**Oakland Schools Science Scope**

**Grade 5**

**Unit 3 – Survival of Organisms**



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**About Our Scope Unit/Lesson Template**

This template is designed to serve several teaching and learning principles considered as staples of state of the art science instruction. Here are the key principles in summary:

* It’s critical to **elicit prior knowledge** as a unit or lesson begins.
* **Key questions** should drive student explorations and investigations.
* **Activity Before Concept** – Student inquiry-based explorations which give personal experience with phenomena and ideas should precede a presentation of science ideas.
* **Evidence is the heart of the scientific enterprise.** Students generate evidence and analyze patterns in data that help to construct scientific explanations around key questions.
* **Concept Before Vocabulary** – Attaching science vocabulary to concepts developed by student investigations yields more success than beginning a unit or lesson with a list of science vocabulary.
* **Talk, argument** **and writing** are central to scientific practice and are among the most important activities that develop understanding.
* **Application** of the ideas provides review, extends understanding, and reveals relevance of important ideas.
* **Assessment** of knowledge, skill, and reasoning should involve students throughout the learning process and be well aligned to the main objectives and activities of the unit.

The Scope Science template is designed to put these principles into practice through the design of the ***SCOPE LEARNING CYCLE FOR SCIENCE***. Each unit has at least one cycle. The components are listed below:

|  |  |
| --- | --- |
| The Key Question for the Unit | Each unit has one open-ended Focus Question that relates to all the content and skills of the unit. The Key Question is presented at the opening of the unit and revisited at the unit’s conclusion. |
| Engage and Elicit | Each unit begins with an activity designed to elicit and reveal student understanding and skill prior to instruction. Teachers are to probe students for detailed and specific information while maintaining a non-evaluative stance. They also can record and manage student understanding, which may change as instruction proceeds.  |
| Explore  | A sequence of activities provides opportunities to explore phenomena and relationships related to the Key Question of the unit. Students will develop their ideas about the topic of the unit and the Key Question as they proceed through the Explore stage of the learning cycle. Each of the activities may have its own Key Question or central task that will be more focused than the unit question. The heart of these activities will be scientific investigations of various sorts. The results, data and patterns will be the topic of classroom discourse and/or student writing. A key goal of the teacher is to reference the Key Question of the unit, the Engage and Elicit of the students, and to build a consensus especially on the results of the investigations. |
| Explain | Each unit has at least one activity in the Explain portion of the unit when students reconcile ideas with the consensus ideas of science. Teachers ensure that students have had ample opportunity to fully express their ideas and then to make sure accurate and comprehensible representations of the scientific explanations are presented. A teacher lecture, reading of science text, or video would be appropriate ways to convey the consensus ideas of science. Relevant vocabulary, formal definitions and explanations are provided. It’s critical that the activity and supporting assessments develop a consensus around the Key Questions and concepts central to the unit. |
| Elaborate  | Each unit cycle has at least one activity or project where students discover the power of scientific ideas. Knowledge and skill in science are put to use in a variety of types of applications. They can be used to understand other scientific concepts or in societal applications of technology, engineering or problem solving. Some units may have a modest Elaborate stage where students explore the application of ideas by studying a research project over the course of a day or two. Other units may have more robust projects that take a few weeks. |
| Evaluation | While assessment of student learning occurs throughout the unit as formative assessment, each unit will have a summative assessment. Summative assessments are posted in a separate document. |

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**Unit 3 – Survival of Organisms**

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**Unit 3 – Survival of Organisms**

**Unit Introduction**

This unit attends to the Michigan Grade Level Content Expectations as they are gathered in Unit 3 of the Michigan Department of Education Science Companion Document. In this life science unit, students investigate the traits of organisms and their influence on survival in the environment. The unit is organized into two learning cycles:

Cycle 1: Acquired and Inherited Traits

Cycle 2: Adaptations and Survival

Students examine how traits are determined by heredity and how they are used to classify living things. Students conduct research and activities to compare and contrast inherited and acquired traits. They explore how the behavioral characteristics of animals and the physical characteristics of all organisms help them survive in their environment. Students examine fossils as evidence of change in living things and the environment. They analyze the relationship between environmental change and catastrophic events to species extinction. Students examine the contributions made by individuals who created a classification system based on the similar features of contemporary organisms.

The resources and opportunities to address these topics are of such abundance and quality that the unit has the tremendous potential to be a highly relevant, real world and investigation-rich experience for students. As teachers look for ways to have students use real world data, apply interactive technology to real world questions, and foster meaningful tasks for reading, writing, argumentation and mathematics and framed by the Common Core Curriculum Standards, the issues here provide abundant opportunity. The main limitation is the class time available given other content demands.

*On the Common Core State Standards for English Language Arts and Literacy in Science*

All science teachers will find the Common Core State Standards of ELA a tremendous asset for reaching learning objectives in science education. Reading, writing, argumentation and discourse are central proficiencies necessary for success in science. All teachers should become fluent with the document and are likely to find it validating.

[**http://www.corestandards.org/assets/CCSSI\_ELA%20Standards.pdf**](http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf)

These standards are best reached with science instruction that connects content to real world problems and experiments, complimented with scientific writing, challenging questions, processes for classroom discussion and debate, and use of scientific text.

It is recommended that teachers require students to use an interactive science notebook to support learning in this unit. Here are some features and policies to consider:

* Use a bound notebook – cut and paste or staple some other materials into it (quad-ruled notebooks are nice for graphing activities).
* The right facing page is for teacher content, the left is for student reflection.
* Leave four pages for a table of contents.
* Leave the notebooks in the room.

**Learning Cycle 1: Acquired and Inherited Traits**

**Introduction**

In Cycle 1, students learn how to identify traits and how they are the result of heredity and environment. Students examine fellow classmates and family to identify traits that are inherited or acquired. They examine acquired traits to see the role played by the environment.

