❖ Teacher Notes ❖
for
The Apprentice's Companion
for
Life Science

Tracy Creek

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Teacher Notes for The Apprentice's Companion for Life Science

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Contents

These notes for teachers are designed to accompany select activities in *The Apprentice's Companion for Life Science* (*ACLS*). Note also that your MyLibrary account page for *ACLS* at classicalacademicpress.com contains several resources that also accompany *ACLS*.

Introduction

With respect to the "On Natural History, Observation, and Sketching" section, we encourage teachers to go as deep with this as possible, given the constraints of your course. Consider these resources:

- At ClassicalU, the professional development video resource for teachers at Classical Academic Press, check out the course "Essentials of Drawing" with Brighton Demerest-Smith.
- Read Samuel H. Scudder's famous essay about learning to observe well, "In the Laboratory With Agassiz." You can find it at https://philosophy.lander.edu/intro/introbook2.1/x426.html.
- Read the delightful, Pulizer-Prize winning book by Annie Dillard, *Pilgrim at Tinker Creek*. Dillard's descriptions of her extended visits to Tinker Creek, where she spent hours observing nature and its wonders, are truly remarkable and will inspire you and your students.
- Enhance your ability to lead the students by learning about keeping a Nature Journal. Here are a few resources to get you started.
  - https://www.lilyandthistle.com/how-to-start-a-nature-journal-today/
  - Leslie, Clare Walker & Charles E. Roth. Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You. Storey Publishing, LLC. 2003.
    ISBN: 978-1580174930.

Activity 3 Collecting, Preserving, and Mounting Flowering Plants, Tree Leaves, or Insects

Activity 3 is fully laid out as three separate collections in Appendix A. This activity needs to be scheduled before the first frost. You must decide whether to allow your students to choose one or more of these three collections or to assign whichever collection works best for your situation. You may choose to divide the class into three groups and assign one collection to each group. After the collections are completed and mounted, divide the class into lab groups that contain at least one of each collection and have them analyze their work together. Your students can help you to collect materials such as small jars, newspapers, and cardboard boxes.

There are several smartphone apps, such as NatureID, that identify plants, making the identification part of this activity very easy. All these apps require an annual fee.

Activity 4 Elements and Compounds

You will only need to purchase the chemicals to create these comparison sets once. They are used for observation only and can be kept from year-to-year. Make one set of six jars for the classroom, or make one set of six jars for each lab group. The jars should be tightly closed and labeled with the name of each chemical and its formula. Use the labels to identify the jars in two separate groups: one group is S, Cu, and C_uSO_4, the other is C, H_2O, and sugar. Students should be reminded not to open the jars.

The carbon for this activity can be coal, charcoal, or graphite.

