

# B5 Recycling

Subexperiment B5.1 Recycling old materials

Subexperiment B5.2 Making new from old: Making paper

Subexperiment B5.3 Recycling organic waste

## 1 Main question

The following questions underlie the subexperiments and guide the activities:

- What is recycling?
- What types of recycling are there?
- Why should we recycle old materials?
- How do you make new paper from scrap paper?
- How is a compost pile set up and what happens in it?

## 2 Background

### 2.1 Relevance to the curriculum

From huge mountains of trash to the recycling of individual materials: By dealing with the topic of recycling, the students will become sensitized to an important topic of environmental protection and sustainable use of our Earth. In working through the subexperiments, the students will be shown opportunities for how they themselves can make a contribution toward preserving the Earth in their daily lives. The students will learn that waste separation is important and that new products can be made from various old materials.

The students will be introduced to a sensible way of dealing with waste. The main focus will be on waste prevention, separation, and recycling. The aim is to heighten the students' awareness that waste is not necessarily the same as residual waste, and that many materials can be recycled. In subexperiment B5.3, the students will learn how organic waste is composted and how significant these natural decomposition processes are for the cycle of substances in nature.

### Topics and terms

Compost (pile), decomposition processes, deforestation, fertilizer, habitat, humus, making paper, newsprint, old materials, organic waste, organisms, residual waste, scrap paper, soil, wood

### 2.2 Skills

The students will ...

- come to understand the significance of waste separation, identify ways that they can become proactive, and begin to learn about environmental protection.
- acquire and expand their awareness of craftsmanship.

## 3 Additional information on the experiment

You will find additional media for preparing or for further study of this experiment on the Siemens Stiftung Media Portal: <https://medienportal.siemens-stiftung.org>

## 4 Conducting the experiment

### Notes:

- The listed materials are designed to allow **one** group of maximum **five** students to conduct the experiment.

- Terms: Waste versus trash

Viewed linguistically, the terms waste and trash are synonyms.

In technical vocabulary, however, “trash” is understood in the sense of “residual waste,” that is, anything that cannot be recycled and ends up at landfills.

Waste is the generic term for everything that accumulates as unusable remainders in a household or in industrial processes. However, this waste may still contain a lot of materials that are recyclable.

The terms are used in this sense in Experimento | 8+.

In everyday language, we refer to a lot of things as trash because we ourselves cannot use them anymore. In actuality, however, these are usually items that contain recyclable materials. So that this is clear, the term “trash” is written in quotation marks in the student instructions.

## 4.1 Subexperiment B5.1 Recycling old materials

### 4.1.1 Required materials

Material	Quantity
Packing tape	1
Scrap paper	Approx. 1 kg.

Material for the additional experiment	Quantity
Adhesive tape	1
Glue stick	1
Scissors	1
Various waste products: toilet paper roll, plastic bag, cable, etc.	Several objects per student

### 4.1.2 Organizational aspects

<b>Facilities</b>	In the classroom or outdoors; access to water is required
<b>Time required</b>	Approx. 90 minutes (together with B5.2)
<b>Experimental variations</b>	Suggestion for working methodically: After a short introduction to the topic by the teacher, the experiments B5.1 and B5.2 can be conducted at the same time in groups of about five students each. The advantage of this is that not all students will be using the frame with screen simultaneously (subexperiment B5.2).
<b>Safety instructions</b>	See the "Safety instructions on the topic of the environment" in the guidebook.
<b>Cleanup</b>	The students may take the finished sandals home.

### 4.1.3 Explaining the subexperiment in the teaching context

The students will learn that there are many creative possibilities for using scrap paper, aside from just making recycled paper.

