FEED THE BIN

School Recycling Program
Wake County Solid Waste Management Division
PO Box 550, Raleigh, NC 27602
FeedTheBin@co.wake.nc.us
919.856.6006

Wake County Solid Waste Management Division

FEED THE BIN

Curriculum Training

Taught in conjunction with WCPSS Curriculum and Instruction Elementary and Middle Science, and Wake County Solid Waste Management Division: Feed the Bin School Recycling Progam.

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PO Box 550
Raleigh NC 27602

Second Edition

FEED THE BIN

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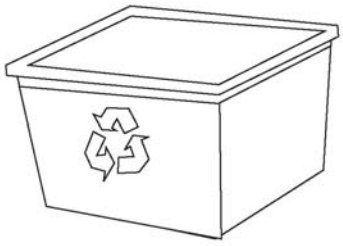


Feed the Bin

Trash Sort
Grades K-2

Materials: "Clean trash" items to be sorted, recycling bin, trash can, laminated copies of matching worksheet
Activity Time: 20 minutes (lesson), 10 minutes (follow-up)
Concepts Taught: Recycling, sorting/grouping objects
Correlations to NCSCOS: Kindergarten: ELA Objective 4.04; Math Objective 5.01, Science Objective 3.04, Social Studies Objective 2.01, Visual Arts Objective 2.03; **Grade 1**: ELA Objective 4.04; Math Objective 5.01, Science Objective 3.02; Social Studies Objectives 2.01, 5.05; **Grade 2:** ELA Objectives 4.04, 4.05; Social Studies Objectives 1.02, 6.01

Objectives:

- Students will understand that some items can be recycled while others cannot.
- Students will sort items based on whether they are recyclable or not.

Background:

- Recycling helps save natural resources such as energy, landfill space, and raw materials and creates jobs.
- The three arrow symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
    - It is important to complete all three steps in the process in order for the recycling cycle to work.
    - Recycled paper is collected, processed, and made into new products such as notebooks, sticky notes, greeting cards, and toilet paper.

Lesson:

1. Review the concepts above with students. We are able to recycle certain materials at the school. When we recycle materials, they are used again and made into new products. The bin likes to be fed certain objects.
2. Ask the students which objects we can feed the classroom bin. Answers may include notebook paper, white and colored computer paper, copy paper, envelopes, junk mail, letterhead, newspapers, file folders, sticky notes, posters, pamphlets and brochures, and magazines and catalogs. Remind students that staples, paper clips, and small amounts of glue and crayon are okay to be included.
3. Explain that students should feed the bin as much as they can each day, but that we should not feed the bin anything it doesn't like. Place the trash can and the classroom bin where students can easily reach them. Give each student a piece of the clean trash. Explain that they must put the clean trash in the correct location: either the trash can or the paper recycling bin. Ask students to take their object to the correct container.
4. After students have placed their objects, go through each bin in front of the class. Ask them to make certain that each bin has the correct objects in it. As you are examining the

contents of the trash can, have students suggest a way the item could be reused in the classroom instead of throwing it in the trash.

5. Use the matching worksheet for students to independently circle items that belong in the classroom bin and X items that go in the trashcan. The laminated sheets may be marked on with crayon and wiped clean with tissues or other soft paper such as scraps of construction paper and reused. Students may exchange cards and check each other's answers.

Extension:

1. Students may enjoy sorting the "clean trash" in small groups. Give each group 10 objects to sort so that they can discuss its location together before placing it in the bin. Groups can be timed with how long it takes them to sort their objects. Each group can try to beat their own group time or compete with other groups to see who can sort the "trash" the fastest.
2. Students may also enjoy a recycling relay. Have two or three teams each form a line, with a recycling bin and trash can at the end of each line. When you say start, they pass objects down the line and say either "trash" or "recycle". Each person must pass the item some way other than how they got it (over head/under legs/around back). Once it gets to the end of the line, they must put it in the correct container. The team that gets the most correct in a certain amount of time wins.
    a. **Please note**: Should this activity be used with older students, the following rules can be used: 1. Groups should quickly and correctly sort the items into the recycling bin or the trash container. 2. NO TALKING! Students can motion or mouth words, but NO NOISE. 3. Each group should have a teacher check the contents of each container. 4. Every person in each group must participate. 5. When a group is finished, all members should raise their hands to signal the teacher, who will then check the results. 6. If anything is incorrect, mix the paper together. Students should start completely over and repeat the process until all items are correct.

Trash Sort Lesson

If your school is not a Wake County Feed the Bin school, check with your local recycling coordinator to find out what materials are recyclable in your area.

Recyclable

- Brochures/Pamphlets
- Colored Paper
- Envelopes
- File Folders
- Junk Mail (not included in packet)
- Letterhead
- Magazines/Catalogs
- Newspaper
- Notebook Paper
- Posters
- Sticky Notes
- White Paper

Not Recyclable

- Construction Paper
- Copy Paper Wrappers
- Facial Tissues
- Food Wrappers
- Lined Wood Fiber Paper (Handwriting Paper)
- Napkins (not included in packet)
- Paper Towels
- Plastic Report Covers (not included in packet)
- Photographs (not included in packet)
- Textbooks (not included in packet)
- Tissue Paper

Name _____

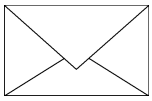
What Can You Feed the Bin?

Make a circle around the things that go in the classroom bin. Make an X on the things that go in the trashcan.


Apple Core

Magazine


Gum Wrappers

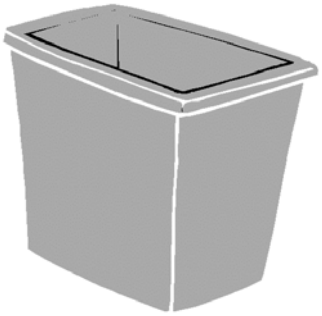

Envelope

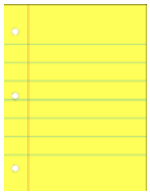

File Folder

Newspaper


Tissues

Classroom Bin


Trash Can


Notebook Paper


Pencil


Copy Paper


Paper Bag

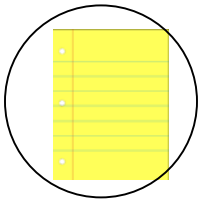

Shoes

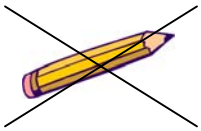

Toilet Paper

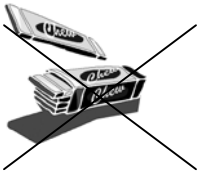
Name ___ANSWER KEY_____

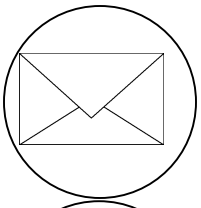
What Can You Feed the Bin?

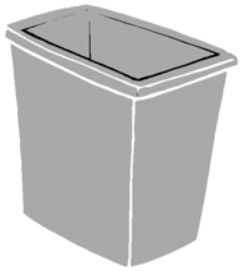
Make a circle around the things that go in the classroom bin. Make an X over the things that go in the trashcan.

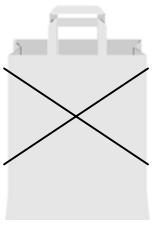


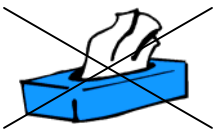




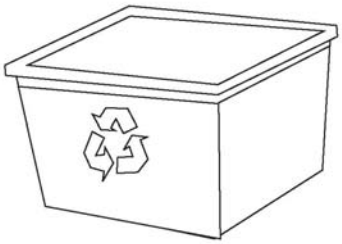








Feed the Bin



Sequencing Recycling at Our School
Grades 3-5

Materials: Scrambled recycling pictures (master included), Recycling sequence pictures (master included), scissors, glue, research material about the life cycle of paper, plastic, & aluminum (included), grading rubric (included).
Activity Time: 20 minutes (lesson), 50 minutes (follow-up)
Concepts Taught: Sequencing, recycling, life cycles
Correlations to NCSCOS: Grade 3: ELA Objectives 1.03, 1.04, 1.06, 2.03, 2.04, 2.05, 2.06, 3.05(?), 3.06, 4.02, 4.07, 4.09; Competency Goal 5; Visual Art Objectives 2.01, 2.03; **Grade 4:** ELA Objectives 1.04, 1.06, 2.03, 3.06, 4.02, 4.03, 4.07, 4.09, Competency Goal 5; Art Objective 1.03, **Grade 5:** ELA Objectives 1.03, 1.05, 2.01, 2.03, 2.05, 3.06, 4.09, Competency Goal 5.

Objectives:

- Students will determine the correct sequence of events for paper recycling.
- Students will work independently or collaboratively to create their own interpretation of the sequence for paper, plastic, or aluminum recycling using writing and illustration skills.

Background:

- Recycling helps save natural resources such as energy, landfill space, and raw materials and creates jobs.
- The three arrow symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
    - It is important to complete all three steps in the process in order for the recycling cycle to work.
    - Recycled paper is collected, processed, and made into new products such as notebooks, sticky notes, greeting cards, and toilet paper.

Lesson:

1. Review the concepts above with students. Remind them that they will follow a certain procedure to recycle paper at their school. Explain that *sequencing* is putting something in order. Students may be familiar with sequencing events from the stories they read in class.
2. Ask students to cut the pictures out of how paper is recycled. These pictures are a general summary of how paper recycling may happen and can vary according to your school.
3. Students should then glue the pictures in order on the sequencing worksheet. Students who finish early may color their sequence or write their own sentences.
4. Go over the answers to the sequence. Ask students to read aloud their captions.
5. Students should create their own sequencing worksheet for the life cycle of paper, plastic, or aluminum. The worksheets can be created by groups or individually. Background information at the end of this lesson plan is taken from the National Energy Education Development Project (NEED) book entitled Trash Talk, pages 13 and 18.
6. Students should do research on one of the life cycles using the research materials provided. They can also use the internet if it is available.

7. After researching the life cycle of paper, plastic, or aluminum, students should draw pictures for each stage of the life cycle. Remind students that their life cycle should include detail (you may want to give a minimum number of 8 steps to include for each life cycle).
8. Underneath each picture the students should write a description of what is happening in the step (1 sentence to 1 paragraph). Life cycles can be graded using the attached rubric. Students should present their life cycles to the class and display them around the room.

Extension:
Students can complete a creative writing exercise in which they pretend they are a tree being cut down and processed into paper according to the life cycle given. Depending on the grade level, several sentences or a short paragraph can be written.

Feed the Bin

Name _____

Recycling Sequence

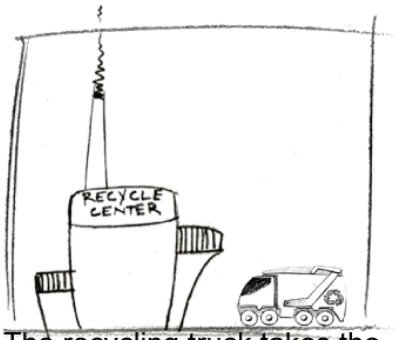
Place the pictures from the Scrambled Recycling in order of how paper is recycled at your school. Glue them in the correct order below.

Feed the Bin

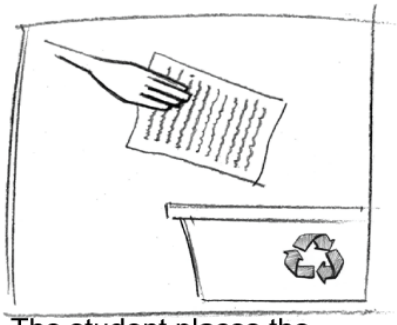
Pictures by Jesse Rademacher, NCDPPEA

Scrambled Recycling Pictures

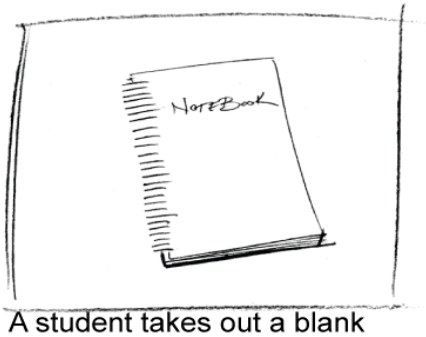
Cut out the pictures and sentences below. Place them in order of how paper is recycled at your school. Attach them to the Recycling Sequence worksheet.



The recycling truck takes the paper to the recycling center to be sorted.



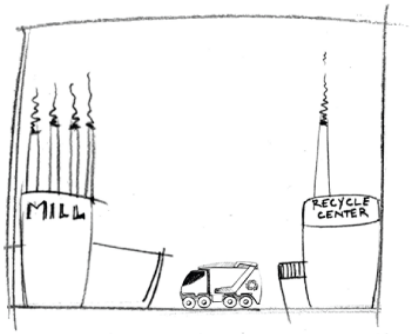
The student places the used paper in the recycling bin.



A student takes out a blank piece of notebook paper.

The student writes on the piece of notebook paper.

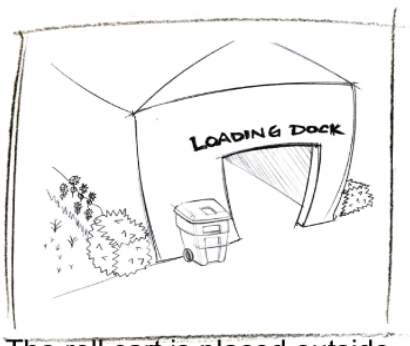
A recycled piece of notebook paper is created!



The sorted paper is taken to the paper mill where new paper is made.

The classroom bin is emptied into a roll cart.

