Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_

**Lesson 2 Worksheet: Measuring Leaf Decomposition**

**Background:**

In our modern-day culture, decomposition and decay are often viewed negatively, and associated with things that are rotten, have a bad smell, or a general worsening of conditions. However, they are vital processes in nature that allow for new growth, by playing an essential role in the breakdown of organic matter, recycling it and making it available again for new organisms to use.

Decomposition I an important part of the cycle of energy and nutrients that define our ecosystems. Everything dies, and without the processes of decomposition and decay the world would quickly overflow with the remains of dead plants and animals. We would also experience a decline in new growth, due to the shortage of nutrients that would not be made available through decomposition.

***What is decomposition?***

Decomposition is the stage in the nutrient cycle which involves breaking down chemicals that have been used by an organism (plant or animal) to build its body, which are returned to the ecosystem upon its death. It is the process whereby the dead tissues break down and are converted into simpler organic structures that are the building blocks of life. The species that carry out the process of decomposition by feeding on dead organisms are known as ***detritivores***, which means literally 'feeders on dead or decaying organic matter'. These organisms play an important part in moving carbon from living things back into a form that can be used by plants, such as the air or the soil.

Decomposers, in fact all organisms, do two things with the material they eat: 1. they convert it into biomass and grow larger, and 2. they use the material as energy to run the physical processes in their body. Consumers eat carbon-containing molecules that contain lots of energy – but in order to access that energy, they have to break the bonds of the carbon containing molecules in their food. They do this through the process of respiration, which is where organisms take in oxygen and glucose (a type of carbon molecule) and put out carbon dioxide, water, and energy. One way to think about decomposers is that they are a special type of consumer that only get their glucose from things that are already dead through unique chemical processes. Of course, decomposers also create waste, which adds nutrients back into the soil. And, decomposers will eventually die, so their bodies will become part of the cycle as well.

***Nature's unsung heroes of recycling***

A wide range of organisms takes part in the decomposition process. The detritivore community includes beetles and their larvae, flies and maggots (the larvae of flies), woodlice, fungi, slime molds, bacteria, slugs and snails, millipedes, springtails and earthworms. Most of them work out of sight, and their handiwork is not immediately apparent, but they are the forest's unsung heroes of recycling. Almost all of them are small in size, and their function happens gradually in most cases, over time periods measured in months or years, but cumulatively they convert all dead plant and animal material into forms that are useable for growth either by themselves or other organisms.

***Decomposition in plants***

The primary decomposers of most dead plant material are fungi. Dead leaves fall from trees and herbaceous plants collapse to the ground after they have produced seeds, forming a layer of litter on the soil surface. The litter layer can be quite substantial in volume, with the litter fall in temperate deciduous forests reaching 3 tons per hectare per year. The litter is quickly invaded by fungi. Bacteria also play a part in this process, as do various invertebrates, including slugs and snails, springtails and, as the decay becomes more advanced, larger invertebrates (note: all earthworms in the Northeast are non-native species).

In a forest, the rate of decomposition depends on what the type of dead plant material is being decomposed. Leaves of deciduous trees and the stems and foliage of non-woody plants generally break down quickly, and are usually gone within a year of falling to the forest floor. Some plant material, such as the fibrous dead fronds of bracken (*Pteridium aquilinum*), takes longer, but will still be fully decomposed within three years. The needles of conifers, such as Eastern White Pine (*Pinus strobus L.*), are much tougher and can take up to seven years to decay. The rate of decay is also determined by how wet the material is. In general, the wetter it is the faster it breaks down, while in dry periods or dry climates, the organic matter becomes ***desiccated***. Many detritivores, such as fungi and slugs and snails, need moist environments to survive, so the decomposition process slows down if desiccation happens.

Portions of this text were based on:

1) Internet Bio Ed Project. “The Ecotree.” 16 March 2015. <http://www.bcb.uwc.ac.za/ecotree/leaves/decidu.htm>.

2) Trees for Life. “Decomposition and Decay.” 18 March 2015. http://treesforlife.org.uk/forest/forest-ecology/decomposition-and-decay/

**Before you begin your lab, make a hypothesis about which tree species' leaves will decompose the most (lose the most mass):**

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**Procedure:**

1. Gather a handful of dry leaves from the same species of tree. (Each lab group should have a different species to compare later).
2. You will make at least two packets with the same species of leaves.
3. Create a 4’’ X 4’’ screen packet to store your leaves using the following directions:
	1. Using scissors cut a piece of window screen that is 10’’ by 5’’.
	2. Fold the cut screen in half
	3. Either fold or staple three edges shut leaving the top open to place the dry leaves.
	4. Weigh the empty screen packet before filling with dry leaves.
4. Measure approximately 2.00 grams of dry leaves and place in the screen packet. Optional: weigh the leaves separately from the packet.
5. Fold the top of the leaf packet over and seal.
6. Weigh the filled screen packet.
7. Place approximately one inch of soil in the bottom of a shallow, plastic food container.
8. Carefully place the filled leaf packet on top of the 1’’ of soil.
9. Add 1’’ – 2’’ of soil on top of the filled leaf packet to completely cover it.
10. Add enough water to the container to moisten but not fully saturate the soil.
11. Poke small holes in the top of the plastic food container and replace the lid.
12. Every 2 – 3 days, open the plastic container and moisten the soil as needed (soil should be moist but not wet).
13. After approximately 3 weeks, remove the filled screen packets and brush as much soil off as possible. *Note: if a lot of soil is stuck to the packets/leaves, rinse each packet with water and hang to dry for 1-2 days.*
14. Allow the packets to air dry at least overnight - you want to weigh dry leaves, not wet ones.
15. Re-weigh the filled screen packets and record your data. If you weighed just the leaves before, open the packets and re-weigh the leaves.

**Data Table 1:** Leaf Decomposition in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (tree species).

|  |  |
| --- | --- |
| **Leaf/Tree Species: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Mass (grams) (+/- 0.01 g)** |
| Mass of the empty screen packet |  |
| Mass of the full screen packet |  |
| Mass of leaves before decomposition(full screen - empty screen) |  |
| Mass of the full screen packet after 3 + weeks of decomposition |  |
| Mass of leaves after decomposition(full screen before decomposition – full screen after decomposition) |  |
| Mass of Decomposed Leaves(leaves after decomposition – leaves before decomposition) |  |

Data Table 2: Comparison of Leaf Decomposition in Tree Species

|  |  |  |
| --- | --- | --- |
| **Lab Group** | **Leaf/Tree Species** | **Mass of Decomposed Leaves** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| 6 |  |  |

**Analysis Questions:**

1. Create a bar graph using your class data to compare the decomposition of leaf species.
	1. Create a title for your graph
	2. Label your axis including units
	3. Under your graph, write a one paragraph analysis of the graph describing any trends that you see.
2. Which tree species lost the most mass, and which lost the least? Suggest a reason why.

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1. Construct a diagram on the back of this page showing the movement of carbon. Make sure to add these transformations in your drawing.
	1. Photosynthesis
	2. Cellular Respiration
	3. Plant Growth
	4. Dropping of Leaves for Deciduous Trees
	5. Decomposition of Leaves
2. Write one full paragraph explaining the role that decomposers play in recycling key nutrients such as carbon throughout an ecosystem. Use the space below or on the back.