

# Compost & Garden Education preK-5

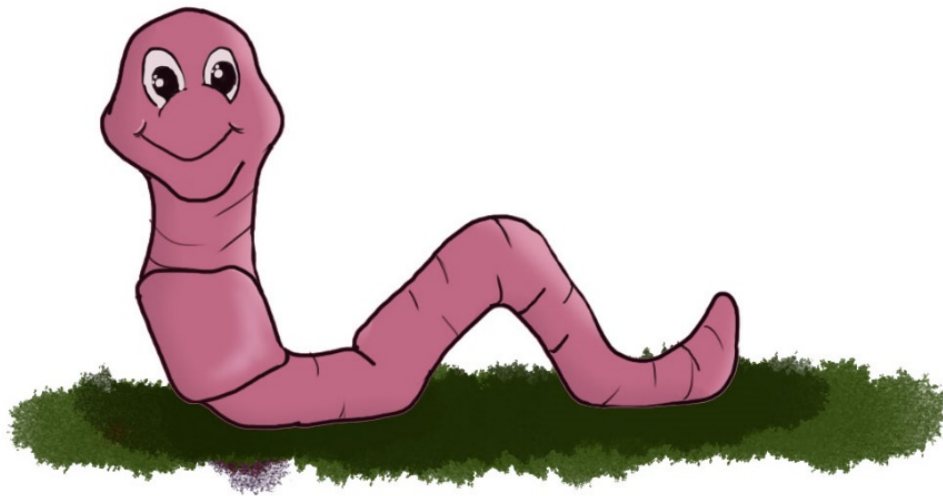
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2<sup>nd</sup> Edition

# Table of Contents

## Part 1: Learning About Composting

- Glossary.....page 3
- Introduction.....page 4
- Composting.....page 5-6
- Soils & Soil Microorganisms.....page 7
- Waste Streams & Waste Management.....page 8
- Vermiculture.....page 9-10-11
- Farm to Table.....page 12-13-14

## Part 2: Activities & Planning

- Poem Sara Sylvia Cynthia Stout by She Silverstein.....page 15
- Activity #1: 2-Liter Bottle Compost.....page 16-17
- Activity #2: How to Compost.....page 18-19
- Activity #3: Worm Bin.....page 20-21
- Compost Word Search.....page 22
- Coloring Pages.....page 23-24

## Part 3: Attributions and More Information

- Conclusion.....page 25
- Who We Are.....page 26
- Bibliography.....page 27-28

## Glossary: *Learn The Language of Composting!*

- **Biodegradable:** Products like food, that can be naturally *decomposed* over time in contrast to industrial products like plastic.
- **Brown Organic Matter:** Also referred to as “*browns*” because they are dry brown organic matter may consist of dead leaves, straw, weed chips, grass, newspaper, etc.).
- **Compost:** Any *decomposed organic* matter that is mixed to make a natural *fertilizer* for plants.
- **Decompose:** To break down/ separate into smaller parts.
- **Fertilizer:** What you put or spray on plants to help them grow faster.
- **Green Organic Matter:** Also referred to as “*greens*” because it is fresh and moist, green organic matter can be products like banana peels, potato peelings, lettuce, bread etc.
- **Methane:** A gas produced by cow poop and by farming.
- **Microorganisms:** Tiny creatures that can only be seen with a microscope (a tool scientists use to observe/examine living creatures that cannot be seen with the naked eye).
- **Organic:** Natural; Coming from only living creatures.
- **Pollutants:** Things that make the air, soil and water dirty.
- **Preservatives:** Plant “food” that helps plants last longer.
- **Sustainable**(method): Ways of handling things so that they will not run out; Friendly to the environment.
- **Recycling Plant:** factory for processing used/abandoned materials.
- **Waste Stream:** Where a flow of waste material (garbage) that has been processed end up at.

## **Introduction**

EVERY YEAR ABOUT 120 MILLION TONS OF WASTE ENDS UP IN ONE OVER 3,500 LANDFILLS IN THE UNITED STATES.

30% of the **waste** by U.S. households is compostable material.

Compost creates *healthy, fertile soil* by returning valuable nutrients to the soil.

An easy *WAY TO HELP* **SAVE THE PLANET** is  
**COMPOSTING.**

Composting is **safe** for our health, keeping **biodegradable** products out of landfills that pollute our water.

It also **saves money** because compost is  
*free natural fertilizer!*

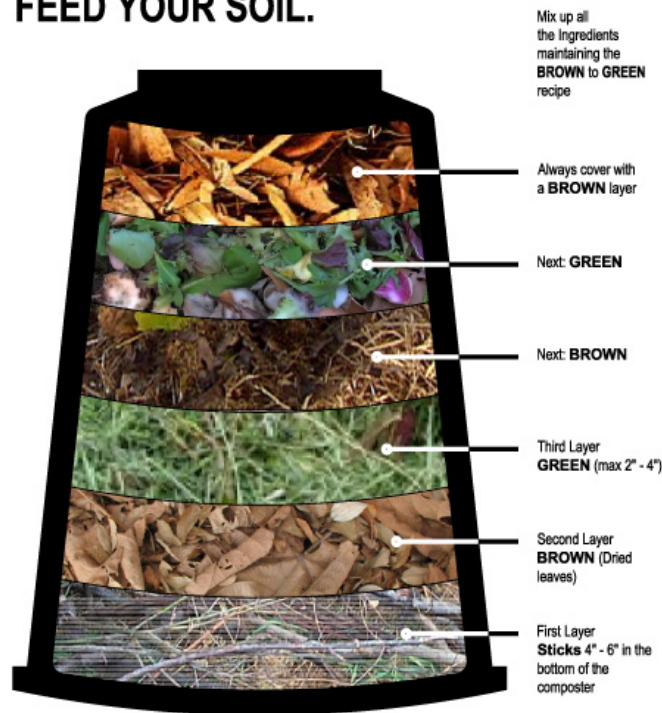
Learn more about compost and  
**help save the planet...!**

# Compost

## What is it...?

**Composting** is a way of turning waste organic matter (like food scraps and grass clippings) into fertilizer for your soil and food for plants. **Compost** is a pile of organic matter that is **decomposed**, or broken down into basic nutrients, by **microorganisms**. A good compost pile is one part “greens” to three part “browns,” with added soil or old compost to **inoculate** the good microbes and promote decomposition. The final result that is produced from the pile is a great, natural fertilizer that can be used for planting and gardening.

