Students should be able to interpret concept maps and diagrams.

> A concept map usually consists of shapes connected by lines or arrows. The shapes contain ideas or headings, and they are connected by lines to show how each shape is related to the others. The concept map below shows the different types of organisms that live in Lee's back yard.



The oval in the center connects to three types of organisms: animals, plants and fungi. Each type of organism connects to specific living things in its own category. For instance, oak trees, grass, and daisies are the plants in Lee's yard. One can also tell by this concept map that mold is a type of fungus that is found in Lee's back yard. Even though there is no title for this concept map, it is clear that the map is displaying the different types of living things found in Lee's yard.

Diagrams, such as blueprints and drawings of models, are another type of graphical representation. Like concept maps, they can also show relationships between different parts or ideas. In addition, diagrams can show sizes, scale, shapes, locations, distances, or processes. The diagram below is of an electrical circuit. It shows the parts of a particular circuit and their locations.



This diagram includes a key, which is common in diagrams. A key describes or defines symbols found in the diagram. In this diagram, the key shows what each symbol means.

Example: Use the diagram of the electrical circuit shown above to answer the following question. How many resistors does this circuit have?

A. 4
B. 6
C. 2
D. 1

Answer: C. The key shows that the symbol for a resistor is a jagged line. There are two of these symbols in the circuit, so there are two resistors.

To help students understand concept maps, have them make concept maps of their families. Their concept maps should be similar to family trees with grandparents or great-grandparents in a central location, branches out to each of their children, more branches representing their children's children, and so on. So that students may better understand diagrams, have each student draw a simple diagram of his or her bedroom. The student can draw what the bedroom looks like from above, using symbols for the different types of furniture and items in the room. Make sure students include a key that defines

each symbol in the diagram. Finally, have them write the distances between different pieces of furniture in the room.

Matching Data to Graphs

A chart is a set of data organized into columns and rows. Charts are often used in science to display or record information in an organized way. Sometimes information from charts is represented in a graphical format to show changes and trends. Some examples are bar graphs, circle graphs (pie charts), and line graphs. Students should be able to match data from a chart to the best graphical representation of the information in that chart.

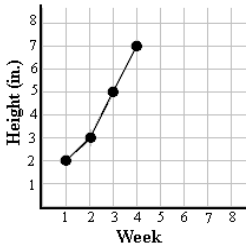
A chart has labels, called headings, that explain the type of information included. The chart below shows information on the growth of a plant over several weeks. Each week, the plant's height was recorded. The chart shows that the plant was two inches tall the first week, three inches tall the second week, five inches the third week, and seven inches the fourth week.

Plant Growth

Week	Height
1	2 in.
2	3 in.
3	5 in.
4	7 in.

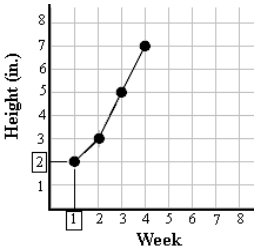
A graph is a pictorial way to display information. Most graphs have an x-axis that is horizontal and a y-axis that is vertical. The x- and y-axes meet at a corner that usually represents "zero" on both axes, unless otherwise labeled. The difference between the values on each axis is called the interval of the graph. The labels on the axes define what the numbers represent, including the units. Most likely, they are a measurement of an amount, such as height, weight, or time. The examples shown below explain different types of graphs.

A line graph is often used to show trends, changes over time, or how one factor affects another. The line graph below shows the information from the plant growth chart above. The numbers on the y-axis represent the plant's height in inches. The x-axis shows the weeks that the plant was measured. The interval on both axes is one because the numbers increase by one each time.



If you look at week one on the graph and follow it up the grid line until it reaches the data point, then follow the grid line to the left, it intersects the y-axis at a height of two inches. This information is the same as the information given in the chart; at week one, the plant was two inches tall. This can be verified for each data point.

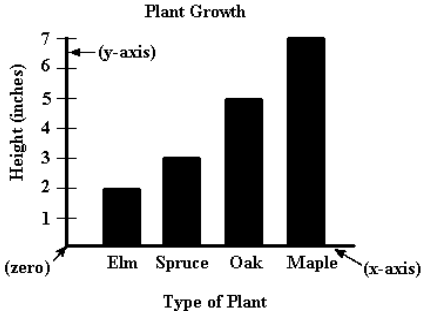
Week	Height
1	2 in.
2	3 in.
3	5 in.
4	7 in.



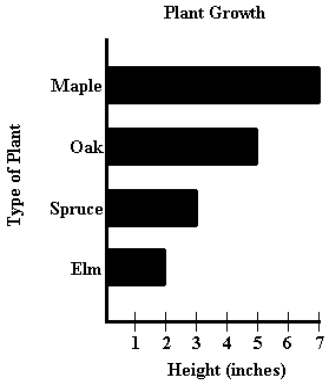
Bar graphs are another way to show quantities in a graphical format. They are usually used to compare items or describe different values. Like a line graph, a bar graph has an x- and a y-axis that show information. In this example, the information comes from the chart shown next to the bar graph. The numbers on the y-axis represent a plant's height in inches. The x-axis shows the type of plant that was measured. There are four bars on the graph, one bar representing each type of plant. The top of each bar represents the height in inches of that plant. If you look at the top of the bar for the elm and follow it over to the y-axis, you can see that it corresponds to a height of two inches. Each type of plant is a different height, so all of the bars on the graph are different heights. It is possible to have more than one bar with the same height, if more than one type of plant has the same measurement. Even if two or more values are the same, each item measured should have its own bar.

Plant Heights

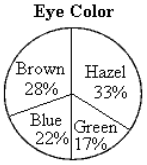
Type of Plant	Height
Elm	2 in.
Spruce	3 in.
Oak	5 in.
Maple	7 in.



Bar graphs can also be oriented sideways. The bar graph shown above could also be made like this:



Circle graphs, sometimes called pie charts, are also used to display information. They often show percentages or parts of a whole. They do not have an x- or a y-axis. The data in the charts shown above would not be displayed in a circle graph because the charts show the specific measurements of one or more plants, not measurements as parts of a whole. The circle graph shown below illustrates the percentage of people in an apartment building that have blue, green, brown, or hazel colored eyes.



The information in this circle graph matches the chart shown below.

Eye Color

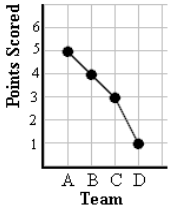
Color	Percentage of People
Brown	28 %
Hazel	33%
Blue	22 %
Green	17%

Example: Which graph below most accurately shows the information in this chart?

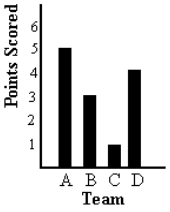
Tournament Scores

Team	Points Scored
A	5
B	3
C	1
D	4

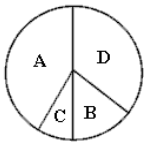
A.



B.



C.



Answer: B. The bar graph accurately shows all of the information from the chart. The bar for each team is the correct height to represent the corresponding number of points, given in the chart. Also, (B) is a better graph to display the type of information given, which is a data set for a group, not a trend. (A) is not correct because according to that graph, Team A scored 5 points, Team B scored 4, Team C scored 3, and Team D scored 1 point. This does not match the information in the chart. Finally, (C) is not correct. Circle graphs show parts of a whole or percentages, which is not the type of information given in the chart.

To help students learn how to match data from a chart to graphical representations, have them make a line graph for chart 1 below, a bar graph for chart 2, and a circle graph for chart 3.

Houses in Trudy's Neighborhood

Year	Number of Houses
1999	5
2000	8
2001	10
2002	15

1

Raul's Classes

Class	Number of Students
Math	24
Science	29
History	25
English	27

2

LeAnn's Day

Activity	Percentage of Day
Sleeping	33%
School	33%
Homework	10 %
Sports	15%
Other	9%

3

Inferences from Data in Charts

A chart is a set of data organized into columns and/or rows. Charts are often used in science to display or record information and numbers in an organized way. A chart has labels, called headings, that explain the type

of information included. Inferences are logical conclusions that can be made after examining data. Students should be able to use the information from a chart to make inferences.

In any situation in which events happen and changes occur, there is always a cause or explanation. Those events and changes will in turn produce effects. Being able to see how different factors relate in any situation and being able to make predictions are important in science. When examining information in a chart, a scientist often looks for patterns or clues that may appear. Recognizing patterns and examining clues help them to notice cause and effect relationships and make inferences. If two sets of numbers increase or decrease at the same rate, or even if one consistently increases as the other decreases, it can be a clue that one is causing the change in the other. For example, the chart below shows information from an experiment on plant growth. Three plants of the same type and age were observed. The temperature of the area they were grown in, the amount of water they were given, and their total growth were recorded.

	Temp.	Water Given Each Day	Height at Week 1	Height at Week 2	Height at Week 3	Height at Week 4	Height at Week 5
Plant 1	60°F	25 mL	4 cm	9 cm	12 cm	12 cm	12 cm
Plant 2	60°F	50 mL	6 cm	11 cm	14 cm	17 cm	19 cm
Plant 3	60°F	75 mL	7 cm	13 cm	16 cm	19 cm	22 cm

As you can see, the height of the plant increases as the amount of water given to the plant increases. We can infer that the more this type of plant is watered, the taller it will grow, and that the extra water caused plant 3 to grow more. Also, observe that Plant 1 is the same height at weeks 3, 4, and 5. From this, we can infer that the plant stopped growing after week 3.

Example: The chart below shows the conditions at Mission Lake on four different days and the number of frogs present on each day.

Day	Water Temp.	Air Temp.	Frogs Seen	Tide
Mon.	64°F	84°F	45	High
Tues.	64°F	82°F	50	Low
Wed.	64°F	73°F	21	Low
Thurs.	64°F	70°F	15	High

What most likely caused more frogs to be seen on Monday and Tuesday than on Wednesday and Thursday?

A. the water temperature
B. the air temperature
C. the tide

Answer: B. From the data in the chart, the most likely factor that contributed to the number of frogs seen is the air temperature. As shown in the chart, many more frogs were seen on Monday and Tuesday than on Wednesday and Thursday. Since the water temperature was the same every day, it probably did not affect the number of frogs seen, so (A) is incorrect. The tide is different on Monday and Tuesday, so it does not correspond to the high numbers of frogs seen on those two days. If the tide had been a factor affecting the number of frogs seen, there would have been many frogs seen on only one of the days (either Monday or Tuesday) and few seen on the day with the opposite tide. Therefore, (C) is incorrect.

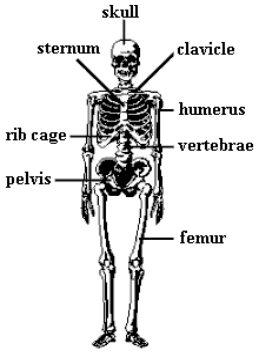
To help students understand how to make inferences using the data in charts, have them find data from

an old experiment that they conducted or data from a lab or science book. They should try to find patterns and explain what caused any apparent changes or differences in the data. Also, they can write down ten events (or effects) they have learned about in science along with the corresponding cause for each event or effect: for example, a plant turning yellow and dying (effect) and the plant's soil not having the proper nutrients (cause).

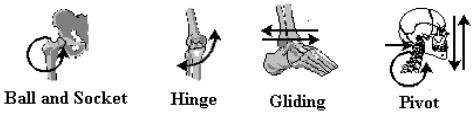
Skeletal and Muscular Systems

The skeletal and muscular systems are the systems of the body that help us move. Students should know the functions of these systems, know their component parts, and understand that they work together.

The skeletal system gives the human body shape, rigidity, and structure. There are over two hundred individual bones that make up the human skeleton. Bones have a hard exterior with a softer center called the bone marrow. A spongy material, called cartilage, cushions the ends of bones. In addition, it is cartilage, not bone, that shapes the ears and the nose on humans. The following diagram shows the location and general shape of some of the major bones in the human body, including the skull, clavicle, vertebrae, humerus, rib cage, sternum, pelvis, and femur bones in the human skeleton.



