Background for Lesson 10
Thinking About Consumption

We use different materials, food, and machines everyday to live, work and play. Greenhouse gases are created during the manufacture, distribution, use and disposal of these materials. Understanding the impacts of our choices can help reduce greenhouse gas emissions.

The **environmental footprint** of a product or process is a measure of its environmental impact based on the amount of natural resources it consumes and the amount of waste or other impacts it generates during its lifetime. In measuring the environmental footprint of a pencil we would consider consumption and impacts over its entire **product lifecycle**: cutting down trees, transporting the logs to the mill, manufacturing the pencil, manufacturing and transporting the lead and eraser parts, transporting the pencil to the consumer, and disposing the pencil in a landfill. A footprint analysis considers the total environmental impact of the pencil from the cradle, production, to the grave, disposal.

The amount and type of energy used during a product's lifecycle is an important aspect of measuring any product's contribution to greenhouse gases. We can use the idea of **energy input pathways** to identify points in the product lifecycle where energy is used and trace the source of that energy. For instance, electricity use for manufacturing the pencil might be traced to a power plant and then to the particular fuels used to run that power plant. Different electricity sources would cause the same product to have different environmental impacts.

Climate Change Connection: Energy is used to make, distribute, use, and dispose of the materials, food, and machines we use everyday. As shown in earlier lessons, when organic or fossil fuels are used to provide this energy, greenhouse gases and other pollutants are emitted.

The **carbon footprint** is a measure of the environmental impact of a product or process in terms of the greenhouse gases produced in its lifecycle. A carbon footprint considers the greenhouse gas emissions produced over the product lifecycle from production to disposal. Looking at all the energy input pathways makes it easier to recognize and measure the emissions related to use of particular sources of electricity, means of transportation, or product use. Carbon footprints are typically measured in tons of CO_2 equivalent.

Understanding a product's lifecycle can help us make informed purchasing and use choices that will reduce greenhouse gas emissions and our impact on the climate.

Background for Lessons 10, 11, 12,13
Waste and Climate Change

Waste is the everyday items thrown away by people. In the United States, 250 millions tons of waste is thrown away every year.[1] In California, on average, each person discards six pounds of waste a day![2] In most areas, 35% of waste sent to landfills is food scraps and food soiled paper products.

Waste can be organized into several categories. **Organic waste**, is all waste that came from plants and animals, food scraps, yard trimmings, and even paper. Inorganic waste is man-made items such as plastics, glass, metals, packaging, and construction materials. **Inorganic waste** may take hundreds of year to decompose, or may not decompose at all. However, inorganic waste can often be recycled. **Hazardous waste** is waste with toxic components such as, paint, batteries, electronics, pesticides, and cleaning products. Hazardous waste needs to be disposed at locations specifically prepared for hazardous waste. Some hazardous waste, like batteries and electronics, can be recycled into new products.

Most of our waste is taken to **landfills**, large outdoor areas where trash is buried. In landfills, garbage is buried on top of garbage and undergoes anaerobic decomposition, decomposition in the absence of oxygen.

Anaerobic bacteria decompose organic waste; however, it cannot generally decompose inorganic waste. In a landfill anaerobic decomposition generates methane, known as landfill gas. **Methane** is a greenhouse gas that traps 21 times more heat than carbon dioxide. In other words, methane's **carbon dioxide equivalent** equals 21 and it contributes significantly to climate change. Landfills have gas control systems that manage the build-up of

[1] EPA, 2006: http://www.epa.gov/msw/facts.htm
[2] CIWMB, 2008: http://www.ciwmb.ca.gov/KidStuff/

methane and capture most of the methane emissions. However, methane does escape into the atmosphere. In California, landfills are the biggest source of man-made methane. Some landfills in California are working on ways to reduce methane emissions by converting methane in landfills into energy for electricity or transportation.

Organic waste can undergo **aerobic decomposition**, which is the breakdown of organic materials by bacteria and other natural decomposers in the presence of oxygen.

Climate Change Connection: Most waste goes to landfills. Disposing waste at landfills generates significant greenhouse gas emissions. First, transporting the waste to the landfills, with garbage trucks or garbage barges, emits greenhouse gas emissions from the burning of fossil fuels for transportation fuel. Second, the anaerobic decomposition in the landfill produces methane, a potent greenhouse gas. Last, throwing away waste usually means that we are replacing our unwanted things with new products. Manufacturing, transporting, and using new products creates greenhouse gas emissions. Reducing the amount of waste that we produce and send to landfills reduces greenhouse gas emissions and helps protect the climate.

The Four R's

The Four 'R's: Reduce, Reuse, Recycle and Rot (or Composting) outline strategies for reducing landfill waste that can be implemented by all sectors of society, from individuals and households, to schools and corporations. These strategies can also reduce greenhouse gases associated with using and disposing of products.

The **reduce** strategy means using less products and materials. For example, we can choose not to purchase disposable water bottles and instead refill a reusable water bottle; however, if we need to purchase water we can choose to purchase a two gallon bottle rather than one pint individual bottles for less waste. Reducing waste has the highest impact for reducing greenhouse gas emissions. Using less products and materials means fewer items need to be manufactured, transported, and disposed, therefore, reducing greenhouse gas emissions at all those points.

The **reuse** strategy emphasizes reducing waste by reusing items. Bags, containers, furniture, and many other things can live many lives as people sell, share, and trade things they no longer need rather than disposing those items.

The **recycle** strategy is about collecting and processing products, like cans and bottles, so that they can be made into new products. Recycling saves enormous amounts of energy and greenhouse gas emissions because it avoids extracting and manufacturing raw materials. Recycling aluminum to make new aluminum cans uses 95 percent less energy than making new cans from bauxite ore, the raw material for aluminum.[3] In supporting the recycling of materials for new products, we should purchase products with post consumer recycled content when possible.

In California, a law was passed in 1989 requiring municipal waste management agencies to divert 50 percent of waste from landfills. California reached this goal in 2005, and today, 54 percent of total waste is recycled in California. The energy savings from California's recycling could power 1.4 million homes every year. Many communities and sanitary districts in the S.F. Bay Area have set goals which exceed the statewide goal of 50% (i.e. Alameda County has a diversion goal of 75%.)

Recycling materials such as aluminum and paper, does create air pollution due to transportation and manufacturing. These problems are outweighed by recycling's benefits. Still, reducing and reusing are the best strategies for reducing waste to the landfill.

The **rot** strategy encourages composting organic waste. **Composting** is the process of collecting organic waste and letting it decompose naturally through aerobic decomposition. Aerobic decomposition is decomposition by bacteria, insects, and other decomposers in the presence of oxygen. Decomposers break down organic waste and create a soil rich in carbon from the organic waste. Some of this carbon is released into the atmosphere, but most of it is sequestered, or stored in the compost soil. Greenhouse gas emissions from aerobic decomposition are considered to be part of nature's carbon cycle

[3] U.S. Energy Information Administration, 2008: http://www.eia.doe.gov/kids/energyfacts/saving/recycling/solidwaste/recycling.html

and are not generally accounted as man-made greenhouse gas emissions.

Composting can take place on two levels: 1) The home/individual compost pile for a family or a school and 2) on a large scale, such as for a whole community, county, or region. The home compost pile cannot breakdown meat or dairy products because it does not reach a high enough temperature as it decomposes. The large scale compost facility is able to compost plant material, food soiled paper and cardboard, as well as meat and dairy products, because the materials are composted at a higher temperature, which kills disease causing bacteria.

Need More Information?

