SCIENCE EXPO 2015 – Life Science & Health Fair - All Activities

Food Chain Aim

Passport Question: _____ act as nutrient recyclers in the ecosystem by breaking down dead and decaying organisms, _____ create their own food from energy from the sun (through photosynthesis), and _____ get their energy by eating other organisms. (Answer: decomposers, producers, consumers)

Learning Target: Students will learn that organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.

Materials:

- Stuffed animals: raccoon, rabbit, flower, mushroom, green copepod, 2 phytoplankton (green), orange copepod, blue bacteria, brown bacteria, minnow, algae
- Organism description cards (12)
- Producer, consumer, decomposer description signs
- Labeled target bins (3)

Background:

This activity aims to address the Next Generation Science Standard LS2.A stating: "Interdependent Relationships in Ecosystems: The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants."

Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals. A food chain is the sequence of who eats whom in a biological community (an ecosystem) to obtain nutrition. A food chain starts with the primary energy source, usually the sun or boiling-hot deep sea vents. The next link in the chain is an organism that makes its own food from the primary energy source -- an example is photosynthetic plants that make their own food from sunlight (using a process called photosynthesis) and chemosynthetic bacteria that make their food energy from chemicals in hydrothermal vents. These are called autotrophs or primary producers. Next come organisms that eat the autotrophs; these organisms are called herbivores or primary consumers -- an example is a rabbit that eats flowers. The next link in the chain is animals that eat herbivores - these are called secondary consumers -- an example is a snake that eats rabbits. In turn, these animals are eaten by larger predators -- an example is an owl that eats snakes. The tertiary consumers are eaten by quaternary consumers -- an example is a hawk that eats owls. Each food chain ends with a top

predator, an animal with no natural enemies (like an alligator, hawk, or polar bear).When any organism dies, it is eventually eaten by detrivores (like vultures, worms and crabs) and broken down by decomposers (mostly bacteria and fungi), and the exchange of energy continues.

The arrows in a food chain show the flow of energy, from the sun or hydrothermal vent to a top predator. As the energy flows from organism to organism, energy is lost at each step. A network of many food chains is called a food web. Some organisms' position in the food chain can vary as their diet differs. For example, when a bear eats berries, the bear is functioning as a primary consumer. When a bear eats a plant-eating rodent, the bear is functioning as a secondary consumer. When the bear eats salmon, the bear is functioning as a tertiary consumer (this is because salmon is a secondary consumer, since salmon eat herring that eat zooplankton that eat phytoplankton, that make their own energy from sunlight). Think about how people's place in the food chain varies - often within a single meal.

In this game, the students will work with very simple food chains that only have one producer, one or two consumers, and one decomposer. Descriptions about each organism in the game can be found on the Food Chain Aim Cheat Sheet.

Procedure:

1. Set up the stuffed animals on their respective descriptive card on the table.
2. Introduce the idea of a food chain and how there are distinct parts of a food chain, most notably: producers, consumers, and decomposers. Show the students the descriptive poster on producers, consumers, and decomposers. Talk about each.
3. Show the students the information on the backs of the cards.
4. Allow the students to sort each food chain into producer / consumer / decomposer by reading about each and tossing the animals into their respective bins.
5. Ask the student to explain their thinking to you as they are sorting the animals.
6. Talk to the student about how, through these food chains, the food of every organism can be traced back to plants.
7. Retrieve the stuffed animals from the bins and set them up on their respective cards again.

Discussion:

- What is a producer? Do you know any additional examples of a producer? *[A producer is an organism that creates its own food from energy from the sun through photosynthesis. An additional example of a producer is a tree.]*
- What is a consumer? Do you know any additional examples of a consumer? *[A consumer is an organism that gets its energy from eating organisms that make their own energy (producers). An additional example of a consumer is a horse.]*
- What is a decomposer? Do you know any additional examples of a decomposer?

[A decomposer is an organism that gets its energy from eating dead and decaying organisms and material in an ecosystem. Through breaking down dead organisms, decomposers return those nutrients into the soil so plants can use them again to grow. An additional example of a decomposer is an earthworm.]

- Can an animal be more than one of these? Can it be a consumer and a decomposer? What would that depend on?
  [Yes, an animal can be more than one of these. It depends on what they are eating at the time. If an earthworm is eating grass it is a consumer but if it is eating decaying material it is a decomposer.]
- Could a rabbit be a part of another food chain with other animals too?
  [Yes, a rabbit eats many different kinds of things so it is part of food chains with those different things as well. For example, rabbits also eat grass and lettuce, they don't just eat flowers.]
- What would happen if we lost one of these species?
  [If we lost an element of a food chain, another organism would most likely take its place. For example, if we lost the rabbit, another animal that eats flowers, like a squirrel, might take its place in the food chain.]
- Which category do humans fall into?
  [Humans are consumers because we get our energy from eating organisms that produce their own food or from organisms that eat other organisms that make their own food. Humans cannot make their own food through photosynthesis so humans cannot be considered producers. Humans do not eat dead or decaying material to get energy so humans cannot be considered decomposers.]

Food Chain	Consumer	Consumer	Producer	Decomposer
Aquatic #1 (marine/ocean)	Large Zooplankton (Large Copepod)	Small Zooplankton (Small Copepod)	Phytoplankton (Euglena)	Aquatic Bacteria

1. Large Zooplankton (Large Copepod): Large copepods can be found in marine and freshwater environments, they often feed on smaller copepods.
2. Small Zooplankton (Small Copepod): Found in the sea and nearly every freshwater habitat. Copepods can be planktonic or benthic, if planktonic, they are consumers as they eat phytoplankton, if benthic, they are decomposers as they eat detritus.
3. Phytoplankton (Euglena): Found in fresh and saltwater habitats. The long flagella helps euglena swim. Euglena produces its own food through photosynthesis so it is a producer. Euglena can also be a consumer as it can ingest other organisms for food through surrounding a particle of food and ingesting it through phagocytosis.
4. Aquatic Bacteria: Found in freshwater and marine environments. Bacteria play an important role in freeing the last of the minerals and nutrients from the last remains of living organisms and recycling them back into the food web. They are decomposers.

Terrestrial	Raccoon	Rabbit	Flower	Mushroom

1. Raccoon: Raccoons eat nuts, seeds, small mammals, fruits, fish eggs, amphibian eggs, and bird eggs.
2. Rabbit: Rabbits eat grass, forbs, flowers, and leafy weeds. They are consumers.
3. Flower: Flowers get their energy through photosynthesis and are thus producers.
4. Mushroom: Mushrooms are decomposers as they obtain their nutrition from metabolizing nonliving organic matter.

Aquatic #2 (freshwater)	Bluntnose Minnow	Phytoplankton (Euglena)	Algae (Anabaena)	Aquatic Bacteria

a. Bluntnose Minnow: This is the most prominent freshwater fish in the U.S. They have an average length of 6.5 cm and a maximum length of 11 cm. They feed on aquatic insects, phytoplankton, algae, and small crustaceans, making them consumers.
b. Phytoplankton (Euglena): Found in fresh and saltwater habitats. The long flagella helps euglena swim. Euglena produces its own food through photosynthesis so it is a producer. Euglena can also be a consumer as it can ingest other organisms for food through surrounding a particle of food and ingesting it through phagocytosis.
c. Algae (Anabaena): Cyanobacteria, blue green algae. Found in freshwater ecosystems all over the world, but can handle salinity as well. Anabaena gets its energy through photosynthesis so it is a producer.
d. Aquatic Bacteria: Found in freshwater and marine environments. Bacteria play an important role in freeing the last of the minerals and nutrients from the last remains of living organisms and recycling them back into the food web. They are decomposers.

Bioramas

Passport Question: True or False: Organisms can survive only in environments in which their particular needs are met. (Answer: True)

Learning Target: Students will understand that organisms can survive only in environments in which their particular needs are met.

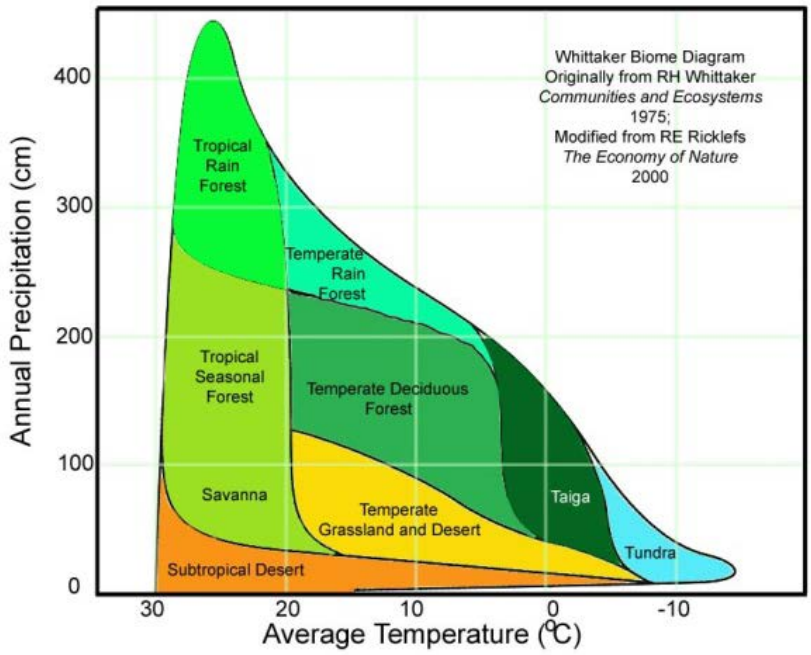
Materials:

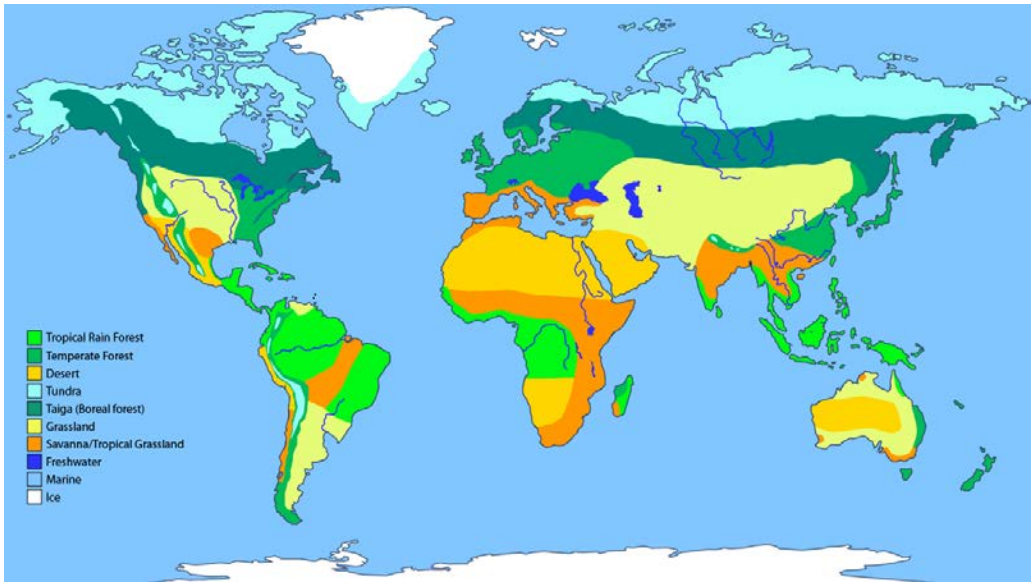
- 5 biome boxes with animals:
    - Freshwater Biome
    - Marine Biome
    - Tundra Biome
    - Desert Biome
    - Temperate Forest Biome
- Globe
- Biome Poster

Background:

This station is aiming to address the Next Generation Science Standard stating: "Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life."

Biomes are regions of the world with similar climate (weather, temperature), animals, and plants. There are terrestrial biomes (land) and aquatic biomes, both freshwater and marine. There is no definitive assessment of how many different types of biomes there are. Some people say there are only 5 major types of biomes: aquatic, desert, forest, grassland, and tundra. Others split biomes further. Forests are separated into rainforest, temperate forest, chaparral, and taiga; grasslands are divided into savanna and temperate grasslands; and the aquatic biome is split into freshwater and marine. Biomes have changed and moved many times during the history of life on Earth. More recently, human activities have drastically altered these communities. Thus, conservation and preservation of biomes should be a major concern to all.





The biomes exemplified in this station are:

Temperate Forest: Temperate forests are found predominantly in areas with warm summers and cool winters, and vary enormously in their kinds of plant life. In some, needle-leaf trees dominate, while others are home primarily to broadleaf evergreen trees or a mix of both tree types. Temperate evergreen forests are common in the coastal areas of regions that have mild winters and heavy rainfall, or inland in drier climates or montane areas. Many species of trees inhabit these forests including pine, cedar, fir, and redwood. Temperate forests

are common in the coastal areas of regions that have mild winters and heavy rainfall, or inland in drier climates or montane areas.

Tundra: Tundra is the coldest of all the biomes. Tundra comes from the Finnish word tunturia, meaning treeless plain. It is noted for its frost-molded landscapes, extremely low temperatures, little precipitation, poor nutrients, and short growing seasons. Dead organic material functions as a nutrient pool. The two major nutrients are nitrogen and phosphorus. Nitrogen is created by biological fixation, and phosphorus is created by precipitation. Tundra is separated into two types: arctic tundra and alpine tundra. Characteristics of Tundra: extremely cold climate, low biotic diversity, simple vegetation structure, limitation of drainage, short season of growth and reproduction, energy and nutrients in the form of dead organic material, large population oscillations.

Desert: Deserts cover about one fifth of the Earth's surface and occur where rainfall is less than 50 cm/year. Although most deserts, such as the Sahara of North Africa and the deserts of the southwestern U.S., Mexico, and Australia, occur at low latitudes, another kind of desert, cold deserts, occur in the basin and range area of Utah and Nevada and in parts of western Asia. Most deserts have a considerable amount of specialized vegetation, as well as specialized vertebrate and invertebrate animals. Soils often have abundant nutrients because they need only water to become very productive and have little or no organic matter. Disturbances are common in the form of occasional fires or cold weather, and sudden, infrequent, but intense rains that cause flooding.

There are relatively few large mammals in deserts because most are not capable of storing sufficient water and withstanding the heat. Deserts often provide little shelter from the sun for large animals. The dominant animals of warm deserts are nonmammalian vertebrates, such as reptiles. Mammals are usually small, like the kangaroo mice of North American deserts. Desert biomes can be classified according to several characteristics. There are four major types of deserts: Hot and dry, Semiarid, Coastal, and Cold.

Freshwater: The freshwater biome is made up of any freshwater body of water such as lakes, ponds, streams, and rivers. They cover roughly 20% of the Earth’s surface and are in various locations all over the world. Most freshwater biomes consist of moving water. The freshwater biome has the second largest diversity among the plants and animals that are found within it. It is believed that more than 700 species of fish, 1,200 species of amphibians, mollusks, and insects all live in these areas. Other inhabitants include frogs, beavers, otters, crab, shrimp, turtles, and tadpoles. The types of fish you will find depend on the location and the time of year. It could be bass, salmon, or trout. You will find many species of low lying plants growing in the freshwater biome. This includes different types of grass and sedge. Cyanobacteria is the blue and

green algae that you will find in most freshwater biomes. It is a significant food source for birds, amphibians, and many other living things in the freshwater biome.

