



**LESSON PLAN  
GRADES 5-12**

[worldwildlife.org/FoodWasteWarriors](http://worldwildlife.org/FoodWasteWarriors)









## “Preventing and reducing food waste is one of the best things you can do to conserve natural resources and save wildlife.”

— Pete Pearson, Director of Food Waste, WWF

### BACKGROUND

How we produce, consume, and waste food represents one of the greatest threats to life on Earth. It's estimated that Americans waste 30-40% of all food produced, or approximately 63 million tons each year. To put that in perspective, if all that food we wasted annually came from one farm, that farm would be three quarters the size of California, and it would harvest enough food to fill a 40-ton tractor every 20 seconds.<sup>1</sup>

This extreme amount of food waste has many negative impacts on our environment. One such impact comes from the way we dispose of food. The majority of the food we waste in the US is dumped into landfills, which emit a collective 124 million tons of greenhouse gases (GHG) each year.<sup>2</sup> These gases, including carbon dioxide (CO<sub>2</sub>) and methane, are major contributors to climate change. In fact, when it comes to methane in particular, our food-filled landfills are the country's third largest source of this potent greenhouse gas, which has a global warming potential that is 25-30 times *greater* than CO<sub>2</sub>.<sup>3</sup>

Another impact comes from how we produce food. Most food production processes use a lot of natural resources (like water) and also create GHG emissions. So when we waste any amount of food that has been produced, that means we have also wasted precious water and caused more climate change stress on the planet than was necessary. In fact, if we reduced our country's annual food waste by 50%, it's possible we could save 1.6 trillion gallons of water and reduce GHGs by 18 million tons each year.<sup>4</sup>

Food production and food waste also negatively impact wildlife. For instance, in North America, increased agricultural expansion to meet rising food and fuel demands is putting tremendous pressure on important ecosystems, such as the biodiverse Northern Great Plains of the US and Canada. There,



Previous page: Pronghorns in South Dakota. Above: Male greater sage grouse in Montana.

we're losing some of the planet's last remaining temperate grasslands on a scale greater than the loss of rain forests in Brazil. In 2014, 1.4 million acres in the Northern Great Plains were lost to tillage, sacrificing the habitat of American wildlife like bison, black-footed ferrets, and sage grouse.<sup>5</sup>

Finally, our food waste problem also impacts our nation's health and well-being, because at the same time that we're wasting millions of tons of food each year, many in the US are going hungry. One in seven Americans lives in a food-insecure household, and 3 million of those households include children—a dire situation that could be resolved if we improved our food production and distribution methods.<sup>6</sup>

It is important that we educate both children and adults about these problems so that we can build a food-secure future, in balance with nature, for all Americans. Including waste reduction awareness programs in schools and city governments is a great starting point for this education—which is why we have created this curriculum. We hope you and your class will enjoy learning how to become “Food Waste Warriors.”



## LESSON SUMMARY

“Be a Food Waste Warrior” is a three-part science and math lesson that can be adjusted in complexity depending on grade level. It includes food waste audit log sheets, discussion questions, a companion PowerPoint, and additional teacher resources and materials.

Students will learn about the ways in which food impacts the environment by recording data from a student food waste audit during their lunch period. The audit will engage basic science and math skills to (1) convert food waste weights to water used and GHGs emitted, and (2) calculate the difference in GHG emissions depending on whether food waste is landfilled or composted. Participating students will ultimately understand how to reduce food waste and why reducing food waste is important to conserving natural resources and wildlife habitat.