- Carbon Footprint
  Ecological footprint quiz for kids and lesson plans: http://www.kidsfootprint.org/

- The Four R's
  - Stop Waste: www.stopwaste.org
  - Guide to composting with worms: http://lancaster.unl.edu/pest/resources/vermicompost107.shtml
  - California Integrated Waste Management Board (CIWMB): www.ciwmb.ca.gov

Thinking About Consumption

Estimated Time: 1 hr

Objectives:
- Learn about energy used to produce the products we use everyday.
- Identify when pollution is generated during production, distribution, and disposal.
- Make the connection between manufacturing, pollution, and global climate change.
- Understand that personal choices have environmental consequences.

CA State Standard Connections:

4th Grade Visual Literacy
Students construct diagrams, maps, graphs, timelines, and illustrations to communicate ideas or tell a story about an historical event.

Tool Kit Materials:
- Handout 1

Additional Materials:
- Butcher paper
- Student journal (one per student)
- Markers and/or color pencils

We use many things in our everyday life, but we rarely think about the energy used to make, transport and power those items. At every step where energy is used, pollution is also generated. In this lesson students learn the impact of product manufacturing and distribution on air quality and climate change. Students will study common objects we use to learn how to think about draw the energy pathway for paper and identify where air pollution is generated during a product's lifecycle.

Key Words

Carbon Footprint: a measure of the total greenhouse gases produced by a process, an activity, or a person. A product's carbon footprint includes all greenhouse gas emissions produced by its lifecycle.

Product Lifecycle: the total process of a particular product's manufacture, transportation, use, and disposal.

Energy Input Pathways: concept used to track how energy is consumed through the lifecycle of a product, from its production, consumption, and disposal or reuse.

Raw Material: natural material used as input to production.

Manufacturing: process of turning raw materials into products that can be used or consumed

Preparation

Review Lesson 10 Background for an overview on the impacts of product use and climate change. Become familiar with the handouts and review the lifecycle examples in Activity 1 prior to teaching the lesson.

Procedure

Setting the Stage

- The total greenhouse gases that come from our lives can be tallied up as our **carbon footprint**. This includes the electricity we use, the things we use, how we get around, and how we dispose of waste. When we counted the number of pounds of CO2 we could save with our actions, we were talking about reducing our carbon footprint.
- We can reduce the greenhouse gas emissions from the things we use by thinking about how they might cause emissions. For example, say you have a choice between buying bottled water that comes from far away, bottled water that is made close by and your tap water. "Which one of these drinks would you guess takes the most energy to make it, package it and bring it to you?" (The bottled water from far away.)
- Anything we eat or use has its own **product lifecycle** starting from gathering the raw material, making the product ready for consumption, how it gets to us, how we use it, and how we dispose of any waste. (Write definition on board.) Normally when we use the word "lifecycle" we're talking about the stages of development in the life of different living things (egg, tadpole, frog). Although the products we use aren't alive, they also have stages of gathering, manufacture, distribution, use and disposal.
- Some of the product lifecycle stages use energy. We know from earlier lessons, that most of our current energy use creates greenhouse gases and other air pollutants. Thinking about how the things we use and consume are made can help us choose wisely and reduce our emissions.

Activity 1- Energy Inputs to the Pathway of a Products We Use

Product Lifecycle of Paper

Let's do a product lifecycle for paper. You will be developing a picture like Handout 1 on the board or an overhead with the help of the students. To do so you will draw pictures of objects in the pathway and link them with arrows. Start by drawing a sheet of paper at one end of the chalkboard.

1. As you draw, have students help fill in the pathway between the ruler and the sun. Prompt students by asking them specific questions, such as:
   - "What is paper made from?" (Wood that comes from trees.) Draw a tree on the far left side of the chalkboard.
   - "What gives the tree energy to grow?" (The sun.) Draw the sun above the tree.
   - "How is paper made?" (A factory called a mill saws up the tree and a paper factory makes paper. Both factories use machines that need electricity to operate.) Draw a factory with a smoke stack in the middle of the board.
   - "How did do the tree get to the factory?" (A lumberjack cuts down the tree, a truck uses fuel to transport the tree to the mill to saw up and then to paper factory.) Draw chainsaws and trucks between tree and factories.
   - "How does the ruler come to us?" (Stores, trucks to stores, we go in our car, or walk, to buy it.) Draw trucks, stores, cars, and people walking to store.
   - "Do we have to refrigerate it or plug it in to use it?" (Just use it, no special storage or turning it on.)

- "How do we dispose of it? Can it be reused? What if we lose it?"

2. These questions represent the different stages in a product lifecycle: gathering raw materials, manufacturing, distribution, use, and disposal. Many of these steps use energy. "Which ones do you see?" (Gas and electricity to run farm equipment, diesel to run the trucks, electricity for the factory, diesel for the store truck, electricity for the store, gas for our car.) These are the **energy input pathways**. Draw fat arrows with different color leading into trucks, stores, factories, equipment.
3. Pass out Handout 1. This is a simple diagram of the lifecycle we've been discussing. To generate further discussion, ask:
   - What happens if the paper is thrown in the trash? (It goes to a landfill where it cannot be re-used.)
   - Does throwing the paper away extend the energy pathway and create more pollution? (Yes, because a truck has to take the paper to a landfill and landfills cause pollution.)
   - What can be done with the paper to avoid more pollution? (Use both sides of paper and recycle it.)

Product Life Cycle of Milk

1. Let's think about the product lifecycle of milk: Draw milk carton a little in from right side of board. We ask the same kinds of questions:
   - Where does milk come from? (Grow and milk a cow.) Draw cow on left side of board.
   - How do we make milk ready to sell and consume? (Take it to a factory, clean it, and package it.) Draw arrow to a truck and another arrow to a milk factory.
   - How does it come to us? (Transported to stores, mostly by truck.) Draw arrow from milk factory to another truck and another arrow to a store and another arrow to a car and another arrow to a house.
   - How do we use it? (Keep it cool, drink it.) Draw an arrow from house to refrigerator to glass of milk.
   - What do we do with the waste? (Compost or throw away cartons.) Draw a picture of a trash can.
2. "Where are the energy input pathways?" (Gas and electricity to run farm equipment, diesel to run the truck, electricity for the milk factory, diesel for the store truck, electricity for the store refrigerators, gas for our car, electricity for our house and refrigerator.) Draw fat arrows with different color leading into trucks, stores, factories, equipment.
3. What can you do with milk cartons when you're finished with them?

Activity 2 – Thinking About Consumption

Now that we know how to think about the energy used in products' lifecycles, we can start to think about what we can do to reduce the carbon footprint of the things we need and use.

1. In our earlier lesson about energy sources, we learned about the connection between greenhouse gases and different fuels. "Do you remember which sources created greenhouse gases?" (Diesel, gas, oil, coal, wood, biomass.)
2. "How can we change the energy pathway of production and distribution of products to reduce air pollution?" (Shorten the pathway between production and distribution i.e. take out some of the steps such as using recyclable paper rather than cutting more trees, use renewable ,non-polluting energy sources such as wind, solar, geothermal, and hydroelectric power, use recyclable materials etc. using natural light or compact fluorescent lights in the factory, workers could carpool or telecommute to work, reduce packaging.)
3. As a society we can think about the energy sources available to us and how to reduce our reliance on these carbon-based fuels. But we can also do things everyday to reduce the carbon footprint of the things we need. The United States consumes more per person and throws away more than any other country on the planet. We can ask ourselves four questions (write on board):
   - **Do I need the new thing** or could I use something I have?
   - **Can I shrink transportation in the lifecycle?** (Get food from a source closer to home like farmers markets rather than supermarkets, walk or bike to pick up.)
   - **Can I avoid waste?** (Don't leave the milk out to spoil, or throw away partially used paper.)
   - **Can I recycle to avoid the first part of the lifecycle?** (Paper or plastic recycling.)
4. All of these actions will reduce the carbon emissions from the things you use. Reducing consumption and recycling will also remove waste from landfills and avoid air pollution emissions.
5. We're going to work in small groups to do lifecycles for some other products we use and ways to reduce their carbon footprint. Working in pairs or groups of 4, please think of something you use everyday and draw its product lifecycle and energy input pathways like the diagrams we've been doing together. Remember to include all the product lifecycle stages: gathering raw materials, manufacturing, distribution, use, and disposal. At the bottom of the page answer the four questions we just discussed for your product.
6. Once you feel your students are comfortable with the energy pathway concept, pass out poster or butcher paper and markers or color pencils to each group. As the students work on their energy pathways, visit each group to be sure they understand the concept.
7. Once completed, ask one group to share their energy pathway product lifecycles and ideas for reducing the carbon footprint with the rest of the class. After the first group has presented, ask if any other group has any steps to add to the process. All the groups should have a chance to add missing steps. Prompt students to explain the linkages in their energy pathways and ideas.