Marine: There are five marine biomes - Atlantic Ocean, Pacific Ocean, Indian Ocean, Southern Ocean, and the Arctic Ocean. Almost 71% of the Earth is covered by ocean. Some believe that the ocean biome is in fact the oldest of all biomes. Majority of the animals and plants that reside in the ocean biome exist in areas of the ocean that are rarely visited by people. Humans have only explored about 10% of the ocean biome. We can find mollusks, fish, whales, crustaceans, bacteria, fungi, sea anemones and many other animals in the marine biome. Although the temperatures of the oceans can vary, the average temperature of any ocean is 39° F.

Procedure:

Students who visit the station will be given the chance to sort the animal figurines into their appropriate biomes. When a student comes over, the facilitator will hand a couple plastic animals from each biome to the student, help the student figure out what each animal is, and figure out which biome to put it in. The facilitator can help the student explore the globe and which biomes are found where by referencing the biome poster. At the end, have the student answer their passport question for Bioramas. Remove a couple animals from each biome box and start over.

Discussion:

As the student is trying to sort the animals ask them why they think particular animals might go in particular biomes (i.e. bears have thick coats so they can live somewhere cold), ask them what the characteristics of that biome are, where that biome may be found on earth (they can refer to the big poster), what other animals they think might live there (deductive reasoning).

Sources: http://www.ucmp.berkeley.edu/glossary/gloss5/biome/
http://kids.nceas.ucsb.edu/biomes/ http://tuningpp.com/major-world-biomes-map/
http://www.ucmp.berkeley.edu/glossary/gloss5/biome/tundra.html

Let's Play with Food (Chains)!
Includes: Food chain online game, food chain cootie catchers

Passport Question: All food chains have producers, consumers, and decomposers. Give an example of one of the food chains you saw in the game. (Answers: 1. flower, caterpillar, bird 2. acorn, mouse, snake, hawk 3. algae, small fish, big fish, dolphin 4. flower, insect, small fish, big fish, seagull 5. plant, grasshopper, lizard, eagle, mushrooms 6. plankton, fish, jellyfish, turtle, shark, bacteria 7. plankton, mussel, small fish, big fish, human.)

Learning Target: Students will understand that all organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. They will learn that the food of almost any kind of animal can be traced back to plants.

Materials:

- iPad
- Cootie catcher papers
- Markers and Crayons
- Scissors (2)
- Recycling bin
- Informational poster

Background:

This activity aims to address the Next Generation Science Standard LS2.A stating "Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or their parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil."

Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals. A food chain is the sequence of who eats whom in a biological community (an ecosystem) to obtain nutrition. A food chain starts with the primary energy source, usually the sun or boiling-hot deep sea vents. The next link in the chain is an organism that makes its own food from the primary energy source -- an example is photosynthetic plants that make their own food from sunlight (using a process called photosynthesis) and chemosynthetic bacteria that make their food energy from chemicals in hydrothermal vents. These are called autotrophs or primary producers. Next come organisms that eat the autotrophs; these organisms are called herbivores or primary consumers -- an example is a rabbit that eats flowers. The next link in the chain is animals that eat herbivores - these are called secondary consumers -- an example is a snake that eats rabbits. In turn, these animals are eaten by larger predators --

an example is an owl that eats snakes. The tertiary consumers are eaten by quaternary consumers -- an example is a hawk that eats owls. Each food chain ends with a top predator, an animal with no natural enemies (like an alligator, hawk, or polar bear). When any organism dies, it is eventually eaten by detrivores (like vultures, worms and crabs) and broken down by decomposers (mostly bacteria and fungi), and the exchange of energy continues.

The arrows in a food chain show the flow of energy, from the sun or hydrothermal vent to a top predator. As the energy flows from organism to organism, energy is lost at each step. A network of many food chains is called a food web.

Procedure:

- The cootie catcher papers, coloring materials, and educational posters will be out on a table so kids can color and cut out cootie catchers if they want and take them home.
- The computer will be cued up to the online game. Kids can play whenever.

A facilitator can:

1. Make sure the computer/iPad is cued up to the online game and not on any other internet pages. Talk to the kids as they're sorting the animals in the game about why they're sorting them the way they are.
   Link:http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm
2. If students don't know how to fold a cootie catcher, you can help them.
   http://www.mytoysandmore.net/ctp2647-samplepages.pdf

Discussion:

- What is a producer? Do you know any additional examples of a producer?
  [A producer is an organism that creates its own food from energy from the sun through photosynthesis. An additional example of a producer is a tree.]
- What is a consumer? Do you know any additional examples of a consumer?
  [A consumer is an organism that gets its energy from eating organisms that make their own energy (producers). An additional example of a consumer is a horse.]
- What is a decomposer? Do you know any additional examples of a decomposer?
  [A decomposer is an organism that gets its energy from eating dead and decaying organisms and material in an ecosystem. Through breaking down dead organisms, decomposers return those nutrients into the soil so plants can use them again to grow. An additional example of a decomposer is an earthworm.]
- Can an animal be more than one of these? Can it be a consumer and a decomposer? What would that depend on?

[Yes, an animal can be more than one of these. It depends on what they are eating at the time. If an earthworm is eating grass it is a consumer but if it is eating decaying material it is a decomposer.]

- Could a rabbit be a part of another food chain with other animals too?
  [Yes, a rabbit eats many different kinds of things so it is part of food chains with those different things as well. For example, rabbits also eat grass and lettuce, they don't just eat flowers.]
- What would happen if we lost one of these species?
  [If we lost an element of a food chain, another organism would most likely take its place. For example, if we lost the rabbit, another animal that eats flowers, like a squirrel, might take its place in the food chain.]
- Which category do humans fall into?
  [Humans are consumers because we get our energy from eating organisms that produce their own food or from organisms that eat other organisms that make their own food. Humans cannot make their own food through photosynthesis so humans cannot be considered producers. Humans do not eat dead or decaying material to get energy so humans cannot be considered decomposers.]

Sources: http://www.enchantedlearning.com/subjects/foodchain/

On the Ground & Beneath the Surface

Passport Question: Producers, consumers and decomposers are all important parts of a _____ chain. (Answer: food)

Learning Target: Students will understand how matter and energy cycle through an ecosystem.

Materials:

- 2 Aquariums
- Aquatic species (3)
- Terrestrial species (3)

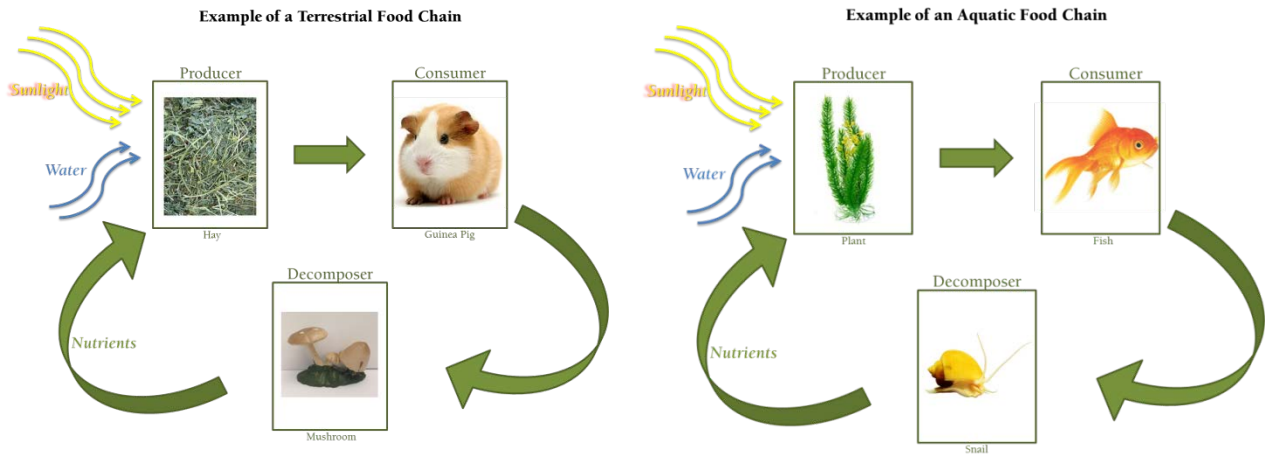
Background:

This station aims to address Next Generation Science Standard stating: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food.]

Aquatic communities, just like land-based communities, are comprised of producers, consumers, and decomposers. Each type of organism plays a role in the functioning and health of the ecosystem. The producers are things like plants that produce their own food from inorganic substances (sunlight, air, water). Consumers are things like fish or bunnies that eat the plants, thereby getting their energy from compounds created by producers. Decomposers are things like fungus (mushrooms), bacteria, and snails that break down dead and decaying material to get their energy; by doing this decomposers return nutrients into their environment.

Procedure:

Aquatic Producer: Plant
Aquatic Consumer: Fish
Aquatic Decomposer: Snail
Terrestrial Producer: Plant
Terrestrial Consumer: Guinea Pig
Terrestrial Decomposer: Mushrooms



<u>Questions To Think About (these will be posted on the aquariums along with the descriptions of the food chains and the organisms in them)</u>:

- Where do plants get their energy? [Plants get their energy through photosynthesis from the sun, the air, and water.]
- What happens to the nutrients the decomposers cycle back into the soil? [The nutrients become available for plants to use to grow, it's a big cycle.]
- What do fish and guinea pigs have in common? [They are both consumers!]
- What do mushrooms and snails have in common? [They are both decomposers!]
- Are humans producers, consumers, or decomposers? [Humans are consumers because we eat other organisms (animals and plants) that produce their own energy.]
- Matter cycles and energy flows through the ecosystem!

In Search of Pollen

Passport Question: Pollination involves the transfer of a flower's _____ to another flower's _____ by a_____? (Answer: pollen, stigma or female reproductive part, pollinator)

Learning Target: Students will understand that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. They will also learn that pollination involves the transport of pollen between the male part of a plant and the female part of the plant and that the evolution of pollination is an example of coevolution between plants and animals.

Materials:

1. 3 – 5 dissecting scopes, dissecting tools
2. Fresh flowers, most likely lilies (they have large stamens and stigmas)
3. Dead pollinator insects or models of these insects (bee, bug, butterfly) to look at under the dissecting scopes along with the flowers (MAY NOT HAVE THIS)
4. Laminated photos of different pollinators, hummingbird, bee, butterfly, etc... with their flowers (photos are included below)
5. Model of flower from SNC
6. Time line of when flowering plants developed (photo included below)

Optional: 2 iPads to play pollination matching interactive website and internet access

Background:

This station aims to address the Next Generation Science Standard 4-LS1-1 that states "Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals...]"

Visit a flower garden in the summer and you'll see and hear lots of activity. Bees are buzzing and busily moving from flower to flower. Butterflies are quieter, but they're visiting the flowers too. Ladybugs crawl and fly about. If you're lucky, you might even see a hummingbird or two. What's going on here? Why is everyone so busy? These animals are attracted to nectar in the flowers. Nectar is a sweet liquid deep inside a flower. Nectar provides food for bees, butterflies and even bats to grow and also to lay eggs. Plants help animals, but the animals are helping the plants too. When bees and other animals move around flowers, they take pollen, which forms on the male part of the flowers, the anthers, and move it to the pistils, or female parts of the flowers. If the pollen lands in the right spot, it moves down through the pistils, to the eggs, which are inside the flower. Once the pollen meets the egg, a seed is formed. Seeds are usually formed in fruit. A berry is a fruit, so is an

apple. Even a pea or tomato is a fruit because they contain seeds. Once the fruit is mature, it releases the seeds. The seeds land on the soil and create new plants. Seeds can't get up and walk, of course, but they move away from the parent plant in many ways. By moving, they can grow in a place where there's enough water, nutrients and light. Seeds have many ways of moving. Sometimes the wind blows them about. When animals eat the berries, the seeds come out in their poop. Some seeds, like cockleburs, attach to people and animals for a ride.

Procedure:

1. Students will first look at the model of the flower, they will then they will identify the reproductive parts of the flower.
2. They will then look at flowers under the dissecting scope and identify reproductive parts of the flowers.
3. Laminated photos of different plants and their pollinators will be set out on the tables, and dead pollinators will be available to look at under the dissecting scopes.
4. Students can play the pollination game on iPads and use flashcards to match different flowers to different pollinators. Students will match the pollinators to the flowers based on the characteristics that they have observed under the scopes, in the flower model and in the laminated photos.

Discussion:

- Is pollination important to plants?
  Yes, it allows sexual reproduction and mixing of genes.
- Do you think plants and pollinators evolved together, why?
  Yes, the form of the plant fits the form of the pollinator and they serve a mutually beneficial purpose, food for the pollinator and mixing of genes for the plants.
- What might happen to a plant species if a specific pollinator is not available?
  Because the plant species cannot move if it needs that specific pollinator it might not get pollinated and might not be able to reproduce. This can lead to extinction of a plant species.

Sources: http://easyscienceforkids.com/all-about-pollination/

Planting Party

Passport Question: What four things do plants need to grow? (Answer: soil, sunlight, water, carbon dioxide)

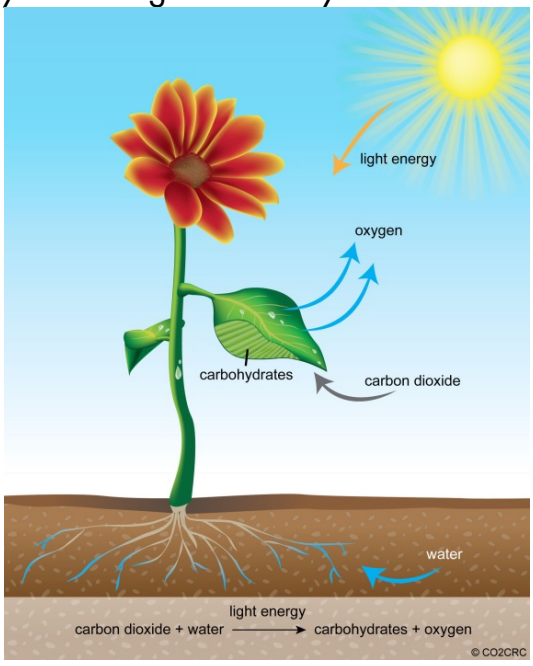
Learning Target: Students will understand that plants grow through photosynthesis and need only air and water to do so.

Materials:

- Plastic Cups
- Soil
- Planting Basin
- Seeds
- Permanent Marker
- Pencils or dowels
- Plastic Wrap
- Scissors
- Rubber Bands
- Procedure photocopies

Background:

The standard this activity aims to address is "5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water."



Photosynthesis converts light energy into the chemical energy of sugars and other organic compounds. This process consists of a series of chemical reactions that require carbon dioxide (CO_2) and water (H_2O) and store chemical energy in the form of sugar. Light energy from light drives the reactions. Oxygen (O_2) is a byproduct of photosynthesis and is released into the atmosphere. The following equation summarizes photosynthesis:

$$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$$

Photosynthesis transfers electrons from water to energy-poor CO_2 molecules, forming energy-rich sugar molecules. This electron transfer is an example of an oxidation-reduction process: the water is oxidized (loses electrons) and the CO_2 is reduced (gains electrons). Photosynthesis uses light energy to drive the electrons from water to their more energetic states in the sugar products, thus converting solar energy into chemical energy.

