# Reduce, Reuse, Recycle

## INTRODUCTION

The connection between humans and the environment is important for students to explore. This lesson focuses on how scientific understanding of waste and the impact of food waste on the environment can help to inform human behavior. By analyzing their food purchasing, usage and waste habits at home, students will come to recognize stages at which food waste occurs, and quantify this waste. They will then translate this into a community action project to encourage sustainable practices at the school or community level.

By participating in these activities, starting with data collection through to analysis and creation of an action plan, students will obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (5-ESS3-1). This project in particular focuses on how human activities in everyday life have major effects on the planet, and how individuals and communities can work together to help protect Earth's resources and environments.

In previous earth science instruction, such as 4-ESS3-1 and 4-ESS3-2, students will have explored human impact on Earth through activities such as energy and fossil fuel usage as well as mitigating natural hazards through design, which builds on concepts in 3-ESS3-1. This lesson explores human impact on Earth in different capacities, specifically focusing on preventable food loss and waste. This is a particularly relevant topic for young students, as food loss and waste (FLW) is an emerging global concern as identified by the United Nations' Sustainable Development Goals (**http://www.un.org/sustainabledevelopment/sustainable-development-goals/**). The United Nations has set a target for all nations to halve food waste and reduce food loss by 2030 (SDG 12.3), as well as substantially reduce waste generation through prevention, reduction, recycling and reuse (SDG 12.5). This project supports young students in realizing that they can contribute to global solutions through their individual local actions and creates tangible connections between what is being learned in the classroom and real-world problems.

## STANDARDS

Throughout this lesson, when Next Generation Science Standards (NGSS) are explicitly incorporated into activities, they will be color coded as appropriate: Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| Asking Questions and Defining Problems | 5-ESS3-1 | Cause and Effect |
| Planning and Carrying Out Investigations | | Influence of Science, Engineering, and Technology on Society and the Natural World |
| Analyzing and Interpreting Data | | |
| Using Mathematics and Computational Thinking | | |
| Engaging in Argument from Evidence | | |
| Obtaining, Evaluating, and Communicating Information | | |

## KEYWORDS

Food loss, food waste, packaging, environment, reduce, reuse, recycle, sustainability, garbage, waste.

## TIME

Approx. 3+ weeks (3-4 days' work time, plus 3 weeks intermittent/data collection time)

## MATERIALS

- Digital access to **Why I Live A Zero Waste Life** (Lauren Singer, TEDx Teen)
- Digital access to **A Look at the Sustainable Development Goals**
- Construction/art supplies for students to create poster or other visual (optional)
- **Appendix A: Reduce, Reuse, Recycle Student Workbook**
- **Appendix B: Reduce, Reuse, Recycle Project Rubric**
- **Appendix C: Supplementary Resources**

## HOW TO DIFFERENTIATE AND ENRICH LEARNING

### Knowledge is accessed and built by:

- Watching and listening to videos and presentations
- Discussing and interviewing
- Reading text, articles, and research papers
- Viewing and interpreting images, photos and graphs
- Note taking by writing or voice recording (audio workbook)
- Mind-mapping
- Collecting and tracking real-world data

### Knowledge is applied/contextualized, practiced, and understood by:

- Sharing personal stories
- Game play with flexibility for reinforcing/repeat
- Choosing personally relevant research topic or project
- Testing ideas through building, experimenting, and prototyping
- Answering formative (check-in) assessment questions
- Drawing and creating storyboards and diagrams
- Evaluating and incorporating feedback

### Knowledge and understanding are demonstrated by:

- Thoughtful reflections and accurate answers in writing or otherwise (journal, test etc)
- Final product uses choice of multi-media (video, website, poster, podcast)
- Creating a product with real-world relevance/applicability
- Creating a product for users/audiences beyond the classroom
- Final product meeting rubric indicators – with student choice for what should be assessed
- Formal oral presentations; participation in campaigns and model displays
- Building model representations for visualizing things that are too small to see
- Collaborating and providing useful/correct feedback to others

# LESSON PLAN

All activities in this lesson are geared towards the ultimate creation of a campaign (video, podcast, poster, website, or other medium) that will be a vehicle for students to educate the community about a specific concern related to food loss and food waste. This campaign will be designed to create change in their local community. Through data collection both before and after the campaign, students will be able to measure whether any change in behavior has occurred over time (and by extension, be more informed about the potential positive impact of their campaign). This action project connects students to their immediate surroundings and helps them create local change; however, the activities are also designed to fit into a larger picture of mitigating food loss and food waste as a global sustainability goal. Teachers are encouraged to discuss the United Nations' Sustainable Development Goals with students and learn about how these goals transcend science instruction; students can begin to understand how scientists need to connect with government and/or other policy makers (as well as other groups, such as educators, industry, and the general public) in order to solve real-world problems.

