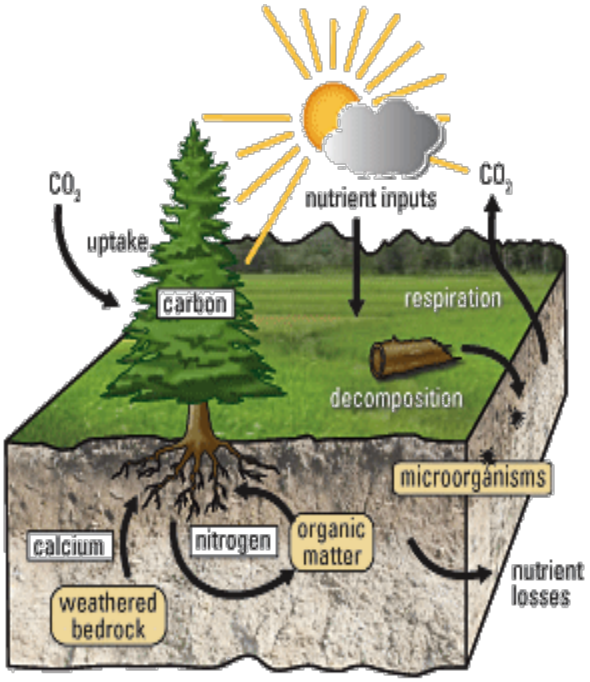
Finally Fall: Decomposers

Revel in the ooey-gooey beauty of fall!

When you think of fall, what comes to mind is probably the beautiful colors, foggy mornings, cups of hot cocoa, and maybe even the crisp crunch of fallen leaves beneath your feet. The part of fall that most people don't spend a lot of time thinking about is the ooey-gooey part, the reason for why those leaves don't stay crunchy long, why you might pass by a park and get a quick whiff of something smelly - decomposition. Sure, it might not be the most pleasant topic of dinner conversation, but it is truly vital to your life and the lives of all creatures on this planet!

These leaves begin their lives as part a tree, absorbing sunlight so the tree can create its own food, and then they lose their green luster and tumble to the ground as the temperature drops and the wind picks up. Here, they expand their roles in the ecosystem by becoming food and shelter for innumerable animals, including those that are too tiny to see with the naked eye (learn and explore more with this article, "Leave the Leaves!" on the Distance Learning Portal!). As these leaves sit longer on the forest floor, the lawn of the local park, or a backyard, they begin to break down through decomposition.



Courtesy of US Geological Survey

This process of decomposition is a part of the nutrient cycle that sustains all life. 95% of the mass of all living things is physically constructed using carbon, hydrogen, and oxygen (otherwise known as non-mineral elements), while they rely on mineral elements such as phosphorous, nitrogen, potassium, calcium, and magnesium to help them perform basic biological functions (Source: Skidmore College). These elements are absorbed from the air, water, and soil around them, so these elements must constantly be replenished by the process of decomposition! Using a tree as the example still, when a branch breaks off and falls to the ground, the wood and leaves become food for detritivores and decomposers, who help to break it down and recycle those structural elements back into the soil, which then gets absorbed by the tree's roots and is used to help the tree continue to grow.

Decomposition is not magic, it's a natural process that occurs in many forms, both physical and chemical. In the animal kingdom, one really important role in the food web is that of the *decomposers*, which is a term that also includes *detritivores* (learn more about a few types of detritivores in our Virtual Creature Fest activity packet, "Something Slimy"). Detritivores are small animals, usually invertebrates, which feed on dead plant and animal material by physically breaking it into smaller pieces by taking bites of it; this group includes slugs, ants, beetles, etc. Decomposers in general are detritivores, but they help to actually break down the dead plant and animal material into smaller chemical compounds, a step beyond just taking bites; fungi and bacteria are great examples of decomposers, because they exist by growing on dead material and using digestive enzymes to actually break it down and ingest what's left.

