Starve the Landfill Unit Overview

Grades 3-8

Grade Level:
3-8

Concepts Taught:

Conservation of resources, computation, pie graphs, problem-solving, sequencing

Activity Time(s):
Lesson 1: 15 minutes (lesson); 30 minutes (follow-up)
Lesson 2: 20 minutes (lesson); 30 minutes (follow-up)
Lesson 3: 20 minutes (set up), 20 minutes (lesson)
Lesson 4: 20 minutes (lesson); 20 minutes (follow-up)

Unit Essential Questions:

- What is a landfill?
- How is a landfill constructed?
- How is a landfill and a dump different?
- How much garbage do we throw away in Wake County?
- Are landfills necessary?
- What is a waste stream?
- How does recycling help us?
- What materials are recycled the most?
- What are the purposes of recycling?
- How do I make a circle graph?
- What is a topographical map used for?

NC CORE/Essential Standards:
3rd Grade: ELA: Std 4, 5; Key Ideas & Details 2, 3; Integration of Knowledge 7, 8; Writing Std 4, 8; Speaking/Listening 1; **Math** 3.NBT.1, 3.OA.5, 3.NF.3 ; **Soc Std** 3.G.1.2, 3.G.1.3; **Science** 3.L.2.4
4th Grade: **ELA**: Key Ideas & Details 1, 2; Range of Reading Level Std 10; Writing Std 2; Craft & Structure 5; Writing 5; Speaking/Listening 1, 2, 3, 3.05; **Math** 4.OA.1, 4.OA.2, 4.NBT.4, 4.OA.3; **Soc Std** 4.G.1.2, 4.G.1.3; **Science** 4.L.1.3
5th Grade: **ELA**: Key Ideas & Details 1; **Math** 5.NBT.5, 5NBT.6, 5.MD.1; **Soc Std** 5.G.1.2
6th Grade: **Math** 6.RP.3.c; **Science** 6.E.2.4, 6.L.2.3; **Soc Std** 6.G.1.2, 6.G.1.3, 6.G.1.4, 6.G.2.1;
7th Grade: **Math** 7.NS.3, 7.G.1, 7.G.2, 7.G.4; **Science** 7.E.1.6; **Soc Std** 7.G.1.1, 7.G.1.3, 7.G.2.1
8th Grade : Science 8.P.2.1, 8.P.2.2, 8.E.1.4; Soc Std 8.G.1.2, 8.G.1.3

Unit Objectives:
- Students will utilize reading comprehension skills to read selected articles about solid waste topics and answer multiple-choice format questions
- Students will utilize various computational skills to solve mathematical word problems
- Students will identify common components of a Municipal Solid Waste Stream.
- Students will predict proportions/percentages for each component of Wake County's MSW stream.
- Students will predict proportions/percentages for each component of the United States' MSW stream.
- Students will review and discuss composition of circle graphs.
- Students will extrapolate similarities and differences between the waste stream of Wake County, the United States, and other geographic locations.
- Students will use data to create a pie graph

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Materials:
Lesson 1: **Landfill Reading and Problem Solving**: transparency of recycling article and questions, article about landfills and corresponding questions (included), landfill word problems and answer key (included)

Lesson 2: **Evaluating Waste Streams**: Samples of waste stream graphs (included), sample waste stream data for Anytown, USA (included), protractors

Lesson 3: **Garbage Pizza**: Steel-coated pizza pan or round circle of cardboard (any size), markers, construction paper, protractor, magnets with adhesive backing, small items such as bottle caps, paper clips, play food, etc. for each garbage category:

- paper
- yard waste
- plastic
- metal (paperclip, pop can tab)
- wood
- food waste
- glass
- rubber, leather, & textiles
- other

Lesson 4: **Building a Landfill Model**: Clean, empty 2-liter bottles (one for each group of 4 students), craft foam sheets in blue and brown, scrap materials such as cardboard, plastic grocery bags, polystyrene packing peanuts, cardboard (see diagram for alternative materials list)

Lesson 1: Landfill Reading and Problem Solving: EOG Review Activities

Grade Level:
3-5

Concepts Taught:
conservation of resources, interacting with expository text, problem solving, computation

Activity Time(s):
15 minutes (lesson); 30 minutes (follow-up)

Essential Questions:

- How does recycling help us?
- What items are recycled the most?
- What is the difference between a dump and a landfill?

NC CORE/Essential Standards:
Grade 3: ELA: Std 4, 5; Key Ideas & Details 2, 3; Integration of Knowledge 7, 8; Writing Std 4, 8; Speaking/Listening 1; Math 3.NBT.1, 3.OA.5, ; Soc Std 3.G.1.3; Science 3.L.2.4
Grade 4: ELA: Key Ideas & Details 1, 2; Range of Reading Level Std 10; Writing Std 2; Craft & Structure 5; Writing 5; Speaking/Listening 1, 2, 3, 3.05; Math 4.OA.1, 4.OA.2, 4.NBT.4, 4.OA.3; Soc Std 4.G.1.2, 4.G.1.3; Science 4.L.1.3
Grade 5: ELA: Key Ideas & Details 1; Math 5.NBT.5, 5NBT.6, 5.MD.1; Soc Std 5.G.1.2

Objectives:
- Students will utilize reading comprehension skills to read selected articles about solid waste topics and answer multiple-choice format questions.
- Students will utilize various computational skills to solve mathematical word problems.

Materials:
transparency of recycling article and questions
article about landfills and corresponding questions (included), landfill word problems and answer key (included)

Part One: Reading Comprehension
1. Explain that reading expository text allows us to gain information about factual topics. Have students name expository topics they have read about before. Tell students that they will be reading an expository article about landfills and will be answering some questions about the article.
2. Display a transparency of the recycling article below entitled "Exhibit 3-Introduction to Recycling" and read it aloud.
3. Have students identify unfamiliar words and clarify their meanings. Answer corresponding questions as a group and discuss whether each answer is found within the text or through making an inference from the text.
4. Students should read the article about landfills and answer the corresponding questions. You may wish to review students' responses to these tasks as a whole group or to review each student's work individually.

Part Two: Math Problem Solving
1. Explain that problem solving allows us to find solutions to unknown problems.
2. Explain how mathematical operations help us find solutions. Have students tell what mathematical operations they are familiar with and tell when those operations would be used.

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3. Make a list of key words that indicate the use of certain operations (i.e. altogether means add, find the difference means subtract, etc.).
5. Students use mathematical operations to solve the word problems on the sheet included in this packet.

EXHIBIT 3—INTRODUCTION TO RECYCLING

WHAT IS RECYCLING?

Recycling means to use something again. Old newspapers are used to make new newspapers. Old aluminum cans are used to make new aluminum cans. Old glass jars are used to make new glass jars. There are many reasons why recycling makes sense.

Recycling Saves Landfill Space.

