Overview:

Students will use scientific tools and processes to identify various groups of organisms that exist in leaf litter and determine species biodiversity by creating a diversity index. Students will them research the organisms in order to identify the genus and species, type of consumer they are and where they would fit in a food web/ chain.

Grade Levels:

HS Environmental Science

Standards:

HS-LS2-6 Evaluate using claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Objectives:

After this lesson, students will be able to:

- Use data and graphical representations to describe the biodiversity in an area and describe how those organisms would be represented in a food web of that ecosystem.

Duration:

4- 50 mins class periods, plus a week for sample drying.

Setting:

Indoor and outdoor

Materials:

- 2-liter plastic bottles
- Calculators
- Entomological forceps
- Field ID Guides
- Lamps with 40 watt to 60 watt incandescent light bulbs (gooseneck style recommended)
- Identification guides (see resources)
- Macrolens
- Mesh screen
- Permanent markers
- Petri dishes
- Rubbing alcohol
- Rulers
- Scissors
- Stereomicroscope
- Toothpicks
- Trowel or other tool to scoop leaf litter.
- Quart-size zipped plastic storage bags

Background Information

Do you enjoy walking on autumn leaves and hearing the crunchy noise under your feet? Those leaves you are stepping on are home to a variety of organisms! When leaves, bark, needles, twigs, and other dead plant material fall to the ground and decay, their nutrients are added to the soil by creating a leaf litter ecosystem teeming with life.

Common "litter critters" are arthropods such as adult and larval insects, mites, millipedes, centipedes and spiders. Other litter organisms include several kinds of worms (nematodes and earthworms), snails and slugs.

The type and amount of organisms present in litter can vary with seasons. Some organisms spend their entire lives in litter, while others are found there only at certain stages in their lives. Some use the litter specifically for nesting or hibernating.

Litter organisms play a vital role in ecology. These organisms use the litter area as a place to feed, reproduce, compete ... and LIVE! In the process, they improve soil texture as they burrow through the soil and excrete fecal pellets made of soil and organic matter.

Good soil structure is important for improving water intake, drainage, aeration and erosion protection. These organisms work the soil, making it fertile, improving its water-holding capacity, aerating it and decreasing its susceptibility to erosion. They all help break down and recycle decomposing plant and animal material. Many litter organisms are predators. Others suck fluids from roots, consume fungi and bacteria and feed on decaying material.

Because litter critters are tremendously diverse, scientists often describe these organisms in terms of size:

- Megafauna refers to vertebrates such as snakes, turtles, foxes, mice, moles, and rabbits that dig in leaf litter for food or shelter. They can easily be seen with the naked eye.
- Macrofauna are leaf litter invertebrates with a body length greater than 1 centimeter that can be seen with the naked eye. Examples include earthworms, centipedes, millipedes, slugs, snails, fly and beetle larvae, adult beetles, ants, and spiders. Their main function involves breaking down organic matter and burrowing into and mixing soil. Most macrofauna eat decaying plant material and organic debris, but centipedes, certain insects and spiders prey on other litter organisms.
- Mesofauna are leaf litter invertebrates with body lengths between 1 centimeter and 1 picometer (1 centimeter equals 1 times 10 to the 10th power picometers). Magnifying lenses are helpful for viewing mesofauna. Mesofauna are extremely diverse and include mites, springtails, pot worms and nematodes. Mesofauna organisms help fragment soil debris, thus improving soil structure.
- Microfauna are minute leaf litter organisms with body lengths less than 0.1 millimeter in size. Microscopes are required to see microfauna. In the soil, microfauna are abundant and widespread – generally several thousand individuals per gram. Microscopic nematodes, protozoa, algae, fungi and bacteria are examples of microfauna.

Biodiversity refers to the variety of life forms in a particular area or region. The level of biodiversity indicates how healthy and stable an ecosystem is. Generally, a higher biodiversity level indicates a healthy ecosystem that is capable of supporting life. A few of the reasons why biodiversity is important include:

- Biodiversity provides us with a variety of foods and raw materials. Without the diversity of pollinators, plants and soils, grocery stores would have much less fruit, vegetables and other produce.