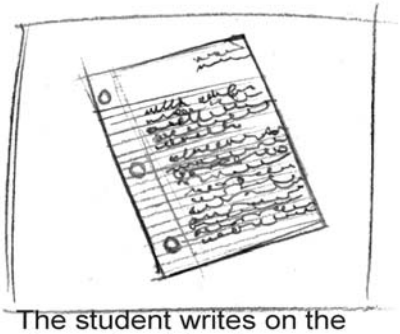
A recycling truck comes to pick up the paper in the roll cart.



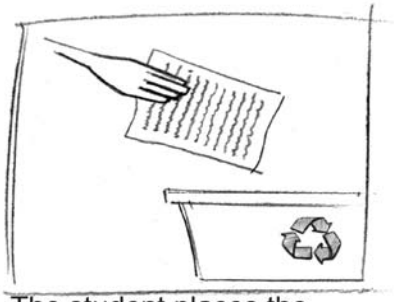
The roll cart is placed outside.

Scrambled Recycling Pictures-Answer Key

A student takes out a blank piece of notebook paper.

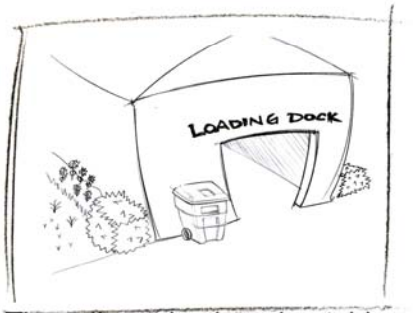


The student writes on the piece of notebook paper.



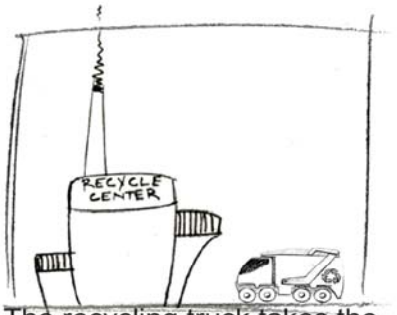
The student places the used paper in the recycling bin.

The classroom bin is emptied into a roll cart.

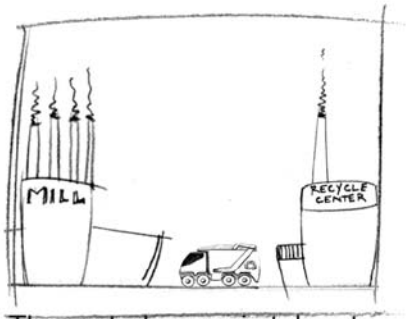


The roll cart is placed outside.

A recycling truck comes to pick up the paper in the roll cart.



The recycling truck takes the paper to the recycling center to be sorted.



The sorted paper is taken to the paper mill where new paper is made.

A recycled piece of notebook paper is created!

Feed the Bin

Please note: Material on following pages is from NEED Book Trash Talk, pages 13-18.

EXHIBIT 4--RECYCLING METALS

In the U.S., we mainly recycle aluminum and steel. Some other metals—like gold, silver, brass, and copper—are so valuable that we rarely throw them away. They do not create a trash problem.

We use a lot of aluminum and steel. Americans use 100 million steel cans and 200 million aluminum cans every day. Recycling is the best way to deal with aluminum and steel waste.

Burning metal trash is not good because metals do not provide any energy. Aluminum melts and steel just gets very hot. Burying is usually not a good idea either. Aluminum, especially, is so valuable that it does not make sense to bury it.

RECYCLING ALUMINUM

Like most metals, aluminum is an ore. An ore is a mineral that is mined for a valuable material in it. Bauxite, a reddish clay-like ore, is rich in aluminum. To get the aluminum out, though, takes a huge amount of energy.

That is why recycling aluminum makes sense. It saves energy—a lot of energy. Recycling just two aluminum cans saves as much energy as the energy in one cup of gasoline. Companies save energy and money by using recycled aluminum, so they will pay you for your old cans—about a penny for every can.

After you have put your old aluminum cans in a recycling bin, what happens next?

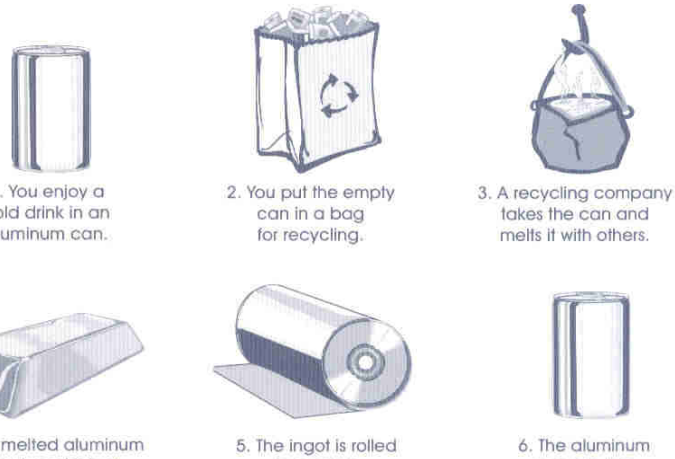
The old aluminum cans are taken to an aluminum plant. The cans are shredded into popcorn size chips and put into a furnace. The melted aluminum is made into thin sheets.

The sheets are usually made into new aluminum cans. This is called closed-loop recycling because the old cans are turned into the same thing again. Aluminum cans are recycled into new cans and put back onto store shelves within 90 days!

OVER AND OVER

Aluminum can be recycled over and over again. It does not lose its quality, and recycling it saves money, energy, and natural resources every time.

ALUMINUM RECYCLING



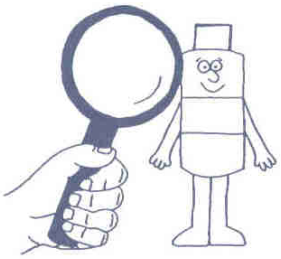
1. You enjoy a cold drink in an aluminum can.
2. You put the empty can in a bag for recycling.
3. A recycling company takes the can and melts it with others.
4. The melted aluminum is hardened into a block called an ingot.
5. The ingot is rolled into a thin aluminum sheet.
6. The aluminum is made into new cans.

Feed the Bin

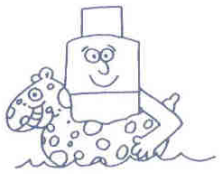
RECYCLING PLASTIC

The pictures below show the steps in recycling plastics.

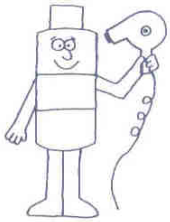
1. Inspection
Workers inspect the plastic for types they cannot recycle.



2. Chopping and Washing
The plastic is washed and chopped into flakes.

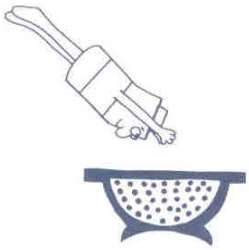


3. Flotation Tank
If mixed plastics are being recycled, they are sorted in a flotation tank, where some types of plastic sink and others float.



4. Drying
The plastic flakes are dried in a tumble dryer.

5. Melting
The dried flakes are melted. Different types of plastics melt at different temperatures.



6. Filtering
The melted plastic is pushed through a fine screen to remove any dirt. It is then formed into ropes.

7. Pelletizing
The ropes are cooled in water, then chopped into pellets. Companies buy the pellets to make new products. Recycled plastics can be made into flowerpots and carpet.

EXHIBIT 5--RECYCLING PAPER AND GLASS

RECYCLING PAPER

What is the number one material in trash? Look around your classroom. What do you see? Posters? Notebooks? Cardboard boxes? Textbooks? Bulletin boards decorated with construction paper? You get the picture. Paper is everywhere!

Paper is the number one material that we throw away. Of every 100 pounds of trash we throw away, 39 pounds is paper. Newspapers take up about 14 percent of landfill space, and paper packaging accounts for 15 to 20 percent.

There are many kinds of paper. It can be glossy or ragged, thin or thick. It can be for newspapers or stuffing diapers. Most paper products are made from trees, though paper can also be made from old cloth or grass.

HOW PAPER IS MADE

Papermaking uses a renewable resource—trees! The first step is cutting down the trees. Paper companies plant trees just for papermaking, like an apple farmer plants apple trees. If one tree is cut down, another is planted.

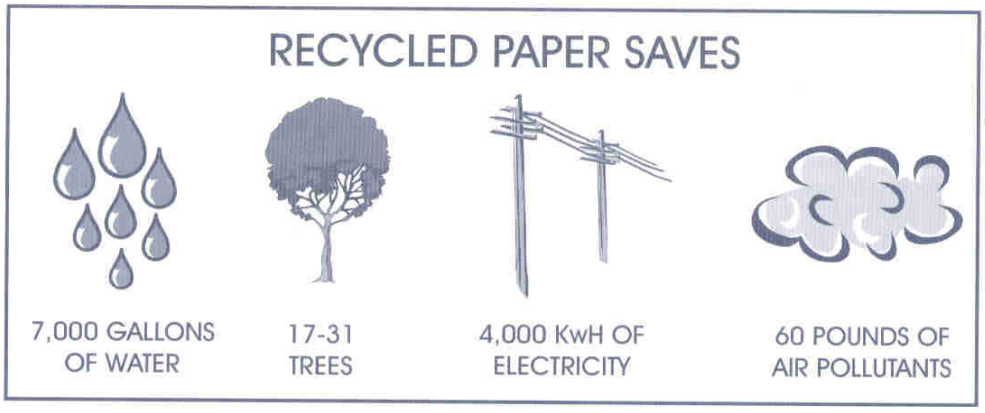
After the trees are cut, they are taken to a paper mill. Paper mills use every part of the tree, so nothing is wasted. The bark and roots are burned and used for energy to run the paper mill.

The rest of the tree is chopped into small chips to be made into paper. The raw paper is the color of grocery bags. Good papers are whitened with bleach and sometimes coated with clay to make them shiny.

Paper mills need a lot of energy to make paper. About 50 percent of their energy comes from burning wood scraps they cannot use to make paper. They buy the rest.

RECYCLED PAPER

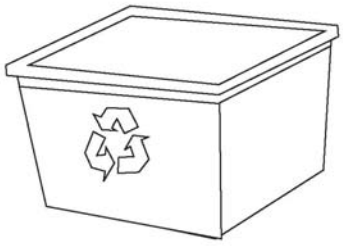
Recycled paper is made from waste paper, usually mixed new materials. Almost all paper can be recycled today, but some types are harder to recycle than others. Papers that have wax, paste, or gum—or papers that are coated with plastic or aluminum foil—are usually not recycled because the process is too expensive.



Rubric: Life Cycle of Paper, Plastic, or Aluminum

CATEGORY	4	3	2	1
Clarity and Neatness	Life Cycle is easy to read and all elements are so clearly written, labeled, and drawn that another student could understand the life cycle.	Life Cycle is easy to read and most elements are clearly written, labeled, and drawn. Another person might be able to understand the life cycle after asking one or two questions.	Life Cycle is hard to read with rough drawings and labels. It would be hard for another person to understand this life cycle without asking lots of questions.	Life Cycle is hard to read and one cannot tell what goes where. It would be impossible for another person to understand this life cycle without asking lots of questions.
Use of Time	Used time well during each class period (as shown by observation by teacher) with no adult reminders.	Used time well during most class periods (as shown by observation by teacher) with no adult reminders.	Used time well (as shown by observation by teacher), but required adult reminders on one or more occasions to do so.	Used time poorly (as shown by observation by teacher) in spite of several adult reminders to do so.
Spelling & Grammar	No spelling or grammatical mistakes on a life cycle with lots of text.	No spelling or grammatical mistakes on a life cycle with little text.	One spelling or grammatical error on the life cycle.	Several spelling and/or grammatical errors on the life cycle.
Content	All content is in the students' own words and is accurate.	Almost all content is in the students' own words and is accurate.	At least half of the content is in the students' own words and is accurate.	Less than half of the content is in the students' own words and/or is accurate.
Required Elements	Life Cycle included all 8 stages as well as a few additional stages.	Life Cycle included all 8 stages and one additional stage.	Life Cycle included all 8 stages.	One or more stage was missing from the life cycle.
Cooperation	Worked cooperatively with partner all the time with no need for adult intervention.	Worked cooperatively with partner most of time but had a few problems that the team resolved themselves.	Worked cooperatively with partner most of the time, but had one problem that required adult intervention.	Worked cooperatively with partners some of the time, but had several problems that required adult intervention.

Feed the Bin



Make a MRF: Build Your Own Recycling Factory
Grades 4-8

Materials: "Clean trash" items including mixed paper, steel cans, aluminum cans, plastic bottles of different colors; recycling bin, "Tools" to sort recyclables such as a small fan, plastic garden tools, sticky paper lint rollers, magnets, flashlight, snorkel, shallow pan of water, clothespins, etc.
Activity Time: 20 minutes (lesson), 10 minutes (follow-up)
Concepts Taught: Recycling, Sorting/Grouping Objects
Correlations to NCSCOS: Grade 4: ELA Objectives 4.02, 4.05; Science 3.01; **Grade 5:** ELA Objective 4.02; Science Objectives 4.06, 4.07; **Grade 6:** ELA Objectives 3.02; Science Objectives 1.02, 1.03, 1.08, 2.01, 2.03, 7.04; **Grade 7:** ELA Objective 3.02; Science Objectives 1.02, 1.03, 1.08, 2.01, 2.03, 6.01, 6.02; **Grade 8:** ELA Objective 3.02; Science Objectives 1.02, 1.03, 1.08, 2.01, 2.03

Objectives:

- Students will simulate a recycling factory by devising and demonstrating methods to sort recyclable materials.
- Students will understand how a real MRF operates.