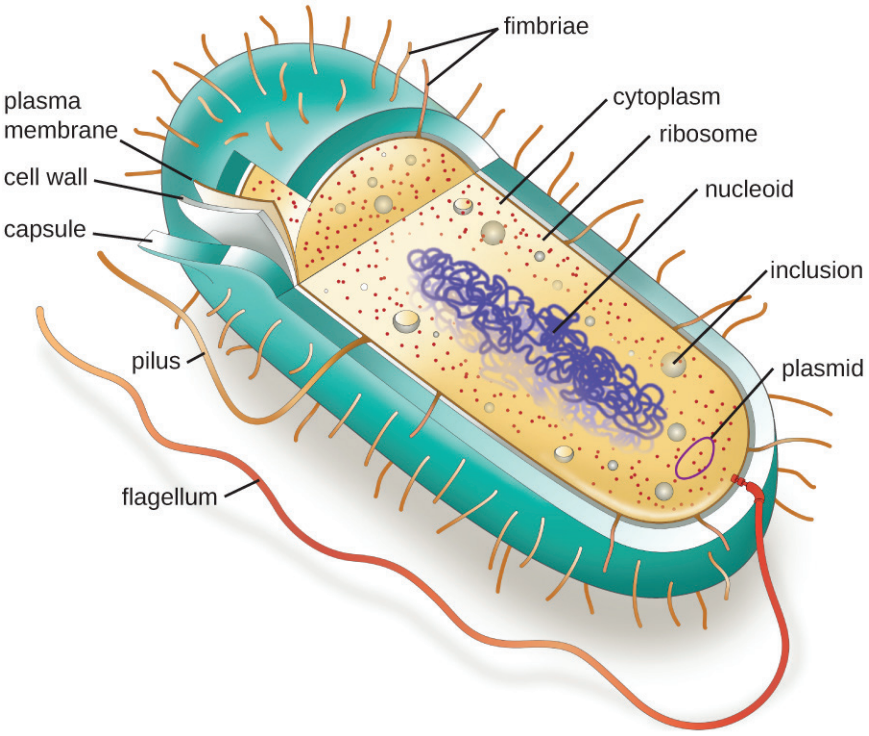
Activity 5 Organic Molecules

This activity is one of several that involve cutting and pasting. To access the Food Images pdf, login to your Classical Academic Press account, click account, and View on My Library. Print copies of this page for each student.

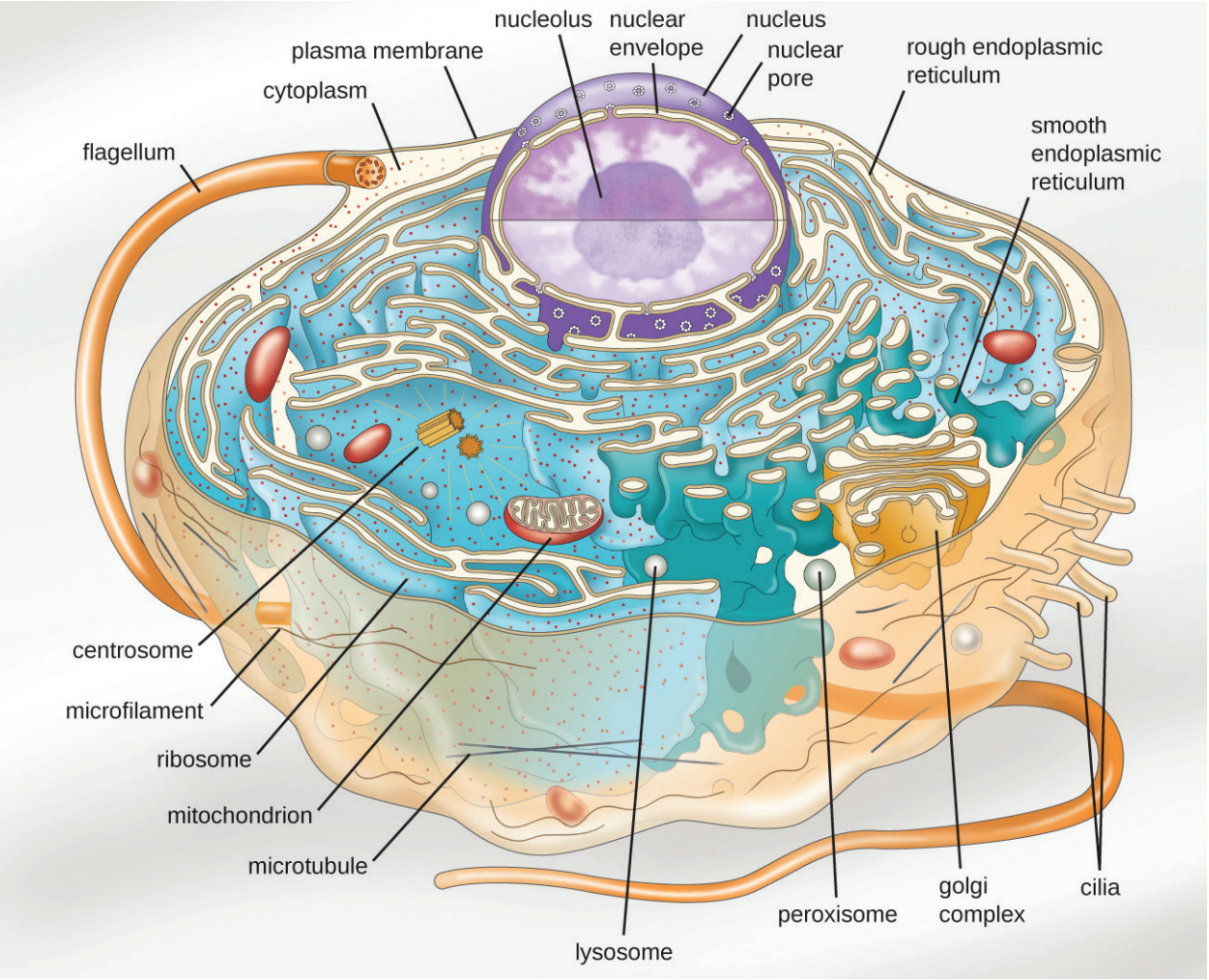
Activity 6 Cell Organization and Function

The following images may be used to check students' work.