- Biodiversity is important to the field of medicine. Many medical discoveries were made because of research into plant, animal and microorganism biology.
- Biodiversity allows ecosystems to adjust from unpredictable naturally occurring catastrophic events such as droughts, fires and floods and from human disturbance such as pollution and habitat disruption. If one tree species becomes extinct, a forest with 20 other tree species is likely to adapt better than another forest with only a few types of trees.
- Biodiversity provides important ecological services such as purifying water, absorbing chemicals and producing oxygen that makes our world livable.
- Biodiversity is the essence of nature's beauty. Many birds, butterflies, tropical fish and flowering plants are recognized for their beauty. Even less known organisms can be just as lovely. For example, the microscopic algae known as diatoms have intricate glasslike shells that are as varied as snowflakes and serve as inspirations in jewelry design. All organisms exhibit the beauty of design. Even the smallest of insects have complete exoskeletons, nervous and digestive systems, and a complex set of muscles. Such insects show a degree of sophisticated miniaturization that has yet to be copied by human engineers.

Biodiversity is one of the most well-known concepts in ecological science. Scientists not only use the Simpson's Diversity Index (Ds) to measure an area's biodiversity, but this measurement is also an indicator of environmental quality.

$$Ds = 1 - \sum ni(ni-1)/ N(N-1)$$

Where N equals the total number of individuals of all species in an area and n equals the number of individuals of species "i." The summation symbol, $\sum$, means to do the calculations following $\sum$ for each species and then add up the results of all the calculations. Ds values closer to 0 indicate low biodiversity, while Ds values closer to 1 signify greater biodiversity.

Advance Preparation:

1. Read the background information and vocabulary to become familiar with lesson concepts.
2. Teacher: Search information on the Berlese funnel.
    a. Watch a video on using a Berlese funnel by searching "How to Make a Berlese Funnel" on YouTube or going directly to: http://www.youtube.com/watch?v=J5rGo3uBFIU
3. Choose areas on your school campus to collect leaf litter. Identify areas with litter that is damp but not wet, that has been sitting a while and that has a nice earthy smell. Look for soil litter that is not disturbed, compacted by traffic, treated with pesticides or periodically flooded.
4. Make copies of the Student Guide (one for each student).
5. Make copies of a chosen identification guide from the resources section (one per group of four).

   a. You can find a guide online at: http://www.handsontheland.org/monitoring/projects/inverts/order_guide.pdf
6. Mix alcohol preservative – half rubbing alcohol and half water. Each group of four will need about one-quarter cup of the mix.
7. Gather materials for each group of four students. Each student group will need the following:
   a. Trowel for digging leaf litter
   b. Zippered plastic storage bags
   c. Permanent markers for labeling plastic bags
   d. Rulers
8. Have students bring the following from home (need one each per group of four):
   a. Empty 2-liter soda bottle
   b. Lamp with 40-60 watt bulb (bendable neck preferred)

Procedure:

Day 1: *Introduction*

1. Lead student discussion on leaf litter ecology using the following probing questions:
   a. What is leaf litter?
   b. What kinds of organisms are found in leaf litter?
   c. Why is leaf litter important? d. How do scientists collect and study litter organisms?

2. Tell students they will be building a Berlese (pronounced ber-lay-zee) funnel and using it to extract "litter critters" from leaf litter.

3. Allow students to explore online to become familiar with the Berlese funnel.
   a. Show the video "How to Make a Berlese Funnel" on YouTube: http://www.youtube.com/watch?v=J5rGo3uBFIU

4. Explain how a Berlese funnel works and review instructions for building a Berlese funnel. Refer to Procedure 1 on Student Guide/work sheet.

5. Organize students into groups of four. Each group is responsible for building one Berlese funnel. Remind students to be careful when using scissors. (To save time, students can provide their own supplies and build Berlese funnels at home.)

6. Tell students they will be going on a mini outdoor field trip tomorrow to collect leaf litter samples. Encourage students to wear closed-toe shoes and other appropriate attire for the outdoor mini field trip.

Day 2: *Litter Collection*

1. Discuss the following safety precautions (and add more, if needed): a. Stay with members during group investigations. b. Stay within boundaries set by teacher when outdoors. c. Stay away from anthills and poison ivy. d. Watch out for snakes, mice, etc. e. Wash hands after handling leaf litter samples.

2. Each student group will need to bring these items on the outdoor mini field trip:
   a. Trowel for digging leaf litter.
   b. Zippered plastic storage bag for collecting and transporting leaf litter.
   c. Permanent marker for labeling plastic bag.
   d. Ruler.

