

Today I Learned About Recycling

Description:

We often hear about the “Three Rs” of environmental solutions, but how does recycling help climate change? Students engage in a design challenge, research recycling in their own community, and investigate US municipal solid waste data.

Skills & Objectives

SWBAT

- Brainstorm and investigate solutions beyond ‘just recycle more’.
- Explain the link between recycling and climate change.
- Understand where recycling in their own community goes.

Skills

- Design Process
- Communication
- Graph and data reading

Students Should Already Know That

- When we burn fossil fuels like coal, oil, and natural gas to make new materials, we release carbon dioxide into the atmosphere. This carbon dioxide acts like a blanket, trapping heat, and the trapped heat is warming our Earth and ocean, causing dramatic changes to weather, droughts, and heat.

Standards Alignment:

HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources.

HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question or solve a problem.

SL.11-12.5 Make strategic use of digital in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Disciplinary Core Ideas:

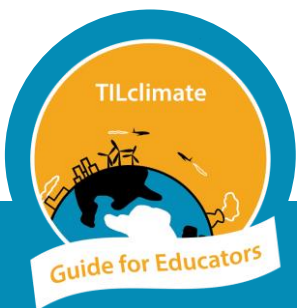
ESS2.D Weather and Climate

ESS3.C Human Impacts on Earth Systems

ESS3.D Global Climate Change

ETS1.A Defining and Delimiting an Engineering Problem

ETS1.B Developing Possible Solutions



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How To Use These Activities:



Pages with the circular “TILclimate Guide for Educators” logo and dark band across the top are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity.

A Note About Printing

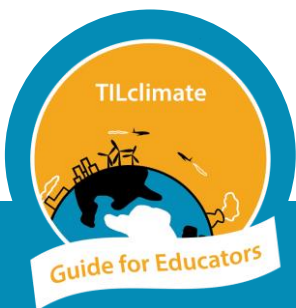
All student pages are designed to be printable in grayscale.

The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

A Note On Timing

- The Communication Challenge may be stretched or reduced as needed to fit class requirements. A shorter challenge could be done in 1-2 class periods.
- The Recycling Investigation will take very little in-class time but will take time outside of class for students to find and ask the relevant people. Depending on initial answers, they may need to pursue the question up a chain of responsibility.
- The Solid Waste Data activity can be shorter with simpler questions, or longer with more complex questions, depending on the needs of the educator.

Share with us! We would love to hear any podcasts or see any other projects you or your students create! Email us at tilclimate@mit.edu, tweet us @tilclimate, or tag us on Facebook @climateMIT.



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Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: TIL about recycling, either as pre-class work at home or in the classroom. https://climate.mit.edu/podcasts/til-about-recycling	10-15
1-2	Recycling Problems and Solutions	While listening to the podcast, students identify recycling problems and solutions. They then learn two different ways to sort solutions.	30+*
3-4	Solutions Sorting Information	Information on the Zero Waste Hierarchy and sorting solutions into three categories. (Used for multiple activities.)	n/a
5	Recycling Solutions Worksheet	If students are not going to listen to the podcast episode, or if they need more practice sorting solutions, this worksheet may be used.	10
6-8	Communication Challenge: Recycling	Students identify recycling problems and brainstorm solutions. Then they choose, propose, and share their solutions.	45+*
9	Recycling Investigation (internet may be required)	Students choose a place in their lives that offers recycling and investigate where that recycling goes and what happens to it.	In-class: 10-15 Home: Variable*
10	Solid Waste Data (internet required)	Students brainstorm questions about Municipal Solid Waste and use EPA data to answer their questions.	20-45+*

*See **A Note on Timing**, previous page.



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Recycling and Solid Waste

This Educator Guide includes a design challenge, an in-person investigation, and a data investigation. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Physical science: Materials science, the engineering design process.
- Life/environmental science: Impacts of solid waste disposal and processing.
- History/social science: Civic engagement on recycling and municipal solid waste.
- ELA/nonfiction: Reading, writing, and communicating scientific and engineering ideas.

MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. <https://climateprimer.mit.edu/>
 - Chapter 10
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. New Explainers are posted monthly. <https://climate.mit.edu/explainers>
 - Net Zero Emissions
 - Climate Justice
 - Cities and Climate Change
 - Mining and Metals
- MIT professors can answer your and your students' questions about climate change! Submit your questions or see other answers at <https://climate.mit.edu/ask-mit-climate>



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Wrap-Up Discussion Questions

- Beyond simply encouraging individuals to recycle more, what other solutions will reduce the amount of energy that goes in to producing and disposing of materials?
- What have you heard about recycling? What questions do you have?
- Where does your recycling go?
- According to the podcast, where are the biggest energy and cost savings in recycling?
- What other benefits or impacts could come from reducing our waste?

Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than asking homeowners to install solar panels. For more on talking about climate change in the classroom, see “How to Use This Guide”.

•Energy Shift

How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?

•Energy Efficiency

What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?

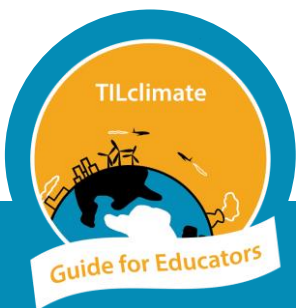
•Adaptation

How can cities and towns adapt to the impacts of climate change?

•Talk About It

Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?

What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.



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“So bottom line? Yes, recycling can make a dent on climate change. ...To see those benefits, we’ll need bigger changes to how products are designed—and we might want to look at how much waste we’re creating in the first place.

Laur Hesse Fisher, Host, TILclimate, MIT Environmental Solutions Initiative
TILclimate podcast: Today I Learned About Recycling

Collecting Recycling Problems and Solutions

Most of us are familiar with recycling as an ‘environmentally friendly’ or ‘eco-friendly’ action. There are problems with recycling -- but also solutions to improve how much waste gets recycled.

As you listen to the podcast episode, write down the problems and solutions that you hear. Then, add a few that you have heard about or experienced. Then, work with your group to answer the questions on the next page.

Recycling Problems

Recycling Solutions

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Recycling: Problems and Solutions

1. Share the problems and solutions that each member of your group wrote down.

What patterns do you notice in the problems and solutions you've identified?

2. Find the simplified hierarchy from the Zero Waste International Alliance on page 3. Read through the level descriptions and discuss with your group until you all agree on what each level means.
3. Sort your group's list of Solutions into the levels of the hierarchy.

Are more of your solutions at the lower end or the higher end of the hierarchy? Why do you think this is?

4. Find the descriptions of the three categories of solution on page 4. Read through the descriptions and examples and discuss with your group until you all agree on what each category means.
5. Sort your group's list of Solutions into the categories.

Which category has the most solutions? Why do you think this is?

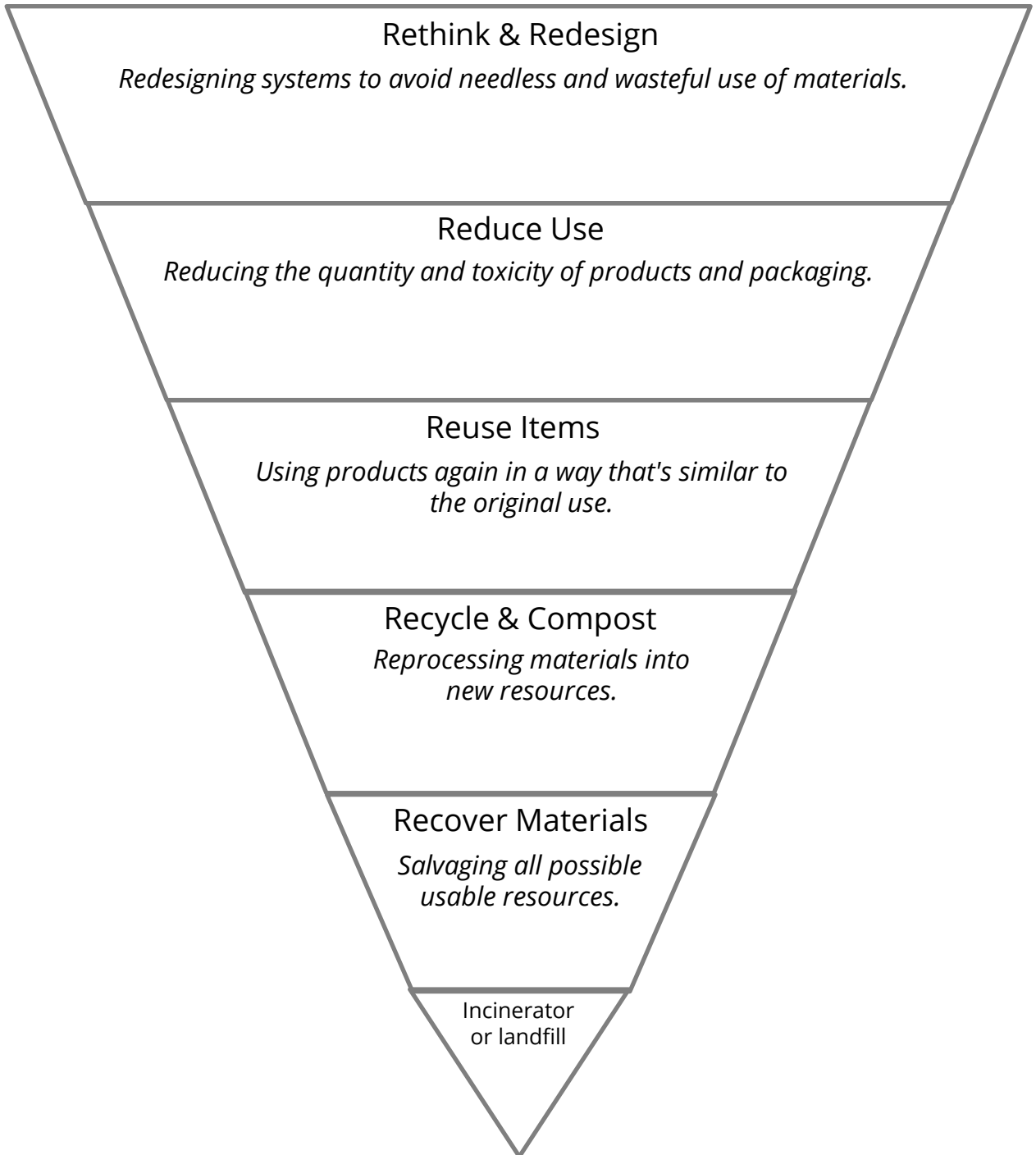
6. Consider your list of Problems. Create your own categories to sort the problems.