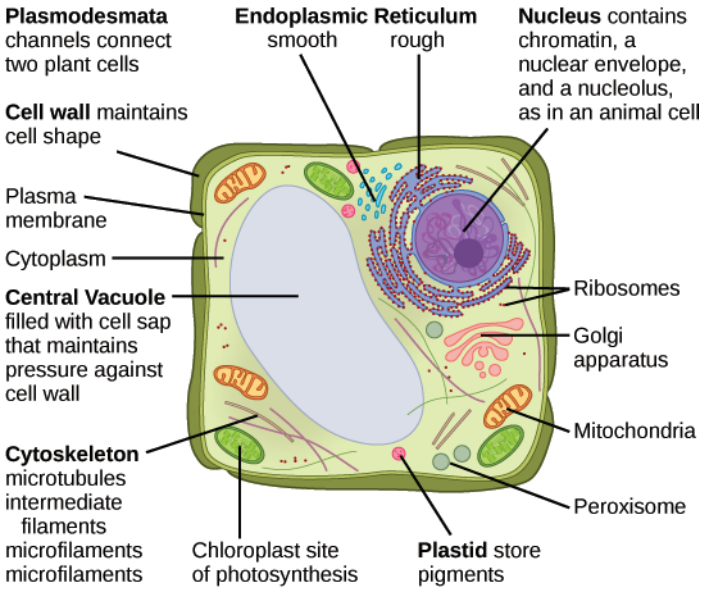
Prokaryotic cell:



Eukaryotic animal cell:



Eukaryotic plant cell:



Activity 7 Muscles and Bones

Boiling a whole chicken in order to remove the meat and clean off the bones is not something that can readily be done in a classroom. If it is possible to have your students complete this part of the Activity as homework, it will provide them with the opportunity to observe and compare different types of muscle tissue. It will also give them in increased sense of ownership of this task. However, if this is not practical in your situation, you may choose instead to prepare the bones yourself. Each lab group will need a complete set of bones to work with.

If multiple classroom groups will prepare their own chickens in class, the chickens can be prepared on different days. Then the classifying activity can be done by all groups on the same day, after all the chickens are prepared.

Activity 11 Vegetative Propagation

Although all your students should have an opportunity to compare the produce with the images in their textbook in order to identify them as bulbs, corms, runners, rhizomes, or tubers, every student or lab group does not need to attempt to grow every type of produce in the list. Feel free to assign one or two plant parts to each student or lab group.

Some advice on lettuce propagation: Remove all of the leafy pieces you can without cutting into the stem of the plant as the leaves will rot quickly. Change the water daily. If desired, the lettuce can be transferred to soil after the roots begin to grow.

Activity 13 Enzymes

In water, the iodine drops are dark brown, with a yellow tinge at the edges where the iodine is diluted. The

brown color indicates no starch.

In the presence of starch, the color changes from dark brown to dark purple.

On a cracker that has been masticated long enough to completely break down the starch, the iodine does not change color, but remains dark brown. If the iodine does change color, the starch in the cracker was not completely broken down to sugar.

Activity 14 Fermentation

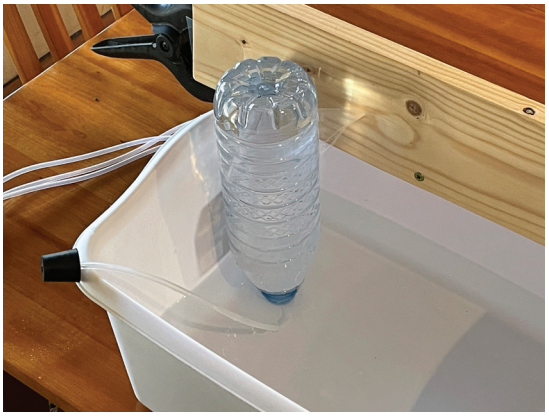
Note that the water basin must have enough spare capacity so that it does not overflow as additional water is pushed into it from the gas collecting bottles as they fill with CO_2.