A joint is formed where bones come together. There are four basic types of moveable joints: ball and socket, hinge, pivot, and gliding. Ball and socket joints allow movement in all directions. The shoulder and hip are examples of ball and socket joints. Hinge joints allow bones to move together and apart, like in the knee and the elbow. The skull and vertebrae come together and form a pivot joint. Pivot joints allow movement up and down and rotation from side to side, like the bones in your neck. Gliding joints can be found in the ankles and wrists, where bones move back and forth, and from side to side. Stretchy, rubber band-like ligaments hold the bones together at the joints. The following diagrams show the four types of joints, with arrows indicating the directions of their movement.

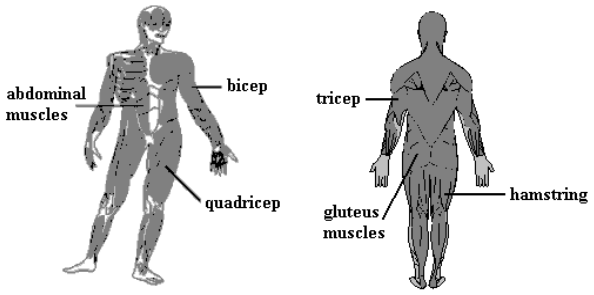


The skeletal and muscular systems are dependent on one another. Muscles are attached to the skeleton in many places because the muscles of the body help the skeleton move. They are attached to bones by bands of tissue called tendons. Without muscles, the body could not move.

Muscle tissue contracts, or squeezes together, and relaxes in order to move the parts of the body. An example of this is the relationship between the bicep muscles in the front of your arm and the tricep muscles opposite to the biceps. When you touch your right shoulder with your right hand, your biceps contract, while the triceps on the other side relax. To stretch the arm back out and hold it flat, the

triceps must contract while the biceps relax. Many muscle groups throughout the body share this same type of relationship.

The following diagram shows the location of the abdominal muscles, the bicep, the quadricep, the tricep, the hamstring, and the gluteus muscles in the human body.



There are three different types of muscle tissue. They are smooth muscle, cardiac muscle, and skeletal, or striated, muscle. The muscles shown in the diagram above are all skeletal muscles. Skeletal muscles are attached to bones and help move the skeleton. They are voluntary muscles, meaning you can consciously make them move. Smooth muscle is found in internal organs. These muscles are involuntary, which means that you are not able to consciously control their movement; they help organs perform certain functions. For example, the smooth muscles of the stomach churns food during digestion. Finally, cardiac muscle is only found in the heart. This type of muscle also moves involuntarily.

To help students understand the skeletal system, have them try to find items around the house or at school that look or work like the different types of joints. A door hinge (hinge joint) and a nut and bolt (pivot joint) are two examples. Another activity students can complete, to help them learn muscles and bones in the muscular and skeletal systems, is to draw a picture of a person. On the picture, they should label the major bones and muscles. Finally, students can make different movements and try to guess which bones, muscles, and joints are moving.

Biotic and Abiotic Parts of Environments

The living things within an environment are called biotic factors, while the non-living things are called abiotic factors. The animals, plants, fungi, and microscopic forms of life that share the same environment are all examples of biotic parts. The soil, water, air, light, heat, minerals, rocks, and weather are all examples of abiotic parts of the environment. Students should be able to identify biotic and abiotic elements in an environment, as well as recognize how they interact.

Example 1: Which of these is a biotic part of a desert environment?

sand **sun** **tarantula** **dew**

Answer: The tarantula. Sand, sun, and dew are important parts of the desert environment, but they are not living things. The tarantula is the only living thing, so it is the biotic part.

Example 2: Which biotic part of an environment relies upon soil to get nutrients?

tree **spider** **bird** **fish**

Answer: The tree. Trees are plants that need nutrients from the soil to make food. Spiders, birds, and fish need to eat plants or other animals to get the nutrients they need. The tree is the biotic part that relies upon soil for nutrients.

The following activities can help the student learn about biotic and abiotic parts of environments:

Activity 1: The student can start by drawing an aerial map of their bedroom. Have the student draw only the abiotic parts of the bedroom environment. On the back of the map, have the student list three abiotic parts that, if changed or removed, would alter the bedroom environment. Have the student explain how each would change the bedroom as a whole.

Activity 2: Have the student choose an area of the ground outside and draw an aerial map of it. The student can draw both the biotic and abiotic parts within the area, and list each on the back of the map in these two separate categories. Again, have the student think of three abiotic parts they drew that, if removed or changed, would alter the environment. Have the student explain how each would change the environment as a whole.

Land Biomes

On earth there are areas that share the same climate and soil conditions, as well as plant and animal life. These areas are called biomes. There are seven major land biomes: tundra, deciduous forest, desert, grassland (savanna), chaparral (scrubland), wetland, and tropical rain forest. Students should be able to describe the characteristics of each biome, as well as recognize some of the plant and animal life that inhabit each biome.

The tundra biome is a treeless, cold area, located in the Arctic Circle. The tundra is treeless because it does not receive enough of the sun's energy to allow for large plants to produce their own food. The plants that live in the tundra are lichens, mosses, and grasses which grow right along the ground, and have very small leaves. Just below the surface of the tundra, the soil stays frozen year-round which inhibits deep root development in plants. This layer of soil is called permafrost. Polar bears and brown bears use the tundra for hunting fish and small rodents. Birds, moose, caribou, and insects migrate to the tundra during warmer summer months to feed and reproduce.

Deciduous forests are located in areas that experience cold winters, warm springs and summers, with seasonal sunlight and rainfall. The plant life in the deciduous forest includes trees, shrubs, and other plants that can live in shadows cast by trees. During fall, the leaves on the trees in deciduous forests change colors, and the trees lose their leaves by winter. Lichens, mosses, and fungi also live in deciduous forests. Because of the abundance of plant life, a variety of animals inhabit the forest. Black and brown bears, deer, rodents, birds, insects, spiders, cats, foxes, wolves, caribou, moose, as well as some amphibians and reptiles, can make their homes there finding plenty of food, water, and shelter.

The desert is a biome that receives very little to no rainfall. Plants in the desert must be well adapted to the harsh temperatures and lack of moisture to survive. In hot deserts, the majority of plants are cacti and grasses, which have special stems for storing water. The animals in deserts must be able to live off of these specialized plants as well as deal with the lack of moisture and extreme temperatures. Certain lizards, tortoises, snakes, rodents, insects, birds, and spiders can live well in a desert. Most of the animals in a desert biome are nocturnal, which means they are mostly active at night when the temperatures are cooler.

The grassland, also called the savanna, is a biome with few or no trees. The primary plant life consists of grasses which depend upon streams, seasonal rainfall, and plenty of sunlight to meet their needs. The wide-open space of the grassland is attractive to migrating and herding animals such as buffalo, horses, deer, antelope, and cattle. Ducks, geese, songbirds, hawks, and falcons, can live in grasslands depending on the

amount of water and food that exist there. Larger animals such as foxes, wolves, lions, cheetahs, and hyenas migrate to the grassland as long as there is plentiful prey and enough shelter. Small rodents, reptiles, insects, and amphibians find grasslands ideal for feeding on plants.

Chaparral, sometimes called scrubland, is a biome located in coastal areas where the climate is moderate, but the environment can be harsh. Rainfall is not predictable, and these areas can experience flooding at times. Winds are strong and the soil is loose and sandy. Plants have adapted to the chaparral by limiting their height, and their leaves tend to be small and dense. Small birds, reptiles, insects, and some rodents live in the chaparral biome. Larger animals migrate there to feed, but the plant life is not ideal for sheltering their larger bodies.

A wetland is a biome that exists where fresh water sources from the land collect in a low lying area. A wetland is sometimes called a swamp or estuary. Many of the trees, grasses, mosses, and shrubs live directly in the water. They may have root systems that grow into the muddy and sandy bottom of the wetland, or may simply float in the water, trailing their roots underneath or beside them. Like the plants, the animals in a wetland spend most of their lives in the water. Alligators, crocodiles, snakes, lizards, amphibians, insects, and birds have adaptations that allow them to move, find shelter, and feed easily in this watery environment. Insects of many kinds find the wetland attractive because of the mild climate and large amount of water. Some rodents make their homes in wetlands, while many fish live in the waters.

The tropical rain forest is the biome with the most diversity in plant and animal life. Tropical rain forests circle the globe, at the equator, on all continents. Near the equator, the temperature is always warm, there is always plenty of sunlight, and much rainfall. Plants with wide, glossy, green leaves live very well in this hot, humid climate. Trees of great height create a canopy, or roof-like covering, over the top of the forest with their branches and leaves. Sometimes this canopy is so thick that no sunlight reaches the forest floor. The layers of plant life in the rain forest learn to adapt to the amount of sunlight they receive, and grow strong from the abundance of nutrients in the soil. The variety of plant life in the rain forest is equaled only by the diversity of animal life. In no other biome can so many animals - insects, birds, reptiles, amphibians, arachnids, rodents, apes, monkeys, cats, bears, boars, bats and humans - live together and have their needs met.

The following activities will help students learn about land biomes:

Activity 1: After developing a color key to identify each of the seven land biomes, students can use a map and the color key to color-code parts of their own country that represent certain land biomes.

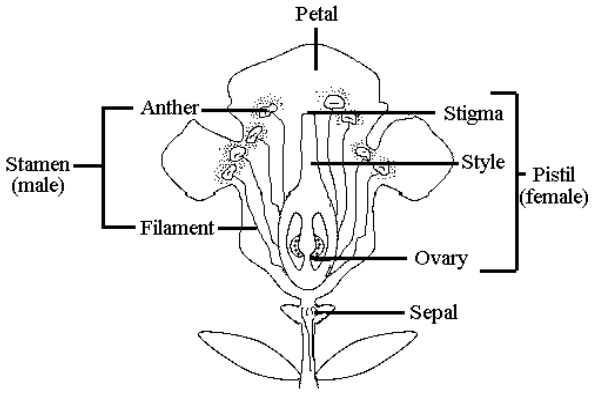
Activity 2: Have students cut out or draw pictures of animals that live in certain biomes around the world. Students can label each picture with the name of the biome where the animal lives.

Activity 3: Making flashcards with a biome fact on one side, and the name of the biome on the other will help students remember the basic characteristics of each land biome.

Flower Parts and Functions

Students should understand the process of reproduction in flowering plants, including the flower parts necessary for reproduction.

The following diagram shows the general shape and location of the parts of a flower.



The petals protect the interior flower parts and attract insects.
The sepal is a small leaf-like part on the bottom of the flower that protects the young flower (bud).
The stamen is the male reproductive structure of the flower and is made up of the anther and filament. It produces powdery pollen grains which are the male sex cells of the flower.
The filament holds up the anther.
The anther produces and holds pollen.
The pistil is the female reproductive structure of the flower and is where seeds are produced. It is made up of three parts: the stigma, style, and ovary.
The stigma is the opening of the ovary.
The style is a tube connecting the stigma to the ovary.
The ovary is where the eggs, the female sex cells of the flower, and seeds are produced.

Flowering plant reproduction begins with a process called pollination, during which pollen is carried to the stigma by wind, insects, or other means. Insects and other animals often carry pollen between flowers. They are attracted to the petals' bright colors and perfumes. After pollination, the pollen grain makes its way down the style into the ovary. Once in the ovary, the pollen grain will unite with the egg. This union is called fertilization. After fertilization, seeds begin to develop inside the ovary. As the seeds grow, the ovary swells and hardens to protect the seeds.

To study the process of plant reproduction, students can make a flow chart showing the steps of reproduction, including the parts of the flower involved. Also, students can find various flower samples and identify their parts. The interior parts of a flower can be observed by removing one or two petals. Different flowers have different forms of flower structures. After identifying the structures inside the flowers, students should discuss each structure's role in reproduction.