### A COMPOST RECIPE TO FEED YOUR SOIL.



**KEEP MOIST:** As wet as a wrung out sponge.

**AERATE:** Air helps to speed up decomposition. Aeration should be done throughout the entire composting process.

**KEEP COVERED:** Use a compost lid, cardboard or canvas over top of your pile.

(image from <http://www.acrd.bc.ca/home-composting> )

## How do we make it?

Compost made from “greens” and “browns”. Each offers its own special contribution to the soil in the form of a *chemical substance*. **Greens** give *nitrogen* to the soil while **browns** give *carbon*. For compost to break down properly and give us healthy soil, it is important to have a specific amount of nitrogen and carbon, and therefore specific amounts of “greens” and “browns”. We typically need 2 parts green and 1 parts brown (ratio= 2:1). **Why? Because the microbes responsible for decomposing your compost pile need a balanced diet of nitrogen and carbon.**

# Why do we use it?

By composting we make sure that less amount of food waste (which we typically throw with the rest of garbage) ends up in landfills (areas with piles of garbage left by garbage trucks). The reason why organic matter (like most of the food we eat) does not belong with industrial products like plastic, tin etc. is because organic matter is biodegradable, which means that it can decompose (break down) naturally over time.

## Why should we compost?

### 5 Very Important Reasons

1. Because landfills are already overflowing, covering large areas of land.
2. Because with composting we can produce fertile soil which will lead to nutritious food.
3. Because with more natural fertilizers, the use of chemical fertilizers which is part of traditional farming will be reduced.
4. Because composting is an efficient and *sustainable* method of producing local food.
5. Because composting can be considered to be a low cost alternative method to gardening.

## Why are chemical fertilizers bad?

### 2 Very Important Reasons

1. In traditional farming, chemical fertilizers are used to help plants grow faster. When it rains though, these chemicals from the farms are carried into nearby waterways such as lakes and rivers, which pollute the water decreasing its *quality* and causing harm to aquatic *organisms*.
2. With less fertilizer use fewer farm workers would be exposed to dangerous chemicals.

### **Conclusion:**

*The more we reduce chemical fertilizer use, the more we are protecting the environment and the safety of farm workers and farm neighbors.*



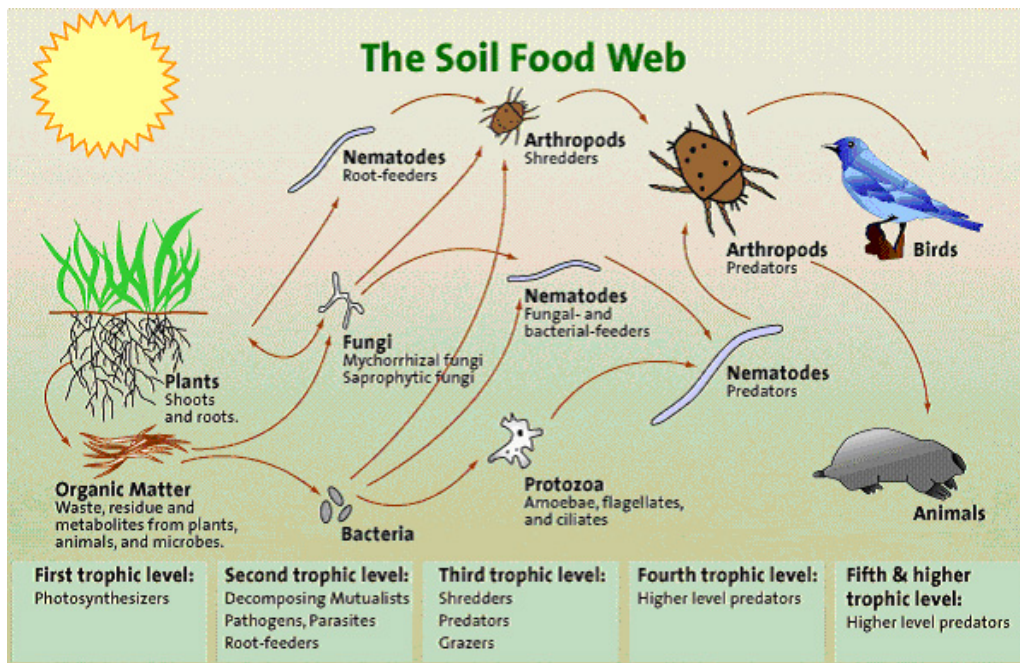
# Soils & Soil Microorganisms

## What are soils?

Soil supports all life. It is made up of minerals including a diverse mixture of clay and rocks, organic matter, and microbes. In order to have a successful season of food production, healthy soil is a necessity. The soil must contain the nutrients for the plants to grow, such as sufficient amounts of nitrogen, phosphorous, and other nutrients. In many cases, fertilizers are added to the soil to enhance its nutrient quantity and therefore enhance the likelihood of successful plant growth. Most fertilizer is industrially produced, which is energy intensive and expensive. Composting is a natural way to produce organic fertilizer locally, making soils healthier!

## What are soil microorganisms?

Soil microorganisms are living things that you need a microscope to see, and help in the natural processes of plant and soil life. Some examples of microorganisms are nematodes, arthropods, bacteria, protozoa, fungi, and sometimes even worms.



## How do microbes relate to composting and gardening?

All organisms are related in a food web. Worms eat other microorganisms like nematode, arthropods, bacteria, protozoa & fungi. They also have the ability to eat through and shred the leaf litter that lies on top of the soil. To successfully grow lots of food, soil must be healthy and fertile. Worms and other organisms make sure this happens.

# Waste Streams and Waste Management

## What are they?

- A waste stream is the flow of disposed waste (garbage) from our houses to wherever they end up which is mostly in a *landfill* or a *recycling plant*.
- Waste management is how we handle/manage our garbage which determines their destination (where they end up).

## Where does our waste end up? The (4) destinations

1. **Landfills:** Places where solid waste is deposited and stored together.
2. **Incinerators:** Plants used for waste disposal by a process of high-temperature combustion gas. This gas burns the products turning them to ashes and dusts.
3. **Composting:** A biological, natural process (but controlled by man) of decomposing (organic) waste.
4. **Recycling:** A method of recovering useful materials from waste in order to reuse them.

## How does this affect us?

The above 4 waste destinations are very important to the environment and our health. For example, when we throw away a wrapper into the garbage can, it will typically end up in a nearby landfill. That landfill gets larger every day and produces a large amount of methane every day, which decreases the quality of the air we breathe. We, consequently, will breathe in the amount of methane or other air pollutants that are emitted from the landfill and this can severely affect our health.

## How can we contribute?

- By sorting our trash into compost, recyclable (glass, plastic, etc.), and trash, we can reduce the amount of waste that ends up in a landfill or in our local waterways,
- Recycling ensures that the waste that does not degrade (break down) fast enough, ends up back in circulation for newer products.
- Composting reduces the amounts of organic waste that would be accumulating the landfill and instead goes towards producing new fresh foods by putting the nutrients back into the soil.