The Rio Grande, Texas

## GRADE LEVEL & SUBJECTS

Grades 5-12; science, math, social studies, health

## ESTIMATED TIME NEEDED

Three 30- to 45-minute periods, which includes time for one food waste audit session at lunchtime (schools may choose to audit one day or multiple days)

## PURPOSES

- to understand the environmental impacts of food and food waste, and how it affects wildlife habitats
- to make calculations and graphically represent data; to calculate weights of food waste
- to estimate water and greenhouse gas resources embedded in the wasted food measured during the audit, including from both direct (food waste) and indirect (food production) sources
- to understand the environmental benefits of different disposal and food waste reduction strategies
- to gain knowledge of ways to reduce food waste on a personal, school-wide, and community-wide level

## OBJECTIVES

As a result of this lesson, students will be able to

- understand what food waste is and where it comes from
- understand and identify how individual food choices impact our environment in direct and indirect ways (including water loss, greenhouse gases, habitat loss, and food insecurity) and why this is important
- calculate daily averages of water wasted and greenhouse gases emitted based on food waste separation and measurement values
- calculate the difference in GHG emissions between landfill and compost disposal methods
- display data in table, chart and/or graph form
- discover ways to reduce food waste on a personal, school-wide, and community-wide level through behavioral changes in the lunchroom and tools such as donation and composting



American bison, Montana

## NEXT GENERATION SCIENCE STANDARDS

### 5TH GRADE:

#### 5-ESS3-3-1. Earth and Human Activity:

*Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.*

#### 3-LS4-4. Biological Evolution: Unity and Diversity.

*Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*

#### 2.MD.D.10. Represent and Interpret Data:

*Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.*

### MIDDLE SCHOOL:

#### MS-ESS3-3. Earth and Human Activity:

*Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

#### MS-ESS3-4. Earth and Human Activity:

*Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.*

### HIGH SCHOOL:

#### HS-LS2-2. Ecosystems: Interactions, Energy, and Dynamics:

*Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.*

#### HS-LS2-7. Ecosystems: Interactions, Energy, and Dynamics:

*Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*





Students learning about food preparation and waste

## MATERIALS NEEDED

- **WWF Food Waste Warrior PowerPoint, Parts 1 and 2**
- **USDA Guide to Conducting Student Food Waste Audits**

*Use ONLY the content in the following sections:*

*Planning your audit*

*Items needed*

*Instructions for food separators*

*Day of audit*

*Sample cafeteria setup for audit*

*Data collection (p.10 only)*

*Food Waste Prevention Ideas*

*Food Separator Weight Log (p. iii in appendix)*

- Printed out audit weight logs from USDA guide
- Two tables per audit station

- Two large trash cans on wheels
- Buckets/crates (for sorting lunchroom food waste)
- Trash bags to line the buckets
- Scale
- Pencil, paper, clipboard
- Clothes and/or paper towels appropriate for spills and cleanup
- Computer or tablet with internet access (to enter your school's food audit data into the **Food Waste Warriors Online!** data tool)

**Optional:** Printed labels for buckets; signage to direct students; gloves for handling food/trash

Find related resources at

[worldwildlife.org/FoodWasteWarriors](http://worldwildlife.org/FoodWasteWarriors)



## PRIOR KNOWLEDGE AND SKILLS NEEDED

- understanding of water and other natural resources as requirements for food production
- understanding of water and other natural resources as requirements for daily living
- understanding of greenhouse gases and the greenhouse effect and how it affects the planet
- basic understanding of the impacts of habitat loss on animals
- measuring volume quantities
- making predictions
- collecting data
- calculating averages
- arranging data into table, graph, and/or chart form
- reading information from tables

## ASSESSMENT

- successful completion of a food waste audit log (one day or multiple days, as preferred)
- successful completion of student calculation activities
- participation in oral presentation of results



Students conducting food waste audit

## VOCABULARY

**biodiversity:** the variety of life in the world or in a particular habitat or ecosystem

**CO<sub>2</sub>e:** a standard unit of measure used by climate scientists to express the total global warming impact of a combination of many different greenhouse gases.