We want the students to understand that plants really only need air and water to produce energy and survive.

Procedure:

1. Select a cup and use a permanent marker to label it with the date, your name and the species of your seed.
2. Poke a small hole in the bottom of the cup using a pencil.
3. Fill the cup ¾ full of packed soil.
4. In the center of the cup, create an approximately 3/4 inch deep hole using a pencil or the back of the tweezers.
5. Select a type of seed you would like to plant. Place seed in the hole using tweezers to get it out of the small bag.
6. Collapse hole and cover the entire cup with a thin layer of fresh soil.
7. Gently pack the soil.
8. Lightly water the surface of the soil.
9. Cover the cup with a thin layer of plastic wrap; keep somewhere sunny.
10. Wrap a rubber band around the cup to hold the plastic wrap tight and securely in place.
11. Keep cup covered until the seed germinates.
12. Uncover the seed after it grows to the point where it nearly touches the plastic.
13. Water heavily (until a significant amount of water begins to drain out of the holes in the base of the cup.) Repeat every 3 days.
14. Transplant to a better pot after one month.

Discussion:

- This investigation provides the opportunity to experience how plants grow and reproduce.
- All of the resources that a seed needs to germinate are contained in the mini terrarium that you will create (nitrogen, phosphorus, oxygen, carbon, hydrogen).

- Germination is the event that occurs as the potential for life contained within the seed is properly nourished and begins to grow beyond the confines of its protective armor. As the plant grows so does its ability to collect sunlight that it uses to generate its own energy (variables: leaf quantity and surface area).
- What are the holes in the bottom of the cup for? The leaves of autotrophs "breathe" carbon dioxide. The roots of a plant breathe oxygen. As plants sit in moist soil they have a tendency to deplete the water in the soil of oxygen. The holes in the bottom of the cup allow oxygen rich fresh water to flush old, oxygen deplete water, out of the soil.

Sources:
http://www.co2crc.com.au/images/imagelibrary/gen_diag/Photosynthesis_media.jpg
http://www.phschool.com/science/biology_place/biocoach/photosynth/overview.html

Pumpkins and Butterflies and Frogs, Oh My!

Passport Question: True or false: Many animals and plants go through similar stages during their life cycles. (Answer: True)

Learning Target: Students will see the similarities in the phases of each life cycle even though the organisms are so different.

Materials:

- Large posters depicting each life cycle
- 2 sets of life cycle cards for each species (Pumpkin, Butterfly, Frog)

Background:

This station addresses the Next Generation Science Standard stating: Develop models to describe that all organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. Emphasis: changes organisms go through during their life form a pattern.

Pumpkins go through 6 stages: seed, sprout, vine, flower, green pumpkin, orange pumpkin. The seed is the initial stage and the pumpkin grows from that into a sprout with the proper nutrition, adequate water and sunlight. If the adequate conditions persist, the sprout will grow into a vine which will then flower. The flowers grown are both male and female. The flowers require cross pollination, usually by a bee, in order to produce a pumpkin. Once pollinated, the flowers will begin to grow into small, green pumpkins *(this is equivalent to the "birth" stage)*, that will eventually mature into a large orange pumpkins. This is the equivalent of the *"growth" stage* specified by the standard. The mature pumpkin will then produce a bunch of seeds inside of it. The mature pumpkin producing the seed is the equivalent of the *"reproduction" stage* specified in the standard. After a certain amount of time the pumpkin will begin to decompose. This is the *"death" stage*. This whole process occurs over 100 to 200 days. The seed will germinate in four to six days, four weeks later the flowers will start to bloom, two to three weeks after the flowers bloom you will start to see little green pumpkins, the pumpkins reach maturity about 100 days after this, and the mature pumpkins, if undamaged will remain healthy for 8 to 12 weeks before they begin to decay.

Frogs go through 5 stages: egg mass, tadpole, tadpole with legs, young frog, adult frog. During mating, the eggs laid by the female frog are fertilized by the male frog *(this is the "birth stage)*, 6 – 21 days after fertilization, the eggs hatch into tadpoles. After about 6 – 9 weeks the tadpoles start to grow small legs. By 12 weeks old, the tadpole starts to look like a young frog. By 16 weeks the fog will have completed its growth cycle *(end of "development" stage).* The frog will then begin this cycle again to produce new frogs

("reproduction" stage). Mature frogs live about 10 – 12 years before they die *("death" stage).*

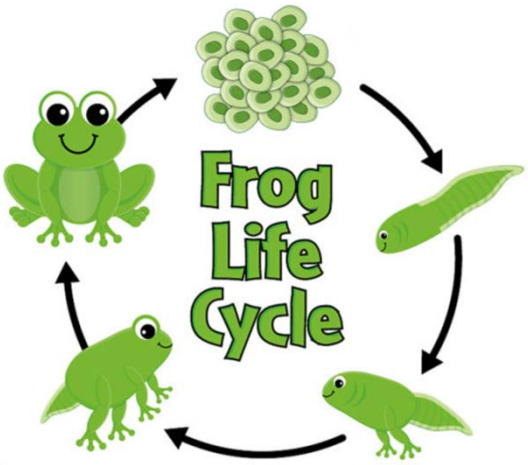
Butterflies go through 4 stages (5 playing cards, though): egg, larva/caterpillar, pupa, emerging adult, adult. Butterflies and moths undergo complete metamorphosis in which they go through four different life stages: Egg - A butterfly starts its life as an egg, Larva - The larva (caterpillar) hatches from an egg *("birth" stage)* and eats leaves or flowers almost constantly, The caterpillar molts (loses its old skin) many times as it grows *("growth" stage)*, Pupa - It turns into a pupa (chrysalis) ("development" stage), Adult - A beautiful, flying adult emerges. There is no growth during this stage. This adult will continue the cycle and reproduce until it reaches the *"death" stage*.

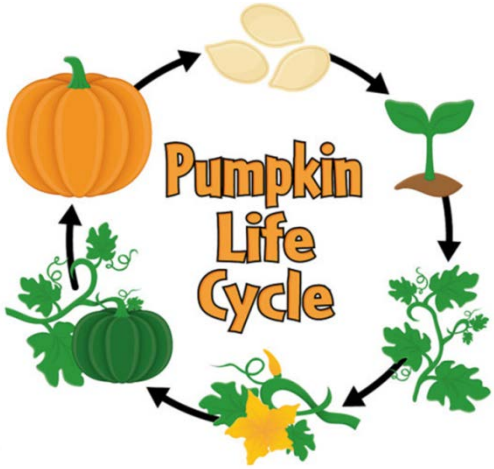
Procedure:

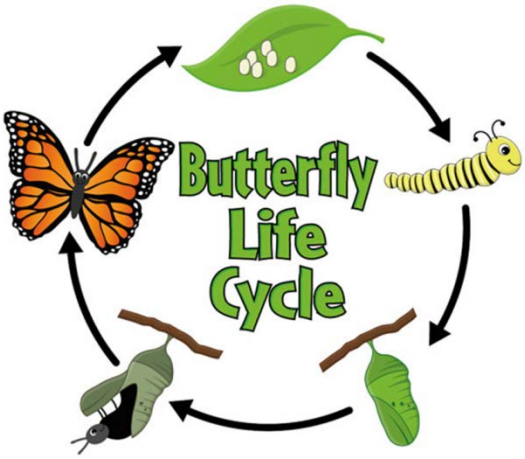
Students can choose to play the frog cards, the pumpkin cards, or the butterfly cards and the facilitator can explain the game to them. For each life cycle (pumpkin, frog, and butterfly), there are two versions of the game, one that has each stage of the life cycle numbered (for younger students), and one with the stages unnumbered (for older students). Each deck has 4 sets of life cycle cards in the deck. Have the students divide the deck in half by dealing one to each person until the cards are gone. They then play just like the traditional War card game. They each play a card, face up on the table between them, and the player who played the card with a more developed life cycle stage on it wins that round so they take both cards into a side pile they have. If the two cards played are the same, each player places three more cards, face down on the table then they play a fourth card and see who's fourth card is the higher card between the two. Once a player has played all the cards in their hand, they can shuffle their side pile and play from that. The idea is that the winner would eventually have all of the cards in the deck in their possession, but that takes a very long time so students can play as long as they would like to. Students can choose to play one or all versions of the game during their time at this station.

Discussion:

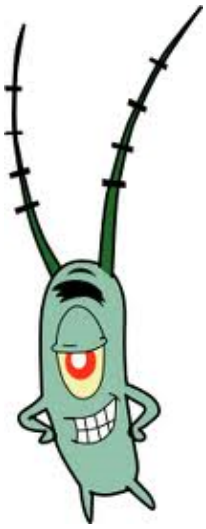
While the students are playing the game the facilitator can discuss with them any similarities they may see between the three life cycles, and how there might be similarities between other organisms as well. Do they know any other life cycles? Dogs? Humans? Butterflies? What are the similarities between each of these life cycles? What do they have in common? What is different between each?


Frog
Life
Cycle


Pumpkin
Life
Cycle


Butterfly
Life
Cycle

Tahoe Plankton!



Passport Question: When it is acting as a primary consumer, zooplankton eats _____. (Answer: phytoplankton)

Learning Target: Students will understand one component of the food web in Lake Tahoe. They will understand that zooplankton act as consumers when they eat phytoplankton, which are producers. They will also understand that zooplankton can act like secondary consumers when they eat other zooplankton (like Mysis Shrimp eating Daphnia).

Materials:

- Microscopes
- Live zooplankton
- Zooplankton slides
- Phytoplankton slides
- Tahoe Food Web poster

Background:

This activity aims to address the Next Generation Science Standard LS2.A: Interdependent Relationships in Ecosystems stating "The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or their parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem."

Food webs demonstrate how a variety of plants and animals are interconnected in numerous ways. Since animals often feed on multiple species, a food web involves a more complicated set of connections than a food chain, which follows a straight line. In the Tahoe Region, there are over 260 different species of mammals, birds, reptiles, amphibians and fish. These plants and animals range in size from microscopic zooplankton, such as daphnia, to large mammals, such as bears. Regardless of the size, each species plays an important role in the formation of Lake Tahoe's food web. In the last 135 years, human impact dramatically altered Lake Tahoe's ecosystem and food web. A few of the major changes include the introduction of Mysis shrimp in 1960's by the Department of Fish and Game, which were meant to be a food source for game fish. Instead, the Mysis are

omnivorous eating algae, detritus, and other zooplankton, increasing competition with resident fish.

In any food chain or web, it is important to distinguish between producers and consumers. Only plants are producers because, as their name suggests, they use energy from the sun to produce their own food. Animals are consumers since they rely on plants and other animals for energy. Within the larger category of consumers there are primary consumers (which only eat plants), secondary consumers (which eat herbivores), and tertiary consumers (which eat carnivores).

The species that reside in Lake Tahoe represent a full spectrum of producers and consumers. The ones we're focusing on are plankton: Zooplankton and Phytoplankton. Depending on the sample we get that day, under the microscope we will have Phytoplankton: diatoms, green algae. Zooplankton: Diaptomus, Epischura, Daphnia, Bosmina, Mysis Shrimp.

Some of the most important components in the Lake Tahoe ecosystem are:

- Sunlight and Nutrients – provide the base of the food web.
- Plankton – microscopic organisms which reside in the lake and compose the most basic level of the Lake Tahoe food web. Specifically, there are phytoplankton (microscopic plants and bacteria) and zooplankton (microscopic animals).
    - Phytoplankton are primary producers and use chlorophyll to convert energy from sunlight to carbohydrates. Common Tahoe phytoplankton include Diatoms, Chrysophytes (golden algae), and Chlorophytes (green algae).
    - Zooplankton can be either primary consumers (which eat phytoplankton) or secondary consumers (which eat other zooplankton). Examples of primary consumers are Daphnia, Diaptomus, and Epischura. Similarly, Mysis Shrimp are an example of a secondary consumer because they eat Daphnia, Diaptomus, and Epischura.

<u>Procedure</u>:

1. Set up microscopes and create a diverse sample of zooplankton in a petri dish.
2. Every 10-15 minutes you might need to put a fresh sample of water and plankton in the petri dishes, use your best judgment. Have microscopes already focused and set, so students will not have to adjust.
3. Discuss the background information, especially the difference between producers and consumers. Have students point out where producers are on the Tahoe Aquatic food web, how they know they are producers. Ask students if they can identify any of the species on the poster.
4. Have students identify the species they see in their petri dish sample under the microscope. Students can compare what they can see in the beaker with just their eyes to what they see under the microscope. If there's time, you can ask students if

they watch "Sponge Bob Squarepants" (kid's TV show). Is the character shown on this sheet, named "Plankton", a type of zooplankton or a phytoplankton? How do they know? He eats crabby patties, so he isn't a producer.

5. Clean-up and potentially switch out samples if needed

Discussion:

Students should understand that our food web is interconnected; therefore major changes to species population or introducing a new species (potential food source or competitor) can be detrimental to an environment. It may not necessarily be a bad thing but there are many different things that can happen. Have students think about what might happen if a new species is introduced into the Tahoe food web: consumer species is introduced and therefore competition for food source, if a food source in introduce, a possibility of the consumer species becoming overpopulated, sometimes an introduced species is not necessarily going to be negative, maybe now there's enough of food for all the consumers with the introduction of another producer etc.

MAGICAL MICROBES

Passport Question: A microbe is a tiny microscopic organism found in water, soil, and in us!

Materials: Microbial ecology columns, Microbial ecology poster, Petri dishes with agar gel, blue tape, Q-tips, Petri dishes with various types of bacteria growing

Main Science Concept: Interdependent Relationships & Ecosystems

Background:
When you think of the various forms of life, you probably imagine all kinds of plants and animals, but did you know that there are tiny, microscopic organisms living everywhere that help us live?

Microbes are very small living organisms, so small that most of them are invisible. The majority can only be seen with a microscope, which magnifies their image so we can see them. In fact, microbes are so tiny you would find over a million in a teaspoon of soil. They make up more than 60 % of the Earth's living matter and scientists estimate that 2-3 billion species share the planet with us.

Microbes include the categories Bacteria and Archaea that you may have seen on the Tree of Life. Bacteria and archaea are not only the most ancient forms of life, going back at least 3.5 billion years, but they are also the most diverse and numerous organisms on Earth. For the first 2 billion years of Earth's history, they were the only living things on the planet. These microorganisms exhibit astounding diversity in where they live and how they survive. They also play an essential role in cycling elements that make the planet habitable for all other types of organisms. The diversity of these simple life forms is evident in the diverse places they inhabit, from hydrothermal vents in bubbling geysers to the acidic lining of your stomach.

Procedure:
1. Let kids look at the bottles of sand/soil and water. Explain that these are samples of water and soil taken from Lake Tahoe and a nearby creek that were given food in the bottle and left to grow.
Ask: What colors do you see? Have them match the color they see to a layer on the poster,

then identify the microbe using the poster.
Explain: Each color is a different type of bacteria living and growing in the water and sediment. All these kinds of microbes living in water and soil help keep these environments healthy.

2. Show kids the Petri dishes with bacteria samples growing in them.
Ask: Which of these locations do you think has the most bacteria? Have them match the places with the dishes, then move them to match the real situation, using the key on the backs of the cards.

