“Solutions-Oriented Learning” Storyline

MS-Food Waste

Storyline introduction and overview:

Food waste is a major contributor to greenhouse gas. Wasted food and the resources to produce that food are responsible for approximately 8% of global greenhouse gas emissions. In this storyline, students learn about the resources required to produce food through following the carbon cycle and discover how food waste contributes to climate change. They will also learn the farm to table transport chain as well as how to conduct a food waste audit. Finally, the students will research solutions to the problem of food waste that can be applicable to their own lives, their school, and their community.

NGSS Learning Progression for this Storyline: The MS Food Waste storyline is part of a larger learning progression that includes students mastering standards pre-K to 12th grade. Take a look at how the Middle School performance expectations fit in a continuum of learning for your students.

Placemaking: Consider the food you will see wasted today as you eat, go to school, shop, make dinner, snack. Washington state agriculture produces a great deal of food. Some of that food ends up at landfills, or waste to energy plants.	**Anchoring phenomena:** Show a plate full of food that represents all the food produced in the US. 40% of the food produced is never eaten (show 40% on the plate).	**Drawdown:** Reduced Food Waste
Indigenous and other relevant cultural connections: For the Natives of the Pacific Northwest, food is more than just what is eaten, it is an important part of culture. To explore the connection between culture and food, reference the Smithsonian Native Knowledge 360’s “Why do the Foods We Eat Matter?”	**NGSS PEs (progress towards):** MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. MS - LS2-3:Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment	

Estimated time required to implement this storyline: 3 weeks or 17 lessons (50 minutes each)

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NGSS PEs:

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

MS-LS2-3:Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

Science & Engineering Practice (SEP)	Disciplinary Core Idea (DCI)	Cross Cutting Concept (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**For MS-LS1-7** **LS1.C: Organization for Matter and Energy Flow in Organisms** Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.	**Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe phenomena.	**For MS-LS2-3** **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	**Energy and Matter** The transfer of energy can be tracked as energy flows through a natural system **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles	**For MS-ESS3-3** **ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such

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to design an object, tool, process or system.	different living things.	factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Learning Sessions

Learning Session	Materials List:
2 **8** **6** **6**	A plate full of food (or a photo) Buckets (6), scale, disposable gloves, tarp Supplies to make compost Bromothymol Blue indicator

1.	**Grounding Native Ways of Knowing:**	Estimated time: 50 minutes
	Ask students: What are your favorite foods? Why? Are there foods that you associate with particular holidays, memories, celebrations, or events? What is the significance of these foods? Read or have your students read Shana Brown’s essay Essential Connections between Food and Culture Essay and/or show the video Food and Culture's Video from Native Knowledge 360. Complete Part A and B of the lesson plan in which students practice making connections and inferences about the cultural foods of the Native Nations of the Pacific Northwest.	

2.	**Examine phenomena: 40% of the food produced in the US is never eaten.**	Estimated time: 20 minutes
	Show a plate full of food that represents all the food produced in the US. Cover up 60% of the plate. In the US, about 40% of the food produced is never eaten (show 40% on the plate). Elicit wonderings and record in order to revisit at the end of the storyline.	

3.	**Pre Assessment:**	Estimated time: 30 minutes
	MS-Food Waste Pre Assessment **MS-Food Waste Assessment Rubric**	

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4.	**Guiding question: What is food waste?**	Estimated time: Three 50 minute periods
	1. Use the Warm-up lesson followed by the Main Activity in Exploring Our Food System. The link: Foodspan Infographic is a good example of a food supply chain. 2. Use the warm-up in Wasted Food Lesson Plan. Students create a food supply chain that represents a food produced in their local area (eastern WA versus central WA for example). On the info-graph they write in the kind of food waste that occurs at each step. 3. Students read Food system primer Wasted Food. Display the pie chart of U.S. food waste. Students compare their journaled food waste over 3 days to U.S. food waste percentages. Students convert the pie graph to a bar graph and overlay their food waste on the bar graph.	

5.	**Guiding question: What happens to food after the "table"? How does food waste contribute to climate change?**	Estimated time: Three 50 minute periods
	1. Use the Carbon Cycle and the role of photosynthesis/respiration to discuss how a plant grows from a seed to a mature plant that is edible. The following lesson includes a game as well as an assessment Traveling through the Cycles. 2. In order to lead students towards thinking about the decomposition of food waste, use The Carbon Cycle and Decomposition which gives definitions of the terms: photosynthesis, respiration, decomposition, fossilization as well as 6 assessment questions. 3. The graphic below can be used for class discussion or be copied in the students' science journals.	

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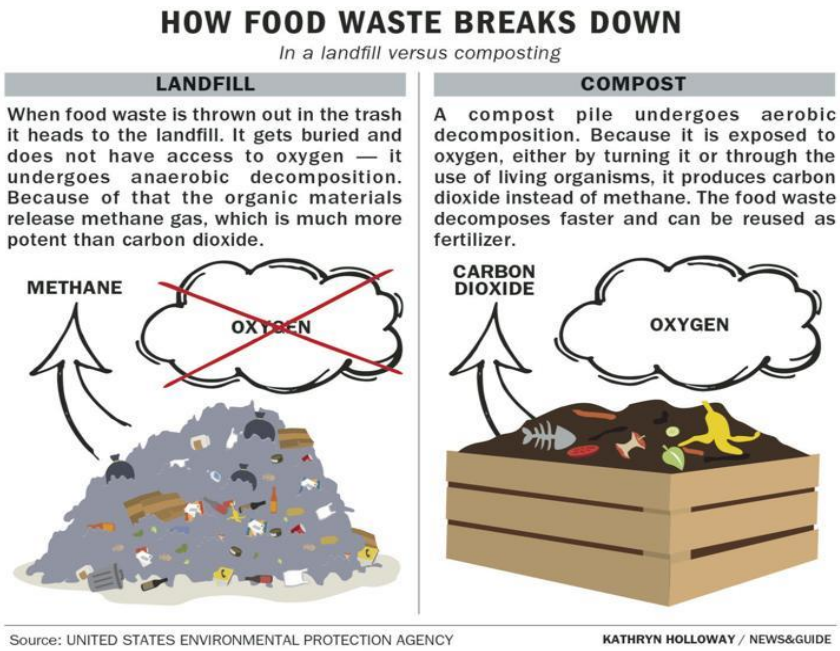