**Learning Objectives**

Students will be able to:

* Describe how the environment influences inherited traits.
* Explain how physical characteristics affect an organism’s survival.
* Explain the difference between acquired and inherited traits.
* Explain why acquired traits cannot be inherited.
* Identify acquired traits (body scars, learned behaviors).
* Identify inherited traits (eye color, leaf shape, body covering, skeletal form, etc.).

**Key Question: What are traits and how do we get them?**

**Engage and Elicit**

**Activity 1 – Human Traits Inventory**

**Purpose**

The purpose of this activity is to discover the background knowledge the students bring with them regarding traits.

**Activity Description**

The teacher begins this activity by posing the question “What are traits and are they important?” This serves the purpose of discovering what the students know and/or think they know about traits. All student answers are accepted without evaluation. When the class has finished, they decide what additional information they need. Following this introduction, the class takes an inventory of traits they have.

**Focus Question**

What are traits and are they important?

**Duration**

Two class sessions

**Materials**

Quick Reference Guide on genetics from University of Utah: <http://teach.genetics.utah.edu/content/begin/traits/traitsreference.pdf>

**Teacher Preparation**

Review the Quick Reference Guide for background knowledge.

**Classroom Procedure**

1. Provide a short list of questions on the board that students copy into their interactive notebook. They should answer them individually. This set of questions will elicit student thinking about the topics in this cycle:
	* List five things you inherited from your ancestors.
	* Which of those things do you share with another family member?
	* Are there any traits that you think you share with a classmate?
	* Think of a pet you or a friend has. What features do you think the animal received from its ancestor? List three features.
	* Think of one of the plants in your yard or garden. What features do you think the plant has received from its ancestor? List three features.
2. After students quietly record their thoughts, have them discuss their ideas with one or two other students. Roam the room and listen to their conversations.
3. Draw the students into a whole-group conversation. Ask for the features they came up with for each question, and list a representative sample on the board.
4. Look for the opportunity to sort the ideas into acquired or inherited traits. Try to determine if students recognize the distinction. Ask “Can this list be sorted into two categories?” Follow and record their ideas on the board.
5. To elicit students’ ideas on how the environment or genetics shape traits, ask “How does science explain “this” trait?” Receive and record their ideas without correcting or evaluating their responses.

**Explore**

**Activity 2 – Hey, Where Did That Come From?**

**Purpose**

To introduce the idea of inherited and acquired traits, and to prepare class for the homework assignment of conducting a discovery game identifying acquired and inherited traits.

**Activity Description**

This activity expands the students’ exposure to traits by relating traits to family and having students discover that some traits may be inherited while others are acquired. The first day, the class prepares the materials from the website and takes them home to do a family survey that evening. The second day, the class discusses their results, and the teacher emphasizes important patterns as results are reported.

**Focus Question**

What is the difference between acquired and inherited traits?

**Duration**

Two class sessions

**Materials**

* PDF document “Family Traits and Traditions: A Make a Match Game”

<http://teach.genetics.utah.edu/content/begin/traits/familytraits.html>

* Atlas URL:

**Teacher Preparation**

Print and copy the first page of the PDF file for each student to take home, as well as a pre-cut set of game cards.

**Classroom Procedure**

1. Distribute the instruction sheet (first page of PDF) and card set to each student.
2. Review the instructions with students, informing them they should read through the family notes and hints with their family members.
3. Make it clear that students should play the game that night because of the analysis that will occur on the following day.
4. Have the students go through the cards and write down predictions about each trait and whether students think traits are inherited or acquired.
5. Tell students to record results right after the game is played.
6. On the second day, have students tally their results on the board.
7. During a whole-class debrief, ask students to write and share summaries of the data. Ask how accurate their predictions were. Ask what surprised them. Discuss the differences between inherited traits and acquired traits. Ask if they can think of other traits that are acquired.

**Explore**

**Activity 3 – Finding Your Genetic Match**

**Purpose**

Students determine the presence of certain high-frequency traits in themselves and their classmates.

**Activity Description**

This activity gives students an opportunity to compare their traits with others in their class and to find the student or students most similar to themselves. Using a genetic inventory sheet, students gather data from classmates on inherited traits. The inventory includes a yes/no taste test of a compound that goes by PTC (phenylthiocarbamide) which people find either bitter or tasteless. After the inventory is used, an analysis of the results follows.

**Focus Question**

What traits are most common in my class?

**Duration**

One class session

**Materials**

* Genetic Inventory sheet with pictures <http://www.biologyjunction.com/genetic_traits_activity.htm>
* PTC taste strips

**Teacher Preparation**

1. Print and copy a class set of the genetic inventory sheets.
2. Obtain a supply of PTC taste strips from a science education supply company.

**Classroom Procedure**

1. Have students identify which of the following 10 human traits they have by having students place a check mark beside that trait.
2. Have students compare the traits they have with other students in the classroom and find the student they most closely match.
3. Have students interpret these results in a class discussion. Ask students to identify which classmate is most like them. How do they differ relative to the compared traits?

**Explain**

**Activity 4 – Handy Family Tree**

**Purpose**

Students determine trait similarities and differences within their own families and recognize the difference between acquired and inherited traits.

**Activity Description**

This activity begins with classroom preparation and is carried out at home with students’ families and finalized the following day in class. This activity will help the students understand inherited and learned (acquired) traits and will personalize the data for each of them. Students construct a family tree based on inherited and learned traits. The activity is a homework project with one class period to prepare materials and to discuss procedure, and one class period to discuss results.

**Focus Question**

How are my traits related to other members of my family?

**Duration**

Two class sessions

**Materials**

Handy Family Tree activity sheet <http://teach.genetics.utah.edu/content/begin/traits/familytree.html>

**Teacher Preparation**

1. Print out and copy the activity for each student.
2. Gather other materials described by the activity.

**Classroom Procedure**

1. Distribute the activity sheet to each student.
2. Review the instructions with students, informing them that they should read through the family notes and hints with their family members.
3. Make it clear that while they will begin the activity today, they must complete it that night because of the analysis that will occur on the following day.
4. Have the students cut out their paper hands and organize the materials.
5. On the second day, have students join small groups and present their findings.
6. During a whole-class debrief, have a few students share their family tree with the class and use the opportunity to review their elicited ideas from Activity 1.
7. Present the main ideas of the cycle (inherited and acquired/learned traits) in the context of the discussion on their family trees.