#### Technical background

The recycling of old materials is becoming increasingly important today. Growing mountains of trash are a huge problem, and most traditional processes for disposing of residual waste are harmful to the environment (for example, dumping in landfills). The mountains of trash are often simply burned to reduce the volume of trash. However, this causes completely different problems: The combustion produces toxins that can end up in the environment and cause damage (to us as well). Combustion also produces carbon dioxide, a climate-damaging gas. In addition, valuable old materials are destroyed in the burning process. In Germany alone, several million tons of waste accumulate every year. In view of the global scarcity of resources for power generation, though, waste incineration also has some importance: The energy from the combustion of trash can be used to generate power or to provide district heating.

If we take a closer look at daily household waste (again, using Germany as an example), we find that over two-thirds can be recycled, such as paper and cardboard, glass, metals, organic waste, and plastic packaging. In many countries, for example, PET bottles are collected, chopped up, and melted down to make new bottles or packaging.

It is important to make the students aware of these connections while they are young in order to protect the ecosystem Earth.

Artists and designers also set good examples of successful recycling, such as when they repurpose truck tarps into durable shoulder bags. However, pollution of the environment is not always taken into account during the production process in such projects.

#### 4.1.4 Ask about the students' prior knowledge and ideas

The question of whether all students have a similar understanding of waste and trash must first be clarified. How are these words used in everyday terms (for example, "trash can," "waste management") and what meaning is understood?




The students are sure to have some creative ideas of what can be made from old materials.





Discuss with the students what uses there are for paper in everyday life. In the Further information section of the experiment, you can also discuss the paper products that they could use more sparingly, for example, paper towels, toilet paper, copy paper, and newspapers.

Write the students' ideas on the whiteboard and instruct the students to collect scrap paper for a week in a bin in the classroom. How much scrap paper will it amount to?

#### 4.1.5 The research cycle


Important aspects and information regarding the individual process steps of the research cycle during the experiment for students:

<b>Recognizing the problem/phenomenon</b> 	This experiment is about realizing how paper can be recycled. This can be illustrated by making a paper airplane or a paper boat, for example.
<b>The research question</b> 	The following alternatives to the research question stated in the student instructions are possible: <ul style="list-style-type: none"> <li>What can you use recycled paper for?</li> </ul>
<b>Collecting ideas and guesses</b> 	Some possible guesses: <b>Related to the research question:</b> <ul style="list-style-type: none"> <li>"I'll glue the paper together in a new way and put on the sandals."</li> </ul> <b>Related to the experiment:</b> <ul style="list-style-type: none"> <li>"I can't wear the sandals in the rain."</li> <li>"The sandals will be uncomfortable."</li> </ul> Segue from the guesses to the experiment.

<b>Experimenting</b> 	<b>Experiment setup:</b> <p>The sandals made of paper exemplify the recycling of old materials. Perhaps the students will also have other ideas or suggestions for improvement. Allow the students to come up with and implement creative suggestions.</p> <b>Conducting the experiment:</b> <ul style="list-style-type: none"> <li>▪ The folded paper looks like the bellows of an accordion.</li> <li>▪ The students can help each other with gluing, trying on, and adjusting the straps. This calls for creativity.</li> </ul>  <p>The paper is folded like this.</p>
<b>Observing and documenting</b> 	<b>Most important observations:</b> <p>The students will see that rolling the individual paper strips tightly provides strength to the shoe. They will test their paper sandals and realize that the sandals are relatively good for walking around. If the ground is wet or muddy, wearing the sandals is not advisable because they could become soggy.</p>
<b>Analyzing and reflecting</b> 	<b>Results to be expected:</b> <p>Allow the students to implement their ideas for decorating the sandals. Perhaps other waste such as plastic pieces or colorful plastic sheets is available that is suitable for decorating the sandals? However, make sure that these improvements do not result in the production of new waste.</p> <b>Reference to the story to get the students thinking about the topic:</b> <p>Through the experiment, you have learned what you can use old paper for, such as to make sandals. The next time, you might make a paper airplane.</p>