Americans make more trash each year. Most of the trash is buried in landfills. Recycling is one way to reduce the amount of trash that is buried.

Recycling Saves Money.

Getting rid of trash isn't free. Garbage trucks must pay to dump their loads at landfills. Recycling reduces landfill costs because less waste is buried.

Recycling Saves Energy.

It almost always takes less energy to make a product from recycled materials than it does to make it from new materials. Recycling aluminum cans, for example, uses 95 percent less energy than making aluminum cans from new materials.

One exception to the rule is plastics. Sometimes it takes more energy to recycle plastics than it does to use new materials.

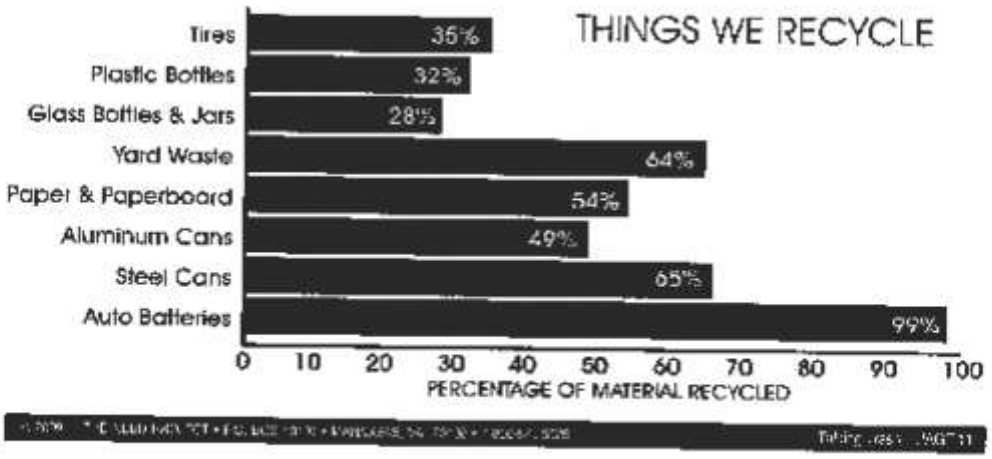
Recycling Saves Natural Resources.

Natural resources are valuable. Natural resources include land, plants, minerals, and water. By using materials more than once, we conserve natural resources.

In the case of paper, recycling saves trees, water, and energy. Making a ton of paper from recycled paper saves up to 17 trees and uses 50 percent less water.

Recycling Reduces Air and Water Pollution.

Using old cans instead of raw materials to make new aluminum cans reduces air and water pollution by 95 percent.



Source: NEED Book Talking Trash p11
http://www.need.org/needpdf/Talking%20Trash.pdf

Comprehension Questions for “Introduction to Recycling”

Respond to the following questions based on what you read in the article.

1. What does it mean to recycle?

a. to throw things in a trash can

b. to use something again

c. to grow something to place items in a recycling bin

2. Why is it important to recycle?

a. It saves landfill space.

b. It saves natural resources.

c. It saves money.

d. All of the above statements are true.

3. Which item has the highest percentage of material recycled?

a. glass bottles and jars

b. aluminum cans

c. auto batteries, paper and paperboard

4. Which material sometimes uses more energy to recycle?

a. paper

b. plastic

c. Glass

d. aluminum

5. Recycling does not:

a. create energy

b. save energy

c. save money

d. save landfill space

Answers- Comprehension Questions for "Introduction to Recycling"

1. b., answer found within text
2. d., answer found within text
3. c., answer found within text
4. b., answer found within text
5. a., inference from reading text
6. a, inference from reading text

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EXHIBIT 8—LANDFILLS: BURYING TRASH

YESTERDAY AND TODAY

For hundreds of years, people used dumps to get rid of their trash. The dump was just a pit or field outside of town where people left their trash.

People tossed all sorts of waste into these dumps. The dumps were breeding grounds for flies, mosquitoes, and rats. Rainwater washed filthy, and sometimes poisonous, liquids from the dump into streams and groundwater supplies that people used for drinking, bathing, and clothes washing.

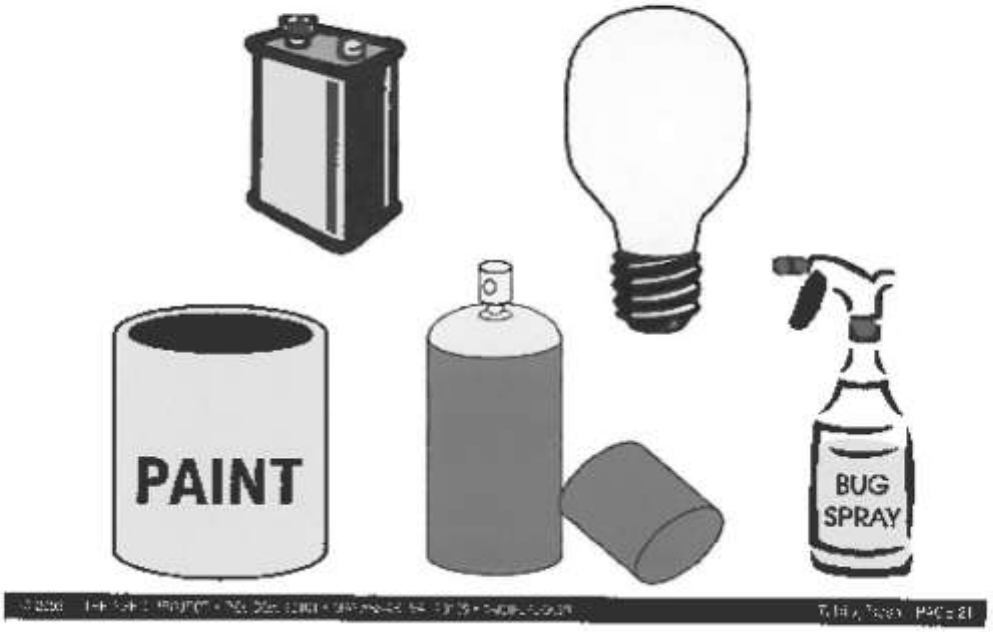
Today, we still bury our trash, but not in the open dumps of yesterday. About 55 percent of our garbage is hauled off in garbage trucks and put into landfills. Landfills are America's number one way of getting rid of trash.

Building new landfills is hard because people don't want trash buried near them. It is expensive, too. A new landfill costs about $10 million to build.

There will always be a need for landfills. Why? Because not all waste can be recycled or burned. How do you recycle a broken light bulb, and why burn it if it doesn't provide any energy?

Landfill burial is the only good way to dispose of some types of waste. Sometimes it's the safest way, too. The best way of taking care of some dangerous wastes—small batteries, paints, pesticides, and lightbulbs, to name a few—are landfills. The landfills are made to keep dangerous wastes from seeping into underground water supplies.