**Learning Cycle 2: Adaptations and Survival**

## Introduction

## Students explore how the behavioral characteristics of animals and the physical characteristics of all organisms help them survive in their environment. Students examine fossils as evidence of change in living things and the environment. They analyze the relationship between environmental change and catastrophic events to species extinction.

**Learning Objectives**

Students will be able to:

* Explain how inherited and non-inherited behavioral characteristics (adaptation, instinct, learned behavior, habit) can be an advantage in one environment and a disadvantage in a different environment.
* Explain how behavioral characteristics can affect survival.
* Explain how fossils provideevidence about how environmental conditions and living things have changed over time.
* Explain how environmental change and catastrophic events have caused species extinctions.
* Use traits to assist in the grouping of organisms into a classification system.

**Key Question: How do traits help organisms survive?**

**Engage and Elicit**

**Activity 1 – Discovering Variability: Big Beans, Little Beans**

**Purpose**

To discover variation in lima beans and test whether these variations affect survival.

**Activity Description**

The early steps of the classroom procedure serve to elicit student thinking about the value of variability. At that point, the activity merges into the Explore phase. After observing variability in a population of lima beans, students grow their own beans and make observations over a three-week period. Students sort the beans by size to test the impact of that variable on germination and growth. In doing so, the students will determine the effect of the size variable on the bean’s survival. This is an adapted, teacher-uploaded activity hosted by <http://www.ucmp.berkeley.edu/about/index.php>, a lesson developed by authors Al Janulaw and Judy Scotchmoor.

**Focus Question**

How does variability influence growth and survival in lima beans?

**Duration**

Two class sessions to begin, and then a third session after two-three weeks of bean growth.

**Materials**

* Nails of four different sizes
* Five small jars
* One kilogram of lima beans per class
* One small plastic bag for each group
* 2-mm rulers for each group
* One Lima Bean Recording Table per group (see below)
* One Lima Bean Graph per student
* Three pots of soil for each group
* Water
* A source of light

**Teacher Preparation**

1. Fill four jars with nails, each with nails of a different size. Fill one jar with a mixture of nails of all four sizes.
2. Make Lima Bean Recording Table sheets and Lima Bean Graph sheets for class data collection.
3. Prepare bags of lima beans for each group.
4. Draw a class Lima Bean Recording Table and a Lima Bean Graph on the board.

**Classroom Procedure**

1. Follow Steps 2-12 during the first class session (adapted from <http://www.ucmp.berkeley.edu/about/index.php>, a lesson developed by authors Al Janulaw and Judy Scotchmoor).
2. Show the class the four jars of nails. Allow students to notice that three jars have nails of uniform sizes and one contains a mixture of nails. Describe this scenario: *You have a place in your home where tools and other useful items are kept. You know that sooner or later you will need a nail or two, but you cannot predict what the need will be. You can only have one jar. Which jar would you select?* Hold a brief discussion, which hopefully leads to students realizing that the mixed jar is potentially more useful because it provides more options. Your needs vary with the tasks at hand, so having a variety of nail sizes may have an advantage.
3. Pass out the bags of lima beans to each group of four students. Have students look at the beans. Are they all the same, or do they vary? How do they vary?
4. Pass out the rulers and recording sheets to the groups. Have groups of four students measure and record the lengths (to the nearest mm) of as many beans as they can in 10 minutes.
5. Have the groups add up the totals of each length of lima bean and individually graph their results, e.g., five beans are 10 mm in length.
6. Ask students, within their groups, to discuss what they notice about their results.
7. Have a brief discussion with the whole class about what patterns they noticed.
8. Next, have a member of each group write their group’s totals on the table on the board.
9. Sum up the group totals and have students mark the data points on the graph on the board. Draw a “best fit” curve on the board graph.
10. Ask the class to compare their initial results with the class results. (The whole-class graph should look more like a normal curve.) Students should notice, both from the activity and from the graphs, that bean size varies and bean size tends to cluster in the middle more than at the larger or smaller sizes.
11. Point out that variation occurs within any population of living things, including beans. Ask: “Might there be an advantage to beans being of any particular size? How could we find out?” Other possible questions to stimulate discussion: “What advantage might a seed have if it is especially large? What advantage might there be in producing lots of small seeds? What problems might a plant have in producing especially large seeds?” Elicit one or more hypotheses from the students, e.g., larger beans will germinate more quickly.
12. Once the students have made their hypotheses, ask them what scientists do next. Elicit the response that scientists test their hypotheses, and ask students how they think they should test theirs. If students don’t suggest it on their own, inform them that they are going to plant beans of different sizes to test the proposed hypotheses about bean size and rate of germination and/or plant growth.
13. Beginning the second class period, have each group select two of the largest beans, two middle-sized beans, and two of the smallest beans, and plant each pair of beans in a pot (paper cup). Have students label each pot with the size of the beans, the names of the members of the group, and the date planted.
14. Put the pots in a well-lit location and water regularly. Growth time for the beans will vary by the temperature, so plan flexibly.
15. After the seeds germinate, have the students draw their plants on a daily basis in a journal, noting the date and any other observations, such as number and size of leaves, color, and height.
16. At the end of the growth period, follow Steps 17 and 18.
17. When the tallest beans have reached several centimeters, have students count the number of leaves and measure the height of the largest plant in each of their pots. Discuss the results: “Is there any difference in rate of germination and/or growth between small, medium, and large lima beans?” (Note: There is no way to predict the results of this experiment. Remember that the point of the lesson is that scientists try things and learn from the results. Perhaps there will be a perceived growth advantage related to bean size, perhaps not.)

