Biodiversity

Grades: 5-8

Indiana Science Standards:

6.1.1 : Explain that some scientific knowledge, such as the length of the year, is very old and yet is still applicable today. Understand, however, that scientific knowledge is never exempt from review and criticism.

6.4.1 Explain that one of the most general distinctions among organisms is between green plants, which use sunlight to make their own food, and animals, which consume energy-rich foods.

6.4.2 Give examples of organisms that cannot be neatly classified as either plants or animals, such as fungi and bacteria.

6.4.5 Investigate and explain that all living things are composed of cells whose details are usually visible only through a microscope.

6.4.6 Distinguish the main differences between plant and animal cells, such as the presence of chlorophyll and cell walls in plant cells and their absence in animal cells.

7.1.4 Describe that different explanations can be given for the same evidence, and it is not always possible to tell which one is correct without further inquiry.

7.4.1 Explain that similarities among organisms are found in external and internal anatomical features, including specific characteristics at the cellular level, such as the number of chromosomes*. Understand that these similarities are used to classify organisms since they may be used to infer the degree of relatedness among organisms.

Objectives:

1. Students will be able to define Biodiversity and explain how it operates in their environment.
2. Students will be able to identify the 5 kingdoms of classification and the defining characteristics of each.
3. Students will be able to use a microscope to view organisms and know how to adjust the lenses for better views.
4. Students will be able to use the Nature of Science to help explain why there are differing and changing views in science and why their views may differ from other students.

Materials:

1. Gathering Materials:
   Ziploc bags -gallon and quart/pint size
   clear plastic cups
   glass Petri dishes (1 for each student ~20 total)
2. Viewing/Classification:
   Markers
   construction paper
   forceps (1 per each group ~5 total)

box of gloves
2-3 microscopes

3. Planting materials
   Soil
   Sand
   Cat litter
   Grass and radish seeds
   3 potting trays
4. Video Clips
5. Folders/Notebook paper

Introduction:
We will begin with introductions, first with all of the teachers in the room, and then each of the students. Possible things to include: name, age, grade, school, hobbies, siblings, favorite subject, why you are at Saturday Science, etc.
15-30 mins.

Engage:
"Welcome to Saturday Science. During our six weeks together, we are going to be exploring biodiversity. Does anyone know what Biodiversity means? (Wait for student answers) **Biodiversity is the variation of life forms within a given ecosystem, biome, or for the entire Earth.** Basically, we are going to be taking a look at various forms of diversity in our lives, ranging from the different life forms ecosystem around us to differences among our family members, all the way to the diverse regions around our world. As an introduction to Biodiversity, we're going to watch a video from Bill Nye the Science Guy.
http://www.youtube.com/watch?v=WWN4nM_AmLY

As you can see, Biodiversity isn't just the variation of life forms within a certain area, but how they are connected and mutually benefit from each other.

Explore: Plant Experiment
To begin our exploration, we will pull out the potting trays, soil, sand, and cat litter, and our seeds for planting. Diversity is common throughout every aspect of our lives, including the land where we live. We are going to explore this more in-depth in a few weeks, but we need to begin this experiment today for it to benefit us later. Here we have three different types of "soil" for our plants: potting soil, sand, and cat litter (to simulate clay). Each of these types of soils represents 3 of the many diverse types of soil throughout the Earth. We will be planting a few grass and radish seeds in each type of soil, and then exposing them to the same amount of sunlight as well as the same amount of water. The purpose of this is to examine how well each plant grows in the different types of soil.

Scavenger Hunt.

Now we are going to have a chance to go and discover some of the biodiversity around us. We are going to go out and collect specimens of different organisms. These organisms can be anything that can fit inside of your Ziploc bag or cup. If you see an animal, do NOT try to catch it. Write down in your journal that you are about to receive what the animal looked like (color, structure, what you think it was) and where you saw it. Also, as you collect each specimen, write down the area where you found it, as well as what the surrounding area looked like. Limit yourselves to 3 or 4 leaves (green specimen). There are plenty of leaves around, and quite a few different types, but many of them have the same structure and will look very similar under the microscope. Try to find different flowers or trees that may not have the same structure as leaves.

Each student will be given one Ziploc bag and a clear plastic cup. They will pair up before exiting the classroom and must stay with their partner the entire time we are outside. Rules:

1. All objects must fit inside the Ziploc bag(s).
2. You must stay within the designated area where the group is located.

We will be spending approximately an hour outside gathering specimens for observation later in the day. We will be going to 3-4 or different locations around campus.

Explain: Once we have visited all locations and the students have collected as many specimens as they can during our time outside, we will come back inside and start classifying each of the items that were collected. The students will be given gloves, tweezers, access to the microscopes, Petri dishes, construction paper, and markers. The students will be instructed to carefully observe each item they have collected by looking at each structure closely. Some ideas of things they may want to take note of are color, shape, structure, where the organism was found, how they think the organism gathers food, etc. They will take their construction paper and divide it up however they see fit to classify their organisms.

After taking 15-20 minutes for the students to classify their organisms on their own, we will come back as a class and organize them all on the dry erase board so the students can see how everyone in the class decided to group their organisms. Most will classify their specimen generally the same way. However, there may be some differences in how the organisms were classified. *Why do you think there are differences in the way these organisms were classified?* (allow students to give their answers…elaborate as necessary). Scientists attribute these differences to something called the Nature of Science. The NOS explains how and why the ideas and facts supporting science change and advance over time. Some of the attributes of the NOS that apply right here in our classroom are Social/Cultural context, creativity (interpretations), subjectivity (background knowledge), and empirically based (scientific knowledge based on evidence). Now that you have an understanding of the NOS, I am going to introduce you to some terms that you may have heard us talking about while we were collecting our organisms. These terms have been decided upon by scientists debating through the NOS, and are now used as a means of classification for living organisms. As we go through the PowerPoint, pay special attention to the different kingdoms and how each one differs from the others.

*PowerPoint

*What are some special things you noticed about the Bacteria/Monera? Protists? Plants? Fungi? Animals?

Now that you have learned the differences between each kingdom, flip your construction paper over and re-classify your organisms according to where you think they would fit. Allow the students 10-15 more minutes to re-classify, then reconvene as a class and discuss the results, writing the new classification on the board.

Which characteristics led you to believe this organism was part of this kingdom?
Is this organism related in any ways to other organisms of other kingdoms?
Could this be part of any other kingdom? Why or why not?

Elaborate:

As a further elaboration on the subjects of diversity and classification, we will have the students pull out ¾ of the specimens they have collected. Instead of classifying them as we had before, the students will now come up with their own classification system and group them based on characteristics of their choosing. Some ideas may be color, size, shape, etc. Each student will present their ideas to the class, and will have to explain their choices for classification.

Evaluate: As an evaluation, we will pass out 3-4 pictures to each of the groups, and they will discuss with one another the classification they feel best suits these organisms. We'll pass the pictures around the groups so that all groups can see all pictures. Once each group has seen all of the pictures, we will collect the pictures and discuss as a class the proper classification of each organism. Also, we will collect the classifications they did on the construction paper (in their folders) to determine how well they understand the kingdoms and the diversity between them.

Diversity in Animals

Grades: 5-8

Objectives:

1. The students will be able to locate and identify the main organs in a frog and a starfish.
2. Students will learn and practice proper lab safety procedures.
3. Students will learn the proper procedures for dissecting an animal in the lab.
4. Students will compare the internal organ systems of two different animals and will note the similarities and differences between the two.

Materials:

1. Preserved frogs
2. Preserved starfish
3. Dissection trays
4. Scissors
5. Probes
6. Forceps
7. T-pins
8. Goggles (1 pair for each child)
9. Gloves (1 pair for each child)
10. Aprons (1 for each child)
11. Cleaning/disinfectant spray (Windex)
12. Rubbing alcohol
13. Old newspaper

Engage:

Over the past 4 weeks, we've been studying about numerous kinds of diversity that surround us. What are some of the different kinds of diversity that we've talked about? How does this diversity play a role in our lives? Each and every thing that we have talked about throughout our time in Saturday Science plays an important role in our lives, and is involved daily in our lives. This week, we've finally made it to the point where we are going to talk about the diversity that makes us animals unique. From our earlier discussions, we know that there are a few things that are unique about us. Does anyone remember what any of those are? For further explanation, we are going to let Bill Nye the Science Guy do a little explaining. http://www.youtube.com/watch?v=pqxKyMPqB7g

Explore:

As we begin our exploration of the diversity of animals, we must discuss a few safety precautions that are extremely necessary to keep in mind while in the lab.

1. You must wear all protective gear at all times.
2. The lab animals are for dissecting ONLY—do not remove them from the dissection tray at any time unless you are given direct instruction to do so.
3. The only use for the pins is to pin the cut skin back away from the animals' body.
4. When cutting the skin, cut very gently, slowly, and do not cut deeply; we do not want to damage any of the internal organs.
5. No running with any of the lab instruments in your hands.