Background:

- Recycling helps save natural resources such as energy, landfill space, and raw materials and creates jobs.
- A MRF (Materials Recovery Facility) is a specialized plant that receives, separates and prepares recyclable materials for sale to factories that will use the recycled material to make new products.

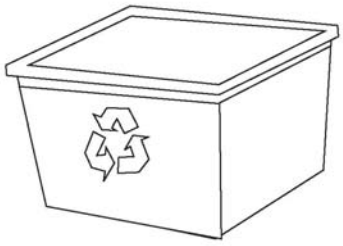
Lesson:

1. Divide students into groups, each with their own bin of mixed recyclables to sort. Each group of students will be their own "factory."
2. Each student should choose (or be assigned) one type of recyclable to sort. For example, student 1 will only pick out aluminum cans. Student 2 will only pick out paper.
3. Students are not allowed to simply use their hands to remove items. They MUST use one of the "tools" provided, such as using the magnet to remove steel cans, the lint roller to pick up paper, and so on. They may not necessarily use all the tools provided.
4. Allow students 10 minutes to make and test their factory plan.
5. Have each group demonstrate their factory to the rest of the group.
6. Show students how a real MRF might operate:
    a. A magnet picks out steel cans
    b. A light shines through the plastic bottle, can detect their color, and signals a fan to blow the green plastics into one pile, clear plastics into another, etc.
    c. A sticky conveyor belt (lint roller) removes the paper
    d. Aluminum cans are left. (These are usually removed with an eddy current-a machine that produces a countercurrent of electricity to repel cans out.)

Feed the Bin

Independent Follow Up:
Have students create their own invention or factory that will make something useful. Students should draw pictures of their invention and label and describe what it does in a few sentences.

Feed the Bin



Life Cycles of Aluminum and Paper
Grades 6-8

Materials: Information about life cycles of aluminum (included), creative aluminum story (included), grading rubric (included).
Activity Time: 30 minutes (lesson), 2-4 class periods (follow-up)
Concepts Taught: Sequencing, recycling, life cycles, creative writing
Correlations to NCSCOS: Grade 6: ELA Objectives 1.01, 1.02, 2.01, 5.01, 5.02, Competency Goal 6; Science Objectives 2.01, 2.04, 6.06, 6.07, 7.04; **Grade 7:** ELA Objectives 1.01, 1.02, 2.01, 5.01, 5.02, Competency Goal 6; Science Objectives 2.01, 2.04; **Grade 8:** ELA Objectives 1.01, 1.02, 2.01, 2.02, 5.01, 5.02, Competency Goal 6; Science Objectives 2.01, 2.04, 4.04, 4.05, 4.06.

Objectives:

- Students will understand the processes involved in production and recycling of an aluminum can.
- Using an example story as a model, students will write a creative story describing the life cycle of a piece of paper.

Background:

- Recycling helps save natural resources such as energy, landfill space, and raw materials and creates jobs.
- The three arrow symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
    - It is important to complete all three steps in the process in order for the recycling cycle to work.
    - Recycled paper is collected, processed, and made into new products such as notebooks, sticky notes, greeting cards, and toilet paper.

Lesson:

1. Review concepts above with students. Remind them that they will follow a certain procedure to recycle paper, plastic, and aluminum at their school. Explain that recycling is just one part of the entire life cycle of paper, plastic, and aluminum. Included is background material from the National Energy Education Development (NEED) Project – The Museum of Solid Waste and Energy book.
2. Ask students what life cycles they have studied in school (butterfly, humans, etc.). Ask what a cycle means (that the process continues over and over). Explain that the objects that we will recycle at school each have their own life cycle. Using the included information taken from the NEED book, go through the life cycle of an aluminum can (pages 13 and 26).
    - We start at the ore where aluminum is mined. The aluminum is still mixed with other elements, so it is sent to a plant. At the plant, the aluminum is dissolved into a liquid salt. Then an electric current separates the aluminum from other elements. The aluminum sinks to the bottom. The electric current requires an enormous amount of energy.

- Next the aluminum is likely to be sent to another factory where it is melted and formed into cans.
- The cans are sent to another factory where they are filled with liquid. The can is now shipped to a store to be sold. Once the can is sold, someone uses the liquid inside.
- Assuming the consumer is a responsible recycler, the can is placed in a recycling bin. After the materials in the bin are collected, a truck picks up the material and takes it to a MRF (Materials Recovery Facility) to be sorted.
- The cans are sorted and taken to a recycling plant. The aluminum is then shredded and melted and formed into a mold called an ingot (information taken from NEED book, page 27).
- The aluminum is then perhaps re-formed into a can and the cycle begins again. Note that the cycle does not include mining the ore & separating the aluminum from other elements. This only has to be completed once.

2. Explain to students that this life cycle can be used to write a creative story about a can. Read aloud the included aluminum story or another you have created. Ask students to pay attention to how each part of the life cycle is used in the story. This will serve as a model of the story they will write independently.
3. Students will use the information provided from the NEED book, pages 15 and 31, (suggest that students use other pages from the NEED book for background information) to write a creative life story of a piece of paper, starting from a tree. Have students complete a draft form for comments and then a final version. Their creative writing can be graded using the rubric. Use the aluminum can story as a model.
4. Students can create their own “Paper Guy” to go along with the life cycle story using recycled materials. “Paper Guys” can be displayed alongside of the stories.

Feed the Bin

My Story: Alum, the Aluminum Can

Hi, my name is Alum. I am an aluminum can and have had a long and exciting life. It all started so long ago, I cannot even remember the exact date. I just remember being pressed tighter and tighter inside of this rock. I was happy to be there, it was safe & cozy and I had my whole family near by.

One day, there was a huge explosion. I was cracked apart. Then, these men came with hammers and ripped me out of my cozy home. They took me away to a plant. Once I was at the plant they put me into a big pot. They made it very hot and dissolved me into a liquid.

Next they ran a huge electric current through me. Wow – it used so much energy! I sunk to the bottom of the liquid, and the oxygen & other elements that had been with me went to the top.

They took me and sent me to another factory. I had to say goodbye to the other elements, because they did not come with me. They got me hot again, melted me, and made me into a flat sheet. Then they made me into something that is called a "can". This is something that humans used to store liquid.

I then was sent to another factory – this one was called Pepsi. They painted me with neat colors and then filled me up with a sweet and fizzy liquid. Then someone put me in a truck where I rode for a while.

Remember how they made me so hot before? Well, now they made me very cold. I was put in a refrigerator in something called a vending machine. Next thing I knew, I was being bumped all around and came out of a slot. A kid's hand reached out and grabbed me.

He opened me up, turned me upside down, and emptied me out inside of him! The kid seemed really happy to see me. But then I got scared. I thought, "What if this is the end? Maybe this will be all I ever do."

Boy, was I wrong! This kid threw me in a special bin that only had other aluminum cans & plastic bottles in it. I even ran into my cousin, Inum, in there! He told me that everything would be okay. Next, someone lifted us out of the bin. I was glad that I could see out since the bag we were in was made of clear plastic. They took us outside.

That afternoon, a truck came. Someone emptied us into the back of the truck with a bunch of other aluminum cans and plastic bottles. The truck drove for about 30 minutes and then brought us to something they called a MRF. The plastic bottle next to me, Dottie Bottle, told me that MRF stood for "Materials Recovery Facility." I didn't get to see Dottie again because we were separated – all of the cans were put into one pile.

Then they took all of us aluminum cans to another factory. We were shredded up (Don't worry, it didn't hurt me. I don't have any nerve endings.) and melted. They poured us into these molds, almost like you pour batter into a cake pan. We got hard. Then they melted us again and made us into aluminum sheets by flattening us.

Now here is the wildest part. Guess what they made me into next? Another can! This time I went to something called a grocery store. Someone drank the liquid inside of me, put me in a recycling bin, and then the whole process of being made into a can started over again.

I love being made into a can over and over again. I have gotten to see so many different parts of the world this way. Some cans tell me that I am lucky. There are ghost stories about cans who get put into something called the trash. They don't get made into a can again. Instead they get buried in the ground with a bunch of other things. I just hope this never happens to me. I love being used over and over and meeting new people!

Well, that is my life story. You now know all about Alum, the aluminum can. Who knows, maybe I'll meet you the next time you buy something in an aluminum can. Please, just make sure to remember to recycle me so I can keep going!

Creative Writing: Life Cycle of Paper

CATEGORY	4	3	2	1
Writing Process	Student devotes a lot of time and effort to the writing process (prewriting, drafting, reviewing, and editing).	Student devotes sufficient time and effort to the writing process (prewriting, drafting, reviewing, and editing)..	Student devotes some time and effort to the writing process but was not very thorough.	Student devotes little time and effort to the writing process.
Neatness	The final draft of the story is readable, clean, neat and attractive. It is free of erasures and crossed-out words.	The final draft of the story is readable, neat and attractive. It may have one or two erasures, but they are not distracting.	The final draft of the story is readable and some of the pages are attractive.	The final draft is not neat or attractive.
Organization	The story is very well organized. One idea or scene follows another in a logical sequence with clear transitions.	The story is pretty well organized. One idea or scene may seem out of place. Clear transitions are used.	The story is a little hard to follow. The transitions are sometimes not clear.	Ideas and scenes seem to be randomly arranged.
Spelling and Punctuation	There are no spelling or punctuation errors in the final draft. Character and place names that the author invented are spelled consistently throughout.	There is one spelling or punctuation error in the final draft.	There are 2-3 spelling and punctuation errors in the final draft.	The final draft has more than 3 spelling and punctuation errors.
Accuracy of Facts	All facts presented in the story are accurate.	Almost all facts presented in the story are accurate.	Most facts presented in the story are accurate (at least 70%).	There are several factual errors in the story.
Creativity	The story contains many creative details and/or descriptions that contribute to the reader's enjoyment. The author has really used his imagination.	The story contains a few creative details and/or descriptions that contribute to the reader's enjoyment. The author has used his imagination.	The story contains a few creative details and/or descriptions, but they distract from the story. The author has tried to use his imagination.	There is little evidence of creativity in the story. The author does not seem to have used much imagination.
Requirements	All of the written requirements (# of pages, # of graphics, type of graphics, etc.) were met.	Almost all (about 90%) the written requirements were met.	Most (about 75%) of the written requirements were met, but several were not.	Many requirements were not met.

Feed the Bin

The following pages were taken from the NEED book Museum of Solid Waste and Energy.

EXHIBIT 5--RECYCLING PAPER AND GLASS

RECYCLING PAPER

What is the number one material in trash? Look around your classroom. What do you see? Posters? Notebooks? Cardboard boxes? Textbooks? Bulletin boards decorated with construction paper? You get the picture. Paper is everywhere!

Paper is the number one material that we throw away. Of every 100 pounds of trash we throw away, 39 pounds is paper. Newspapers take up about 14 percent of landfill space, and paper packaging accounts for 15 to 20 percent.

There are many kinds of paper. It can be glossy or ragged, thin or thick. It can be for newspapers or stuffing diapers. Most paper products are made from trees, though paper can also be made from old cloth or grass.

HOW PAPER IS MADE

Papermaking uses a renewable resource—trees! The first step is cutting down the trees. Paper companies plant trees just for papermaking, like an apple farmer plants apple trees. If one tree is cut down, another is planted.

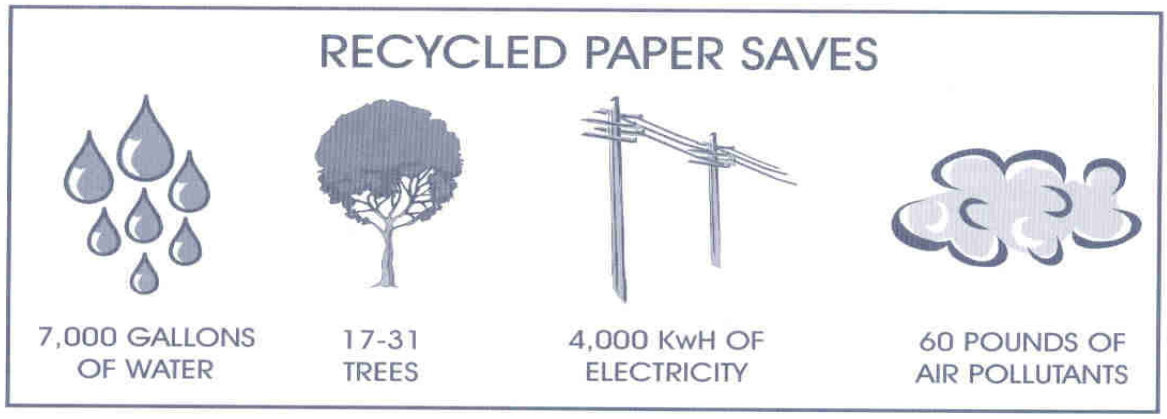
After the trees are cut, they are taken to a paper mill. Paper mills use every part of the tree, so nothing is wasted. The bark and roots are burned and used for energy to run the paper mill.

The rest of the tree is chopped into small chips to be made into paper. The raw paper is the color of grocery bags. Good papers are whitened with bleach and sometimes coated with clay to make them shiny.

Paper mills need a lot of energy to make paper. About 50 percent of their energy comes from burning wood scraps they cannot use to make paper. They buy the rest.

RECYCLED PAPER

Recycled paper is made from waste paper, usually mixed new materials. Almost all paper can be recycled today, but some types are harder to recycle than others. Papers that have wax, paste, or gum—or papers that are coated with plastic or aluminum foil—are usually not recycled because the process is too expensive.



RECYCLED PAPER

Recycled paper is made from waste paper, usually mixed with fresh wood pulp. If the paper contains ink, the paper must be **deinked**. Deinking also removes fillers, clays, and fiber fragments.