Ask for students’ conclusions from the experiment. Which hypotheses were supported by this experiment? Which were not? Point out that it’s all right if student results are inconclusive. On the other hand, if there are differences in growth rates, ask such questions as “Under what conditions in the wild might big beans or small beans have advantages? How might it be advantageous for the lima bean species to have variation in bean size?”

1. Have students write what they have learned about variation from this activity.

## Lima Bean Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bean | Length in mm |  |  |  |  |  |  |  |  |  |  |  |  |  |
| #  | 4mm | 5mm | 6mm | 7mm | 8mm | 9mm | 10mm | 11mm | 12mm | 13mm  | 14mm |  |  |
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**Explore**

**Activity 2 – Animal Adaptations: Focus on Bird Beaks**

**Purpose**

To explore how variability in bird beaks affects feeding ability, food source and survival.

**Activity Description**

This activity provides students with hands-on means to explore animal adaptations, namely the shape of a bird’s beak in relation to its food source. Students will discover the advantage or disadvantage of various beak shapes as these beaks affect birds’ food choices and feeding efficiency. Adapted from “Animal Adaptations: Focus on Bird Beaks,” University of Montana, Endorsed by Lisa Blank.

**Focus Question**

How does a trait become an adaptation?

**Duration**

Two class sessions

**Materials**

**Beaks:**

* Two eyedroppers
* One pliers
* Five sets of chopsticks
* Four tweezers
* One shoestring
* One sponge strip
* One straw
* One wrench
* Two slotted spoons
* One strainer
* Three tongs
* One envelope
* One turkey skewer

**Food:**

* Colored water in a long narrow container
* Gummy worms
* Sunflower seeds
* Styrofoam cubes
* Popped popcorn
* Rice
* Marshmallows
* Loose tea

**Other Materials:**

* Challenge cards
* Potting soil
* Shallow pans
* Eight boxes
* Data tables for each student
* Eight cups
* Vase or graduated cylinder
* Pictures of various birds with corresponding environment/habitat and food source

**Teacher Preparation**

1. Gather and prepare materials for the beaks and food.
2. Set up the eight stations (one for each challenge) following the directions on the challenge cards.
3. Print and copy the challenge cards (one set per station) and data tables (one per student).

**Classroom Procedure**

1. Use the following procedures: *Ask students if they have had to adapt to a situation.* Adaptation means organisms change to better live in their environment. Remind students that most of the examples we've talked about have been examples of behavioral adaptations.
2. Ask students to think of an example of an animal's characteristic that helps that animal to survive.
3. Make a list on the board.
4. Do a "Birdbrain Storm." Ask the students to share with the class what they know about birds. What makes a bird a bird? What do birds need to survive? What kinds of food do students think birds eat? (Insects, seeds, berries, and meat are among the most common.) Where do birds live? Can students name some birds they see or hear near their home or school?
5. Use an overhead with pictures of birds and their beaks (the beaks of these birds should reflect the supplies you are using).
6. Have students open their science notebooks or take out a piece of paper.
7. Label the top "My Predictions" and number 1 through 8.
8. Project the Bird Beak and Adaptation chart on the board (covering all but the bird beak pictures).
9. Have students predict what each bird eats with its beak and write any ideas they have about how it might use its beak to eat. Students may want to sketch the beak next to their predictions.
10. In front of the class, arrange:
* A tall, thin vase filled with colored water
* A dish of potting soil with gummy worms buried throughout
* Sunflower seeds spread throughout a pan
* A dish of water with Styrofoam cubes floating in shallow water
* A dish of water with loose-leaf tea or herbs
* Popped popcorn
* Rice grains tucked into the bark of a log (or Styrofoam)
* Marshmallows hanging on strings.
1. Tell students that each of these items represents a type of food eaten by various birds.
2. Ask students if they can hypothesize what each bird would have to do to reach its food supply. Does the shape of a bird's beak limit its food supply? (See chart below.)
3. Ask students if they have ever wondered why there are so many types of bird beaks. The most important function of a bird beak is feeding, and it is shaped according to what a bird eats. You can use the type of beak as one of the characteristics to identify birds. Here are some common beak shapes and the food they are especially adapted to eat:

|  |  |  |
| --- | --- | --- |
| **SHAPE** | **TYPE** | **ADAPTATION** |
| cracker | Cracker | Seed eaters like sparrows and cardinals have short, thick conical beaks for cracking seed. |
| shredder | Shredder | Birds of prey like hawks and owls have sharp, curved beaks for tearing meat. |
| chisel | Chisel | Woodpeckers have beaks that are long and chisel-like for boring into wood to eat insects. |
| probe | Probe | Hummingbird beaks are long and slender for probing flowers for nectar. |
| strainer | Strainer | Some ducks have long, flat beaks that strain small plants and animals from the water. |
| spear | Spear | Birds like herons and kingfishers have spear-like beaks adapted for fishing. |
| tweezer | Tweezer | Insect eaters like warblers have thin, pointed beaks. |
| swissarmy | Swiss Army Knife | Crows have a multi-purpose beak that allows them to eat fruit, seeds, insects, fish, and other animals. |

1. Divide class into eight different groups.
2. Pass out challenge cards to each group. Each group gets a different food source and a set of three different utensils, which they are to use as sample "beaks." The Challenge Cards are:

**Challenge 1 *-* Graduated Cylinder**

1. You have been given a graduated cylinder with 50 mls of water as a food source. You have also been given sample beaks: 1) a shoestring, 2) a medicine dropper, and 3) a sponge strip.
2. Your challenge is to find out how many seconds it takes each "beak" to get 10 ml of water from the graduated cylinder to the cup.
3. Record the three times in the data table provided. Try several trials with each "beak."
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 2 - Gummy Worms**

1. You have been given gummy worms as your food source. You have also been given sample beaks: 1) a straw, 2) chopsticks, and 3) a wrench.
2. Your challenge is to find out how many seconds it takes to remove the gummy worms from the dirt using each "beak."
3. Use multiple trials, burying the worms after each trial.
4. Record your times in the data table.
5. Calculate the average time for each "beak."
6. Construct a bar graph of the averages.

