CFAES
OHIO STATE UNIVERSITY EXTENSION

PROJECT IDEA STARTER

Get Started with Composting

By Kim Hupman, Horticulture Program Assistant, Agriculture and Natural Resources; and Rebecca Supinger, Extension Educator, 4-H Youth Development. Reviewed by Trevor Corboy and Mary Griffith, Extension Educators, Agriculture and Natural Resources.

Composting is a natural process that changes organic material into fertilizer for your soil. These organic materials are readily available and can include kitchen scraps and yard waste. Seeing these materials transform over time into finished compost is fascinating and rewarding!

Finished compost is the result of vegetable scraps, grass clippings, leaves, weeds, and other organic matter decaying (breaking down) into a crumbly, dark mixture. This finished compost makes your soil more fertile, allowing the plants in your garden to grow better.

Decomposers are key players in a compost pile. These organisms are important in any ecosystem. They break down organic materials and recycle them into a nutrient-rich compost that looks and feels like soil. In a compost pile, they range in size from microscopic bacteria and fungi (microorganisms) to earthworms and crickets (macroorganisms).

- Microorganisms are called chemical decomposers because they use chemicals in their bodies to break down organic material.
- The macroorganisms, called physical decomposers, tear and chew materials into smaller pieces. Other examples of these decomposers include sow bugs, beetles, ants, and centipedes.

Just like all living things, decomposers need water, air, and food to survive. In a compost pile, most of the water they need comes from moisture in the food scraps that you add. The decomposers get air when you mix and turn the pile. Their food is the vegetable scraps, banana peels, leaves, grass clippings, sawdust, etc. that you put in the pile.

Good quality compost needs four elements:

- **Heat** is created when decomposers break down organic matter.
- **Nutrients** feed the decomposers and keep them healthy and active.
- **Oxygen** also helps increase the number of decomposers.
- **Water** helps the decomposers stay at the right temperature so they continue to grow well.

The key to successful composting is finding the right balance of each of the elements to meet the needs of the decomposers.

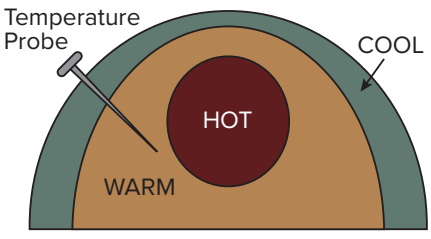
PLAN YOUR PROJECT

Use this idea starter AND publication 4-H 365 *Self-Determined Project Guide* as the starting place for your 4-H self-determined project. The *Self-Determined Project Guide* is available from your county OSU Extension office or on the Web at **ohio4h.org/selfdetermined**. You may choose to do a little or a lot depending on your level of interest. Be sure to register your project with your county OSU Extension office.

Heat

The microscopic decomposers do most of the work in a compost pile. With billions of bacteria breaking down organic material, the pile gets hot. The ideal temperature for a compost pile is 140–160^{0}F. After you start your pile, you need to check its temperature daily with a compost thermometer. Keep track of how your pile is doing by recording these readings in a notebook or spreadsheet. Temperatures will vary depending on your composting ingredients and methods. However, a pile that is 170^{0}F or higher can kill decomposers. Temperatures under 130^{0}F slow decomposition and allow disease-producing bacteria to live.

Compost piles need to be a certain size to self-insulate and maintain high temperatures in the center. Self-insulate means the pile has enough material to cover its heated center and keep it hot. The outside of the pile is cool compared to the hot center where decomposers are busy breaking down materials. A thermophile is an example of a bacteria that grows best at these high temperatures. Interestingly, thermophilic bacteria also live in the geyser at Yellowstone National Park.



Ideal temperatures for a compost pile.

The Old Faithful Geyser hosts the same heat-loving thermophilic bacteria as compost piles.

When you build a compost pile, a good size to start with is between 3 x 3 x 3 feet (one cubic yard) and 5 x 5 x 5 feet across. This is big enough for the materials to develop a hot center with a cool outside layer. It is also a manageable size to turn easily. The pile's temperature cools as decomposers use water, air, and food. That's your signal to add more materials and turn the pile. Mixing the pile's materials helps them breakdown more evenly.

Nutrients

Decomposers need carbon and nitrogen to fuel their activity and break down the organic matter in your pile into compost. The vegetable scraps, grass clippings, and other organic material you put in your compost pile all include carbon and nitrogen needed to feed the decomposers. Different materials contain different amounts of carbon compared to nitrogen.