Also, we want to mention that each of the animals being dissected here today were raised for the specific scientific purpose of dissection. No wild animals were harmed in the preservation process, and each of the animals were raised with the distinct purpose of being preserved for dissection. It is not ethical to capture wild animals to dissect, as they each serve a purpose in the wild.

Starfish Dissection

(Aboral Surface):

1. Obtain a preserved starfish and rinse off any preservative with water.
2. Place the starfish in the dissecting pan with its dorsal or aboral (top) surface upward.
3. Observe the starfish and determine its symmetry.
4. Locate the central disc in the center of the starfish. Count and record the number of arms or rays the starfish has.
5. Locate the small, round hard plate called the madreporite on top of the central disc. Water enters through this into the water vascular system. Label the central disc, arms, and madreporite on Figure 1.
6. Feel the upper surface of the starfish for spines. These spines protect the starfish and are part of their internal skeleton. Label these on figure 1.
7. Look at the tip of each arm and find the eyespot. Label this on Figure 1.

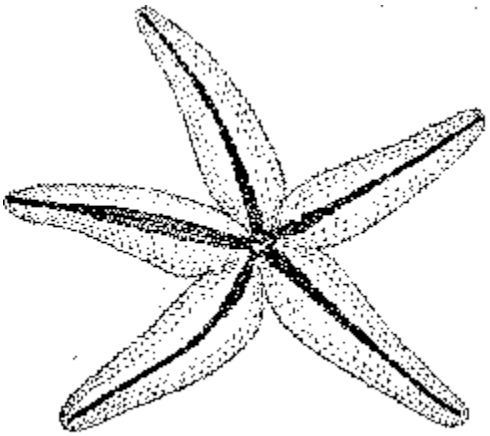
Figure 1 -Aboral Surface

Procedure (Oral Surface):

7. Turn the starfish over to its ventral or oral surface (underside).

8. Locate the mouth in the center of the central disc. Find the ring of oral spines surrounding the mouth. Label these on figure 2.
9. Find the groove that extends down the underside of each arm. This is called the ambulacral groove. Label this on figure 2.
10. Feel the numerous, soft tube feet inside each groove. these are part of the water vascular system & aid in movement and feeding. Label these on Figure 2.

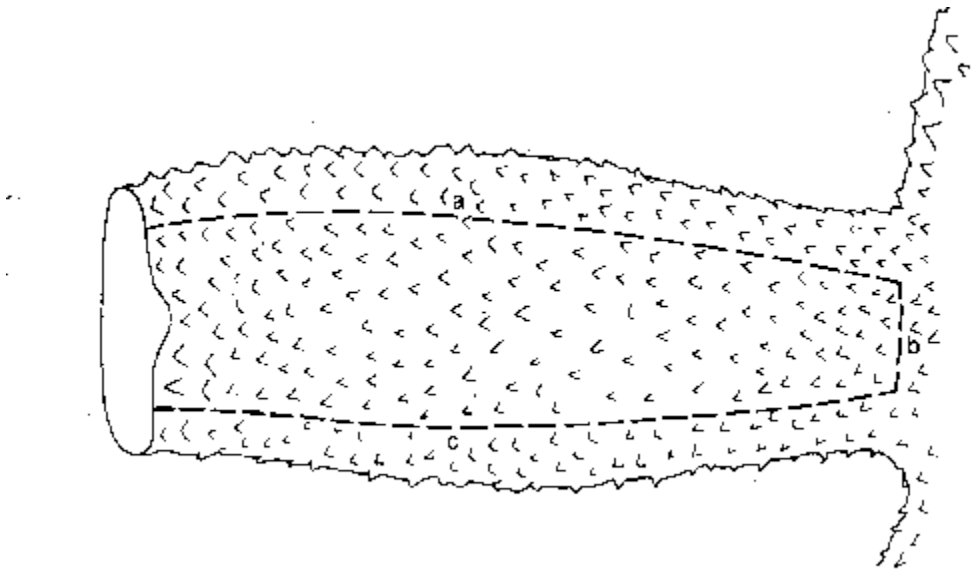
Figure 2 - Oral Surface



Procedure (Internal anatomy):

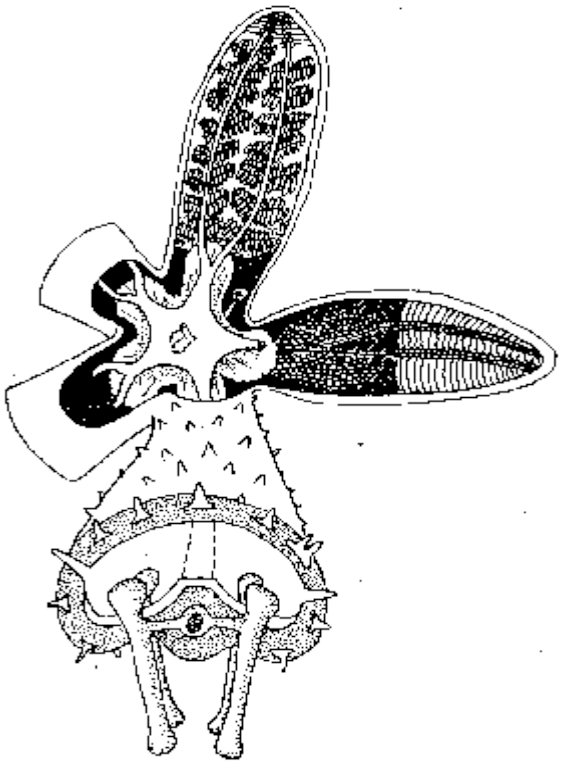
11. With the starfish's aboral surface facing you, cut off the tip of a ray. Cut along lines a, b, and c (Figure 3) and then remove this flap of skin.

Figure 3 - Cuts in Arm



12. Inside each arm, locate two long digestive glands called the pyloric caeca. These make enzymes to digest food in the stomach. Label these in Figure 4.
13. Cut a circular flap of skin from the central disc. (You will have to also cut around the madreporite in order to remove this flap.) Observe the stomach under the central disc. Label this on Figure 4.
14. Remove the pyloric caeca from the dissected ray. Find the gonads (testes or ovaries) underneath. These may be small if the starfish is NOT in breeding season. Label these on figure 4. Remove these to see the rest of the water vascular system.
15. Cut off the tip of a ray to observe the parts of the tube feet. Find the zipper-like ridge that extends the length of the ray. The tube feet are attached to these.
16. Locate the bulb-like top of a tube foot called the ampulla. This sac works like the top of an eyedropper to create suction. The bottom of the tube foot is a sucker. Label these in Figure 4.
17. Embedded in the soft body wall are skeletal plates called ossicles. Locate these and label them in Figure 4.

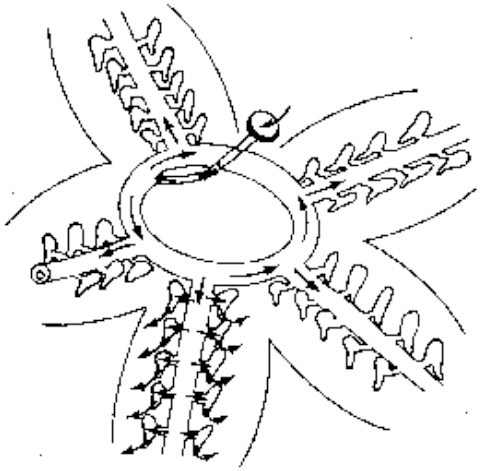
Figure 4 - Starfish Digestive & Reproductive Systems



18. Running down the center of each arm is a lateral canal to which tube feet are attached. Label this in Figure 5.
19. In the central disc the five lateral canals connect to a circular canal called the ring canal. Find this canal & label it on figure 5.
20. A short, canal called the stone canal leads from the ring canal to the madreporite where water enters. Find this canal & label the stone canal & madreporite on Figure 5.

21. Draw an arrow on Figure 5 tracing the path that water takes when it enters & moves through the starfish.

Figure 5 - Water Vascular System



Break:
We will take a 10-15 minute break before we begin the next dissection.

Explain:

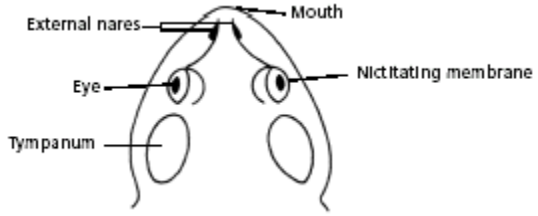
Now we are going to take a look at some of the different systems found in both frogs and starfish. To do this, there are stations set up comparing similar systems in each of the animals' bodies. You may want to jot some notes down as you visit each station, as they may help you in the dissection of the frog.