4. How does food waste break down?
    a. The chemical pathway is as follows:
        i. Food(carbohydrates, fats, proteins which all contain carbon) + Oxygen → Carbon dioxide mainly
        ii. When Oxygen is used up in the landfill:
            Carbon dioxide + Hydrogen → Methane mainly.

If more background is needed to explain this process to the students, this is a good resource: Landfill Gas Basics

    b. The following video introduces students to the decomposers that break down food. Dead stuff: The secret ingredient in our food chain.

5. Use the website Climate Kids: Meet the Greenhouse Gases use this resource to complete your lesson on why methane produced from food waste contributes to climate change.
6. Using the learning from steps 1-5, students create a model (either a poster or 3D) that demonstrates their understanding of how food waste can generate methane (a greenhouse gas) that leads to global warming.

6.	**Guiding question: What are some solutions to food waste? Composting**	Estimated time: Two 50 minute periods

	1. What is composting and what are the benefits? 2. Students will create a classroom compost pile (page 31-34 in Composting in the Classroom) or create a home compost pile. Composting Basics - EPA is a good site to have your students read. Students can share their progress on social media using the hashtags #compost and #foodspan. * 3. An extension to the composting project is to have students test the decomposition of samples of everyday food by using a bottle bioreactor. The bottle bioreactor can be used to test for CO2 in the columns using the indicator Bromothymol Blue as evidence of aerobic decomposition. Test for smell in the anaerobic (landfill) column. See Composting - Nature's Disappearing Act for lesson details. * 4. Students revisit the essay and video from Grounding Ways of Knowing. Why do the foods we eat matter? Construct an argument (e.g., detailed outline, graphic, presentation, or essay) that addresses the question using evidence from the relationship indigenous people have with the food and the science behind how wasting that food impacts climate change. * A well-tended compost pile generally yields finished compost in 2 weeks to 4 months.

7.	**Guiding question: What are some solutions to food waste? Understanding how food is labeled in order to reduce wasting food**	Estimated time: 50 minutes
	1. What do "Best By" dates mean? Write student comments on the board. Save the comments to revisit after the lesson in step two. 2. Use the Warm -up and Main Activity in Decoding Food Labels lesson plan to discuss how food labeling can lead to food waste. If time, assign the extension activity *Food Tracking* as a week long homework project. This project would support student learning in discerning credible sources of information and distinguishing between scientific claims vs non-scientific claims.	

8.	**Guiding question: What is one solution that we (my class) can do to reduce food waste in our school?**	Estimated time: Two 50 minute periods
	1. What is a food waste audit? The main goal of a student food waste audit is to learn why students are not eating certain food items and to make changes so that they eat more of what's on their tray. 2. Use the form Food Waste Audit Submission form from Lifesmart's 2017 competition as a template to guide students through the audit. This form can be used to record the data as well as the pertinent information about the school. It also allows for the food waste	

audit to be done in a classroom if the cafeteria is not an option. Materials needed include: Buckets (6), scale, disposable gloves, tarp

3. To complete this lesson, have students answer questions 1 and 4 in the critical thinking section 3 of the submission form.

9.	**Guiding question: What is one solution that we (my class) can do to reduce food waste in our community?**	Estimated time: Three 50 minute periods

1. Part 1: Use the video Taste the Waste (3 min) for the class to discuss what could be done differently at different parts of the video. Make a list on the board. Turn the discussion to your own community. Assign groups of students to one of the following (this is a partial list - the class may think of additional groups to research on a local level) and instruct students to find out how each of these groups manage their food waste and report to the class. This is the informational part of this two part project.
    a. Bakeries
    b. Hospitals
    c. Schools
    d. Restaurants
    e. City Waste Mgt
    f. Food Banks
    g. Composting Facilities

2. Part 2: Using information gathered in Part 1, identify IF there is a food waste problem. Write a letter to the community member describing a solution to the food waste problem
    a. Criteria: Based on scientific evidence, identify the problem
    b. How does this problem contribute to climate change?
    c. Describe a solution to minimize food waste and how to monitor whether the solution is working.

10.	**Possible next steps/off-ramps/actions:**	

- Teachers can use the PBS lesson plan Speaking your mind about global warming Students produce a video to share their own views and concerns. They learn the science behind the events of global warming, then watch videos created by young producers, like themselves, that tackle this subject. They then go through the process

	of creating their own videos individually or in groups, first developing a treatment and script and then producing the final video. ● If students are interested in what kind of jobs there might be in working to reduce food waste, they can research careers in food sustainability. These careers range from farming and research to media, communication and advocacy positions to policy and public health jobs. For more detail, see Get to Work! Jobs in Food Sustainability.

10	**Post Assessment:**	Estimated time: 30 minutes
	MS-Food Waste Post Assessment **MS-Food Waste Assessment Rubric**	

OER Tracker Resources - MS Food Waste

Pacific Education Institute would like to acknowledge and thank the writing team for their work. The team included Michelle Townshend, Cinnamon Bear, and Shelley Stromholt. In you have comments or questions please contact info@pacificeducationinstitute.org .

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