Gas volumes produced during our pilot were:

#1	0
#2	120 mL
#3	320 mL
#4	500 mL

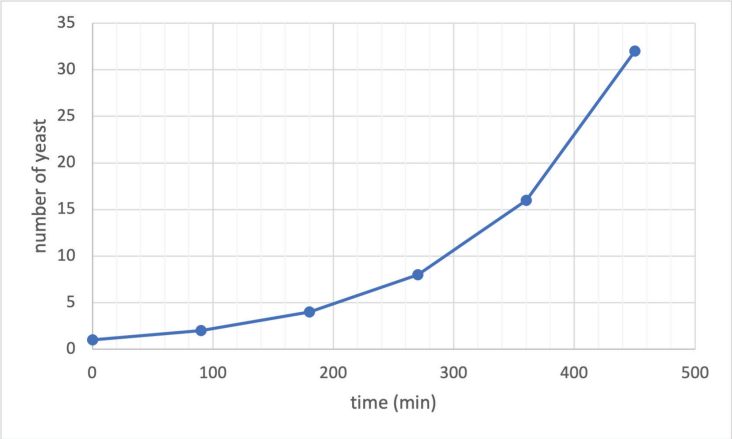
The mass scale required for weighing out the sugar adds some cost to this experiment. However, the balance recommended in the materials list is relatively inexpensive and works great as a scale in the kitchen for cooking. For home school families, this makes the investment worthwhile. Of course, the scale may also be used for experiments in later science courses.

Below are some photos showing the setup.



For classroom teachers repeating this experiment year after year: This experiment can be enhanced if you are able to 1) make (or have someone make) a rack for holding the four gas collecting bottles so that they are not covered in tape and can be easily marked anywhere on the bottle (at any water level); and 2) monitor and record the gas levels every 15 minutes for 2–3 hours. A rack would need to fit in the basin and hold the bottles 1/4 in above the bottom of the basin. It would also need to be designed so that the bottles can be placed into the rack without raising the bottle opening above the surface of the water, so that none of the water escapes from the bottle.

The enhancement would be to mark the water level on each bottle every 15 minutes for the duration of the experiment. (This may be impractical for schools where students change classrooms, but could work for home schools and for school classrooms if students remain in the same room for the day.) Beside each mark write the corresponding run time—15 min, 30 min, 45 min, etc. Students could then determine all the volumes corresponding to the marks and make a graph showing the volume of gas in each bottle vs. time. With ample food supply, the population of yeast doubles every 90 minutes, as shown in this chart:



Students can compare their graphs and data to this graph and comment on what they see.

Activity 15 Experimental Design

Prior to this activity, survey all participants for allergies. Have this information available on the day of the activity and make sure all participants are informed accordingly.

Possibilities for odorants include:

Foods: bananas, orange peels, lemon juice, peanut butter, bell peppers, onions, cantaloupe