Elaborate:

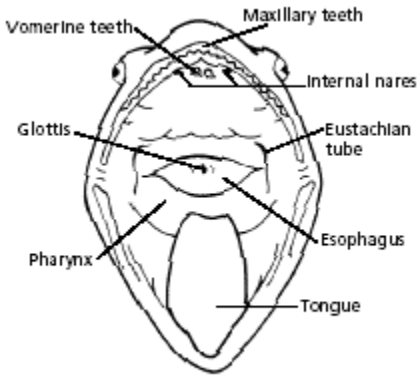
Frog Dissection

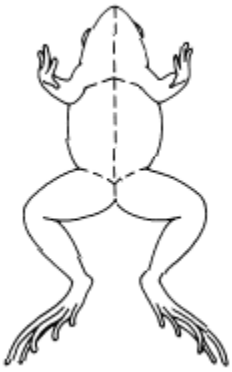
2. Place a frog on a dissection tray. To determine the **frog's sex**, look at the hand digits, or fingers, on its forelegs. A male frog usually has thick pads on its "thumbs," which is one external difference between the sexes, as shown in the diagram below. Male frogs are also usually smaller than female frogs. Observe several frogs to see the difference between males and females.

3. Use the diagram below to locate and identify the external features of the head. Find the **mouth**, **external nares, tympani, eyes, and nictitating membranes.**

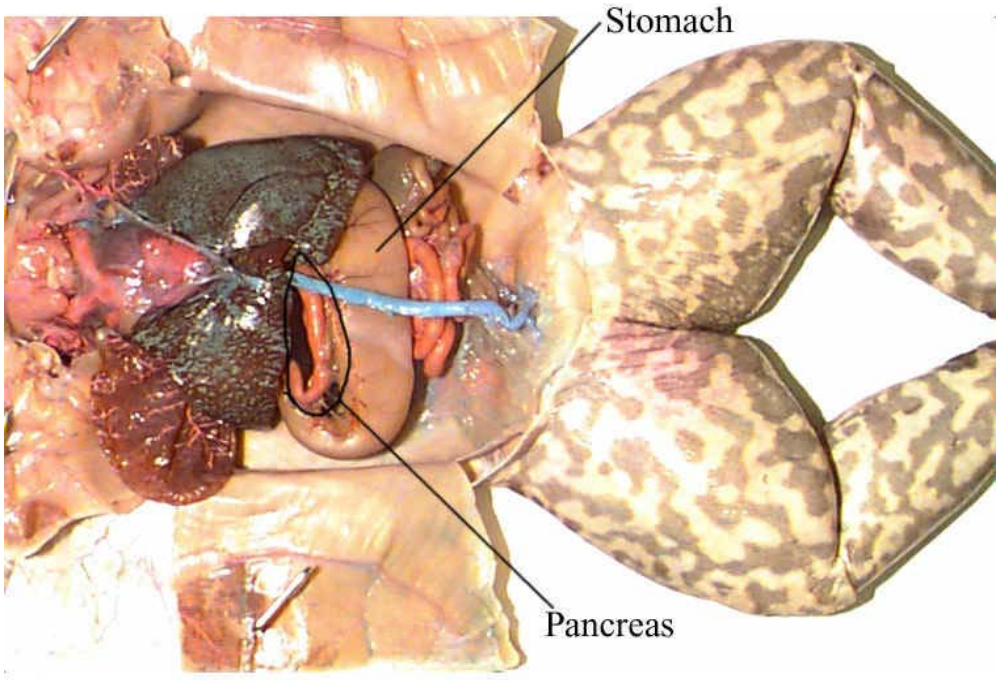


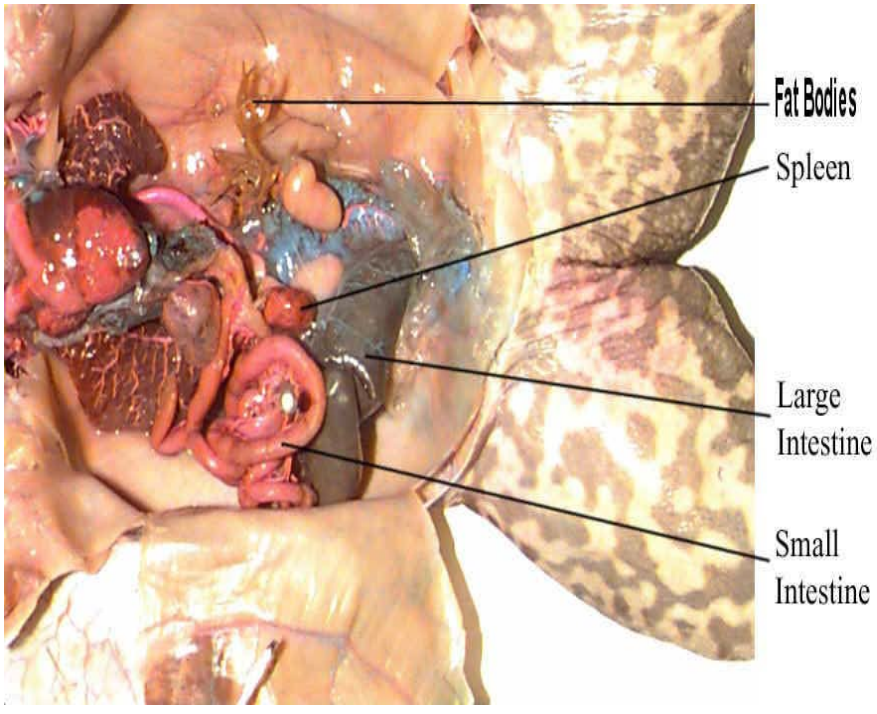
4. Turn the frog on its back and pin down the legs. Cut the hinges of the mouth and open it wide. Use the diagram below to locate and identify the structures inside the mouth. Use a probe to help find each part: the **vomerine teeth**, the **maxillary teeth**, the **internal nares**, the **tongue**, the openings to the **Eustachian tubes**, the **esophagus**, the **pharynx**, and the slit-like **glottis**.

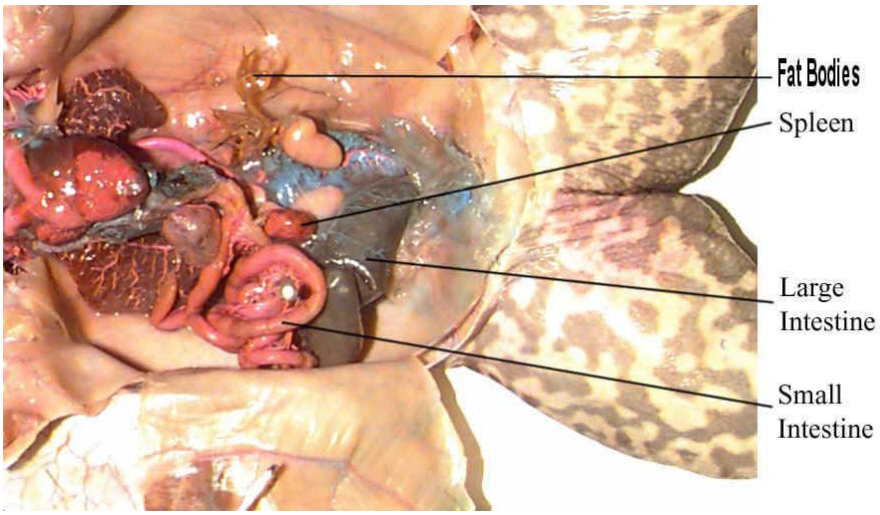



Incisions for Dissection

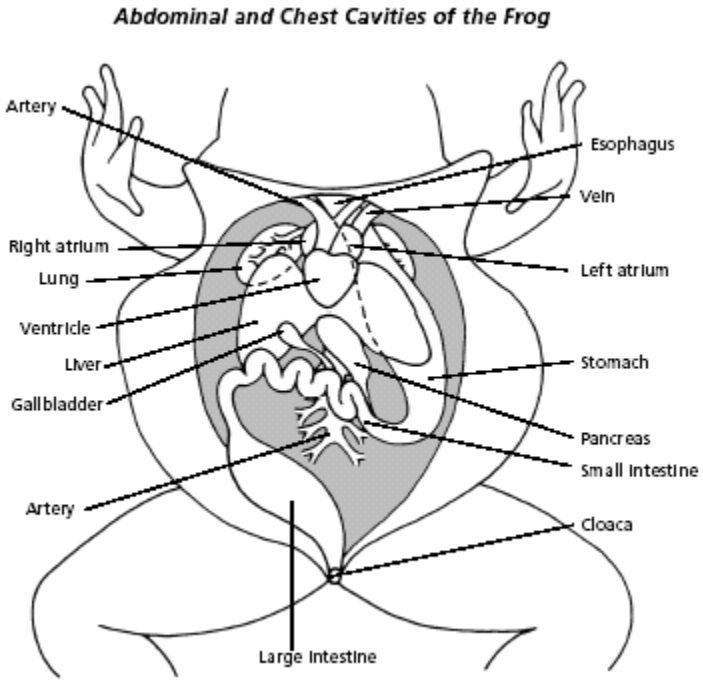
5. Look for the opening to the frog's **cloaca**, located between the hind legs. Use forceps to lift the skin and use scissors to cut along the center of the body from the cloaca to the lip. Turn back the skin, cut toward the side at each leg, and pin the skin flat. The diagram above shows how to make these cuts
6. Lift and cut through the muscles and breast bone to open up the body cavity. If your frog is a female, the abdominal cavity may be filled with **dark-colored eggs**. If so, remove the eggs on one side so you can see the organs underlying them.
7. Use the diagram below to locate and identify the organs of the digestive system: **esophagus, stomach, small intestine, large intestine, cloaca, liver, gallbladder, and pancreas.**