3. Take class outdoors and demonstrate proper technique for collecting leaf litter samples. Refer to Procedure 2 on the student work sheet. Monitor students as they collect leaf litter samples.
4. Have students label bags with their names, date, and collection location of their litter samples.
5. Return to the classroom and tell class about size classification for litter critters. Refer to background information for explanations about:
    a. Megafauna.
    b.
    c. Macrofauna.
    d. Mesofauna.
    e. Microfauna.
6. Ask students if they saw any megafauna when digging their samples?
    a. Discuss why the presence of megafauna would be an indicator of healthy leaf litter. (Answer: the presence of megafauna is an indicator that other types of fauna are present. All these types of fauna together create a food web.)
7. Tell students they will examine their litter samples to extract macro-, meso- and micro-fauna. Model how to observe the sample and refer to Procedure 3 on Student Guide/work sheet. Review the following safety precautions (and add more, if needed):
    a. Wash hands after handling leaf litter samples.
    b. Wear eye protection when handling alcohol.
    c. Avoid inhaling alcohol fumes.
    d. Keep light source away from alcohol.
8. Allow time for students to set up experiments and tidy up workspaces.

Days 3-7: *Sample Drying*

1. Allow samples to sit underneath the lamp bulb to dry (usually takes five days). The leaf litter samples are done when the leaves are completely dry.

Day 8: *Critter Identification*

1. Pass out the identification guides to each group or have them access a guide online, using the resources at the end of the lesson. Review guides with the class and discuss the types of organisms likely to be found in their extractions.
    a. Make sure students understand that they do not need to identify the actual organism, but instead, to identify the group that the organism belongs in. Thus, Beetle 1, Beetle 2, Beetle 3,… is sufficient identification.
    b. If students are unable to identify even the group, they can list it as Organism A, Organism B, Organism C, etc.
2. Discuss safety precautions (and add more, if needed).
    a. Wash hands after handling litter and litter critters.
    b. Avoid inhaling alcohol fumes.
3. Direct groups to examine their samples, sort the organisms and record their counts in Table 1 of their Student Guide. Refer to Procedure steps 4 and 5 in the Student Guide. 13.
4. Allow time at the end of class to tidy up work area.

Day 9: *Data Analysis*

1. Begin class by leading a discussion on biodiversity, using the following probing questions:
    a. What is biodiversity?
    b. Why is biodiversity important?
    c. How is biodiversity measured?
2. Introduce the equation for Simpson's Diversity Index and review sample calculations. Refer to Procedure 6 on Student Guide/work sheet.
3. Draw the following table on the board for the class to compile its data:

Student Group Number	***1***	***2***	***3***	***4***	***5***	***6***	***7***
Simpson's Index of Diversity							

4. Direct students to calculate the Simpson's Diversity Index for their litter samples and record the values on the chart on the board.
5. Have students answer conclusion questions in Student Guide/work sheet. Use responses as an assessment tool.
6. Wrap up lesson with any final thoughts, comments and reflections.
7. Homework: Use "Recycling Leaves" as a take-home assignment.

    a. This assignment introduces the ecological benefits of leaf recycling and simple ways to use leaves in the landscape.
    b. Students should read the article and answer questions about University of Delaware's Cooperative Extension article "Recycling Leaves."

Assessment:

Have students:

- Use data and graphical representations to describe the biodiversity in the area you tested and describe and draw a model on how those organisms would be represented in a food web of that ecosystem.

Resources:

Blackline Masters: • Article: Recycling Leaves • Article Assessment • Student Guide

American Museum of Natural History Website, How to Set Up a Berlese Funnel, accessed Sept. 20, 2014, at http://www.amnh.org/learn/biodiversity_counts/read_select/ht/berlesefunnel.htm. Nice illustration on setting up a Berlese funnel.

Barcelona Field Studies Centre Website, Simpson's Diversity Index, accessed Sept. 20, 2014, at http://geographyfieldwork.com/Simpson'sDiversityIndex.htm. Simple explanation on how to calculate Simpson's Diversity Index.

National Wildlife Federation Website, What is Biodiversity?, accessed Sept. 20, 2014, at http://www.nwf.org/Wildlife/Wildlife-Conservation/Biodiversity.aspx. Easy-to-read literature on importance of biodiversity.

United States Department of Agriculture Website, Soil Food Web- Soil Biology and the Landscape, accessed Sept. 20, 2014, at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/biology/?cid=nrcs142p2_053868. Background information on soil ecology appropriate for both teachers and students.