# OUTLINE

## Day 1: Introduction

This introductory class is designed to position students in the topic of waste as well as human impact on the environment. By watching the TEDx Teen video, **Why I Live a Zero Waste Life**, students are exposed to tangible actions that they could consider taking to contribute to a bigger movement to reduce waste production around the world. To further emphasize the relevancy of learning about human impact on the earth, the United Nation's Sustainable Development Goals are presented to students as one actionable framework to achieve global change. The project concept of this larger lesson is to create a campaign that will create shifts in human behavior to improve (reduce) waste produced in students' local environments (i.e., their home or school). They are introduced to the project concept and the data collection that will need to occur before they can create their campaign.

1. Begin by asking students: What is a "zero waste life"? Students may be unfamiliar with this concept, so take a few moments to let students generate ideas with an elbow partner before discussing as a large class. Particularly in 4-ESS3, students will have learned about fossil fuels and energy consumption; have students think about "waste" in as many environmental situations or definitions as possible. Record all responses on a whiteboard.

> Zero waste means not producing any garbage, sending nothing to landfill, throwing nothing in a trash can. Recycling and composting are key components of zero waste.

## Day 1: Outline Continued...

2. Watch the TEDx Teen video, **Why I Live a Zero Waste Life**, by Lauren Singer (running time: 13:30). While students are watching the video, ask them to pay attention to the following things:
    - What actions did Lauren take to create change?
    - What benefits does Lauren list to a zero waste life?

| INFORMATION FROM LAUREN'S VIDEO | |
|---|---|
| Actions to create change:<br><br>1. Stop buying packaged food<br>2. Make your own products<br>3. Shop second-hand<br>4. Downsize | Benefits:<br><br>1. Save money<br>2. Eat better/more healthy<br>3. Happier (aligned with her values) |

3. Following the video, return to the question: What is a "zero waste life?" Allow students the opportunity to add to their common understanding of this concept by putting more related terms or ideas on the board, and potentially correcting any misconceptions that were previously recorded.
4. Remind students of the statistic from the video: The average American produces 4.4 lbs of trash per person, per day. This project is focused on mobilizing students to help tackle the problem of waste and trash in our world. However, this is not just an American concern - waste is an international sustainability issue. Students can watch **A Look at the Sustainable Development Goals** (produced by the United Nations); goal 12 is Responsible Consumption and Production. The United Nations has set a target for all nations to halve food waste and reduce food loss by 2030 (SDG 12.3), as well as substantially reduce waste generation through prevention, reduction, recycling and reuse (SDG 12.5).
5. At this point, **Appendix A: Reduce, Reuse, Recycle Student Workbook** can be distributed to students as well as **Appendix B: Reduce, Reuse, Recycle Project Rubric**. Students will be creating an action campaign based on one area of concern in their own local community related to waste production. Discuss the data collection with students - they will possibly need time to collect garbage before beginning on project work. The tracking of trash will be according to the three categories of waste as introduced in the video, **Why I Live a Zero Waste Life**:
    - Food packaging
    - Product packaging
    - Organic food waste

    Depending on class needs, the analysis of students' data collection may need to occur several days or even a week after this initial introductory class, in order to give students sufficient time to collect food packaging, product packaging, and organic food waste. The table provided in the student workbook allows for up to seven days of data collection before beginning the project.

## Days 2+: Project Work

The concept of this larger lesson is to create a campaign that will create shifts in human behavior to improve (reduce) waste produced in students' local environments (i.e., their home or school). Students will first start by analyzing the data they have collected on their waste production, drawing on mathematics and computational thinking to quantify this waste in addition to qualitatively describing it. Based on the analysis, students will be challenged to think critically and select only one area of focus for their action project/campaign, using evidence to justify what they see as the most serious waste problem. The campaign asks students to educate others about the waste concern and use compelling, persuasive language to elicit positive change in others' behavior to help solve the problem. This campaign can be in the form of a poster, podcast, video, website, or other medium; during the campaign, students will be asked to continue to collect data so that by the conclusion of the campaign, they can analyze data and see if behaviors changed over the course of time.