Stomach
Pancreas

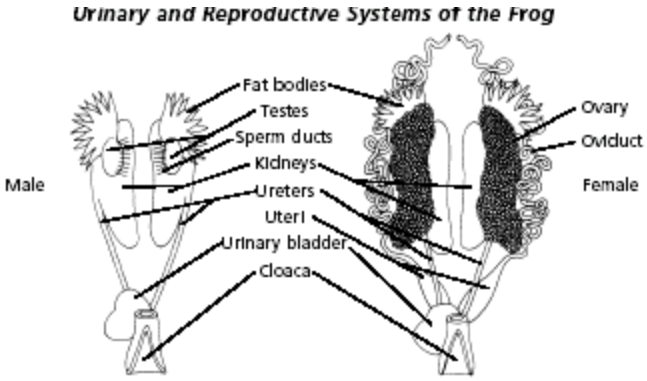

Fat Bodies
Spleen
Large
Intestine
Small
Intestine



8. Again refer to the diagram below to identify the parts of the circulatory and respiratory systems that are in the chest cavity. Find the **left atrium, right atrium, and ventricle** of the heart. Find an **artery** attached to the heart and another artery near the backbone. Find a **vein** near one of the shoulders. Find the **two lungs**.



9. Use a probe and scissors to lift and remove the **intestines** and **liver**. Use the diagram on the next page to identify the parts of the urinary and reproductive systems. Remove the **peritoneal membrane**, which is connective tissue that lies on top of the red kidneys. Observe the yellow **fat bodies** that are attached to the kidneys. Find the **ureters; the urinary bladder; the testes** and **sperm ducts** in the **male;** and the **ovaries, oviducts**, and **uteri** in the **female.**



10. Remove the **kidneys** and look for threadlike **spinal nerves** that extend from the spinal cord. Dissect a thigh, and trace one nerve into a **leg muscle**. Note the size and texture of the leg muscles.

Evaluate:

The students will make a chart in their journals listing the similarities and differences between a frog and a starfish. They will then make inferences as to why they think these differences in characteristics are exhibited.

Resources:

1. "Starfish Dissection" http://www.biologyjunction.com/starfish_dissection2.htm
2. "Frog Dissection" http://www.biologyjunction.com/frog_dissection.htm

Diversity in Evolution

Grades: 5-8

Standards:

6.4.4 Recognize and describe that a species comprises all organisms that can mate with one another to produce fertile offspring.

6.4.9 Recognize and explain that two types of organisms may interact in a competitive or cooperative relationship, such as producer*/consumer*, predator*/prey*, or parasite*/host*.

6.4.11 Describe that human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions.

7.4.2 Describe that all organisms, including the human species*, are part of and depend on two main interconnected global food webs*, the ocean food web and the land food web.

Objectives:

1. Students will find the process of adaptive characteristics becoming more common in a population over many generations is called evolution by natural selection.
2. Students will understand that some traits are passed on because certain characteristics are more desired in a partner than others. This is evolution by sexual selection.
3. Students will understand the defining characteristics of the 5 kingdoms and how their diversity relates to biodiversity.
4. Students will recognize different types of evolution and the effect they have on a population.

Materials:

1. Assorted colors of pipe cleaners (10 each of 4 different colors).
2. 3000 Multicolored paper clips
3. 3 Tablecloths
4. Soil
5. Sand
6. Cat Litter
7. Grass seeds
8. Potting Trays
9. Construction Paper
10. Markers
11. 1 Two liter bottle
12. Assorted colors of beads (100 total)
13. Evolution video: http://www.youtube.com/watch?v=faRlFsYmkeY

14. Moose fighting video: http://www.youtube.com/watch?v=W81UMix0cf8.
15. Before class hide the 40 pipe cleaners in a natural area near campus. Pick an area that has some vegetation but is otherwise open.

Wrap up from last week:

Last week, we talked about Biodiversity and how it is connected all around us. We also talked about the Five Kingdom classification system. Who remembers what the five kingdoms were? (As students name the kingdoms, ask about the different traits of each/significant factor of each)

Bacteria: single-celled, prokaryotic (no nucleus), present everywhere, take in food or can make their own, help recycle nutrients

Protists: Eukaryotic (nucleus), lots of different types, either unicellular or multicellular w/o simple tissues, simple organization

Fungi: mostly multicellular, cell wall, eukaryotic yeasts and molds, as well as the more familiar mushrooms, take in food from other organisms (decompose organic matter), nutrient cyclers, food source

Plants: multi-celled, cell walls, have nucleus, living organisms, most obtain energy through photosynthesis→autotrophic

Animals: multicellualr, have movement/nervous systems, heterotrophic (eat/gather food), cells lack cell walls

Now let's pull out some of our organisms from last week. At the end of class, we were working on classifying each of these organisms based on the characteristics we discussed for each kingdom. Now, we are going to have a chance to make up our own classification system. You can choose whatever characteristics you want, but you must be able to describe and defend you different classifications to me.

Engage:

As we have talked about all of the different kingdoms, you may have noticed that many of them have some characteristics in common. This isn't just a coincidence. All life is related at some point in evolutionary time, which explains why many organisms share similar characteristics. Now we are going to watch a video that shows a rapid development of life, though its accuracy and detail can be questioned.

http://www.youtube.com/watch?v=faRlFsYmkeY

As you may have noticed, Homer transitioned through a very rapid evolution. However, the evolution of life has taken millions and millions of years to get to the point we are at now, and we are still continuing to evolve even now, as we will explore later today.

Explore:

Pipe Cleaner Activity

Begin the game by telling all of the students that they are going to play a fun outdoor game. The rules of the game are:

- They are to find as many of the pipe cleaners as they can. For discussion purposes, the pipe cleaners are to be referred to as "worms".

- It does not matter what color the worms are, they are to find as many as they can.
- They will have 10-15 minutes to find the worms.

Take the students outside to the area that you have chosen and have them search for the worms. There are different ways to do this. One way is to have a strictly timed foot race to the chosen area. If you have defined areas such as boardwalk trails, you can have the students try to find them over a longer period of time.

Explain: After the field exercise collect all of the worms. Make a table with the number of each worm that was collected on the board corresponding to color. What colors or traits were best adapted to surviving? Were the students predators or prey? Why do you think there were some worms that hadn't adapted to their environment yet?

Elaboration: After the data has been collected, give each of the students a piece of construction paper and a marker, and have them construct a bar graph representing the number of worms that were captured of each color.

What percent of the red worms were captured? The blue worms? Yellow? Green?

What percent of each of these survived?

Evaluation: After constructing the graph, the students will analyze their results and make inferences as to which colors had the best rates of survival and why. They will share these with the class and come to a conclusion as to why they have the best rate of survival. After making these conclusions, we will discuss real life examples where animals have adapted to their environment for their survival. Ex: Polar bears white fur, chameleons changing colors, bird beaks, etc.

Paper Clip Activity

1. Spread out onto the tabletop the habitat (tablecloth) given to you by your instructor.
2. Count out 25 paper clips of each of the 4 colors provided for a total of 100 paper clips as your initial population. (If you have fewer than four people in your group, reduce the number of colors used. For example, if you have three people, use 25 paper clips of three different colors only. Record on the data sheet which colors of paper clips you have and how many you have of each color (25).
3. Appoint one person as the prey (paper clip) distributor. That person should spread the paper clips out randomly over the entire fabric, making sure the clips do not stick together (use a sweeping motion to mix and spread the paper clips). The other members of the group should have their backs turned during this procedure so that they cannot see what is happening.
4. The predators (other group members) should then turn around and take turns to pick off paper clips one by one. Keep going until each person has collected 25 paper clips. (When you have finished, 25 paper clips should remain on the tablecloth.) COUNT CAREFULLY.