Assessment

Look for understanding of all the stages in the product lifecycle, energy input pathways, and answers to the four questions in students' posters. Evaluate the groups' ideas for reducing the carbon footprint of the pathway and their use of vocabulary from the lessons.

Extensions

1. How Far does Your Food Travel? (Could be a homework assignment) – Students bring in one piece of fruit/vegetable and explain its travel "history." Tell students to look for produce that is labeled in terms of where it comes from or ask a store clerk. Ask students to locate the place of origin on a map. Calculate the number of miles that item has traveled from field to grocery store. Create a "Passport" for your produce item. Include an energy pathway for a processed food item including all the inputs and other processes used for that food item-for example, are fuel-burning tractors or other equipment used? Is the item roasted or processed somehow? Is the item packaged? After students complete this assignment (either individually or in groups), they should share their pathways with the rest of the class and develop strategies that they could use to help reduce the air pollution associated with these food items (grow fruits and vegetables at home or school, go to a Farmer's Market for locally grown produce).
2. Make a poster - What can YOU do to reduce your Food Carbon Footprint?" Some ideas: grow some of your own food such as strawberries, carrots, lettuce etc. in a home or school garden; buy from a farmer's market where food is local and in season, thus not trucked or shipped long distances; buy food or products with little or no extra packaging; bring your own bag to the grocery store to fill up; pack your lunch in a reuseable bag; and combine trips i.e. going to the store and library all in one trip.
3. Visit a Farmer's Market and make a list of foods that are available there. Include the month and season you visited. Talk to one of the growers to find out how far the food traveled to get to this market and how many day before the market it was picked. Go to your local grocery store and talk to the produce clerk, find out how far the bananas, or other food item, traveled and when it was picked. Report back your findings to the class.

Calculate Your Carbon Footprint

Students inspire their households to adopt changes to reduce emissions associated with their lifestyles. View the online footprint calculators listed below to create a handout that includes the questions from the calculators. Ask students to work with their parents to complete the handout and to use the information they've gathered to enter in the online calculator and record the results. Look over the "take action" calculator and ask students to think about which actions they could try. Have them write an ecological footprint pledge to take home and discuss with their parents about making changes.

Ecological footprint calculator: http://www.earthday.net/Footprint/index.asp
Take action calculator: http://www.earthday.net/Footprint/english/take_action.html

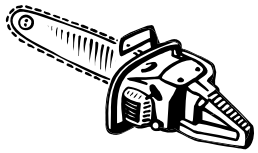
Name_____ Date:_____

Thinking About Consumption

Lesson 10, Handout 1

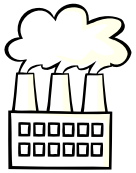
START HERE

Fossil fuels used to power the chainsaw, as fuel for transportation, and energy for electricity and manufacturing.



Trees cut down

Logs transported



Paper manufacturing

Paper transported to store

Paper purchased

Paper used

Paper disposed or recycled

THE PRODUCT LIFECYCE OF PAPER

Estimated Time: 30 - 45 minutes per day for four days

Objectives:

- List types and amount of garbage generated in the classroom and develop strategies to reduce waste.
- Understand and be able to define and implement the concepts of the 4 R's: Reduce, Reuse, Recycle, and Rot.

CA State Standard Connections:

4th Grade Investigation and Experimentation
Students will measure and estimate the weight, length, or volume of objects.

5th Grade Investigation and Experimentation
Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.

Tool Kit Materials:

- Hanging scale to weigh waste materials
- Handout 1 (one per group)
- Handout 2 (one per student)

Additional Materials:

- A one pound weight or an object that weighs one pound(i.e. butter, bag of coffee)
- Student Journal
- Plastic gloves

Class Waste Audit

Reducing the amount of waste sent to the landfill helps protect the climate. In this five-day lesson, students will evaluate the amount of waste that they produce and develop strategies to reduce waste generation in the classroom and elsewhere.

Key Words

Waste: items thrown away and not used again.

Reduce: using fewer products and materials in our daily lives.

Reuse: to use again.

Recycle: collecting and processing products into new or different products.

Rot or Compost: natural decomposition of organic matter (grass clippings, food scraps, leaves) which can be used to enrich the soil.

Preparation

Review Lesson 11 Background material for an overview of waste and climate change. Start the lesson on a Monday. Ask the custodian not to empty your class' wastebaskets or recycling bins during the four-day lesson. At the end of each school day, have students collect the trash in a large paper or plastic bag and the recycling in a separate bag, so that it is not collected by the custodian by mistake. This also insures that the wastebaskets start empty each school day. Remind students to use only the wastebasket(s) in their classroom. Food waste should be put in a separate wastebasket and collection bag.

Make copies of Handout 1 (two sided) and Handout 2 (two sided). Complete the Setting the Stage and Activity 1 on the first day of the lesson, and on the second day begin the Waste Audit. Decide whether you will complete the activity on Friday or count and weigh Friday's trash and recycling and do final calculations on Friday or the following Monday.

Procedure

Setting the Stage

- Tell students they are going to monitor the amount of trash and recycling generated by the class for one week and see if they can lower the amount of waste using the '4 R's' strategies. Since they now have a better idea of how the pathway of energy for a product, such as paper, creates greenhouse gases, they are better able to understand how their choices as a consumer can make a big difference in slowing the rate of global warming.
- Discuss the following:
  - "First of all, what is a consumer?" Somebody who purchases material goods.
  - "How many of you are consumers?" All
  - "What are some of the things you purchase, consume?" (Clothes, toys, food, entertainment (-i.e. tickets to movies, ballgames, transportation, books, lessons.)
  - "As a consumer, what can you do to reduce the production of greenhouse gases generated by the things you consume?" (Reduce the amount I buy, or the amount I travel. Reuse things like water bottles. Recycle paper and plastic. Compost my food scrap and lawn clippings.)

On the chalkboard draw a "t" chart, and label as 'things we throw away', and how many. Have students make the same 't' chart in their journals.

- During the exercise students will estimate what is thrown away or recycled and how much it weighs. Pass around a few objects that weigh a quarter pound, half pound, one pound. Allow each student a few seconds to feel the weight of the object. Tell students that the object weighs one pound. This will help them estimate the weight of different objects.
- "Using the name column in 't' chart in the journals or on the board, list items that might be thrown in the class wastebaskets during the week. In the 'number' column, list the estimated number that will be thrown away of each type of item on the list. After completing the 't' chart, have them add up the estimated weight to get the estimated total weight of the trash that they think their class will generate in one week.
- If your class already recycles, still do the activity, but remember to weigh the recycled materials separate from the wastebaskets on the first day, as well as the following days.
- Ask students to share their lists with the class and compose a class list. Elicit the fact that the listed items can be put in the following categories: food scraps, plastic, paper, glass, metal, cardboard, other. Items that don't fit the other categories, such as crayons, or items made of more than one material such as pencils.
- Tell the students that the categories they have come up with are the same categories that waste disposal agencies and sites use to sort waste.