Almost all paper can be recycled today, but some types are harder to recycle than others. Papers that are waxed, pasted, or gummed—or papers that are coated with plastic or aluminum foil—are usually not recycled because the process is too expensive.

Even papers that are recycled are not usually recycled together. Waste papers should be sorted. You shouldn't mix newspapers and cardboard boxes together for recycling.

Different grades of paper are recycled into different types of new products. Old newspapers are usually made into new newsprint, egg cartons, or paperboard. Old corrugated boxes are made into new corrugated boxes or paperboard. High-grade white office paper can be made into almost any new paper product—stationery, newsprint, or paper for magazines and books.

Sometimes recyclers ask you to remove the glossy inserts that come with newspapers. The newsprint and glossy inserts are different types of paper.

Glossy inserts have a heavy clay coating that some paper mills cannot accept. Besides, a paper mill gets more recyclable fibers from a ton of pure newsprint than it does from a ton of mixed newsprint that is weighed down with heavy clay-coated papers.

NOT ALWAYS RECYCLABLE

Unlike most other recyclables, paper cannot be recycled over and over again. Eventually the fibers become too weak and short to be used again. That is why virgin paper fiber is usually mixed with recycled paper when new paper products are made. Most cardboard boxes are a mixture of 50 percent new and 50 percent recycled fibers.

SAVING ENERGY

So does paper recycling save energy? Yes it does, although the energy savings are not as spectacular as they are with aluminum and steel recycling.

PAPER*recovery*

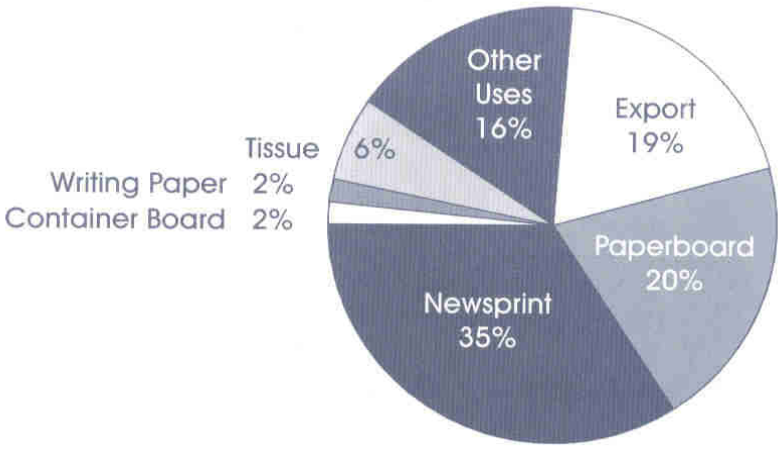
In 1995, the paper industry in the U.S. reached its goal to recover 40 percent of all paper. Today, we recover about 42 percent of the paper we use.

When the industry's goal of 50 percent recovery is achieved, 20 million tons more paper will be recovered than landfilled.

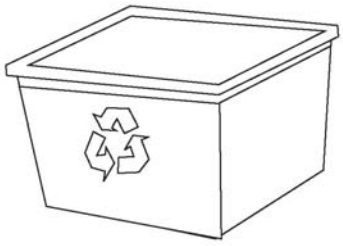
Today, more than a third of all the paper that is recovered in the world is recovered in the U.S.

Old corrugated containers (boxes) account for nearly 50 percent of the total paper that is recycled.

WHAT HAPPENS TO RECOVERED PAPER



Feed the Bin



Paper vs. Plastic Debate
Grades 9-12

Materials: Research material & suggested websites for paper & plastic (included), grading rubric (included).
Activity Time: 2-4 class periods
Concepts Taught: environmental issues, recycling, debate skills, research skills, oral presentation
Correlations to NCSCOS: English I: Objectives 2.01, 2.02, 4.01, Competency Goal 3; **English II:** Objectives 2.01, 2.02, 3.01, 3.04, 4.04; **English III:** Objective 2.01, Competency Goal 3; **English IV:** Objective 2.01, Competency Goal 3; **AP English:** Objective 2.01, Competency Goal 3; **Chemistry:** Objective 2.04; **Earth/Environmental Science:** Objectives 1.05, 1.06, 2.07; **AP Earth/Environmental Science:** Objectives 5.04, 7.02, 7.04; **Civics and Economics:** Objectives 9.04, 9.08, 10.01, 10.05; **Contemporary Issues in North Carolina History:** Competency Goal 1; **Computer/Technology Skills:** Objectives 3.02, 3.03, 3.04

Objectives:

- Students will work collaboratively to research the life cycles of paper and plastic bags.
- Students will determine whether paper or plastic bags are a better choice and prepare arguments to defend their choice.
- Students will participate in a team debate utilizing their prepared arguments.

Background:

- Recycling helps save natural resources such as energy, landfill space, and raw materials and creates jobs.
- The three arrow symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
    - It is important to complete all three steps in the process in order for the recycling cycle to work.
    - There are benefits and costs (both financial and environmental) to recycling certain materials.

Lesson:

1. Review the concepts above with students. Remind them that they will follow a certain procedure to recycle paper, plastic, and aluminum at their school. Reiterate to students that they must make a choice each time they recycle. Information about recycling is from the National Energy Education Development Project (NEED) entitled Museum of Solid Waste and Energy, pages 24 and 31 (see below).
2. An age-old question heard each time you visit the grocery store is “Paper or plastic?” Students will work together to determine which they think is the better choice to make for the environment. Explain that the students will work in 2 teams to debate their decision.

Students can choose the paper side or the plastic side. Alternatively, teachers can assign the students to the two teams.

3. The debate will involve several steps. Each student should be involved with a step. The first stage is research. Web sites for each side of the debate are included. Students should choose what they feel to be the stronger points.
4. Another step is "opposition research." Students should research the other side's information, so that they can be prepared to counter any arguments made. The Internet will be the best source of information. (Books are also useful, but may be outdated in terms of correct data.)
5. Students must then write their opening argument (2 minutes) and their closing argument (1 minute). Ideas of counter points should be written and organized in a manner so that speakers can easily find the information.
6. Lastly, speakers should practice their opening and closing arguments. All students will have the opportunity to speak by raising their hand. The teacher must call on a student to speak.
7. Both teams will gather to conduct the actual debate. Depending on the time available, you may want to allow 15-30 minutes for the debate between the opening and closing arguments. (Depending on the class, the debate may go longer than this!) Use the included rubric to grade debate teams.
8. After the debate has concluded, ask students to vote which they will choose when they go to the grocery store. There is no correct answer – both paper and plastic have advantages & disadvantages. One side may make a stronger argument, however.

Paper vs. Plastic Websites

Life Cycle of Plastic:

- http://perc.ca/waste-line/hidden/
- http://lifecycle.plasticsresource.com/

Life Cycle of Paper:

- http://www.afandpa.org
- **BOOK** Recycled paper from start to finish by Samuel G. Woods

Life Cycle of Both:

- http://www.nedlac.org.za/research/fridge/plastics/executive1.pdf
- http://www.nedlac.org.za/research/fridge/plastics/life.pdf
- http://techalive.mtu.edu/meec/module14/title.htm
- http://www.ilea.org/lcas/franklin1990.html
- http://www.ecocycle.org/askeco-cycle/20030613.cfm
- http://www.loyno.edu/lucec/paper.html
- http://www.angelfire.com/wi/PaperVsPlastic

Paper vs. Plastic Debate Rubric

CATEGORY	4	3	2	1
Respect for Other Team	All statements, body language, and responses were respectful and were in appropriate language.	Statements and responses were respectful and used appropriate language, but once or twice body language was not.	Most statements and responses were respectful and in appropriate language, but there was one sarcastic remark.	Statements, responses and/or body language were consistently not respectful.
Information	All information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear and accurate, but was not usually thorough.	Information had several inaccuracies OR was usually not clear.
Rebuttal	All counter-arguments were accurate, relevant and strong.	Most counter-arguments were accurate, relevant, and strong.	Most counter-arguments were accurate and relevant, but several were weak.	Counter-arguments were not accurate and/or relevant
Use of Facts/Statistics	Every major point was well supported with several relevant facts, statistics and/or examples.	Every major point was adequately supported with relevant facts, statistics and/or examples.	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable.	Every point was not supported.
Presentation Style	Team consistently used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	Team usually used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	Team sometimes used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	One or more members of the team had a presentation style that did not keep the attention of the audience.
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	All arguments were clearly tied to an idea (premise) but the organization was sometimes not clear or logical.	Arguments were not clearly tied to an idea (premise).
Understanding of Topic	The team clearly understood the topic in-depth and presented their information forcefully and convincingly.	The team clearly understood the topic in-depth and presented their information with ease.	The team seemed to understand the main points of the topic and presented those with ease.	The team did not show an adequate understanding of the topic.

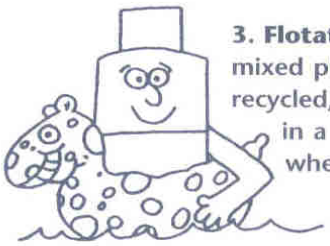
Please Note: Information below is taken from NEED Book: Museum of Solid Waste and Energy pages 24 and 31.

RECYCLING*plastic*

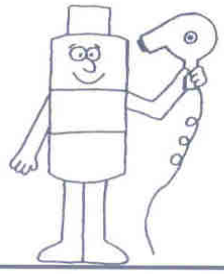
A recycling plant uses seven steps to turn plastic trash into recycled plastic:*

1. Inspection Workers inspect the plastic trash for contaminants like rock and glass, and for plastics that the plant cannot recycle.

2. Chopping and Washing The plastic is washed and chopped into flakes.



3. Flotation Tank If mixed plastics are being recycled, they are sorted in a flotation tank, where some types of plastic sink and others float.



4. Drying The plastic flakes are dried in a tumble dryer.

5. Melting The dried flakes are fed into an extruder, where heat and pressure melt the plastic. Different types of plastics melt at different temperatures.

6. Filtering The molten plastic is forced through a fine screen to remove any contaminants that slipped through the washing process. The molten plastic is then formed into strands.

7. Pelletizing The strands are cooled in water, then chopped into uniform pellets. Manufacturing companies buy the plastic pellets from recyclers to make new products. Recycled plastics also can be made into flower pots, lumber, and carpeting.

*From *Garbage* magazine, January/February 1991.

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Glossy inserts have a heavy clay coating that some paper mills cannot accept. Besides, a paper mill gets more recyclable fibers from a ton of pure newsprint than it does from a ton of mixed newsprint that is weighed down with heavy clay-coated papers.

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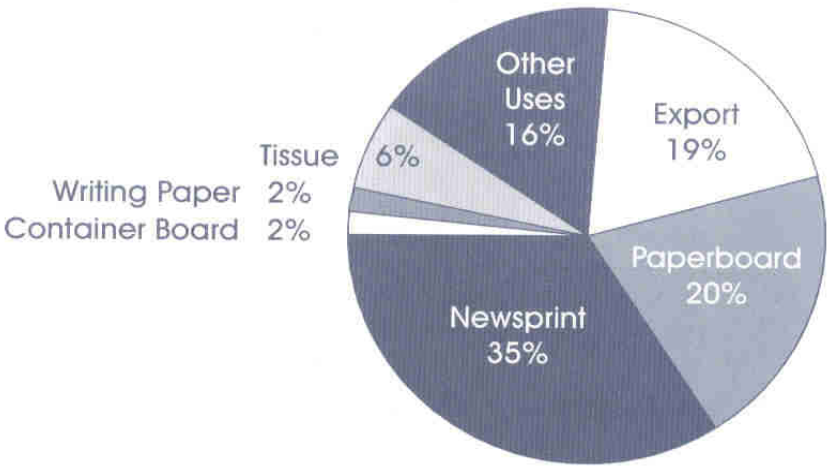


Feed the Bin

Starve the Landfill

Building a Landfill Model
Grades 3-5

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, cardboard (see diagram for alternative materials list)
Activity Time: 20 minutes (lesson); 20 minutes (follow-up)
Concepts Taught: conservation of resources, sequencing
Correlations to NCSCOS: **Grade 3:** ELA Objectives 2.08, 3.05, 4.02, 4.04; Math Objective 4.01; Science Objectives 2.01, 2.04; Social Studies Objective 4.04; **Grade 4:** ELA Objectives 2.09, 3.05, 4.002, 4.05; Math Objective 4.01; Social Studies Objective 1.04; **Grade 5:** ELA Objectives 2.09, 4.02; Math Objective 4.01; Science Objective 1.06; Social Studies Objective 1.06.

Objectives:

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

Background:

- Landfills are necessary.
- Modern landfills are highly designed and operated facilities that have little impact on the environment.
- Wake County's population generates enough total waste to average a little more than one ton per person per year.
- Students can help reduce the amount of trash produced in many ways such as recycling at school and at home.

Lesson:

1. Introduce concepts above. 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. They will then construct the landfill. Reading aloud, 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.