Predators should quickly take the first paper clip they see and follow each one to the discard area with their eyes so as not to see the remaining paper clips, and should keep track of the number of clips they get. In other words, do not take the time or effort to "study" the placement of paper clips. Move quickly and get the job done!

5. Carefully collect the remaining survivors (the remaining 25 paper clips).
6. Group the survivors according to color. Count and record these numbers on the data sheet provided.

7. Each survivor paper clip will now produce three offspring. Using the extra paper clips given to you, gather up three clips of the same color to go with each of the survivors. Enter the total number of paper clips in this next generation on your data sheet (the number of survivors multiplied by 4; if you started with 100 paper clips at the beginning, have 25 left, and add in three paper clips for each "survivor," you should have 100 paper clips again).
8. Mix these paper clips together and redistribute them onto the tablecloth as in step 3.
9. Repeat the entire process two more times, for a total of three generations of prey being preyed upon.

Exercise 2

In the next set of experiments, each member of the foraging group will obtain a "beak." While foraging, it is important that the forager use only the "beak" to collect food; do not use other parts of your body.
1. Your group will be divided into different species (different beak types). Scatter 100 paper clips (or 75, if there are only three people in your group) across the habitat.
2. When the instructor signals the class, each forager will collect food (paper clips) for 15 seconds. You may use only your "beak" to transport your food. Again, you may pick up only one piece of food at a time, as in the previous exercise.
3. When the instructor signals the end of the 15 seconds, record the amount of food by each beak type in your group in Table 2. You must collect at least five paper clips to survive to the next generation. If you collect fewer than five pieces, you do not survive and must just observe for subsequent generations!
4. Continue taking data until the food source is gone.

Name_____ **Date**_____

Data Sheet

Exercise 1	**Colors**			
Number at start				
# after 1st predation				
# after 1st reproduction				
# after 2nd predation				
# after 2nd reproduction				
# after 3rd predation				
# after 3rd reproduction				

Exercise 2	**# Collected By Each Beak Type**			
	Hands	Garden glove	Forceps	Utensils
Generation 1				
2				
3				
4				
5				
6				
7				
8				
9				

Exercise 1

1. This is a highly concentrated experimental model, compared with what happens in a natural setting. What interactions and/or adaptations were you modeling in this experiment?

2. Discuss the results of your experiment. Compare the original and survivor populations. Was one color of paper clip represented more than others in the first generation of survivors? What, if any, change occurred between the 1st and 2nd, and again between the 2nd and 3rd generation of survivors? Is there any color from the original population that is NOT represented in the survivor population? If so, what color (or colors)?

3. What about the different environments that were used? Do you think these played any role in helping the survival/predation of particular species? What helped/hurt about having this particular habitat?

4. What are some examples you can think of where this happens in the wild?

Exercise 2

1. Obviously, this is a highly contrived experimental model, compared with what happens in a natural setting. What interactions were you modeling in this experiment?

2. Create a line graph with number of generations as your *x*-axis and the number of prey taken as your *y*-axis. You should include results from each beak type in your graph.

3. Summarize the results illustrated in your graph. Which beak(s) appear(s) to be the most successful? Explain the criteria you used to determine success.

4. Biologists define success in terms of *fitness*. Evolutionary fitness is the relative contribution an individual makes to the gene pool of the next generation (i.e., how many offspring they produce). Discuss the potential evolutionary fitness of the different species represented by the various beaks.

Genetic Drift Activity

1. Start with a glass jar with 20 marbles (10 red and 10 blue)
2. Pull out a marble from the glass jar, and place a marble of the same color in jar #2. This is offspring #1 for generation #2. Replace "parent" marble.
3. Repeat until there are 20 marbles in jar #2.
4. Count the number of each color marble in the jar, and write these numbers on the chart on the board.
5. Repeat steps 2-4 using jar #2 as the parents and jar #3 for generation #3.
6. Repeat these steps until you have 5-6 generations, which will provide enough data to make observable inferences.

Genetic drift refers to the random chance involved in the passing of genes in each generation. While evolution occurs through the passing of genes, there is still a random chance involved with each generation, and traits will not always be passed as expected, which is exhibited by the erratic numbers in our data set.

Planting Activity

Continuing with our study of Biodiversity, we are going to do an experiment where we are going to try and grow plants. As you know, there are many different types of soils and plants all around our world. The inhabitants of each of these places have adapted to the climate and land types their surroundings present and have developed methods to cultivate and grow crops that provide them with food useful materials. Now, in your groups, you are going to get the chance to develop your own method to get your crop (grass) to grow in different types of soil. (Allow the students time to work in their groups to plant their seeds in their soil type and allow them time to water and place the plants in an area they think will help the plant grow).

"Explain": What each group has done here is develop their own method for growing and cultivating plants. As you have noticed, this did not take you very long at all. However, to get the method you used today, many people have tried various different ways to grow and cultivate plants, keeping the best practices and ridding themselves of the ways that did not yield as many crops. Their systems **evolved (**changed) as they were passed from generation to generation, until finally reaching the format you may have used today. This evolution is a type of **natural selection**, where the best traits or adaptations are passed on while the not-so-beneficial traits are left behind.

This also ties in to the ecological aspect of biodiversity. Every action that we take has an impact on the environment around us and can impact it for the better or for the worse. That is why we should strive to take better care of our environment, in hopes that we can sustain life around us.

Diversity in Evolution

Grades: 5-8

Standards:

6.4.4 Recognize and describe that a species comprises all organisms that can mate with one another to produce fertile offspring.

6.4.9 Recognize and explain that two types of organisms may interact in a competitive or cooperative relationship, such as producer*/consumer*, predator*/prey*, or parasite*/host*.

6.4.11 Describe that human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions.

7.4.2 Describe that all organisms, including the human species*, are part of and depend on two main interconnected global food webs*, the ocean food web and the land food web.

Objectives:

1. Students will find the process of adaptive characteristics becoming more common in a population over many generations is called evolution by natural selection.
2. Students will understand that some traits are passed on because certain characteristics are more desired in a partner than others. This is evolution by sexual selection.
3. Students will understand the defining characteristics of the 5 kingdoms and how their diversity relates to biodiversity.
4. Students will recognize different types of evolution and the effect they have on a population.

Materials:

1. Assorted colors of pipe cleaners (10 each of 4 different colors).
2. 3000 Multicolored paper clips
3. 3 Tablecloths
4. Soil
5. Sand
6. Cat Litter
7. Grass seeds
8. Potting Trays
9. Construction Paper
10. Markers
11. 1 Two liter bottle
12. Assorted colors of beads (100 total)
13. Evolution video: http://www.youtube.com/watch?v=faRlFsYmkeY

14. Moose fighting video: http://www.youtube.com/watch?v=W81UMix0cf8.
15. Before class hide the 40 pipe cleaners in a natural area near campus. Pick an area that has some vegetation but is otherwise open.

Wrap up from last week:

Last week, we talked about Biodiversity and how it is connected all around us. We also talked about the Five Kingdom classification system. Who remembers what the five kingdoms were? (As students name the kingdoms, ask about the different traits of each/significant factor of each)

Bacteria: single-celled, prokaryotic (no nucleus), present everywhere, take in food or can make their own, help recycle nutrients

Protists: Eukaryotic (nucleus), lots of different types, either unicellular or multicellular w/o simple tissues, simple organization

Fungi: mostly multicellular, cell wall, eukaryotic yeasts and molds, as well as the more familiar mushrooms, take in food from other organisms (decompose organic matter), nutrient cyclers, food source

Plants: multi-celled, cell walls, have nucleus, living organisms, most obtain energy through photosynthesis→autotrophic

Animals: multicellualr, have movement/nervous systems, heterotrophic (eat/gather food), cells lack cell walls

Now let's pull out some of our organisms from last week. At the end of class, we were working on classifying each of these organisms based on the characteristics we discussed for each kingdom. Now, we are going to have a chance to make up our own classification system. You can choose whatever characteristics you want, but you must be able to describe and defend you different classifications to me.

Engage:

As we have talked about all of the different kingdoms, you may have noticed that many of them have some characteristics in common. This isn't just a coincidence. All life is related at some point in evolutionary time, which explains why many organisms share similar characteristics. Now we are going to watch a video that shows a rapid development of life, though its accuracy and detail can be questioned.

http://www.youtube.com/watch?v=faRlFsYmkeY

As you may have noticed, Homer transitioned through a very rapid evolution. However, the evolution of life has taken millions and millions of years to get to the point we are at now, and we are still continuing to evolve even now, as we will explore later today.