Energy Pyramid

The energy pyramid is a model that shows the relationships between trophic levels in an environment and the amount of energy that is passed from organism to organism. A trophic level is a group of organisms performing a specific role in an environment. The trophic levels are producers, primary and secondary consumers, and scavengers.

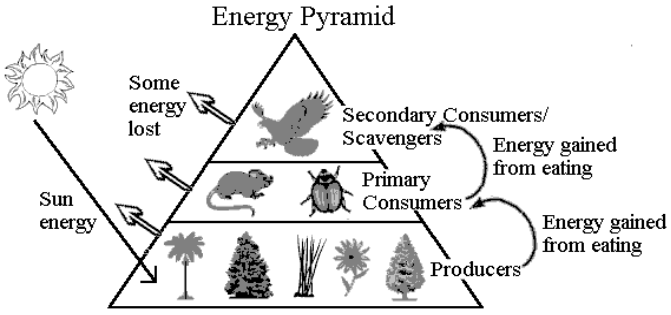
Students should know the definitions and apply an understanding of the energy relationships between primary and secondary consumers, producers, and scavengers.

Producers are plants; they make their own food from the sun. A consumer is an organism that cannot make its own food, so it feeds on plants or other animals. Primary consumers eat only producers and secondary consumers eat other consumers. A scavenger is a secondary consumer that feeds on dead or

decaying organisms. Here are some examples of the interactions between these trophic levels:

A sparrow (secondary consumer) eats a seed (producer).
A vulture (scavenger) eats a dead lion (secondary consumer).
An owl (secondary consumer) eats a mouse (primary consumer).
A mouse (primary consumer) eats grass (producer).

An energy pyramid shows most of these relationships in pyramid form. Producers are on the bottom of the energy pyramid. They get all of their energy from the sun. The next level is the primary consumers. They get their energy from eating the producers, but there is less energy at this level because some energy was lost in the exchange as heat. Secondary consumers get energy from eating primary consumers. There is the least amount of energy at the top level of the pyramid because energy is lost in each exchange. As you can see in the following diagram, the higher you go in the pyramid, the less the amount of energy.



To study energy pyramids, students can cut out pictures of plants and animals from magazines and classify them as producers, primary consumers, secondary consumers, or scavengers. On a piece of blank paper, they can create their own energy pyramid by pasting the organisms in the proper trophic level and labeling the trophic levels on the pyramid.

Population

Students should understand the biotic and abiotic factors that impact population sizes in an environment, including the concepts of sustainability, limiting factors, biotic potential, and carrying capacity.

Living things in an environment, such as trees and animals, are called biotic factors. Non-living parts of an environment, such as amount of sunlight, climate, soil, and cleanliness of the air, are called abiotic factors. A population is a group of the same type of organism in an ecosystem. Populations increase and decrease in number, based on the birth rates as well as how long organisms survive.

A limiting factor is a specific biotic or abiotic factor that stops a population from increasing. Sometimes an area has plenty of water, space, and clean soil, but there are not enough mice for the owls to eat. The lack of food may be the limiting factor for the owl population, because without food, fewer owls will survive and the population will decrease. After a few seasons, the mouse population may increase because there are fewer owls to kill them. The mouse population could reach its biotic potential, where the conditions of the environment are just right for the maximum capacity of mice to survive and reproduce. If too many mice are present though, the population may reach carrying capacity. The carrying capacity is the maximum population size that an ecosystem can support before food, water, shelter, or space begin to run out. These shortages will eventually affect reproduction and survival, and therefore limit the population.

Sustainability is the ability to maintain, support, or provide for something. An environment reaches sustainability when there are enough resources, space, and diversity so that the needs of all organisms are being met. Sustainability in an environment is important because it means an environment can allow many different organisms to survive for a long time. Without sustainability in an environment, population numbers fluctuate greatly or carrying capacity is reached quickly.

Example: Eagles eat fish. If the lake in the eagles' habitat becomes extremely polluted, how will the eagle population be affected?

A. The eagle population will increase.
B. The eagle population will decrease.
C. The eagle population will stay the same.
D. The eagle population will reach their biotic potential.

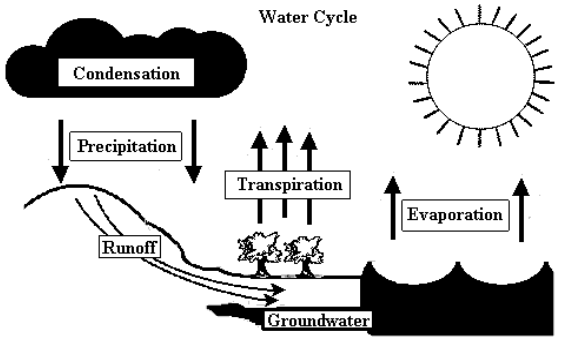
Answer: B. If the lake is extremely polluted, the fish that live there will die. Since the lake is in the eagles' habitat and is where they get fish, the eagles will not have enough food. This will decrease the eagle population.

To understand populations and how they change, students can write a short story about a specific environment and the changes in a population there. They should include details about both biotic and abiotic limiting factors, effects on other organisms in the environment, and when the population may have been at its biotic potential or carrying capacity. Students should try to focus on one or two types of organisms instead of all organisms in the environment.

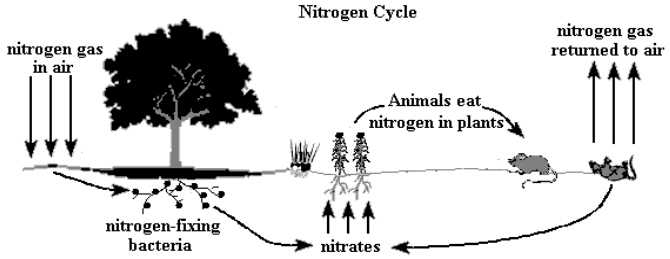
Material Cycles

Students should understand how materials in the environment, such as water, nitrogen, carbon, and oxygen, are distributed, replenished, and cycled. In addition, students should understand the impact of environmental changes on the material cycles.

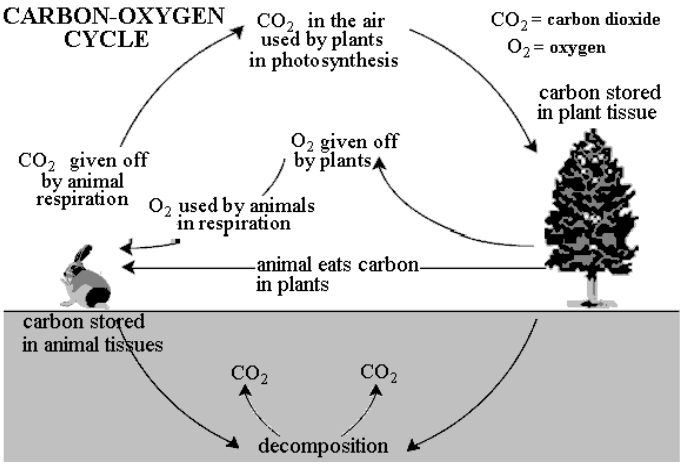
One example of a material cycle is the water cycle. Water from oceans and lakes is heated by the sun and turns into water vapor, a gas, in a process called evaporation. The vapor enters the atmosphere, cools, and turns into droplets, called condensation. Condensation is what forms clouds. The clouds move over land and release snow, hail, or rain, called precipitation. As the water falls to earth, several things can happen. Some of the water runs off the land into streams or rivers, or it seeps into the soil to become groundwater. Groundwater is water that is found underground in spaces between soil particles or rocks. The streams and rivers eventually empty water back into lakes or oceans. Water can also seep into the ground where plants absorb and use it. As water is used by plants, it reenters the atmosphere through transpiration, a process where plants give off water vapor. As water evaporates, the process repeats itself. The following is an illustration of the water cycle.



All living things need nitrogen to live. Though our atmosphere is about 78% nitrogen, it is not in a form useable to many organisms. In the nitrogen cycle, nitrogen gas in the air is converted to useable nitrogen. This process begins with bacteria in the soil and on the roots of plants. These bacteria, called nitrogen-fixing bacteria, use the nitrogen in the air and convert it to nitrates in the soil. Nitrates are nitrogen compounds that can be used by plants. Plants absorb the nitrates from the soil to use in photosynthesis, a process by which plants make their own food. Animals get the nitrogen they need from the plants that they eat. When plants and animals die or produce waste, decomposers in the soil break down the material and convert it to nitrates. Some of the nitrates are broken down further by other bacteria, which release nitrogen gas back into the atmosphere. The following is an illustration of the nitrogen cycle.



The carbon and oxygen cycles work together because both elements are combined in our air as carbon dioxide. The carbon from carbon dioxide is used by plants in photosynthesis, and oxygen is given off during the process. Oxygen is used by animals and plants in respiration, or breathing, and carbon dioxide is released. Respiration is the process where the cells exchange gasses with the environment. Like nitrogen, carbon is also stored in plant tissues, which are then eaten by animals. After organisms die, their decomposed tissues release carbon dioxide into the atmosphere. The following is an illustration of the carbon and oxygen cycle.



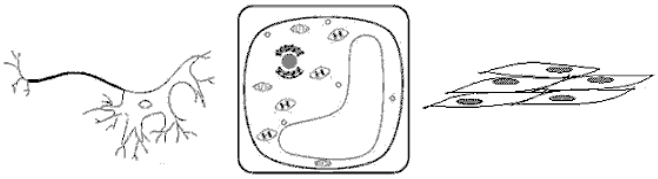
Any change that effects the materials involved in these cycles can in turn affect the environment in some way. For instance, if all of the plants in an area were removed due to clear cutting or development, the water cycle would be affected. Transpiration, an integral part of the water cycle, would not take place in that area. The nitrogen cycle would be affected because there would be no plant roots to convert nitrogen in the air to useable nitrogen in the soil. Also, animals in the area would not have plants to eat in order to obtain the nitrogen they need. Finally, the carbon and oxygen cycle would be disrupted in that area. Since there is no photosynthesizing plants, there is no oxygen production.

To understand material cycles, students can draw a diagram of each of the cycles, showing all materials and where they originate. All the underlined terms discussed here should be included.

Hierarchy of Body Systems

Cells are the smallest units of life. Though it contains even smaller parts, a cell is the smallest unit of life that undergoes all life processes. Students should know that multicellular organisms (organisms with many cells) are made up of various types of cells with specific functions. The structures of each type of cell help them to perform their functions. Cell adaptation to a specific role in the organism is called specialization. Specialized cells are the basic unit that form other structures in the body, including tissues, organs, systems, and organisms. Students should understand these structures and how they are organized.

The following cells look different because they are specialized to perform different roles:



Nerve Cell Plant Cell Muscle Cells

Nerve cells must pick up signals from the senses and carry them to other parts of the body. Nerve cells have long filaments that help them spread throughout a larger area, reaching all parts of the body. This lets the nerve cell pick up signals. Plant cells must make food or energy for the plant and give the plant structure to stand upright. Plant cells contain chloroplasts, which are green structures that allow them to make sugars, giving the plant energy. Plant cells are surrounded by a cell wall, a rigid layer of strong material that helps give the plant more support. Muscle cells contain many special structures that allow them to use a lot of energy. Muscle cells lie close together, in long fibers, in order to work together more effectively.

Similar cells that perform the same functions organize to form tissues. Different types of cells form different tissues. For example, muscle tissue is made of muscle cells, and root tissue in a plant is made of root cells. Although it is in liquid form, blood is considered a tissue because it is made up of blood cells. Different types of tissues are organized to form organs, which have specific functions. The stomach, eye, heart, and lungs are all organs that contain more than one type of tissue. When two or more organs work together for a greater function, they form a system. The brain, spinal cord, eyes, nose, ears, and tongue are all organs that work together to make up the nervous system. Some other systems of the human body are the digestive, muscular, circulatory, and respiratory systems. When a group of systems work together, they form a whole organism.