YouTube Website, Christopher Tippin, March 23, 2011. How to Make a Berlese Funnel, accessed Sept. 20, 2014, at http://www.youtube.com/watch?v=J5rGo3uBFIU. Dr. Christopher Tipping goes through the steps involved in collecting insects with a Berlese Funnel in this 3.5 minute video.

Identification Guides Online:

- Order Identification Guide: http://www.handsontheland.org/monitoring/projects/inverts/order_guide.pdf
- Illustrated Guide to Major Groups of Soil Invertebrates: http://www.colby.edu/biology/BI131/Lab/Lab08SoilinvertGuide.pdf
- Life in the Leaf Litter: http://www.amnh.org/our-research/center-for-biodiversity-conservation/publications/general-interest/life-in-the-leaf-litter

Litter Critters – Student Guide

Name_____ Date _____

Student Guide

In this lesson, you will collect leaf litter samples and use Berlese funnels (pronounced "ber-lay-zee") to extract organisms, which we're going to call "litter critters," that are present in the samples. You will identify various groups of organisms that exist in leaf litter, then determine species diversity by organizing and using one of the Identification Guides listed in Materials. You will then count the organisms and calculate your sample's Simpson's Diversity Index.

Using what you learn through your research you will then construct a food chain/ web using the organisms you found and identified.

Safety:

- Stay with assigned group members and work as a team.
- Stay within boundaries set by your teacher when you are working outdoors.
- Stay away from anthills and poison ivy when conducting outdoor investigations.
- Watch for snakes, mice and so forth when outdoors.
- Wash hands after handling leaf litter samples and litter critters.
- Be careful when using scissors.
- Wear eye protection when using alcohol.
- Avoid inhaling alcohol fumes.
- Keep light sources or other electrical devices away from alcohol.

Materials for Each Group:

- Alcohol/water mixture
- Calculators
- Empty 2-liter plastic soda bottle
- Forceps, toothpicks, probes and so forth for handling leaf litter organisms
- Lamp with 40–60-watt incandescent light bulb (bendable neck fixture or lamp preferred)
- Identification guide
- Macro lens (one per class)
- Mesh screen to cover opening of 2-liter soda bottle.
- Microscope
- Permanent marker for labeling plastic bag
- Petri dishes
- Ruler
- Scissors for cutting plastic bottle.
- Trowel for digging leaf litter.
- Zippered plastic storage bag for collecting and transporting leaf litter.
- Computer or printed identification guides.

Identification Guides Online:

- Order Identification Guide: http://www.handsontheland.org/monitoring/projects/inverts/order_guide.pdf
- Illustrated Guide to Major Groups of Soil Invertebrates: http://www.colby.edu/biology/BI131/Lab/Lab08SoilinvertGuide.pdf
- Life in the Leaf Litter: http://www.amnh.org/our-research/center-for-biodiversity-conservation/publications/general-interest/life-in-the-leaf-litter

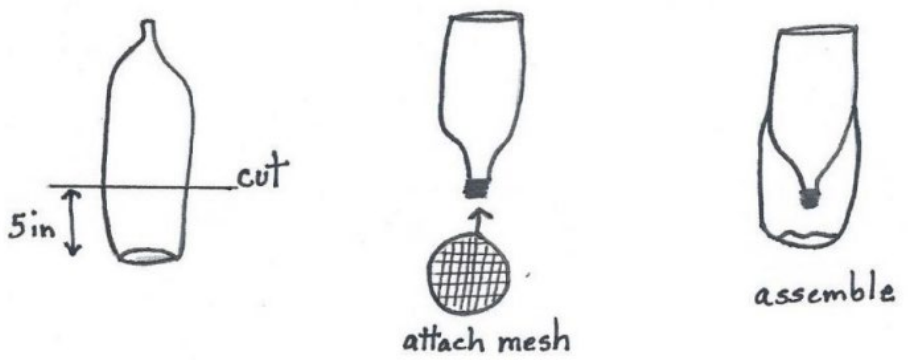
Learning Objectives:

- Identify various groups of organisms that live in leaf litter.
- Evaluate species biodiversity of leaf litter habitats using a Simpson's Diversity Index.
- Understand the importance of biodiversity to ecosystem stability.
- Create a food chain/ web model using organisms you identified in the leaf litter ecosystem.