## OUTLINE

1. Based on the data collected, have students brainstorm as many different problems or challenges with current usage as they can. These can be general (e.g., "There is too much organic waste that could be composted.") or specific (e.g., "There are too many half-eaten apples in the trash that could be composted."). The goal is to get all the problems listed so that students can later refine what problem they will focus on for their campaign.
2. Have students share their lists of problems with the class, creating a class-wide list of challenges, until all ideas have been shared.
3. **Identify the Problem:** Next - students must work as a class to identify what they see as the most serious problem. This will become the class-wide focus for an action project. (Note: There is flexibility here for the entire class to focus on a single initiative, which can promote group unity and collaboration, or each small group can choose a different problem to tackle). To identify the most serious problem, have students consider:
    - What are the consequences of not addressing this problem?
    - Who is impacted by this?
    - How many people are contributing to this problem?
4. **Brainstorm/Research:** Once the main problem has been identified, students can work as individuals or in groups of 2-3 to research more about the identified problem (defining the issue) as well as possible solutions that may already be in place in society. These possible solutions can be clustered in notes under the headings "reduce," "reuse," and "recycle." Have students document their research findings.

    Research to further understand the problem and any current solutions to that problem can be conducted in a variety of ways:
    - Looking online for information about the problem; what solutions have been adopted both in the local community and beyond
    - Interviewing other people (teachers in the school, adults in the home, other peers) about the issue and what solutions they can think of to help solve this problem
    - Visiting a local recycling depot, landfill, grocery store, etc. (any place that would be handling waste) to survey them about how they are addressing this problem (or if they see this problem - what are they experiencing? What does this problem look like for them?)

| Problem | Excess Packaging | Problem | Throwing out compostable items |
|---|---|---|---|
| Details | Students will need to take notes - encourage both quantitative and qualitative data to help explain the problem. | Details | Students will need to take notes - encourage both quantitative and qualitative data to help explain the problem. |
| Possible Solutions: | | Possible Solutions: | |
| Reduce | Distributors can eliminate packaging - people can buy items that use less packaging | Reduce | Discard less food |
| Reuse | Packaging can be saved and used again for repackaging other food | Reuse | Learn how to use leftover food in more inventive ways |
| Recycle | Redirect packaging in garbage into recycling | Recycle | Create a school-wide compost program to redirect waste |

5. **Refine a Solution:** Depending on group size, have students either select a class-wide solution as an initiative (all groups within the class would focus on the same topic), or create small groups where each group picks a different solution to promote. The solution should fall under the category of reduce, reuse, or recycle (or a combination of these). The solution chosen by the class (or by the group) must then be promoted in a campaign:
    - Creating a poster, website, video, podcast, or other medium to educate peers/community about the problem, as well as the proposed actionable solution. Both images and words (incorporating persuasive language to encourage people to participate in the solution) should be included.
    - Students should devise their method(s) of data collection to gather evidence as to how successful their campaign is at creating change (i.e., involving people in the solution). This data collection could be in the form of a survey and/or taking garbage/recycling samples. This data collection and analysis (e.g., finalized tables and graphs) should be a part of the class presentations/debrief.
6. **Presentations & Debrief:** Following students' campaigns, the class should regroup to present their campaigns and final results.
7. Discuss:
    - How did student groups choose to execute their campaign? Were any methods more (or less) impactful?
    - What data was collected?
    - Does this data support that the campaign created change in their school/community, or not? Why/why not?
    - What could be done differently next time to achieve different (or better) results?

    Have students submit their student workbooks (along with their attached data collection) and their campaign materials for assessment against the project rubric.
8. **Optional Extension:** Real-world experiences, such as visiting a local grocery store or restaurant to explore how they deal with food loss and waste, can help students see connections between what they are learning and the community. If students are in a rural area, they could also visit a farm (where is food lost in crop production and harvesting?). **Appendix C: Supplementary Resources** also contains digital interactives and games that further support student understanding of waste and our world. These can be used at the end of the project to review key concepts and support instruction, or interjected at any point during the lesson and/or campaign activity to supplement student learning. These supplementary resources are a useful tool for students who may need additional support in understanding the key terminology and concepts presented in this lesson, and can be presented either in class or outside of class time to further support student learning.

