Module 3 –

Essential Questions

How is life so diverse yet so connected?

Why are some organisms more successful than others?

**Instructional goals**

1. Using Darwin’s observations, draw conclusions relating to how life is so diverse yet so connected.

2. Using homologous structures and vestigial structures, investigate evolutionary relationships and make a cladogram.

3. Interpret rock layer or other data to determine the age of the earth. (age of Earth, fossils)

4. Describe and give examples of how environmental forces drive changes in organisms over time. (Natural Selection, adaptation)

5. Read and interpret cladograms and dichotomous keys.

Misconceptions -

* Students have a difficulty understanding the age of the Earth.
* After learning about Darwin, students believe that Darwin was the only scientist who contributed to the development of Evolution.
* An adaptation is not a verb, it is an inherited characteristic that increases the chance of survival and reproduction.... Students believe that if an organism wants to change, it can so that it can survive.
* Individuals do not evolve, populations do.
* Classification: students do not realize that organisms are classified into other categories besides Fungi, plants, and animals.

**Vocabulary**

fossil artificial selection adaptation fitness natural selection homologous structure analogous structure vestigial structure biogeography binomial nomenclature genus species family order class phylum kingdom taxon phylogeny clade cladogram derived character domain adaptation

**Sequence**

1. Darwin paradigm activity.

2. Natural Selection bean activity- Jelli Bellicus Activity

<http://www.nsta.org/publications/news/story.aspx?id=53245>

3. Artificial Selection

4. Fruit Loops Selection Activity

5. Selection Pressures Paradigm

6. Timeline of Earth’s history <http://johnkyrk.com/evolution.html>

7. Getting into the fossil record:<http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/index.html>

8. rock layer activity- “who’s on First” <http://www.ucmp.berkeley.edu/fosrec/BarBar.html>

9. Homologous/Vestigial Structure activity.<http://evolution.berkeley.edu/evolibrary/article/similarity_hs_01>

10. Create a cladogram.

11. dichotomous key activity

<http://www.msc.ucla.edu/oceanglobe/pdf/Invertebrates/Inverts_Key_Phyla.pdf>

12. Review

13. Test (not completed)

**Overview (not yet created)**

**Instructional Notes**

**1. Darwin Paradigm Activity (1 day - 50 min)**

1. Pre Activity Class Discussion:

Q1: Begin discussion with asking students where lions and kangaroos live. (Lions live in the grasslands of Africa and kangaroos live in the grasslands of Australia. - Species vary globally.)

Q2: Where do snakes live? What kind of snakes do we have? (Species vary locally.)

Q3: What do wooly mammoths look like? What do elephants look like? Did elephants live the same time as wooly mammoths? Do wooly mammoths live with elephants today? (Species vary over time.)

2. Activity:

Set up: Post world map at front of the room highlighting the names of the major areas where Darwin explored: Europe, South America, Galapagos Islands, Australia, Africa.

In classroom, set up 6 stations with pictures of animals and plants: Extinct Organisms, Europe, South America, Galapagos Islands, Australia, Africa.

Materials needed: Pictures of animals and plants, worksheets

Student groups move around the room as they observe the different animals and plants in different continents. Each group will whiteboard their observations of the animals in the country of their group.

3. Post-activity discussion – In large circle, students can look at the other groups’ observations.

Use leading questions to help the students draw the following conclusions: Species vary locally, globally, and over time.

**2. Natural Selection - Jelly Bellicus (2-3 50 min days)**

1. Pre Activity Discussion:

Questions for Jelly Bellicus- Whiteboard

1. What observations can you make from the Jelly Bellicus?

2. How are the Jelly Bellicus’ simulating living organisms?

3. What do you think the word “adaptation” means? You may not use your book!

4. Why is it necessary to come up with a simulation for evolution?

2. Activity:

Materials:

6-8 Lab boxes - (bins) for classroom materials

4-6 Bags of cedar bedding for hamsters or small rodents

6-8 Bags of Jelly Belly Beans, You may also choose to go to a specialty candy store and pick out specific colors.

Stopwatch

Procedure:

Each lab group will need 1 Lab box with bedding in the bottom. There should be 80 total jelly belly beans per box. There will be 10 jelly beans of each color in the box. Recommended Colors to use according to the lab directions: Brown, Beige, White, Red (necessary), Pink with red spots (necessary), Blue, Green, Yellow, Orange, Pink.

Students need to reset the lab boxes with 10 of each color at the end of each class to prepare for the next class.

Graphing Analysis:

Students will then graph the data for Part 3- Population Shift. Students will create a plot/line graph that shows how each species (color) of Jelly Bellicus changed over the course of three generations. Students should see that those species with adaptations suitable for survival and reproduction are the most successful and thus, grow in numbers over time. Species with adaptations not suitable for survival and reproduction decrease in numbers over time.

3. Post Discussion:

Students will post their results on their whiteboards then do an art gallery walk/boardwalk. Students will edit their boards for the end of class discussion.

See teacher’s notes on link for extension activities. ( Hardy- Weinberg)

**3. Artificial Selection (1 50 min day)**

1. Pre Activity Class Discussion:

Leading Questions: What comes to mind when you hear the word natural. Where have you heard this term used before? What kinds of things are natural? What about the term artificial? Is one necessarily “better” the other?

2. Activity: using the website: <http://learn.genetics.utah.edu/content/variation/artificial/> students will fill out the worksheet Natural Vs. Artificial Selection.

3. Post Discussion:

Students will white board and present questions 5 and 7.