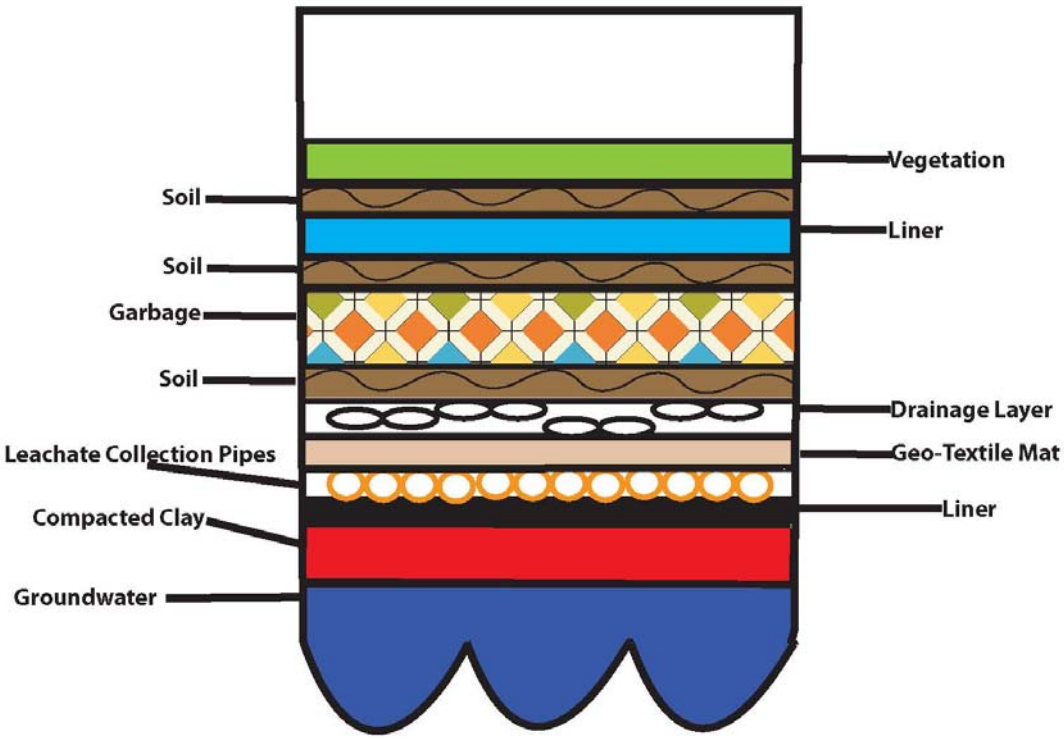
- Leachate Collection Pipes: often called “garbage coffee,” leachate is any liquid produced as trash settles. It must be collected and treated to remove any hazardous chemicals.
- Geo-Textile Mat and Drainage Layer: combining gravel and another synthetic liner, these layers help drain liquids from the 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

Simplified Wake County 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

Starve the Landfill

Landfill Reading and Problem Solving
EOG Review Activities
Grades 3-5

Materials: transparency of recycling article and questions, article about landfills and corresponding questions (included), landfill word problems and answer key (included)
Activity Time: 15 minutes (lesson); 30 minutes (follow-up)
Concepts Taught: conservation of resources, interacting with expository text, problem solving, computation
Correlations to NCSCOS: **Third Grade**: ELA Objectives 1.04, 2.03, 2.04, 2.05, 2.08, 3.05; Math Objectives 1.06, 4.01; Social Studies Objective 4.04; **Fourth Grade**: ELA Objectives 1.04, 2.01, 2.03, 2.05, 2.09, 3.05; Math Objectives 1.02, 1.04, 1.05, 4.01; Social Studies 1.04; **Fifth Grade**: ELA Objectives 1.03, 2.01, 2.03, 2.05, 2.09, 3.05; Math Objectives 1.03, 4.01; Science Objective 1.06; Social Studies Objective 1.06.

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.

Background:

- Landfills are necessary.
- Modern landfills are highly designed and operated facilities that have little impact on the environment.
- Wake County's population generates enough total waste to average a little more than one ton per person per year.
- Students can help reduce the amount of trash produced in many ways such as recycling at school and at home.

Lesson:

Part One: Reading Comprehension

1. Review concepts above with students.
2. 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.
3. Display a transparency of the recycling article below entitled "Exhibit 3-Introduction to Recycling" and read it aloud. 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.

Starve the Landfill

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.
3. Have students tell what mathematical operations they are familiar with and tell when those operations would be used.
4. 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.

Starve the Landfill

Please note: the following excerpt is from the NEED Project book Trash Talk.

EXHIBIT 3--INTRODUCTION TO RECYCLING

WHAT IS RECYCLING?

Recycling means to use something again. Newspapers are used to make new newspapers. Aluminum cans are used to make new aluminum cans. 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 96 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.

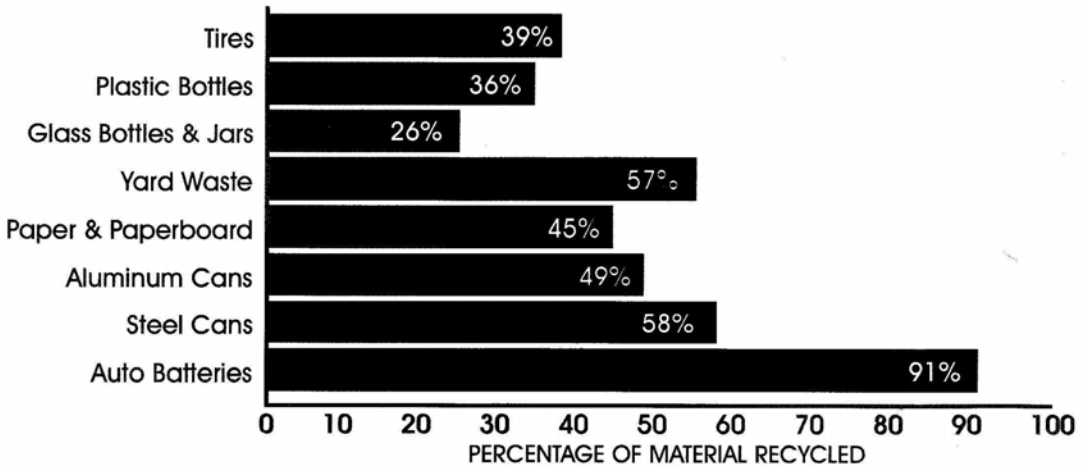
Recycling Saves Natural Resources.
Natural resources are valuable. Natural resources include land, plants, minerals, and water. By using materials more than once, we conserve natural resources.

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.

THINGS WE RECYCLE

The chart below show you some of the things we recycle and how much we recycle.



Starve the Landfill

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
    d. 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
    d. 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

6. The main idea of this article is:
    a. Recycling is important for many reasons
    b. Natural resources include land, plants, minerals, and water
    c. Recycling aluminum cans saves energy
    d. Recycling paper saves water and trees

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

Starve the Landfill

Please note: the following excerpt is from the NEED Project book Trash Talk.

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.

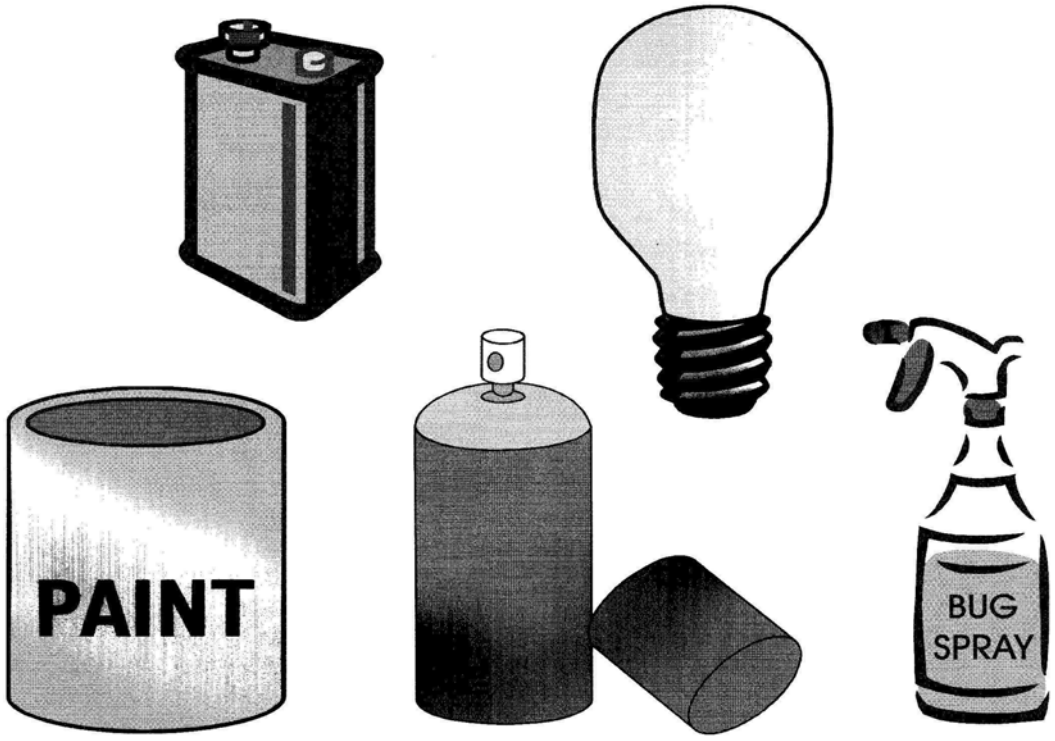
People tossed all sorts of waste into these dumps. The dumps were breeding grounds for flies, mosquitoes, and rats. Rainwater washed filthy, and sometimes poisonous, liquids from the dump into streams and groundwater supplies that people used for drinking, bathing, and clothes washing.

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—batteries, paints, pesticides, and the like—are landfills. The landfills are made to keep dangerous wastes from seeping into underground water supplies.



Starve the Landfill

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.

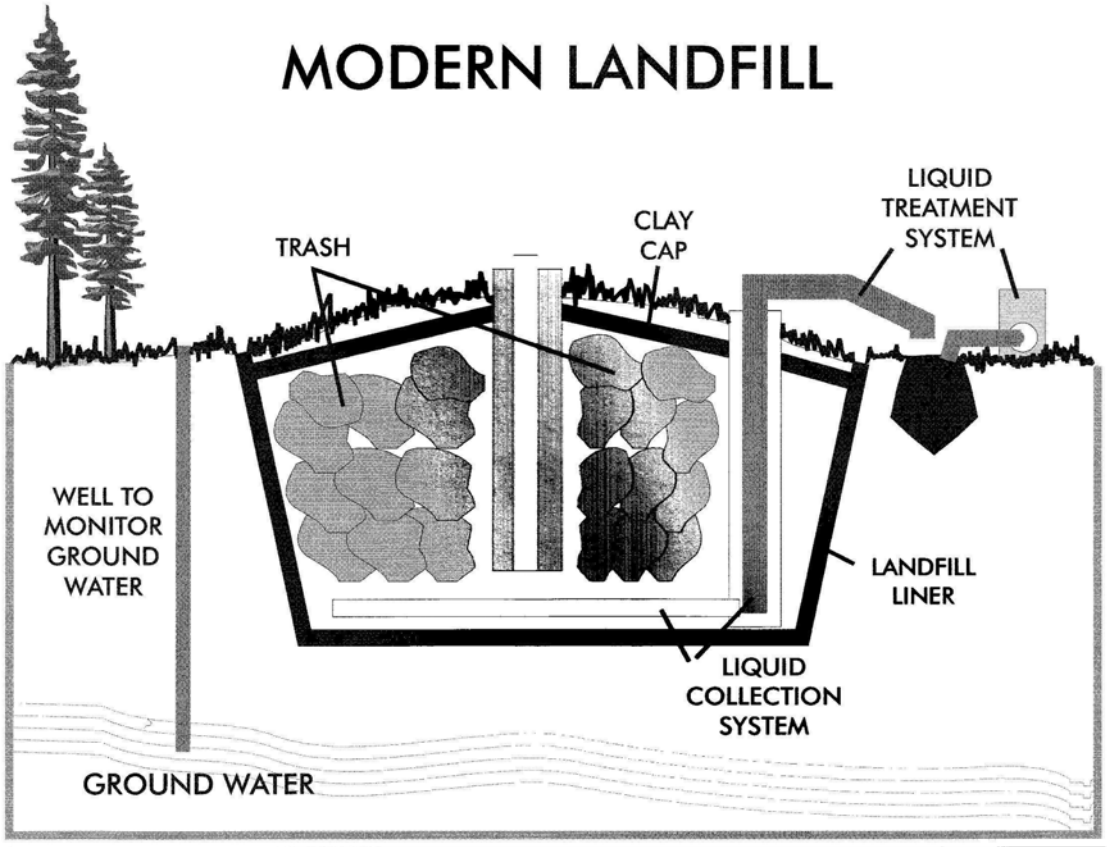
A network of drains collects the liquid and pumps it to the surface where it can be treated. Wells are drilled around the landfill to check the groundwater and make sure it is clean.

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 a layer of clay and earth, and then seed the area with native grasses.

A FULL LANDFILL

When a landfill is full, workers seal the landfill with a final cover of clay and dirt. 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.



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
    d. 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.

Starve the Landfill

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 trash can 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 trash can?

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?

Starve the Landfill

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 pick-up 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 the 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?

Starve the Landfill

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

Starve the Landfill

Evaluating Waste Streams
Grades 6-8

Materials: Samples of waste stream graphs (included), sample waste stream data for Anytown, USA (included),
Activity Time: 20 minutes (lesson); 30 minutes (follow-up)
Concepts Taught: conservation of resources, circle graphs
Correlations to NCSCOS: **Grade 6**: Math Objective 1.02, Science Objective 3.06, 3.08, 7.04; Social Studies Objectives 2.02, 3.01; **Grade 7**: Math Objectives 1.04, 4.01; Social Studies Objectives 2.02, 3.01; **Grade 8**: Math Objective 4.01

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.

Background:

- Landfills are necessary.
- Modern landfills are highly designed and operated facilities that have little impact on the environment.
- Wake County's population generates enough total waste to average a little more than one ton per person per year.
- Students can help reduce the amount of trash produced in many ways such as recycling at school and at home.