Activity 1 - Investigating our Waste

1. At the beginning of the school day on the first day of the activity, be sure to tell students to only use the classroom's wastebasket(s) this week for everything they throw out, except for food waste which will be put in a separate designated wastebasket.
2. Divide the class into groups of three. Provide each group with a copy of Handout 1. Explain that each group will write down items they remember throwing away during the day in the chart on Handout 1. They will categorize their items of trash as paper, glass, metal, plastic, food, or other for items composed of materials that cannot be easily categorized. For example, if a group threw out a total of four milk cartons, they would write the number 4 in the 'other' column, since milk cartons are made from paper infused with a wax.
3. Have students calculate the percentage for each type of waste on Handout 1 by dividing the number of items by each waste type by the total number for all waste types. For example, if a group counted 12 pieces of paper and the total number of pieces of waste was 36, then the percentage is 12 divided by 36, or 33% of the group's waste.
4. Finally, have groups answer the questions at the bottom of Handout 1.
5. Engage the class in discussion by asking them the following:
   - What does the chart tell us about our class' waste?
   - Was there anything thrown away that could have been used again? (Paper could be used on both sides before it is recycled. Plastic sandwich bags can be washed and reused.)
   - Was there anything thrown away that could have been recycled? (Paper, glass, metals, and plastics can be recycled.)
   - Was there anything that could have been composted? (Food items and paper towels can be composted. Fruit and vegetable food scraps can composted in a school or home compost bin or compost pile.)
   - Are there other ways that we can reduce the amount of waste that we throw out? (Use re-usable water bottles instead of disposable bottles, etc. Bring a handkerchief instead of using tissues.)
6. Remind students to only use the classroom's wastebasket(s) this week for everything they throw out, except for food waste which will be put in a separate designated wastebasket.

Activity 2– Class Waste Audit

Tuesday, Day 2:

1. Distribute a copy of Handout 2 to each student.
2. Tell the students they are now going to find out how much waste their class generated on Monday. Set up the hanging scale. Take the garbage bag(s) filled with yesterday's waste and weigh them. Weigh an empty garbage bag and subtract the weight of the empty bag from the weight of the garbage bag(s) filled with yesterday's waste. Have students record the weight of the waste, minus the weight of the empty bag, on the chart in Handout 2.
3. If the classroom also collects recycling, have students repeat the above steps with the recycling container. Weigh an empty recycling container and record the weight. Weigh the recycling container with the recycling materials and subtract the weight of the empty container. Record the weight of the recycling material on the chart on Handout 2.

4. Engage students in a discussion by prompting them with the following:
   - What does the handout tell us about our class' waste?
   - What are some things we can do to reduce the weight of the trash? (Use both sides of paper before throwing it out, reuse plastic bags, set up recycling bins.)
5. Remind students to only use the classroom's wastebasket(s) for everything they throw away, except food, for the remainder of the day.

Wednesday, Day 3:

6. Analyze Tuesday's waste and dispose of it before Wednesday's waste is added to the waste bin. Repeat the steps of weighing and recording the trash and the recycling. Have students record their findings on the chart in Handout 2.
   - Ask students, are you doing anything differently today to reduce the amount of waste?
7. Collect Handout 2 from students to keep until the next day's activity. Remind students to only use the classroom's wastebasket(s) today for everything they throw away except food.

Thursday, Day 4:

8. Analyze Wednesday's waste and dispose of it before Thursday's waste is added to the waste bin. Repeat the steps of weighing and recording the trash and recycling. Have students record their findings on Handout 2 and calculate an average daily weight for trash and recycling.

Friday, Day 5:

9. Analyze Thursday's waste and dispose of it before Friday's waste is added to the waste bin. Repeat the steps of weighing and recording the trash and recycling. Have students record their findings on Handout 2 and calculate an average daily weight for trash and recycling.
10. Calculations of average daily weight can be done later in the day on Friday or on the following Monday.
11. Have the students complete the questions for Handout 2.
12. Encourage discussion by asking students the following questions:
    - What was the difference in the amount and type of waste we collected on Monday compared to the waste we collected on Friday?
    - Did we reduce the amount of waste that went into the waste bin? By how much? Was it easy to do? Why or why not?
    - What can we do at home to reduce waste?

Assessment

Have students answer the following questions in their journals:

- "Do you think our class can maintain or improve on our efforts to reduce waste or do you think we will go back to the weights and numbers on the first day of the Class Waste Audit? Why or why not?"
- "What surprised you the most about our findings from the Class Waste Audit?"

- Draw a Venn diagram comparing the classroom waste with what you would expect to find from your home wastebaskets.

Extensions

1. Home Waste Audit Project - Students perform a waste audit at their homes. Provide students with a table similar to Handout 2 and allow students to conduct the audit over a week's time. Students use a bathroom scale to weigh their home's trash. At the end of the week students report their findings and share the ways they were able to reduce, re-use, recycle and rot (compost) in their homes.

2. Learn about the Life of Garbage - Begin by leading a discussion with students about where garbage goes once it is thrown away. Ask students to use their observation skills to determine on which days garbage is picked up from the school and how much is taken away. If garbage is picked up during school hours, organize the students into teams to conduct quick spot interviews with the garbage collectors about their work, where they are going and where they have been, and the composition of school garbage. Interviews could also be conducted with custodial or janitorial staff about their work and about garbage disposal. Ask the students to report on what they have learned from their interviews. Organize a class field trip to a local dump or landfill.

Develop a School Waste Reduction Plan

Obtain for the students the school's monthly disposal fees. Lead students in conducting waste audits at different times of day for classrooms, the cafeteria, and other spaces to examine the amount and composition of the garbage. Guide students in creating a graph that charts the school's monthly garbage production/disposal over a few months. The graph can also include a pie chart illustrating the percentage of recyclable, compostable, and reuseable items that are in the trash. Ask students to develop a school waste reduction plan. Ideas include: launching salad bar programs filled with local produce from neighboring farms, school gardens and implementing a composting program. Using the resources found in the links below, create a program appropriate for your students and school resources.
Guidelines and resources for school food projects: http://www.eecom.net/mfsp/guide.html
Waste emissions calculator:
http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html

NAMES:_____ DATE:_____

Class Waste Audit

Lesson 11 Handout 1

Class Waste Analysis

What did you throw away at school today? Use the chart below to count up the number of pieces of each waste type your group threw away. Next, calculate the percentage of each waste type for the total amount of waste that you threw away. Finally, answer the two questions at the bottom.

Paper: Notebook paper, newspaper, copy paper, paper bags

Glass: Glass bottles, jars

Plastic: Bags, wrappers, bottles, containers

Cardboard: Boxes

Metal: Aluminum cans, aluminum foil, tin cans

Food items: Food scraps like apple cores or orange peels

Other: Items made of more than one material that cannot easily be separated, like milk cartons or pencils

Waste Type	Paper	Card-board	Glass	Metal	Plastic	Food	Other	Total
Number of pieces thrown out today								
Percentage of what we threw out today								**100%**

1. Which material did your group throw away the most?_____

2. Which material did your group throw away the least?_____

NAME:_____ DATE:_____

Class Waste Audit

Lesson 11 Handout 2

Record the weight of trash and the weight of recycling from each day's collection in the chart below. After you have weighed the trash and recycling for all five days, calculate the average daily weight for the trash and recycling. Then, answer the questions at the bottom of the page.