**NAME**: _____ **CLASS**: _____ **DATE**: _____

What do you think is the biggest waste problem in your community?

How would you go about solving it, if you were in charge?

In this project, you'll be asked to think about exactly that. Your job is to create a campaign to educate people in your community (whether it's your school or neighbourhood) to help create positive change. You've learned about the impact that a single person can make on the environment - here's your chance to make a difference!

Still not sure that you can actually change the world? You'll also be collecting scientific data as evidence to investigate whether your campaign created any change in people's behavior and ideas around waste. Ready, set, recycle!

The Plan:


## STEP 1: COLLECT DATA

Complete the following table using waste collected in your home over the course of one week.

| Waste Type | Day - Number of items collected and/or mass (g) of all items | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Food Packaging | | | | | | | |
| Product Packaging | | | | | | | |
| Organic Food Waste | | | | | | | |

- Food packaging: cereal boxes, egg cartons, Styrofoam trays;
- Product packaging: battery packages, empty tissue boxes, toilet paper rolls;
- Organic food waste: chicken bones, egg shells, coffee grounds.

**NAME**: _____ **CLASS**: _____ **DATE**: _____

## STEP 1 CONTINUED...

What is the total number of each item type that you collected?

(Note: add up all days of data collection)

| Waste Type | Total Number of Items |
|---|---|
| **Food packaging** | |
| **Product Packaging** | |
| **Organic Food Waste** | |

What is the total mass of each item type that you collected?

(Note: add up all days of data collection)

| Waste Type | Total Mass (g) of Items |
|---|---|
| **Food packaging** | |
| **Product Packaging** | |
| **Organic Food Waste** | |

**NAME**: _____ **CLASS**: _____ **DATE**: _____

## STEP 2: IDENTIFY THE PROBLEM

List all the problems that you see from your data collection. Don't worry about solving them right now - but what were some of the things you observed that you think are a problem when it comes to managing waste? Be as specific as you want.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

From the list that you made, what do you think is the biggest or most important problem? Use the space below to explain this problem and why you think it is the most important one.

_____

_____

_____

_____

_____

**NAME**: _____ **CLASS**: _____ **DATE**: _____

## STEP 3:

Use the space below to research more details about the main problem you will be investigating for this campaign. You can talk to people in your community and look online for information.

| **Problem** | |
|---|---|
| **Defining the Problem:** | |
| Details | |
| **Possible Solutions:** | |
| Reduce | |
| Reuse | |
| Recycle | |

**NAME**: _____ **CLASS**: _____ **DATE**: _____

## STEP 4: CAMPAIGN & COLLECT DATA

Now you will create your campaign. There are two purposes to your campaign:

1. Educate other people about the waste problem.
2. Convince other people to change their behavior - and follow your recommended action.

You can choose to create your campaign in any way you like - some ideas include:

- Posters to display in the school or community
- A website you can share with others
- A video or podcast that you could publish online
- An interactive display that illustrates the problem and solution(s)
- Other ideas that you can come up with!

Your campaign should be informative and creative. Remember, you are trying to convince people to change their behavior!

As part of your campaign, you will also need to collect data on at least three different days while your campaign is running. You'll want to assess whether or not change is happening over time, so remember to spread out the days and be consistent with your data collection methods. Use the space below to brainstorm what your campaign method will be and what data you plan to collect - this will need to get approved by the teacher before you can start your work.

**NAME**: _____ **CLASS**: _____ **DATE**: _____

| Campaign | DATA |
|---|---|
| What form of campaign will you create?<br><br>Where and how will you share it?<br><br>How can you make sure your campaign reaches the most number of people? | What data do you need to collect?<br><br>How will you collect it? (e.g., photos, video, quantifying with tables/graphs, other?). Note that you must include some quantitative data (numbers), not just photos.<br><br>What methods can you use? (e.g., a survey, collecting waste at home or at school, other?) |
| | |

For your final submission, you will need to attach the data you collect for your teacher to review.