**Challenge 3 - Sunflower Seeds**

1. You have been given sunflower seeds as your food source. You have also been given sample beaks: 1) pliers, 2) chopsticks, and 3) tweezers.
2. Your challenge is to find out how many seconds it takes each "beak" to crack the shell and remove the seed inside.
3. Record your times in the data table. Try this several times.
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 4 - Styrofoam Squares**

1. You have been given floating Styrofoam squares as your food source. You have also been given sample beaks: 1) chopsticks, 2) tweezers, and 3) a slotted spoon.
2. Your challenge is to find out how many seconds it takes each "beak" to remove all of the Styrofoam square from the water. Try several trials, returning the squares after each trial.
3. Record your times in the data table. Try this several times.
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 5 - Tea**

1. You have been given loose tea as your food source. You have also been provided sample beaks: 1) a slotted spoon, 2) a strainer, and 3) tweezers.
2. Your challenge is to find out how many seconds it takes to get all of the tea from the water. Try this several times, returning the materials each time.
3. Record your times in the data table.
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 6 - Rice**

1. You have been given rice as your food source. You have also been provided sample beaks: 1) a medicine dropper, 2) tongs, and 3) tweezers.
2. Your challenge is to find out how many seconds it takes for each "beak" to remove 30 grains of rice from the bark of a tree. Try this several times, returning the rice to the bark each time.
3. Record your times in the data table. Try this several times.
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 7 – Marshmallows**

1. You have been given marshmallows hanging from a string as your food source. You have also been provided sample beaks: 1) chopsticks, 2) tongs, and 3) a turkey skewer.
2. Your challenge is to find out how many seconds it takes for each "beak" to remove five marshmallows from the string. Try this several times.
3. Record your times in the data table. Try this several times.
4. Calculate the average time for each "beak."
5. Construct a bar graph of the averages.

**Challenge 8 – Popcorn**

1. You have been given popped popcorn as your food source. You have also been provided sample beaks: 1) tongs, 2) an envelope, and 3) chopsticks.
2. A group member will gently toss some kernels into the air.
3. Your challenge is to find out how many seconds it takes to capture 20 kernels with each "beak." The kernels must be caught while they are in the air.
4. Try this several times.
5. Record your times in the data table.
6. Calculate the average time for each "beak.'
7. Construct a bar graph of the averages.
8. After they read their card, ask students to write which "beak" they predict will work best for "eating" their specific "food" in their science notebooks. Each group will follow the directions on their challenge card.
9. Have them record the results for their challenge in their notebooks.
10. Ask each group to describe their "food" and rationalize which shape of beak and bird from the overhead they think would best suit the food source.
11. Ask them if they can think of any other adaptations that might help each bird better survive in its niche.
12. Ask the class as a whole what kinds of adaptations they think birds in this area might have (osprey, magpie, or pet birds, etc.).
13. Review how students made predictions about what each bird will eat. Were their predictions supported with evidence?
14. Have them write an explanation next to their prediction. How might they see things differently after doing the experiment?
15. As a final question, ask students to relate what might happen to a bird population if its natural environment experienced a natural disaster where all the flora or fauna were wiped out. What would happen if a farmer used an insecticide that killed off all the insects? What would happen to woodpeckers or other birds that eat small bugs? What would happen if the old trees and snags were cut down? Where would osprey and eagles watch for their meal?

**Explore**

**Activity 3 – Creeping and Crawling: Observing Mealworms and Earthworms**

Purpose

Students will observe mealworms and earthworms to determine observable traits and to investigate responses of these animals to a number of variables. These variables will identify a variety of responses expanding student understanding of inherited and learned (acquired) behaviors.

**Activity Description**

Students will explore animal behaviors and conduct experiments to observe responses from two different kinds of animals. Students use these observations to identify inherited and learned traits and behaviors occurring in six different tests the animals are given. The tests demonstrate how different animals respond to the same stimulus and promote questions about how these responses can be advantageous. This activity was adapted from an article from [www.agclassroom.org/ut](http://www.agclassroom.org/ut).

Duration

Two-three class sessions

Materials

* 25-50 live mealworms. Mealworms are very inexpensive and can be purchased at any pet store. Please read “Caring for Mealworms” below.
* 25-50 live earthworms or night crawlers. Earthworms are very inexpensive and can be purchased at any fishing supply store.
* One tray for each group
* One metric ruler for each group
* Black and white construction paper to cover half of each tray
* One flashlight for each group
* Two chenille stems for each group
* Several items to serve as barriers, such as pencils, clothespins, blocks of wood, crumbled pieces of paper, or soil for each group
* Paper towels
* Waxed paper
* One pipette or eyedropper for each group
* One small container of water for each group
* Bran flakes or oatmeal, carrot tops or celery leaves
* An assortment of mealworm adults, larvae, and pupae (if you do not grow mealworm larvae to adulthood); see “Additional Resources” for ordering information

**Teacher Preparation**

1. Obtain a class supply of mealworms and earthworms.
2. Gather and organize the sets of materials for each experiment.
3. Check materials list for supplies.

Classroom Procedure

1. Explain to students that teams will investigate mealworms and earthworms and that they will record their observations, questions, and conclusions in their science journals.
2. Divide students into cooperative groups of three or four students.
3. Place a live mealworm and a live earthworm on a tray for each group.
4. Allow students to observe these organisms moving around on the tray.
5. Have students sketch each organism, measure how long each is, record how each one moves about, and chart any kind of noise made as it moves.
6. Have students discuss which end is the head and which is the tail of each organism. Have them give observable evidence to justify their reasoning.
7. Encourage students to gently pick up each organism and describe what it feels like on their hands.
8. After allowing students to make their initial observations, gather the trays and return the worms to their containers.
9. Have each group rotate through the six experimental situations, allowing approximately 20 minutes for each. Group work stations are described below:
10. Use questions for discussion, investigation and assessment.
* As a class, list examples of instinctual and learned behaviors in other organisms and humans.
	+ Examples of instinctual behaviors include: wolves living in a pack, moths flying toward the light, and bird and salmon migrations.
	+ Examples of learned behaviors include: riding a bike, dogs scratching at the door to be let outdoors, and cats meowing to be fed.
* Discuss the role that instinctual and learned behaviors might play in providing an organism with a survival advantage or disadvantage in a particular environment.
* Have teams present arguments to support their claims for the meal worms and earthworm behaviors.

