Decomposition

Grade Level: Elementary, Middle School
Ecological Concepts: Nutrient cycle, Food chain
Arizona Science Standards: Science as Inquiry; Life Science

Materials:
1) Scale (kitchen scale is fine)
2) Plastic tubs
3) Fine mesh netting*
4) Writing/drawing materials
5) Trowels*
6) Water
7) Dead plants or parts of plants
* May be borrowed from SCENE.

BACKGROUND
Decomposition is the process whereby **organic** material is broken down into its smaller molecules. The primary producers, plants, can then use these molecules again. Decomposition is one step in the **food chain**, and thus the **nutrient cycle**, of an ecosystem. Most plant matter, over 90% in terrestrial ecosystems, is not used by herbivores but is broken down by decomposers in the litter and soil.

Decomposers, or **detritivores**, are organisms such as bacteria, fungi, flies and worms. They are consumers in the food chain, just as herbivores and carnivores are. Without detritivores, the Earth would quickly be covered with dead, but not decaying, organic matter. The nutrient cycle would grind to a halt because so many nutrients would be tied up in the dead matter and not available to living organisms.

Decomposition rates vary due to **abiotic** factors such as moisture level, temperature, and soil type. They also vary depending on the amount of initial breakdown caused by the prior consumers in the food chain. This means what form the organic matter is in, original plant or animal, partially eaten, or as fecal matter when the detritivore encounters it. The more broken down the matter, the faster the final decomposition.

GUIDED INQUIRY
Observation/Exploration Period: Examine the habitat for potential sites of decomposition. Places with lots of organic matter like leaves would be likely decomposition sites. Compost piles are hotbeds (pun intended) of decomposition. Warning: Whenever handling litter like leaves or grass, be on the watch for scorpions.

Group Discussion and Question Period: Does our habitat have decomposers? If so, what kinds? How fast does decomposition occur? What factors affect the decomposition rate? Does the amount of moisture available affect decomposition? What causes some plants to decompose faster than others?

Important aspects of guided inquiry are encouraging students to generate multiple hypotheses, and letting students make decisions about what data are important and create their own data sheets. Keeping these ideas in mind, the sample in the box below illustrates how ONE OF MANY possible investigations around this topic might develop.

Sample Hypothesis: Let's use the question, "Does the amount of moisture available affect decomposition?" Our hypothesis could be, "Moist organic matter will decompose faster than dry matter because the detritivores need water to survive and function."

Sample Experiment Design: The **independent variable** will be moisture level and the **dependent variable** will be how much material decomposes in a set amount of time. Collect enough plant matter (leaves work well) to set up fifteen piles, each weighing about 500 grams. **Control** for the type of

organic matter by using either material all from the same plant species, or select from a well-mixed pile of multiple organic materials. To control for moisture level to start, dry all the material very well in the sun or an oven. Place the piles in fifteen separate waterproof containers (plastic tubs) with fine mesh netting on top to exclude airborne organisms while allowing in light and air. Add 10-20 grams of soil dug from the ground to each container to provide detritivores. Drying the organic material can kill detritivores already present so we need to add some to make sure decomposition proceeds.

The treatments will be high and low water added and a **control** of no water added. Five piles receive 50 ml of water three days per week, five piles receive 250 ml the same three days per week, and five piles receive no water. This gives five **replicates** for each treatment.

After the determined number of days has passed, dry all the piles completely. Carefully separate the material in each container into decomposed and not decomposed piles; weigh each pile. Identification of decomposed versus not decomposed will be somewhat subjective. Decomposed would be matter that no longer looks like it did when it started the experiment. If it's crumbly and brown count it as decomposed. If it still can be identified as plant material, it goes in the not-decomposed pile.

Sample Prediction: The piles of organic material receiving more water will yield more decomposed material.

Record Results: Record the weights of each pile at the beginning of the experiment. Record the weights of decomposed and not decomposed piles for each container separately at the end of the experiment. Subtract the beginning weight of the soil from the decomposed pile weight since the soil will mostly end up in this pile due to its texture.

Sample Analysis of Data and Presentation: Compare the weights of each treatment on a **bar graph**. The treatment (amount of water) goes on the horizontal axis and the total weights of decomposed and not decomposed for each treatment go on the vertical axis. Calculate the **average** weights. Graph the average number on the vertical axis.

Discussion: Was your hypothesis supported? If yes, go on to test other hypotheses. If not, why not? What did happen? Why? This is a great opportunity to revise your hypothesis and do another test.

MORE:
(1) Elementary:
(a) Buy or collect earthworms. Run a similar experiment with worms and no worms added being the independent variable.
(b) Compare decomposition in dark containers and containers exposed to daylight. Try to keep other factors like moisture and temperature constant.

(2) Middle School:
(a) Find the **mean**, **median**, **mode** and **range** of the data.
(b) Run carbon, nitrogen and phosphorous tests on the different decomposition piles before and after the experiment. Do carbon, nitrogen or phosphorous levels change?

(3) High School:
(a) Calculate the **variance** and **standard deviation** of the averaged data.
(b) Do a **t-test** comparing the treatments. (T-test is a standard statistics test comparing **means** of two samples).
(c) Calculate the rate of decomposition over time. Collect weights of the piles weekly. Graph the data on a **line graph**.

(4) All Levels:
(a) Collect samples of compost or samples from the decomposition experiment (above). Examine with eyes, loupes, and microscope for potential detritivores.