#### 4.1.6 Further information

##### In the student instructions

<b>Doing further research</b> 	<p>Many artists work with waste and create art from discarded materials. One reason for doing this is to give the waste a new purpose. You can also work together with an art teacher to have the students create “trash artwork” as a project and display it at the school. This helps make the students aware of trash issues.</p> <p>Give each student the same waste, such as a toilet paper roll, a plastic bag, and scrap paper. Other suitable materials include dry foliage, old hoses and cables, and bicycle tires.</p> <p>You can foster the individuality of the artwork by having each student integrate other objects into his or her artwork. You can do this by taking the students on a walk, being mindful of the supervision requirement, with the goal of collecting waste for individual artwork. For example, walk around the playground or go to a nearby park or public square. If there is no opportunity for a group walk or if only hygienically questionable waste is found, the students can also bring waste from home. Point out that they should not rummage through trash cans, that the waste must be dry and clean, and that no animal materials may be used. In addition, they may not use sharp-edged or rusty objects. Excessively dirty waste must be rejected; pay attention to adequate hand hygiene and possibly the hygiene of the objects.</p>
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##### Miscellaneous

Research project for homework: Find out how scrap paper is recycled in a recycling factory and write down what you learn.

## 4.2 Subexperiment B5.2 Making new from old: Making paper

### 4.2.1 Required materials

Material	Quantity
Bowl	1
Cotton cloth	1
Disposable gloves for everyone or one pair of dishwashing gloves per group	
Large plastic tub*	1
Frame with screen	1
Scrap paper (newspapers)	At least one newspaper per student
Water	Several liters, depending on the size of the tub

\* The selected tub must be big enough so that the frame with screen fits easily inside.

### 4.2.2 Organizational aspects

<b>Facilities</b>	In the classroom or outdoors
<b>Time required</b>	Approx. 90 minutes (together with B5.1)
<b>Experimental variations</b>	<p>Suggestion for working methodically: See subexperiment B5.1</p> <p>The paper-water mixture can also be stirred with a mixer (if available) and allowed to stand overnight. The finished paper can be ironed so that it is even smoother and easier to write on. These two variations were excluded here for safety reasons and to save electricity.</p>
<b>Safety instructions</b>	<p>See the "Safety instructions on the topic of the environment" in the guidebook.</p> <ul style="list-style-type: none"> <li>Use only standard printed newspapers, not heavy glossy magazines; this paper contains additives to make the paper heavier and smoother; the color inks used can also be a cause for concern.</li> <li>Make sure that the students wear gloves during the entire experiment, even for shredding the newspapers. Otherwise, their skin could be irritated by the newspaper ink that rubs off. When they mix the shredded paper with water, make sure that water does not get inside the gloves.</li> </ul>
<b>Cleanup</b>	<p>If possible, all of the paper pulp should be used to make the paper.</p> <p>The remaining dirty water can be poured down the sink.</p> <p>Clean any newspaper ink off all materials.</p> <p>In the spirit of avoiding trash, the disposable gloves can also be washed (using dish detergent) and used again for similar experiments.</p>

### 4.2.3 Explaining the subexperiment in the teaching context

The students will learn how to make recycled paper from scrap paper following a simple procedure. Students will mix a paper pulp and make sheets of recycled paper using a frame with screen. After the individual sheets dry, they can be written on and tested for their usability.

#### Technical background

Making paper is a handicraft method for obtaining new paper from scrap paper. The scrap paper is shredded and mixed with water in a bowl to form a paper pulp. Sheets of new recycled paper are made using a frame with screen. In this way, the students will experience something that large machines do for people today.

In addition, the production of recycled paper requires considerably less energy than the production of new paper. Not only are far fewer trees needed, but only a fraction of the water is used, and a fraction of the pollution is generated as compared to the production of new paper (virgin-fiber paper). Ideally, bleach is not used, so that the recycling of paper makes an important contribution to environmental protection.