Black and white surface stimulus:

1. Give each group a tray with half of the surface covered with black paper and the other half with white paper.
2. Have students predict whether mealworms will prefer the black or white surfaces and justify their predictions.
3. Place several mealworms directly on the dividing line between black and white.
4. Allow 5-10 minutes for students to observe the mealworms’ behaviors. Have students record their observations with an explanation for the mealworms’ behaviors.
5. Repeat this process with earthworms.

Light and touch stimulus:

1. Have students predict the mealworms’ response to light from a flashlight, and to being gently touched with a chenille stem. Have students justify their predictions.
2. Put mealworms on trays and give one to each group.
3. Shine a flashlight directly on the mealworms and observe their behaviors.
4. Gently touch the mealworms with a chenille stem that has a small loop at that end and observe their behaviors.
5. Allow 5-10 minutes for students to observe the mealworms’ behaviors. Have students record their observations with an explanation for the mealworms’ behaviors.
6. Repeat this process with earthworms.

Barrier stimulus:

1. Give each group several items to act as barriers (a pencil, a clothespin, a block of wood, a crumpled piece of paper, or a pile of soil, etc.).
2. Have students predict the mealworms’ responses to these barriers. Will they initially go around a barrier? Crawl over it? Burrow underneath it? Try to keep going forward? Go backwards? Will their responses differ for different barriers? Have students justify their predictions. Allow 5-10 minutes for students to observe the mealworms’ behaviors. Have the students record their observations with an explanation for the mealworms’ behaviors.
3. Repeat this process with earthworms.

Moisture stimulus:

1. Have students predict whether mealworms will prefer a moist surface or a dry surface and have them justify their predictions.
2. Give each group a tray with half of the surface covered with a moist paper towel and the other half covered with a dry paper towel.
3. Place several mealworms directly on the dividing line between moist and dry.
4. Give each group a pipette or eyedropper and a small container of water. Have students gently place one drop of water on each mealworm and make observations of its response. Have students record their observations in their journals with an explanation for the mealworms’ behaviors.
5. Repeat this process with earthworms.

Temperature stimulus:

1. The day before this activity, place several slightly damp paper towels in a freezer. Place layers of waxed paper in between the damp paper towels for easy separation.
2. Prior to this activity, slightly moisten several paper towels and leave them at room temperature.
3. Just before this activity, place several slightly damp paper towels in a microwave to heat them.
4. Have students predict how mealworms will react to a cold surface, a room-temperature surface, and a hot surface, then have them justify their predictions.
5. Give each group a tray and a cold, a hot, and a room-temperature paper towel.
6. Place several mealworms on each paper towel.
7. Allow 5-10 minutes for students to observe the mealworms’ behaviors. Have students record their observations with an explanation for the mealworms’ behaviors.
8. Repeat this process with earthworms.

Food stimulus:

1. The day before this activity, put mealworms and earthworms in a container with no food for 24 hours.
2. Have students predict how hungry mealworms will react when a food source is placed at the other end of a tray. Will they follow a direct route to the food? Will they meander around until they find it? Will they ignore it? Give each group a tray with a small pile of bran flakes at one end.
3. Place several mealworms on the opposite end of the tray from the bran flakes.
4. Allow 5-10 minutes for students to observe the mealworms’ behaviors. Have students record their observations with an explanation for the mealworms’ behaviors.
5. Repeat this process with earthworms, using carrot tops or celery leaves instead of bran.

**Explore**

**Activity 4 – Stories from the Fossil Record**

**Purpose**

To develop an understanding of what fossils are, how they are formed, environmental conditions when they lived, and changes that have occurred over time.

**Activity Description**

Students use an online website to study what fossils are and how they are formed. The website guides students through four different categories of fossil studies: Paleoecology, Biodiversity, Geologic Time, and Past Lives.

**Focus Question**

What are fossils and what do they tell us?

**Duration**

Two class sessions

**Materials**

Website for materials and procedure: [**http://www.ucmp.berkeley.edu/education/explorations/tours/stories/guide/index.html**](http://www.ucmp.berkeley.edu/education/explorations/tours/stories/guide/index.html)

Teacher Preparation

1. Visit website prior to students doing the activity, and familiarize yourself with the site.
2. Make a class set of the fossil evidence student handout sheet.
3. Make a class set of the vocabulary list.
4. Make a class set of the pre- and post-test.

**Classroom Procedure**

1. Introduce the class to the topic of fossils by describing the activity and its objectives.
2. Give the pre-test and ask students to put the pre-test in their notebook for reviewing after the activity.
3. Give each student a copy of the fossil evidence chart and the terms list.
4. Have students work in pairs as they go to the website.
5. Instruct class that each group may proceed through the four topics at the website in any order.
6. Make sure all groups understand how to navigate through the website.
7. Explain that groups will need two days to complete the four different topics.
8. When all groups have completed the four topics, discuss with class the evidence chart. Draw attention to evidence and non-evidence and clarify the difference.
9. Give students the post-test.

Explore

A**ctivity 5 – Sequencing Time**

**Purpose**

To develop an understanding of time sequencing and to relate the sequencing of personal life experiences with Earth events so that students can explain and experience relative time.

**Activity Description**

Students will use their own life events to sequence and assign relative times to each event. Students will construct a personal time sequence. This activity helps students personalize life events and sequence them in a chart similar to events in the History of the Earth Sequence so that reference can be given to the relative and/or numerical time at which each event occurred. The activity helps to make sense of the enormous expanse of time that has elapsed since the origin of the Earth. The activity will help students understand the methods used by geologists in creating the Geologic Time Scale.