# Vermiculture

## *What is it?*

Vermiculture is when people use worms to break down organic food waste, turning the waste into a new, full of nutrients material. This material helps plants grow faster and consistently. In composting we use the *Eisenia fetida* worm also known as red worms, tiger worms, earth worm, red wiggler worm etc. This kind of worm is native to Europe and is a species of *earthworm* that is adapted to decaying organic material. These worms will thrive in environments with compost, rotting vegetation and manure and have a distinct smell that works as an antipredator mechanism. *Brady, Nyle C; Ray R. Weil (2009).*

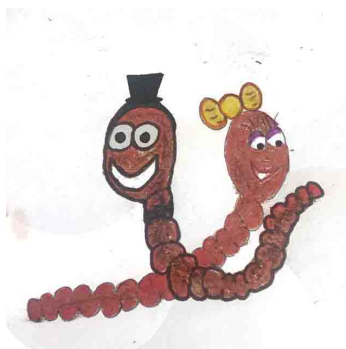
## *How do we use it?*

In vermiculture, the most widely used kind of worm is the red worm. In order for the worms to survive and thrive, it is important to keep the soil moist and to stock the garden bin full of organic matter such as leaf litter.

- Beware not to use products that are too acidic as this can deter worms from eating the waste.
- Also, dairy and meat products will not be very beneficial to the worm bin. **Why?** Because these products may attract animals from around the area that may dig up your compost bin.
- Worms prefer a darker space, so make sure there is shade over wherever they are being kept.





## *What are the benefits of it?*

1. **Aeration of the soil by the movement of the worms throughout the soil and organic matter.**
2. **Aerated soil is beneficial due to the ability to water to transport quickly throughout.**
3. **Worms have the ability to concentrate nutrients and when added to gardens or compost bins, higher productivity can be expected and at faster rates.**



# Worms & Composting

Red worms, also known as earthworms are very important to the environment. Worms eat the organic waste added to the worm bin. Their poop is high in nutrients and works as a very effective fertilizer, ready to be used to grow healthy food and heal infertile soil or dirt. When it comes to compost there are certain varieties that are best for home composting.

<u>NAME</u>	<u>USE?</u>	<u>IMAGE</u>	<u>WHY</u>
<i><b>Eisenia foetida</b></i>	<b>YES!</b>	 <p style="text-align: center;">(Wikimedia)</p>	<p>This variety of earthworms are best for composting since they produce large amounts of compost in their natural habitats that mostly consist of leaves, manure and other decaying organic materials.</p>
<i><b>Lumbricus rebellus</b></i>	<b>YES!</b>	 <p style="text-align: center;">(discoverlife.org)</p>	<p>This is another great variety of earthworms that will easily adapt to the worm box environment even though they are really soil earthworms.</p>
<i><b>Lumbricus terrestris</b></i>	<b><u>NO!</u></b>	 <p style="text-align: center;">(Wikimedia)</p>	<p>Even though this kind of earthworm is great at decomposing organic matter too, they like to tunnel in the soil sometimes 3 feet deep which makes them great for healing soil as they aerate it pretty well but unsuitable for the shallow worm box life. This type of earthworm is widely sold to farmers who wish to better the health of their soils.</p>
<i><b>Garden Worms</b></i>	<b><u>NO!</u></b>	 <p style="text-align: center;">(garden.org)</p>	<p>Identifying earthworms in your garden requires the study of their sexual organs and their behavior. Considering that there are more than 12,000 species of earthworms it's best to stay with worms you have purchased for composting.</p>

# More about worms

Worms is a large category of animals that typically have a long cylindrical tube-like body and no limbs. Worms can live in almost all parts of the world including marine, freshwater and terrestrial habitats. Some, for example live on the ground and help protect and heal soil.

We classify worms in three groups:

1. **Segmented Worms** (*Annelida*) – These worms, also known as Annelids are found all around the world from the deepest marine sediment to the soil in our yard/local park. These kind of worms is today split in three other categories: *Polychaeta*, *Oligochaeta* (earthworms) and *Hirudinea* (leeches). In segmented worms, each segments has the same sets of organs and a pair of fleshy appendages called **parapodia**. These are used for movement and in many species, for respiration.
2. **Flatworms** (*Platyhelminthes*)– There are about 20,000 of species in this group. Flatworms can be free living or parasitic (living under the skin of other organisms). Flatworms are found in marine and freshwater. The best-known flatworm is the tapeworm, which can get into an individual’s digestive tract and grow to enormous lengths.
3. **Roundworms** (*Nematoda*)– Roundworms are worms with a long round body. They can vary in length from several millimetres to up to two meters. This type of worm is parasitic and is what is usually found under the fur of puppies. But roundworms are parasites of humans too. Roundworms usually live in the human gut. However many species of roundworms are known to be able to travel from the gut to other parts of the body. Their youngs, also known as *larvae* live in the soil.

Some other categories of worms according to their phyla are the following:

- **Gnathostomulid (jaw worms)** - With over 100 species that are known so far, jaw worms are tiny worms (.5 up to 1 millimeter long) that live under the sand in shallow coastal areas. As their name imply jaw worms have a wider body and neck which gives it a distinct head.

**Nematoda (roundworms)** - Even though there are 15,000 different known species of roundworms more that 20,000 species have been described. This type of worms has adapted in nearly every ecosystem including marine, freshwater, soils, polar/tropic regions and in the highest/lowest of elevations. Parasitic roundworms can grow up to 15 meters long. *University of California - Berkeley (1997)*



# Farm to Table Food Production

## *What is it?*

Farm to table food production is when fresh food is planted, grown, harvested, and shipped for human consumption. It is a term used to describe a new trend for an increased interest about where food comes from which goes hand in hand with a high demand for locally grown food products. This process eliminates the need for preservative use and allows the food to maintain its natural nutritional values.

## *How is it beneficial?*

Using local farm systems offers many benefits for both the farmers and the population. First of all, local buyers and sellers ensure that more money is put back into the local economy, benefiting all the people in the area. Secondly, buyers become more “connected” to their food as it is from the same neighborhood as theirs. Thirdly buying locally means sustaining a seasonal diet which is better for the environment as it is a more natural way of eating. Having a seasonal diet also means that there is a less need for preservatives since the growing food corresponds naturally with the seasons and it is better and fresher.

## **Therefore...**

- Local buying means supporting the community and local economy.
- Local food buyers tend to feel more connected to their food.
- Seasonal diets are healthier for us and the environment (less preservative use, fresher food).