Dry drink ingredients: coffee grounds, cocoa powder, tea leaves

Spices: cinnamon, paprika, chili powder, oregano, basil, ginger

Extracts or syrups: vanilla, maple, lavender

Nonfood items: crayons, pencil shavings, ivory soap, wet clay, damp earth

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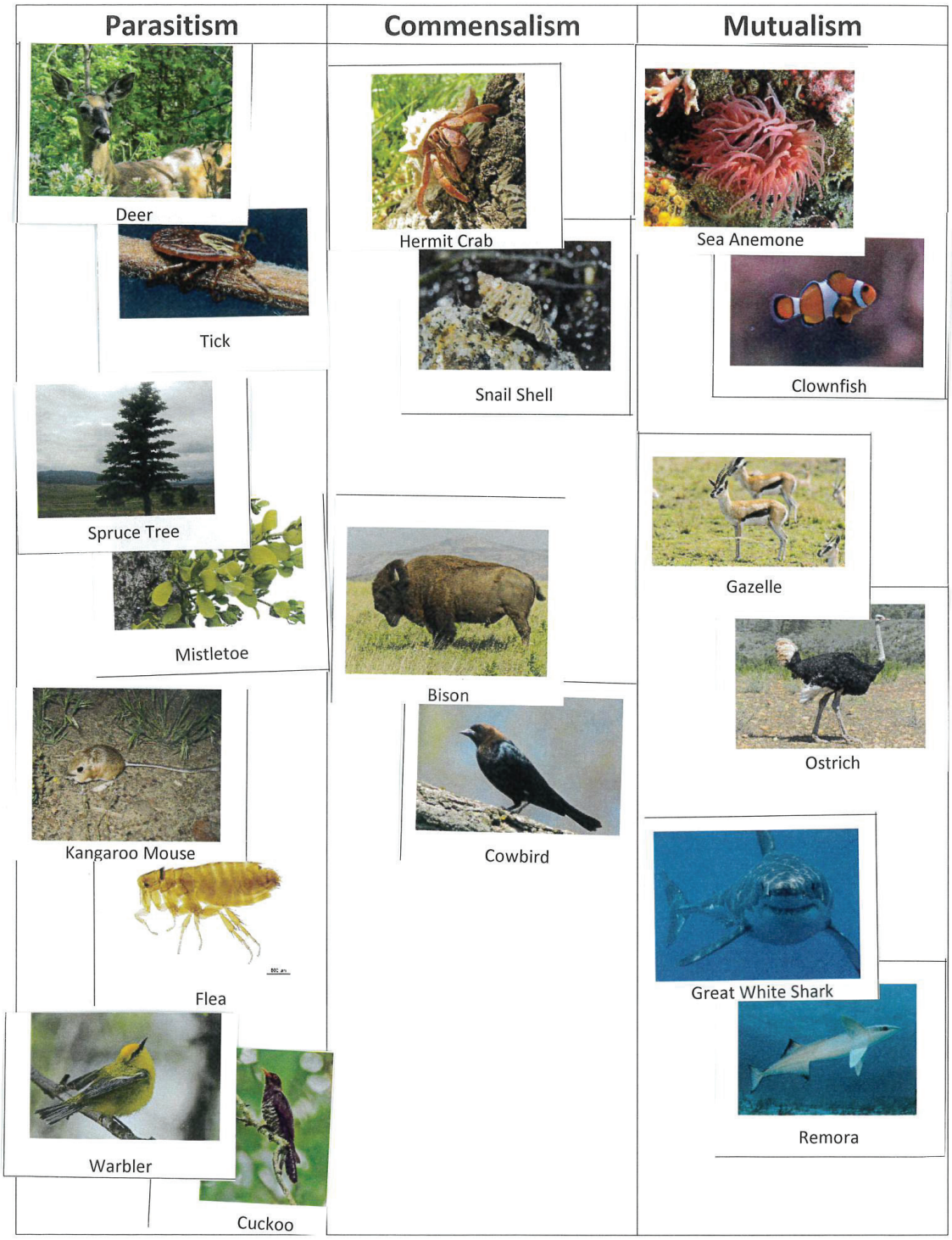
Activity 17 Exponential Growth

If you want to explore further the article about the Fibonacci numbers in nature, check out the adorable YouTube videos by Vihart entitled Doodling in Math: Spirals, Fibonacci, and Being a Plant (parts 1–3).

Activity 18 Classifying Symbiosis

Here is the second activity that involves cutting and pasting. As in Activity 5, access the pdf file of images of various organisms through your CAP account.

Below is an example chart showing the pairings students should discover, followed by definitions and explanations.



Parasitism—a symbiotic relationship in which the parasite benefits while the host is harmed.

Commensalism—a symbiotic relationship in which one organism benefits and the other is neither harmed nor helped.

Mutualism—a symbiotic relationship in which both organisms benefit.

Parasitism pairs:

Dear and Tick: The tick feeds on the deer's blood and the deer is exposed to diseases such as Rocky Mountain spotted fever.

Spruce Tree and Mistletoe: The mistletoe gains nutrients and water from the tree, weakening it and making it at risk for disease and drought.

Kangaroo Mouse and Flea: The flea feeds on the mouse's skin and blood and the mouse is exposed to disease.

Warbler and Cuckoo: Some species of cuckoo find host birds such as warblers and lay eggs in their nests. When the cuckoo egg hatches, the chick will push the warbler eggs or chicks out of the nest.

Commensalism pairs:

Hermit Crab and Snail Shell: The hermit crab makes a home of the discarded sea snail's shell. This does not affect the snail.