3. Give each kid a Petri dish with agar gel. Have them use a Q-tip to swab either a surface in the room, or their cheek/hand, and wipe it lightly across the surface of the gel. Tape their Petri dishes closed and tell them to check it in a few days to see what grows!
You may also put their name on the dishes with a Post-It and hold the dishes on the counter for them to pick up at the end of their session.

Discussion:
Bacteria is everywhere! And it is not all bad. Although many kinds of bacteria can get you sick, there are other kids that keep us healthy!

How are we able to see these invisible microbes in the bottles and in the Petri dishes?
- When we help the bacteria to grow with experiments like the bottles or the Petri dishes with gel, we get a group large enough that we can see them. Now that's magic!

GONE FISHIN' IN LAKE TAHOE

Passport Question: What was the original large trout species in Lake Tahoe? What species has replaced it? Answer: Lahontan Cutthroat Trout; Mackinaw / Lake Trout

Materials: kiddy pool, laminated fish, food web poster, 2 fishing poles

Main Science Concept: Interdependent Relationships & Ecosystems

Background: Until the mid-1800s, Lake Tahoe existed in its natural state, isolated high in the mountains, and untouched by humans except for a small number of Washoe Indians that lived in the area. European settlers that came to the land immediately knew the area was special for its beauty as well as its abundant natural resources. Much of these natural resources, as they soon discovered, lay beneath the lake surface, in the form of fish.

Several native species of fish existed in the lake, but by far the most impressive of these native fish was the Lahontan Cutthroat Trout, growing up to fifty inches in length and 40 pounds in weight, and being the top predator of the lake. Settlers at once saw the value of this fish as a food resource, and began to harvest it intensively, sending it by train to cities as far away as San Francisco and Chicago. Soon there were almost no trout left in Lake Tahoe, and the officials had to step in to prevent further fishing.

To fix the problem, the government decided to introduce several new species of fish into the Lake to allow fishing to continue, bringing species of fish like the brook trout, brown trout, and rainbow trout. Instead of fixing the problem, this introduction instead created new ones. One of these species, the Mackinaw trout, began to outcompete the few native Lahontan Cutthroat trout that were left, and soon enough they could no longer be found in the lake.

Over the past 150 years, many more non-native species of fish, crustaceans, and plants have found there way into Lake Tahoe, some intentionally and some accidentally. While some of these species fit relatively well into the ecosystem of the lake, others are harmful, preying on or outcompeting native species and leading to disastrous changes in the food web.

Some of the native and non-native species that can be found in Lake Tahoe include:

Native	Non-Native

Lahontan Cutthroat Trout	Mackinaw / Lake Trout
Tui Chub	Brook Trout
Mountain Whitefish	Brown Trout
Speckled Dace	Rainbow Trout
Paiute Sculpin	Kokanee Salmon
Lahontan Redside	Bluegill
Tahoe Sucker	Largemouth bass
	Smallmouth bass
	Bullhead catfish
	Crayfish

These species can be classified into three categories…

Native Species: Species originated or spread to the area without human assistance

Non-Native Species: Species accidently or intentionally introduced to the area but with limited consequences

Invasive Species: Species accidentally or intentionally introduced to the area but with harmful consequences to other native species

Procedure:
Ask: Why are we concerned about having lots of non-natives in Lake Tahoe?
- Because they can drive out native species and alter the food web.

Introduce students to the different fish species that can be found in Lake Tahoe.

Have students one at time take turns "fishing".

When the students catch a fish, ask them to identify the fish by its species (They can look on the chart), then whether it's native or non-native. After they guess have them check on the flip chart, or if the species is not there, use the chart above.

Discussion:
Did your group catch more native or non-native fish? What does that tell us about the fish populations in Lake Tahoe?
- More non-native. And there are more non-natives than natives in the lake currently.

Why do we care about fish?

- Many people simply enjoy fishing for sport and to catch something tasty to cook up for dinner. But in order to keep being able to fish, we must pay attention to how we treat them and their ecosystems.

What are some ways that we can protect fish and their ecosystems?

- We should limit the number of fish we catch per year, allowing them time to reproduce and grow so they will be enough the next year. We also must be careful about introducing new species in the lake, doing lots of research before any introduction. These are all regulations we have in Tahoe today!

FRUIT AND VEGGIE DNA

Passport Question: Name one thing that has DNA and one thing that does not have DNA.
Answer: Answers vary, but must be a living thing for what has DNA and a non-living thing for what does not have DNA.

Materials: Strawberries, peas, table salt, blender, strainer, beaker, Ziploc freezer bags, dishwashing soap, test tubes, test tube rack, meat tenderizer, rubbing alcohol (stored in freezer if possible), tweezers, Plant cell poster

Main Science Concept: Inheritance

Background:
What is DNA? DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other living organisms. Nearly every cell in a person's body has the same DNA, and most of this DNA is located in the nucleus of the cell.

All living things have DNA. For example—humans, animals, plants, bacteria, everything you can see on the Tree of Life. Non-living things do not have DNA—things like rocks, clouds, stars, chairs, houses.

Even plants have DNA! Including the fruits and vegetables we are going to use in this demonstration. You will see in this experiment that DNA is a real thing you can see and touch!

Procedure:
1. Break strawberries or peas into smaller pieces and measure between ½ -1 cup of them. Combine strawberries/peas, ¼ teaspoon table salt, and 1 cup cold water into a blender. Have students help where appropriate. Blend on high for 15 seconds or until you have a thin soup.
2. Pour the blended mixture through a strainer into the beaker. Add 2 tablespoons of dishwashing soap and swirl to mix it all up.
3. Put the mixture to the side to settle and take out the previous group's mixture (cooking show style) to show them one that has already settled.
4. Fill the test tubes about halfway with the mixture (1 tube for every 2-3 students), add a

pinch of meat tenderizer and stir *GENTLY*. If you stir too hard, you'll break up the DNA strands and make it harder to see at the end.
5. Tilt the test tube to the side so you can pour rubbing alcohol slowly down the inside of the test tube. The alcohol should form a layer on top of the bean mixture about an inch thick.
6. Put the test tube back in the test tube rack and watch for DNA to appear at the boundary between the water and alcohol. You should start seeing a white, stringy clump of DNA.

*Because it may take a few minutes to see the DNA precipitate out of the solution, we recommend that for each demonstration you do the experiment as described in the procedure, but for showing of the clump of DNA, show your results from your previous experiment, or in the case of the first one of the day, use a test tube full of DNA from the day before.

Discussion:
1. What are some different living organisms that contain DNA?
 - They all do!

2. What are some things you could find outside that don't have DNA?
 - Rocks, water, clouds, etc.

3. Where is most DNA located?
 - In the cell (Refer to poster)
And in which part of the cell is most of the DNA located?
 - The nucleus, which is in the center of the cell (Refer to poster)

4. Why are we adding soap and meat tenderizer to the mixture?
 - Soap breaks up the fats that make up the cell wall (refer to poster) and the enzymes in meat tenderizer break apart long protein strands that make up other parts of the cell, freeing the DNA.

5. Why does the DNA come out of the water solution when the alcohol is added?
 - Adding the salt to the mixture created salty DNA which will precipitate out of the solution when alcohol is added. The rising DNA pulls more strands with it as it rises through the alcohol, creating the clump of DNA.

DNA RECIPES

Passport Question: All living things have their own unique code called DNA.

Materials: Plastic DNA model pieces, DNA recipes for various organisms, organism stickers, Animal cell poster

Main Science Concept: Inheritance

Background:
What is DNA? DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other living organisms. Nearly every cell in a person's body has the same DNA. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). The order, or sequence, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences, or the ingredients in a recipe make up the dish. Differences in how the bases are put together can cause differences in eye color, height, size, hair color, etc.

How does it form? DNA bases pair up with each other, A with T and C with G, to form units called base pairs. Each base is also attached to a sugar molecule and a phosphate molecule. Together, a base, sugar, and phosphate are called a nucleotide. Nucleotides are arranged in two long strands that form a spiral called a double helix. The structure of the double helix is somewhat like a ladder, with the base pairs forming the ladder's rungs and the sugar and phosphate molecules forming the vertical sidepieces of the ladder.

How do we get more DNA? An important property of DNA is that it can replicate, or make copies of itself. Each strand of DNA in the double helix can serve as a pattern for duplicating the sequence of bases. This is critical when cells divide because each new cell needs to have an exact copy of the DNA present in the old cell.

How much DNA does a person have? Each DNA sequence that contains instructions to make a protein is known as a gene. The size of a gene may vary greatly, ranging from about 1,000 bases to 1 million bases in humans. The complete DNA instruction book, or genome, for a human contains about 3 billion bases and about 20,000 genes which if unraveled and laid out the strand would stretch from the earth to the sun 100 times! ← This may be a cool

fact to tell the kids!

Procedure:
1. Students choose an organism they want to make from the recipe cards.
2. They then build a strand of DNA using the plastic model pieces by following the color pattern on the recipe. Explain to the students what each plastic piece represents:

White: Sugar molecule
Black: Phosphate molecule, together with the sugar builds a backbone structure for the base pairs
Colored: base pairs – each bases always matches with the same base (adenine with thymine, cytosine with guanine) in this case, red with yellow and blue with green. The order of these base pairs is the code that determines what the DNA makes—what type of organism and its unique characteristics.

3. Help students build their strand and twist the ladder into a double helix shape, then check to see they followed the pattern correctly. If they did, give them a sticker of the organism they made.

Discussion:
Do you notice any patterns in the color code?
- Yellow is always with red, and green is always with blue. This is how base pairs work! A (adenine) is always with T (tyrosine) and C (cytosine) is always with G (guanine).

How is DNA like a recipe?
The base pairs make up a code. Their order tells one type of cell what other kinds of cells to make, which determines the characteristics of the organism—making a flower have petals or a fish have scales.

Where is DNA found?
- In the cell! (Refer to poster)
And in what part of the cell?
- In the center, or the nucleus! (Refer to poster)

How come a brother and sister can look very much alike or very different?

- They can look alike because they both receive DNA from the same 2 parents, so they have similar DNA. They can be different because exactly what they receive is up to random chance, so they do not have the exact same DNA sequence, unless they are identical twins.

Why, when animals or other organisms reproduce, they have a baby of the same type? i.e. Why does an elephant have baby elephants? Why do strawberry plants produce more strawberries?

- Because DNA replicates itself, and is transferred from parent to child

CRAZY TRAITS

Passport Question: What trait would help a creature to hear better?
Answer: Elephant ears or big ears.

Materials: Materials provided by Lou Loftin and Brian Crosby. Includes: Crazy Traits creature base, attachable parts

Main Science Concept: Inheritance, Variation

Background: Your traits are determined by the genes you inherit from your parents. For each gene, you get at least one allele from your mother and one allele from your father.

Genotype: combination of alleles that determine a particular trait (eg: If Tt = short tail, "Tt" is the genotype)
Phenotype: expression of a genotype (eg: If Tt = short tail, "short tail" is the phenotype)

The alleles you end up with are determined by two factors: 1. the genotypes of your parents, and 2. the allele from each parent you inherit. The alleles you inherit from each parent are determined by chance.

In this activity, we will assume that both parents have the same genotype for all traits (Tt). The genotype of each parent could be Tt, TT, or tt. We are choosing to have parents with the Tt genotype for each trait. In this investigation, you will play a game that will help you learn about inheritance.

Procedure:
1. Each kid will receive a work sheet, one die, and a body base for their creature. If there are more than 6 kids, they can pair up, 2 kids to one body base.
2. The facilitator will go through Traits 1-14, one by one, explaining the genotypes and phenotypes of each, with their corresponding dice rolls. (ie: dice roll of 1-3 = X genotype, 4-6 = Y genotype for sex trait).
3. Kids will roll their die twice, mark which trait their creature received, then put that feature on their body base for all 14 traits.
4. When everyone is done, have the kids look at everyone's creature and compare.

Discussion:
Ask: What are traits?
Do traits vary in a species?
How are traits inherited?
What role does chance play in an organism's heredity?

Examine the creatures. Do any of them look exactly alike? Why or why not?
- Some look similar, but no two are alike. For two to look exactly alike, every single flip of all three coins would have to be the same for both creatures. That seems very unlikely.

How does this investigation explain why siblings may resemble each other, but never look exactly alike (unless they are identical twins)?
- Since siblings share the same parents they will likely share many of the same traits. With the huge amounts of traits possible for humans the probability of all of them matching from sibling to sibling is very small.

Count the number of males and number of females. Does the number of each match the chances of getting a male or female in the game? Why or why not?
- Not exactly because the sample is small. Larger samples yield results that are closer to the average

TREE OF LIFE

Passport Question: True or false… All living things are related.
Answer: True!

Materials: Big simplified Tree of Life poster, smaller scientific Tree of Life poster, organisms with Velcro, real animals (from Pet Station) and plants

Main Science Concept: Variation, Natural Selection

Background: If you are to take one piece of information from everything you've learned at the Science Expo 2015, it should be that every living thing is connected!

Begin with the Tree of Life poster. Go over organism groups on the tree that the students do not know…

Bacteria: One of the first life forms on earth! Microscopic organisms found in soil, water, plants, and animals.
Archaea: One of the first life forms on earth! Made of a single cell, these guys can be found in some of the most extreme places on earth, like boiling water of hot springs or super salty lakes.
Protist: includes algae (plankton), some pathogens, and many other microscopic organisms
Fungi: includes yeasts, molds, mushrooms, and more. Fungi are more closely related to animals than plants!
Molluscs: squids, octopi, snails, slugs, and shellfish

Explain the concept of "Character" or "Characteristic" as a trait that we use to identify an organism and group it with other organisms that are similar. Emphasize that certain characters are not useful for grouping things together on a large scale (i.e., bird, bat and insect wings, or red flowers, red insects and red birds) but can be useful to separate organisms into small groups (species). Starting at the bottom of the tree, work as a group to determine what characters all organisms in a branch have in common. Eg: … Explain that these are just some characters we can use—others that we cannot directly see are also used to construct the tree of life: DNA sequences, bone structure, etc.

Explain that all living things have a place on the tree of life-- organisms are grouped by their similarities and differences. The branches also show how organisms are evolutionarily related to each other.

Procedure: Have students draw an organism from the bin. Let them decide where the image would be on the tree, guiding students that are having trouble. Remind them we are grouping based on the similar characteristics.

They may also examine the live plants and animals at this time. Challenge them to match a real organism they see to something on the smaller poster, or the large Tree of Life.

After all students have put their organisms up, look at the tree and have a discussion.

Discussion:
How did the students decide where their organism went? What is one characteristic that all the species in your branch have?

Ask: Who can choose an organism they learned about today (eg: plankton, owl, fish, lily) and decide where it would go on the Tree of Life?
Discuss the variety, or diversity, of living things. Eg: Does it seem like plankton and an owl would be related? They are so different! But they are related through the Tree of Life.

Discuss how things evolve as the tree continues to grow and branch out – that all life began from one common ancestor (point to "Origin of Life") and that over time branched out to more and more species.

Take Away Points…
1. Everything living is related, originally coming from one common ancestor.
2. The Tree of Life shows how living things are related to each other.
3. Characters, or traits, can be used to put organisms into different groups.
4. Scientists classify organisms to understand them better.

BRILLIANT BIRD BEAKS

Passport Question: The shape of a bird's beak is an adaptation to their food source.