These are two examples of the levels of organization:
Muscle cells make muscle tissue that forms the calf muscle (organ), which is part of the muscular system, a system in a human (organism).
Skin cells make covering tissue that forms the intestines (organ), which is part of the digestive system, a system in a dog (organism).

To learn about cell specialization, students can look at pictures of cells, note their special characteristics, and discuss how those characteristics can help the cell perform certain functions. To learn about the hierarchy of body systems, students can make flow charts showing the relationship between the levels of organization in an organism.

Organism Interactions
Students should know the definition of symbiosis and apply an understanding of these symbiotic relationships: mutualism, parasitism, and commensalism. Students should also be able to recognize acts of cooperation, predation, and competition among animals.

Organisms in a habitat interact constantly. Sometimes these interactions are helpful to a particular organism, sometimes they are harmful, and sometimes the organism is not affected at all, but these interactions are all an important part of keeping an ecosystem functioning. When two organisms of a different species interact with each other it is called symbiosis. There are three types of symbiotic relationships: mutualism, parasitism, and commensalism.

Mutualism is a relationship that benefits both organisms involved. Birds sit on the backs of water buffalo and eat insects off of them. This allows the birds to get food, and protects the water buffalo from getting insect bites. When one organism benefits from a relationship but the other organism is harmed, it is called parasitism. Mistletoe is a parasitic plant because it grows on a tree and takes the tree's water and nutrients. Eventually, the tree may weaken and die because it doesn't get enough water and nutrients. Commensalism is when one organism benefits from the relationship while the other organism is not affected. Remora are fish that attach themselves to the fins of sharks. This is good for the remora because they get food scraps from the shark and they get carried through the ocean, but they don't affect the shark at all.

Cooperation can occur in ecosystems when two or more organisms of possibly the same species act in order to get benefits from one another. For example, fish swim together in schools to protect themselves against predators. Another way organisms interact is through competition. Since many organisms may have the same needs and there may only be a limited amount of material in the ecosystem, they must compete for food, water, shelter, or space. Both organisms are adversely affected. Acts of predation, when a predator hunts prey, sometimes bring about competition among organisms. An example of this is when a lion catches and eats an antelope. Many other lions, or scavengers like hyenas and vultures, will try to eat the same antelope that was killed by the lion.

Example: A leech attaches itself to a human to drink his blood. What type of relationship is this?

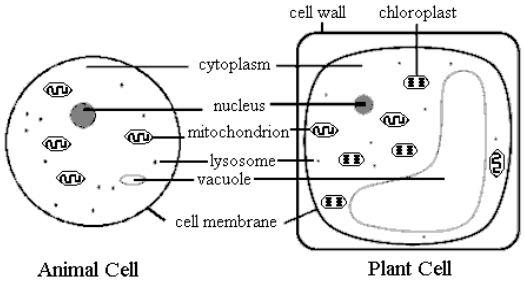
A. mutualism
B. commensalism
C. cooperative
D. parasitism

Answer: D. This is a parasitic relationship because the leech benefits by getting food, but the human is harmed because the leech is taking valuable blood away from the human.

Students can study organism interactions by making a table of the above underlined terms and finding examples of these relationships in the community, on television, or on the Internet.

Cell Parts - A
Students should be able to differentiate between a plant and animal cell and know the location and function of the following cell parts: nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, lysosomes, vacuoles, and mitochondria.

The following diagram shows the cell parts, or organelles:



The cell membrane is the layer that surrounds the cell, protects it, and allows some materials to pass in and out of the cell.
The cell wall is an extra layer on the outside of plant cells that is rigid to give the plant support and prevent loss of moisture.
The cytoplasm is a thick jelly-like substance inside the cell in which all of the organelles are suspended.
The nucleus is an organelle on the inside of the cell that controls the functions of the cell and contains genetic material.
Chloroplasts contain green pigments found in all green parts of plants, especially leaves. They are the organelles in plants where photosynthesis, the process in which plants make their food using the sun's energy, occurs.
Vacuoles are used for the storage of water, food, or wastes inside the cell.
Lysosomes contain enzymes to digest materials inside the cell.
Mitochondria provide energy for the cell by breaking down nutrients.

There are a few specific differences between plant cells and animal cells. Animal cells do not have a cell wall and they have small vacuoles or none at all. They also do not have chloroplasts so they cannot make their own food. However, plant cells have a cell wall, large vacuoles, and chloroplasts.

To learn more about cell structure, students can observe the parts of onion cells and skin cells using a hand lens or microscope. Students can draw what they see and label the organelles that can be distinguished. If a hand lens or microscope is not available, you can find several books in the library that have pictures of plant and animal cells. Using the pictures of plant and animal cells, students can note the differences between the two and identify all parts and functions.

Genetics - A
Students should understand that an individual's inherited characteristics, or traits, may be dominant or recessive. Students should also be able to use Punnet squares to determine the probability of offspring expressing a certain trait, including its sex.

Some traits, like eye color and hair color, are determined solely by heredity, while others, like intelligence and musical ability, may be influenced by outside factors. Inherited traits can be dominant or recessive. In most situations, dominant traits are expressed if they are present and recessive traits are only expressed if the dominant trait is not present.

Alleles are letters that represent particular forms of a trait, capital letters for dominant traits and lowercase letters for recessive traits. For example, if you are looking at the gene for the ability to roll your tongue, an "R" may represent the dominant trait of the ability to roll your tongue and an "r" would represent the recessive trait of not being able to roll your tongue. An individual will have a pair of

these alleles like Rr, RR, or rr, representing his or her genotype. These genotypes are a combination of one allele from each parent acquired through sexual reproduction. If the genotype has a dominant allele in it, the individual will express the dominant form of the trait. People with a genotype of Rr or RR will be able to roll their tongue. If only recessive alleles are present, the recessive form of the trait will be expressed. A person with a genotype rr will not be able to roll his or her tongue. The actual trait or characteristic that is expressed is called the phenotype. For example, a genotype of RR will cause a phenotype of the ability to roll the tongue.

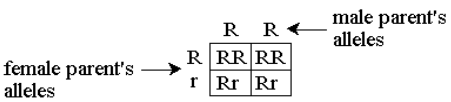
Students will also need to know the following terms:
Crossbreeding is the reproduction between two individuals of different breeds or genotypes.
A hybrid is an individual that has a genotype with two different alleles, one dominant and one recessive. Rr is an example of a hybrid genotype.
A purebred has inherited two similar alleles, so their alleles are either both dominant (pure dominant) or both recessive (pure recessive). RR is an example of a pure dominant genotype and rr is an example of a pure recessive genotype.

Example 1: Use the following information to determine the genotype of a yellow seed.

> The yellow seed is pure dominant.
> Y = yellow
> y = green

Answer: YY
Students should know that the genotype of a pure dominant yellow seed is YY. Yellow is dominant because it is represented by a capital letter and since the seed is pure dominant, both alleles must be the dominant "Y".

Alleles and genotypes are used to describe the genetic makeup of an individual. They are placed in a chart called a Punnet square, used to find the probability of offspring expressing a certain trait. The alleles on the outside of the following Punnet square are from the parents' genotypes for tongue rolling. The four different genotypes on the inside represent the possible genotypic combinations for each offspring. The top of the Punnet square is labeled with one parent's genotype, and the side is labeled with the other parent's genotype. In the top left square, the "R" from the mother and the first "R" from the father combine to form RR. The top right square is RR because the "R" from the mother and the second "R" from the father combine. The bottom left square is Rr because the "r" from the mother and the first "R" from the father combine. The bottom right square is Rr because the "r" from the mother and the second "R" from the father combine. In the following Punnet square, the probability of having offspring with a genotype of RR is 50% and having offspring with a hybrid genotype of Rr is also 50%, though all four genotypes will show the same dominant phenotype of the ability to roll their tongue.



Example 2: Using a Punnet square and the following information, find the probability of having a child with cystic fibrosis, a disorder that impairs breathing and digestion.
The mother does not have cystic fibrosis and has a hybrid genotype of Nn.
The father does have cystic fibrosis.
Answer: 50%, or 1/2. Students should know that a Punnet square for this example should look like

this:

	n	n
N	Nn	Nn
n	nn	nn

The mother's genotype is Nn, which means "N" stands for the dominant allele of not having cystic fibrosis because it is a capital letter. The father's genotype is nn because cystic fibrosis is a recessive trait. The only way he can have cystic fibrosis is if both alleles are recessive, and since he is pure recessive, those alleles must both be the lowercase "n". The top of the Punnet square is labeled with one parent's genotype, and the side is labeled with the other parent's genotype. In the top left square, the "N" from the mother and the first "n" from the father combine to form Nn. The top right square is Nn because the "N" from the mother and the second "n" from the father combine. The bottom left square is nn because the "n" from the mother and the first "n" from the father combine. The bottom right square is nn because the "n" from the mother and the second "n" from the father combine. Two of the squares are Nn, which have a phenotype of no cystic fibrosis, and the other two squares are nn, which have a phenotype of cystic fibrosis. The probability of having a child with cystic fibrosis is 50% because two out of four, or one half, of the squares show the phenotype of cystic fibrosis.
The sex of offspring can also be determined using Punnet squares. Males have a genotype of XY and females have a genotype of XX. Neither X nor Y are dominant. Only the presence or absence of a Y chromosome determines sex. Using the following Punnet square, we can see that the two on the right are XX and the two on the left are XY. Since an XX genotype produces a female and XY produces a male, this means parents have a 50% chance of giving birth to a female and a 50% chance of giving birth to a male.

	X	Y
X	XX	XY
X	XX	XY

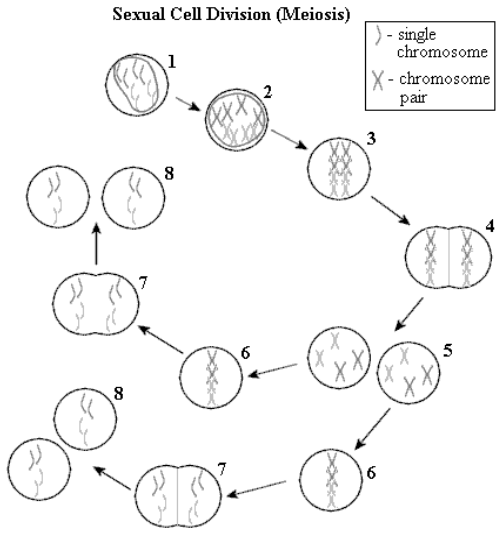
To learn more about heredity, the student can look at pictures of family members and try to guess the genotypes for certain traits by observing the phenotypes. Students can also make some Punnet squares of their own using these genotypes.

Cell Division and Reproduction

Cell division is a reproductive process in which cells divide to create more cells. There are two main types of cell division processes: one for sexual reproduction, known as meiosis, and one for asexual reproduction, known as mitosis. Students should know the similarities, differences, and basic characteristics of sexual and asexual reproduction, including the main steps of the cell division processes.

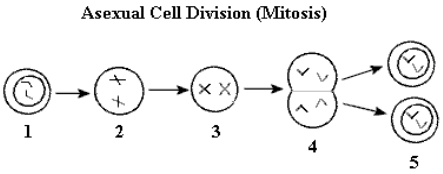
To understand these processes, it is important to understand genes and chromosomes. Genes control heredity, the transfer of characteristics from parents to offspring, and determine the traits that will be expressed. Genes link together to form chromosomes. Chromosomes are the structures that carry genes and are usually found as pairs.Sexual reproduction requires two different sex cells, a sperm and an egg, called gametes. The sperm is the male gamete, and the egg is the female gamete. These two gametes must unite, in a process called fertilization, to produce offspring. If fertilization does not occur, cell division will not begin and the organism will not develop. Gametes only have half the normal number of chromosomes so that when they unite, they produce an organism with the correct amount of genetic material. Since two different gametes from two separate individuals unite in sexual reproduction, the offspring receive a combination of genetic material from each parent. Half the genetic material is from the father, and half is from the mother. This mixing produces variation among the offspring of sexual reproduction. Humans are an example of an organism that reproduces sexually.