Nevertheless, even recycling causes environmental pollution; for example, clean water is used to remove the newspaper ink from the scrap paper and this wastewater must in turn be disposed of. For this reason, it is just as important to use new paper sparingly as it is to use recycled paper. This is because paper is made of cellulose, which is obtained from wood. No new trees have to be cut down to make paper from scrap paper. By doing so, people protect the forests, the habitat of many living organisms, whose existence is threatened by deforestation and the associated intrusion into the ecosystem (see problem of rainforest deforestation).

### 4.2.4 Ask about the students' prior knowledge and ideas




The students may be familiar with the collection of scrap paper at home. In addition, they have presumably already encountered different types of paper in everyday life. Ask whether the students know what kind of scrap paper is suitable for making recycled paper.


### 4.2.5 The research cycle

Important aspects and information regarding the individual process steps of the research cycle during the experiment for students:

<b>Recognizing the problem/phenomenon</b> 	In this experiment, the students will learn how new paper is made from old paper that can be recycled.
<b>The research question</b> 	The following alternatives to the research question stated in the student instructions are possible: <ul style="list-style-type: none"> <li>▪ How can paper be recycled?</li> </ul>




<b>Collecting ideas and guesses</b> 	<p>Some possible guesses:</p> <p><b>Related to the research question:</b></p> <ul style="list-style-type: none"> <li>▪ “I’ll wash the paper.”</li> </ul> <p><b>Related to the experiment:</b></p> <ul style="list-style-type: none"> <li>▪ “You have to remove the color ink from the newspapers.”</li> </ul> <p>Segue from the guesses to the experiment.</p>
<b>Experimenting</b> 	<p><b>Experiment setup:</b></p> <p>No particular information.</p> <p><b>Conducting the experiment:</b></p> <ul style="list-style-type: none"> <li>▪ Make sure the students wear gloves.</li> <li>▪ The amount of water depends on the amount of paper: Less water should be used initially, and then more water can be added, if necessary.</li> <li>▪ The paper pulp must drain well on the frame with screen and then dry overnight.</li> <li>▪ The frame with screen consists of two parts. The wooden frame without the screen is used to achieve a clean edge for the paper being made. It can be omitted for easier handling. The students can then cut the finished sheet of paper.</li> </ul>
<b>Observing and documenting</b> 	<p><b>Most important observations:</b></p> <ul style="list-style-type: none"> <li>▪ The students will observe the transformation of scrap paper to pulp and then to recycled paper. They will test their newly created paper for usability by writing on it.</li> <li>▪ The students will compare the amount of scrap paper needed with the amount of recycled paper that is produced and determine the difference.</li> </ul>

<b>Analyzing and reflecting</b> 	<p><b>Results to be expected:</b></p> <ul style="list-style-type: none"> <li>▪ The homemade paper is coarser and therefore more prone to running, which causes the ink of a pen to bleed.</li> <li>▪ Irregularities in the paper's surface can make writing uneven.</li> <li>▪ The recycled paper is not as white as new paper.</li> <li>▪ The students will suspect that recycled paper can be used just like the paper in their notebooks, especially if the recycled paper was factory-made. They can counteract any disadvantages by using other writing instruments.</li> <li>▪ Insights regarding pollution of the environment during paper treatment include: The gloves turn black due to the frequent contact with the newspaper. The recycling process requires a lot of fresh water that is contaminated when the colors are washed out. If the process takes place mechanically, additional chemicals are used for cleaning and possibly for bleaching the scrap paper. The equipment gets dirty and therefore must also be cleaned. Despite all this, recycled paper is an environmentally friendly alternative to new paper!</li> </ul> <p><b>Reference to the story to get the students thinking about the topic:</b></p> <p>You now know how recycled paper is produced. Ben and Maria's notebooks are made from recycled paper. That's why they look a little darker than notebooks made from new paper.</p>
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#### 4.2.6 Further information