Materials: Plastic bin, small bowls, tweezers, popsicle sticks, spoons, forks, chopsticks, tea ball, Swedish fish/gummy worms, bird seed, yarn, pasta, sequins, stopwatch, Bird diversity poster

Main Science Concept: Natural Selection, Adaptation

Background:
There is a ton of diversity within the animal category of birds! Did you ever wonder why there are so many types of bird beaks or bills? The most important function of a bird beak is feeding, and it is shaped according to what a bird eats. The beak is one of the characteristics used to identify birds-- you can figure out what a bird eats and where it lives just by looking at its beak!

A bird's beak is a character that has changed for each species over time as an adaptation to food sources. Beaks have changed so much and so drastically because food is a very important factor that determines which birds survive and reproduce better.

Procedure:
Explain rules to students:
1. Do not spill or drop "food"! Food is too important to survival for birds to waste any.

Game:
1. Fill large bowl with a small amount of each "food" type.
2. Each student is given one tool, and told that they are a bird and this is their beak.
3. Facilitator tells students to "Go!" carefully collecting as much food as they can into their cup in 30 seconds, keeping time on their stopwatch.
4. When time is up, students look at how much food they caught and what types they were and were not able to collect.
5. Now students will add data to our chart. Marking how many of each type of food they caught next to their tool, with 1 tally mark for each piece of food (for bird seed and sequins, just mark a check if you got some.)

Discussion:
Think of the birds you've seen before. Have you ever been to a place that does not have birds?
- They're everywhere! And so they must be adapted to many different food sources. This is how we get so many kinds of beaks—from the pelican's huge bowl to the hawk's hooked beak.

What kind of beak is your tool most like? Look to the birds on the poster and see which one your beak is most like. What kinds of food could you get with this beak?

Could any "beak" get all the types of food?
- No, most animals are adapted to a single or a few food sources (specialists), but some are able to choose between more food sources than others (generalists).

NATURAL SELECTION IN ACTION

Passport Question: The process that caused the moth population to change over time…
Answer: Natural Selection

Materials: 4 trees (2 with Velcro spots, 2 without), Velcro moths, Anthropocene poster

Main Science Concept: Natural Selection, Biodiversity & Humans

Background: When newly industrialized parts of Britain became polluted in the nineteenth century, smoke killed lichens growing on trees and blackened their bark. Pale colored moths which had been well camouflaged before when they rested on tree trunks now stood out and were eaten by birds. Rare dark moths, which had stood out before, were now well camouflaged in the black background. As birds switched from eating mainly dark moths to mainly pale moths, the most common moth color changed over time from pale to dark. The process of natural selection had caused a change in the British moth population. The moths had evolved!

This hypothesis was proposed by J.W. Tutt in 1896, and tested by Bernard Kettlewell in the 1950s. It then became a classic example of Darwinian evolution in action. In this station we will simulate this evolution event that really happened.

Procedure:
1. Start with the board with the white background with 9 light moths. Explain: Originally all the peppered moths were white with flecks of black. A few, rare moths were seen that had more black markings than white. These dark moths were mutants. Ask a student to stick a black moth on the board.

Tell one student that they are a bird that eats moths. Have them close their eyes, then open them, and grab the first moth they see. Do this with 5 students. Observe what is left. The black one likely got taken, because he is not camouflaged from predators like the white ones are. Ask: Which color moth has a better chance of survival? (Answer: the white ones)

2. Tell students that over time the trees got darker and darker, moving from the first tree to the next darkest, then the next, and then to the darkest tree.

Ask: How do you think this happened? Show them the lump of coal as a hint.
Explain the story above of how coal pollution during the industrial revolution in the 1850's began to pollute the area and changed the color of the trees y covering them in soot.

3. Now show the board with the black background with 9 black moths and 1 white one. Explain that this was the situation 50 years later (1900's). Repeat the procedure, having 5 kids pull moths off the board. Notice that the white one was taken. Ask: Which color moth has a better chance of survival in this situation? (Answer: the black ones) Explain that the black ones were selected for survival by the new environment.

4. Finally, explain bring up the white board again, and explain that this is what the peppered moth population is like today—that after 50 more years (1950's) we stopped burning so much coal for energy, so the environment got cleaner and the population was able to return to its original state.

Discussion:
Explain that what happened here was the process of <u>natural selection</u> – that a characteristic (in this case color- black or white) that helps an organism survive better in a particular environment becomes more common in a population over time. This is how many traits for many species have come to be!

<u>Ask</u>:

What other types of human pollution could change an animal's habitat?

How could something similar happen in a water environment? In the air?

BLUBBER GLOVE

Passport Question: What helps animals in arctic waters stay warm and keep afloat?
Answer: Blubber!

Materials: freezer bags, Crisco, duct tape, ice, water bin, towels, pictures of Arctic animals

Main Science Concept: Adaptation (Animal)

Background:
The Arctic Circle contains some of the harshest environments to survive in. Imagine you are an animal surviving in the Arctic and Antarctic waters, what animal are you? Penguin, Narwhal, Walrus, Seal, Whales, etc. These species spend much of their lives in freezing cold waters. How do you think that these animals can survive in the cold water? Many of these species share a common feature (Blubber!) that physically adapts them to survive in this habitat. They have thick layers of fat, called blubber, under their skin.

Blubber helps keep animals warm because it acts as an insulator. An insulator slows down the transfer of heat, keeping the animal's body heat, keeping the animal's body heat from escaping into the water and protecting it from the cold. Many species have some sort of insulation method whether it's in the way of fur or feathers on the outside. This activity will give you a firsthand feel for how blubber, feathers, and fur insulate animals from the cold.

Procedure:
Prep: Put hand in a Ziploc bag then slather a thick layer of vegetable shortening on the glove. Cover the glove and shortening with another Ziploc bag and seal in shortening between the two gloves by using duct tape to attach the top of the deli glove to the kitchen glove. Ensure the opening in the Ziploc bag will be large enough so that another person could fit their hand back inside. Also be sure that the shortening is sealed in properly. Then make one more dual bag, this one without shortening. This will be the control glove. Have bucket or bin filled with ice water ready to simulate arctic waters. Water only needs to be approximately 6 inches deep.

1. Before a student puts on the blubber glove, have the one student or the group make a prediction of what they think will happen in the experiment, writing this down on the sheet

provided.

2. Have students one at a time put on both gloves, one on each hand and simultaneously submerge hands into the ice water. Make sure student do not dip hands too far, we want to keep the inside of gloves dry.

3. Let each student have a try, remove control hand from ice water if it gets too cold.

4. While 1 or 2 kids are testing the blubber glove, have the others look at the photos of arctic animals and guess which do and do not have blubber. Answers are on the back of the cards.

Discussion:
Why do we have these two different gloves?
- In this experiment the glove with Crisco is the represents having blubber and glove without Crisco represents no blubber (this one is the "control").

Besides keeping animals warm, is there anything else that blubber does?
- It improves buoyancy and acts as food reserves for animals. Did your hand with the blubber glove feel lighter in the water than the control hand? That's called buoyancy! It's like a buoy, and is an adaptation to living in water.

How is shortening like blubber?
- It's a semi-solid fat that's similar to the fatty tissue that is blubber, which means it is able to prevent your hand from losing heat in the icy water, just like blubber prevents the arctic animals from losing body heat to a cold environment.

AWESOME OWLS

Passport Question:
Name one adaptation that helps owls survive.
Answers: fixed eyes, frayed wings, silent feathers, facial disk, asymmetrical ears, zygodactyl feet, sharp talons, flexible necks, making pellets

Materials: Owls of Tahoe Poster, Great Horned Owl Wings, Grouse Wing, Pellets/bones in Petri dish, Owl feet, Owl Skull, Owl Adaptation Flip board poster, iPad with Owl video

Main Science Concept: Adaptation (Animal)

Background:
Owls have developed many adaptations in order to survive in their environment. All Owls share strong, curved, downturned bills; forward facing, immovable eyeballs surrounded by a disk of stiff feathers and zygodactyl feet with arching claws. Unlike diurnal birds of prey (hawks, falcons etc.) mainly nocturnal owls have an outer toe that can rotate backwards, asymmetrical ear openings, and lack a crop. When hunting, most owls use a combination of sight and hearing to detect their prey and avoid competition with diurnal predators, such as hawks, by feeding at night.

There are approximately 240 different species of Owls on Earth, living on every continent except Antarctica. Owls eat a wide range of food, including moths, beetles, earthworms, crayfish, reptiles, amphibians, fish, various birds up to the size of grouse, geese, and even other owls; and mammals ranging in size from shrews and bats to cats and skunks. What Owls eat determines their size, behavior and habitat, and different owl species have a lot of differences from each other. Flammulated Owls (weighing 1.6-2.2 ounces) eat insects almost exclusively while Great Horned Owls (32-88 ounces in weight) typically eat prey ranging in size from rats to skunks. Both of these species of Owl live in the Tahoe Basin, and defer greatly in size and food source.

Although variations between species exist, many adaptations of Owls are the same, as stated in the first paragraph. These adaptations helped them become incredible hunters, being able to find and capture their prey efficiently. At this station the students will be exploring these adaptations and how they help Owls thrive in their environment.

Procedure:
Students will be able to explore the different adaptations that Owls have by looking at question on the flip board which explains different Owl adaptations, think about possible answers, then read the answer behind the question for the correct answer. Students will also observe different specimens and examples of adaptations up close.

Questions for front of the flip board:

How Do Owls…… Hunt at night effectively? Fly so quietly? Hear so well?
Why do Owls….. Have to turn their head so far around? Make pellets? Catch their prey?
What is a negative to these adaptations?

Adaptation	Description	Possible Activity/ Question
Adaptation	Special traits or physical features that help an animal survive in its environment.	
Fixed Eyes	Large eyes set forward on their head enable great depth perception for hunting. Owls eyes take up as much as 70 percent of their skulls (humans only take up 5 percent). The large eyes allow owls to pick up as much light as possible which helps them see an image 2.5 times brighter than what we see. They cannot move their eye balls, which improves their ability to estimate distance of prey.	Hunt at night effectively
Frayed Wings	The sound of their approach is minimized by the soft, comb-like leading edge on their flight feathers and the fuzzy upper surface that allows for silent flight. The auditory hunting of owls is effective only in a quiet environment.	Fly so quietly? Look at actual wings
Facial disk and Asymmetrical Ears	Owls have a ring of stiff feathers around their face and facial disks functioning like an antenna which focuses sound into the ear. The asymmetry allows owls to triangulate on sounds made by their prey, meaning they can pinpoint the prey	Hear so well?

	they are hunting. They need this to find prey under cover like snow.	
Zygodactyl feet with sharp talons	Owls are capable of pivoting their outer toe back and forth. This allows the owl to have two toes in front and two in the back, helping have a strong, symmetrical grip on squirming prey. Some owls have feathers on their feet to insulate them from the snow when punching through it for prey.	Catch their prey?
Necks	Owls necks have a large turning radius for following prey as they move. Owls can swing their heads about 270 degrees without moving their body. Owls are unable to move their eyes within their sockets, meaning they must turn their entire head to see in a different direction. Turning their head allows owls to focus its super sensitive hearing and vision directly at its prey..	Turn their heads so far around?
Pellets	Owls save weight by having a beak instead of teeth and a jaw, making it easier to fly. Owls swallow their prey whole and eight hours later regurgitate the inedible fur, feathers, and bones as a compact pellet, which helps aids the owl with digestion.	Make pellets?
Negatives to Adaptations- Rain-	Silent feathers cannot also be waterproof, and owls cannot hear prey over the loud noise of rain. Hypothermia can set in when the owls get wet from rain. Wet weather can be fatal for owls.	Negatives to these adaptations?

Discussion:
Why do animals adapt?
- In order to have greater survival in their environment or a new environment

What are some adaptations Owls have? How do they help the Owls survival?
- On the table above

FLOWER ENGINEERS

Passport Question: The colors and shapes of flowers are adaptations that help them to attract pollinators.

Materials: Pollinator chart, scissors, tape, colored tissue paper, pipe cleaners, pom-poms, brass fasteners, colored markers, orchid, anthurium, daffodil, daisy

Main Science Concept: Adaptation (Plant)

Background: Why do flowers have such beautiful and varied shapes, colors, and sweet-smelling nectar? Because flowers cannot move, they use their shapes, colors, and smells to attract insects and other pollinators like moths, hummingbirds, butterflies, honeybees, and beetles. Pollinators are hungry for nectar, the sweet-smelling liquid inside the flower, and when they take nectar from deep within the flower, they get covered with pollen. The pollinator then moves from flower to flower and is unaware that it is spreading pollen along the way. This turns out to be a pretty good deal for both the insect or bird and the flower, because the pollinator needs the nectar from the flower for energy, while the flower needs pollen from another flower to be fertilized. Do the pollinators go to just any flower? No. Certain insects and birds are attracted to certain flower shapes and colors.

These flower features are adaptations—strategies the plant has developed over time to help it survive and reproduce better in its environment.

The transfer of pollen in and between flowers of the same species leads to fertilization, and successful seed and fruit production for plants. Pollination ensures that a plant will produce full-bodied fruit and a full set of viable seeds. Over 1,000 plants grown for food, beverages, fibers, spices, and medicines need to be pollinated by animals--including apples, blueberries, chocolate, coffee, melons, peaches, potatoes, pumpkins, vanilla, and almonds. Worldwide there is disturbing evidence that pollinating animals have suffered from loss of habitat, chemical pollution, invasive plant and animal species, diseases, and parasites, and we are seeing far fewer of these animals that we depend on for our food!

Procedure:
Choose your favorite pollinator, then use the Pollinator Chart to create a flower that would attract it with colored paper, tissue paper, pipe cleaners, + other materials.

Potted flowers are examples the kids can look at (but not touch too much!) that demonstrate the different flower shapes described on the pollinator chart.

Make sure to explain clearly to students that they choose one pollinator (either honeybee, butterfly, beetle, or hummingbird) and choose the color and shape of their flower based on the pollinator's preferences. Help them in constructing the flower if they need help. The easiest way is to take a few sheets of stacked tissue paper and punch a hole in the center with a pipe cleaner. Coil it as needed to secure the paper, or use a brass fastener poked down through the paper, then have the facilitator glue on any decorations they'd like. Facilitator, please be in charge of the quick dry glue because it is very powerful!

Discussion:
Why might the beetle like white flowers? (Hint: Many beetles are nocturnal- they only go out at night.)
- White is the easiest color to see in the dark.

What is one reason some flowers have large base petals?
- For bees, butterflies, and beetles to land on while they pollinate.

Why are some flowers tube shaped?
- To fit a pollinator's long beak, like a hummingbird, or long tongue, like a butterfly.

Why does a flower want to be attractive to pollinators?
- Because they carry its pollen to different flowers, helping the flower to reproduce!

SEEDS ON THE MOVE

Passport Question: What is one way a seed can travel?
Answers: by wind, by water, on animals (carried on their fur), in animals (ingested/eaten)

Materials: small fan, stuffed bear, water basin, seed strategy key, various seeds in bags

Facilitator's Quick Key:
Wind- Catalpa, Redbud, Scotch pine, American elm, Alfalfa, Sycamore, Cottonwood
Water- Black Willow, Silver Maple, Green Ash
Stuck on animals- Sweetgum
Eaten by animals- Red Cedar, Watermelon, Pumpkin, Tomato, Hackberry, Black Walnut

Main Science Concept: Adaptation (Plant)

Background: Seed dispersal is the movement of seeds away from the parent plant.