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 circle 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 almost everything we purchase is in a container or a wrapper.
5. Other items to discuss with students regarding the graph:

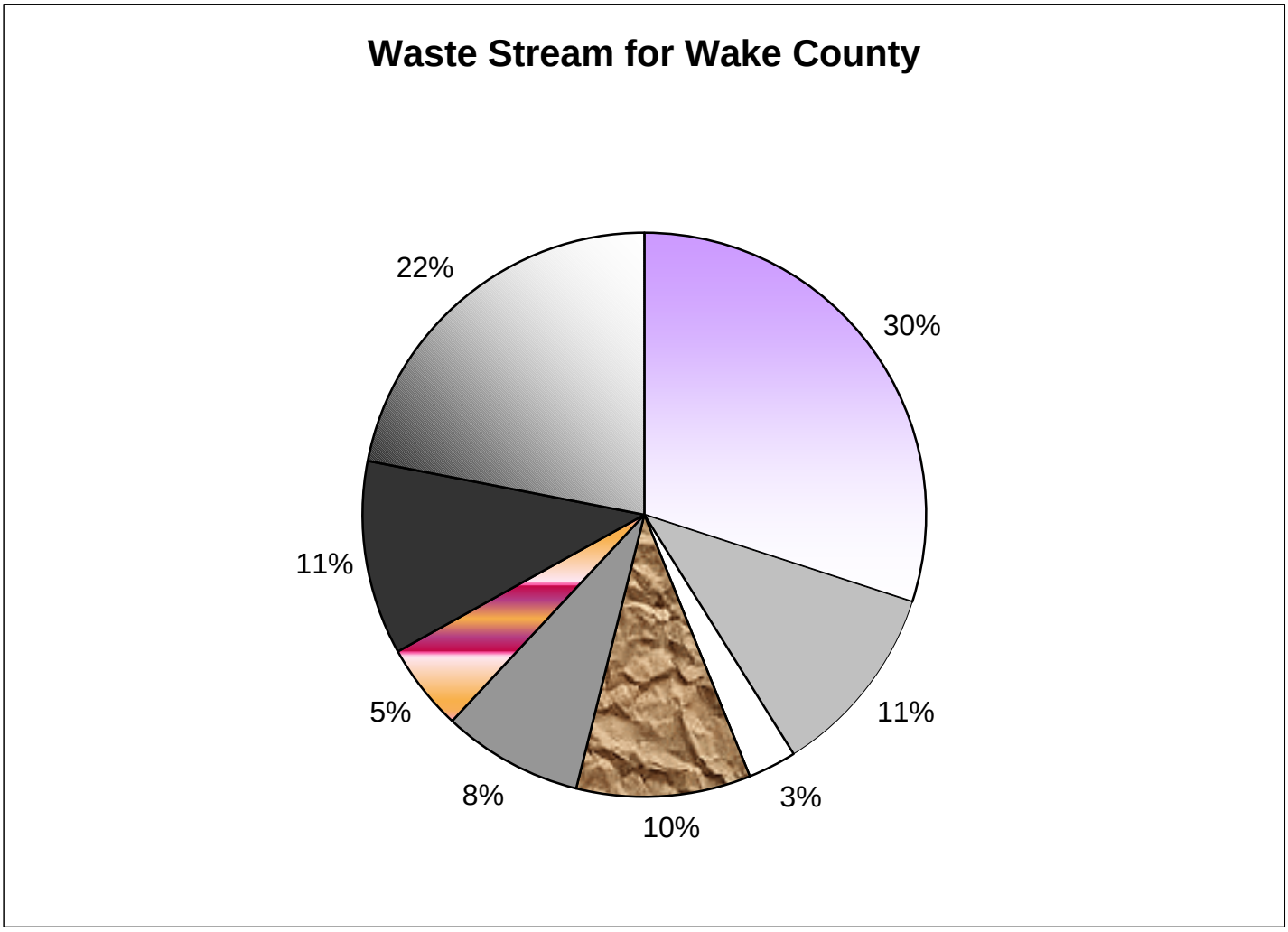
a. What is the title of this circle graph? (Waste Stream for Wake County) Notice that it describes the graph without using too many words, but gives enough detail so that the reader knows exactly what the graph is about.
b. How do you think you make a portion of the circle graph to measure exactly 30%, 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. Let's try another one. 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 provided percentages and 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.

Starve the Landfill



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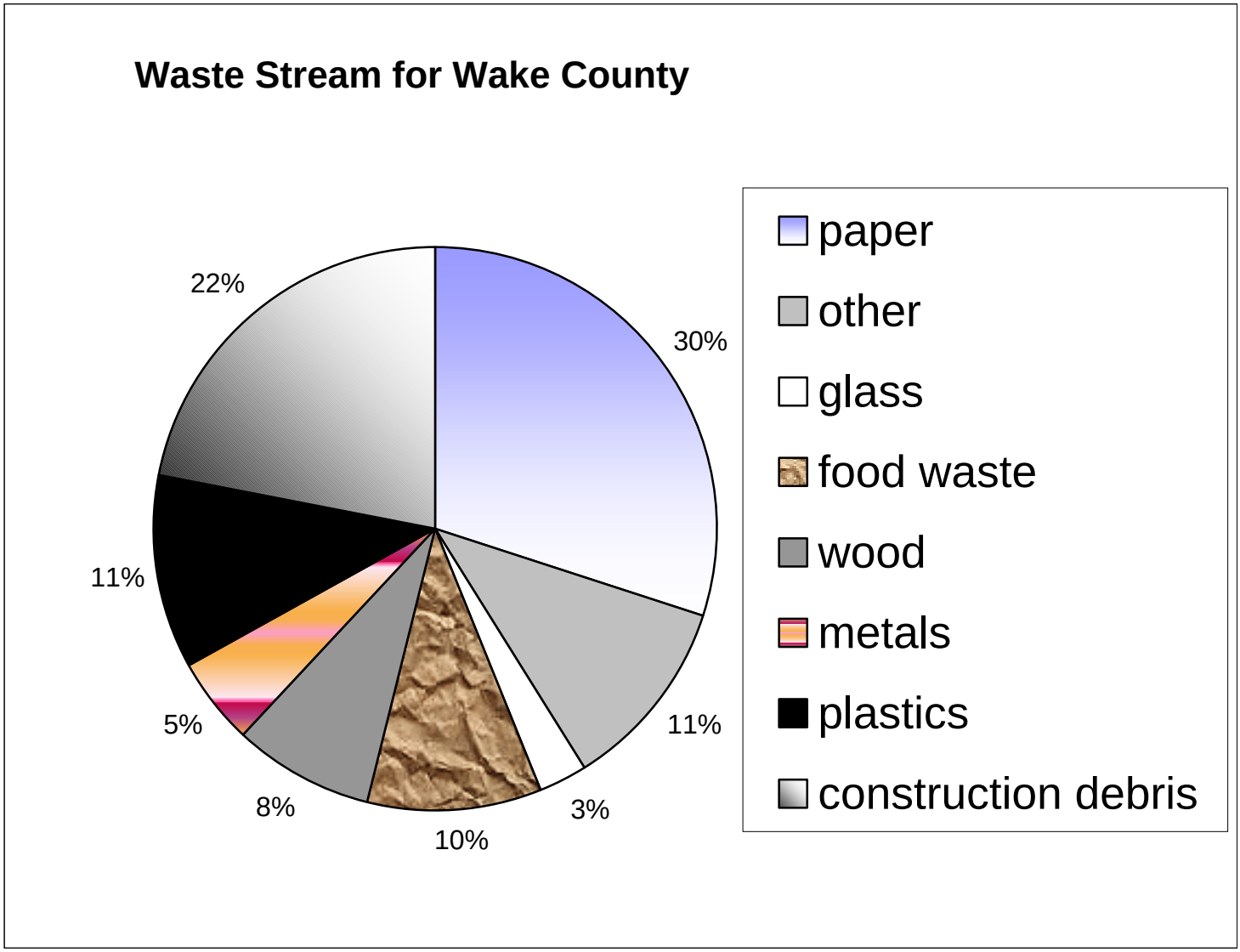
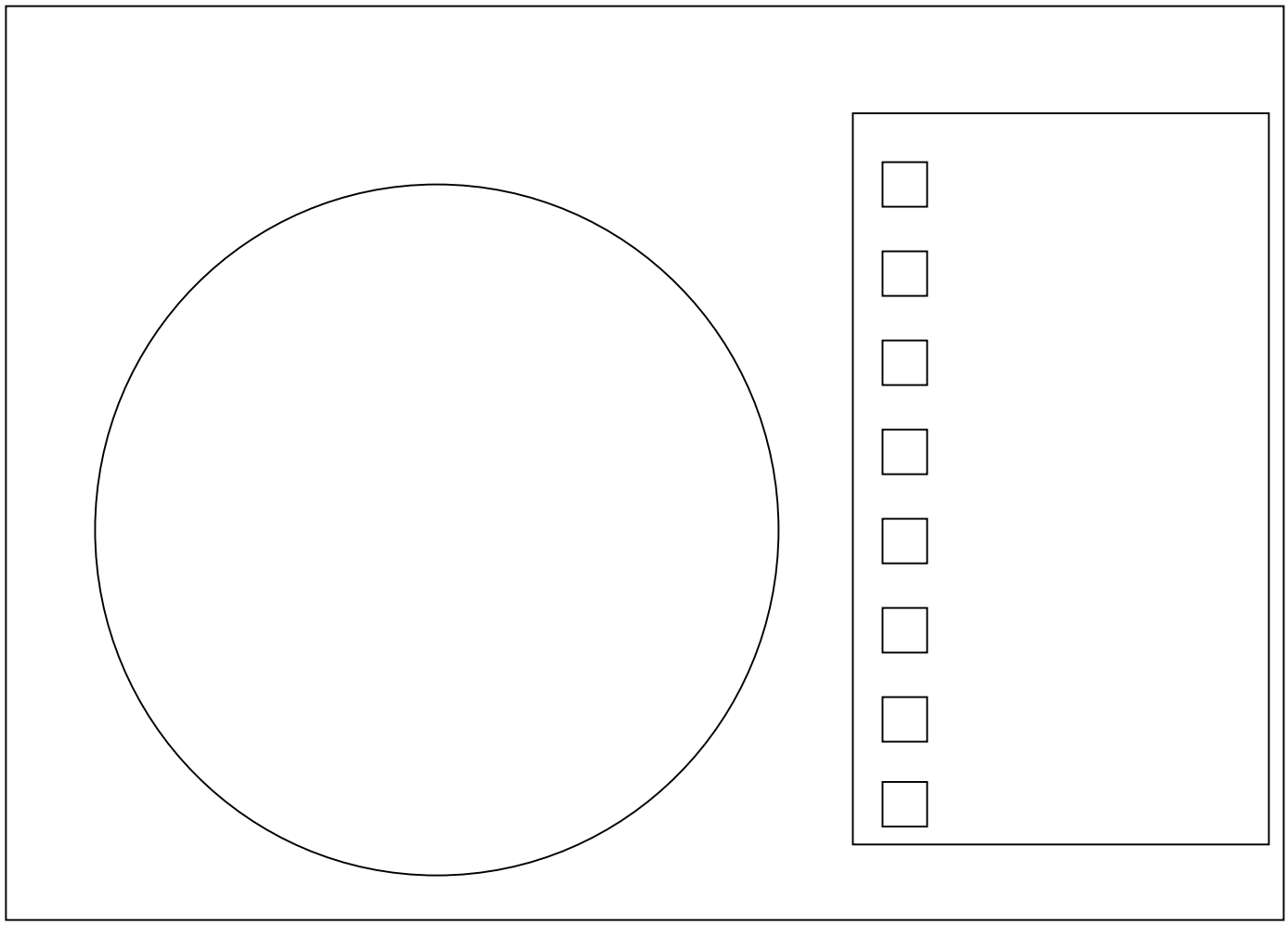