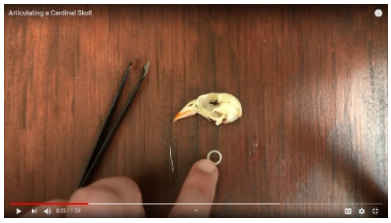
Here at Duke Farms, we aim to engage the community with nature in as many ways as possible so we can encourage stewardship. To develop those methods, we usually look to nature itself as a guide! In order to introduce participants to our local habitats, we try to use natural sources for our educational materials, and that includes any animals that we find on the Duke Farms property that have died. These animals live wild in the restored habitats at Duke Farms, and when they pass on naturally and we are lucky enough to encounter them, we can collect them for use in education. To turn a decomposing carcass into an educational tool is relatively easy if you learn how to from the best teacher on Earth: Earth itself!

Red-Bellied Woodpecker video lesson

As stated earlier, detritivores are an important part of the nutrient cycle, and one really interesting native species that fills this role in North America is the dermestid beetle, of which there are over 100 species native to the north east; at Duke Farms we have a colony of *Dermestes lardarius*, which are found worldwide. These organisms are regularly purchased by scientific organizations for use in various scientific purposes. These beetles are not interested in freshly dead animals, instead they prefer dried out, older dead animals and plants, which means they are great for helping us naturally clean the skeletons of the animals that we find. These insects simply live their lives, doing their part in the nutrient cycle, and we are able to keep the skeletons of the specimens, clean them up further, and then use them for educational purposes!


Dermestes lardarius

To see some of these cleaned bones in action, check out the Bird of the Week programs listed on the Distance Learning Portal, as well as this behind-the-scenes video about putting together a cleaned cardinal skull on our Duke Farms YouTube page. Even though you may never have noticed their activities until now, as you take your next foggy walk and admire the bright colors of the leaves left on the trees, don't forget to thank the oozy activities of the bacteria, worms, and mushrooms for providing the vital nutrients needed to grow them!



Articulating a cardinal skull

Activity: The Leaf Decay Contraption

Objective: In this activity, students can conduct an experiment to replicate a version of a Massachusetts Institute of Technology study and gain knowledge about how concepts such as climate change, decomposition, the nutrient cycle, and even invasive species are connected.

Materials:

- MIT article for reference and background knowledge
- "The Leaf Contraption" printable guide (courtesy of Scholastic) found on the next page
- Recycled plastic bottle
- Cheesecloth/stocking/fabric that can be used to filter water
- Scissors
- Rubber band
- Marker

Background Information: In this article written for MIT News by Jennifer Chu in 2012, the leading technical Institute conducted a study into the decay rates of leaves in search of the answer to whether or not decomposition rates were more or less dependent on factors such as the type of leaf, the climate, composition, etc. It revealed that, though the type of leaf did determine a range of time in which the leaf would decay, the commonality of either increasing or decreasing those rates was the climate. It was shown that as the climate warms, the speed of decomposition increased across all species of leaf, which leads to the conclusion that our warming global climate can result in increased decomposition of plant material, which then in turn results in an increase in soil and water nutrients. This can cause a host of environmental issues such as overgrowth of toxic algae in waterways and invasive species taking advantage of the excess soil nutrients.

Procedure: This experiment can be tailored in a few different ways, such as creating a separate contraption for individual leaf species, mixed species, leaves from different locations, etc. Be creative and think of as many variations as you would like. Follow the steps in the Leaf Contraption guide to construct your experiment. Leave contraptions in different conditions, such as dry, wet, direct sun, shade, etc. Create a mathematical connection by having participants graph the results each week and compare them at the end of the experiment.

Discussion: How does the water change over time as it filters past the leaves as they go through decomposition? Does the decomposition rate differ between any conditions, such as a contraption without any added water or with tap versus water from a stream? What are the uses for this water that is not full of decomposed plant matter? How could it be good or bad for the local environment?