**Key Question**

How can we develop a personal time sequence chart?

## Duration

## Two class sessions

## Materials

* A copy of the worksheet “Events in Your Life”

<http://www.ucmp.berkeley.edu/fosrec/ScotchmoorTime.html#events>

* A copy of the sheet “Your Personal Time Line” (click here to download a PDF version)

<http://www.ucmp.berkeley.edu/fosrec/ScotchmoorTime.html#pers>

<http://www.ucmp.berkeley.edu/fosrec/images/timeline.pdf>

* Explore this link for additional information on the topics covered in this lesson: Geologic Time

<http://evolution.berkeley.edu/evosite/evo101/IIEAddingtime.shtml>

**Classroom Procedure**

1. Tell the students to look at the events listed on the sheet titled “Events in Your Life.” Arrange these events in order, by placing the number 1 in front of the event that occurred first in your life, a number 2 for the second, etc.
2. On the worksheet titled “Your Personal Time Line,” write these events in order in the third column, “Sequential Time.” Write them so that the most recent event is at the top of the list, and the event that occurred first is at the bottom of the list. This list is now similar to what a geologist might refer to as a Sequential Time Line.
3. Teacher should use his/her own sequential time line to describe events in his/her life. For instance, “I learned to ride my bike after I learned to walk but before I started second grade.”
4. Have the students describe events in their lives in a similar way.
5. Now, using sequential time, ask “How could you describe when *Tyrannosaurus rex* roamed the Earth?”
6. Return to your time line worksheet. In the middle column titled, “Numerical Time,” place a zero by today's date.
7. Ask class to write the number of years ago each event happened. Write these numbers in the column in front of each event. Round off to the nearest whole year.
8. These numbers are the numerical ages of the event and make up a numerical time line. Now you can use both the sequential and the numerical information to describe events in your life. Using both of these, describe when you started kindergarten. An example might be: “I started kindergarten four years ago, after I learned to walk but before I lost my first tooth.”
9. Divide the events into two time intervals. Draw a horizontal line above the last event that happened before you started kindergarten. Now every event above the line took place after kindergarten, and every event below the line took place before kindergarten.
10. In the first column titled “Time Interval,” write the word **Preschoolian** below the line and the word **Schoolian** above the line.
11. This worksheet now resembles a complete time line for the events in your life. They are in the proper sequence. They have been given a date in time, and they have been grouped into two major event groups.
	1. Describe a single event using the information in all three columns. An example: “I started Kindergarten at the beginning of Schoolian time, four years ago...”
	2. Think of another event which has occurred in your life. For example, the first time you tasted pizza. You probably cannot remember the exact year when that occurred, but you probably can place it between two events that you can remember. Therefore, you would know its relative time. How could you give it a numerical time?
12. Have students compare the Personal Time Line to the actual Geologic Time Scale to note similarities and differences.

Explain

Activity 6 – What Came First?

Purpose

To construct a timeline and gain an understanding of deep time—[4.6 billion years of Earth's history](http://www.ucmp.berkeley.edu/exhibit/geology.html).

Activity Description

This activity is an effective follow-up to [Sequencing Time](http://www.ucmp.berkeley.edu/fosrec/ScotchmoorTime.html). After Sequencing events in their own lives and assigning each a numerical time, students use the same process to sequence actual events in the evolution of life on Earth.

Students also will become familiar with events in the Earth's history and how they relate to one another.

**Key Question**

How does a time sequence chart help us understand the Earth’s history?

**Duration**

Two class sessions

**Materials**

A time line made of adding machine tape or strips of vinyl glued together. You will need a length of 25.5 feet. (A product called Goop is an excellent adhesive for the vinyl strips.)

**Teacher Preparation**

1. Explore these links for additional information on the topics covered in this lesson:
* Nature of Science

<http://evolution.berkeley.edu/evosite/nature/index.shtml>

* Geologic Time

<http://evolution.berkeley.edu/evosite/evo101/IIEAddingtime.shtml>

* History of Life

<http://evolution.berkeley.edu/evosite/evo101/IIHistory.shtml>.

1. Prepare the time line using a scale of 1" = 15 million years. The timeline begins 4.6 billion years ago.
2. Mark this at one end of the time line.
3. Place the following information at the distances indicated in the table below (bya = billions of years ago, mya = millions of years ago).
4. Make Event Cards by copying images and text from sources provided, and pasting them into a PowerPoint file.
5. Print in handout mode—two slides per page.
6. Select various events in the Earth's history—one for each student or team of students.
7. Select an appropriate number of events for your class size (either small group or individual students).
8. Use events that will be meaningful to your students. Suggestions include: [Bacteria](http://www.ucmp.berkeley.edu/bacteria/bacteria.html), [Green algae](http://www.ucmp.berkeley.edu/greenalgae/greenalgae.html), [Jellyfish](http://www.ucmp.berkeley.edu/cnidaria/cnidaria.html), [Trilobites](http://www.ucmp.berkeley.edu/arthropoda/trilobita/trilobita.html), [First vertebrate](http://www.ucmp.berkeley.edu/vertebrates/vertsy.html), [Spiders](http://www.ucmp.berkeley.edu/arthropoda/arachnidasy.html), Ferns, [Earthworms](http://www.ucmp.berkeley.edu/annelida/annelida.html), Greatest extinction, Formation of Pangaea, [First mammal](http://www.ucmp.berkeley.edu/synapsids/synapsida.html), [Sharks](http://www.ucmp.berkeley.edu/vertebrates/basalfish/chondrintro.html), [*Archaeopteryx*](http://www.ucmp.berkeley.edu/diapsids/birds/archaeopteryx.html), [First flowering plants](http://www.ucmp.berkeley.edu/anthophyta/anthophyta.html), [Ants](http://www.ucmp.berkeley.edu/arthropoda/uniramia/hymenoptera.html), *Triceratops*, Grass, Camel, and "Lucy" or any other events of note to your students.