**4. Fruit Loops Activity (1 50 min day)**

1. Pre Activity Class Discussion: Students brainstorm environmental selection pressures.

2. Activity:

Materials: Fruit Loops

Instructions for activity are on document entitled “Fruit Loop Natural Selection Activity” , pre-Lab is optional for instructor

3. Post Discussion: Students will whiteboard their scenarios that they come up with for the second and third graphs. They need to show their graphs and explain what happened to the class. Students can then conduct an “Art Gallery” and put comments on post-it notes.

4. Corrections to the original whiteboards and classroom discussion follow.

**5. \*OPTIONAL DEPENDING ON TIME\***

**Environmental Pressures Paradigm Project ( 3 50 min days depending on how students work outside of class)**

1. Pre Activity Class discussion: Brainstorm environmental pressures.

2. Activity:

In small groups, students will research an organism that have become extinct or are in danger of becoming extinct. They will need to describe in detail the environmental pressures that may be a cause of the extinction.

Students can present their project in a model, movie, news broadcast, etc.

3. Post activity discussion: Class discussion after each presentation.

**6. Timeline of Earth’s History (1-2 50 min days depending on how long the discussion takes)**

1. Pre Activity Class Discussion:

Materials: pictures ofmusicians

As a class, students will make a short timeline of musicians. Teacher will use leading questions to help the students learn how they use context clues to make the order they have chosen.

2. Activity:

Materials: pictures of events of earth’s history (pictures taken from <http://johnkyrk.com/evolution.html)> In groups, students will create a timeline using the pictures of the events of earth’s history.

3. Post-activity discussion –

Using dueling whiteboards, each group will justify their timeline.

4. As a class the students and teacher will look at the following website to compare their timelines with the current scientific timeline of the Earth’s history. <http://johnkyrk.com/evolution.html>

**7. Getting into the fossil record ( 1 50 min day)**

1. Pre Activity Class Discussion: Brainstorm how fossils are made. Teacher can ask students what are fossils and how are they made.

2. Activity:

Materials: Getting into the fossil record worksheet and access to the internet.

Students will answer questions on the worksheet using the following website:<http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/index.html>

3. Post-activity discussion –

4. Extension: The class can watch the video clip about how fossils are made then make their own movie explaining how fossils are made.

**8. Who’s on First? – Relative Dating (2 50 min days)**

1. Pre Activity Class Discussion:

Teacher can use leading questions to help the students start to think about index fossils, what type of rock the fossils might come from, and the law of superposition.

2. Activity:

Materials: cards from the website

Suggestion: When cutting the cards for the activity, make sure you remove or cover up the letters so that the students don’t use the letters to put the cards in order.

Procedure B:<http://www.ucmp.berkeley.edu/fosrec/BarBar.html>

1. In groups, students will try to place the pictures of the fossils in order according to how they might be found in rock layers. They can tape the pictures to their white board so they are prepared for dueling whiteboards.

2. Students will use dueling whiteboards to justify their product.

3. Post-activity discussion – Questions taken from the website.

1) Which fossil organisms could possibly be used as index fossils?

The graptolite, placoderm, ammonite, ichthyosaur, and shark's tooth could possibly be used as index fossils since they are found in only one layer. Technically, however, given only this set of strata, one cannot say that the shark's tooth and ichthyosaur could be used as index fossils because we do not know if they continue in younger rock layers above this set of strata.

2) Name three organisms represented that probably could not be used as index fossils and explain why.

The brachiopod, crinoid, eurypterid, foraminifera, gastropod, horn coral, pelecypod, and trilobite could probably not be used as index fossils since they overlap more than one stratum.

3) In what kinds of rocks might you find the fossils from this activity?

Marine sedimentary rocks such as limestone, shale, and sandstone might contain fossils similar to those depicted in this activity.

4) State the Law of Superposition and explain how this activity illustrates this law.

In a "normal" horizontal sequence of rocks, the oldest rock layers will be on the bottom with successively younger rocks on top. This activity illustrates this law because when the cards are placed in the correct order, the vertical stack shows the oldest fossils in a rock layer in the bottom of the stack and the youngest fossils in rock stratum on the top.

**9. Homologous Structures/Analogous Structures Classification Internet Activity (1 50 min day)**

1. Pre-Activity Classroom Discussion- Teacher lead questions relating to homologous structures: Example: Name some structures of organisms that look similar. Why are they similar? What about a human and bird? Are they similar? How?

2. Activity - Website and worksheet

3. Post- Activity Discussion

Come up with examples of structures of organisms that are homologous. Please provide 3 pairs of structures of organisms.

Provide 3 pairs of structures of organisms that are analogous.

**10. Create a Cladogram ( 1 50 min day)**

1. Pre Activity Class Discussion:

Materials: pictures of amoeba, earthworm and cat. Ask the class to brainstorm physical characteristics of these animals. What order would they put them in on a timeline? What characteristics changed between the animals as they evolved?

2. Activity:

Materials: pictures, vocab words, tape

In groups, students will create a cladogram using the materials provided. They can tape their pictures to their whiteboard.

3. Post Discussion

Dueling Whiteboards: Students will have to justify the cladogram they created.

**11. Dichotomous key Activity (1 50 min day)**

1. Pre activity class discussion:

Teacher led questions: How are organisms classified?

How are organisms classified when they are very similar? - Like an earthworm and a snake....

Why is it important to classify organisms?

2. Procedure: ( also in link)

Students will be put into small groups and are given pictures of several marine invertebrate phyla. Students follow the dichotomous key to determine what phylum the invertebrate belongs

Students are provided with vocabulary terms to assist them in identification.

3. Follow up discussion/ Board Meeting :

Students present their results for each picture. They must also answer the following questions and address them in the board meeting.

Was the key helpful in identifying the invertebrates? Why?

Write the characteristics of each animal pictured, its phylum, and common name.

Would you change the identification key? How?