Procedure

1. *Constructing Berlese Funnels*

Work in your assigned group throughout the lesson. Cut the 2-liter bottle into two parts, cutting five inches from the bottom of the bottle. The top half of the bottle will serve as a funnel, and the bottom half will function as a base and collection chamber. See figure below. Insert a piece of mesh screen to cover the funnel's neck from the inside. The mesh will form a stable platform for the litter sample and will prevent soil from falling through. Insert the funnel (small opening down) so it fits snugly into the bottom base. Use a permanent marker to write your name(s) on the Berlese funnel. This funnel should remain in the classroom when you go outside for your sample collection.



2. *Gathering Samples*

When instructed, follow your teacher outside to the collection site. Working in your assigned group, use your ruler to select and designate a 30-centimeter-by-30-centimeter (roughly 1 square foot) site for collecting leaf litter. Using a trowel or other collection tool, place approximately 2 cups of leaf litter into a zippered plastic bag. When collecting leaf litter, collect both surface litter (twigs, leaves, needles, etc.) and the underlying top few centimeters of soil. Good litter is slightly damp, but not wet. Look for soil litter that is not disturbed, compacted by traffic, treated with pesticides, or periodically flooded. Once you have collected the litter, seal the bag and label it with your name(s), date, and collection location. Store sample in a refrigerator if it is not used right away.

3. *Drying Samples*

Once you are back in the classroom, work as a group to set up your leaf litter samples for drying. First, pour a small amount of alcohol/water mixture (from teacher) in the bottom portion so it barely covers the bottom of the 2-liter bottle. Replace the top part, facing down, and adjust its height so the mouth of the bottle is sitting just above the alcohol layer. Carefully pour your leaf litter sample into the funnel. See figure illustrating this process. Place a lamp over the top of the Berlese funnel to heat and dry the litter sample. The light will dry the sample for approximately five days. As the leaf litter dries from the top down, organisms in the litter will migrate down (in an attempt to remain moist) and eventually fall into the alcohol-water mix.

4. *Sorting and Counting Litter Critters*
    a. Once the leaf litter is completely dry, work as a group to sort and count your litter critters. First, discard the litter from the Berlese funnel. Then pour the alcohol, which now contains the leaf litter organisms, from the bottom portion of the Berlese funnel into one or more Petri dishes (depending on the size of your sample).
    b. As a group, observe the organisms in your Petri dish with your naked eye, a magnifying lens, and a microscope. Using toothpicks, probes, forceps, and other tools provided to you, separate the sample into piles of similar organisms in a new Petri dish. You can remove and place the specimens on a white sheet of paper, if desired. Use the identification guide to help you identify the taxonomic group of organisms in each pile. Note: You do not have to identify the actual organism, just the taxonomic group. Thus, you can name the organisms things like Beetle 1, Beetle 2, Beetle 3, etc. If you cannot determine the group, you can simply call then Organism A, Organism B, Organism C, etc.
    c. Determine the total numbers of each type of organism and record this information as absolute abundance in Table 1 below.
5. *Data Analysis*
    a. Relative abundance compares the number of organisms of a particular species with the total number of organisms found in the sample. Relative abundance of a species is calculated by dividing the number of individuals of that species by the total number of individuals in the entire sample. Here is an example of the calculation for relative abundance:

Organism Type ("Species") (i)	Absolute Abundance (n_i)	Relative Abundance (p_i)
Beetle A	25	25/85 = 0.294
Beetle B	50	50/85 = 0.588
Worm A	10	10/85 = 0.118
# of different species = 3	N= 85	

Relative abundance (p_i) = n_i/N
i = a particular type of organism or species
n_i = number of individuals of a particular species
N = the total number of individuals of all types collected in sample.

b. Determine the **relative abundance** of each individual species and record in **Table 1** below. The absolute abundance is determined by counting the number of individuals of each different species.