Explore:

Pipe Cleaner Activity

Begin the game by telling all of the students that they are going to play a fun outdoor game. The rules of the game are:

- They are to find as many of the pipe cleaners as they can. For discussion purposes, the pipe cleaners are to be referred to as "worms".

- It does not matter what color the worms are, they are to find as many as they can.
- They will have 10-15 minutes to find the worms.

Take the students outside to the area that you have chosen and have them search for the worms. There are different ways to do this. One way is to have a strictly timed foot race to the chosen area. If you have defined areas such as boardwalk trails, you can have the students try to find them over a longer period of time.

Explain: After the field exercise collect all of the worms. Make a table with the number of each worm that was collected on the board corresponding to color. What colors or traits were best adapted to surviving? Were the students predators or prey? Why do you think there were some worms that hadn't adapted to their environment yet?

Elaboration: After the data has been collected, give each of the students a piece of construction paper and a marker, and have them construct a bar graph representing the number of worms that were captured of each color.

What percent of the red worms were captured? The blue worms? Yellow? Green?

What percent of each of these survived?

Evaluation: After constructing the graph, the students will analyze their results and make inferences as to which colors had the best rates of survival and why. They will share these with the class and come to a conclusion as to why they have the best rate of survival. After making these conclusions, we will discuss real life examples where animals have adapted to their environment for their survival. Ex: Polar bears white fur, chameleons changing colors, bird beaks, etc.

Paper Clip Activity

1. Spread out onto the tabletop the habitat (tablecloth) given to you by your instructor.
2. Count out 25 paper clips of each of the 4 colors provided for a total of 100 paper clips as your initial population. (If you have fewer than four people in your group, reduce the number of colors used. For example, if you have three people, use 25 paper clips of three different colors only. Record on the data sheet which colors of paper clips you have and how many you have of each color (25).
3. Appoint one person as the prey (paper clip) distributor. That person should spread the paper clips out randomly over the entire fabric, making sure the clips do not stick together (use a sweeping motion to mix and spread the paper clips). The other members of the group should have their backs turned during this procedure so that they cannot see what is happening.
4. The predators (other group members) should then turn around and take turns to pick off paper clips one by one. Keep going until each person has collected 25 paper clips. (When you have finished, 25 paper clips should remain on the tablecloth.) COUNT CAREFULLY.

Predators should quickly take the first paper clip they see and follow each one to the discard area with their eyes so as not to see the remaining paper clips, and should keep track of the number of clips they get. In other words, do not take the time or effort to "study" the placement of paper clips. Move quickly and get the job done!

5. Carefully collect the remaining survivors (the remaining 25 paper clips).
6. Group the survivors according to color. Count and record these numbers on the data sheet provided.

7. Each survivor paper clip will now produce three offspring. Using the extra paper clips given to you, gather up three clips of the same color to go with each of the survivors. Enter the total number of paper clips in this next generation on your data sheet (the number of survivors multiplied by 4; if you started with 100 paper clips at the beginning, have 25 left, and add in three paper clips for each "survivor," you should have 100 paper clips again).
8. Mix these paper clips together and redistribute them onto the tablecloth as in step 3.
9. Repeat the entire process two more times, for a total of three generations of prey being preyed upon.

Exercise 2

In the next set of experiments, each member of the foraging group will obtain a "beak." While foraging, it is important that the forager use only the "beak" to collect food; do not use other parts of your body.
1. Your group will be divided into different species (different beak types). Scatter 100 paper clips (or 75, if there are only three people in your group) across the habitat.
2. When the instructor signals the class, each forager will collect food (paper clips) for 15 seconds. You may use only your "beak" to transport your food. Again, you may pick up only one piece of food at a time, as in the previous exercise.
3. When the instructor signals the end of the 15 seconds, record the amount of food by each beak type in your group in Table 2. You must collect at least five paper clips to survive to the next generation. If you collect fewer than five pieces, you do not survive and must just observe for subsequent generations!
4. Continue taking data until the food source is gone.

Name_____ **Date**_____

Data Sheet

Exercise 1	**Colors**			
Number at start				
# after 1st predation				
# after 1st reproduction				
# after 2nd predation				
# after 2nd reproduction				
# after 3rd predation				
# after 3rd reproduction				

Exercise 2	**# Collected By Each Beak Type**			
	Hands	Garden glove	Forceps	Utensils
Generation 1				
2				
3				
4				
5				
6				
7				
8				
9				

Exercise 1

1. This is a highly concentrated experimental model, compared with what happens in a natural setting. What interactions and/or adaptations were you modeling in this experiment?

2. Discuss the results of your experiment. Compare the original and survivor populations. Was one color of paper clip represented more than others in the first generation of survivors? What, if any, change occurred between the 1st and 2nd, and again between the 2nd and 3rd generation of survivors? Is there any color from the original population that is NOT represented in the survivor population? If so, what color (or colors)?

3. What about the different environments that were used? Do you think these played any role in helping the survival/predation of particular species? What helped/hurt about having this particular habitat?

4. What are some examples you can think of where this happens in the wild?

Exercise 2

1. Obviously, this is a highly contrived experimental model, compared with what happens in a natural setting. What interactions were you modeling in this experiment?

2. Create a line graph with number of generations as your *x*-axis and the number of prey taken as your *y*-axis. You should include results from each beak type in your graph.

3. Summarize the results illustrated in your graph. Which beak(s) appear(s) to be the most successful? Explain the criteria you used to determine success.

4. Biologists define success in terms of *fitness*. Evolutionary fitness is the relative contribution an individual makes to the gene pool of the next generation (i.e., how many offspring they produce). Discuss the potential evolutionary fitness of the different species represented by the various beaks.

Genetic Drift Activity

1. Start with a glass jar with 20 marbles (10 red and 10 blue)
2. Pull out a marble from the glass jar, and place a marble of the same color in jar #2. This is offspring #1 for generation #2. Replace "parent" marble.
3. Repeat until there are 20 marbles in jar #2.
4. Count the number of each color marble in the jar, and write these numbers on the chart on the board.
5. Repeat steps 2-4 using jar #2 as the parents and jar #3 for generation #3.
6. Repeat these steps until you have 5-6 generations, which will provide enough data to make observable inferences.

Genetic drift refers to the random chance involved in the passing of genes in each generation. While evolution occurs through the passing of genes, there is still a random chance involved with each generation, and traits will not always be passed as expected, which is exhibited by the erratic numbers in our data set.

Planting Activity

Continuing with our study of Biodiversity, we are going to do an experiment where we are going to try and grow plants. As you know, there are many different types of soils and plants all around our world. The inhabitants of each of these places have adapted to the climate and land types their surroundings present and have developed methods to cultivate and grow crops that provide them with food useful materials. Now, in your groups, you are going to get the chance to develop your own method to get your crop (grass) to grow in different types of soil. (Allow the students time to work in their groups to plant their seeds in their soil type and allow them time to water and place the plants in an area they think will help the plant grow).

"Explain": What each group has done here is develop their own method for growing and cultivating plants. As you have noticed, this did not take you very long at all. However, to get the method you used today, many people have tried various different ways to grow and cultivate plants, keeping the best practices and ridding themselves of the ways that did not yield as many crops. Their systems **evolved (**changed) as they were passed from generation to generation, until finally reaching the format you may have used today. This evolution is a type of **natural selection**, where the best traits or adaptations are passed on while the not-so-beneficial traits are left behind.

This also ties in to the ecological aspect of biodiversity. Every action that we take has an impact on the environment around us and can impact it for the better or for the worse. That is why we should strive to take better care of our environment, in hopes that we can sustain life around us.

Diversity in Plants

Grades: 5-8

Objectives:

1. Students will be able to observe many different types of plants and see the diversity among one kingdom.
2. Students will be able to classify numerous types of plants they collect.
3. Students will be able to mention different characteristics of many types of plants.

Standards:

6.4.1 Explain that one of the most general distinctions among organisms is between green plants, which use sunlight to make their own food, and animals, which consume energy-rich foods.

6.4.6 Distinguish the main differences between plant and animal cells, such as the presence of chlorophyll* and cell walls in plant cells and their absence in animal cells.

6.4.10 Describe how life on Earth depends on energy from the sun.

7.4.7 Describe how plants use the energy from light to make sugars from carbon dioxide and water to produce food that can be used immediately or stored for later use.