What categories did you create? Why did you place the problems in these categories?

7. In your group, discuss:
 - Do you think solutions at the top or bottom of the hierarchy are more effective? Why?
 - Which categories of solutions do you think are the most effective?
 - Take one solution that is low on the hierarchy and discuss how you could change the solution to move it up to a higher level.

TIL About Recycling: Zero Waste Hierarchy

The Zero Waste International Alliance created and updated a multi-level hierarchy (pyramid) of ways that we create, use, and dispose of materials in our lives. A simplified version of this pyramid is below.



Simplified Zero Waste Hierarchy based on The Zero Waste Hierarchy 8.0 <https://zwia.org/zwh/>

TIL About Recycling: Categories of Solutions

Recycling solutions often fall into three major categories, though there can be overlap among them. Not all problems can be solved in all three ways, and many problems require solutions in all three categories.

Example Problem: Food packaging ends up in the trash.

Category 1: Behavior Change Solutions

How could people acting differently solve your problem? What strategies could make them shift their behavior?

(Tip: Make your solution easier or cheaper than what they're doing now.)



Example Behavioral Solution: A restaurant chain makes takeout containers that can be brought back for a discount on your next order. They clean and reuse the containers.

Category 2: Technological or Design Solutions

How could a new technology - or a redesign of a part of the system - reduce your problem?



Example Design Solution: A lot of food packaging is currently made of materials that cannot be recycled. Redesign food packaging so that it is easier to recycle or reuse.

Category 3: Systemic or Policy Solutions

How can laws, policies, or incentives help shift behavior or technology?



Example Policy Solution: Companies that make food packaging are required to take back and recycle, reuse, or repurpose that packaging.

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Practice: Sorting Solutions

Solutions to recycling problems can come in many shapes and sizes. Use the Zero Waste Hierarchy (p. 3) and the Solutions Categories (p. 4) to complete the following practice.

Example problem: The school trash is filled with plastic water and soda bottles.
Draw lines to connect each proposed solution to its place in the hierarchy.
Using the definitions on the next page, draw lines to show which solutions are behavioral, technological, or policy. (Some may fit more than one category.)



Rethink & Redesign

Art or science project reusing thrown-out water bottles.

Behavior Change Solution

Reduce Use

Poster or social campaign to encourage people to bring in their own reusable water bottles from home.

Reuse Items

Design a machine to sort the trash to find and recycle plastic bottles.

Technology or Design Solution

Recycle & Compost

Advocate for a deposit return system in your community.

Put more recycle bins around the school.

Make sure there are plenty of places to refill water bottles with good-tasting water.

Recover Materials

Ban the sale of plastic bottles at school.

Poster or social campaign to encourage people to recycle more.

Policy or Systemic Solution

Which solution(s) do you think would be most effective?
What other solutions can you think of?

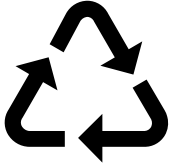
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"I think it's important when we talk recycling - especially when we also talk design - if we can design for reuse solutions, that's of course better than going straight to recycling."

Anders Damgaard, Technical University of Denmark

TILclimate podcast: Today I Learned About Recycling

Beyond the 3 Rs



Many of us are familiar with the "Three Rs": Reduce, Reuse, Recycle. But there's a more effective way to reduce trash and waste: by looking at the ways that design, systems, and incentives affect how we create, use and dispose of materials. This gives us access to solutions that are more impactful than just "recycling more".