**composting:** a process where organic materials are broken down naturally (via aerobic processes) and can be used to improve soil health and plant growth

**ecosystem:** a system, or a group of interconnected elements, formed by the interaction of a community of organisms with their environment

**food:** any substance—whether processed, semi-processed, or raw—that is intended for human consumption

**food waste:** food that is discarded or lost uneaten, and is safe and nutritious for human consumption

**greenhouse gas (GHG):** any of the gases whose absorption of solar radiation is responsible for the greenhouse effect which warms the planet (includes carbon dioxide, methane, ozone, and fluorocarbons)

**habitat:** the natural home or environment of an animal, plant, or other organism

**habitat loss:** a process in which natural habitat becomes unable to support the species present in it, so that the species are displaced or destroyed and biodiversity is reduced

**methane:** a type of greenhouse gas that traps up to 100 times more heat in the atmosphere than carbon dioxide within a 5-year period; the biggest source is from food waste in landfills and from livestock

**natural resource:** an economically valuable, naturally occurring material (e.g., soil, water, sunlight)

**water and energy conservation:** reservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife





## EDUCATOR BACKGROUND PREPARATION

Refer to this background information when preparing the lesson.

- **WWF Food Waste Warrior PowerPoint**
- **USDA Guide to Conducting Student Food Waste Audits**

Use *ONLY* the content in the following sections:

*Planning your audit*

*Items needed*

*Instructions for food separators*

*Day of audit*

*Sample Cafeteria Setup*

*Data collection (p.1 only)*

*Food Waste Prevention Ideas*

*Food Separator Weight Log*

- **BEACN Food Waste Data Calculator** – calculates water and greenhouse gas impacts by food category
- **Four Ways to Fight School Food Waste fact sheet** – details practical approaches schools can take to reduce food waste (teachers can use these facts to augment the student brainstorming done in Step 3 of the lesson plan)
- Additional Resources list on page 15 of this lesson plan
- Preview the **WWF Food Waste Warriors Online** data tool, where after the lesson you can enter your school's audit data and receive a picture of how your class or school is doing compared to other schools around the country



Images from the WWF Food Waste Warrior PowerPoint





## STEP 1 | INTRODUCTION AND PREPARATION

Before beginning this activity, be sure the single day or multi-day audit has first been approved by school administrators.

1. Begin the lesson with a general discussion about food and food waste. Ask students to brainstorm about food waste and its impacts, using some of the questions below.

*What is food waste? Why do people waste food?*

*How much food do you think is wasted in the U.S. each year?*

*What natural resources do you think we use when producing food?*

*What do you think happens to these resources when the food is thrown away?*

*What could be other potential consequences of wasting food? Can you think of a way that food waste could affect wildlife?*

*Could we figure out how much food we waste just in this school? How could we do it?*

2. Next, show them PART 1 of the **WWF Food Waste Warrior PowerPoint** to highlight some of the answers to these questions and discuss what they learned about the answers. At the conclusion, discuss and address any questions.
3. Explain to students that they will be doing a food waste audit to estimate the level of food waste in their school. Review the relevant sections of the **USDA Guide to Conducting Student Food Waste Audits** with your class to explain how it will work. (See “Materials Needed” on page 3 of this lesson plan for a list of the sections needed.)

4. Clarify what the class will be measuring and separating:

- **Measurement #1: Several different UNOPENED/UNEATEN food categories**

Determine which individual food categories of unopened/uneaten foods you want to separate out and measure.

IMPORTANT: Choose categories from the list found on the **BEACN Food Waste Data Calculator** under the drop-down menu labeled “Type” (e.g., meat & poultry; fish & shellfish; cheese; dairy products; fruits; vegetables, etc.).

*Note: The class will measure separate weights for each category AND will also calculate a total combined weight for all these food categories, added together.*

- **Measurement #2: ALL OTHER categories of food**

This is a total measurement of all food NOT included in #1 above that is thrown away during the lunch hour, including

- opened or partially eaten foods (including liquids)
- categories of uneaten food you did not choose to separate and weigh

To get this measurement, you can set up an “Everything Else” trash bin for all other types of food that were not individually measured. Line this bin with a trash bag and at the end of the lunch period, weigh that sole bag of food waste.