Meiosis is the sexual cell division process that produces the gametes necessary for sexual reproduction and is shown below with a explanation of each numbered step.



1. This is the original cell that is about to undergo meiosis.
2. The chromosomes duplicate so there are now two copies of each chromosome.
3. The chromosome pairs align.
4. The chromosome pairs separate and the cell begins to divide.
5. The cell has divided into two cells.
6. The chromosomes align.
7. Individual chromosomes separate and the cell begins to divide.
8. The cell has divided into four cells total, each with half the number of chromosomes as the original cell.

Asexual reproduction requires only one cell and is necessary for the growth and repair of cells. This cell division process is called mitosis. During mitosis, the original parent cell will divide into more cells and will pass on exact copies of its genetic material to its daughter cells. Since there is no contribution of genetic material from another cell, the daughter cells will be identical copies of the parent cell. There is no variation among asexually reproduced offspring. Mushrooms are an example of an organism that can reproduce asexually, with spores, instead of gametes. The asexual cell division process is shown below with a explanation of each numbered step.



1. This is the original (parent) cell about to undergo mitosis.
2. The chromosomes duplicate and begin to move.
3. The chromosome pairs align.
4. The chromosome pairs separate and the cell begins to divide.
5. The cell has divided into two identical cells.

To study this topic, students can make a table that includes all of the characteristics of sexual reproduction and all of the characteristics of asexual reproduction. Also, they can research examples of

organisms that reproduce sexually, and ones that reproduce asexually. Finally, students can make a flipbook to show each cell division process. Draw the steps of each process on a separate sheet of paper in the bottom corner. Stack the sheets in reverse order, with the first step on the bottom and the last step on top. When the pages are flipped through quickly, the book will show the process in action.

Characteristics of Life

Students should understand that there are several characteristics that all living things have in common, including those that occur at the cellular level, and should be able to list these characteristics.

All living things require energy, can reproduce, dispose of wastes, are organized and complex, grow and change, respond to the environment, and are made of one or more cells. Although different organisms may exhibit these characteristics in various ways, they must have all of these characteristics to be considered living.

	Cells	Trees	Cars	Light Bulbs
require energy	✓	✓	✓	✓
can reproduce	✓	✓		
dispose of wastes	✓	✓	✓	
are organized and complex	✓	✓	✓	
grow and change	✓	✓		
respond to the environment	✓	✓	✓	✓
are made of one or more cells	✓	✓		

All organisms require energy so that they can carry out certain life processes, though the method they use to obtain energy varies. For example, organisms can get energy by eating other organisms (animals), absorbing decomposed minerals and nutrients (fungi), or making their own food through a process called photosynthesis (plants). During these processes, organisms produce waste products that must be released. For example, plants release wastes into the air through their leaves. Another process carried out by living things is reproduction. Organisms must reproduce to ensure the continuation of their species. Organisms also grow and change throughout their lives and respond to the environment for survival. For example, plants may respond to sunlight by growing towards the sun to get more light. Finally, organisms are organized by complex systems that function together to help each organism meet its needs.

All living things are composed of one or more cells (organisms made of one cell are called unicellular, and organisms made of more than one cell are called multicellular), and each cell exhibits the characteristics of life. For instance, all cells require energy to carry out their various functions. Through processes called digestion and respiration, cells are able to obtain valuable nutrients and energy. Waste is produced by cells, and must be disposed of in a process called excretion. Cells are able to reproduce by dividing. Cells are organized by their parts and each part has its own function. Cells can grow, change, and respond to their environment.

Example: Which of the following is NOT a living thing?

copy machine **tree** **mushroom** **paramecium**

Answer: The copy machine. A copy machine may require energy and be able to reproduce, but it is not composed of cells, cannot grow, and cannot dispose of wastes. A tree, a mushroom, and a paramecium can do all of these things. Paramecia are only made of one cell, but they have all the characteristics listed above, so they are considered living things.

To understand the characteristics of living things and the differences between living things and non-living things, students can think of more examples of non-living things that show some, but not all, of these characteristics.

Behavior

Students should understand what behavior is, what causes something to exhibit a behavior, and the two main types of behaviors: learned and innate.

Behavior is the way an organism responds to a stimulus. A stimulus is an action or condition that creates a response. A stimulus can be internal, like a hunger pang, or external, like a cold breeze.

There are two main types of behaviors, those that are learned, and those that are inherited. A learned behavior develops due to interaction with the environment. These are behaviors that are not inherited. An innate behavior is one that an organism is born with and it is inherited from its parents. Involuntary responses and instincts are examples of innate behaviors.

Example: Which of the following is a learned behavior?

A. becoming quiet when your teacher walks into the room
B. naturally pulling your hand away from a hot object
C. your knee jerking when it is hit
D. blinking your eyes

Answer: A. Students do not naturally become quiet when the teacher walks into the room. However, while in school, students may have learned that teachers will tell them to be quiet if they are too loud, so they quiet down when the teacher enters the room. (B), (C), and (D) are innate behaviors, they happen involuntarily or naturally.

Tropisms are the movements or behaviors of plants toward or away from an external stimulus. Examples of these behaviors include flowers opening towards the sun and the growth of roots downward into the ground.

To learn about behavior, students can list some of the behaviors they have exhibited throughout the day and determine if they are learned or innate. Also, students can monitor plants and discuss any tropisms they observe.

Evaluating Hypotheses from Data

A hypothesis is a statement that is believed to be true based on initial observations and is tested and modified until a final conclusion, or solution is reached. Hypotheses are tested through experimentation to try to determine if they are true or false. Students will be able to determine the best hypothesis to use for an experiment and evaluate the hypothesis when provided with data.

Problems in science can be solved using a system called the scientific method. The scientific method is a sequence of steps to follow in order to reach a solution. The steps are listed below.

1. Observe the problem.
2. Make a prediction based on the observation.
3. Form a hypothesis based on the prediction.
4. Test the hypothesis through an experiment.
5. Modify the hypothesis based on observations from the experiment.

6. Return to step number 4 until the hypothesis needs no more modification and the problem is solved.

One common mistake made when forming a hypothesis is writing it in the form of a question instead of a clearly defined statement. Other mistakes include writing a statement that does not precisely address the experiment, one that does not answer the questions asked in the experiment, or one that is not testable by an experiment. A hypothesis should include only one condition, item or event that is changing. For example, examine the hypothesis "The age and breed of cow affects its eating habits." Two separate hypotheses should be formed and tested from this statement, one dealing with the age of the cow and another with the breed. A final mistake to avoid is confusing hypotheses with conclusions. Though a hypothesis may seem to be the same as a conclusion, it is different because a conclusion is not re-tested or modified like a hypothesis may be.

Below is a specific example showing the steps of the scientific method being used, including the formation of a hypothesis.

1. A student notices that if he drinks orange juice whenever he has a headache, the headache instantly stops.
2. He predicts that the orange juice causes headaches to stop.
3. He develops a hypothesis that states "When people with headaches drink orange juice, their headache stops."
4. He conducts an experiment in which other people with headaches drink orange juice.
5. If the headaches stop only when the people in the experiment drink orange juice, the experiment supports the hypothesis and could be evidence that the statement is true. This would mean the hypothesis does not need to be modified and a conclusion was reached.

However, the results could be different. If drinking orange juice did not cause the headaches to stop, or if the headaches stopped whether orange juice was consumed or not, then the hypothesis is <u>not</u> supported and the experiment could be proof that the statement is false. In this case, the hypothesis would have to be modified. The modified hypothesis might be "When people drink orange juice regularly, they do not get long-lasting headaches." Then, the steps of the scientific method would have to be repeated.

Example: Which of the following is the best example of a **hypothesis** about why the length of daylight on earth changes?

A. The length of daylight changes because the seasons change.
B. Is the length of daylight always the same?
C. The length of a day on earth is 24 hours.
D. Why does the length of daylight on earth change?

Answer: A. (A) is a definitive statement about why the length of a day changes, so it is correct. (B) and (D) are questions, not hypotheses. (C) does not really address the experiment and answer <u>why</u> the length of daylight on earth changes.

To practice determining the best hypothesis for an experiment and assessing a hypothesis developed from data, students can make a list of ten different experiments they find in a book, on the Internet, or create themselves. Next to the experiment description, have them write a hypothesis for each. Then, students should make two charts or other displays that could feasibly be developed from the experiment. One should demonstrate support for the hypothesis, and one should not support the hypothesis. Another activity that may help students is to develop hypotheses from questions they have about their environment.

Determining if Hypothesis Supported

A <u>hypothesis</u> is a statement that is believed to be true based on initial observations. It is tested and modified

until a final conclusion, or solution is reached. Hypotheses are tested through experimentation, and the results of the experiment are analyzed to determine whether or not they support the hypothesis. Students will be able to interpret the results from an experiment in order to determine if they support a given hypothesis.

Hypotheses are an important part of a process called the scientific method. Problems in science can be solved by using this process. The scientific method outlines specific steps to follow in order to reach a solution. The steps are listed below.

1. Observe the problem.
2. Make a prediction based on the observation.
3. Form a hypothesis based on the prediction.
4. Test the hypothesis through an experiment.
5. Analyze data or interpret results.
6. Modify the hypothesis based on the data analysis.
7. Return to step number 4 until the hypothesis needs no more modification and the problem is solved.

For example, a student developed a hypothesis that states "The more water sunflower plants are given, the taller they will grow." He conducted an experiment using five different sunflower plants. Each plant was the same height when he began the experiment, but some were watered more than others. The results of his experiment are shown in the chart below.

Plant	1	2	3	4	5
Amount of Water Received	1 L	2 L	3 L	4 L	5 L
Inches of Growth	2 in.	4 in.	5 in.	2 in.	1 in.

To determine if a hypothesis is supported or not, one should look at the results of the experiment and analyze them for evidence that the hypothesis was right or wrong. As you can see in the chart, even though plants 4 and 5 were watered more than plants 1, 2, and 3, they did not grow taller. So, the student's hypothesis is NOT supported by these results.

To help understand how to determine if experimental results support a hypothesis, students can find hypotheses for simple experiments on the Internet and in their science books, come up with their own ideas, or use the following to help them get started:

1. Water will boil faster if salt is added to it.
2. Water weighs more when it is frozen.
3. Foods that contain sugar sink in vinegar.
4. Smaller animals have faster heart rates than larger animals.

Students should then conduct experiments to test these hypotheses and record the results. After reviewing the results, they can determine whether or not the results support the hypothesis and why. Also, students can find results of experiments in their notes, textbooks, past lab investigations, etc. After looking at the experimental results for each, they can write a hypothesis that IS supported by the results and one that is NOT supported by the results.

Dichotomous Key

A dichotomous key is a guide that is used to classify or identify items and organisms. Students will be able to use a dichotomous key in order to identify or classify given items and organisms.

To use a dichotomous key, one must answer questions by observing the organism that needs identification. The answer to each question indicates where to look next to eventually determine the organism's identity or classification. For example, if a student wanted to identify a flower she was given, the dichotomous key she might use could look like this:

1. The flower has 3 or 6 petals, or other sets of 3 petals.....go to 2
   The flower has petals in sets of 4 or 5.....go to 3

2. The flower's stem branches into various flowers.....go to 4
   The flower has its own, non-branching stem.....go to 5

3. The flower's stem branches into various flowers.....Columbine
   The flower has its own, non-branching stem.....Poppy

4. The flower is red, white, or pink.....Lily
   The flower is purple or blue.....Day Flower

5. The flower is red or white.....Amaryllis
   The flower is yellow.....Zinnia

To use this key, start at number one. Read the two statements or questions and decide which of them best describes the given organism or object. When an answer is chosen, go to the number indicated and read those two statements. This process continues until a name is given for the organism or object you are classifying.