Some wastes with harmful chemicals, such as paints, should be taken to special facilities for disposal rather than placed in regular trash containers.



Source: NEED Book Talking Trash p21
http://www.need.org/needpdf/Talking%20Trash.pdf

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A MODERN LANDFILL

Today's landfills are very different from the dumps of the past. The landfills are lined with layers of clay or plastic to keep any liquid waste from escaping into the soil.

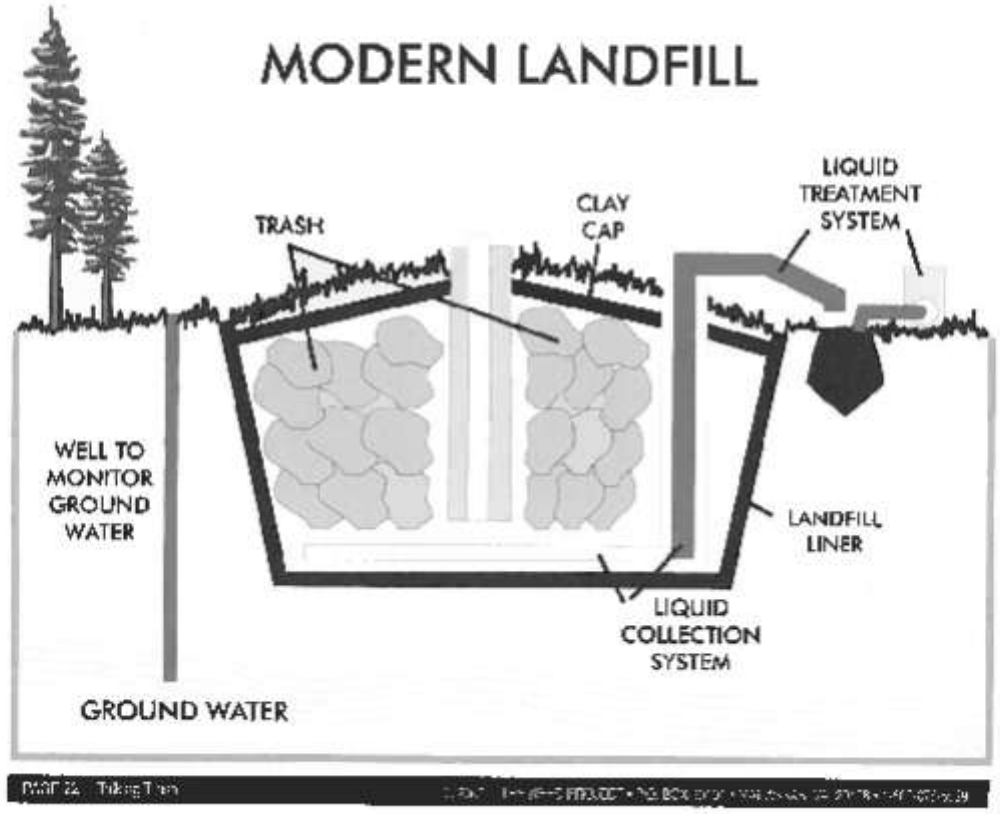
A network of drains collects the liquid and pumps it to the surface where it can be treated. Wells are drilled around the landfill to check the groundwater and make sure it is clean.

At the end of each day, workers spread a layer of earth—called the daily cover—over the trash to reduce odor and control pests. The workers seal each section of the landfill when it is full with another layer of clay and earth.

A FULL LANDFILL

When an entire landfill is full, workers seal the whole landfill with a final cover of clay and dirt, and then seed the area with native grasses. Workers continue to check the wells for years after a landfill is closed to make sure nothing is leaking into the water.

Closed landfills can be turned into parks, parking lots, golf courses, and ski slopes. Building homes and businesses on landfills isn't allowed, though, since it can take many years for the ground to settle.



Source: NEED Book Talking Trash p22
http://www.need.org/needpdf/Talking%20Trash.pdf

Comprehension Questions for "Landfills: Burying Trash"

Respond to the following questions based on what you read in the article.

1. What is a dump?

a. a landfill
b. a trash container
c. a pit outside of town where people leave trash
d. a store where people sell their trash

2. Why are landfills important?

a. because they hold trash that cannot be recycled or burned
b. because they are easy to build
c. because they are inexpensive to build because they have been around for many years

3. Which of the following describes one reason why building landfills is hard?

a. Landfills take up small amounts of land.
b. It takes a lot of people to build a landfill.
c. People want to live near landfills.
d. Landfills are expensive to build.

4. Which of the following is true of both landfills and dumps?

a. They have both been around for hundreds of years.
b. They both are designed around the idea of burying trash.
c. They both keep groundwater clean.
d. They both cost $10 million to build.

5. Landfills are NOT:

a. America's number one way of getting rid of trash
b. safe
c. Expensive

d. open holes in the earth for dumping trash

6. Landfills of today are different than those of the past because:

a. They are bigger.

b. They have clay or plastic liners.

c. They are deeper.

d. They have water inside them.

7. According to the picture in the article, what is the purpose of clay when constructing a landfill?

a. to provide a foundation for the landfill

b. to hold the trash together

c. to provide a cap over the landfill when it is full

d. to make sure enough water seeps into the landfill

8. **What devices are used to check that groundwater is kept clean?**

a. flares

b. liners

c. daily covers

d. wells

9. Which of the following is NOT a purpose of the daily cover?

a. to reduce odor

b. to control pests

c. to keep the trash in the landfill dry

d. to get rid of unwanted soil

10. The main idea of this article is:

a. Landfills are important in keeping our environment clean and safe.

b. Landfills have been around for hundreds of years.

c. Landfills can be turned into parks when they are full.

d. Landfills are easy and inexpensive to build.

Answers-Comprehension Questions for “Landfills: Burying Trash”

1. b.
2. a.
3. d.
4. b.
5. d.
6. b.
7. c.
8. d.
9. d.
10. a.

Problem Solving

1. Many pieces of trash are taken to the landfill each day. On a recent visit to the landfill, David threw away 30 pieces of trash, Susan threw away 20 pieces, Sarah threw away 25 and Jane threw away the most at 50. **How many pieces of trash did Susan, Sarah and Jane throw away?**

2. Trash cans are used to hold trash until the garbage can be put in a truck and taken to the landfill. Janet wants to buy a trashcan that costs $50. She has $25 already and wants to save the rest in equal amounts for five weeks so she can buy it just in time for school to start. **How much must she save each week to buy the trashcan?**

3. Every second, one person comes to the Anytown Landfill. How many people come to the landfill in a **minute**? How many people come to the landfill in an **hour**?