5. Then, prepare for your audit. Designate 2-4 student leaders responsible for coordinating the audit, and have them divide the class up into different teams who will conduct the various tasks required. Gather and set up all materials needed in the cafeteria and print out all worksheets and labels/signs necessary.



## STEP 2 | ACTIVITY – CONDUCTING THE FOOD WASTE AUDIT

Right before the audit session is about to begin, have student leaders review the audit game plan again with the rest of the class.

1. You can ask students these questions before conducting the food waste audit:

*We know now that 63 million tons of food are wasted in the US each year, and how that affects the environment. What benefits could come from reducing food waste in the US?*

*Do you usually eat all of your lunch? If not, why not?*

*When you buy lunch at school, do you think you have to take certain items? Why?*

2. Begin the lunchtime food waste audit, using the relevant sections and procedures in the **USDA Guide to Conducting Student Food Waste Audits**. (See page 4, under “Materials Needed,” for which sections to use.)
3. As described in the USDA guide, during the audit the class should keep a log, recording the weights of the different food waste categories described in Step 1 of this lesson plan.
4. You can choose to hold the audit on just one day, or have the students audit lunches for several days in a row and combine results.
5. Once the audit process is completed, have students discuss with you and among themselves the results of their food waste audit log sheets and what they reveal. They can also complete the following activities (as grade appropriate):

### A. Create a food waste graph or pie chart

- Have the class calculate the weight measurements for different individual food categories and create a chart or graph that shows the total food waste for each category, so they can see which items were wasted the most.

### B. Calculate the PRODUCTION IMPACT of individual food waste categories

- Remind students that to produce food, lots of valuable natural resources like water are used. Plus, production and transport of food requires energy use, which results in greenhouse gases. So when we waste food that was already produced, it means water was lost and GHGs were released that didn't have to be. These kinds of unnecessary impacts really hurt the environment, our climate, the places we live, and the habitats where wild animals live. Therefore, it's important to know what impact we are making with our own food waste.
- Tell them they'll now be calculating the production impact of the food waste they measured for the school.
- Choose one of the UNOPENED/UNEATEN food categories you weighed during the audit and show them how to use the online **BEACN Food Waste Data Calculator** to calculate and record the total water waste and greenhouse gas emissions that ended up occurring unnecessarily to produce food that ultimately got thrown out.

#### How to use the calculator:

Use the “Type” drop-down to select the food category you are measuring. *NOTE: You do NOT have to use the second “Specific Types” drop-down—just leave that blank.*

Type the number of pounds of the food waste category in the field provided.

Hit “Calculate.”

Then have the class focus on the results on the “liters of water” and “carbon footprint” lines. This will show them how much water was wasted and give them a sense of how much greenhouse gas was emitted during the production of the food.





- Then, have students follow the same procedure individually, choosing a new category of food and using the calculator to discover and record what the water and carbon footprints are for those foods. Have them share their individual results with the class.
- Next, have students add up ALL water or carbon footprint numbers to see the collective impact of all unopened/uneaten foods—how much was wasted in production, and how it ultimately affects our environment.

*Note: You can use this total in Step 3 of this lesson plan, to discuss the importance of donating the school's food instead of wasting it.*

### **C. Calculate the LANDFILL IMPACT of food waste vs. the COMPOSTING IMPACT**

- Remind the class that landfills release a lot of greenhouse gases, which negatively affect the environment, our climate, the places we live, and the habitats where wild animals live, too.