Materials:

1. Wax Paper
2. Iron
3. Ironing board
4. Old rag(s)
5. Scissors
6. Field Guides

Engage:

We will be meeting at the corner by the Jordan Hall greenhouse. The past three weeks, we have been talking about Biodiversity throughout many aspects of our lives. What have been some different aspects of diversity that we've talked about? What do you remember from last week? How does our DNA make us diverse? Think back to the very first week we were together, during the activity where we collected many different specimens to take back to the classroom to look observe. Does anyone remember the kingdoms we talked about when we tried to classify these organisms? There is one particular kingdom we are going to be talking about today, and as most of you may have inferred by meeting at the greenhouse, we are going to be talking about the plant kingdom. As an added bonus, Dr. Michaels has volunteered to guide our tour today, so let's be respectful of him while he talks to us today and also remember these rules while we are inside the greenhouse:

1. Remember, we are guests here. We must be respectful of our surroundings at all times.
2. You are allowed to touch some of the plants. However, make sure that you do not pull on them or pull any of the parts off the plants.
3. Make sure you stay with the group so you can hear what Dr. Michaels is saying about the plants.

Explore:

Field Trip

1. Field trip to Jordan Greenhouse (with guest speaker Dr. Michaels)

Leaf Hunt/Press

1. As we return to the education building, take a look at all the different trees that surround us. There are lots of different trees here in just this small little area where we are standing. Just imagine how many different types of trees there are all across campus, whether they naturally grow here or have been imported by the university. As we make our way back, I want you to try and collect as many different leaves as you can. You should try and get as many different varieties and colors as you can! (Crossing campus back to the Education building should take approximately 20 minutes between all of the walking and the students stopping to gather their leaves).
2. Once we get back to the classroom, we will have our break before we begin again.

Explain:

Let's take a minute and think about our field trip to the greenhouse. Do you remember any of the names of the plants that we saw? What were some of the different characteristics you remember? Why do you think all of these plants have these different parts? If you think back a couple of weeks, we talked about certain things some species have done to better fit into their environment. Do you remember what these are? (Adaptation, Natural Selection, etc). How do you think these plants have used these different types of evolution to their advantage?

Now take a look at your leaves. How many of you have leaves that are different colors besides green? Does anyone know why these leaves changed colors? Let's think about it this way… Leaves are nature's food factories. Plants take water from the ground through their roots. They take a gas called carbon dioxide from the air. Plants use sunlight to turn water and carbon dioxide into oxygen and glucose. Oxygen is a gas in the air that we need to breathe. Glucose is a kind of sugar. Plants use glucose as food for energy and as a building block for growing. The way plants turn water and carbon dioxide into oxygen and sugar is called photosynthesis. That means "putting together with light." A chemical called chlorophyll helps make photosynthesis happen. Chlorophyll is what gives plants their green color. As summer ends and autumn comes, the days get shorter and shorter. This is how the trees "know" to begin getting ready for winter. During winter, there is not enough light or water for photosynthesis. The trees will rest, and live off the food they stored during the summer. They begin to shut down their food-making factories. The green chlorophyll begins to break down and disappears from the leaves. As the bright green fades away, we begin to see yellow and orange colors. Small amounts of these colors have been in the leaves all along. We just can't see them in the summer, because they are covered up by the green chlorophyll.

Elaborate:

1. Now that we know *why* the leaves change color, we are going to use our resources and identify our leaves. You can use the computers in the room and we also have field guides available for you to look through. Once you have identified a leaf, I want you to write down its scientific (genus and species) and common name, an interesting fact about the type of tree, and where they are most commonly found in your journals.

Make sure you know what information goes with each leaf, as you will be writing all of the information on each leaf after they have been pressed!

2. Each leaf represents a small contribution by nature to the diversity we have been studying. To help us remember that diversity, we are going to press our leaves in order to preserve them and help remind us of the diversity we are surrounded by.
    a. Sandwich your leaves between 2 sheets of waxed paper.
    b. Cover your ironing board with an old cloth rag, so you don't get wax on the board.
    c. Place the sandwich on top of the rag.
    d. Place another old cloth rag on top of the sandwich.
    e. Heat the iron to high, but NO STEAM.
    f. Slowly run the iron back and forth over the cloth rag. Don't press too hard to begin with, or the leaves will shift. Once the paper has begun to seal, use the full weight of the iron and hold it for about 4-5 seconds on each spot.
    g. Lift the rag to see if the waxed paper as melted and sealed. The leaves will be much clearer when the wax has melted.
    h. Allow the sandwich to cool, then cut out individual leaves. Leave a small margin around the leaves so the waxed paper stays sealed.

As we observed last week, our habitats have grown quite a bit. Let's rearrange into our groups once again, sitting at the table with our habitat. As we talked about, each habitat has a different make up, much like the different land types all around the world. What do you think is special about your habitat make-up? Why do you think you were able to grow as much grass as you did? Do you think there are any other factors that might help the growth of grass in your habitat?

Evaluate:

Turn to a blank page in your journal and draw a lowercase t, with the long line being down the center of the page, and the cross being somewhere along the top of the page. On the top of the left-hand column, write "What I Know." On the right-hand column, write "What I Learned." Now, on the bottom part of the left hand column, write some of the terms that we have been talking about throughout the course of our time together, such as DNA, evolution, genetics, adaptation, kingdoms, photosynthesis, etc. Leave 4 or 5 lines between each word as you write. Now, in the right-hand column across from each word you wrote, write a sentence or two describing what you have learned about this term, and be able to tell us what you know about each term as we move from table to table.

Chad Weaver
Saturday Science Wk 3
October 10, 2009

Diversity in your Genes

Grades: 5-8

Objectives:

1. Students will be able to identify dominate and recessive traits.
2. Students will know what a punnet square is and how to use it to find possible phenotypes/genotypes of future generations.
3. Students will observe traits that are passed from generation to generation and understand why some traits are visible/not visible.
4. Students will be able to define Genotype/Phenotype and know the difference between the two.

Standards

5.1.3 Explain that doing science involves many different kinds of work and engages men, women, and children of all ages and backgrounds.

5.4.1 Explain that for offspring to resemble their parents there must be a reliable way to transfer information from one generation to the next.

8.4.1 Differentiate between inherited traits, such as hair color or flower color, and acquired skills, such as manners.

8.4.7 Recognize and explain that small genetic differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors.

Materials:

1. DNA necklace kit
2. DNA necklace student handout (20)
3. DNA necklace teacher's manual
4. Human Genetics activity worksheet
5. Test tube rack
6. Latex gloves
7. Journals
8. Goggles
9. Crayons
10. Sharpies (2)

Engage:

As you know, the past two weeks we have been talking about biodiversity? Can anyone tell me…what IS biodiversity? (wait for student answers) How does biodiversity play a part in your life? Did you know that you are surrounded by diversity even when you are at home with your family?

Explore:

DNA Necklace Activity
(Instructions are in manual/on student handout)

http://www.sciencekidsathome.com/science_topics/genetics-a.html#more

Human Characteristics:

Ear lobes. The dominant phenotype is free-hanging ear lobes; attached ear lobes is a recessive trait.

Widow's peak. In some people, the hairline forms a distinct point in the center of the forehead. This is known as widow's peak, which is the dominant phenotype; the recessive phenotype is a continuous hairline. (Baldness may mask this characteristic).

Dimples. Some people have small indentations in the skin of their face, especially when they smile. Having dimples is dominant. No dimples is recessive.

Tongue rolling. A dominant allele gives some people the ability to roll the tongue into a distinct upward U-shape when the tongue is extended from the mouth. The recessive phenotype allows only a slight downward curve of the tongue when it is extended from the mouth.

Iris pigmentation. An individual who is homozygous recessive for has no pigment in the iris, and light reflected back through the iris results in a blue color. A dominant allele causes pigment to be deposited and results in other colors such as brown or green. (Other genes that affect the structure of the iris and the density of the pigment cause the range of eye colors, but we shall consider only the presence or absence of pigment).

Bent little finger. The dominant trait results in the last segment of the little finger to bend at a sharp angle in toward the fourth finger. The recessive trait is a straight finger.

Interlocking fingers. When the fingers are interlocked, some people will almost invariably place the right thumb over the left; others will place left over right. Amazingly, this is a genetically determined trait. Left over right is dominant; right over left is recessive.

Elaborate:

1. Record your phenotype for each of the above characteristics and indicate the possible genotype(s) in the table below. Also record your data as a tally mark in the appropriate column for each characteristic on the blackboard.

2. Determine the total number of students in the class who show each characteristic and record this data in the table.

	Your Phenotype	**Your Genotype**	**Number in Class**	
Ear lobes			Free (A)	Attached (a)
Widow's peak			Present (B)	Absent (b)
Dimples			Present (C)	Absent (c)
Tongue-rolling			Present (D)	Absent (d)
Iris			Pigmented (E)	Not pigmented (e)
PTC tasting			Taster (F)	Non-taster (f)
Little finger			Bent (G)	Straight (g)
Interlocking fingers			Left (H) Right	Right (h) Left

3. The amount of genetic variation in a population is remarkable. To demonstrate this and to show how each of us is the result of a unique combination of alleles, the whole class will stand while one person will slowly read off his or her phenotype. As soon as that phenotype differs from yours, sit down.

a. How many people matched the reader's first trait? _____ = _____%

b. How many genes were surveyed before the uniqueness of the reader was shown?_____

c. What does this imply about the variation in a population for one trait vs. many traits? What is the general likelihood of any given person sharing all of the same traits you do (high, low) and why?