## *Where can this be done?*

In the United States thousands acres of farmland have been decreasing over the past several years, and only about 18% of farmland is in/around metropolitan areas. This is a problem since the highest demand for local food is in the cities while the supply (the actual food) is in rural areas. Although there are still 1.2 million smaller farms, more land is taken up everyday by large-scale farms, leaving local farmers hopeless. Supporting local food could be accomplished with the help of local gardens or even, it could be done per household, with people creating small-scale gardens to be less depended on large-scale farms and grocery stores.



*This is a picture of Stone's Throw Urban Farm located in Minneapolis, MN. This is a local farm that utilizes a vacant space in the heart of the city.*

# Massachusetts and Farming

Today in the State of Massachusetts, there are 7,755 farms. The farmers work over 523,000 acres to produce \$492 million in agricultural products, and the average farm produces \$63,470 of agricultural products in only 68 acres of farmland. Even though the U.S. suffered from a decline in agriculture between 2007 and 2012, the state of Massachusetts was one of the few states to experience a 1% growth not only in the number of farms but also in acres of farmland (USDA, 2012). The reasons why Massachusetts is prominent in agriculture are likely many, but Community Supported Agriculture and the Kestrel Land Trust have strongly influenced farming and agriculture in the Pioneer Valley.

## Community Supported Agriculture

The state of Massachusetts ranks 6<sup>th</sup> in the nation for number of farms with Community Supported Agriculture with a 96% increase since 2007 (USDA). Community Supported Agriculture (CSA) is way for consumers to purchase local, seasonal produce, directly from a farmer that belongs to their community. When someone joins a CSA, he/she may either sign up for regular home deliveries of fresh fruits, vegetables, and in some case meat and dairy products depending on the farm, or chose to visit the farm and purchase goods from there. The advantages of CSA are numerous and with the growth in popularity of the CSA, farmers actually start to make sufficient funds that works as incentive for more people to take up these positions.

## Why CSA?

The benefits of Community Supported Agriculture are very promising. Some ways in which CSA betters our nation are the following:

- **Supports Local Farmers:** Not all farmers are funded by the government! Unlike buying from a grocery store, when you buy locally from a CSA farm you directly support the people who live in the same community as you do.
- **Trust:** CSA allows for a trustworthy relationship between farmer and consumer. When you buy your products you can ask to see how they were grown. For example, if you buy local milk you can ask to see the cow!
- **Fresher Food:** Whether you chose to buy organic or not, food produced locally will always be fresher than food that has to travel thousands of miles to get to your table.

## Kestrel Land Trust

In the states of Massachusetts agricultural interest and incentive is also preserved by land trusts. The Kestrel Land Trust encourages farmers to continue their valuable work making their

lives easier by conserving farm-land for them. Kestrel Trust was founded in 1970 in Amherst, Massachusetts and started off as an all-volunteer land trust. Like most land trusts, the Kestrel Land Trust depends on private donors to leverage state money and in addition, holds annually a 5k run and a 2 mile walk in late October in order to fundraise for land conservation. Today, their mission statement is:

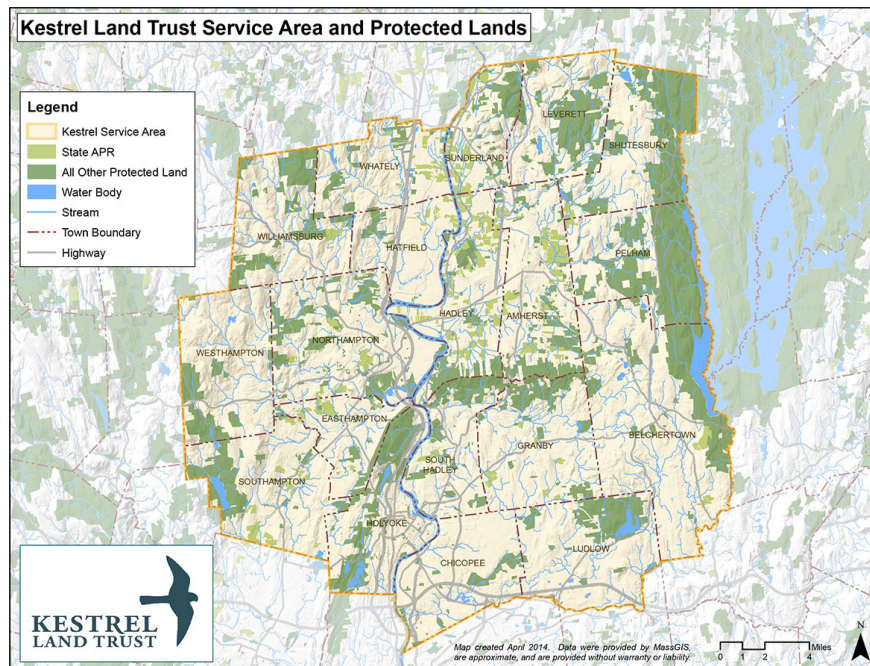
*“To work with landowners, governmental agencies, citizen groups, and other organizations to protect land, including farmland, woodlands, wild lands, wildlife habitat, water resources, historic landscapes, rare and endangered species habitat, and scenic vistas in the heart of the Connecticut River Valley of western Massachusetts. “*

Kestrel’s greatest success occurred on December 23, 2011 when the *Massachusetts Energy and Environmental Affairs (EEA)* Secretary Richard K. Sullivan Jr. announce that 2,486 acres owned by W.D Cows, Inc. would be protected through a conservation restriction. This deal is the largest land protection deal done in Massachusetts since 1920 and the largest conservation restriction ever done in the state.

### **What does a conservation restriction do?**

When a conservation restriction is set on a land, the landowner sells or donates the development rights of a land to a nonprofit organization or government agency, to be held in trust. This results in a prohibition of developing that land, and thus in a conservation of land.

### **Kestrel Land Trust Service Area and Protected Lands**



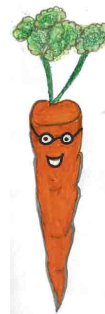
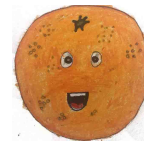
(kestreltrust.org)

## Sara Sylvia Cynthia Stout by Shel Silverstein

Sarah Cynthia Sylvia Stout  
Would not take the garbage out!  
She'd scour the pots and scrape the pans,  
Candy the yams and spice the hams,  
And though her daddy would scream and shout,  
She simply would not take the garbage out.  
And so it piled up to the ceilings:  
Coffee grounds, potato peelings,  
Brown bananas, rotten peas,  
Chunks of sour cottage cheese.  
It filled the can, it covered the floor,  
It cracked the window and blocked the door  
With bacon rinds and chicken bones,  
Drippy ends of ice cream cones,  
Prune pits, peach pits, orange peel,  
Gloppy glumps of cold oatmeal,  
Pizza crusts and withered greens,  
Soggy beans and tangerines,  
Crusts of black burned buttered toast,  
Gristly bits of beefy roasts. . .  
The garbage rolled on down the hall,  
It raised the roof, it broke the wall. . .  
Greasy napkins, cookie crumbs,  
Globs of gooey bubble gum,  
Cellophane from green baloney,  
Rubbery blubbery macaroni,  
Peanut butter, caked and dry,  
Curdled milk and crusts of pie,  
Moldy melons, dried-up mustard,  
Eggshells mixed with lemon custard,  
Cold French fried and rancid meat,  
Yellow lumps of Cream of Wheat.  
At last the garbage reached so high  
That it finally touched the sky.  
And all the neighbors moved away,  
And none of her friends would come to play.  
And finally Sarah Cynthia Stout said,