TABLE 1: Absolute and Relative Abundance by Organism Type for Leaf Litter Sample

Organism Type ("Species") (i)	Absolute Abundance (n_i)	Relative Abundance (p_i)
Total i =	Total N =	

i = total number of "species" N = total number of individuals in entire sample

6. *Simpson's Diversity Index*

The Simpson's Diversity Index can tell us how diverse a sample is. It is an index that represents a quantitative measurement of a habitat's biodiversity. It takes into account the number of species present, as well as the abundance of each species.

a. Study this example of the calculation of Simpson's Diversity Index:

Organism Type ("Species") (i)	Absolute Abundance (n_i)
Beetle A	25
Beetle B	50
Worm A	10
	N= 85

$$D_s = 1 - \left[\frac{\sum n_i(n_i-1)}{N(N-1)} \right]$$

The Greek symbol, Sigma ∑, means "sum of."

$$Ds = 1 - \left[\frac{(25(24) + 50(49) + 10(9))}{85(84)} \right]$$

$$Ds = 1 - \left[\frac{3140}{7140} \right] \qquad Ds = 1 - 0.44 = \boxed{0.56}$$

Ds values closer to 0 = low diversity *Ds values closer to 1 = greater diversity*

b. Determine the biodiversity of your sample by calculating the Simpson's Diversity Index (D_s).

TABLE 2: Simpson's Diversity Index for Litter Samples

Species Identification:	*Number Found:*	*Number Found-1:*	*(Number Found) Multiplied by (Number Found-1)*
1.	n_1=	n_1-1=	$n_1*(n_1-1)$ =
2.	n_2=	n_2-1=	$n_2*(n_2-1)$ =
3.	n_3=	n_3-1=	$n_3*(n_3-1)$ =
4.	n_4=	n_4-1=	$n_4*(n_4-1)$ =
5.	n_5=	n_5-1=	$n_5*(n_5-1)$ =
6.	n_6=	n_6-1=	$n_6*(n_6-1)$ =
7.	n_7=	n_7-1=	$n_7*(n_7-1)$ =
8.	n_8=	n_8-1=	$n_8*(n_8-1)$ =
9.	n_9=	n_9-1=	$n_9*(n_9-1)$ =
10.	n_{10}=	n_{10}-1=	$n_{10}*(n_{10}-1)$ =
Total	*N*=	---	**$\sum$n(n-1) =**

Total of all individuals (total of "Number rolled") N= _____ Sum: $\sum$n(n-1) = _____

N-1 = _____

N*N-1 = _____

$$D = 1 - \left[\frac{\sum n(n-1)}{N(N-1)}\right] = 1 - \frac{\quad}{\quad} = \_\_\_\_\_$$

D-diversity index, N = total number of all species found, n= number of individuals of a single species, $\sum$ = sum

Condusions/ Questions:

1. Explain how a Berlese funnel is able to separate organisms from leaf litter.

2. Sketch and identify some "critters" found in your litter sample.

3. Which litter organism had the greatest absolute abundance? Which litter organism had the greatest relative abundance?

4. Which litter organism had the lowest absolute abundance? Which litter organism had the lowest relative abundance?

5. What was the Simpson's Diversity Index for your sample? Does this indicate a low or high level of diversity? If the diversity was low, why might that be so?

6. What value does the Simpson's Diversity Index offer scientists? Why might it be useful for scientists to work with an established index rather than raw data?

7. Describe the differences in the Simpson's Diversity Index among the different student groups in your class. Was there a great deal of difference in the calculated index? Does this surprise you? If there were differences in the calculated index among the student groups, give some reasons for this variation.

8. What kinds of organisms are most common in leaf litter?

9. Why are leaf litter organisms important?

10. What would happen if the organisms that eat and live in leaf litter disappeared?

11. Create a food chain/ web model using the critters you found in your leaf litter ecosystem.

Recycling Leaves

Revision Date: 31 January 2009
Rebecca Pineo, Botanic Gardens Intern
Susan Barton, Extension Specialist
University of Delaware
Bulletin #134

What organic material is full of nutrients, essential for the natural processes of soil rejuvenation, and arrives absolutely free of cost to millions of homeowners every autumn? You guessed it— the colorful liberated leaves of deciduous trees. Recycling leaves offers a great alternative to the environmental and economic expense of removing this resource from your property.

Benefits of recycling leaves

Here, leaves raked into a garden bed provide an attractive background for the autumn colors of oakleaf hydrandgea (Hydrandgea quercifolia)

- Reduces waste going to landfills. In areas where yard waste is not permitted in landfills, recycling leaves reduces the difficulty and expense of finding an alternative disposal site.
- Encourages improvement of soil through natural processes. In one acre of temperate forest, it is estimated that over 2 tons of leaves are deposited each autumn. The resulting leaf litter hosts myriads of beneficial organisms that break down the plant material and return nutrients to the soil—beginning the cycle in which those nutrients are taken up by the trees to manufacture a new crop of leaves the following spring.
- Provides habitat for wildlife. Aside from beneficial organisms, many other creatures use the leaf litter for habitat and as a place to forage—insects, spiders, slugs, turtles, toads, and small mammals, to name a few. These in turn provide food for other animals, such as birds.
- Reduces economic and environmental impacts of fertilizer use. With free nutrients provided by leaf litter, you won't need to use as much commercial fertilizer. Reducing fertilizer use not only saves money but also provides ecological benefits by reducing the energy consumed during production as well as decreasing the potential nutrient load in runoff stormwater.