Dispersal of seeds is important for the survival of a plant species. If plants grow too closely together they compete for light, water, and soil nutrients-- therefore, seed dispersal is a way to distribute offspring so they have a better chance of survival.

In flowering plants like apple trees, one or more seeds are housed within a fruit which is the portion of the apple that we eat. Sweet fruits like apples are eaten by animals that disperse the undigested seeds. Other plants have fruit that remain on the plant and disperse only the seeds. In either case, plants have evolved different dispersal mechanisms and methods of transport. Some fruits can be carried by water, like the coconut. Burdock fruits have hooks that attach to and are dispersed by animals. Dandelion fruits are suspended from feathery "parachutes" that are carried on the wind. The fruit of ash trees have wings that let them float on air. These various strategies can be categorized into dispersal by wind, water, on animals, or ingestion by animals.

Procedure:
Introduce: In this activity your job is to investigate how your seed disperses with the tools provided.

1. Students each choose a seed in a bag.
2. Have each student take their seed out of the bag and look at it closely. Ask each student to describe their seed to you in one word. Have them make predictions of how they think their seed would travel, choosing between the 4 mechanisms of dispersal.
3. Next, they will test their seed using the 4 stations—dropping it in the water, letting it go in front of the fan, trying to stick it to the bear, and asking the bird, would you eat this?
4. Have each student decide what they think the seed's dispersal strategy is. Once they have an idea, they can ask you to tell them if they are correct. You will find the answer on your seed key, where each number corresponds with a seed type. (You are also welcome to leave the seed key out for them to check.) Note: the dispersal method given on the key is not the *only* was the seed may disperse—tell kids that some seeds have multiple strategies for dispersal, so their predictions may have been right—the key just gives its *main* method.

Discussion:
Dispersal strategies are an example of adaptation. You are probably familiar with animal's adaptations to their environments, but did you ever think that plants have strategies for survival too?

Why do you think dispersal is important for plants?
- Dispersal is important because if the seeds are not dispersed, the seedlings will grow very close to the parent plant. This results in competition (for light, space, water and nutrients) between every one of the seedlings and with the parent plant.

Train Your Brain

Passport Question: True or false … Every time you learn something new, like how to read or what each color is called, you change the structure of your brain.

Passport Answer: True

Materials:

- (12) Color cards in corresponding color
- (12) Color cards with wrong color
- (10) Spanish color cards with wrong color
- (10) Item cards in different colors
- Timer
- White board and markers

Background:

The psychological test we now call "the Stroop effect" was first described in 1935 by John Ridley Stroop. The Stroop effect appears to tap into important cognitive processes. This activity tests your brain to ignore its instinct, to read the words written on the card, and instead name the color it is written in. It is a challenge of concentration and focus, and teaches students they have changed the structure of their brains by learning to read.

Procedure:

1) Start with the color cards written in the correct color. Tell the student to say the color of the word. Time how long it takes the student to go through the twelve cards saying the color that is written on them.
2) Record on the whiteboard the amount of time it takes to go through the first stack of cards.
3) Next, take the cards with colors written in the wrong color. Tell the students their job is to say the color the words is written in. Time how long it takes them to read through the 12 cards this time.
4) Record on the whiteboard.

Additional challenges:

5) There are 10 cards written in Spanish, with the colors written in the wrong color, similar to the second test. Tell the students they can try this additional challenge, and you can mix English/Spanish words together if the student wants an extra challenge.

It would be great to introduce the Spanish cards to those students who speak Spanish as their first language.

6) Another challenge they can try is to use the set of everyday words and have students say the color oppo sed to the word written.

Discussion:

Ask the students why they think it takes them longer to say the color instead of reading the word. You can also ask them if they thought it was harder or easier to say the color when the words that were written weren't colors (stack 4, or the Spanish words if they speak English).

There are a few hypotheses to explain why saying the word is harder than reading it. You can talk to the students about these hypotheses and what a hypothesis is (a proposed explanation about how things work). *If you want to keep it simple, just explain the "automatic word recognition hypothesis".*

On explanation is called the "*automatic word recognition hypothesis*", and is considered the most plausible explanation for the Stroop Test. This theory says that reading is an automatic process, which cannot be turned off once you learn how to do it. In other words, people see the meaning of words without much effort once they learn to read. On the other hand, naming colors is not automatic. It requires more effort than reading, and causes interference in the Stroop task.

The "*speed of processing*" hypothesis says that word processing (reading) is much faster than color processing (saying). Therefore, when you have to say the color, the read information arrives at the decision making part of the brain before the color information. This results in processing confusion. On the other hand, when you have to read the word, a decision can be made to say it before the conflicting color information arrives in the brain, since the color information travels slower.

The "*parallel distributed processing hypothesis*" says different tasks develop separate processing pathways in the brain, and practice creates pathway strengths. Therefore it is strength, not speed that is more important. We automatically want to read the word over saying the color because that pathway is stronger. For the Stroop task this means that if two pathways are active at the same time, and the pathway that leads to the response is stronger (naming words), no interference occurs. However, if two pathways are activated at the same time and the pathway that leads to the response is weaker (naming the color of the word), interference results and it takes longer to do.

Think Fast!

Passport Question: _____ are voluntary or controllable; _____ are involuntary, or happen without your control.

Passport Answer: Reactions; Reflexes

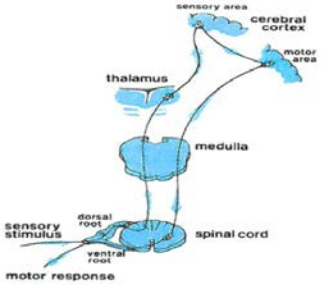
Materials:

- Reaction time rulers set
- Percussion Hammer (2)
- Decks of cards (2)
- Pen Lights (2)
- Timers (3)
- White board and dry erase markers

Background:

Reflexes and reactions are often confused, but important differences exist. Reactions are voluntary responses whereas reflexes are involuntary or unintentional (not subject to conscious control in most cases). Each type of response is initiated by a sensory stimulus that may be visual, audible, tactile, olfactory, or gustatory in nature. The stimulus excites specialized sensory receptors that respond specifically to a certain type, quality, and/or intensity of stimulation. Once activated, the receptors propagate nerve impulses that travel toward the brain along sensory nerve tracts. The speed of a reflex is greater than that of a voluntary reaction, due largely to the relative complexity of the neural pathway for a reaction (Fig. 1) compared to that for a reflex (Fig. 2).

Fig. 1 Pathway for a voluntary response to a stimulus



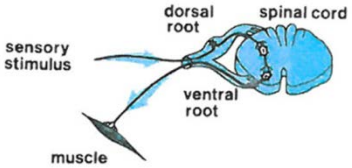


Fig. 2 Generalized Reflex Arc

Procedure:

Ask about the words reaction and reflex, and see if the students know the words and can explain the difference.

1. Have each student find a partner to go through the reaction tests. Record times for each participant on the whiteboard as they go through the tests. Have the students report their data to you.
    a. In the first test a student holds the reaction time ruler out, and their partner places their thumb and fingers around opposite sides of the bottom of the ruler at the 'thumb line' ready to catch it when the first person releases it. The location on the ruler where they catch it shows their reaction time. Make sure the student dropping the ruler is holding it straight up and down. Students can do this a few times to see if they can improve their score. Then they switch. Students can design their own experiments, testing the effects of distraction and other factors on their performance such as saying ready set go or just dropping it without warning.
    b. The second test is to go through a deck of cards and sort them by color or suite for a harder test. They can time each other and compare times amongst themselves.
2. Students can stay in the same partners and go through the two reflex tests.
    a. In the first test students can use the pen lights to observe the reflex of the pupil when a light is shined in it. The pupils will contract in response to light. Talk to the students about what is happening and why.
    b. The second test is using the percussion hammers on each other knees to get the kick reflex. There is a chair for the student getting the test done on them to sit down.
3. Now that the students have completed the tests, ask them again what the difference is between a reaction and a reflex. Why do they think it is important to have those functions in our brain?

Discussion:

Why are reactions and reflexes important for humans? Ask your students why they think they are important, and if they can give you examples. Below is an example involving baseball.

> A baseball player is at bat. He faces the pitcher, who stands 60 feet away while he prepares to deliver a fastball at 90 mph. The ball will travel from his hand to the plate in approximately half a second. That is all the time the batter will have to respond by either swinging the bat or allowing the ball to pass by. Many hours of practice have provided him with an uncanny ability to judge how the pitch should be played.
>
> The pitcher loses control and hurls a fastball directly at the batter's face. The batter's eyes close involuntarily as he reacts by ducking sideways to avoid being hit.
>
> Although reflexes are automatic and predictable, they have value in the avoidance of injury. In the above situation, the batter's eyes closed reflexively in response to the

baseball thrown at his face, thereby lessening the likelihood of injury to his eyes. At the same time, he responded to the danger by utilizing voluntary movement to get out of the way.

Reaction time is the amount of time required for an individual to perceive and respond to a sensory stimulus (such as the act of swinging a bat at a baseball). Reaction time improves somewhat through repetition, which is a beneficial result of the many hours of practice that athletes endure. Ultimately, however, the speed at which a nerve impulse travels along a neural pathway limits reaction time. Reflexes cannot be improved through practice, because the signal doesn't travel through the brain the way a reaction does. It only makes it as far as the brain stem.

Confusing the Senses

Passport Question: Illusions trick your _____, changing how you perceive and experience your senses of touch, taste, hearing, smell and sight.

Passport Answer: brain

Materials:

- Optical Illusion pictures
- 2 point discriminators
- Fruit juice (red, purple, yellow Gatorade)
- Cups
- Small straws
- Orange food coloring
- Extracts – peppermint, vanilla, strawberry,
- balloons
- Containers Markers
- Paper (half sheets)
- Directions
- Pencils

Background:

An illusion is a thing that is, or is likely, to be wrongly perceived or interpreted by the senses. By looking at illusions, students learn about the limitations of their senses. We will test four of the five senses, touch, sight, smell and taste.

Students will:

- Learn about the reception of stimuli through the senses of touch, sight, smell, and taste.
- Explore the limitations of the senses and the limitations of perception.

Procedure:

1. The first sense the students can test is their sight, and try out different kinds of optical illusions. Most students are probably familiar with these things and the word optical. Ask them if they know what optical means, and if they think they can trick their other senses.
2. The next test they can try is the touch test. Have the students partner up and use the 2-point discriminator, where one partner closes their eyes and the other person tries to tell whether they are being touched by one point or two. Students can test neck, back,

legs, arms, hands fingers etc. They can test distance by sliding the grey part of the sale. CAUTION: make sure students are being safe and not hurting each other with the two point discriminator.

The students may alternate randomly between touching the patient with one point or with two points on the area being tested (finger, arm, leg, toe). Students report whether one or two points was felt. The smallest distance between two points that still results in the perception of two distinct stimuli is the student's two-point threshold.

3. For the taste test, have four cups on the table, with the bin of straws next to eat. Each student gets one straw for tasting. Fill one cup with red Gatorade, one cup with purple Gatorade, one cup with red Gatorade, and one cup with water with orange food coloring in it. Have the students report to each other in their partnerships what flavor the drinks are. See how many students report the flavor as orange due to the color. Discuss with them how sight can trick our perception of the taste.

Optical Art

1. Trace your hand.

2. Draw straight lines from one end of the page to the other. Make the line "jump" from one side of the hand to the other in a curved line.

3. Continue until the lines fill your paper. Add color if you wish.

Discussion:

Sight

Optical illusions – all descriptions for the tricks for each optical illusion are described on the back of the picture.

Touch

2 point discriminators - Body areas differ both in tactile receptor density and somatosensory cortical representation. Normally, a person should be able to recognize two points separated by as little as 2–4 mm on the lips and finger pads, 8–15 mm on the palms and 30–40 mm on the shins or back. The posterior column-medial lemniscus pathway is responsible for carrying information involving fine, discriminative touch. Therefore, two-point discrimination can be impaired by damage to this pathway or to a peripheral nerve.

Taste

Does what you see influence what you taste? How many people said your unflavored drink was "Orange"? Food companies add color to food to influence what it tastes like. People like to see foods in colors that they expect.

A Close Up of You

Passport Question: Name some different types of tissue found in the human body.

Materials:

- (6) Microscopes
- All about me human tissue samples
- Flip charts on each type of tissue
- Human body book

Background:

Students will get an up close look at six different types of tissue in their body – blood, bone, muscle, hair, skin and epithelial (cheek cells).

Procedure:

1. When kids approach the table, tell them they have to put their hands behind their back, then can take turns looking in all the microscopes.
2. The slides are human tissues: skin, bone, muscle, blood, hair and epithelial (cheek) cells.
3. Help the kids use the flip chart to figure out what they are looking at and why it looks that way.
4. After each round of kids comes through, check the microscopes to make sure they're in focus.
5. Students should not touch the microscope knobs themselves!

Discussion:

Blood

Red blood cells - Blood gets its bright red color when these cells pick up oxygen in the lungs. As they travel through your body, they release oxygen to your tissues. White blood cells - These are important for the body defending itself against infection. They can move in and out of the bloodstream to reach affected tissues.

Muscle

Smooth muscles - Your brain and body tell these muscles what to do without you even thinking about it. Your smooth muscles are at work all over your body, like in your stomach. Your cardiac muscle makes up your heart. The thick muscles of the heart pump blood out and back to circulate it through the body. Just like smooth muscle, cardiac muscle works all

by itself with no help from you. Your skeletal muscles have stripped light and dark parts of the muscle fibers. You can control what they do. Skeletal muscle is attached to one end of a bone.

Bone

Bone marrow is like a thick jelly, and its job is to make blood cells. Canals allow veins and arteries carrying blood to pass through bone. Spongy cancellous bone is very strong! The surface of bone is a thin membrane that contains nerves and blood vessels that feed the bone. Compact bone is smooth and very hard. It's the part you see when you look at a skeleton.

Hair

There's hair on almost every part of your body, except: lips, palms of hands, soles of feet. Hair on your eyebrows, head, arms, and legs is easy to see - but other hair, like that on your cheek, is almost invisible!

1. Hair has many jobs!
    a. Keeps your head warm
    b. Eyelashes protect your eyes from dust
    c. Eyebrows protect your eyes from sweat dripping down from your forehead.
2. Hair Facts:
    a. You have more than 100,000 hairs on your head.
    b. You lose about 50 to 100 hairs every day.
    c. New hairs are constantly replacing those that have fallen out!
    d. Each hair on your head grows for 2 - 6 years.
    e. When it finally falls out, it is replaced by a new hair, which begins to grow from the same hair follicle.
3. Hair Parts
    a. Root – cells form Keratin, a protein hair is made of
    b. The root is inside a follicle which is a small tube in the skin.
    c. Oil gland
    d. Cuticle - the outer part of a strand of hair
    e. Medulla – inner part of a strand of hair

Cheek/ Epithelial Cells

Cheek tissue is made up of epithelial cells. They are layers of cells that cover the surfaces of organs, like your skin and breathing airways. They are a barrier between what they cover and the environment surrounding it. Inside our mouths they protect us from cuts and small germy invaders!