"OK, I'll take the garbage out!"  
But then, of course, it was too late. . .  
The garbage reached across the state,  
From New York to the Golden Gate.  
And there, in the garbage she did hate,  
Poor Sarah met an awful fate,  
That I cannot now relate  
Because the hour is much too late.  
But children, remember Sarah Stout  
And always take the garbage out!

*Shel Silverstein, 1974*



# Activity #1

## 2-Liter Bottle Compost

Goals	The goal of this activity is to learn how to build your own compost bin. Further on, another goal is to get familiar with concepts such as decomposition and recycling.
Duration	<p><b>Set up:</b> 20-25 min.</p> <p><b>Results:</b> 3 months for full results.</p>

### What You Need:

- A clear 2-Liter plastic bottle per student (or per pair of students).
- Approximately 1 bag of soil (store bought\*).
- Various compostable items brought in by student/teacher/group.
- Paper or Journal for observations (optional).
- Something to cover your compost bin at the end (plastic, wood, etc).  
 → Why? Covering your compost bin will protect it from being over-watered by rain and will enhance decomposition since microorganisms prefer a darker environment.

### What you Do:

#### DAY 1

1. Each student is given a 2-Liter bottle.
2. Using scissors and following the diagram, cut off the top two inches of the bottle. This is where your compostable items will stay.
3. **Add 1-2 cups of soil to the bottle along with various compostable materials.** You should have a ratio of 2:1 **greens: browns**.

#### LAYERS:

1<sup>ST</sup> Lay twigs or straw first.

→ Why? This helps drainage and aerates the pile.

2<sup>nd</sup> Lay a layer of “greens”.

3<sup>rd</sup> Lay a layer of “browns”.

4<sup>TH</sup> Continue to alternate “greens” and “browns” remembering the analogy 2:1.

5<sup>th</sup> Add “greens” (manure) like grass clippings, buckwheat, wheatgrass, etc.

→ Why? Even though the use of manure in farming has declined dramatically over the years, manure is still a valuable fertilizer for any farming operation.



6<sup>th</sup> Cover with anything you have (wood, plastic sheeting). Covering will prevent the compost from being over-watered by rain.

Add some water for moisture. You will know that the water is enough when you have enough to create a sponge-like environment. For best results slightly water each layer you add in your compost bin.

.....

## DAY 2 (after 2-3 days)

1. After 2-3 days, observations can be made and notes may now be taken about the changes happening with the compostable items and how the soil in the bottle altered.

**What to expect: Decomposition has started to take place in your compost bin! Now you may be able to see a humus-like material that is great for your gardening!**

### Can I use soil from my own garden?

*For living organisms to grow on your soil it needs to be light, loose, crumbly and “fluffy”. Depending on how well you keep your garden your soil may or may not be suitable for composting. For example, pH levels can be crucial to your plant’s ability to absorb nutrients. A pH between 6.5-6.8 is perfect for most minerals and nutrients to be absorbed. It doesn’t matter how rich it is in nutrients, the plants won’t be able to absorb them. If you would like to use soil from your own garden then you can get your soil tested here: <https://nifa.usda.gov/Extension/> or purchase your own testing kit here: <http://www.planetnatural.com/product/soil-test-kit/>*

WHAT YOU LEARN	<b>Conclusion:</b> With Composting we can recycle organic matter and make fertile soil.
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## Activity #2

# How to: Compost Bin Activity

GOALS	The purpose of this compost activity is to understand how to make a compost bin by adding the appropriate materials. Further on, to understand the relationship between “greens” and “browns”.
DURATION	<p>Set up: <u>30 min.</u></p> <p>Results: <u>Up to three months for results.</u></p>

What you need:

- A large bin with an opening for mixing & adding (built or bought online at [https://www.amazon.com/EDUCATIONAL-INSIGHTS-SEE-THROUGH-COMPOST-CONTAINER/dp/B00486Y80A?ie=UTF8&\\*Version\\*=1&\\*entries\\*=0](https://www.amazon.com/EDUCATIONAL-INSIGHTS-SEE-THROUGH-COMPOST-CONTAINER/dp/B00486Y80A?ie=UTF8&*Version*=1&*entries*=0) ).
- “Greens”.
- “Browns”.
- Yard trimmers (examples: leaves, grass clippings, wood chips, etc.).
- Thermometer.
- Soil (from your yard or bought).
- Journal for observations (optional).
- Moisture probe (estimate, or buy online at [https://www.amazon.com/Etekcitey-Indoor-Outdoor-Moisture-Hygrometer/dp/B00CTPXXEE/ref=sr\\_1\\_1?ie=UTF8&qid=1467391350&sr=8-1&keywords=moisture+probe](https://www.amazon.com/Etekcitey-Indoor-Outdoor-Moisture-Hygrometer/dp/B00CTPXXEE/ref=sr_1_1?ie=UTF8&qid=1467391350&sr=8-1&keywords=moisture+probe)).

What you do:

### DAY 1

1. In the large bin, first lay some twigs or straw (“brows”) for aeration.
2. Add 2 -3 cups of soil mixed with “greens” and “browns”. You can either chose to lay in your compost bin layers of “greens” and “browns” alternating between the two or mix the two kinds of material into one which you will mix with the soil.

→ Don’t Forget!!! As mentioned in the beginning, it is best to have a ratio of 2 parts green: 1 parts brown for best results!

→ You will want food waste to be at least 2.5 feet deep for heat to be generated.

3. Sprinkle grass clippings on top of the food waste to avoid welcoming insects in your compost bin.
4. Add some water for moisture and check your moisture probe. Best results come with your compost being 40-60% moisture (check readings on moisture probe).
5. Use your thermometer to check the temperature of your compost. For best results, your compost pile should not exceed 140 degrees F (temperature in the center). **Why?** If your compost pile gets too hot (160-165F) to the point where organisms are growing too fast, these organisms may use up all the oxygen in the pile, causing aerobic organisms to die. To avoid this from happening, if your pile gets too hot, pour some water or turn the pile over.