4. Mary has some aluminum soda cans to recycle. Joan has 3 times as many. Mary already recycled 14 soda cans and now has half that many left. **How many aluminum soda cans does Joan have to recycle?**

5. Trucks deliver trash to the Anytown Landfill each day. The first trash truck delivered its load on August 20 followed by the hundredth trash truck on September 5. (There are 31 days in the month of August). **How many days later did the hundredth trash truck come to the landfill?**

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6. Most of the trash that is delivered to the Anytown Landfill is taken there by truck. Sue takes one pick-up truck load of trash to the landfill each day. About how many truck loads of trash would Sue take to the landfill in two weeks?

7. An exciting way to learn more about the landfill is by taking a landfill tour. There are 24 seats on a large school bus that will carry students on a tour of the landfill. If three students occupy each seat, how many students can the bus carry?

8. A couch is an example of an item that cannot be recycled. A couch manufacturer has some couches he wants to throw away. He has sixty-five couches and can only take 5 couches to the Anytowm Landfill at a time. How many trips to the landfill will the couch manufacturer make?

9. It costs $39.00 a ton for a business to get rid of trash at the Anytown Landfill. Power On has one ton of trash to throw away. How much change would Power On receive if they threw away one ton of trash at the landfill and paid with a fifty-dollar bill?

10. The landfill in Anytown, USA opened in January of 1982 and will close in December of 2007. How many years will the town landfill have been open?

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Answers to Word Problems:

1. 20 + 25 + 50 = 95

2. $50 - $25 = $25; $25/5 = $5

3. minute: 60 x 1 = 60 people
   hour: 60 sec. x 60 min. = 3600 sec. x 1 = 3600 people

4. Mary: 14 – 7 = 7; Joan 3x 7 = 21

5. August has 31 days, therefore 16 days would pass between Aug. 20 and Sept. 5

6. 7 pick-up truck loads (b/c there are 7 days in a week) x 2 weeks = 14 pick-up truck loads of trash total

7. 24 seats/3people per seat = 72 people

8. 65/5 = 13

9. $50.00 - $39.00 = $11.00

10. 2007 – 1982 = 25 years

Lesson 2: Evaluating Waste Streams

Grade Level:
6-8

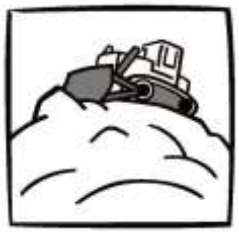
Concepts Taught:
Conservation of resources, circle graphs

Activity Time(s):
20 minutes (lesson); 30 minutes (follow-up)

Essential Questions:

- What is municipal solid waste (MSW)?
- What is a waste stream?
- What can pie graphs tell us?
- What is the make up of the waste stream for Wake County, N.C.?

NC CORE/Essential Standards:
Grade 6: Math 6.RP.3.c; Science 6.E.2.4, 6.L.2.3; Soc Std 6.G.1.2, 6.G.1.3, 6.G.1.4, 6.G.2.1;
Grade 7: Math 7.NS.3, 7.G.1, 7.G.2, 7.G.4; Science 7.E.1.6; Soc Std 7.G.1.1, 7.G.1.3, 7.G.2.1
Grade 8: Science 8.P.2.1, 8.P.2.2, 8.E.1.4; Soc Std 8.G.1.2, 8.G.1.3



Objectives:

- Students will identify common components of a Municipal Solid Waste Stream.
- Students will predict proportions/percentages for each component of Wake County's MSW stream.
- Students will review and discuss composition of circle graphs.
- Students will extrapolate similarities and differences between the waste stream of Wake County and other geographic locations.
- Students will use provided data to create a circle graph.

Materials:
Sample of county waste stream graph (included) —make a transparency
Sample waste stream data for "Anytown, USA" (included)- make a transparency and student worksheet
Protractors for each student

Lesson:
1. Review concepts about landfills. Landfills are necessary. They are specially designed and operated to minimize effects on the environment. Students have many opportunities to reduce the amount of garbage taken to the landfill such as recycling at school.

2. Review the term Municipal Solid Waste (MSW). Explain that MSW makes up part of our waste stream, which is the waste material output of a community. Other parts of the waste stream can include agricultural waste, industrial waste, tires and batteries. Explain that during this lesson, students will focus only on the MSW part of the waste stream. MSW is made up of paper, plastics, metals, wood, food waste, glass, construction and demolition debris, and other materials that are sent to the landfill.

3. Show the pie graph without legend of the MSW waste stream for Wake County, NC. Ask students what materials they think make up each section of the waste stream.

4. Show the circle graph with legend and discuss why the waste stream is proportioned that way. Most of the waste stream is made up of containers and packaging because

Most everything we purchase comes in some type of packaging.

5. Other items to discuss with students regarding the graph:

a. *What is the title of this circle graph?* (Waste Stream for Wake County) Notice that it describes the graph without using too many words, but gives enough detail so that the reader knows exactly what the graph is about.

b. *How do you think you make a portion of the circle graph to measure exactly 30%, like the paper portion on this graph?* First, you know that there are 360 degrees in a circle. We have to figure out how many degrees 30% of this circle would measure. Multiply 360 by 0.30 (or 30%). (Use calculators or pencil and paper.) This makes 108 degrees. If you were making a circle graph, you would use your protractor and the center of the circle to measure 108 degrees to show the paper portion of the circle.

c. *How many degrees would the food waste portion of the circle use?* Multiply 360 (because there are 360 degrees in a circle) by 0.10 (or 10%). You should get 36 degrees for the food waste portion of the circle graph.

d. *How many degrees should all of your portions add to total?* (360)

e. *What is a legend?* (It's the key that shows what each section of the circle graph stands for. This can be done using colors or patterns (such as dots, diagonal lines, etc.).