To give the decomposers a "balanced diet," a compost pile needs carbon and nitrogen in the right amounts, or C:N, meaning carbon:nitrogen ratio, or carbon "to" nitrogen. (In this case, always read the colon as the word "to.") The optimum ratio is 30 parts carbon: 1 part nitrogen. Carbon-rich materials, or "brown materials," are dry. Nitrogen-rich materials, known as "green materials," are fresh and moist. If you have too much brown material (carbon), it will not heat up. If there is too much green material (nitrogen), the compost may become too hot, killing the decomposers. High heat can also keep the pile from getting oxygen, which results in a foul-smelling mess.

This article from Planet Natural Research Center explains an easy way to start a compost pile: **planetnatural.com/composting-101/making/compost-pile**:

1. Start with a clear area that measures 3 feet by 3 feet (as mentioned above).
2. Add a large amount of brown materials, a much smaller amount of green materials

(about a quarter of the amount of brown materials), and a bucket or two of something with microorganisms such as aged manure or soil.

The article continues with how to allow air to circulate under the pile, and which materials to layer on top to create a full pile. It also describes other methods of composting.

When it is time to add new material, keep the 30 parts carbon: 1 part nitrogen ratio in mind. The ratio does not have to be exact, just try to keep it close. This "Compost C:N Ratios Made Simple" video at **youtube.com/watch?v=jTHUaIsT8sQ** shows an easy way to learn how to add materials to your pile. If the balance is off too much, the pile's temperature is your clue.

The greatest microbial activity is when the carbon-to-nitrogen ratio is 30:1.

Checking the pile's temperature tells you if the decomposers are getting what they need.

- When the pile has too much carbon, it becomes too cool and the decomposers stop working.

If this happens, add green (high in nitrogen) materials, such as grass clippings, a little at a time to increase the heat.

- When the pile gets too hot, the decomposers start to die.

Adding brown materials (high in carbon) balances the pile's ratio and lowers the temperature to safer levels.

When you add new materials, be sure to mix them into the whole pile. Adding brown and green materials gradually helps the compost pile stay in the proper temperature range.

How do you know what to add to keep your pile healthy? Use these tables to tell which items have higher percentages of carbon (below left) and which have high percentages of nitrogen (below right). For example, corn stalks are 60 parts carbon to 1 part nitrogen. Because they are mostly carbon, they are considered brown material. Coffee grounds are only 20 parts carbon to 1 part nitrogen. Compared to materials like corn stalks, they are low in carbon and high in nitrogen, and are therefore green material.

Carbon to Nitrogen Ratios

Carbon-Rich (Brown) Ingredients	Carbon to Nitrogen Ratio*
Corn stalks	60:1
Corrugated cardboard	600:1
Dry leaves	40–80:1
Mixed paper products	200–800:1
Newspaper	150–200:1
Pine needles	60–110:1
Sawdust, weathered 2 months	625:1
Sawdust, weathered 3 years	142:1
Straw	50–150:1
Woody plant trimmings	200–1,300:1

Nitrogen-Rich (Green) Ingredients	Carbon to Nitrogen Ratio*
Coffee grounds	20:1
Food scraps	17:1
Garden plants and weeds	20–35:1
Grass clippings	10–25:1
Hay	10–25:1
Kitchen scraps	10–50:1
Manure, aged	20–50:1
Vegetable scraps	25:1

** Representative ranges only. Actual carbon to nitrogen ratios vary depending on plant species and if the material has already started to decompose.*

Everyone who has a yard has plenty of greens in summer, followed by an abundant supply of browns in the fall. To balance your compost easily, save shredded leaves and store them in trash bags, an old garbage can, or a large wire pen. In summer, if watermelon rinds and spent plants overload your compost with greens, mix in some leaves to get it back on track. Composters who live in areas where leaves are scarce often use shredded newspaper to keep summer compost from going gloppy with too many greens.

Oxygen

The decomposers breaking down your pile need air to survive. If your pile gets too dense or too moist, you need to increase the air flow. Adding a large, fluffy material such as straw allows more air to flow through the pile.

Water

Another basic element of composting is moisture. You don't want your pile to be too wet or too dry. Aim for moist but not soggy, like a damp sponge that has just been wrung out.