Weight of Trash and Recycling

Day	Weight of Trash	Weight of Recycling
Monday's Waste		
Tuesday's Waste		
Wednesday's Waste		
Thursday's Waste		
Friday's Waste		
Average daily weight		

1. Did the weight of the trash increase, decrease, or stay about the same throughout the five days of weighing trash?

Trash: _____ Recycling: _____

2. Why do you think it increased, decreased, or stayed about the same?

Trash: _____

Recycling: _____

3. What are some things we can do to help reduce the amount of waste that we throw away at school?

_____

Recycling and the Climate

Estimated Time: 1.5 hrs

Objectives:
- Know that recycling saves energy, prevents greenhouse gas emissions, and promotes resource conservation.
- Understand that products made with recycled content require less energy to produce than products without recycled content.
- Identify strategies for waste reduction through recycling.

CA State Standard Connections:

4th Grade Number Sense

4th and 5th Grade Statistics, Data Analysis:
Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings.

5th Physical Science:
Each element is one kind of atom, organized in Periodic Table

Tool Kit Materials:
- Overhead of Handout 1
- Handout 1 (for half the class)
- Handout 2 (one per student)

Extension Materials
- 2 plastic bins
- Junk mail or recycled office paper
- 2 small plastic grid screens
- 2 pieces of felt
- 2 pieces of felt
- Blender
- Strainer

Recycling saves energy and prevents greenhouse gas emissions. In this lesson, students will learn about the benefits of recycling paper and compare the energy usage in recycling versus disposing of waste in landfills.

Key Words

Raw Material: material in its natural form that is used to make products.

Recycled Content: amount of recycled material in a new product.

Preparation

Review Lesson 12 Background for an overview on the impacts of recycling on energy consumption and climate change. Precede this lesson with Lesson 11. Before you make paper with the class, set up the materials and do a trial run. Prepare an overhead of Handout 1. Delivering these facts without the use of additional paper will model the behavior you want and promote listening and notetaking skills.

Procedure

Setting the Stage

- Begin by asking the class what kinds of things they recycle at home. (Aluminum cans, paper, plastic bottles, etc.)
- Ask the class what they think happens to each item after it is recycled. (Cans are melted down and generally made into new cans.)
- Discuss reasons why we would want to recycle items instead of just making new ones from 'new' materials. (Recycling saves energy and **raw materials**.)

Activity 1 – Benefits of Recycling

1. Project Handout 1 onto the overhead screen. Ask one student to read out loud the opening paragraph on the handout. Ask students in the class to read out loud the different facts. Discuss these as you go and ask students to write facts in their journals.

Have students answer the following question in their journal: After looking at the information about recycled paper, what surprises you the most? How much of a difference do you think recycling paper will make in climate change? Explain your thinking.

2. Engage the students in a discussion about paper recycling by reviewing the product lifecycle for paper done in lesson 10. Ask the following questions:
   - "Now that you have looked at some of the statistics about paper and reviewed its energy path, why do you think many people still do not recycle paper products? (Answers will vary.)
   - "Do you think making recycled paper is easy or difficult? Why?
   - "What can be made out of recycled paper?" (More paper can be made from recycled paper.)
3. "Paper made with recycled content needs much less energy to produce than paper from new wood material. What other benefits do we get from using recycled paper? Think in terms of greenhouse gas emissions" (Trees absorb CO_2 from the atmosphere. Cutting down less trees allows more CO_2 can be absorbed.)
4. "Besides recycling, what are some other ways we can prevent more trees from being cut down to make paper?" (We can use less paper by using computers, internet, overheads and use both sides of paper.)

Activity 2 - Making Recycled Paper

Paper-Making Project. In this project, students will make new paper from recycled paper:

- Have each student shred the equivalent of 2 to 3 pieces of used paper into thin strips.
- Take one cup of the paper and add to blender with 1 cup of water. Blend the mixture.

- Add the mix from the blender to a second large plastic bin. Dip a screen into the paper water. You can put string, glitter, or other decorative items on the screen at this point.
- Take another screen and squeeze the water out by placing it on top of the first screen and lifting it out of the bin, sandwich style.
- Next, take the sandwiched screens and place on one piece of felt; place another felt piece on top. Roll out the excess water.
- Transfer the paper onto a piece of newspaper and let dry; repeat process until there is a new piece of paper for each student.

Activity 3 – Calculating the Energy Savings from Recycling

1. Distribute one copy of Handout 2 to each student and review the table together.
   - "Which recycled material saves the most energy?" (Aluminum.)
   - "Why do you think this is the case?" (The extraction, mining, and manufacturing of raw materials to make new aluminum cans is significantly more energy intensive than the processes to make the other new products.)
2. Assist students in completing the handout as needed.

Assessment

In their journals, have students respond to the following questions: What do they think is easiest for them to recycle and why? What is most difficult for them to recycle and why.

In a class discussion, have students share what is most difficult and what would need to happen to make it easier to recycle those items/materials. Brainstorm additional ways to improve ease of recycling.

Extensions

1. Field Trip – Visit the local recycling center to take a tour and learn about what is and is not recycled in your area and how it is recycled.

2. Have your class collect materials and make recycled art projects.

Start a School Recycling Program

If the school does not have one yet, start a school recycling program. Guide students in communicating and working with office and custodial staff to assess current levels of solid waste. Lead students in researching the community's local recycling resources and coordinating recycling pick-ups at the school. Discuss with students ideas for other creative recycling programs such as recycling the library's unwanted books; electronic recycling for old phones, batteries, and computer parts; and encouraging the school to purchase paper and class equipment made from environmentally friendly recycled materials. Work with students to develop and implement a school outreach campaign to launch the program.

NAME:_____ DATE:_____

Recycling and the Climate

Lesson 12 Overhead

Most recycled paper is made back into paper and paper products. For example, recovered copy paper can be used to make new recycled copy paper. Recycled paper can also be molded into egg cartons, insulation, paint additives, and roofing. Even cat litter can be made from recycled paper!

Did you know[4]**...**

- The world's first piece of paper was made from recycled material. Around 200 B.C., the Chinese used old fishing nets to make the world's very first piece of paper.
- Americans recycle over **51%** of all the paper they use. Paper recycling now averages **346 pounds** for each person in the United States.
- In the United States, we use enough office paper each year to build a 10-foot-high wall that's 6,815 miles long, or two and a half times the distance from New York to Los Angeles.
- More than **90%** of the printing and writing paper made in the United States is from new (non-recycled) wood material.
- The paper industry is the **second largest industrial consumer of energy** in the United States.
- One ton of computer paper made from new wood material uses **24 trees**. One ton of newspaper from new wood material uses **12 trees**. One ton of magazine paper from new wood material uses a little more than **15 trees**.
- Producing recycled paper requires about **60%** of the energy used to make paper from new wood material.
- Recycling one ton of newspaper saves the equivalent of **100 gallons of gasoline** when taking into consideration the lifecycle emissions of producing paper from raw materials.

[4] *The facts come from the Technical Association of the Pulp and Paper Industry (TAPPI) www.tappi.org, and from Metro, http://www.metro-region.org/article.cfm?articleid=5574.*

NAME:_____ DATE:_____

Recycling and the Climate

Lesson 12, Handout 2

Recycling saves energy and protects the climate. By recycling, we reuse materials instead of using raw materials to make new products. Raw materials are materials that are extracted from the environment to make products we use in our daily lives. For example, ore is mined from underground as a raw material to make aluminum cans; and trees are cut down from forests as a raw material to make paper for newspapers and magazines. Using raw materials for manufacturing products usually requires a lot more energy by burning fossil fuels, which creates greenhouse gas emissions, than using recycled materials.