Bison and Cowbird: The movement of bison through the prairie grass disturbs insects which the cowbird eats.

Mutualism pairs:

Sea Anemone and Clownfish: The clownfish lives within the anemone's tentacles, scaring off predator fish and providing nutrients to the anemone through its waste. The anemone gives the clownfish protection and shelter.

Gazelle and Ostrich: As gazelles and ostriches feed next to each other, they are alert for predators. Ostriches are taller and have great eyesight, so they can spot predators that gazelles may miss. Gazelles have better senses of smell and hearing, so they may become aware of predators that the ostriches don't see. When either species reacts to the presence of a by fleeing, the other species also flees.

Great White Shark and Remora: The remora fish attach to the shark's underbelly and eat scraps of prey dropped by the shark. They benefit the shark by eating parasites off of the shark's skin, preventing irritation.

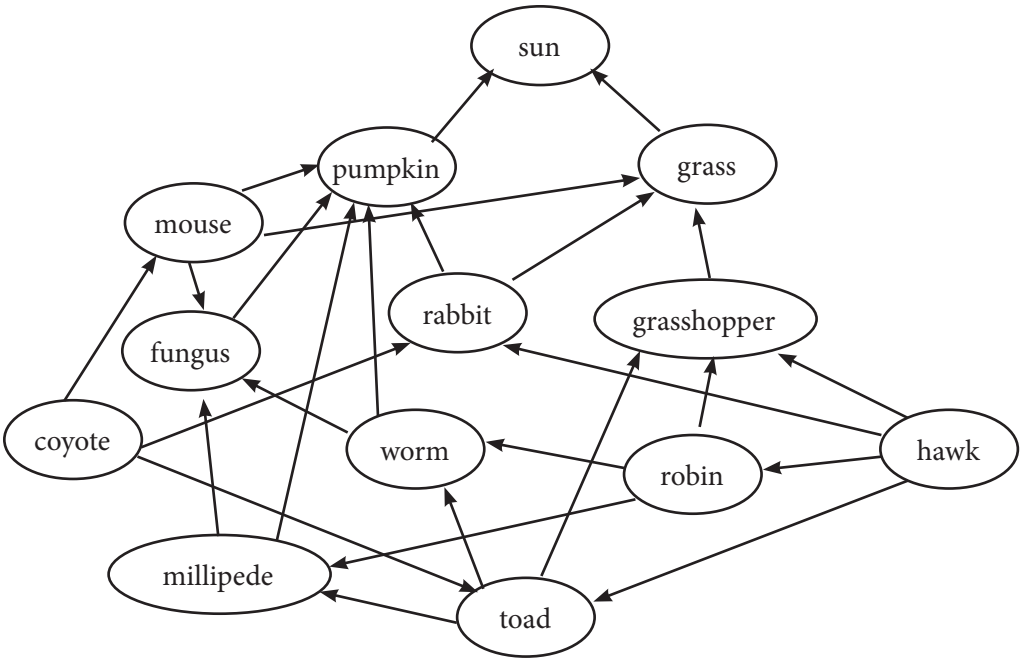
Activity 19 Energy Transfer

This activity is designed to be used in person, with at least a dozen students in a class. Modify the procedure if fewer students are involved or if the group is meeting in a virtual classroom.

Prepare adhesive names tags for each student in the class. Make one for the sun. Others are grasses, grasshoppers, mice, rabbits, rats, robins, hawks, coyotes, millipedes, worms, decaying pumpkins, and fungi.

Prepare the yarns by cutting several 5-ft lengths for each color.

Possible relationships students can establish are shown below. Arrows point to the organism's source of energy.



Activity 20 Ecosystems

This research project may be assigned to students individually or to small groups of up to six students. Students may be allowed to choose ecosystems or can be assigned an ecosystem to study.

Activity 25 Modeling DNA Construction and Replication

Here is the last activity that involves cutting shapes from a handout. As in Activity 5, access the pdf file of shapes for the DNA models through your CAP account.

In this activity, it is helpful if the paper to be cutout is stiff. Have students glue the PDF page onto a piece of cardstock before cutting. Alternatively, print the pdf onto cardstock instead of regular-weight copy paper.

Activity 26 Investigating a Genetic Bottleneck

If your set of 10 colors of beads do not match those in the tables on p. 88, have students mark through and rename the colors that have substitutions.