The more greens you have in your pile, the less water you need. In some cases your pile will be too wet, and you may need to add leaf matter, shredded paper, or other dryer materials that can soak up excess moisture. If you get a lot of rain, a layer of straw or a tarp on top of your pile will protect it from getting too wet.

Finished Product

When compost decomposes completely it is called humus. Compost is ready when the pile no longer emits heat, turns dark in color, and crumbles easily. It will look, smell, and feel like soil. It takes anywhere from a month to a year to reach the finished product, depending on whether the basic elements of heat, nutrients, oxygen, and water have been supplied. Finished compost is what you need if you plan to use it as a growing medium. The nutrients in organic matter are not available to plants until they are broken down. This is one reason why composting is a great idea.

Be prepared to harvest and store your compost as each batch matures. Save plastic bags, such as the large bags that mulch is packed in, and use them to store compost until you are ready to use it. When kept in bags, lightly moist compost continues to cure, which encourages the decomposers that operate at a lower temperature to put their finish touches on the pile.

An alternative to bagging your finished compost is to spread it over your vegetable garden in the fall to let it sit over winter. Another option is to have a few piles—one ready, one in-process, and one that needs materials added to it. You do not have to maintain perfect timing on your piles. If you have the space, maintaining more than one pile is easier than storing compost in bags.

> Compost can be used before it decomposes completely if you plan to use it as a top-dressing. To top-dress an area you would spread the almost-finished compost 1–4 inches thick across the garden or landscape bed. Almost-finished compost no longer emits heat but is not yet to the humus stage. Larger organisms and rain help the compost to continue to age. Be careful though. Unfinished compost can be harmful to plants if it is incorporated into the soil before it reaches the humus stage.

Chickens snack on fresh items of a newer pile that's next to a pile of finely textured finished compost.

Types of Compost Bins

If you want to keep the compost pile neat and the conditions right for proper aging, you can build a homemade bin or purchase a pre-made container. Your choice may be guided by the size of your area and the size of your family.

- **Homemade bins.** Larger homemade bins can be constructed from various types of materials such as wood pallets or slats, snow fencing, or wire. These bins should have three sides with the back panel facing prevalent winds. The open side should be easily accessible for adding materials and turning the pile.
- **Pre-made containers.** Pre-made containers come in a variety of sizes. The size should

be equal to the amount of material your family produces to be composted. A container that can be rotated by turning with a handle is an easy way to keep the pile healthy.

Location

Locate your container or bin in an area that is easily accessed for moving materials in and out. Look for a place that is in partial shade. Full sun (a minimum of six hours of sun) can overheat the pile and kill the microscopic decomposers.

Materials to Avoid

Avoid putting these materials in your pile:

- Animal waste (meat, bones, grease, fat, eggs, and dairy products). Animal waste can cause strong odors and attract rodents.
- Cat, dog, or human feces. Feces transmits disease and should not be used.
- Fresh (non-composted) manure. Only aged manure should be added. Fresh (non-composted) manures contain E. coli and other harmful bacteria.
- Weeds that have gone to seed. If the compost temperature is not high enough to kill seeds, they can grow. Use only the flowers, leaves, and stems of weeds in your pile.

Always wash all fruits and vegetables harvested from the garden. This minimizes the possibility of soil contaminated by bacteria being transmitted into food for human consumption.

Trouble Shooting

Symptoms	Problem	Solution
The compost has a bad odor.	Not enough air.	Turn it.
The center of the pile is dry.	Not enough water.	Moisten material while turning the pile.
The compost is damp and warm only in the center, instead of the entire pile.	Too small.	Collect and add more material.
The heap is damp and sweet-smelling but will not heat up.	Lack of nitrogen.	Mix in a nitrogen source like fresh grass clippings or aged manure.

AREAS OF INTEREST AND THINGS TO DO

Every self-determined 4-H project has various areas of interest. Each area offers specific things members can address during their project adventures. Using *4-H 365 Self-Determined Project Guide*, identify at least three areas of interest with at least three activities per area to explore. Take your ideas from the list below or make up your own.

This compost has reached the humus stage and is ready to use.