- Tell them they'll now be calculating the impact the school's food waste would have in a landfill, versus the impact it would have if disposed of by composting instead.
- To begin, have students calculate the total weight of ALL waste by adding together:
  - The total weights you calculated for all unopened/uneaten food categories
  - The weight of the “Everything Else” food waste (anything not measured above), including all opened or partially eaten foods (including liquids) that were thrown out.
- Take that total weight of all food waste and have the class use the formula below to calculate the amount of greenhouse gas that will be released when that waste goes to a LANDFILL:

**Food Waste [lbs] x 1.19 [lbs CO<sub>2</sub>e] = Total LANDFILL greenhouse gas emissions score**

*Note: 1.19 lbs CO<sub>2</sub>e is the total GHG impact of one pound of landfill food waste<sup>7</sup>*



- Next, take the total weight of all food waste and have the class use the formula below to calculate the amount of greenhouse gases that would be released if that waste were COMPOSTED

**Food Waste [lbs] x 0.40 [lbs CO<sub>2</sub>e] = Total COMPOST greenhouse gas emissions score**

*Note: 0.40 lbs CO<sub>2</sub>e is the total GHG impact of one pound of composted food waste<sup>7</sup>*

- Explain that a lower score means less greenhouse gases emitted—and the less emitted, the better it is for the environment and the plants, animals, and natural resources we depend on.

You may also wish to explain why compost and landfill have such different emissions numbers, even though they are breaking down the same food. The difference comes from the process each uses to break down natural waste. The composting process uses oxygen to break down food, while a landfill does not. That lack of exposure to oxygen causes much larger amounts of GHGs to be released—especially methane, a GHG with 25-30 times more global warming potential than CO<sub>2</sub>.

*Note: You can use these landfill vs. composting calculations in Step 3 of this lesson plan to discuss the importance of composting the school's food waste instead of throwing it in the trash.*

#### **D. Calculate the impact of a school's waste over many days, or across many schools**

- When discussing, you can have students think about the fact that their food waste totals were for only ONE day of school (or however many days you audited).
- Have them think about—or take one of the totals and try to calculate—how much waste and environmental impact might occur if they multiplied that daily total across one week of school—or all the days of school they have in one year.

- Then ask them to think about how many schools there are in the town, and in the state, and in the country, and how that adds up. Emphasize the need to find better solutions, which they'll talk about in Step 3.

#### **E. OPTIONAL: Submit your class's findings to WWF online and join schools across the country in the fight against food waste.**

- Visit [worldwildlife.org/schoolfoodaudit](http://worldwildlife.org/schoolfoodaudit) and enter the following:
  - the weights you measured in the audit and any other categories (if some categories do not apply to your class, you can leave them blank)
  - your email, school name, grade, city, state, and daily meals served
- Hit the “submit” button, and WWF will email you extra information you can share with your class, such as
  - how your school ranks against others in the country in food waste and reduction
  - the average pounds of food waste per student

#### **EXTENDED LEARNING OPTION**

Visit [worldwildlife.org/FoodWasteWarriors](http://worldwildlife.org/FoodWasteWarriors) for resources students can use at home with their families to measure, discuss, and reduce waste in their own kitchens.





## STEP 3 | WRAP-UP AND CONCLUSIONS

1. Once the food waste audit has been completed, discuss with students what they have learned.
2. To help them summarize their conclusions, show them Part 2 of the **WWF Food Waste Warrior PowerPoint** and guide them with the following questions:

*What information do we now have about the food categories we measured? Which are wasted most often? Why do you think these are wasted more than others?*

*Which had the highest production impact for water? Which had the highest carbon impact?*

*When we did our landfill versus composting calculations, why was there a higher greenhouse gas emissions score for landfilling food waste?*

*Which option—landfill or composting—has the least environmental impact? How could we use this information to help protect our environment and wildlife?*

*What can our school or city do to keep so much food from going into landfills?*

*What are some changes we can make in order to avoid negative landfill and production impacts? What can we do as individuals to reduce food waste on our own plates?*

*One in seven families in the US don't have enough food to eat, including in our community. Meanwhile, our school had [fill in #] pounds of unopened food in just one day. How could we use leftover unopened or unused food to help those in need—and also decrease production and landfill impacts?*