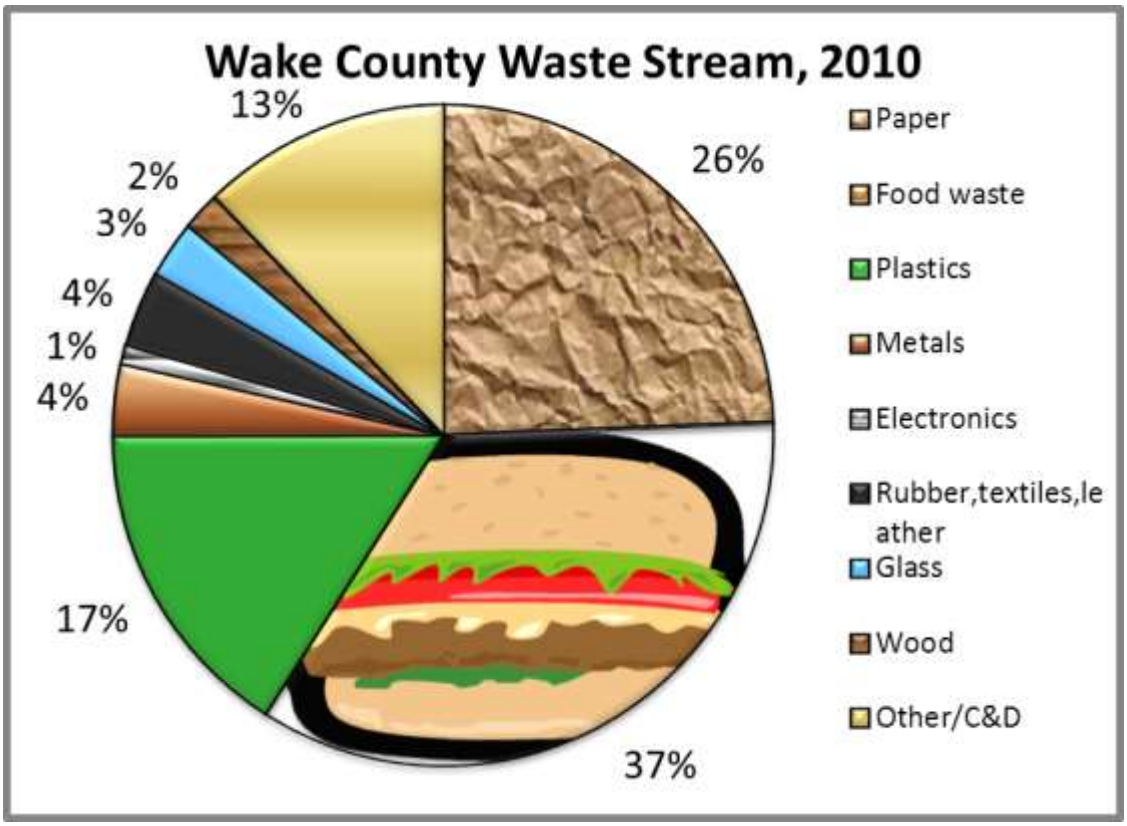
6. Ask if students think the graph of waste streams from other geographic locations will look similar or different to Wake County's waste stream. Other locations that do not have curbside recycling services may have an increased amount of plastic, paper, glass, and metal thrown away. Also, the construction and demolition debris section would probably be bigger in an area that has recently experienced a natural disaster or is rapidly growing and where many homes are being built.

7. Have students use the provided worksheet to create a circle graph showing the waste stream distribution for "Anytown, USA". Students must also include all the necessary parts of a circle graph including labels, title, and legend. A grading rubric is attached. Follow up this activity by discussing how the waste stream graph might look different if the waste were measured in weight instead of volume. [For example, items like Styrofoam® weigh less but take up more volume].

Extensions:

1. Trash Journals: Students record what type of materials they place in the trash can over the course of a day or a week and analyze how each individual's trash compares to the waste streams that were discussed in the lesson. Data collected can be organized in graph format (i.e., bar graph, circle graph).

2. Make an "Alternative Garbage Pizza" with students using the activity following this one.



Source: SCS Engineers; 2011 Wake County Solid Waste Composition Study

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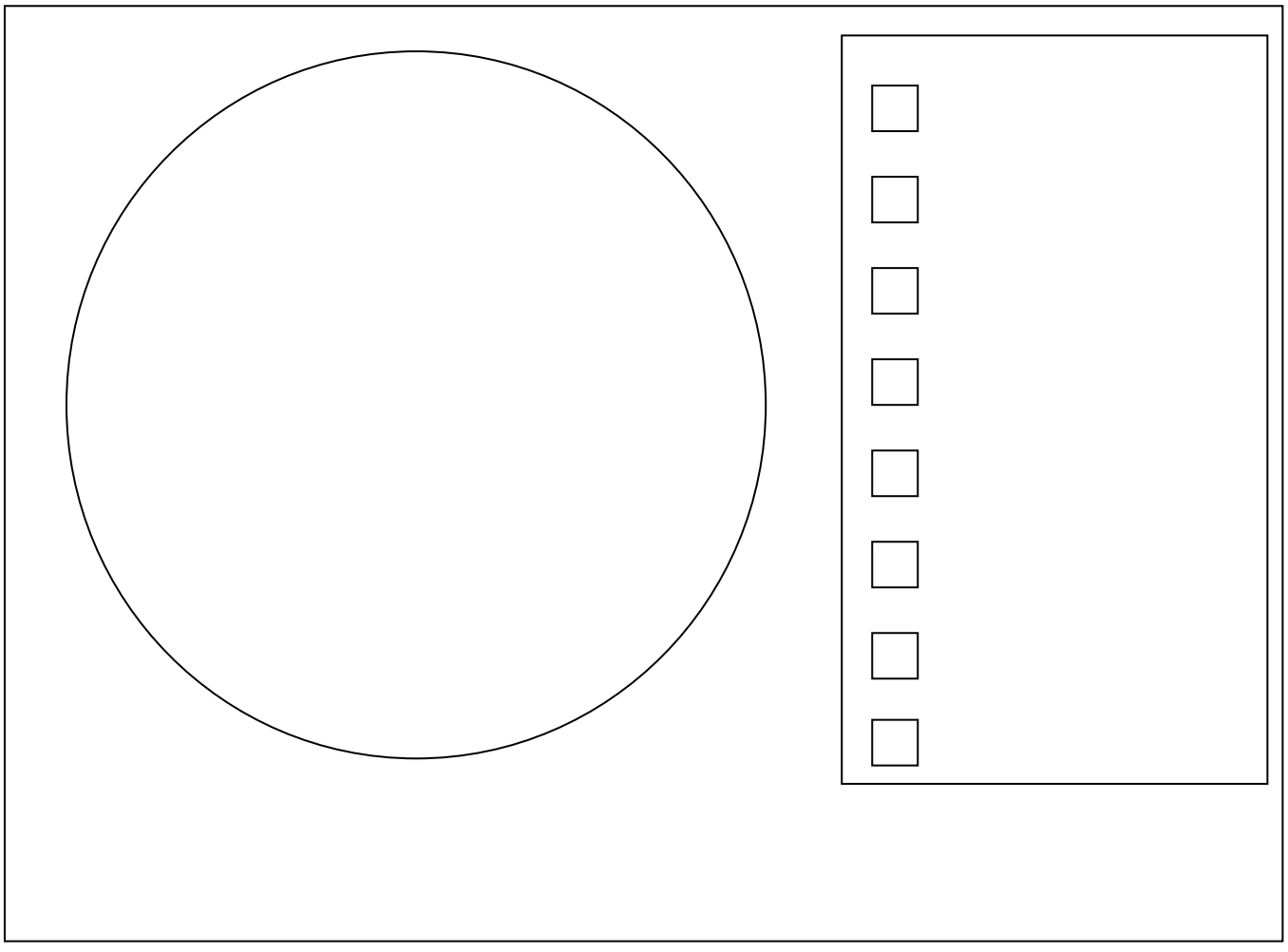
NAME _____