Skin

The skin is made up of three layers, each with its own important parts. The layer on the outside is called the epidermis. The epidermis is the part of your skin you can see. The next layer down is the dermis. You can't see your dermis because it's hidden under your epidermis. The dermis contains nerve endings, blood vessels, oil glands, and sweat glands. The nerve endings in your dermis tell you how things feel when you touch them. The third and bottom layer of the skin is called the subcutaneous layer. It is made of fat and helps your body stay warm and absorb shocks, like if you bang into something or fall down. The subcutaneous layer also helps hold your skin to all the tissues underneath it.

Name That Organ

Passport Question: Name one organ and its function in our bodies.

Materials:

- (2) Organ Vests
- Quiz Cards
- Stick on wall organ poster
- Small organ model

Background:

An organ is a group of tissues in a living organism that has a specific form and function. Organs are grouped together into organ systems. Organ systems perform a specific task. In most animals there are ten major organ systems. All together we have 22 internal organs in the human body, not all are represented in this game.

Procedure:

1) Tell the students they are going to participate in a quiz game. Show them the wall poster and tell them that they will have to choose the correct organ from the clue you give them, and they also have to put it in the right spot to get the question correct.
2) If you have multiple students they can team up.
3) Have two students put on the vests and remove all the organs to a spot on the table.
4) Read quiz questions and have them answer by getting the correct organ in the right spot. They can look at the wall poster for help.
5) You can choose to stop when it's completely filled or ask them additional questions where they have to pull the right organ off or point at.
6) Questions should cover function and fun facts about organs.

Discussion:

Organs are a part of every system in your body. Organs can work within several systems of your body any organs also have specific cells or tissues that have different functionality. Systems connect to other systems and rarely work alone. All of the systems in an organism are interconnected. A simple example is the connection between the circulatory and respiratory systems. As blood circulates through your body, it eventually needs fresh oxygen from the air. When the blood reaches the lungs, part of the respiratory system, the blood is re-oxygenated.

Brain – It thinks and tells the body what to do, even when you are dreaming!

Heart – This is a strong muscle that pumps the blood through our bodies, delivering oxygen.

Lungs – Fill up with clean air when we breathe in (inhale), and give our bodies oxygen through our blood. They also release the used Carbon dioxide from our blood back into the air.

The esophagus – The esophagus is a tube that transports the food we eat down to the stomach

The stomach- the stomach holds the food and begins breaking it up into a liquid so that the nutrients can be absorbed and used by our bodies for energy.

The liver – Cleans our blood and stores vitamins

The small and large intestines – these organs work together to take all the vitamins and minerals out of the food as it travels through the. They also push out wastes that our body can't use.

The kidneys – Help clean out our blood, and remove waste that would make us sick and send it out of our bodies through the bladder.

Tips for this station: Keep it simple! Many kids know the basics but the liver, kidneys and intestines may be new to them. You can challenge them by pointing out how systems are connected.

Play To Your Strength

Passport Question: Give two reasons why it's important to exercise
1._____ 2. _____.

Passport Answer: It strengthens muscle, strengthens joints, strengthens bones, prevents injury, prolongs endurance, boost happiness, improves heart health and overall muscle health.

Materials:

- Fat and Muscle 5 pound models
- Two scales
- Timers
- Muscle wall posters
- Mirror
- Interactions of muscle and bone kit

Background:

Did you know you have more than 600 muscles in your body? They do everything from pumping blood throughout your body to helping you lift your heavy backpack. You control some of your muscles, while others — like your heart — do their jobs without you thinking about them at all.

Muscles are all made of the same material, a type of elastic tissue (sort of like the material in a rubber band). Thousands or even tens of thousands, of small fibers make up each muscle. You have three different types of muscles in your body: smooth muscle, cardiac muscle, and skeletal muscle.

Procedure:

1. Ask the students to show you some of their muscles – most of the time you will probably get arm flexes. You can then explain how we have three different kinds of muscle, and tell them a little about each kind using visual aid.

2. The tests at this station are going to focus on skeletal muscles, the ones we can control. Muscle strength is built through exercise. Ask the students why they think it is important to have strong muscles and to exercise. Share with them the reasons from the passport answer above.

3. So where do we have skeletal muscles? The first place to look is in your face. There are 43 muscles in your face, but not everyone can use them the same. You can check them out in the mirror. Facial muscles don't all attach directly to bone like they do in

the rest of the body. Instead, many of them attach under the skin. This allows you to contract your facial muscles just a tiny bit and make dozens of different kinds of faces.

4. Have the kids look in the mirror and make various faces. Have them try raising their eyebrows, wiggling their nose and ears and using their tongues. The tongue is a muscle attached on only one end! Your tongue is actually made of a group of muscles that work together to allow you to talk and help you chew food. Stick out your tongue and wiggle it around to see those muscles at work.

5. Next move on to other fitness tests. The first test the students will do is a wall sit. Show them how to properly do it by sitting with you back against the wall and your knees at a 90 degree angle. You can have them a ready set go and see how long they can hold that position for without moving, falling or standing up. You can have a timer going and give them their times as they fall out of it. Make this a fun competition.

6. The next test they can do is a plank. To properly do a plant, they have to lay down and hold themselves up on their forearms, making sure to keep their butt level, not sticking up in the air, as shown below.

7. Now that you have exercised your skeletal muscles, question the kids about whether or not they think you can exercise the muscles you can control, like your heart? Discuss how exercise actually benefits all of your muscles.

Discussion:

Smooth Muscle

Smooth muscles — sometimes also called involuntary muscles — are usually in sheets with one layer of muscle behind the other. You can't control this type of muscle. Your brain and body tell these muscles what to do without you even thinking about it.

Smooth muscles are at work all over your body. In your stomach and digestive system, they contract (tighten up) and relax to allow food to make its journey through the body. Your smooth muscles come in handy if you're sick and you need to throw up. The muscles push the food back out of the stomach so it comes up through the esophagus and out of the mouth. You'll find smooth muscles at work behind the scenes in your eyes, too. These muscles keep the eyes focused.

Cardiac Muscle

The muscle that makes up the heart is called cardiac muscle. The thick muscles of the heart contract to pump blood out and then relax to let blood back in after it has circulated through the body. Just like smooth muscle, cardiac muscle works all by itself with no help from you. A special group of cells within the heart are known as the pacemaker of the heart because it controls the heartbeat. How Do

Can We Exercise Smooth or Involuntary Muscle?

We know how we can exercise the muscles we have control over, but how do we exercise smooth muscle, or those muscles that work automatically without us ever thinking about it? Because there is no conscious control when it comes to involuntary muscle:

- direct exercise of these tissues is not possible
- it is very important to keep these tissues healthy and working properly.

As always, healthy nutrition including good foods and herbals, reducing stress, keeping the nerves freed up and healthy, and general exercise of the voluntary muscles that we can control, can help us exercise the smooth muscles of our body.

For example:

Cardiovascular exercise, which is conscious, will not only help the overall wellbeing and integrity of the voluntary muscles of the body, but it will also help the involuntary muscles of

the heart and blood vessels. This is why we are concerned about doing our cardio exercises and keeping that heart pumping blood through the blood vessels. With proper exercise, the cardiovascular system becomes not only healthier, but also more efficient.

This means that it is more capable of delivering the increased needed nutrients and oxygen to every cell of the body when increased demands are made. It also removes metabolic wastes from those same cells. All of this equates with developing a stronger and more efficient cardiovascular system, both voluntary and involuntary.

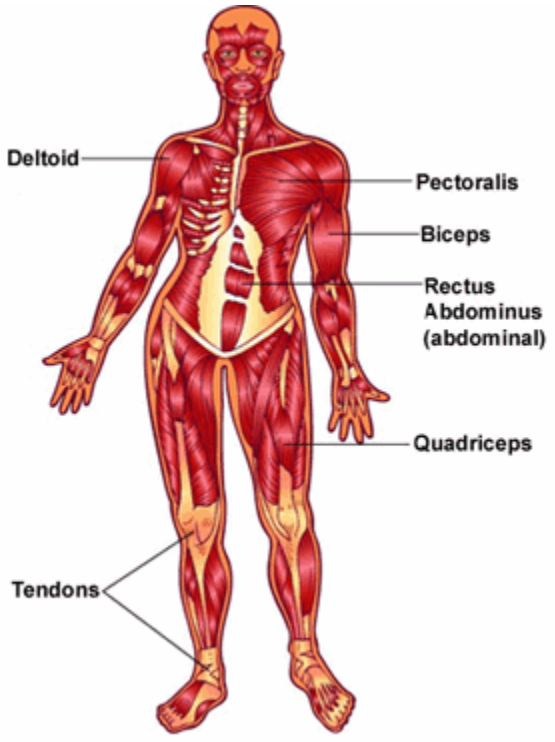
The same type of analogies can be applied to other areas of the body which have involuntary smooth muscle, such as:

- the digestive system
- the reproductive system
- the skin
- the internal organs
- even the muscles of the iris in the eye

All are benefited by conscious voluntary types of exercise, by proper nutrition, by eliminating things that harm and weaken the body such as smoking, alcohol, and drugs, and by doing all of the other things that make our bodies healthy. Basically, this means that when we exercise it not only makes us look good and feel good, but it also strengthens all of our muscles, whether they are voluntary - the ones that we can make move, or smooth muscles, the involuntary ones.

Skeletal Muscle

The kind of muscle you think of when we say "muscle", the ones that show how strong you are.



Skeletal muscles are voluntary muscles, which means you can control what they do. Your leg won't bend to kick a soccer ball unless you want it to. These muscles help to make up the musculoskeletal system — the combination of your muscles and your skeleton, or bones.

Together, the skeletal muscles work with your bones to give your body power and strength. In most cases, a skeletal muscle is attached to one end of a bone. It stretches all the way across a joint (the place where two bones

meet) and then attaches again to another bone.

Skeletal muscles are held to the bones with the help of tendons. Tendons are cords made of tough tissue, and they work as special connector pieces between bone and muscle. The tendons are attached so well that when you contract one of your muscles, the tendon and bone move along with it.

Skeletal muscles come in many different sizes and shapes to allow them to do many types of jobs. Some of your biggest and most powerful muscles are in your back, near your spine. These muscles help keep you upright and standing tall.

A Bone of Your Own

Passport Question: Your _____ is based on posture and the movement of your skeleton.

Passport Answer: Balance

Materials:

- Skeleton model
- Plumb Line
- Bean bags
- Skeleton wall poster
- X-rays

Background:

Every single person has a skeleton made up of many bones. These bones give your body structure, let you move in many ways, protect your internal organs, and more.

A baby's body has about 300 bones at birth. These eventually fuse (grow together) to form the 206 bones that adults have. Some of a baby's bones are made entirely of a special material called cartilage, some are partially made of cartilage. This cartilage is soft and flexible. During childhood, as you are growing, the cartilage grows and is slowly replaced by bone, with help from calcium.

By the time you are about 25, this process will be complete. After this happens there can be no more growth — the bones are as big as they will ever be. All of these bones make up a skeleton that is both very strong and very light.

Your Skeleton and Posture

Posture is the position in which you hold your body and limbs when standing, sitting or lying down. To have good posture means that you need to be aware of always holding yourself in a way that puts the least strain on your back, whatever you are doing.

Having good posture means that:

- your bones and joints are in line so that muscles can be used properly
- your spine has its three normal curves
- ligaments holding the spine together are not being stressed
- you don't get tired as quickly
- you don't get pain in your back or other muscles
- You look good!

To have good posture, you will need:

- Strong, flexible muscles, especially each side of the spine
- Well balanced muscles, not overdeveloped on one side
- To be able to move freely
- To be aware of your posture and work to improve it

Regular exercise like running, walking, cycling and playing different sports will help to keep your back strong.

Procedure:

1) See how many bones the students can name in their body, if they know any facts about their bones, and take them to the x-rays and skeleton poster to check them out.
2) Have students use the plumb line to check their posture. Their shoulders, hips, and ankles should all be in a straight line. Tell them the reasons why it's good to have good posture, highlighting that you look good, and confident.
3) Next try the balance tests. Have them stand on one foot. Then in that position close their eyes. Then try and lower yourself down toward the ground in a 'squat' position on one leg with their eyes closed.
4) Have them try to go from sitting down cross-legged, to standing up straight while balancing a bean bag or small stuffed animal on their heads.
5) Next test their ability to walk from one line, around a designated spot, back across that line with a bean bag or small stuffed animal on their heads.
6) Discuss the relationship between posture and balance; ask them why the think it's important to have good posture and balance. Do they know what posture is and why it's important? What can they do to take care of their bones and maintain good posture?

Discussion:

Thinking about good posture and being careful to look after your spine will help you to have a strong healthy back. In the 'olden days', girls were made to practice walking around balancing books on their heads to improve their posture. You don't need to do that, but you may want to try it out to see how straight and tall you can stand and how good your balance is.

Your bones help you out every day so make sure you take care of them. Here are some tips:

Protect those skull bones (and your brain inside!) by wearing a helmet for bike riding and other sports. When you use a skateboard, in-line skates, or a scooter, and be sure to add wrist supports and elbow and knee pads. Your bones in these places will thank you if you have a fall!

Strengthen your skeleton by drinking milk and eating other dairy products (like low-fat cheese or frozen yogurt). They all contain calcium, which helps bones harden and become strong.

Be active! Another way to strengthen your bones is through exercise like running, jumping, dancing, and playing sports.

*Important concept: When your bones and joints are aligned so that you can use your muscles properly, that is called having good posture!

Don’t Hold Your Breath

Passport Question: Your lungs transport _____ from the air into your lungs, and the _____ from your lungs into the air.

Passport Answer: oxygen, carbon dioxide

Materials:

- Lung model
- Health lung
- Smokers lung
- Posters
- Ruler & pen hand outs (Wed. Public session)
- Phlegm jar
- Tar jar
- Foot pump

Background:

Your lungs are in your chest, and they are so large that they take up most of the space in there. You have two lungs, but they aren't the same size the way your eyes or nostrils are. Instead, the lung on the left side of your body is a bit smaller than the lung on the right. This extra space on the left leaves room for your heart.

Your lungs are protected by your rib cage, which is made up of 12 sets of ribs. These ribs are connected to your spine in your back and go around your lungs to keep them safe. Beneath the lungs is the diaphragm, a dome-shaped muscle that works with your lungs to allow you to inhale (breathe in) and exhale (breathe out) air.

Procedure:

1. Show the students how the lung model works. Gently push and pull the handle of the diaphragm to move the “muscle” in and out of the bottle. What do you notice happening to the balloon lung?
2. Let the students try, see if they can say what each part of the model represents
3. Show the students the healthy and unhealthy lung models. The models can be blown up by attaching the foot pump to the white tube that is holding up the lungs. Both lungs can be inflated.
4. Discuss the effects of cigarette smoke on lungs, and how you can keep your lungs healthy! Show them the tar jar, and the phlegm jar and discuss the health problems brought on by smoking - COPD, emphysema and lung cancer

5. Talk to the students about the different functions of their lungs.

Discussion:

Lung model

The rubber/ latex sheet represents your diaphragm, the large muscle that sits below your lungs. When you pulled the sheet (diaphragm) outside the structure, you increased the space inside the plastic structure. This lowered the density of air molecules and reduced the pressure inside the structure. Air from the outside rushed into the balloon to keep the volume of air inside the bottle the same.