→ Check back every 3-4 days, and do not be surprised if it is a little steaming at some points: This allows certain microorganisms to eat and reproduce faster

6. Allow air to flow throughout the compost pile by turning it about once a week.

→ At this point you can also check moisture levels and add more water if it your compost has dried, to maintain a sponge-like moist environment.

7. Maintain your compost pile by adding the ratio 2 greens: 1 browns over and over again and by adding/allowing the necessary moisture and air.
  - Your result from your compost bin will be a humus-like material that is great for your garden!
  - You can collect it once the break down of the organic matter has been completed
  - Now you can sprinkle it around you garden. This will add nutrients to the soil and encourage plant growth.

<h2>WHAT YOU LEARN</h2>	<p><b>Conclusion:</b> Decomposition can only happen in a warm and moist environment.</p>
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## Activity #3 Worm Bin

<b>Goals</b>	The goal of this activity is to learn how to make and use a compost bin with worms, including, learning how to build, maintain and take advantage of your bin for your soil!
<b>DURATION</b>	<b>Set up:</b> <u>30 min</u>  <b>Results:</b> <u>Up to three months for results</u>

### What you need:

- A large bin with air holes you can purchase here [https://www.amazon.com/EDUCATIONAL-INSIGHTS-SEE-THROUGH-COMPOST-CONTAINER/dp/B00486Y80A?ie=UTF8&\\*Version\\*=1&\\*entries\\*=0](https://www.amazon.com/EDUCATIONAL-INSIGHTS-SEE-THROUGH-COMPOST-CONTAINER/dp/B00486Y80A?ie=UTF8&*Version*=1&*entries*=0) ).
- Shredded newspaper, cut up cardboard/toilet paper rolls for bedding
- “Greens” and “Browns”.  
→ Avoid citrus fruit, animal products and minimize grains.
- Water.
- Thermometer.
- Moisture probe (estimate moisture levels, or buy online at [https://www.amazon.com/Etekcitey-Indoor-Outdoor-Moisture-Hygrometer/dp/B00CTPXEE/ref=sr\\_1\\_1?ie=UTF8&qid=1467391350&sr=8-1&keywords=moisture+probe](https://www.amazon.com/Etekcitey-Indoor-Outdoor-Moisture-Hygrometer/dp/B00CTPXEE/ref=sr_1_1?ie=UTF8&qid=1467391350&sr=8-1&keywords=moisture+probe)).
- 1 Pound of worms you can purchase here:( [https://www.amazon.com/Uncle-Jims-Worm-Farm-Composting/dp/B00EZPSSGY/ref=sr\\_1\\_1?ie=UTF8&qid=1467300265&sr=8-1&keywords=compost+red+worms](https://www.amazon.com/Uncle-Jims-Worm-Farm-Composting/dp/B00EZPSSGY/ref=sr_1_1?ie=UTF8&qid=1467300265&sr=8-1&keywords=compost+red+worms)).

### What you do:

- Slightly moisten the bedding before placing it in 1-2 inch layers in the bin.
- Alternate layers of “greens” and “browns”, adding a top layer of food scraps and a little bit of soil (about half a cup), (optional) and add some thin paper such as newspaper that is also moistened.  
→ **Why?** Even though newspaper is compostable, it breaks down quite slowly because of its high lignin content. (Lignin: substance found in the woody cell walls of plants, and it is highly resistant to decomposition. Therefore, to accelerate its decomposition be sure to wet the newspaper.

- Wait for 3 days with the bin covered and pour some water again to keep moistened. If you're using a moisture probe, it should read 40-60%. If you're estimating the moisture levels, your bin will be wet enough when it feels like a sponge like – environment.
- Gently scatter the worms around the container so they are dispersed.
- Do not place the bin in the sunlight!

## MAINTANANCE

- Keep the bedding moist, but not too wet.  
**Depending on how moist you keep your worm bin, you will get varying amounts of worm tea to harvest. You should be harvesting about 3 tablespoons of worm tea per week or less.**
- Use your thermometer to check that the bin is always at a temperature between 40 – 90 degrees F.  
→ **Why? Usually, an ideal temperature for microorganisms is around 160 degrees F. But this temperature is way too hot for the worms to decompose. The best temperature range for red worms is 55-77 degrees.**
- Occasionally add more bedding and food scraps to the mix.  
**Make sure to mix the food scraps so it is mostly underneath the bedding because the worms will avoid being in the light**
- Worms are very flexible eaters so you can feed them as often as every day or as infrequently as every other week. Ideally you should feed your worms every 2-4 days.

## HOW TO FEED YOUR WORMS

**(FUN FACT: 2lbs. of red wigglers will recycle 1lb of organic matter in 24h).**

### 2 ways of feeding you worms

- **Alternating between a layer of food and a layer of bedding starting from the bottom of the bin (where the holes are).**
- **Dig down into one side of your bin and put the food there. The next time feed the other side of you bin.**

**What to expect:** The end result will be more “worm tea” which you will find in your worm bin. This is very high in protozoa and other nutrients that are good for the soil.