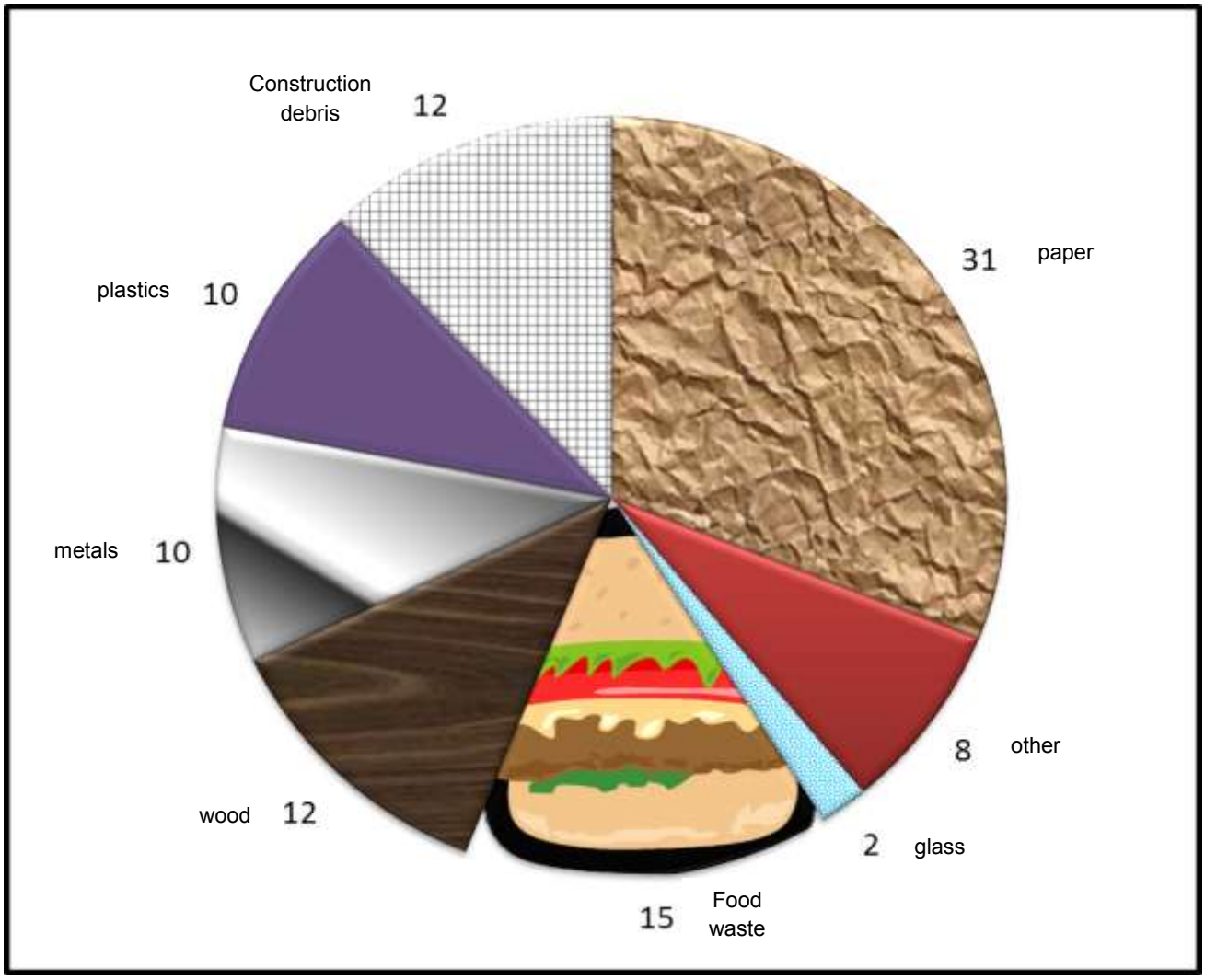
Directions: using a protractor and the provided percentages in the chart, create a circle graph for each material listed in Anytown, U.S.A.

Anytown, U.S.A Waste Stream

Paper	31%
Other	8%
Glass	2%
Food waste	15%
Wood	12%
Metals	10%
Plastics	10%
Construction and demolition debris	12%



Waste Stream for Anytown, U.S.A.—Answer Key



Grading Rubric for Circle Graphs

CATEGORY	4	3	2	1
Neatness	The graph is readable, clean, neat and attractive. It is free of erasures and crossed-out words.	The graph is readable, neat and attractive. It may have one or two erasures, but they are not distracting.	The graph is readable and somewhat attractive.	The graph is not neat or attractive.
Sections	The graph contains the correct number of sections that are all correctly apportioned.	The graph contains the correct number of sections, but may not be drawn or calculated appropriately.	The graph is missing one or more sections. An attempt has been made to correctly apportion the categories.	The graph is missing two or more sections. There has been little or no attempt to correctly apportion the categories.
Title	The graph has been appropriately titled. The title is in the correct place.	The graph has been appropriately titled, but the title is not in the correct place.	The graph has an inappropriate title.	The graph has not been titled.
Labels	All sections of the pie graph are appropriately labeled.	The graph has one section that is not labeled.	The graph has two sections that are not labeled.	The graph has three or more sections that are not labeled.
Legend	The graph contains a legend that matches all sections of the graph.	The graph contains a legend that may be missing one section or does not match one section of the graph.	The graph contains a legend that may be missing two or more sections or does not match two or more sections of the graph.	The graph does not contain a legend.

Lesson 3: Garbage Pizza: a No-Waste Take on the Original

Grade Level:
3-6

Concepts Taught:
conservation of resources, human impact on natural resources, reading circle graphs

Activity Time(s):
1-hour (prep),
20-30 minutes (lesson)

Essential Questions:

- What is a waste stream?
- What is municipal solid waste?
- What is the percentage of items we throw away in Wake County?

NC CORE/Essential Standards:
Grade 3: ELA: Speaking/Listening 1; Math 3.NBT.1, 3.NF.3 ; Soc Std 3.G.1.2, 3.G.1.3; Science 3.L.2.4

Grade 4: ELA: Speaking/Listening 1; Math 4.NBT.4; Soc Std 4.G.1.2, 4.G.1.3; Science 4.L.1.3

Grade 5: Soc Std 5.G.1.2

Grade 6: Soc Std 6.G.1.2, 6.G.1.3, 6.G.1.4, 6.G.2.1, 6.E.1.2

Objectives:

- Students will identify common components of a Municipal Solid Waste Stream.
- Students will predict proportions/percentages for each component of the United States' MSW stream.
- Students will extrapolate similarities and differences between the waste stream of the United States and other geographic locations.