Starve the Landfill

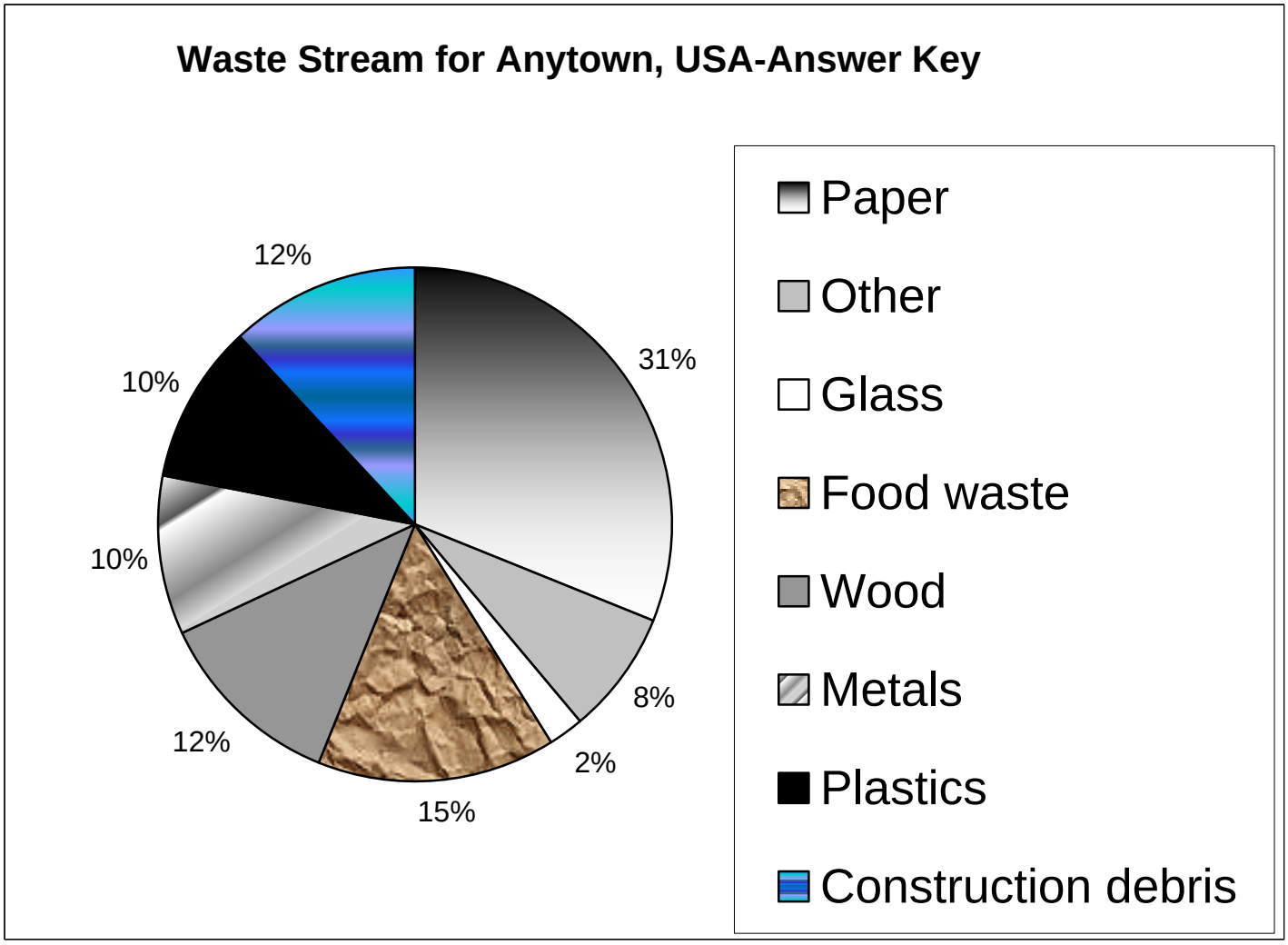
Name_____

Anytown, USA Waste Stream

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



Starve the Landfill



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 which 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 are 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.

Starve the Landfill

Garbage Pizza: a No-Waste Take on the Original
Grades 3-8

Materials: Steel-coated pizza pan (any size), 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)
Activity Time: 20 minutes (set up), 20 minutes (lesson)
Concepts Taught: conservation of resources, reading circle graphs
Correlations to NCSCOS: Grade 3: ELA Objectives 3.05, 4.02, 4.04; Math Objectives 1.01, 1.05, 4.01; Social Studies Objective 1.01; **Grade 4:** ELA Objectives 3.05, 4.02, 4.05; Math Objectives 4.01, 5.02; Social Studies Objectives 1.04, 4.03; **Grade 5** ELA Objective 4.02; Math Objective 4.01; Science Objectives 1.06; Social Studies Objectives 1.04, 1.06; **Grade 6:** ELA Objectives 1.03, 2.01; Math Objective 1.02, Science Objectives 3.06, 3.08, 7.04; Social Studies Objectives 2.02, 3.01; **Grade 7:** ELA Objectives 1.03, 2.01; Math Objectives 1.01, 4.01; Social Studies Objectives 2.02, 3.01; **Grade 8:** ELA Objective 2.01; Math Objective 4.01

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.

Set up:
Pizza Pan:

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 2. Within each section, write the corresponding number percentage value.
4. Place adhesive magnets 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

Starve the Landfill

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, construction and demolition debris, 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 2005 (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.
8. 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?

Starve the Landfill

Starve the Landfill

Creating Topographical Landfill Maps
Grades 9-12

Materials: topographical map of Wake County (included), one piece of graph paper per student, colored pencils for each student
Activity Time: 45 minutes (lesson); 45 minutes (follow-up)
Concepts Taught: landfill design, reading and constructing topographical graphs
Correlations to NCSCOS: **Earth/Environmental Science:** Objectives 1.06, 2.05; **AP Earth/Environmental Science:** Objectives 4.06, 5.04; **Contemporary Issues in NC History:** Objectives 10.01, 10.03.

Objectives:

- Students will recognize that landfills are specially designed.
- Students will examine topographical maps and identify factors used to determine appropriate location of a landfill.
- Students will construct a topographical map using provided data and information.

Background:

- Landfills are necessary.
- Modern landfills are highly designed and operated facilities that have little impact on the environment.
- Wake County's population generates enough total waste to average a little more than one ton per person per year.
- Students can help reduce the amount of trash produced in many ways such as recycling at school and at home.

Lesson:

1. Review the concepts above with students.
2. Inform students that landfills are specially designed to minimize health hazards, environmental damage and nuisances. Layers within the landfill's construction allow it to meet environmental safety specifications.
3. Topographic maps are used to represent three-dimensional surfaces on a flat piece of paper. Each contour line illustrates a particular elevation by connecting the points of equal elevation across the site. Each elevation is represented by a closed loop. Lines of different contours do not cross. The closer together the contour lines are on the map, the steeper the slope. Streams, or channels of water, are indicated on a topographical map using v-shaped lines.
4. Display the topographical map of the North Wake County Landfill and point out the location of hills and valleys. Point out the location of the North Wake Landfill on the map and compare its representation to that of a hill. (It is the trapezoid-shaped hill in the center of the map.)
5. Discuss how students could use a topographical map if given the task of selecting the location for a landfill (the area should not be too steep, should be open, should not be too close to a stream). Compare these factors to the location of the North Wake Landfill on

6. the Wake County topographical map. Discuss how open and closed sections of the landfill may appear differently on the map (closed sections will be steeper thus being represented by contour lines that are closer together).
7. Have students use colored pencils to construct a topographical map of the North Wake Landfill using the included map with only elevation numbers. Students should use the elevation numbers to create contour lines. On the map, they should identify the two closed sections of the landfill. Ask students to comment on whether or not this map is detailed enough to discern lakes, ponds, rivers, or streams. (Rivers and streams are usually shown by parallel V-shaped contour lines.) Also, students should write a paragraph explaining how to read their map and explaining why the North Wake Landfill site was most likely chosen based on its geographical location.

Extension:
Students will select a county in eastern North Carolina or a state other than North Carolina and study its geographical features to determine the best location for a landfill. Some criteria to consider:

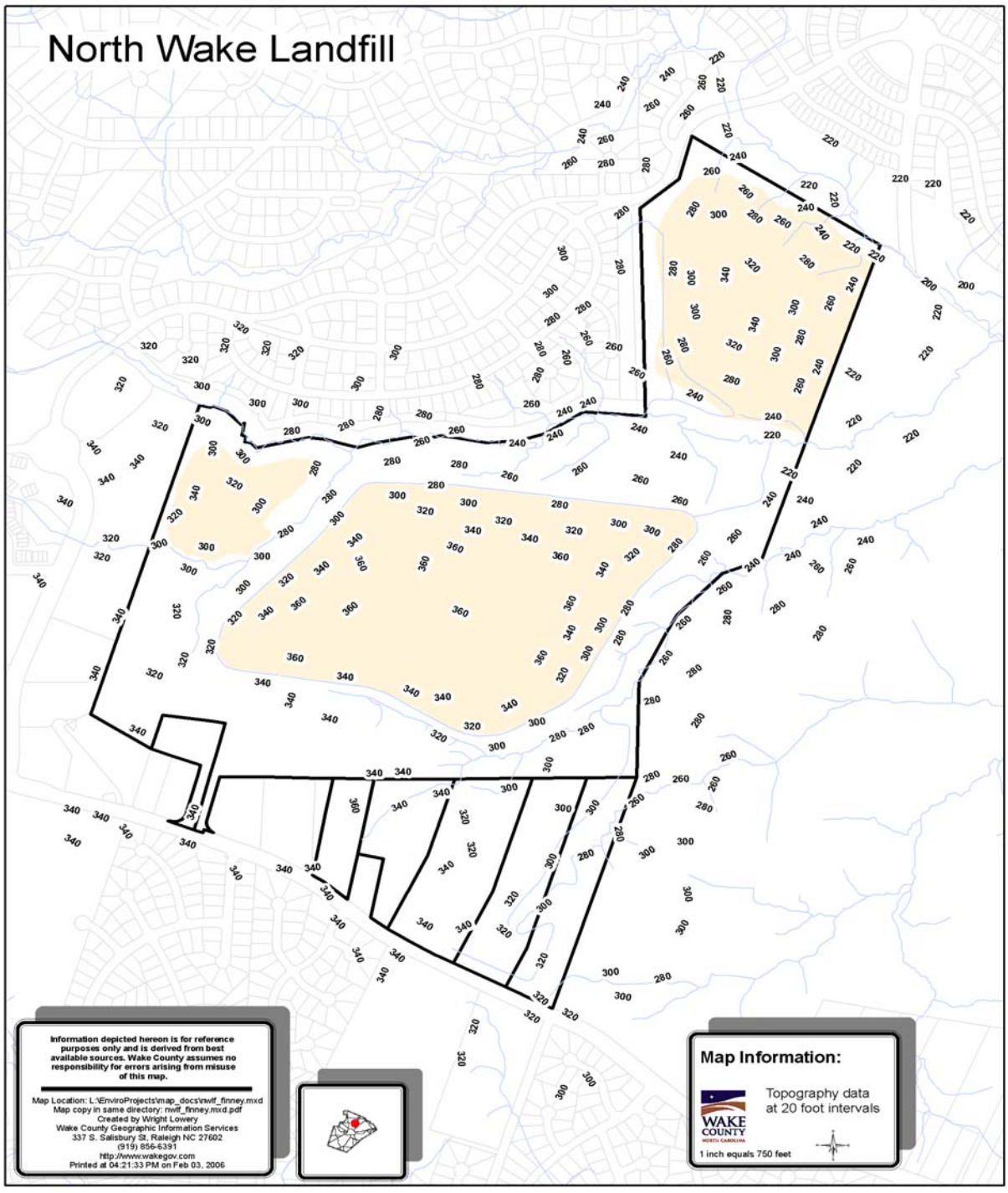
- The site is close to roads
- There are few or no houses nearby
- There are no streams or lakes in close proximity
- There is sufficient dirt to provide daily soil cover

Then, students will use colored pencils to create a topographical map showing the landfill of their selected state. Students can extend the complexity of their map by indicating places on the map where monitoring wells, collection pipes and leachate collection ponds would be placed.

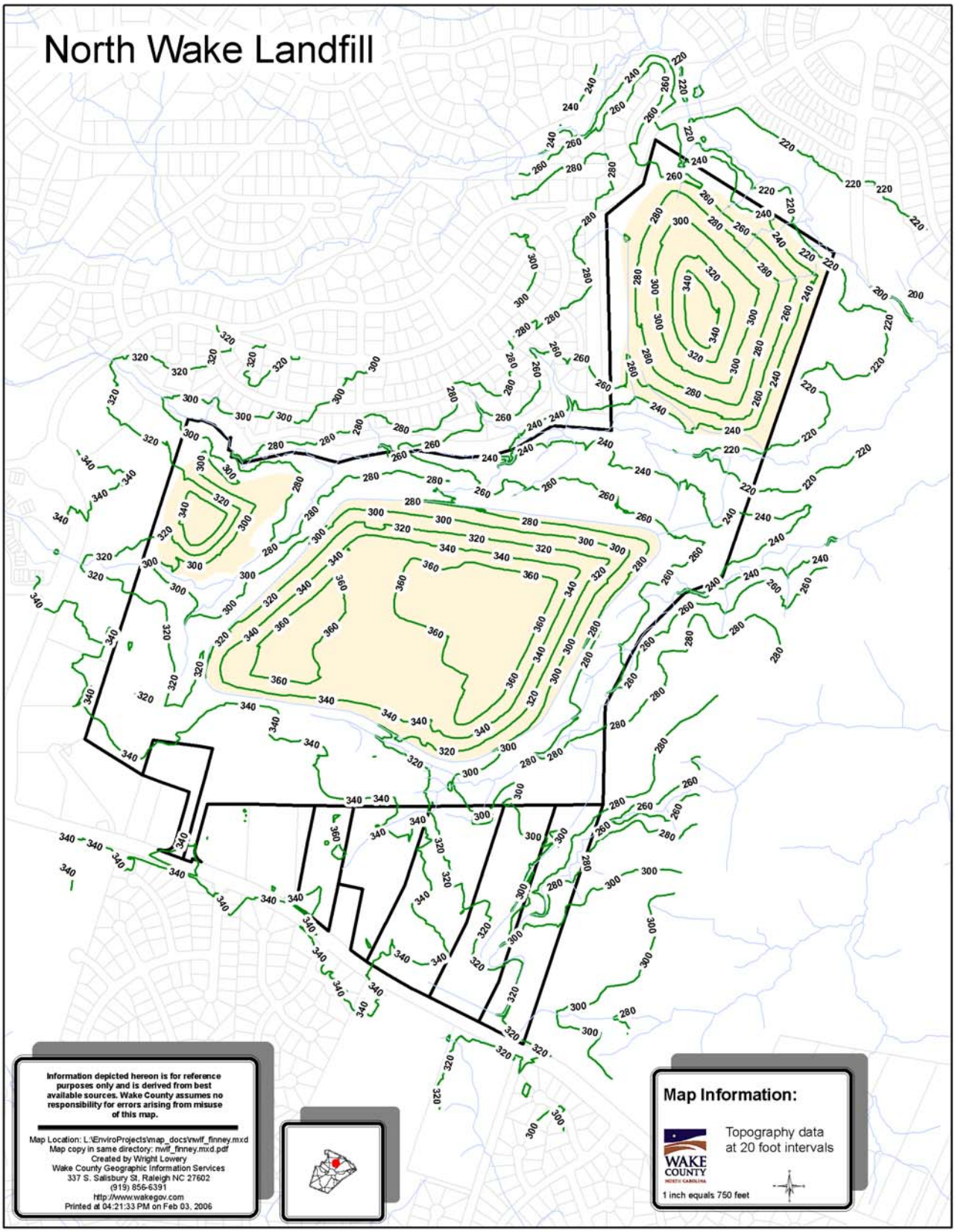
Starve the Landfill

Name_____

Use colored pencils to construct a topographical map of the North Wake Landfill. On the map, identify the two closed sections of the landfill and other prominent landmarks such as lakes, ponds, rivers, and streams. On the back of this sheet, write a paragraph explaining how to read your map and explain why the North Wake Landfill site was most likely chosen based on its geographical location.