To become more familiar with using dichotomous keys, have students visit local libraries, nearby nature centers, or the Internet to find dichotomous keys that are specifically designed for plants or animals that can be found in the area. They can use these keys to identify some specimens they observe in their backyards. These keys will most likely be much longer than the example above, but are used in the same manner. Also, students can create their own dichotomous keys for the shoes in their closet and their brand names. Have them give the key to a family member to use to classify the shoes.

Evaluating Models

Models are often used in science. Students will be able to evaluate models.

Sometimes, it is impossible or impractical to use actual objects to explain concepts or to learn facts. For example, a teacher cannot use an actual atom to explain its parts or may not be able to bring a live octopus to the classroom to show how octopi propel themselves in the water. Representations, or models, of these things can be used in their place. Models do not necessarily have to be objects; they can be descriptions or ideas that help understanding. The best models are those that are very similar to the real thing, but all models have slight differences and limitations. Models should be similar to the objects they represent in the aspects that are being explained or taught. For instance, if a teacher wants to discuss an aquifer, which is a source of water that is trapped in spaces between soil particles, a good model might be a sponge because water in a sponge is trapped in its spaces.

To learn how to evaluate models, students can find objects around the house that could represent objects or concepts they have talked about in science class. They should discuss how the model represents characteristics of the real thing. Also, students can write down a list of objects that would not make good models for something and explain why. Then, they can suggest an alternative object or set of objects that would be a better model of the real thing.

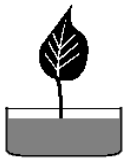
Vascular/Non-Vascular Plants

Some types of plants have a system of small tubes inside their stems and leaves that allows water and nutrients to be transported to and from all parts of the plant. This is called a vascular system. Students will demonstrate an understanding of the function of a vascular system, the characteristics of vascular and non-vascular plants, and the outcomes of experiments involving vascular and non-vascular plants.

A very tall tree must transport water and minerals from the soil through its roots all the way up to the leaves on its highest branch. Small straw-like structures help bring the water upwards, to all parts of the plant. There is another set of tubes that transports nutrients from the leaves to other parts of the plant. These two sets of tubes are called the vascular system. All trees, flowering plants, and ferns have a vascular system. Mosses and other plants, such as liverworts and hornworts, are non-vascular. They are short and must live in wet environments in order to absorb water and nutrients for all of their parts to use. Non-vascular plants do not have true leaves, stems, or roots.

Many experiments on vascular plants involve observing the tube-like structures inside the plant. When the very bottom of a vascular plant's stem, stalk, or leaf is cut and then placed upright in a dish of colored water, its vascular system will take up the colored water, allowing the colored "tubes," or veins, to be seen. The process can take anywhere from minutes to days and is not possible in non-vascular plants.

Example: The stem of the leaf below is cut and placed in a dish of blue colored water. If the leaf came from a vascular plant, what will most likely be the result?



A. The veins in the leaf will turn blue.
B. The leaf will not change at all.
C. The leaf will die because it cannot absorb the water.
D. The veins will dissolve.

Answer: A. The leaf is from a vascular plant, so the vascular "tubes" or veins in the leaf will absorb the colored water.

Students can learn more about plants containing vascular systems by gathering small samples of plant leaves and stems in the back yard and using a magnifying lens to look at the cut section of the stem for the small tube-like structures. To help students understand where the "tubes" are and what they look like, cut the bottom of a celery stalk off, have the student place the cut end into a dish of colored water, and over five days, have them observe the colored "tubes" inside the celery stalk.

Student Name: _____

Class: _____

Date: _____

Instructions: **Read each question carefully and select the correct answer.**

1. Halah is experimenting with water rockets of different weights. She wants to know which one will fly the highest. If she planned an experiment to answer this question, which of the following variables in the experiment must remain constant to get the fairest results?

1. the weight of each rocket without water
2. the body design of all the rockets
3. the amount of water used to propel each rocket

A. 1, 2, and 3
B. 1 only
C. 2 and 3 only
D. 2 only
E. Don't Know

2. Why is it important to control variables in an experiment?

A. so it is faster and easier to complete the experiment
B. so the only factor affecting the outcome of the experiment is the variable being tested
C. so you can predict the outcome of the experiment
D. so you are able to make the results of the experiment match your predictions
E. Don't Know

3. A study was conducted to determine whether annual rainfall affects tourism in Summerville. A researcher found Summerville's annual rainfall for each of the past ten years, along with its annual number of tourists for each of these years.

Which is the **independent**, or **manipulated**, variable in this study?

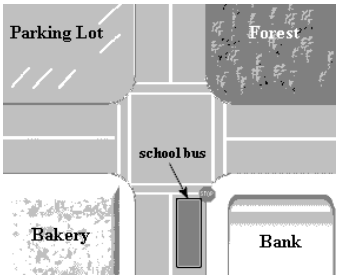
A. the average annual rainfall in Summerville over the past ten years
B. the annual rainfall in Summerville for each of the past ten years
C. the number of tourists in Summerville for each of the past ten years
D. the average number of tourists in Summerville over the past ten years
E. Don't Know

4. Doctors conducted an experiment to determine whether children that had housecats during their first year of life were less likely to develop allergies to cats. Out of 1000 families studied, all of which had new babies, 500 had housecats and the others had no pets in the house. Five years later, all of the children were tested for cat allergies.

Which is the **independent**, or **manipulated**, variable in this experiment?

A. whether or not the families had housecats
B. whether or not the children developed allergies
C. whether or not the adults developed allergies
D. whether or not the children received allergy shots
E. Don't Know

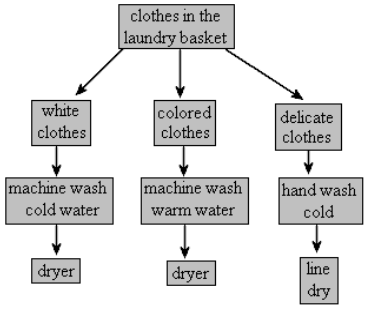
5. Use the diagram below to answer the question.



What is most likely the purpose of the diagram?

A. to show the location of the school bus
B. to show what the school bus looks like
C. to show driving directions to the parking lot
D. to show how the bus gets to school
E. Don't Know

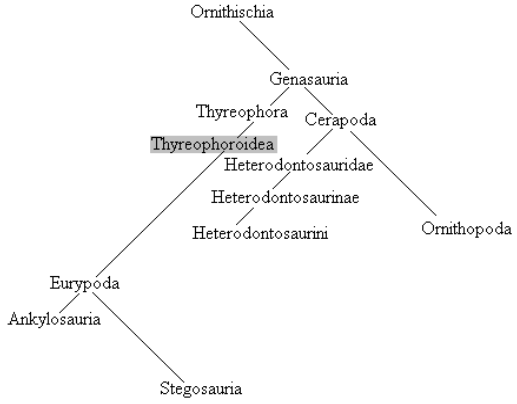
6. Use the diagram to answer the following question.



Which of the following would be the best title for this diagram?

A. Weekly Chores
B. Doing the Laundry
C. Types of Clothes
D. Laundry Basket
E. Don't Know

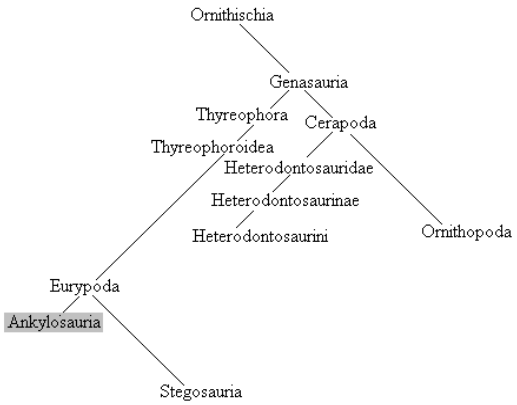
7. The diagram below shows evolutionary relationships between dinosaurs. Use the diagram to answer the following question.



Which of the following is most closely related to Thyreophoroidea?

A. Ornithopoda
B. Stegosauria
C. Thyreophora
D. Heterodontosauridae
E. Don't Know

8. The diagram below shows evolutionary relationships between dinosaurs. Use the diagram to answer the following question.



Which of the following is the most distant relative of (least related to) Ankylosauria?

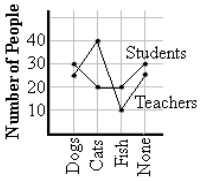
A. Eurypoda
B. Genasauria
C. Stegosauria
D. Ornithischia
E. Don't Know

9. The chart below shows the percentages of different types of pets owned by the teachers and students at School # 324. Which of the following graphs most accurately represents the information in the chart?

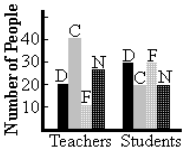
Pets

	Dogs	Cats	Fish	None
Teachers	25%	40%	10%	25%
Students	30%	20%	20%	30%

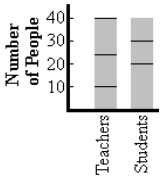
A.



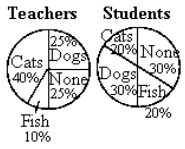
B.



C.



D.



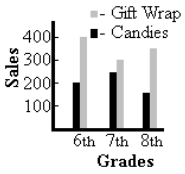
E. Don't Know

10. The chart below shows the results of a fundraising sale for which sixth through eighth graders sold candies and gift wrap. Which of the following graphs most accurately represents the information in the chart?

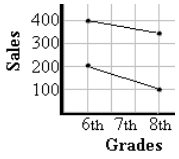
Fundraising Sales

	6th	7th	8th
Candies	$200	$250	$150
Gift Wrap	$400	$300	$350

A.

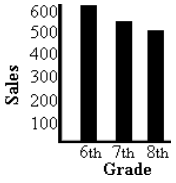


B.



C.

D.



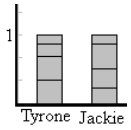
E. Don't Know

11. The chart below shows how much of the day Tyrone and his sister Jackie spend doing different activities. Which of the following graphs most accurately represents the information in the chart?

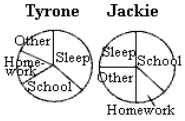
Daily Activities

	Sleeping	School	Homework	Other
Tyrone	$1/3$	$1/3$	$1/6$	$1/6$
Jackie	$1/4$	$1/3$	$1/6$	$1/4$

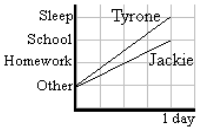
A.



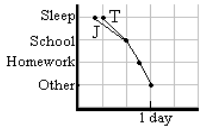
B.



C.



D.



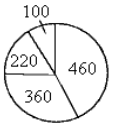
E. Don't Know

12. The chart below shows the distance a herd of gazelle traveled in the span of four days during their migration. Which of the following graphs most accurately represents the information in the chart?

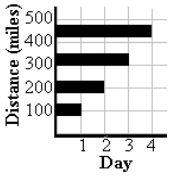
Gazelle Migration

Day	Distance Travelled
1	100 miles
2	220 miles
3	360 miles
4	460 miles

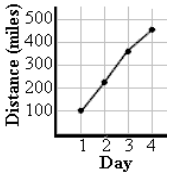
A.



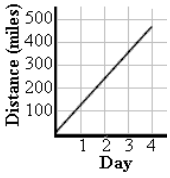
B.



C.



D.



E. Don't Know

13. The chart below shows the conditions at various beaches.

Beach	Annual Visitors	Average Temp.	Area of Beach
A	90,000	84°F	4 mi^2
B	50,000	82°F	1 mi^2
C	40,000	83°F	1 mi^2
D	35,000	84°F	0.5 mi^2

According to the chart, what most likely causes more people to visit Beach A?