*What food waste reduction or redistribution strategies have we talked about or have you used already that seem effective? How can we help our school create less food waste?*

3. Ask students to identify the food waste reduction strategies they think could work for their school and develop an action plan
  - Facilitate the discussion using the list of reduction strategies found in Part 2 of the PowerPoint presentation, as well as the prep material you read in the **Four Ways to Fight School Food Waste** fact sheet online.
  - Once students have identified the strategies they think would work best for your school, work with them to create an action plan that they can share with the student body and/or administration.
4. Inform students that after new waste reduction strategies are put in place, the class can do follow-up audits later in the year to see if the strategies they identified helped reduce food waste (see details about repeat audits in the Extended Learning Options section on the next page).



Students sort food for Share Table donation



## EXTENDED LEARNING OPTIONS

1. Immediately after the audit, students can

- Share the collected food waste data and their proposed waste reduction strategies with the larger student body and administrators to encourage them to develop solutions to food waste in their school
- Engage in a letter-writing campaign to city/county officials to comment on food waste diversion strategies that are under way or to encourage additional action

*Note: You can use the **Write to Reduce** activity found in the Additional Resources section on this page as a guide to help students with these activities.*

2. After new reduction strategies have been put in place at the school, teachers are strongly encouraged to have students

- Conduct another food waste audit later in the year on a day when the cafeteria is serving lunch items similar to those served during their first audit. This will help students monitor the school's progress and see if their reduction strategies have helped decrease food waste since the previous audit. They will also be able to track how well the

school is doing at lowering its emissions and water footprint over time.

- Submit the new data sets to the same email address from previous audits, and WWF will send them a graph of the school's audit results over time, providing visual evidence of improvements and lower emissions scores (should the numbers reveal that).
- Repeat this audit and submit their data as many times as they like, to continue tracking the school's progress over time.

## ADDITIONAL RESOURCES

Educators can use the resources below to further their understanding of food waste and augment the material found in this lesson:

- **WWF's Food Waste Overview**
- **Further With Food: Center for Food Loss and Waste Solutions**
- **Write to Reduce** Language Arts Activity
- **Working Together** Teacher Resource for Approaching Cafeteria Managers and School Administrators

## ENDNOTES

- <sup>1</sup> ReFED 2016 Report, "A Roadmap to Reduce U.S. Food Waste By 20 Percent." [http://www.refed.com/downloads/ReFED\\_Report\\_2016.pdf](http://www.refed.com/downloads/ReFED_Report_2016.pdf).
- <sup>2</sup> Venkat, Kumar. "The Climate Change and Economic Impacts of Food Waste in the United States." *International Journal on Food System Dynamics* (2011): CleanMetrics. <http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf>.
- <sup>3</sup> "Basic Information about Landfill Gas." EPA. Environmental Protection Agency, 09 Aug. 2017. <https://www.epa.gov/lmop/basic-information-about-landfill-gas>.
- <sup>4</sup> ReFED 2016 Report, "A Roadmap to Reduce U.S. Food Waste By 20 Percent." [https://www.refed.com/downloads/ReFED\\_Report\\_2016.pdf](https://www.refed.com/downloads/ReFED_Report_2016.pdf).
- <sup>5</sup> 2016 Plowprint Report, The World Wildlife Fund. <https://www.worldwildlife.org/projects/plowprint-report>.
- <sup>6</sup> "Hunger in America 2014." Feeding America, 2014. Web. <http://help.feedingamerica.org/HungerInAmerica/hunger-in-america-2014-full-report.pdf>.
- <sup>7</sup> "Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)." (2016): pg 1-32. U.S. Environmental Protection Agency. Web. [https://www.epa.gov/sites/production/files/2016-03/documents/warm\\_v14\\_organic\\_materials.pdf](https://www.epa.gov/sites/production/files/2016-03/documents/warm_v14_organic_materials.pdf).

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