Ways to Compost and Structure

- ☐ Visit and study a compost bin or pile. What is working? What is not? Make a list of your observations for future reference.
- ☐ Check out “How to Build a Compost Bin” at **extension.missouri.edu/publications/g6957**. Determine which one is best for your situation. If possible, build it.
- ☐ Create a vermiculture bin. Observe decomposition and the benefits that worms provide to the soil. Learn how

vermiculture red worms and earth worms are different and how to safely discard non-native worms. For more about vermicomposting visit **kids.niehs.nih.gov/topics/reduce/vermicomposting/index.htm**.

- ☐ Research the pros and cons of an off-the-ground compost bin vs. an on-the-ground compost pile. Make a chart that evaluates insect activity, ease of use, different rates of decomposition, and anything else you observe.
- ☐ Get started with "Lasagna Composting" at **ccetompkins.org/resources/compost-lasagna-layer-composting**. Start one lasagna composting bed in the fall and another one in the spring. To see which one creates compost faster, track the progress of both in a journal.

Essentials of Composting

- ☐ Research the three classes of composting bacteria—thermophiles, psychrophiles, and mesophiles—and the stages when they are active. The classes are described at at **sfyl.ifas.ufl.edu/sarasota/natural-resources/waste-reduction/composting/what-is-composting/meet-your-composting-team/composting-bacteria**. Make a poster showing what you learned.
- ☐ The greatest microbial activity is when the carbon-to-nitrogen ratio is 30:1 (C/N). Research which ingredients could be added if your ratio needs adjusting, and then record the result. How did you know the ratio needed adjusting?

- ☐ Identify four different insects and their scientific family. At which stages do they appear? What insects do you typically find in a compost bin? View the food web (a chain of life-forms that depend on others to live) of a compost pile in a pyramid diagram at **compost.css.cornell.edu/invertebrates.html**.
- ☐ Based on research, build a compost pile that works for you and your family. Create a weekly composting schedule. Incorporate all tasks needed to take care of the pile such as turning it, adding water if needed, checking the temperature, and any other maintenance. The Environmental Protection Agency has a helpful tip sheet about what, how, and why to compost at **epa.gov/recycle/composting-home**.
- ☐ How will you determine when the compost is finished? Create a checklist of what to look for and a plan for your next steps.

Ingredients for Composting

- ☐ What could you do to ensure you have the materials needed year-round for your compost needs? Make a list of ideas so your pile can continually progress to the next stage.
- ☐ Research what should not go into a compost pile and why. Post a "Don't Add to the Compost Pile" list so all family members know how to keep the pile healthy.
- ☐ Investigate how moisture and temperature affect the breakdown of materials. What happens if your compost is too wet or too dry? How can you solve the problem? Learn how to fix problems with your pile by reading "Seven Solutions to Common Compost Problems" at **ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=11125**. Create a "Cause and Effect" poster showing the results of what you tried.
- ☐ Create a micro compost bin by recycling in a clear container (plastic container, Mason jar, pop bottle, etc.). How did you modify the size of your ingredients to fit into this micro bin? Record findings and difficulties.

Being a Steward of the Earth

- ☐ Create an environmental log that challenges you to reuse, recycle, or compost items from a week's worth of daily food. If an item must be thrown away, can your family substitute a different item to cut down on future waste? Read about ways to cut down on what you throw away, buy products that can be recycled, and reduce unwanted postal mail at **nature.org/en-us/about-us/where-we-work/united-states/delaware/stories-in-delaware/delaware-eight-ways-to-reduce-waste**.
- ☐ Research commonly used compost ingredients in other countries. How do they differ from what you would use? What compost ingredients are unique to where you live as compared to other countries? Share what you learn with your project helper.
- ☐ Create a report and present it to a school or community leader encouraging them to implement a compost plan at their location.
- ☐ Give a presentation on the environmental benefits of composting. Focus on encouraging other people to start composting.

RESOURCES

- The Kids Gardening website, **kidsgardening.org/gardening-basics**, is full of great ideas including how to start a garden and set up a composting site at your school, what to plant to attract pollinators, how to create a reading garden, and much more!
- If you do not garden, there are plenty of things to do with the compost you create. Just search online for "things to do with compost if you don't garden" and learn how you can help your community.

SOURCES

- "Compost Pile Microbes" at **calrecycle.ca.gov**
- "Home Composting Made Easy" at **homecompostingmadeeasy.com/carbonnitrogenratio.html**
- "Hot Composting vs. Cold Composting" at **finegardening.com**.

Unless otherwise noted, all images are from iStockphoto.com by Getty Images.

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

4/2021