Solutions Are All Around Us

Your group is going to use a design process to research, design and share a solution to a recycling problem. Your solution may be technological, systemic, behavioral, or something entirely new. Through this process, you will:



Identify a problem



Brainstorm solutions



Select an idea



Design a model, prototype, or draft



Share your solution

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Identify a Problem

1. In your group, compare and discuss the problems and solutions you have collected.
2. Pick one problem that you want to focus on for your group project.
 - Which problem(s) have you experienced in your own life?
 - Which problem(s) have you heard about by word of mouth, in the news, or on social media?



Brainstorm Solutions

3. In your group, brainstorm solutions for your chosen problem. Use the Zero Waste Hierarchy (p. 3) and Categories of Solutions (p. 4) to help.
 - How can your problem be seen from other angles?
 - Are there solutions that fit in all levels of the hierarchy?
 - Are there solutions that fit in all three categories?



Select an Idea

4. Sort your solutions according to the Zero Waste Hierarchy.
5. Decide which category of solution you are most interested in pursuing.
6. As a group, choose a solution to focus on.
 - Remember that solutions higher on the hierarchy will have the largest impacts.

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Design Your Solution

7. What does your solution look like? How would you convince others to adopt it? Design a way to share your solution with others.

Depending on the category and type of solution you chose, this could be:

- a *prototype* (for example: board game designers make prototypes that are hand-drawn on cardboard or printed after having been designed using stock images)
- a *model* or *mockup* (for example: a general sense of what your art piece would look like)
- a *draft* (for example: a document describing a proposed policy change)
- or something else.



Share Your Solution

Solutions work best when the right people are excited about them. Design a communication plan for sharing your solution with the most influential audience.

8. Who has the power to decide to use your solution? This is your audience.
9. What are the interests and attention span of your audience?
 - Why would your audience be excited about your solution?
 - What information would they need to get excited about your solution?
10. How would your audience most want to receive the information about your solution?
 - If your audience is a policymaker, would they want to see a petition from the community? A business plan? A draft policy?
 - If your audience is your neighbors, would they want a video? A poster? A demonstration of a prototype?
 - What skills does your group have that could be used? Consider writing, music, art, podcasts, videos, lessons, etc.

Today I Learned About Recycling

“For pretty much any material the recyclable materials are much cheaper to reprocess than the virgin materials. And this is the main reason why we do recycling.”

Anders Damgaard, Technical University of Denmark

TILclimate podcast: Today I Learned About Recycling



Where Does Your Recycling Go?

Recycle bins are common in many places. You may see one or more in your classroom, cafeteria, home, library, shops, etc. But where does all that recycling go? There is no centralized recycling system in the US, so the answer is different for each of these places.

Choose one place in your daily life that offers recycling.

Location:

1. What kind of place is this?
2. Who could you ask to find out where that recycling goes?
3. Ask that person. Do they know? Try to get the name of a company or service.
4. If they do not know, who else can you ask (building supervisor, town administrator, store manager)?
5. Once you get the name of a company or service, visit their website.
6. From the website, try to learn the following:
 - a. Where does the recycling go? (How far away?)
 - b. How is it sorted?
 - c. Where do the sorted materials go?
 - d. Do they have any special rules about what can and cannot be recycled?
 - e. What else did you find that was interesting or surprising?
7. Compare with a partner. What did they learn about their place? What surprises you?

Today I Learned About Recycling

“We have to relearn [for] ourselves, that any material actually has a value. And we had to appreciate that both from a fiscal point of view, but also from an environmental point of view.”

Anders Damgaard, Technical University of Denmark

TILclimate podcast: Today I Learned About Recycling

Investigate: US Municipal Solid Waste

The US Environmental Protection Agency (EPA) has been collecting data on trash and recycling since the 1960s. What we generally call “trash”, the things we throw out or recycle from our homes, schools, and stores, is called *Municipal Solid Waste* (MSW). This does not include construction debris or industrial waste.

The issues around how we create and manage MSW are complex, and you probably still have questions. You can use EPA data to answer some of those questions.

Brainstorm Questions

With your group, brainstorm questions you still have about recycling and trash. Depending on how much time you have, you may go for relatively straightforward questions such as “What percent of x material gets recycled each year?” or more complex ones like “Which material has had the fastest growth in recycling since 1990?”

The EPA reports the following kinds of data. Use this list to help you decide which question(s) to investigate.

- Generation: What kinds of materials are we throwing away or recycling?
- Recycling: Of those materials, which ones get recycled the most?
- Composting: What materials are getting composted?
- Combustion with Energy Recovery: What materials are going to incinerators?
- Landfilling: What materials are going to landfills (dumps)?
- Trends: For all these questions, how have the numbers changed over time?

Investigate Answers

Visit <https://climate.mit.edu/ed/mswfacts>¹

Use the clickable table of contents at the top of the page to jump to the section that will best answer your question.

¹ <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>