The table below shows the amount of greenhouse gas emissions, in CO_2e units, saved when a product is manufactured from using recycled materials instead of raw materials.

Greenhouse Gas Emissions Created From Manufacturing Products with New Materials Compared to Using Recycled Materials[5]

	A	B	C
One ton (2,000 lbs) of product	Pounds of CO_2e emissions from manufacturing product using raw materials	Pounds of CO_2e emissions from manufacturing product using recycled materials	Pounds of CO_2e emissions saved from using recycled materials instead of raw materials (A-B)
Example: Glass	*1,051*	*728*	*323*
Tires	8,811	3,638	
Phonebooks	5,497	3,395	
Newspapers	4,688	2,748	
Plastic	4,527	404	
Aluminum Cans	28,535	2,263	

[5] *Adapted from EPA report, "Solid Waste Management and Greenhouse Gases Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks" http://www.epa.gov/climatechange/wycd/waste/SWMGHGreport.html*

1. Fill in Column C to determine the amount of greenhouse gas emissions saved by using recycled materials instead of raw materials.

Which material has the largest CO_2e savings when made with recycled materials?

_____

2. Why do you think using recycled aluminum cans to make new aluminum cans creates less greenhouse gas emissions than making cans from raw materials?

_____

_____

3. If your city recycled all its unused phonebooks, instead of throwing them in the trash, how much greenhouse gas emissions would be saved? Assume all the phonebooks in your city have a total weight of 4 tons (8,000 lbs).

_____

_____

Bonus Activity: Look at the paper lifecycle diagram from Lesson 10, Handout 1. At what steps would greenhouse gas emissions be saved if recycled paper, instead of raw materials, were used to make new paper?

_____

_____

_____

Composting Benefits

Estimated Time: two 45-minute lessons, 1.5 hr total

Objectives: Students will

- Describe what happens to green waste after it is collected from their home or school..
- Identify the major components of a compost bin
- Identify the two major gases emitted from a landfill and their carbon dioxide equivalents.
- Explain the difference between a landfill and a transfer station

CA State Standards:

4th Grade Investigation and Experimentation

5th Grade Investigation and Experimentation

Tool Kit Materials:

- Thermometers (one per group)
- Handout 1 (one per group or an overhead transparency)
- Handout 2 (one per student)
- Handout 3 (one per group or an overhead transparency)

Additional Materials:

- Scissors
- Permanent marker
- Clear packing tape or masking tape
- Green leaves/grass clippings
- Brown leaves or straw
- Spray bottle/s for water

Adapted from the Plant to the Home less in Energy for Keeps: Electricity from Renewable Energy, Energy Education Group, www.energyforkeeps.org.

Landfills generate potent greenhouse gases as waste decomposes. Composting can decompose the same waste without generating methane, a potent greenhouse gas. In this lesson, students investigate the breakdown of waste in a landfill and in a compost pile, calculate the greenhouse gas emissions from each process, and compare the relative impacts on climate change.

Key Words

Landfill: large outdoor area , usually specially constructed, where waste is dumped and buried.

Decomposition: breakdown of organic materials by bacteria and other decomposers, fungus and insects.

Composting: process of collecting organic waste and letting it decompose naturally through aerobic decomposition.

Aerobic: decomposition in the presence of oxygen

Anaerobic: decomposition in the absence of oxygen

Methane: a greenhouse gas created by anaerobic decomposition.

Preparation

Review Lesson 13 Background for an overview of the lifecycle of waste and greenhouse gas emissions from waste disposal. Review the Handouts prior to teaching this lesson.

The Discussion section of this lesson will need to be conducted in two parts, the first part before lunch and the second part after lunch or the next day. Decide how best to collect students' lunch scraps in a bucket or a waste basket lined with a plastic bag. For example, students can bring all lunch scraps back to the classroom after lunch.

For Activity 2 you will need to prepare and build a sample composter before teaching this lesson, if you are planning to use the soda bottle composter rather than deli containers. See Handout 3 for list of materials to collect for Activity 2.

Procedure

Setting the Stage

- Begin by asking students if they know where garbage goes after we throw it away.
- "Has anyone ever been to a transfer station or a landfill? What was it like?" (Most students will call the transfer station, 'the dump,' thinking it is one and the same. Very few people are allowed at landfills anymore, except in some rural communities. However, they can take their waste to a transfer station.)

Show students images of Landfill, Transfer Station, and Recycling Facility. Images on CD or can be printed from CD onto an overhead transparency.

- Look at the images to help students get a sense of the amount of trash, waste generated by people in their community and what a difficult problem it is to deal with.
- "Where do you think our trash goes when the landfill becomes full?" (Another landfill further away, out to the ocean.)
- In our own classroom audit, we found some food and other organic garbage that decomposes over time. How this material decomposes makes a big difference in the carbon emissions from waste. In this lesson we're going to look at why composting is especially important in reducing carbon emissions from waste disposal.

Activity 1– Lifecycle of Waste

1. Project Handout 1 showing the Lifecycle Emissions of a Product. Remind them that this is like the product lifecycles they worked on earlier but written in a general way for any product.
2. "How do all the product lifecycles end?" (Landfill disposal or recycling.) Pass out Handout 1 to each student. Have students look at the Landfill Lifecycle Stage on the handout. Discuss the following points and questions:
   - There is a new emission on this general product lifecycle. The symbol CH_4 stands for methane. The symbol tells us that methane is made of what elements? One carbon atom and 4 hydrogen atoms.
   - **Methane** (CH_4) is a greenhouse gas that is 21 times more effective at trapping heat in the atmosphere than carbon dioxide. Methane is produced when microorganisms living in anaerobic conditions break down organic wastes. **Anaerobic** means the absence of oxygen.
   - There is little or no oxygen in a landfill because waste is buried under soil and other waste. The anaerobic bacteria who can live in these conditons decompose the waste and methane is emitted.
   - Our diagram shows that organic waste could go to be composted instead of the landfill. In a compost pile a different kind of decomposition takes place. A compost pile sits in the open air and is aerated, mixed or turned over to allow oxygen in, which means **aerobic decomposition** can take place by aerobic bacteria and other decomposers like worms and bugs.

- **Aerobic composting does not produce methane.** About 90% of carbon in a compost remains locked up, or sequestered, leaving less than 10% to be converted to carbon dioxide by decomposers such as worms and bacteria.

Ask questions to make sure students understand and them ask them to write these answers in their Journals.

- "At what point in the lifecycle of waste is methane produced?" *Methane is generated in the landfill.*
- "What are some differences between the landfill lifecycle and the composting lifecycle?" *The compost produces CO_2, not methane.*
- How can we reduce methane emissions? *Throw away less and compost what we can.*

3. Distribute one copy of Handout 2 to each student. Ask one student to read the handout's sidebar out loud. To ensure comprehension of key concepts, ask the following:
   - How many times more powerful is methane to carbon dioxide in trapping heat in the atmosphere? *Methane is 21 times more powerful than carbon dioxide.*
   - *What is the CO_2 equivalent of methane? The CO_2e of methane is 21.*
4. Explain to the students that after lunch they will calculate how much lunch waste the class generates. Emphasize that students will need to place all lunch food scraps in the bucket after lunch.
5. Next, weigh the bucket that you will be filling with food scraps and write that figure on the board.
6. After lunch have all the students place their food scraps into the bucket. Once the food scraps are collected, weigh the bucket.
7. Subtract the weight of the bucket from the weight of the bucket with the food scraps to get your result. Explain to the students that this is the amount of pounds of food waste we as a class threw away from our lunch today. Now, using Handout 2 the students are going to calculate effect of food waste on climate change in a landfill and a compost pile.
8. Have groups brainstorm a list of ways to cut down on the food waste generated by the class and share the results.
9. Share journal responses and elicit from the class that they generate much less waste if they bring only what they will eat each day. If no food waste is generated then no carbon dioxide is emitted into the air because there is nothing to compost. Even the 10% carbon dioxide from the natural carbon cycle is not emitted.
10. To find out how much CO2e could be prevented by the entire class if they composted all food waste for one year, add up each student's answer to question #6 of Handout 2 on the chalkboard. Next, have students complete the 'Bonus Questions' at the bottom of the handout and then share the answer with the rest of the class.