A. its smaller area
B. its larger area
C. its warmer temperature
D. its cooler temperature
E. Don't Know

14. The chart below shows the data from an investigation about road conditions.

Road	Cars Per Day	Width	Percent Cracked	Material
Ash	900	12 ft	12%	concrete
Birch	350	15 ft	3%	asphalt
Main	500	25 ft	5%	concrete

According to the chart, what most likely causes cracks in the highway?

A. the width of the highway
B. the fact that it is made of asphalt
C. the fact that it is made of concrete
D. a high number of cars that travel on it
E. Don't Know

15. The chart below shows information about a pet rabbit.

Age	1	2	3	4	5	6
Weight	4 lbs	4 lbs	5 lbs	6 lbs	9 lbs	12 lbs

What inference can be made, based on this information?

A. The rabbit was fully grown at age 6.
B. The rabbit grew the most before age 2.
C. The rabbit did not exercise as much when it was older.
D. The rabbit gained more weight when it was older than it did when it was younger.
E. Don't Know

16. The chart below shows a region's weather conditions from 1930 to1999.

Time Period	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999
Average Annual Rainfall (inches)	50	51	50	49	49	50	47
Average Daily Temperature (°F)	71	71	72	74	76	75	77

Based on this data, which statement is probably true?

A. Global warming is occurring.
B. Some regions get colder over time.
C. The climate of the area is gradually warming.
D. It will rain more between 2000-2009 than it did from 1990-1999.
E. Don't Know

17. Fill in the blank.

The elbow and the knee are examples of _____ joints.

A. hinge
B. ball and socket
C. pivot
D. gliding
E. Don't Know

18. Fill in the blank.

The shoulder joint permits movement in all directions. The shoulder is an example of a _____ joint.

A. hinge
B. ball and socket
C. pivot
D. gliding
E. Don't Know

19. Fill in the blank.

_____ can be found in the ears and nose, as well as cushioning the ends of bones.

A. Tendons
B. Smooth muscle
C. Marrow
D. Cartilage
E. Don't Know

20. Fill in the blank.

Cardiac muscle can be found in the _____ .

A. shoulder
B. thigh
C. stomach
D. heart
E. Don't Know

21. Earthworms eat dead plant material, breaking it down into nutrients. What abiotic part of an environment is changed due to the work of earthworms?

A. water
B. plants
C. soil
D. animals
E. Don't Know

22. Which does NOT show a relationship between biotic and abiotic parts of an environment?

A. a wolf and the rabbit it hunts
B. a beetle and the rock it lives under
C. a tree and the soil its roots grow in
D. a river and the fish that swim in it
E. Don't Know

23. Which of the following is a **biotic** factor that can affect the survival of a rabbit in a forest?

A. the air quality in the forest
B. the number of predators in the forest
C. the amount of water in the forest
D. the type of soil in the forest
E. Don't Know

24. Which of the following is an **abiotic** component of an ocean ecosystem?

A. starfish
B. sea lions
C. sand
D. seaweed
E. Don't Know

25. In which biome would you find permafrost?

A. desert
B. grassland
C. rain forest
D. tundra
E. Don't Know

26. In which biome would a bear with a heavy coat of fur best survive?

A. in the grassland
B. in the desert
C. in the tropical rain forest
D. in the tundra
E. Don't Know

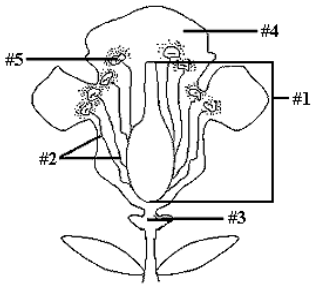
27. Which of the following best describes a desert?

A. tropical
B. moderate temperatures
C. dry
D. no plants
E. Don't Know

28. Which of the following animals are typically found in wetlands?

A. lions
B. dolphins
C. monkeys
D. alligators
E. Don't Know

29. Use this picture of a flower to name the part labeled #5.



A. pistil
B. ovary
C. anther
D. seed
E. Don't Know

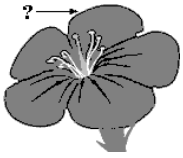
30. In which part of the flower are eggs produced?

A. anther
B. ovary
C. sepal
D. stamen
E. Don't Know

31. Which part of the flower is indicated below?

A. petal
B. ovary
C. sepal
D. anther
E. Don't Know

32. Which part of the flower is indicated below?

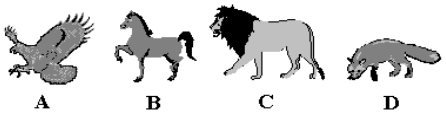


A. ovary
B. petal
C. stamen
D. sepal
E. Don't Know

33. Which organism listed below is considered a secondary consumer?

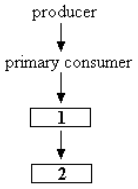
A. rabbit
B. coyote
C. mouse
D. cow
E. Don't Know

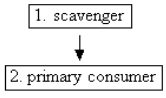
34. Which one of these animals is a primary consumer?

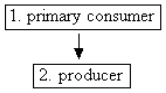


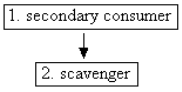
A. A
B. B
C. C
D. D
E. Don't Know

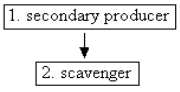
35. Which of the following can correctly complete this diagram of the relationship between organisms?



A.


B.


C.


D.


E. Don't Know

36. Which of the following organisms would belong on the same level of an energy pyramid as grass?

A. a woodpecker
B. a frog
C. the sun
D. a peanut plant
E. Don't Know

37. Fill in the blank.

The maximum number of organisms an environment can support is called the _____.

A. limiting factor
B. carrying capacity
C. biodiversity
D. fertility rate
E. Don't Know

38. Which term describes an ecosystem that has plenty of resources for all organisms, resulting in populations that do not fluctuate much?

A. biotic
B. limited
C. carrying capacity
D. sustainable
E. Don't Know

39. Which of the following is a biotic factor in an ecosystem that can limit an organism's population size?

A. amount of sunlight
B. climate
C. predators
D. water
E. Don't Know

40. Burrowing owls eat insects and a variety of small animals. They build nests in burrows dug by other animals, such as prairie dogs. Prairie dogs are considered pests and are often killed by farmers. What will probably happen to the owls if the population of these burrowing animals declines?

A. The owls will not be able to find enough nesting sites.
B. The owls will not have enough food.
C. The owls will learn to dig their own burrows.
D. The farmers will start killing the owls.
E. Don't Know

41. Which of the following changes would negatively affect the water cycle?

1. animals drinking from a pond
2. a severe drought
3. a large city pumping groundwater for daily use

A. 1, 2, and 3
B. 3 only
C. 2 and 3
D. 1 only
E. Don't Know

42. Which of the following occurs as part of the nitrogen cycle?

1. nitrogen in the air is converted to useable nitrogen
2. as plants grow, the nitrogen in their tissue evaporates in to the air
3. animals acquire nitrogen by eating plants or other animals

A. 3 only
B. 1 and 2
C. 2 only
D. 1 and 3
E. Don't Know

43. Which organisms play the largest role in changing atmospheric nitrogen into a form that most living things can use?

A. animals
B. bacteria
C. fungi
D. plants
E. Don't Know

44. The destruction of tropical forests has led scientists to make what prediction?

A. The process of photosynthesis will be sped up in other areas.
B. Groundwater will become contaminated.
C. Diseases carried by insects will increase.
D. The oxygen and carbon cycles will be altered.
E. Don't Know

45. Fill in the blank.

The cells of a multicellular organism are _____.

A. all alike
B. without a nucleus
C. the same size
D. specialized
E. Don't Know

46. Fill in the blank.

The heart is an example of a/an _____.

A. cell
B. organ
C. body system
D. tissue
E. Don't Know

47. Which of the following is true about a multicellular organism's cells?

A. They are all identical so the organism is able to perform life functions.
B. They are specialized so they can carry out unique functions.
C. They are specialized so they do not infect other organisms in the area.
D. They are all identical so the organism doesn't reject them.
E. Don't Know

48. Fill in the blank.

_____ cells join together in the body to form a liquid tissue responsible for transporting oxygen in an animal's body.

A. Blood
B. Bone
C. Nerve
D. Cardiac
E. Don't Know

49. In certain grasslands, elephants and zebras must drink from the only watering hole in the area. Which of the following is true about these two animals?

1. One animal will have to kill the other.
2. Only one animals will survive.
3. They must compete for the water.

A. 1 and 2
B. 3 only
C. 1 and 3
D. 2 only
E. Don't Know

50. In a commensalistic relationship, what is true?

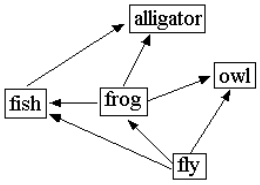
A. One organism benefits and the other is harmed.
B. Both organisms are harmed.
C. Both organisms benefit.
D. One organism benefits and the other is not harmed.
E. Don't Know

51. Fill in the blank.

A lichen is fungus and algae living together in a close, interconnected relationship. These organisms have a _____ relationship.

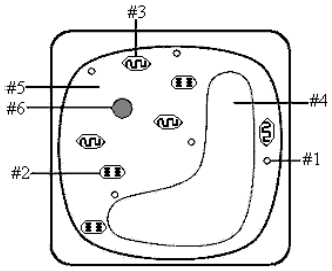
A. neutral
B. photosynthetic
C. symbiotic
D. predatory
E. Don't Know

52. In the food web below, which organism is competing with the alligator for food?



A. the fish and the frog
B. the frog
C. the owl and the fish
D. the owl only
E. Don't Know

53. The part of the cell below labeled # 5 is a thick liquid in which all other organelles are suspended. What is it?

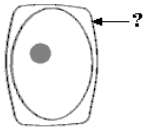


A. the cell membrane
B. the cell wall
C. the nucleus
D. the cytoplasm
E. Don't Know

54. Which of the following describes the function of a vacuole?

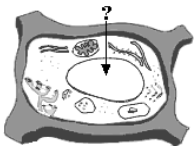
A. to produce energy for the cell
B. to fight off harmful substances
C. to break down food
D. to store food, water, and wastes
E. Don't Know

55. Which part of this plant cell is indicated by the arrow?



A. cytoplasm
B. cell membrane
C. cell wall
D. nucleus
E. Don't Know

56. Which cell part is indicated in the plant cell below?



A. mitochondrion
B. lysosome
C. nucleus
D. vacuole
E. Don't Know

57. In humans, a hereditary disease known as phenylketonuria (PKU) is caused by an autosomal (NOT sex linked) recessive gene. Individuals will be born with PKU if they are homozygous recessive.

If a man who is heterozygous for the trait marries a woman who is also heterozygous for the trait, what is the chance that they will bear a child with PKU?

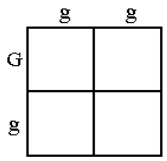
A. 0%
B. 25%
C. 50%
D. 75%
E. Don't Know

58. Huntington's disease (HD) is caused by a faulty gene that triggers the degeneration (breakdown) of neurons. The HD gene is autosomal (NOT sex linked) and dominantly expressed over the normal recessive gene. The faulty gene is assigned an allele of H, and the normal gene is assigned an allele of h.

If a man who is heterozygous for Huntington's disease has a child with a woman who has homozygous HD, what is the chance that their child will also contract Huntington's disease?

A. 0%
B. 25%
C. 75%
D. 100%
E. Don't Know

59. Use the Punnet square below to answer the question.



What is the probability that the offspring of these two organisms will have a genetic makeup of GG?

A. 75 %
B. 50 %
C. 0 %
D. 25 %
E. Don't Know

60. What is the probability of an offspring having the genotype PP, if one parent has the genotype PP and the other has the genotype Pp?

A. 100%
B. 25%
C. 0%
D. 50%
E. Don't Know

61. Fill in the blank.

Offspring produced by sexual reproduction _____ .