##### In the student instructions

<b>Doing further research</b> 	<p>Give the students a piece of the homemade paper to take home. In order to reinforce the topic of waste and the different forms of disposal and recycling, the students should make a list (if possible, on their recycled paper) of all waste thrown away in their household on one day. They will need the assistance of their family, since otherwise they would have to rummage through the trash can. Point out to them that this is not desirable (shards, sharp edges of aluminum cans, mold, etc.). Then the students should contemplate whether something else could be made from the waste: tin cans as pen holders, parts of empty plastic bottles decorated colorfully as a bracelet, a soccer ball made of paper, etc.</p> <p>If the students feel that no other use is possible, they can think about what happens to residual waste: incineration plant, landfill, etc.</p>
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#### Miscellaneous

Guide them in thinking on a regional level: Where are forests located in their own country, and how are they treated? Is deforestation taking place? What for? What consequences can deforestation have? Some regions lend themselves well to these questions: rainforests (extinction due to habitat destruction), Carpathian Mountains (timber thieves, erosion), etc.

### 4.2.7 Reference to values

#### What is your opinion?



In the discussion about values for this experiment, the teacher can provide a prompt or tell a story in which a problem is posed. Both actions lead to a discussion based on reflections. What's important is that the reference to values can be established in the experiment. The discussion can focus either on learning-process-related values (for example, working reliably in groups) or on object-related values (for example, handling paper as a resource). The student instructions for **B5.2 Making new from old: Making paper** address object-related values.

#### Object-related dilemma:

An object-related dilemma can be integrated in the discussion of the value "environmental awareness" (treating the environment carefully) at the end of the student instructions. The students should express their opinions about it.

**Dilemma related to grandmother's trash:** You spend many afternoons at your grandmother's house. She frequently sits in her armchair because she can no longer get around very well. One day she tells you that she finds it bothersome to have to neatly gather her scrap paper and toss it in the designated recycling bin. She finds it much easier to throw her wastepaper in the normal trash bin instead of using the paper recycling bin. She says it's much more practical and, besides, your grandmother always did that in the past.

*Think about it:* What do you think about your grandmother's behavior?

#### Possible statements by the students for and against waste separation:

Reasons for waste separation.	Reasons against waste separation.
<ul style="list-style-type: none"> <li>Paper separation is important for the environment.</li> <li>Paper separation doesn't take much effort.</li> <li>Separating trash afterwards is more effort.</li> </ul>	<ul style="list-style-type: none"> <li>The grandmother isn't used to separating trash.</li> <li>The grandmother cannot get around very well.</li> <li>The grandmother doesn't want to make the effort.</li> </ul>

**Objective:**

The students should reflect upon how they can carefully treat the environment. The value of environmental awareness (treating the environment carefully) will be addressed in the process.

**Alternatives:**

Statements or questions as prompts related to the story told in the student instructions are also suitable for encouraging discussion. The value of environmental awareness (treating the environment carefully) remains unchanged.

- **Image for discussion:**



- **Question for discussion:** What can you do to save paper or to use paper multiple times (for example, at home, at school)?

**Notes:**

The students should reflect on values and express their opinions. It may turn out that several values are addressed.

## 4.3 Subexperiment B5.3 Recycling organic waste

### 4.3.1 Required materials

This experiment requires a compost container and a suitable location for it. Therefore, a few items must be clarified in advance:

#### Permissions

The following rules are examples of regulations that are in effect in Germany. Please research the regulations that are in effect in your country and at your school.

- An arrangement must be made and permission received from the school administration and possibly from the budget and finance office.
- When permission is obtained for the project, the time frame and the size of the compost pile should also be specified.
- It must be clarified in advance how the compost pile will be “disposed of” after the experiment. People can usually be found who will take over the compost pile.