Materials:
Steel-coated pizza pan (any size) or cardboard circle
markers, construction paper
protractor
magnets with adhesive backing
small items such as bottle caps, paper clips, play food, etc. for garbage categories (paper, yard waste, plastic, metal, wood, food waste, glass, rubber, leather, & textiles and other)

Pizza Pan Set-up:

1. Using the pizza pan as a guide, cut out brown construction paper within about 1" of the edge of the pan. Attach to pan using tape or glue. This is the "crust."

2. Using markers, color in "pizza sauce" on the construction paper.

3. With a marker and protractor, draw in the sections of the circle graph to match those on page 41. Within each section, write the corresponding number percentage value.

4. Place adhesive magnets or Velcro on the underside of small sample "trash" items to represent the categories of the waste stream:

Paper: sticky notes, newspaper pieces, shredded paper

Yard waste: potpourri, foam leaves and trees (available at craft stores)

Plastic: bottle lids, miniature toys, drink bottle labels

Metal: paper clips, brads, nuts and bolts, aluminum can pull tabs

Wood: popsicle sticks, toothpicks

Food Waste: play food items, foam cutouts of food (DO NOT use real food)

Glass: sea glass

Rubber, Leather, and Textiles: cloth scraps, shoelaces, rubber bands

Other: scraps

Lesson:

1. Review the term Municipal Solid Waste (MSW). Explain that MSW makes up part of our waste stream, which is the waste material output of a community. MSW is made up of paper, plastics, metals, wood, food waste, glass, and other materials that are sent to landfills.

2. As a class, brainstorm items that people throw away and write them on the board.

3. Using the categories in the list above, categorize the brainstormed items.

4. Show the students the pre-made pizza pan. Divide students into 9 small groups. Assign each group one of the categories above and give them the all the sample items from that category with magnets.

5. Explain that the pizza will be passed around the room and each group will place ALL of their trash items onto ONE section of the pizza. Students may NOT change another group's placement of their items. The pizza and its sections represent the types of trash that were disposed of in the U.S. in 2008 (EPA data).

6. After the pizza has made its way around the room, show the answers by writing the percentages next to the categories on the board. Discuss whether their pizza was accurate or not.

7. Ask if students think the graph of waste streams from other geographic areas will look similar or different to the United States' waste stream. Other locations that do not have curbside recycling services may have an increased amount of plastic, paper, glass, and metal thrown away. Also, the construction and demolition debris section would probably be bigger in an area that has recently experienced a natural disaster or is rapidly growing.

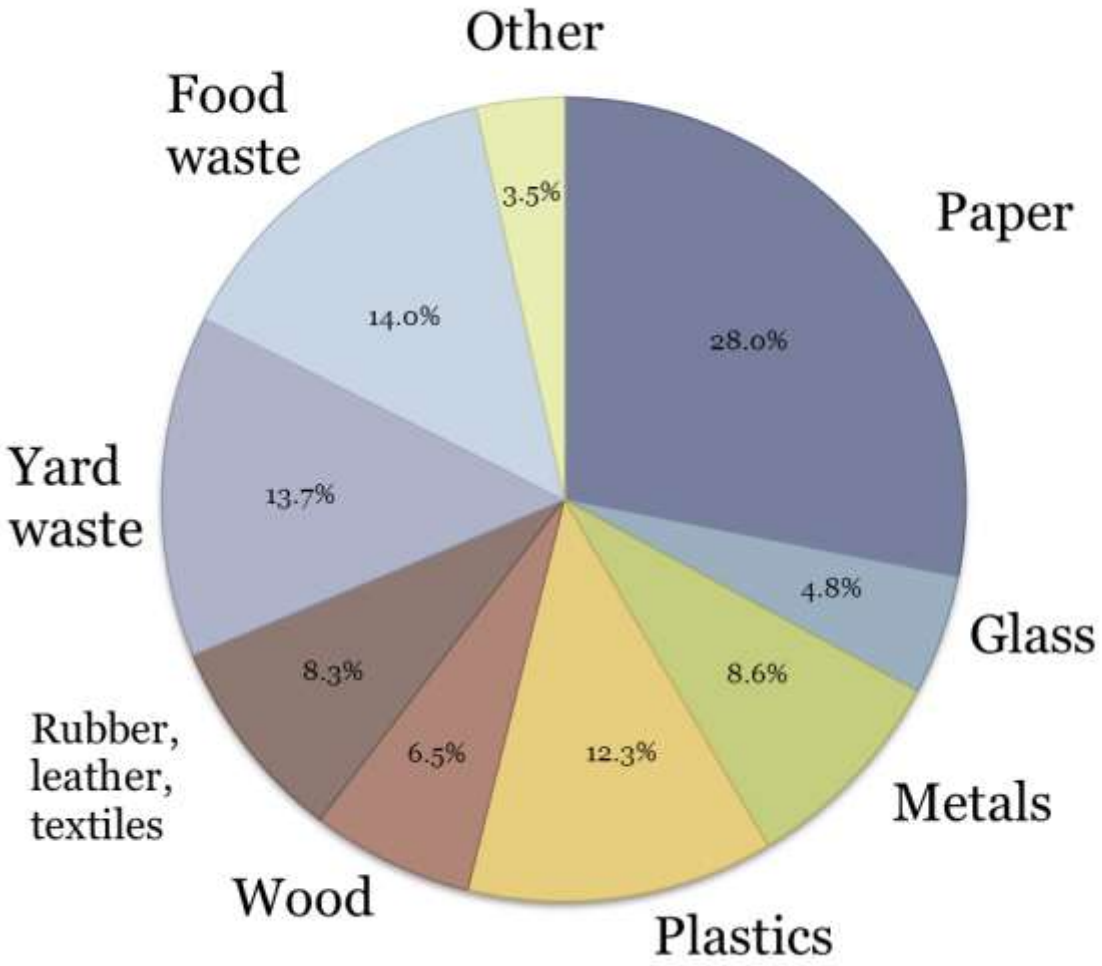
Extensions:

Explain to students that in North Carolina, it is illegal to landfill yard waste. What are some ways that we dispose of yard waste (composting, mulching, etc). How might the graph look different for North Carolina?

What do you think happens to materials from construction sites? (it goes to a C&D—construction and demolition debris landfill)

Garbage Pizza: Waste Stream for USA, 2009

U.S. EPA Waste Stream Data, 2009



Lesson 4: Building a Landfill Model

Grade Level:
3-5

Concepts Taught:
conservation of resources; human impact on natural resources

Activity Time(s):
1 hour (prep)
20 minutes (lesson)
20 minutes (follow-up)

Essential Questions:
- What is a landfill?
- What types of items can be disposed in a landfill?
- How is a landfill designed?

NC CORE/Essential Standards:
Grade 3: Soc Std 3.G.1.2, 3.G.1.3; Science 3.L.2.4
Grade 4: Soc Std 4.G.1.2, 4.G.1.3; Science 4.L.1.3
Grade 5: Soc Std 5.G.1.2

Objectives:

Students will demonstrate understanding of the landfill layers concept by building a landfill model.