**NAME**: _____ **CLASS**: _____ **DATE**: _____

## STEP 5: ANALYZE & PRESENT

For your final task, you'll submit your campaign materials along with this student workbook and any data you collected. You'll present your campaign to the class and the resulting findings you collected. Use the space below to reflect on the following questions:

_____

_____

_____

_____

_____

In what ways was your campaign successful?

_____

_____

_____

In what ways could your campaign be improved for next time, to achieve different/better results?

_____

_____

_____

## Appendix B: Reduce, Reuse, Recycle Project Rubric

**How to use this rubric:**

- Provide this rubric in advance of starting the project - make sure that students understand evaluation - or, if desired, the indicators can be created collaboratively with students for greater ownership over what they are trying to achieve.
- This rubric can be used both for self-reflection and for teacher evaluation.
- Students can choose which four of the six categories they wish to be evaluated on, for a total of 100%. Teacher comments and feedback is encouraged for all categories, regardless of which scoring categories are selected.

| OUTCOMES | Indicators (can be demonstrated in different ways) | Comments and Feedback | Score |
|---|---|---|---|
| **Research and self-directed learning** | • Collects data correctly and completely<br>• Documents information and ideas effectively<br>• Gathers information from a wide variety of sources<br>• Identifies problems and solutions relevant to the data collected<br>• Makes productive use of time | | 25% |
| **Plan and Design** | • Shows correct application of ideas and learnings<br>• Thinks critically to assess problems and pick the most serious one, with justification<br>• Provides complete and well thought-out plan for campaign<br>• Develops strategy for data collection for their campaign, including a plan for both qualitative and quantitative data<br>• Implements creative and unique elements into the campaign | | 25% |
| **Build & conduct the campaign** | • Uses materials, equipment, class space and time adequately and responsibly<br>• Builds campaign that follows closely the planned design<br>• Carries out all necessary data collection<br>• Incorporates data into campaign activity<br>• Actively promotes campaign in the community | | 25% |
| **Campaign conclusion** | • Analyzes and interprets data fully and correctly<br>• Evaluates results and draws thorough and meaningful conclusions based on the data<br>• Thinks critically to assess success of campaign and brainstorm solutions to improve the campaign | | 25% |
| **Collaboration** | • Considers and incorporates feedback and suggestions from others<br>• Makes thoughtful contributions to class discussions and debriefs<br>• Has respectful and productive interactions with others | | 25% |
| **Communication and Presentation** | • Communicates in ways that are logical and effective; to others, can back up ideas and have meaningful and constructive dialogue<br>• Shares and justifies ideas and information clearly and thoroughly<br>• Presents in a confident and engaging fashion showing understanding and competence | | 25% |

## Appendix C: Supplementary Resources

Other Wonderville.org games and digital resources that can be used to support student learning, and their corresponding content themes are:

Note: To access the following resources a free membership on **Wonderville.org** is needed.

| Digital Resources | Content Theme | Description |
|---|---|---|
| **Waste No More** | Biochar | This video introduces biochar, a charcoal produced from plant matter deposited and stored in the soil through natural events, such as forest and grassland fires. It illustrates to students the concept of waste turned into something useful (time: 5:44) |
| **Sorting it Out: Beverage Container Recycling** | Recycling | The beverage container recycling program is in full swing. Join the professor in this video as he explores the many layers of polycoat containers - things like juice boxes have lots beneath the surface to discover! (time: 7:26) |
| **Science Extras: Beverage Container Recycling** | Recycling, waste diversion | Most beverage containers can be recycled, but need some cool science to make it happen. Recycling a juice box requires that you separate its layers using a machine called a hydropulper. This hands-on activity shows students how to separate a juice box into its layers. |
| **Building with Waste** | Repurposing waste; engineering applications | Ever wonder what a waste material engineer does? Neither had Marty and Jessie. In this comic, Quantum helps them to understand what waste management engineering is and the many products that are developed thanks to engineering. |
| **Waste Avengers** | Recycling, composting | Do you have what it takes to be a Waste Avenger? This game will teach you how organic, plastic and paper waste can be recycled or composted as you try your hand at being an environmental superhero. |
| **Zero Waste** | Biodegradable materials, zero waste | Can you imagine a world with no garbage? What if we could take trash and turn it into useful stuff? Learn more about how recycling and using biodegradable materials can come together to work towards a world with zero waste. |