#### Location

See the student instructions

#### Building the compost container

There are various options, depending on the approved size and available materials:

- A compost container made of logs or plastic, for example, can be purchased.
- The compost container can also consist of a wooden box. Important: The bottom must be removed since contact must be made with the ground underneath. The sides of the box must have holes for aeration. The holes do not have to be particularly large.
- A compost container can be built from a plastic tub or plastic rain barrel. The advantage of this is that “windows” can be built in for observation. The container should be at least 50 cm tall. The bottom must be removed, for example, with a utility knife; the bottom corners can remain to provide stability to the container. Some holes must still be cut into the sides. To make a “window,” cut out a larger piece from the middle of a side, use superglue to adhere a transparent plastic film over the opening from the outside (“windowpane”), and then attach the window cutout (“window shutter”), for example, with packing tape. During the weekly examination of the compost pile, the students can open the window and observe the interior through the plastic film. The window should be taped shut again afterwards due to the photophobic organisms. The compost container can be constructed together with the students. The students are not to carry out the work with the utility knife, etc.

Material	Quantity
Container for the compost pile	1
Clear drinking glass	1
Gloves (alternative): <ul style="list-style-type: none"> <li>▪ Disposable gloves</li> <li>▪ Dishwashing/garden gloves</li> </ul>	5 pairs 1 pair
Magnifying glass	1
Trowel	1
Yard and kitchen waste (see appendix)	Depending on the size of the compost container

Material for the additional experiment	Quantity
Additional yard and kitchen waste, for example, two apple cores	2 portions
Scissors	1

#### 4.3.2 Organizational aspects

<b>Facilities</b>	Outdoors
<b>Time required</b>	Approx. six months; new soil is not produced until this much time passes.  The length of the period over which the student group can observe the compost pile also depends on the season (temperature variations, vacation periods). For this reason, the experiment is scheduled for three months. Of course, a longer observation period is also possible.
<b>Experimental variations</b>	The observations can be photographed and documented in pictures. A video recording and presentation of the process as a time-lapse video is also possible.  The rules for adding organic waste to the compost pile, as summarized in the appendix, can be laminated and hung up in the classroom and by the compost pile.
<b>Safety instructions</b>	See the “Safety instructions on the topic of the environment” in the guidebook.  The students should wear gloves when gardening to prevent injuries and infections (for example, tetanus).
<b>Cleanup</b>	See “Permissions” section

#### 4.3.3 Explaining the subexperiment in the teaching context

The students will gain insight into the cycle of substances in nature. They will learn that there are some living organisms that utilize organic and yard waste and produce fertile soil (humus) in the process.

The close-to-nature encounter with these topics encourages lasting involvement and consideration of one's own behavior.

## Technical background

In ecology, the study of the ecosystem, organisms are divided into three groups: the producers, the consumers, and the decomposers. **Producers** include plants, which build energy-rich compounds with the help of minerals (nutrient salts), water, carbon dioxide, and sunlight. **Consumers** are dependent on the utilization of high-energy compounds: They feed on other organisms. **Decomposers** break down and utilize any dead organic material (dead plant material, carcasses, excretions) and in the process release the minerals important for the producers. Important: Only the nutrient salts are released in the process, not nutrients (carbohydrates, proteins, fats); the producers do not need these!

The **soil** is generally made up of inorganic material (for example, sand) and organic material (for example, cellulose). The organic component is called **humus**. When organic substances such as organic waste are broken down, not only is humus produced, but **minerals** are released as well, for example, nitrates, ammonia salts, phosphates, and potassium and magnesium compounds. Since the formation of humus and minerals go hand in hand, they are often collectively referred to as humus. Due to the concentration of minerals, humus is commonly used as fertilizer.

Decomposers play a decisive role in the formation of humus. The decomposition process of the dead organic material takes place in many stages of degradation involving different living organisms; for example, the excretions of decomposers are ingested by other decomposers.

(One example: Nitrate salts are released from proteins in several stages via the metabolism of various decomposers.)

A compost pile shows this part of the cycle of substances: Dead organic material is broken down and decomposed by decomposers, primarily with the aid of oxygen.