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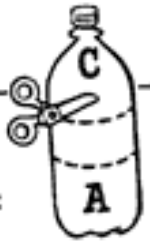
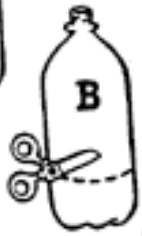
The Leaf-Decay Contraption

What To Do



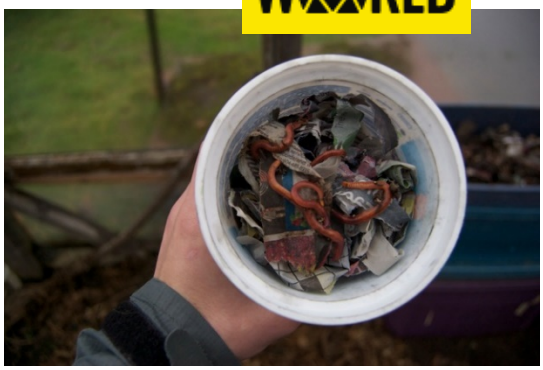


1. Cut and label the soda bottles like this:
2. Put the stocking piece over the spout of B. Secure it with a rubber band.
3. Set B, small end down, inside A.
4. Mix the leaves with the soil. Put the mixture inside B and gently pack it down. With the crayon, mark on B where the top of the mixture reaches.
5. Loosen the cap on C. Set C, spout down, inside B.
6. Pour the rain water into C. The water will drip through the loosened cap, the leaves and soil, and down into A.
7. Keep the Leaf-Decay Contraption in a warm place, but not in the Sun. Each day, pour the water from A into C.
8. At the end of a week, stir the mixture and pack it down. Mark the top of the mixture again. Do this for a month or longer, if possible.

What do you think will happen to the leaf and soil mixture?

Make a chart on the back of this sheet. Record what you observe each week.

A great hands-on project that can be educational and useful for anyone with a home garden or houseplants is this do-it-yourself worm farm! Yes, that's right we said, "worm farm". This is a small-scale version (just the size of a yogurt container) of a contraption that is used by many people who wish to fertilize their gardens or house plants using natural fertilizer made right at home, with the added benefit of disposing of their biodegradable waste! This awesome activity from Science World is in-depth and offers a great way to engage kids and adults in a creative way to live a little greener. Check out the end of the article for some more great resources and activities!



The small worm farm that you can create at home! courtesy of Science World

Environmental Science is as interconnected a discipline as anyone could ask for, so it is no surprise that there is a way to explore and observe its subjects in an artfully scientific manner. In recent years, there has been incredible strides in macro photography, and this has allowed us to enter the miniscule world of decomposers in a way that we have not been able to before. Artists like Alison Pollack bring the world of fungi to life in a big way by photographing the very tiny parts of this ecosystem (check out her Instagram here) but she's not alone; Steve Axford of Australia has magical fungus photography on his website and Zhou Qingfeng of Shanghai, China has spent 8 years taking these beautiful photos. These photographs display the stunning majesty of these organisms that are usually associated with a pretty severe ick factor! Explore your artistic expression by trying your hand at capturing whatever beautiful decomposers you can find living around you!

Zhou Qingfeng in her studio. Courtesy of CGTN

Lamproderma scintillans photo by Zhou Qingfeng

The topic of decomposers can be used to enhance your lessons in an assortment of content areas, including those related to the recently released Climate Change initiative from the NJDOE. It is applicable to K-12 public schools and has a multidisciplinary focus:

- Climate Change across all content areas, leveraging the passion students have shown for this critical issue and providing them opportunities to develop a deep understanding of the science behind the changes and to explore the solutions our world desperately needs.

For more ideas on how to incorporate this lesson, or to conduct these activities virtually or in the classroom, contact Kate Reilly, Manager of Education, Duke Farms at kreilly@dukefarms.org.