Materials:
Clean, empty 2-liter bottles (one for each group of 4 students)
craft foam sheets in blue and brown
scrap materials such as cardboard, plastic grocery bags, polystyrene packing peanuts, construction paper, straws
(see diagram for alternative materials list)

Lesson:
1. Review the Teacher Background Section. Landfills are necessary because we all create trash everyday.
2. Ask students why it is important to build landfills a special way. Answers may include: to keep the environment safe, to keep the trash contained in an area, to make it easy for trucks to dump trash at the landfill.
3. Using the diagram below, arrange students in groups of four or five (or use as an independent center activity).
4. They will then construct the landfill.
5. Explain each layer's function as you go along:

- Groundwater: this is water running beneath the earth's surface that feeds wells and springs. Landfills are constructed to keep groundwater safe and protected.
- Compacted Clay: a thick layer of clay is a barrier to prevent liquids in the landfill from coming in contact with the groundwater. Clay is a soil type that is resistant to water moving through it. (You may want to discuss the three main soil types here and why they would or would not make a good landfill layer: sand is not appropriate because it would allow water to move through it very easily, as would humus.)
- Liner: this thick plastic liner is impermeable and serves as an excellent barrier to keep trash and liquids from coming in contact with soil and groundwater below.

Starve the Landfill

- Leachate Collection Pipes: often called "garbage coffee," leachate is any liquid produced as trash settles. It must be collected and treated to remove any hazardous chemicals
- Geo-Textile Mat and Drainage Layer: combining gravel and another synthetic liner, these layers help drain liquids from the landfill.
- Soil: soil is placed on top of all these layers before the first layer of garbage.
- **Garbage**: placed and compacted daily on the landfill.
- Soil: placed and compacted on top of the garbage each night to prevent smells, wind-blown litter, and environmental hazards. If you have enough materials, students may repeat the garbage layer and soil layer several times to show how garbage is continually placed on top of other garbage layers.
- Liner: another liner is placed on top of the soil and garbage layers when the landfill closes.
- Soil: more soil is placed on top of the liner to prepare for vegetation planting.
- Vegetation: planted on top of the landfill. Grasses are planted rather than trees or other plants that have major root structures.

Extension:

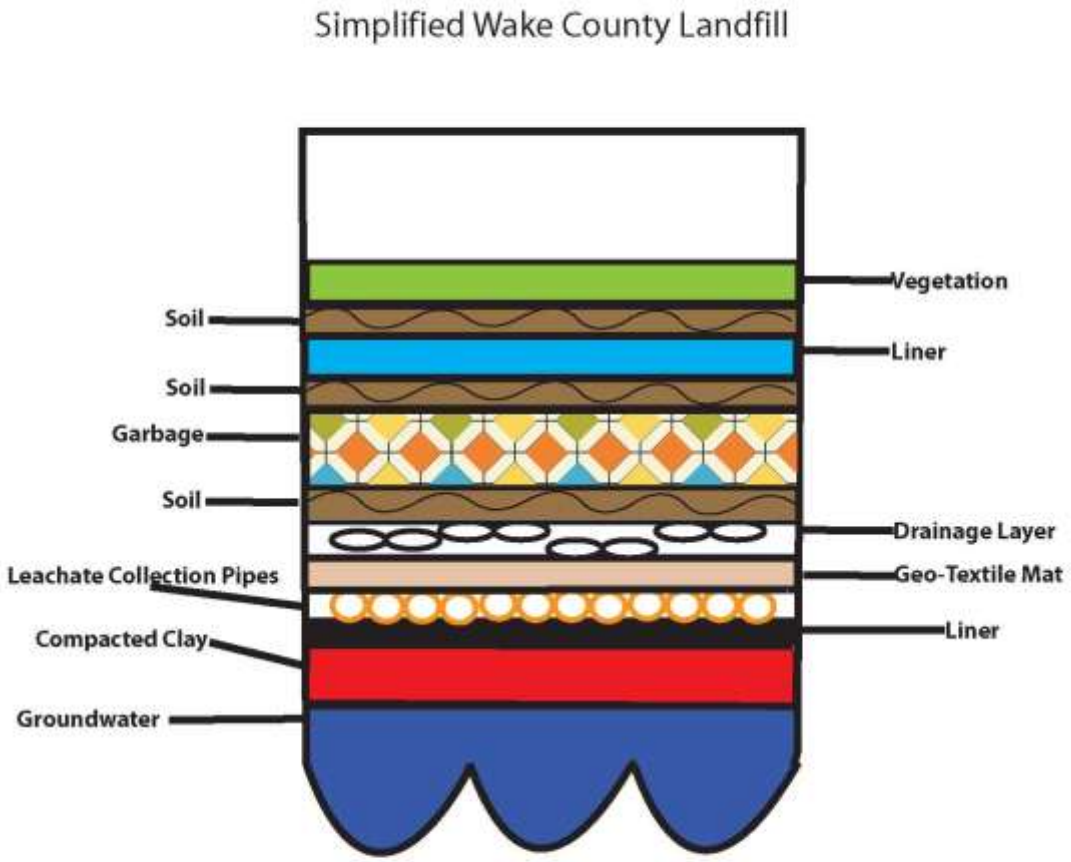
Ask students to keep a log of each piece of trash they throw away in the class garbage can for a week using the following categories: paper, plastic, food waste, wood, and metals.

Keep a chart hung near the trashcan where students can mark their trash.

At the end of the week, use the student data to create a bar graph showing how much trash is composed of each of the categories.

Discuss why some bars on the graph are higher or lower than others and discuss how the graph might look different if students kept a record of what they throw away in their garbage can at home.

Starve the Landfill



Edible Landfill	Other Landfill Options
This can be made in a large baking or serving dish for a classroom of students. Making individual servings in small cups generates a great deal of waste. Please be mindful of food allergies. If you use ice cream, have students examine the bottom of the container to see if the "liner" is functioning properly. If so, the cookies will remain dry.	Two-liter bottles can also be used to construct a landfill model. Cut the top off the bottle and use scraps of paper, plastic, or other items to make the layers as shown above.
Groundwater.....blue tablecloth Clay.....Oreo half with filling Liner.....fruit roll-up Leachate Pipes.....licorice pieces Drainage Layer and GeoText. Mat.....graham crackers Soil.....Oreo half without filling Garbage.....candy pieces or ice cream Vegetation.....Cool Whip or green sprinkles You can also use birthday candles to represent the methane flare.	Groundwater .....blue foam or construction paper Clay.....brown foam circles Liner.....black trash bag circles Leachate Pipes.....straws Drainage layer and GeoText.Mat....packing peanuts Soil.....cardboard circles Garbage.....candy wrappers, napkins, etc. Vegetation.....green construction paper, potpourri