These processes are collectively referred to as **composting**.


The decomposers include worms, woodlice, insect (larvae), bacteria, protozoa, fungi (incl. mold), arachnids, and snails.




### 4.3.4 Ask about the students' prior knowledge and ideas

First, ask what organisms live in the soil. The students are certainly familiar with earthworms and their role in aerating the soil. But are the students also aware of how many soil dwellers there are and what roles they play? Ask them about observations in the forest: What happens to a fallen tree? What happens to the leaves in the forest? The students may possibly think that this dead material disappears or is eaten, for example, by ants. Ask how they handle organic waste at home and segue to the benefits of this waste for nature.



### 4.3.5 The research cycle

Important aspects and information regarding the individual process steps of the research cycle during the experiment for students:

<b>Recognizing the problem/phenomenon</b>  	In this experiment, the students will learn what happens to organic waste in nature.
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<b>The research question</b> 	<p>The following alternatives to the research question stated in the student instructions are possible:</p> <ul style="list-style-type: none"> <li>What happens to organic waste in nature?</li> </ul>
<b>Collecting ideas and guesses</b> 	<p>Some possible guesses:</p> <p><b>Related to the research question:</b></p> <ul style="list-style-type: none"> <li>"Animals eat the organic waste."</li> <li>"The organic waste rots over time."</li> </ul> <p><b>Related to the experiment:</b></p> <ul style="list-style-type: none"> <li>"We'll make a pile of organic waste and wait."</li> <li>"We'll periodically examine the organic waste."</li> </ul> <p>Segue from the guesses to the experiment.</p>
<b>Experimenting</b> 	<p><b>Experiment setup:</b></p> <ul style="list-style-type: none"> <li>Together with the students, collect suitable waste a few days before building the compost pile (see rules in the appendix).</li> <li>Set up an organic waste bucket for the classroom. Line it with old newspaper, for example, or used paper towels. Clarify with the classroom cleanup team that the organic waste must be emptied daily for hygiene reasons.</li> <li>Show the students a suitable location for the compost pile and discuss the location characteristics.</li> <li>Also discuss the type of waste to be added and what they must pay attention to. Go through the rules from the appendix together.</li> </ul> <p><b>Conducting the experiment:</b></p> <ul style="list-style-type: none"> <li>The observation primarily involves the close visual inspection of the compost pile, which teaches attentiveness. In addition, samples can be taken and observed using a magnifying glass. If the compost container has a "window," the students can also observe the inside of the compost pile.</li> <li>Make sure that the students wear gloves, ideally sturdier gardening gloves, for example, in case insects bite.</li> <li>In addition, the living organisms should be left alone as much as possible: During the weekly observations, teach the students to disturb the system as little as possible and to handle living organisms respectfully.</li> <li>Provide assistance as they complete the log: What points can be recorded? How can observations be noted?</li> </ul>



<b>Observing and documenting</b> 	<p>The students will discover that their own compost pile is a small organic recycling factory for kitchen and yard waste. Based on this model, they will see how nature converts organic waste all on its own.</p> <p><b>Most important observations:</b></p> <p>Depending on the type of waste, the students may observe decomposition and rotting processes. Since the organisms responsible for this cannot necessarily be found at any given time or cannot be recognized with the naked eye due to their size, it appears that the waste is “disappearing as if by magic.” Discuss all impressions and ideas the students have.</p>
<b>Analyzing and reflecting</b> 	<p>The students will determine how sensible waste separation is with regard to organic waste and what benefits people can derive from it. Use the humus to fertilize a potted plant in the classroom or school. Depending on how much compost is obtained, it can also be spread around trees or bushes in the school garden or on the playground.</p> <p><b>Reference to the story to get the students thinking about the topic:</b></p> <p>Through the experiment, now you know how organic waste at your home can become humus. Many tiny organisms decompose the waste and make humus from it.</p>