Activity 2– Build a Composter

1. Divide students into groups of 2 –3 and assign a number to each group. Distribute a copy of Handout 3 to each student. Explain that to help in the investigation of landfills and composting, students will build a composter.

2. Read Handout 3 out loud so that students understand the procedure for building the composter. Pass around the composter you built prior to class as an example. Next, distribute the materials required to build the composter to each student. Have students write their group's number on the containers.
3. Have students set up a series of tests using the scientific method to find out which composts/rots the fastest, slowest, most/least completely. Brainstorm a list of variables their group might test. Remind them that only one variable can be changed for each group to ensure accurate test data. Examples of compost samples to test:
   - Container sealed and not opened until the end of the experiment (no air).
   - Container left open to air with nothing additional added over the course of the experiment (This will be your control sample).
   - Holes punched into the lid of the closed container, to enable the container to be shaken or rotated each day to aerate the contents. Nothing additional added over the course of the experiment.
   - Holes punched into the lid of the closed container, to enable the container to be shaken each day to aerate the contents. Contents sprayed with additional water every 4-5 days before the container is shaken or rotated.

Reminder: Look at Standards for Investigation and Experimentation for your grade level.

4. Students will need 5-15 minutes to build their composters depending on whether you use the plastic deli containers or build the 'bottle composter.' Check in with students to ensure they properly complete the procedures on Handout 1.
5. Collect the composters from students and place somewhere in the classroom that does not get direct sunlight. Ask students, "What do you think will happen in the composters over the next three weeks?" (The food waste will decompose, rot.)
6. Over the next three weeks be sure to provide time for students to check on their composters and record changes.

Extensions

1. Students write a letter or create a pamphlet to show their parents or others how composting can reduce climate changing greenhouse gas emissions and/ or instructions on how to start a backyard composter. If your local waste disposal district does not compost food waste, write a persuasive letter and send it along with the pamphlet, to the Sanitary District Board with your recommendations, backed by facts.

Pack a No Waste Lunch

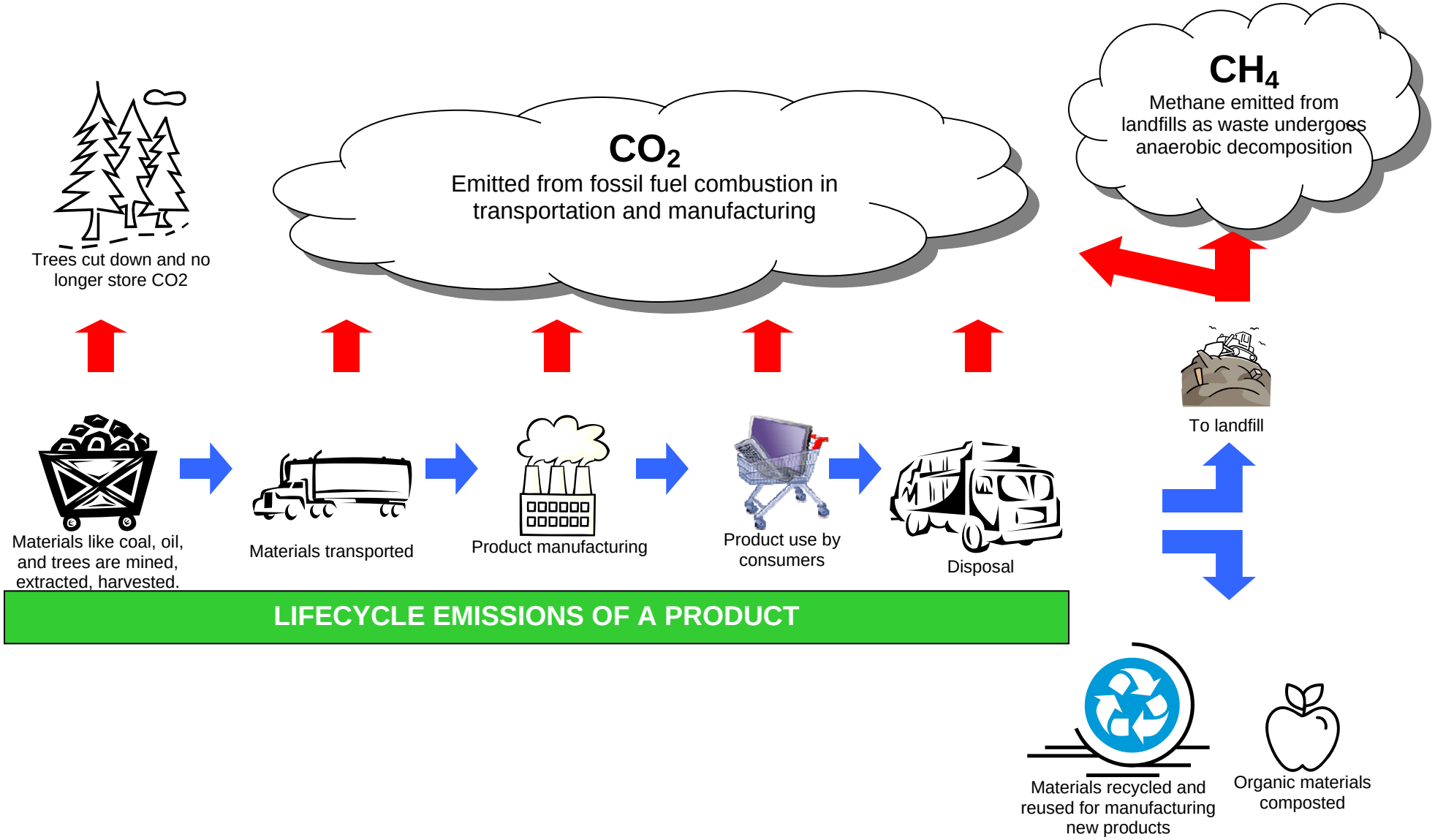
Packing a lunch in reusable containers can actually be cheaper than buying packaged foods, and generates less waste. By putting on a "no-waste" lunch day, this project can inspire students and parents to creatively reduce lunchtime waste. Create a tip-sheet for parents on how to make a no-waste lunch. For example, use a lunch box with reusable containers, include a cloth napkin, don't pack plastic silver wear, and use a thermos or water bottle instead of packaged drinks and soups.

Tips for a no-waste lunch: http://www.recycleworks.org/schools/lunch.html

Name:_____ Date:_____

Composting Benefits

Lesson 13, Handout 1



NAME:_____ DATE:_____

Composting Benefits

Lesson 13, Handout 2

A byproduct of anaerobic decomposition is "landfill gas", which contains approximately 50 percent methane and 50 percent carbon dioxide with small amounts of nitrogen and oxygen.

Methane is a powerful greenhouse gas. One molecule of methane traps as much heat in our atmosphere as 21 molecules of CO_2.

Scientists use a standardized unit called the carbon dioxide equivalent, or CO_2e when they measure greenhouse gasses. They estimate that about 1 pound of CO_2e is released for every pound of food waste in a landfill. This number includes the impact of both methane and carbon dioxide emissions.