When you pushed the diaphragm inside the structure, you decreased the space inside the structure. This increased the density of air molecules and increased the pressure inside the structure. Air inside the balloon rushed out of the balloon.

Our lungs function the same way, but our lungs are not empty sacs like the balloon. They are like a sponge, with tiny holes and tubes.

Healthy/ Unhealthy lung talking points:

- The lungs are both pig lungs, but the size of an average 180 pound male
- The smokers lung has been dyed by an artist in collaboration with a doctor – they have been made to match a man's lungs who had lung cancer, emphysema and COPD
- There is a large tumor in the unhealthy lung, and you can see that the lobe below the tumor no longer inflates

Lung Health

Lungs allow you to breathe, talk to your friends, shout at a game, sing, laugh, cry, and more! Your lungs even work with your brain to help you inhale and exhale a larger amount of air at a more rapid rate when you're running — all without you even thinking about it once.

Keeping your lungs looking and feeling healthy is a smart idea, and the best way to keep your lungs pink and healthy is not to smoke. Smoking isn't good for any part of your body, and your lungs especially hate it. Cigarette smoke damages the cilia in the trachea so they can no longer move to keep dirt and other substances out of the lungs. Your alveoli get hurt too, because the chemicals in cigarette smoke can cause the walls of the delicate alveoli to break down, making it much harder to breathe.

Finally, cigarette smoke can damage the cells of the lungs so much that the healthy cells go away, only to be replaced by cancer cells. Lungs are normally tough and strong, but when it comes to cigarettes, they can be hurt easily — and it's often very difficult or impossible to make them better. If you need to work with chemicals in an art or shop class, be sure to wear a protective mask to keep chemical fumes from entering your lungs.

You can also show your love for your lungs by exercising! Exercise is good for every part of your body, and especially for your lungs and heart. When you take part in vigorous exercise (like biking, running, or swimming, for example), your lungs require more air to give your cells the extra oxygen they need. As you breathe more deeply and take in more air, your lungs become stronger and better at supplying your body with the air it needs to succeed.

Your Amazing Heart

Passport Question: Your heart is a muscle that pumps _____ and circulates it around your body through the circulatory system.

Passport Answer: Blood

Materials:

- Pumping heart model (2)
- Valve heart model
- Stethoscopes (2)
- Finger pulse oximeters (2)
- Wall chart
- Sticky notes
- Pens/ markers

Background:

Your heart is a muscle, sort of like a pump. The heart muscle is special because it sends blood around your body. The right side of your heart receives blood from the body and pumps it to the lungs. The left side of the heart does the exact opposite: It receives blood from the lungs and pumps it out to the body. The blood provides your body with the oxygen and nutrients it needs, and also carries away waste.

Procedure:

1) The first thing to show kids is where their heart is in their body, by putting your hand over your heart like they do when they say the pledge of allegiance.
2) How big is your heart? Make a fist, which is the approximate size of your heart. Is it bigger or smaller than your classmates?
3) What do you know about your heart? It pumps blood around your body which circulates oxygen. It is also a muscle.
4) Show the students how to take their pulse using their fingers. You can feel a small beat under your skin. Each beat is caused by the contraction (squeezing) of your heart. Two good places to find it are on the side of your neck and the inside of your wrist, just below the thumb.
5) Use a watch or timer and count how many beats you feel in 15 seconds, then multiply by 4 to find beats per minute. Check the conversion chart to go from 15 seconds to a minute. Check the other chart for average resting heart rate for their age group. When you are resting, you will probably feel between 60 and 100 beats per minute.

6) Students can then use the stethoscopes to listen to each other's heartbeat. Tell them that they are hearing their resting heart rate.
7) Optional: Using the heart models, explain what they are feeling/ hearing when they are taking their pulse or listening to a stethoscope. When the heart contracts, it squeezes — try squeezing your hand into a fist. That's sort of like what your heart does so it can squirt out the blood.
8) Next have the students do 30 jumping jacks in place. Have them take their pulse again for 15 seconds, and multiply by 4 to find a minute. Ask them why they think their heart beats faster when they're doing exercise? Their heart is trying to supply more oxygen to their body to keep up with exercise.
9) The students can take turns using the pulse oximeter to find out how accurate they were when taking their pulse. They can also see how much oxygen is in their blood, and talk about how their blood circulates oxygen and carbon dioxide to and from their lungs.

Discussion:

The movement of the blood through the heart and around the body is called circulation, and it takes less than 60 seconds to pump blood to every cell in your body. Your body needs this steady supply of blood to keep it working right. Blood delivers oxygen to all the body's cells. To stay alive, a person needs healthy, living cells. Without oxygen, these cells would die.

The left side of your heart sends that oxygen-rich blood out to the body. The body takes the oxygen out of the blood and uses it in your body's cells. When the cells use the oxygen, they make carbon dioxide and other stuff that gets carried away by the blood.

The returning blood enters the right side of the heart. The right ventricle pumps the blood to the lungs for a little freshening up. In the lungs, carbon dioxide is removed from the blood and sent out of the body when we exhale. What's next? An inhale, of course, and a fresh breath of oxygen that can enter the blood to start the process again. And remember, it all happens in about a minute!

Keep Your Heart Happy!

Most kids are born with a healthy heart and it's important to keep yours in good shape. Here are some things that you can do to help keep your heart happy:

Remember that your heart is a muscle. If you want it to be strong, you need to exercise it by being active in a way that gets you huffing and puffing, like jumping rope, dancing, or playing basketball. Try to be active every day for at least 30 minutes! An hour would be even better for your heart!

Eat a variety of healthy foods and avoid foods high in unhealthy fats, such as saturated fats and trans fats (reading the labels on foods can help you figure out if your favorite snacks contain these unhealthy ingredients).

- Try to eat at least five servings of fruits and vegetables each day.
- Avoid sugary soft drinks and fruit drinks.
- Don't smoke. It can damage the heart and blood vessels.

Germy Transfer

Passport Question: Germs are tiny living organisms that spread disease and make you sick. Name one or more ways you can prevent the spread of germs.

Passport Answer: Washing hands, covering your mouth when you cough or sneeze, getting vaccinated, not touching your T-Zone

Materials:

- Glo powder
- Tennis balls/ hacky sack
- Black lights (2)
- Extra AAA batteries
- Glo Box (2)
- Sink
- Hand soap
- Towels

Background:

Germs are tiny organisms, or living things, that can cause disease. Germs are so small and sneaky that they creep into our bodies without being noticed. In fact, germs are so tiny that you need to use a microscope to see them. When they get in our bodies, we don't know what hit us until we have symptoms that say we've been attacked!

Once germs invade our bodies, they snuggle in for a long stay. They gobble up nutrients and energy, and can produce toxins, which are proteins that are actually like poisons. Those toxins can cause symptoms of common infections, like fevers, sniffles, rashes, coughing, vomiting, and diarrhea.

How do doctors figure out what germs are doing? They take a closer look. By looking at samples of blood, urine, and other fluids under a microscope or sending these samples to a laboratory for more tests, doctors can tell which germs are living in your body and how they are making you sick.

Procedure:

1) Add a very small amount of Glo Powder to the hacky sack
2) Invite the group of students to gently play catch with you with the hacky sack
3) Ask the students while you are passing what they know about germs; what are they? What do they do? How do you get them?
4) After a few minutes of discussion, end the game of catch and discuss how passing the ball could spread germs.

5) Gather them around the glow box and have them put their hands inside the box. When you turn the light on, they will see the "germs" on their hands.
6) Have the students wash their hands, and re-do the black light test, so they can see how properly washing hands prevents the spread of germs.
7) Discuss ways to prevent the spread of germs. How well did the students so to remove all the "germs"? Should they wash again?

Discussion:

Explain to the students that any glow on the hands indicates a positive result for the "germ," or in this case "cold virus." If they had been coughed on or shaken hands with a person who really did have a cold, they could have been exposed to the cold virus and could get sick.

Most germs are spread through the air in sneezes, coughs, or even breaths. Germs can also spread in sweat, saliva, and blood. Some pass from person to person by touching something that is contaminated, like shaking hands with someone who has a cold and then touching your own nose.

Steering clear of the things that can spread germs is the best way to protect yourself. And that means… Hand washing! Remember the two words germs fear — soap and water. Washing your hands well and often is the best way to beat these tiny warriors. Wash your hands every time you cough or sneeze, before you eat or prepare foods, after you use the bathroom, after you touch animals and pets, after you play outside, and after you visit a sick relative or friend.

There is a right way to wash your hands. Use warm water and soap and rub your hands together for at least 20 seconds, which is about how long it takes to sing the "A, B, C's."

Cover your nose and mouth when you sneeze and cover your mouth when you cough to keep from spreading germs. So if you have to cough, it is best to do it in your elbow so you are not contaminating your hands.

Using tissues for your sneezes and sniffles is another great weapon against germs. But don't just throw tissues on the floor to pick up later. Toss them in the trash and, again, wash your hands!

Another way to fight and prevent infections is to make sure you get all the routine immunizations from your doctor. No one likes to get shots but these help keep your immune system strong and prepared to battle germs. You can also keep your immune system strong and healthy by eating well, exercising regularly, and getting good sleep. All this will help you to be prepared to fight germs that cause illness.

Now that you know the facts about germs, you may still pick up a cough or a cold once in a while, but you'll be ready to keep most of those invading germs from moving in.

What Types of Germs Are There?

Germs are found all over the world, in all kinds of places. The four major types of germs are: bacteria, viruses, fungi, and protozoa. They can invade plants, animals, and people, and sometimes they make us sick.

Bacteria are tiny, one-celled creatures that get nutrients from their environments in order to live. In some cases that environment is a human body. Bacteria can reproduce outside of the body or within the body as they cause infections. Some infections bacteria cause include sore throats (tonsillitis or strep throat), ear infections, cavities, and pneumonia.

But not all bacteria are bad. Some bacteria are good for our bodies — they help keep things in balance. Good bacteria live in our intestines and help us use the nutrients in the food we eat and make waste from what's left over. We couldn't make the most of a healthy meal without these important helper germs! Some bacteria are also used by scientists in labs to produce medicines and vaccines.

Viruses need to be inside living cells to grow and reproduce. Most viruses can't survive very long if they're not inside a living thing like a plant, animal, or person. Whatever a virus lives in is called its host. When viruses get inside people's bodies, they can spread and make people sick. Viruses cause chickenpox, measles, flu, and many other diseases. Because some viruses can live for a while on something like a doorknob or countertop, be sure to wash your hands regularly!

Fungi are multi-celled (made of many cells), plant-like organisms. Unlike other plants, fungi cannot make their own food from soil, water, and air. Instead, fungi get their nutrition from plants, people, and animals. They love to live in damp, warm places, and many fungi are not dangerous in healthy people. An example of something caused by fungi is athlete's foot, that itchy rash that teens and adults sometimes get between their toes.

Protozoa are one-cell organisms that love moisture and often spread diseases through water. Some protozoa cause intestinal infections that lead to diarrhea, nausea, and belly pain.

Re-Think Your Drink

Passport Question: If you are between the ages of 9 - 19, you should be getting no more than _____ teaspoons of added sugar a day.

Passport Answer: between 5-8 teaspoons; or 25 – 50 grams

Materials:

- Soda making kit
- Worksheets with exhibit A, B and C drinks
- Pre-assembled bags of sugar
- Empty drink bottles
- Pre-filled drink bottles
- Various other food and condiments
- Types of added sugar containers

Background:

Children do need to consume a small amount of sugar each day because it's an important source of energy. The problem is that many children consume far too much added sugar, which is the least nutritious and doesn't supply any of the nutrients that growing children need. Natural sugars found in fruits, vegetables, and grains are the best option, since those foods also contain vitamins and nutrients. Too much 'added sugar' in your diet can be harmful.

Procedure:

1) Split the students in two groups. Have them compare exhibits A, B, and C. What do they think each drink is? Which had the most sugar? Which as the most vitamin C?
2) Now that the students have an idea of how to read labels, have them try and arrange the food and drinks in order from least to most sugar. They can do this by lining the item up behind the corresponding tower of sugar cubes, which will be aligned from least to greatest.
3) Once they have matched each item, let them know if they are right or wrong by matching the numbers on the towers to each label. Discuss with the kids what they are looking at, what added sugar is, and the maximum amount of sugar they should consume in a day.
4) See what items matched as having the same amount of sugar. How much sugar would you get if you ate both in the same day? Does one item seem okay to have in a day and one not okay?

5) Discuss the relationship between added sugar and natural sugar. What does added sugar look like, and what do natural sugars looks like?
6) Why are natural sugars better than added sugar? This is the most important lesson for them to hear. See the discussion below.

Optional: "Make Your Own Soda"

In the empty bottle mix

1) 2 cups of water
2) 6 tablespoons of sugar
3) 3 drops of yellow food coloring
4) 1 drop of red food coloring
5) Mix together!

Regular soda has carbonated water so the ingredients don't separate. Other than that soda is just color, water and sugar!

Discussion:

Daily Recommendations

The average 1- to 3-year-old consumes about 12 teaspoons of sugar each day, and the average 4- to 8-year-old takes in 21 teaspoons, according to the American Heart Association. And the numbers don't get better for tweens and teens -- kids between the ages of 9 and 19. Boys in this age group average between 29 and 34 grams of sugar a day, and girls in the same age group average between 23 and 25 grams, according to the journal "Circulation." These numbers exceed the recommended sugar limits for children by a significant amount. The actual limit of sugar for children is 3 to 4 teaspoons during the preschool and early elementary years, and between 5 and 8 teaspoons during the tween and teen years.

Sizing Up Sugar

Foods that are high in added sugar (soda, cookies, cake, candy, frozen desserts, and some fruit drinks) tend to also be high in calories and low in other valuable nutrients. As a result, a high-sugar diet is often linked with obesity. Eating too many sugary foods also can lead to tooth decay.

The key to keeping sugar consumption in check is moderation. Added sugar can enhance the taste of some foods, and a little sugar, particularly if it's in a food that provides other important nutrients, such as cereal or yogurt. Instead of serving foods that are low in

nutrients and high in added sugar, offer healthier choices, such as fruit — a naturally sweet carbohydrate-containing snack that also provides fiber and vitamins that kids need.

Instead of soda or juice drinks (which often contain as much added sugar as soft drinks), serve low-fat milk, water, or 100% fruit juice. A note: Although there's no added sugar in 100% fruit juice, the calories from those natural sugars can add up. So limit juice intake to 4-6 ounces for kids less than 7 years old and to no more than 8-12 ounces for older kids and teens.

Sugar and Health

Though small doses of sugar do provide children with energy, it's important to provide nutritious sources of sugar. The sugars found in fruits, vegetables and dairy foods are natural, which means they should have a prominent spot in your healthy eating plan. What's dangerous to children's health is added sugar, which is found in desserts, soda and baked goods, according to MayoClinic.com. White bread, white pasta and even condiments such as ketchup and barbecue sauce also contain added sugar. Too much added sugar can cause unhealthy weight gain, and it also makes you more susceptible to tooth decay.

High sugar intake over your lifespan can lead to harmful diseases such as diabetes and heart disease. These diseases result from damaging your internal organs because they are not able to process the amount of sugar in some people's diets. Learning more, exercising and watching what you eat can lower your risk for getting these diseases!