How to recycle leaves

- Mow them and leave them where they lie. If your leaf layer is less then one inch, wait for it to dry out as much as possible and simply run over the leaves with a lawn mower. (If the leaves are somewhat damp, you may need to mow them again at a right angle to your original path.) The resulting small particles will decompose quickly without suffocating your grass, adding their organic bounty of nutrients. If your leaf layer is greater than one inch, recycle using one of the methods below.
- Shred them and use as mulch. Shredding can be accomplished in a few ways. You can use a bag attachment on your lawn mower and simply run over them as they lay. Or, you can first rake them into a pile and then run over them several times. Empty the bag frequently in a wheel barrow, on a cart, or onto a tarp. You can also purchase a vacuum shredder to collect and shred leaves; this will make a fine mulch, but can only be used with dry leaves. A string trimmer dipped into a sturdy garbage can full of dry leaves also works as an effective shredder.

  How NOT to Recycle Your Leaves

  Never burn your leaves, as this generates carbon monoxide and chemical compounds known to cause cancer.

  Shredded leaf litter makes fantastic natural mulch that will suppress weeds, regulate soil temperature, conserve moisture, reduce soil erosion and compaction, and decompose over time to provide nutrients. For best results, add 3–4 inches of leaf litter mulch around shrubs or trees and 2–3 inches over perennial beds.
- Shred them and till into the soil. In addition to using shredded leaves as mulch, you can spread them over fall planting beds and till them in to the soil, improving drainage as well as adding nutrients. You can also spread them over annual and vegetable beds and till them in prior to planting in the spring.
- Compost them, shredding them first for best results. Leaf litter makes fabulously rich compost. For quickest results, shred the leaves first and turn the pile often.

Additional Resources

Yard Waste and You, and the Ban Now in Effect in Northern New Castle County

Bibliography

Delaware Department of Natural Resources and Environmental Control. (Unknown date). Yard Waste and You, and the Ban Now in Effect in Northern New Castle County. Retrieved November 20, 2008 from http://www.dnrec.delaware.gov/yardwaste/Pages/Yard%20waste%20explained.aspx.

Keyser, Joe. (Unknown date). Turning Autumn Leaves into Healthy Lawns. The Green Man: Earth-Friendly Gardening & Landscaping. Montgomery County Department of Environmental Protection. Retrieved November 20, 2008 from http://www.montgomerycountymd.gov/content/dep/greenman/autumnleaves.pdf.

Mannino, Vince et al. (Unknown date). Don't Bag It: Leaf Management Plan. Texas A&M System Department of Horticultural Sciences AgriLife Extension. Retrieved November 20, 2008 from http://aggie-horticulture.tamu.edu/extension/homelandscape/dontbag/dontbag.html .

Marr, Charles W. and Robert I. Neier. (1995). Solid Waste Management Fact Sheet No. 12: Leaf Recycling. Kansas State University Cooperative Extension Service. Retrieved November 20, 2008 from http://www.oznet.ksu.edu/library/solw2/ep12.pdf .

Williams, Dave. (Unknown date). Recycling Leaves. Alabama Cooperative Extension System. Retrieved November 20, 2008 from www.aces.edu/dept/extcomm/specialty/leaves.html.

Litter Critters – Student Guide

Name_____ Date _____

Questions for the Article "Recycling Leaves"

1. What is meant by the phrase "recycled leaves"?

2. What are some benefits of using recycled leaves in the landscape?

3. Suppose your neighbor, Mr. Arbor, has a yard full of trees and is interested in recycling his fallen leaves. What advice would you give Mr. Arbor?

4. Describe how you could recycle leaves where you live.

5. Miss Sally uses recycled leaves as mulch in her flower beds. What kind of organisms do you think you would find living in her leaf mulch?

6. Explain how using recycled leaves as garden mulch could improve biodiversity.