<b>WHAT YOU LEARN</b>	<b>Conclusion:</b> Worms play a significant role in composting. The end result worm tea is our soil “medicine”.
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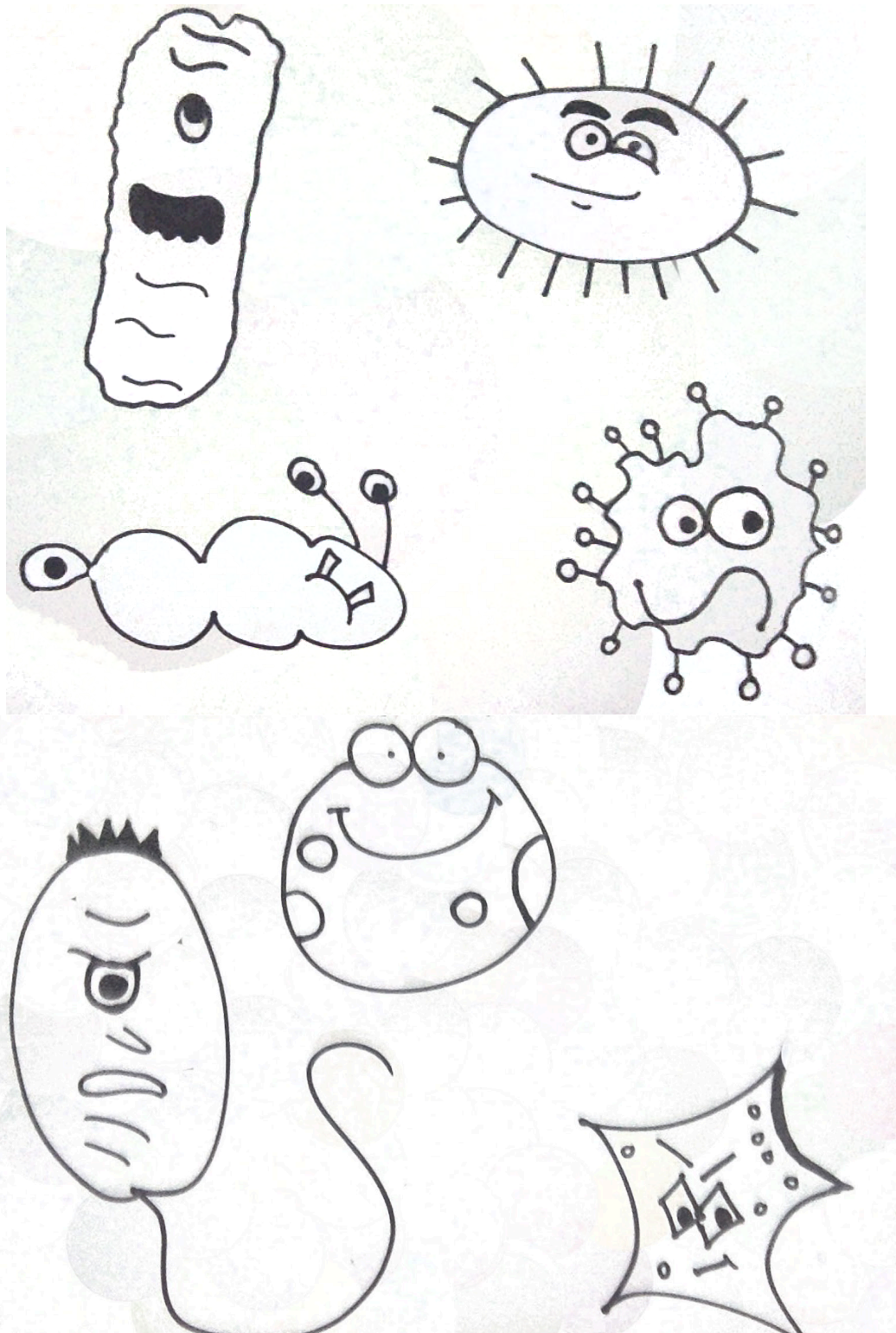
# Word Search