A. are exactly like one of the parents
B. show no variation in characteristics
C. form from one sex cell of one organism
D. show variation in characteristics
E. Don't Know

62. What is required to begin asexual reproduction?

A. two cells uniting to form one cell
B. one cell splitting into two cells
C. pollination
D. fertilization
E. Don't Know

63. Fill in the blank.

The **sexual** cell division process is called _____ .

A. meiosis
B. mitosis
C. fertilization
D. symbiosis
E. Don't Know

64. In which cell division process do chromosomes align and separate two different times?

A. sexual cell division
B. asexual cell division
C. neither sexual nor asexual cell division
D. both sexual and asexual cell division
E. Don't Know

65. Which of the following is a characteristic of <u>all</u> living things?

A. can move around in their environment
B. can make their own food by photosynthesis
C. can reproduce sexually
D. can dispose of wastes
E. Don't Know

66. Which of the following is an example of how a clam responds to stimuli to protect itself?

A. It filters food from the water.
B. It closes its shell when a predator swims too close.
C. It is composed of many cells.
D. It breathes underwater.
E. Don't Know

67. Which of the following is a way some flowers can respond to the environment?

A. it can move to another area
B. it can grow
C. it can close its petals when it is cold
D. a flower cannot respond to its environment
E. Don't Know

68. Which of the following is NOT a processes that all cells undergo?

A. excretion
B. energy production
C. sexual reproduction
D. respiration
E. Don't Know

69. Which of the following is an example of an **innate** (inherited) behavior of a human?

A. running down the street
B. blinking the eyes
C. talking to others
D. drinking out of a straw
E. Don't Know

70. A flower had its petals open, until it started to rain. At that point, the petals closed. What is the **response** in this scenario?

A. the petals closing
B. the rain
C. the flower
D. the open petals
E. Don't Know

71. Look at the picture and answer the question.

Which of the following was most likely the **stimulus** that caused this animal's behavior?

A. the horse's brain
B. a cool drink of water
C. the horse standing on it's hind legs
D. a loud noise
E. Don't Know

72. When a squid feels threatened by seals or other animals swimming by, it changes colors. What is the **stimulus** in this scenario?

A. the squid changing color
B. the squid's bright coloring
C. seals or other animals swimming by
D. the squid swimming in the ocean
E. Don't Know

73. A grocer wanted to determine the type of lettuce that turned brown the fastest, so he conducted an experiment. His data is shown in the table below.

Type of Lettuce	Iceberg	Romaine	Red Leaf
Temperature	65°F	65°F	65°F
Sugar Content	3 g	1 g	0.5 g
Time it Took to Turn Brown	1 hour	2 hours	4 hours

Which of the following would be the best **hypothesis** to use if he wanted to conduct further experiments on why iceberg lettuce turns brown faster than other types of lettuce?

A. Lettuce turns brown faster when it is at room temperature than when it is in the refrigerator.
B. Romaine lettuce is the same color as iceberg lettuce.
C. Iceberg lettuce contains the most sugar, so it turns brown the fastest.
D. Different types of lettuce turn brown at different rates.
E. Don't Know

74. A researcher conducted an experiment to determine if people living in cold climates exercise more than those living in warm climates. His data is shown below.

Person	1	2	3	4
Type of Climate	warm	warm	cold	cold
Have Own Equipment?	yes	no	yes	no
Closest Exercise Center	2 miles away	1 mile away	12 miles away	9 miles away
Days Per Week Person Exercises	3	4	1	1

Based on this data, what would be the best hypothesis to use if he wanted to conduct another experiment, this time to find out why people in warm climates exercise more than people in cold climates?

A. Most people in warm climates would rather run than ride a bike.
B. People in cold climates are more likely to have their own exercise equipment
C. People in warm climates are more likely to have workout centers near their homes, which causes them to exercise more.
D. People in cold climates exercise less than those in warmer climates because they are busier than those living in warm climates.
E. Don't Know

75. Which of the following would be the best hypothesis for an experiment on the growth rate of roses?

A. What will decrease the growth rate of roses?
B. Different roses have different sized leaves.
C. Roses grow the fastest when they are watered twice a day.
D. What is the growth rate of roses?
E. Don't Know

76. Which of the following would be the best hypothesis for an experiment on the weather in Kamakura?

A. What is the average temperature in Kamakura?
B. Kamakura is located near the ocean.
C. Kamakura receives the most rain in June.
D. What is the weather in Kamakura like?
E. Don't Know

77. Before conducting an experiment, Grant hypothesized that the wider the leaves of the palm tree, the older it was. He conducted an experiment and recorded his results in the table below.

Palm Tree	1	2	3	4
Average Leaf Width	2 ft	4 ft	1 ft	6 ft
Tree's Age	5 years	3 years	2 years	2 years

Was his hypothesis supported by the data?

A. no
B. yes
E. Don't Know

78. A student conducted an experiment after forming the hypothesis that people who live in towns with a small population receive more sleep each night than people who live in towns with a larger population. His results are shown in the diagram below.

Town	A	B	C	D
Town's Population	500	2,000	15,000	100,000
Resident's Average Amount of Sleep	6 hours	7 hours	7 hours	8 hours

Which of the following statements is true about his hypothesis?

A. His hypothesis was not tested by his experiment.
B. His hypothesis is not supported by his experimental results.
C. His hypothesis is supported by his experimental results.
E. Don't Know

79. A scientist formed the hypothesis that male spiders make smaller webs than female spiders. She conducted an experiment and recorded her results in the chart below.

Spider	1	2	3	4
Sex	Female	Female	Male	Male
Web Size	11 in.	9 in.	5 in.	6 in.

Which of the following is true about her experimental results?

A. Her results do not support her hypothesis.
B. Her results support her hypothesis.
C. Her results do not provide enough information to determine if her hypothesis is supported.
E. Don't Know

80. A botanist formed the hypothesis that the sandier the soil, the more cones a Torrey pine tree will produce. He conducted an experiment and recorded his results in the chart below.

Tree	1	2	3	4
Percent Sand in Soil	3 %	6 %	12 %	16 %
Cones Produced	50	55	61	70

What is true about his results?

A. They do not support his hypothesis.
B. They support his hypothesis.
C. They are incorrect.
D. There is not enough information to determine if his hypothesis is supported.
E. Don't Know

81. Using the dichotomous key below, answer the following question.

Key

1. The plant grows upwards.....go to 2
   The plant grows along the ground.....go to 3
2. The plant has groups of leaves on each stem.....go to 4
   The plant has a single leaf on each stem.....go to 5
3. The plant has spiky, jagged leaves.....Mr. Connor's
   The plant has curved leaves .....Ms. Mandela's
4. The plant has a single stem.....Ms. Cruz's
   The plant has many stems.....Mr. Moore's
5. The plant has stripes on its leaves.....Ms. DiPietro's
   The plant does not have stripes on its leaves.....Mr. Li's

In whose classroom does this plant belong?

A. Ms. Connor's
B. Ms. DiPietro's
C. Mr. Li's
D. Mr. Moore's
E. Don't Know

82. Using the dichotomous key below, answer the following question.

Key	
1. The print appears to have toes	go to 2
The print does not have toes	go to 3
2. The print has 3 toes	go to 4
The print has more than 3 toes	go to 5
3. The print is rounded at the top	springbok
The print is not rounded at the top	merganser
4. The toe portion is connected to the entire footprint	tapir
The toe portion is not connected to the entire footprint	sloth
5. The print has 4 toes	wombat
The print has 5 toes	quokka

What type of animal made this footprint?

A. springbok
B. tapir
C. sloth
D. merganser
E. Don't Know

83. Using the dichotomous key below, answer the following question.

Key	
1. The print appears to have toes	go to 2
The print does not have toes	go to 3
2. The print has 3 toes	go to 4
The print has more than 3 toes	go to 5
3. The print is rounded at the top	springbok
The print is not rounded at the top	merganser
4. The toe portion is connected to the entire footprint	tapir
The toe portion is not connected to the entire footprint	sloth
5. The print has 4 toes	wombat
The print has 5 toes	quokka

What type of animal made this footprint?

A. quokka
B. springbok
C. sloth
D. wombat
E. Don't Know

84. Using the dichotomous key below, answer the following question.

Key	
1. The tree has a rounded top	go to 2
The tree has a pointed top	go to 3
2. The tree has a bending, branching trunk	go to 4
The tree has one straight trunk	white oak
3. The tree has a visible trunk	blue spruce
The tree has no visible trunk	balsam fir
4. The tree has large visible flowers	magnolia
The tree has no visible flowers	maple

What type of tree is this?

A. maple
B. blue spruce
C. magnolia
D. white oak
E. Don't Know

85. A muscle is made up of a series of fibers that work together to make the whole tissue strong. Which of the following would be the best model of a muscle?

A. a rope
B. a leaf
C. a strand of hair
D. a car's bumper
E. Don't Know

86. The trachea is a long, straight tube that allows air to pass through to the lungs. Which of the following would be the best model of the trachea?

A. a wire
B. a straw
C. a string
D. a pencil
E. Don't Know

87. The spinal cord is a long, thick column that has many smaller cords connecting to it from all directions. Which of the following would be the best model of the spinal cord?

A. the trunk of a tree
B. the spine, or edge, of a book
C. an electrical outlet
D. a light bulb
E. Don't Know

88. The particles in a crystal are neatly organized into columns and rows. Which of the following would be the best model of the particles in a crystal?

A. a pile of laundry
B. a brick wall
C. a bag of grapes
D. a tree
E. Don't Know

89. A student placed the cut end of a leaf from a tree into a dish of purple-colored water. What will most likely happen to the leaf after a day?

A. The leaf will die.
B. The veins in the leaf will be purple.
C. The leaf will turn yellow or brown.
E. Don't Know

90. Which of the following plants does NOT have a vascular system?

A. a carrot plant
B. a hornwort
C. a rosebush
D. grass
E. Don't Know

91. Which of the following cells compose the phloem in vascular plants?

A. parenchyma cells
B. guard cells
C. sieve tube elements and sieve cells
D. tracheids and vessel members
E. Don't Know

92. Fill in the blank.

The primary direction of water flow in the xylem is from _____ of the plant.

A. one side to the other side
B. the top to the bottom
C. the bottom to the top
D. the xylem to the phloem
E. Don't Know

93. Which of the following statements best describes **gene splicing**?

A. removing all of an organism's genetic material
B. duplicating an organism's genetic material
C. combining two portions of different organisms' genetic material
D. removing part of an organism's genetic material

94. Which type of genetic engineering would be best to use to produce a cat with the traits of two different types of cats?

A. cloning
B. selective breeding
C. vegetative propagation
D. gene splicing

95. Which of the following are methods of genetic engineering?

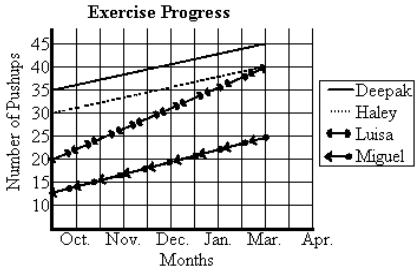
1. cloning
2. selective breeding
3. asexual reproduction

A. 3 only
B. 1 only
C. 1 and 2
D. 1, 2, and 3

96. The branch of a lemon tree is cut off and bound to the trunk of a lime tree. Eventually the two plant parts grow together as one tree. Which type of genetic engineering has occurred?

A. selective breeding
B. cloning
C. vegetative propagation

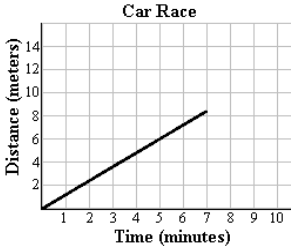
97. The graph below shows the average number of pushups four students completed each month.



How many pushups will Haley probably do in April?

A. 43 pushups
B. 28 pushups
C. 35 pushups
D. 48 pushups

98. Use the graph below to answer the following question.



At what time will the car most likely reach 11 meters?

A. 10 minutes
B. 8 minutes
C. 7 minutes
D. 9 minutes