4. Is it true that dominant phenotypes are always the most common in a population: Does "dominant" mean "more prevalent?" Explain your answer.

5. If you showed a dominant phenotype for a given trait, it is impossible for you to know your exact genotype without further research. One way a geneticist could determine your genotype would be to perform a **testcross**. In a testcross, an individual with a *dominant phenotype* is mated to an individual with a *recessive phenotype*. An analysis of the offspring would show which genotype the parent had.

Work through a test cross for an individual with free-hanging earlobes.

a. If the individual has free-hanging earlobes, what are the possible genotypes?:

_____ or _____.

b. Draw two Punnett squares to show crosses between each possible genotype in part (a) and a homozygous recessive individual. Indicate the ratio of the phenotypes of the offspring for each cross below the Punnett squares.

c. From this analysis, you could determine which genotype the original individual was. However, it is difficult to do this kind of analysis with humans, as they are reluctant to participate in arranged "crosses" and produce few offspring to track. A more useful technique in humans is to look at the family history of a trait and construct a **pedigree**, or a diagram showing the phenotypes and possible genotypes of other family members of the individual in question.

d. Examine the table above and list the traits for which you have the dominant phenotype:

6. Knowing something about your genotype allows you to predict what your offspring might look like. You can use a Punnett square to help you figure this out.

a. If two people are both heterozygous for a widow's peak, what is the probability that a child of theirs would also have a widow's peak? _____ Show your work below.

b. i. If two people were heterozygous for *both* a widow's peak and tongue-rolling, what is the probability that a child would also have a widow's peak and be a tongue-roller? _____ What is the probability that a child would exhibit neither trait? _____ Show your work below.

Before we move on, let's think back to our main topic of biodiversity. How does knowing about all of these genes and their variations between each of us play a part in the biodiversity around us?

Explain:

Human Characteristics

Many human characteristics are caused by multiple genes or are influenced by environmental factors, but many others are known to be determined primarily by only one gene. In this case, a gene encodes for a protein that contributes to the outward expression of that **character** (heritable feature). Each feature, however, has more than one visible form. These are technically referred to as **traits**. This expression of the trait (the **phenotype**, or appearance) reflects an underlying genetic make-up, or **genotype**.

Because you inherit two copies of the gene from each parent the combination of the specific **alleles** (versions of the gene) you inherited is the basis of your genotype. A genotype is written with two symbols, each representing the alleles of the gene and their relative dominance over one another. A **dominant** allele will mask a **recessive** allele—in combination, you will see the dominant phenotype. To see a recessive phenotype, you need two recessive alleles, one from each parent.

How to determine your genotype from your phenotype:

Dominant phenotype: Your genotype may be either **homozygous** dominant (two of the same allele: AA) or **heterozygous** (two different alleles: Aa). Since you don't know for sure, in this exercise you may use the nomenclature "A_" for the dominant genotype. The "_" indicates that the nature of the second allele is not known.

Recessive phenotype: You *must* have a homozygous recessive genotype, which is shown as "aa."

Note that the same general symbol (in this case, a letter) is used to represent the different alleles of the same gene. Dominant vs. recessive is indicated by upper- and lower-case letters, respectively. If you were to make up a new symbol for each trait, it would indicate that the two phenotypes result from the expression of different *genes*, not different combinations of alleles from the *same* gene, so make sure you stick to the same gene designation and come up with ways to differentiate dominant from recessive alleles. While we will use letters of the alphabet to do this, other designations include using a "+" or "–", for example.

Below is a list of some common human characters with different patterns of expression. Examine your own body (or have a partner look for you) to determine your *phenotype*. Record it in the table below. Then, determine your *genotype* for each characteristic using letters of the alphabet and the rules above.

Elaborate/Evaluate:

Traits Bingo

Creating/Sustaining Biodiversity

Grades: 5-8

Objectives:

1. The students will show their understanding of similarities and differences between a frog and starfish through a chart showing each of these.
2. Students will help sustain biodiversity in their environment by creating a bird feeder to be placed outdoors near their house.

Standards:

5.4.4 Explain that in any particular environment, some kinds of plants and animals survive well, some do not survive as well, and some cannot survive at all.

5.4.5 Explain how changes in an organism's habitat are sometimes beneficial and sometimes harmful.

5.6.3 Recognize and describe that almost anything has limits on how big or small it can be.

Materials:

1. 5 Dowel rods
2. Packing tape (clear)
3. Bird seed
4. Eyelet screws (one for each student)
5. Ziploc bags (1 for each student)
6. Construction paper
7. Markers (Permanent/Washable)
8. Drills
9. Saw
10. Wire
11. 4 Rulers

Engage:

If you think back to last week, you'll recall that we dissected both a starfish and a frog, and looked at many of their characteristics. I asked you to create a chart that showed both similarities and differences between the two as homework. How many of you brought those with you? If you did, go ahead and pull those out. If not, go ahead and get out a piece of paper and try to make up the chart real quick, and we will discuss it in 5 minutes.

Explore:

Now we are going to be creating bird feeders for you to take home with you to help you remember some of the things we have talked about the past 5 weeks, as well as to help create and sustain biodiversity around your house. We've got stations set up around the room with the various tools and materials you will need to create your bird houses. We will rotate from station to station in groups of 2 or 3 to ensure that everyone is working at all times. I'm going to walk you through the procedure quickly, and then you can go to the stations and start working on it yourselves.

1. You are going to need to measure 3"-4" from the top of the 2 liter bottle (the end with the cap) and make a mark with a permanent marker.
2. Next, find a way to make a mark in the same spot on the exact opposite side of the bottle.

3. Measure down two inches from each of these markings and draw a line 1” in length. Draw 1” lines perpendicularly from each end of the original line, and then one final line to complete the square.
4. Measure 8” of dowel rod, and bring it down to the sawing station to get help sawing.
5. Bring your bottle to one of the two drilling stations to have the dowel rod holes drilled, the starter holes drilled for the feeding holes, and a hole drilled on top for the eyelet screw.
6. Cut 3 of the 4 lines of the drawn square, leaving the side closest to the bottle cap attached.
7. Twist the eyelet screw into the hole at the bottom of the bottle. Attach wire in large loop so bird feeder can be hung.
8. Decorate the outside of the bottle with whatever materials you would like.
9. Once decorated, bring the bird feeder over to get bird seed in your feeder and a bag of bird seed to take home with you.

Explain:

As we look back on the six weeks we’ve spent together, let’s think a little about what we’ve talked about. Think back to the first week when we talked about the 5 kingdom classification system. Do you remember the names of the kingdoms? As you think about each of these kingdoms, think about all the similarities and differences that exist between them. There are a number of similarities that exist, but there are many more differences, not only between each kingdom, but even between all of the organisms classified within each kingdom. The next couple of weeks we talked about evolution and genetics, and looked at the ways everything is constantly evolving around us because of all kinds of different factors, whether they are environmental or genetic. Finally, the last couple of weeks, we’ve talked about two of the easiest ways for us to view all of the biodiversity around us: through the plant and animal kingdoms. As we have seen, there is great diversity in each of these kingdoms, from structure to purpose and many other different ways. And life as we know it would be very different if all of this diversity wasn’t present. This is one of the reasons each and every one of us need to do our part to **sustain** this diversity. Does anyone know what it means to sustain something? When we say that we are trying to sustain something, we mean that we are trying to preserve something. How do you think the creation of these bird feeders will help sustain biodiversity in your environment? As you can see, there are many different factors that play a role in the biodiversity of our environment, and each piece, including each of you, have an important role in the upkeep of the biodiversity that surrounds us. In order for each of us and all of the many organisms that are surrounding us to survive, we need to do our part in helping sustain the environment around us. My hope is that, by introducing you to all of these different kinds of diversity, you have become more aware of how much life and diversity we are surrounded by, and will share that knowledge with all of those around you so that we can do our best to help sustain the environment where we are.

Elaborate:

As we have just finished making our birdfeeders to help increase biodiversity in our environments, we are now going to help in sustaining the environment around campus. What are some things we could do around campus to help increase the sustainability of this environment? (Take as many answers as the students have) Those are all great ideas! Now that we have given all of these ideas, we are going to put one of them in motion: Recycling/cleaning up the environment. We’re going to go outside and pick up all the trash we can find around the

Education building, and then come back inside and separate it by recyclable/non-recyclable for disposal.

Evaluate: Students will be evaluated based on the completion of their bird feeders, the separation of trash collected, and through the notebooks they have filled out during Saturday Science.