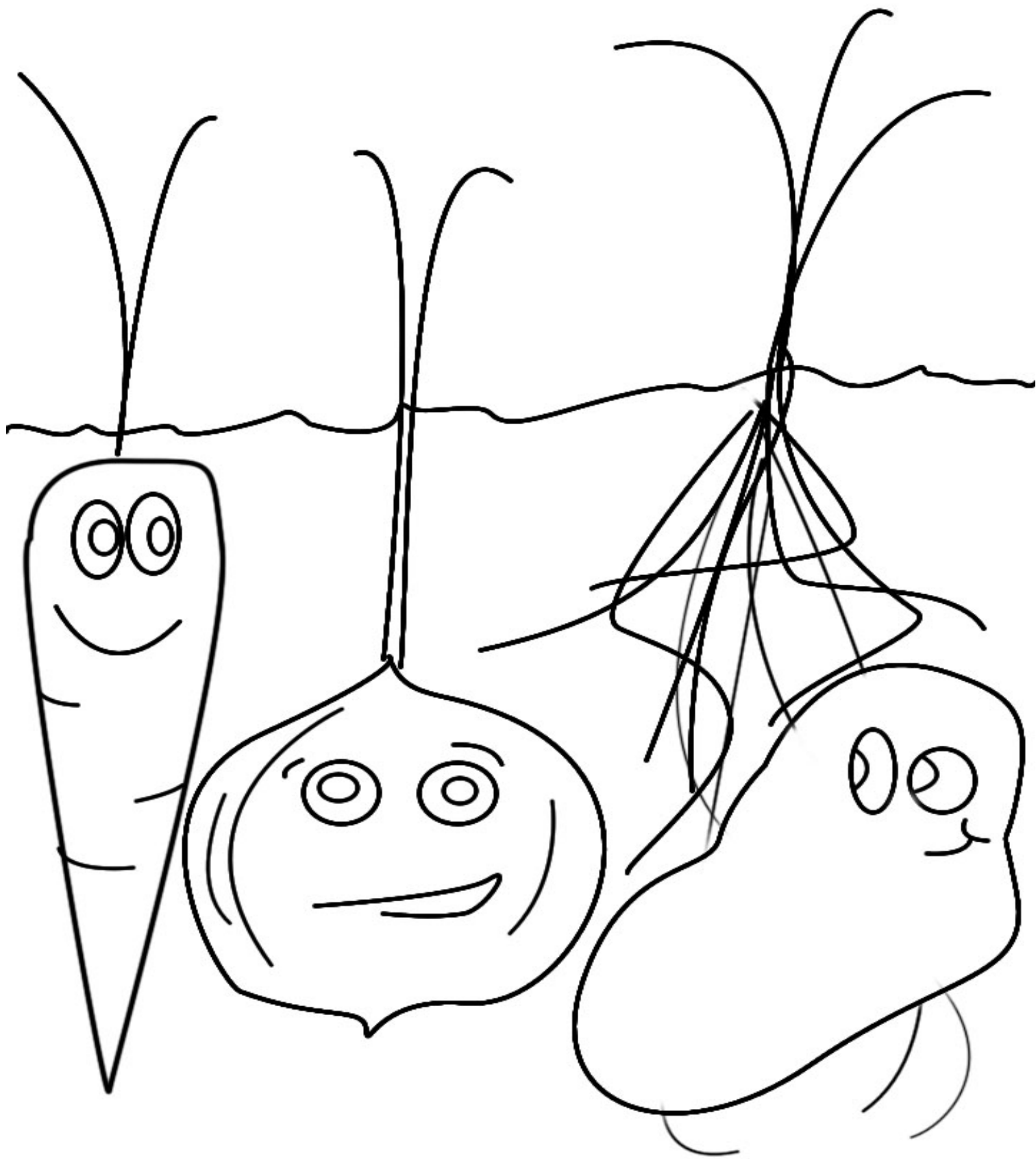
## Compost and Gardening

V L M K K M G N A W L V B Z P U V Y A E C N I Q Y  
C N P S X T F I W O I U R X O T J R D R V V K T V  
O H F J O V J X E M O A E C V Z Q Q L U P M F R H  
N D E L P P V O F Z S B S H J H C G H T L A J S G  
X I I B T D E T S A W C O W Z A L Q X L B F Q Z O  
P F N P V W X W K I X P D S M Y D U J U K N P I P  
X N I J N H H W H L S G J W Y J T T K C U I U F A  
B L X D J S R K Z X P L Q V G J O G M I I U K P J  
W A P S H U I R C G O J I C N E Z A N M I K L M B  
Q V J N M X B V A J F Z A E K R C R D R X K A P I  
A V M F E R F V O V F L Q M Z A I I Y E D I L L C  
C O I C G R A G T J I M T S U Z U J T V O V U A P  
C O M P O S T F P G R D O C X L E T V F P O K V B  
M Z G M F U W Q D D O Z I L P T V R V G V L E M S  
I H F H Y X C O K O R J A J I H A H U E Q L Y Q W  
J Q F K E F Q V F Y Z G P M W Y O D M K B G X R Q  
R L Y X Y S T Y Y V J A N B B E Q G B A T S W D O  
Y E D D X H H B D U M R W A O F R U N E Z O Y L X  
X E C E M U N C Z S W D E W G B J I J Q R K F J N  
O K X Y P K W R Z K W E F C Z L A Q U M O F J P E  
G N K E C I D D L J W N Z G B T T R S H Y P A W N  
D U O T V L T V T Q B C T G S R C G K L G O P A M  
J W D H V E E I W U K R W U A K X W E P R R O G H  
I N X H V Q V U U S C Q S L N S A Y C V J Z D P I  
H V A E X P W I K M K G F O V L R N E U U W L G Q

COMPOST  
FARMS  
FOOD  
GARDEN  
RECYCLE  
SOIL  
SUSTAINABLE  
VERMICULTURE  
WASTE  
WORMS

# Color the Microorganisms







# Conclusion

The benefits of **composting** are tremendous! Composting is an easy way to help protect the planet, by making the most out of our household's organic garbage. Making compost means creating a toxic-free healthy mixture that wards off harmful pests and creates the perfect setting for fruit and vegetable growth.

Compost is also **environmental friendly** as by composting we are reducing the amount of waste that ends up in landfills. Moreover, composting saves money both for individual households and the whole city. Households that compost have access to a fertile, healthy and **free** plant "food" while cities benefit from wasting less money on gas for the trucks that transport our garbage. Since human activity has harmed the environment in so many ways, whatever we do that can help minimize this damage is really important and should be encouraged. After all, living on this planet requires that we all **respect** and **protect** the environment, if we want our stay on Earth to be pleasant and last for next generations.



# Who We Are



The Microbial Ecology Section of ESA is a section supporting ecologists who work in the field of microbiology. Our section supports researchers by providing student travel scholarships and facilitating interactions between microbial ecologists at the annual ESA meetings. Moreover, our section engages in microbial outreach and posts jobs and funding opportunities.

Our 2016 Officers are

- Kristen DeAngelis, section chair, [deangelis@microbio.umass.edu](mailto:deangelis@microbio.umass.edu)
- Ed Hall, section vice chair, [edhall@colostate.edu](mailto:edhall@colostate.edu)
- Kristen Hofmockel, section secretary, [kristen.hofmockel@pnnl.gov](mailto:kristen.hofmockel@pnnl.gov)
- Jessica Moore, student representative, [Jessica.am.bryant@gmail.com](mailto:Jessica.am.bryant@gmail.com)

For the online version of this book or to find more information about our activities and outreach visit our website: <http://esa.org/microbial/>

- Twitter @ESAMicrobe
- Facebook @ <https://www.facebook.com/groups/ESAMicrobialEcology/>



## Bibliography

“A Critical Reappraisal of the Fossil Record of the Bilaterian Phyla”.

[Budd, G. E.; Jensen, S \(2000\)](#)

Agricultural Resources Facts and Statistics  
[mass.gov/eea/agencies/agr/statistics/](http://mass.gov/eea/agencies/agr/statistics/)

Amazon Products  
[amazon.com](http://amazon.com)

Community Supported Agriculture  
<http://www.farmfresh.org/>

Composting 101 - "How to Make Compost."  
[planetnatural.com/composting-101/](http://planetnatural.com/composting-101/)

Composting for Facilities Basics  
[epa.gov/compost/basic.htm](http://epa.gov/compost/basic.htm)

Dictionary  
[dictionary.com](http://dictionary.com)

"Elements of Nature and Properties of Soil"  
[Nyle C. Brandy; Ray R. Weil \(2009\)](#)

Farm Demographics  
[agcensus.usda.gov/Publications/2012/Online\\_Resources/Highlights/Farm\\_Demographics/](http://agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farm_Demographics/)

"Historical Studies on Halicyrtus Spinulosus (Priapulida)"  
[Oeschger, R. ; Janssen H.H. \(1991\)](#)

"Elements of Nature and Properties of Soil"  
[Nyle C. Brandy; Ray R. Weil \(2009\)](#)

How much do we waste daily?  
[center.sustainability.duke.edu/resources/green-facts-consumers/](http://center.sustainability.duke.edu/resources/green-facts-consumers/)

How to Build a Compost Bin.  
[Eartheasy.com](http://Eartheasy.com)

"Introduction to the Nematoda"  
[University of California \(1997\)](#)

Kestrel Land Trust  
<http://www.kestreltrust.org/>

Land Use Overview.  
[epa.gov](http://epa.gov)

Occupational Employment Statistics  
[agcensus.usda.gov](http://agcensus.usda.gov)

"Phylogenomic Analyses Unravel Annelid Evolution"

[Struck, T. H. ; Paul, C.; Hill, N.; Hartmann, S.; Hosel, C.; Kube, M.; Lieb, B.; Meyer, A.; Tiedemann, R.; Purschke \(2011\).](#)

“Phylum Phoronida”  
[Emig, Christian C. \(2003\).](#)

“Sacramento Area’s Worms and Worm Castings.”  
<http://www.wormfancy.com/>

Soil Health and fertility.  
[dpi.nsw.gov.au/agriculture/resources/soils/biology/earthworms](http://dpi.nsw.gov.au/agriculture/resources/soils/biology/earthworms)

“The Platyhelminthes”  
[Walker J.C.; Andersen , D.T \(2001\)](#)

“Velvet Worms” Extraordinary Animals: An Encyclopedia of Curious and Unusual Animals.”  
[Piper, Ross \(2007\).](#)

Vermiculture Composting.  
[wormpoop.com/Composting/Composting.htm](http://wormpoop.com/Composting/Composting.htm)

What is Composting?  
<http://www.recycleworks.org/compost/>

Word Search Puzzle.  
[puzzlemaker.discoveryeducation.com/code/BuildWordSearch](http://puzzlemaker.discoveryeducation.com/code/BuildWordSearch)

“Nemertini, Rhychozoela, Nemertea”  
[Scott, Thomas \(1996\).](#)