#### 4.3.6 Further information


##### In the student instructions

<b>Doing further research</b> 	<p>Decomposition processes are excellent for illustrating an increase in surface area and its advantages (compare with Experiment <b>C5.2 Large and small air sacs</b>).</p> <p>The students should observe the decomposition process of two portions of organic waste of the same size and type: One portion is placed whole on the compost pile, and the other portion is cut up into smaller pieces with scissors beforehand.</p> <p>The expected result is that the chopped portion will decompose faster. The reason for this is the larger surface area for the same mass: More microorganisms can “dock” onto the waste, so therefore more decomposition processes can take place simultaneously.</p>
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##### Miscellaneous

- The students should also bury a small plastic bag, for example, so that they can observe it easily through a window. What happens to the plastic bag, and what conclusions can be drawn about environmental protection? The significance of waste separation can also be discussed.
- After all three subexperiments have been completed, it is useful to reflect upon and clarify once again the differences between types of trash and waste.

### 4.3.7 Reference to values

<div>What is your opinion?</div> <div></div>	<div>In the discussion about values for this experiment, the teacher can provide a prompt or tell a story in which a problem is posed. Both actions lead to a discussion based on reflections. What’s important is that the reference to values can be established in the experiment. The discussion can focus either on learning-process-related values (for example, working reliably in groups) or on object-related values (for example, handling paper as a resource). The student instructions for <b>B5.3 Recycling organic waste</b> address object-related values.</div> <div><b>Object-related dilemma:</b></div> <div>An object-related dilemma can be integrated in the discussion of the values “environmental awareness” and “initiative” at the end of the student instructions. The students should express their opinions about it.</div> <div><b>Dilemma related to trash:</b> Your classmate Paul’s birthday is today. His mother gave him small bags of gummy bears for his classmates. He collects all the “trash” in one bag. After recess, you watch as Paul throws the whole bag into the organic waste bin.</div> <div><i>Think about it:</i> What would you do?</div> <div><b>Possible statements by the students on an alternative procedure:</b></div> <table><tr><th>Alternatives</th></tr><tr><td><ul style="list-style-type: none"><li>▪ I would remove the bags myself.</li><li>▪ I would tell the teacher.</li><li>▪ I wouldn’t care.</li><li>▪ I would talk with Paul.</li><li>▪ We would remove the things together.</li></ul></td></tr></table>	Alternatives	<ul style="list-style-type: none"><li>▪ I would remove the bags myself.</li><li>▪ I would tell the teacher.</li><li>▪ I wouldn’t care.</li><li>▪ I would talk with Paul.</li><li>▪ We would remove the things together.</li></ul>
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**Objective:**

The students should reflect upon how they can treat the environment carefully and protect it on their own initiative. The values of environmental awareness and initiative are addressed.

**Alternatives:**

Statements or questions as prompts related to the story told in the student instructions are also suitable for encouraging discussion. The values remain the same.

**For discussion:**

You know a lot about organic waste. You take a look in your organic waste bin and discover paper and plastic.

- **Image for discussion:**



- **Question for discussion:** Why don't other things belong in the organic waste bin?

**Notes:**

The students should reflect on values and express their opinions. It may turn out that several values are addressed.

**Appendix: Rules for adding waste to the compost pile****This kind of waste may be added to the compost pile**

- Cardboard, paper towels, tissues (caution: not too much paper!)
- Cut flowers, soil from repotting plants, straw
- Kitchen waste: vegetable and fruit scraps, eggshells, coffee filters, tea bags (remove staples!)
- Yard waste: leaves, grass, remains of plants

Tip: Earthworms love onion skins and coffee grounds!

**This kind of waste may not be added to the compost pile**

- Animal products such as cheese, sausage, meat, or bones (attract mice and rats)
- Diapers, kitty litter
- Plant materials that are diseased or infested with pests
- Scraps from citrus fruits, banana peels (often sprayed)
- Vacuum cleaner bags, wood ashes