**Classroom Procedure**

1. Hang the time line around the room and discuss what it is. See if students can name any of the time periods. Identify the [Pre-Cambrian](http://www.ucmp.berkeley.edu/precambrian/precambrian.html), [Paleozoic](http://www.ucmp.berkeley.edu/paleozoic/paleozoic.html), [Mesozoic](http://www.ucmp.berkeley.edu/mesozoic/mesozoic.html), and [Cenozoic](http://www.ucmp.berkeley.edu/cenozoic/cenozoic.html).
2. Ask each student or team of students to pick one Event Card. Explain that each card represents the first evidence of an organism in the fossil record or the occurrence of a particular event during the Earth's history.
3. Have students arrange themselves in sequence according to their event—the oldest event first and the most recent last.
4. Undoubtedly there will be some errors. Most students are surprised that grass is so recent and spiders are so old! Allow discussion as you place students in the correct sequence.
5. Now that the proper sequence of events has been determined, ask students to stand in front of the time line at the place that represents the right age of the event.
6. Once again, there will probably be many errors. Move students to the correct places and discuss. Students are surprised to see that for very long periods of early history, very little happened. Then there was the [Cambrian Explosion!](http://www.ucmp.berkeley.edu/cambrian/camb.html)
7. Students can find other events to research and add to the time line.
8. Students can make their own time lines. Adding machine tape is an excellent material for individual time lines.

**Sample Event Card**

[](http://www.ucmp.berkeley.edu/synapsids/pelycosaurs/dimetrodon.gif)

The mammals of today are but one branch of the Synapsida, a great vertebrate group with a 300-million year history. Pre-mammalian synapsids—including the famous "finback" Dimetrodon, shown at the top left—dominated the land vertebrate fauna of the Permian and early Triassic before losing ground to the diversifying dinosaurs and other archosaurs. These pre-mammalian groups have at times been called "mammal-like reptiles." This term is now discouraged because although many had characteristics common with mammals, none of them were actually reptiles.



**Elaborate**

**Activity 7 – Creepy Critters**



## Purpose

## To apply inherited traits to the task of describing organisms and their relationships.

## Activity Description

In this activity, students will use traits to classify living things. Scientists who study living things organize them into categories based on their relationships. Early classification systems were based simply on how things looked. Now scientists focus on genetics, cellular make-up, and other more specific traits when they classify creatures. Classification systems include big groups subdivided into smaller groups. Here's one way classification might work using aliens as an example. (This activity is based on an activity developed by the National Association of Biology Teachers.)

**Focus Question**

How do traits help us to classify organisms?

**Duration**

One class session

**Materials**

* Scissors
* Critter cards
	+ [http://www.microbeworld.org/images/stories/resources/experiment/cards1.gif](http://www.microbeworld.org/images/stories/resources/experiment/cards1.gif%20%20)
	+ <http://www.microbeworld.org/images/stories/resources/experiment/cards2.gif>
	+ [http://www.microbeworld.org/images/stories/resources/experiment/cards3.gif](http://www.microbeworld.org/images/stories/resources/experiment/cards4.gif%22%20%5Co%20%224%22%20%5Ct%20%22_blank)
	+ [http://www.microbeworld.org/images/stories/resources/experiment/cards4.gif](http://www.microbeworld.org/images/stories/resources/experiment/cards4.gif%20%20)
	+ <http://www.microbeworld.org/images/stories/resources/experiment/cards5.gif>
	+ [http://www.microbeworld.org/images/stories/resources/experiment/cards6.gif](http://www.microbeworld.org/images/stories/resources/experiment/cards6.gif%20)

**Teacher Preparation**

1. Present the following scenario to your class. “Imagine it's the year 2525. A planet similar to Earth has recently been found in a newly identified solar system in another galaxy. We have sent a space probe with a molecular transport beam to this planet to beam back a variety of living creatures. Scientists examine the structure of each of these creatures and realize they need to create a classification scheme to help them compare the alien life forms to each other and to discover how the life forms might be related. The lead scientist sends you illustrations of the organisms and asks you to help develop this classification system. Your role is to study the illustrations and come up with a possible classification scheme based on the information provided about each organism. You'll be asked to explain to the scientific team how and why you organized the creatures this way.”
2. Have students print out the pages in the Materials list and follow the directions to do this activity at home. When they’ve completed the activity, have students test their newfound knowledge by answering the questions included in Classroom Procedure. (No fair peeking at the answers before doing the activity!)

Classroom Procedure

1. Teacher clicks on the link in the Materials list for critter cards pages. Print out each page and cut out the cards. Keep the last four cards separate from the others.
2. Have students study all the cards except the last four, noting similarities and differences among the creatures. Have students create a table on their paper to help organize what they see. They might have columns to describe bristles, antennae, eyes, etc. They might want to number their cards to help keep track of what they’re describing.
3. Now have students put the cards (except the four they’ve kept separate) into groups based on the similarities and/or differences they see. Each group should include creatures that have something in common. Now have students create a new table, listing the traits common to each group they’ve made.
4. Have students choose one of the cards from the four they’ve kept separate. This is a picture of a creature just beamed back by the space probe and sent to students by the lead scientist. They need to decide where it fits in the group system they’ve just created. Do they need to make a new group for this creature, or can they find some way to fit it into one of the existing groups?
5. Have students write a brief paragraph explaining their classification scheme, how it works, and how easy or hard it is to fit new creatures into it.
6. Ask these questions:
* Why do we classify things?  [Answer](http://www.microbeworld.org/index.php?option=com_content&view=article&id=345" \t "_blank)
* Is your way the only way possible to organize the critter cards? [Answer](http://www.microbeworld.org/index.php?option=com_content&view=article&id=346" \t "_blank)
* Do you happen to know the biological classification scheme used by scientists who study living things?  [Answer](http://www.microbeworld.org/index.php?option=com_content&view=article&id=347" \t "_blank)



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