If the same food waste goes to a compost pile, less than 10% of the carbon will be converted into CO_2 through aerobic respiration. The rest of the carbon remains locked up in the compost. The CO_2 that is released is considered part of the natural carbon cycle.

Does your food waste affect climate change?
Read the sidebar on the left of the page and answer the following questions.

Part 1. In the Landfill

1. How many pounds of food waste did you and your class throw away from lunch yesterday?
_____ lbs

2. Multiply this number by 7 to estimate one week's worth of food waste in pounds:

$$\frac{\text{lbs}}{\text{day}} \times \frac{7 \text{ days}}{\text{week}} = \frac{\text{lbs food waste}}{\text{week}}$$

3. Scraps and peeling from preparing meals also goes to the landfill. For the purposes of this activity, we will estimate that preparation waste is approximately 1/5 of the weight of the prepared food. To find the weight of the scraps and peelings divide the number of pounds of food waste for one week by 5.

$$\frac{\text{lbs}}{\text{week}} \div 5. = \frac{\text{lbs scraps \& peelings}}{\text{week}}$$

4. Add the weight of the food waste for one week to the weight of the prep waste (scraps and peelings) for one week to find a total weight of waste transported to the landfill.

$$\text{lbs Of lunch waste} + \text{lbs prep waste} = \text{lbs food waste Total}$$

5. For every pound of food that is transported to a landfill and then decomposes in the landfill, 1 pound of CO2e is released. Multiply your answer in #4 by 1 lbs to find out how many pounds of CO2e are produced by one week's worth of food waste in the landfill:

$$\frac{\text{lbs food waste}}{\text{week}} \times \frac{1 \text{ lbs } CO_2e}{1 \text{ lbs food waste}} = \frac{\text{lbs } CO_2e}{\text{week}}$$

Part 2. In the Compost Pile

6. A compost pile has zero net emissions – any CO_2 emissions from aerobic composting are considered part of the natural carbon cycle and are not counted as greenhouse gas emissions. Therefore, how much CO_2 equivalent would you **keep out** of the atmosphere by composting for a week?

_____ (hint: this is the same number as your answer in #5)

7. What if your class composted every day's food waste for a year?

$$\frac{\text{lbs } CO_2e}{\text{week}} \times \frac{52 \text{ weeks}}{\text{year}} = \frac{\text{lbs } CO_2e}{\text{year}}$$

Part 3. Taking it one step Further:

8. Exchanging one standard incandescent light bulb with energy efficient CFL will prevent around 30 pounds of CO_2e from entering the atmosphere each year. Composting your food waste for one year is like changing how many light bulbs? (hint: Divide the answer for # 7 by 30 lbs).

$$\frac{\text{lbs } CO_2e}{\text{year}} \div \frac{1 \text{ CFL}}{30 \text{ lbs } CO_2e} = \text{CFLs saved each year}$$

Bonus Questions

1. How much CO_2e would the whole school prevent in a year if it composted all food waste?

_____

2. Composting the entire school's food waste for one year is like changing how many light bulbs?

_____

NAME:_____ DATE:_____

Composting Benefits

Lesson 13, Handout 3

Composter Materials:

- A piece of fruit with a seed or a peel (banana, apple, peach, orange)
- 1/2 cup of green leaves and grass cuttings
- 1/2 cup of brown leaves or straw
- 2 cups of soil
- 1 cup of newspaper or paper towels torn into small pieces, approx. 1 in. wide or less
- 1 re-useable container with top (plastic soda bottle or clear plastic container
- A permanent marker
- Scissors
- Tape
- Spoon
- Water spray bottle
- 1 thermometer

Procedure:

1. If you are using a plastic soda bottle, measure about 7 inches from the bottom of the bottle and mark with the permanent marker. Draw a line around the bottle at the 7 in. level. Use scissors to cut around this line. Do not cut all the way around! Leave about 1-1 1/2 inches to serve as a hinge for a flip lid.

2. Open the flip lid of the container and add the ingredients in the following order:
   - 1cm of soil
   - Fruit scraps from the student's eaten fruit
   - 1cm of soil
   - Green grass/leaves
   - Brown leaves/straw
   - 1cm of soil
   - Torn up newspaper
   - Fruit scraps
   - 1cm of soil

3. Once the layers have been added, give the surface a quick spray of water. This can be done throughout the experiment as the surface becomes dry over time.

4. Insert the thermometer into each container so that the temperature can be read.

5. Seal the bottle or place the lid on and tape it so it is secure. Draw small lines on the side of the container with a marker to mark the layers of the bottle. Make a note of the initial temperature inside the bottle.

6. Over the next 3 weeks monitor the bottle. Keep daily records of the temperature and changes inside the bottle. You may even start to grow types of mold and bacteria. Be sure to make notes about changes that you see, smell, etc. After 3 weeks use the compost you created as soil for a classroom plant or in your school garden, or in your backyard at home.

Inspiring Change Projects

Calculate Your Carbon Footprint

Students inspire their households to adopt changes to reduce emissions associated with their lifestyles. View the online footprint calculators listed below to create a handout that includes the questions from the calculators. Ask students to work with their parents to complete the handout and to use the information they've gathered to enter in the online calculator and record the results. Look over the "take action" calculator and ask students to think about which actions they could try. Have them write an ecological footprint pledge to take home and discuss with their parents about making changes.
Ecological footprint calculator: http://www.earthday.net/Footprint/index.asp
Take action calculator: http://www.earthday.net/Footprint/english/take_action.html

Pack a No Waste Lunch

Packing a lunch in reusable containers can actually be cheaper than buying packaged foods, and generates less waste. By putting on a "no-waste" lunch day, this project can inspire students and parents to creatively reduce lunchtime waste. Create a tip-sheet for parents on how to make a no-waste lunch. For example, use a lunch box with reusable containers, include a cloth napkin, don't pack plastic silver wear, and use a thermos or water bottle instead of packaged drinks and soups.
Tips for a no-waste lunch: http://www.recycleworks.org/schools/lunch.html

Develop a School Waste Reduction Plan

Obtain for the students the school's monthly disposal fees. Lead students in conducting waste audits at different times of day for classrooms, the cafeteria, and other spaces to examine the amount and composition of the garbage. Guide students in creating a graph that charts the school's monthly garbage production/disposal over a few months. The graph can also include a pie chart illustrating the percentage of recyclable, compostable, and reuseable items that are in the trash. Ask students to develop a school waste reduction plan. Ideas include: launching salad bar programs filled with local produce from neighboring farms, school gardens and implementing a composting program. Using the resources found in the links below, create a program appropriate for your students and school resources.
Guidelines and resources for school food projects: http://www.eecom.net/mfsp/guide.html
Waste emissions calculator:
http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html

Start a School Recycling Program

If the school does not have one yet, start a school recycling program. Guide students in communicating and working with office and custodial staff to assess current levels of solid waste. Lead students in researching the community's local recycling resources and coordinating recycling pick-ups at the school. Discuss with students ideas for other creative recycling programs such as recycling the library's unwanted books; electronic recycling for old phones, batteries, and computer parts; and encouraging the school to purchase paper and class equipment made from environmentally friendly recycled materials. Work with students to develop and implement a school outreach campaign to launch the program.

Ask Local Government to Adopt Best Practices in Waste Management

Across the country, communities have a wide range of recycling, compost and other waste reduction strategies. Students can take a role in pushing their community to adopt better waste management strategies. Investigate what your community is doing, what other communities have done and prepare a presentation to your local city council on what they might change.
San Francisco's composting program: http://www.sunsetscavenger.com/composting.htm
The Bay Area Recycling Outreach Coalition: http://www.bayarearecycling.org/