Starve the Landfill



Close the Loop

What am I Made Of? Matching
Grades K-2

Materials: Recycled content products, NEED Project book Trash Flipbook (optional)
Activity Time: 20 minutes (lesson), 10 minutes (follow-up)
Concepts Taught: Recycling, sorting/grouping/matching objects
Correlations to NCSCOS: Kindergarten: ELA Objectives 1.03, 4.04; Math Objective 5.01, Science Objective 3.04, Art Objective 2.03; **Grade 1**: ELA Objective 4.04; Math Objective 5.01, Science Objective 3.01; **Grade 2:** ELA Objectives 4.04, 4.05

Objectives:

- Students will recognize that recycled materials are made into new things.
- Students will match recycled content items to the recyclable materials they are made from.

Background:

- The three-arrow recycling symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
- The phrase "Close the Loop" refers to the idea that buying products with recycled content finishes the loop made by the three arrows in the recycling symbol.
- **The three-arrow recycling symbol does not always indicate that a product is made from recycled content.**
    - It can simply be a reminder to recycle or can indicate that the product is recyclable.
    - There may also be labels on the product that describe the amount of post-consumer material included in the product. Post-consumer content is material that has been through consumer hands, or material that people have used and recycled. Other recycled content is usually factory leftovers such as material left over after a box has been cut from a pattern or items reclaimed from the factory floor.
- Buying recycled content material saves natural resources such as trees, land, and energy.
- Some examples of recycled content products include: newspapers, bathroom tissue, or notebook paper made from recycled paper; aluminum cans, pie tins, or bleachers made from recycled aluminum cans; fleece jackets, toys, T-shirts, lumber and playground equipment made from recycled plastic bottles.

Lesson:

1. Introduce the concepts above. When we recycle materials, they are used again to be made into new products. Use the NEED Project's Trash Flip Book to discuss with students how items that we recycle are used to make new things. Pages 33-43 are especially helpful.

2. Show the students recycled content products along with the materials used to make them. For example, explain that recycled cereal boxes are made from old boxes and paper that people have recycled, showing the three-arrow recycling logo and message that says that the box is made from recycled materials. Repeat for the other items that can be found easily at home or school:
   a. Bathroom tissue made from recycled paper
   b. Cracker or cake boxes made from recycled paper/chipboard
   c. Sticky notes made from recycled paper
   d. Pencils made from recycled paper
   e. Fleece made from recycled plastic bottles
   f. Steel food cans made from recycled steel

3. Continue to show the items to the students, allowing them to pass the items around to find the three-arrow recycling symbol. Include some items that do not have the symbol and allow students to discuss how that product could possibly be made from recycled materials.
4. Use the matching worksheet for students to independently match an item that can be recycled to its final recycled content product. The sheets may be laminated and marked on with crayon and wiped clean with tissues or other soft paper such as scraps of construction paper and reused. Students may exchange cards and check each other's answers.

Extension:

- Students can participate in a scavenger hunt to look for items that contain recycled content.
- Students can look at home, school, stores, or in catalogs for items that have the three-arrow recycling symbol or labels that indicate the product is made from recycled content.
- They can collect items from home and bring them in or make a list of the things they found, or cut out pictures of the symbol or label. Students can exchange items or lists, and discuss how the items could be used at home or school.

Close the Loop

Name_____

What Am I Made Of?

Draw a line from the pictures on the left to what it is made of on the right.

Classroom Bin

Aluminum Can

Soda Can

Pencil

Paper

Toilet Paper

Rulers

Plastic bottle

Newspaper

Foil

Close the Loop

Name___Answer Key_____

What Am I Made Of?

Draw a line from the pictures on the left to what it is made of on the right.

Classroom Bin

Soda Can

Pencil

Toilet Paper

Rulers

Newspaper

Foil

Aluminum Can

Paper

Plastic bottle

Close the Loop

Buy Recycled Friendly Letters
Grades 3-5

Materials: Friendly letter example transparencies, reusable stationery, grading rubric (included), examples of packaging
Activity Time: 20 minutes (lesson), 50 minutes (follow-up)
Concepts Taught: Letter-writing, sentence structure
Correlations to NCSCOS: Grade 3: ELA 4.02, 4.04, 4.06, 4.07, 4.09, 4.10, Competency Goal 5; Social Studies Objectives 1.01, 5.02; Computer/Technology Skills Objective 3.03; **Grade 4**: ELA Objectives 4.02, 4.05, 4.06, 4.07, 4.09, 4.10, Competency Goal 5; Social Studies Objective 6.04; Computer/Technology Skills Objective 3.06; **Grade 5**: ELA Objectives 4.02, 4.05, 4.06, 4.07, 4.09, 4.10, Competency Goal 5; Social Studies Objective 5.01

Objectives:

- Students will understand the phrase "Buy Recycled" and realize its importance.
- Students will write a friendly letter to persuade another person to buy recycled.
- Students will utilize proofreading and editing skills in preparation of a final draft letter.

Background:

- The three-arrow recycling symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
- The phrase "Close the Loop" refers to the idea that buying products with recycled content finishes the loop made by the three arrows in the recycling symbol.
- **The three-arrow recycling symbol does not always indicate that a product is made from recycled content**.
    - It can simply be a reminder to recycle or can indicate that the product is recyclable.
    - There may also be labels on the product that describe the amount of post-consumer material included in the product. Post-consumer content is material that has been through consumer hands, or material that people have used and recycled. Other recycled content is usually factory leftovers such as material left over after a box has been cut from a pattern or items reclaimed from the factory floor.
- Buying recycled content material saves natural resources such as trees, land, and energy.
- Some examples of recycled content products include: newspapers, bathroom tissue, or notebook paper made from recycled paper; aluminum cans, pie tins, or bleachers made from recycled aluminum cans; fleece jackets, toys, T-shirts, lumber and playground equipment made from recycled plastic bottles.

Close the Loop

Lesson:

1. Review the concepts above with students. Remind them what the three-arrow recycling symbol means and why it is important to close the loop and buy recycled.
2. Show students examples of the three-arrow recycling symbol on packaging (cereal boxes, cracker boxes, and similar boxes are usually good examples).
3. Ask students what they think a "pen pal" is and if they have ever had a pen pal. Explain to students that they will write a letter to a friend telling them why buying recycled is important. Remind students that they should ask questions in the letter so that the person receiving it will have something to respond to.
4. Brainstorm ideas to write about and write them on the board. Ideas could include reasons why buying recycled is important, explaining the phrase "close the loop," and giving examples of recycled content products. Brainstorm and record questions that might be included in the letter.
5. Review the format of a friendly letter using the friendly letter template included in this kit. A sample letter is also provided.
6. Have students write a rough draft of their letter. Students should then exchange letters with a partner and proofread each other's work. Instruct students to write their revised letters on final stationery.

Extensions:

1. Letters can be typed, printed, and edited using computers, or sent to pen pals at another school or in another country.

2. Students can participate in a scavenger hunt to find recycled content symbols and labels on products. They can collect items from home and bring them in or find items in the classroom, stores, or catalogs. They can write down or cut out objects with this symbol or label. These examples could then be included in the friendly letter.

Close the Loop

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Close the Loop

Friendly letter template

___Date_____

___Greeting_____,

Body_____

_____

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_____

_____

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_____

Body_____

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_____

___Closing_____,

___Signature_____

Close the Loop

Tuesday, May 2, 2005

Dear Susan,

I hope you are doing well! I learned some really cool information at school today! Do you know how important it is to buy recycled products? Well, let me tell you, it's really important! When you buy recycled products it saves natural resources like trees and land. You can tell if the product is made with recycled material by looking for the three arrow symbol and reading words that say the product is made with recycled materials. Buying recycled products also saves energy because it takes less energy to make something using recycled materials than it does to use new materials to make it.

I was amazed at how many products can be made from recycled materials. Some of these products are notebook paper, pencils, toys and even t-shirts. I think we should plan to go shopping this summer and buy some recycled products. What do you think? I will be out of school on June 1. Write back soon.

Your friend,

Charlie

Close the Loop

Grading Rubric

CATEGORY	4	3	2	1
Layout/Design	The letter is creatively designed with easily read text. Grammar, style, and purpose are excellent for a friendly letter.	The letter is eye-catching and attractive. Text is easy to read. Grammar, style, and punctuation is indicative of a friendly letter.	Letter appears messy. Text may be difficult to read. May have some grammar and/or punctuation that indicates it is a friendly letter.	Letter is inappropriate. Text is difficult to read. It does not have proper grammar or punctuation for a friendly letter.
Use of Time	Used time well during each class period (as shown by observation by teacher) with no adult reminders.	Used time well during most class periods (as shown by observation by teacher) with no adult reminders.	Used time well (as shown by observation by teacher), but required adult reminders on one or more occasions.	Used time poorly (as shown by observation by teacher) in spite of several adult reminders.
Spelling & Grammar	No spelling or grammatical mistakes within the letter.	Few spelling or grammatical mistakes within the letter.	Several spelling or grammatical errors within the letter.	Many spelling and/or grammatical errors within the letter.
Content	All content is in the student's own words and is accurate and creative.	Most content is in the student's own words and is accurate and interesting to read.	At least half of the content is in the student's own words, but information is limited.	Less than half the content is in the student's own words and/or is poorly written or incomplete.
Required Elements	Letter is complete with all required elements.	One friendly letter element is missing.	Two friendly letter elements are missing.	Three or more friendly letter elements are missing.
Cooperation	Worked cooperatively with partner all the time with no need for adult intervention.	Worked cooperatively with partner most of time but had a few problems that the team resolved themselves.	Worked cooperatively with partner most of the time, but needed limited adult intervention.	Worked cooperatively with partners some of the time, but needed frequent adult intervention.

Close the Loop

Buy Recycled Business Letters
Grades 6-8

Materials: Business letter example (included), editing mark handout (included), grading rubric (included), examples of packaging.
Activity Time: 20 minutes (lesson), 50 minutes (follow-up)
Concepts Taught: Letter-writing, sentence structure, proofreading and editing
Correlations to NCSCOS: Grade 6: ELA Objectives 2.01, 3.02, 3.03, Competency Goal 6; **Grade 7**: ELA Objectives 2.01, 3.02, Competency Goal 6; **Grade 8**: ELA Objectives 2.01, 3.02, 3.03, Competency Goal 6.

Objectives:

- Students will understand the phrase "Buy Recycled" and realize its importance.
- Students will write a business letter to persuade a business or organization to buy recycled.
- Students will utilize proofreading and editing skills in preparation of a final draft letter.

Background:

- The three-arrow recycling symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
- The phrase "Close the Loop" refers to the idea that buying products with recycled content finishes the loop made by the three arrows in the recycling symbol.
- **The three-arrow recycling symbol does not always indicate that a product is made from recycled content.**
    - It can simply be a reminder to recycle or can indicate that the product is recyclable.
    - There may also be labels on the product that describe the amount of post-consumer material included in the product. Post-consumer content is material that has been through consumer hands, or material that people have used and recycled. Other recycled content is usually factory leftovers such as material left over after a box has been cut from a pattern or items reclaimed from the factory floor.
- Buying recycled content material saves natural resources such as trees, land, and energy.
- Some examples of recycled content products include: newspapers, bathroom tissue, or notebook paper made from recycled paper; aluminum cans, pie tins, or bleachers made from recycled aluminum cans; fleece jackets, toys, T-shirts, lumber and playground equipment made from recycled plastic bottles.

Lesson:

1. Review the concepts above with students. Remind them what the three-arrow recycling symbol means and why it is important to close the loop and buy recycled.
2. Show students examples of the three-arrow recycling symbol or label on packaging and products.

Close the Loop

3. Explain to students that they will write a persuasive letter to a business or organization asking them to buy and use recycled content products. Brainstorm names of businesses and ideas to write about and map them on the board. Ideas could include reasons why buying recycled is important, thinking of examples of recycled content products applicable to a particular business or organization, and explaining the phrase "close the loop."
4. Review the format of a business letter using the provided template. Remind students that they must maintain a professional tone throughout the letter, while still sounding persuasive and passionate about the topic. Students should explain why they are writing and express their feelings toward buying recycled, as well as give opinions and suggestions for implementation at the business. Letters should end on a positive note, with students thanking the organization for their attention. A sample business letter is provided.
5. Review commonly used editing marks on the provided handout and explain to students that they will use these marks to edit another student's letter.
6. Have students write a rough draft of their letter. Students should then exchange letters with a partner and proofread each other's work using appropriate editing marks. Instruct students to write their revised letters on final stationery. Letters can be typed, printed, and edited using computers. Letters could be sent to the PTA or principal of the school, to the Wake County Public School System, the school board, or a parent's place of work. Students can also use the Internet to research companies that sell recycled content products and list those companies in their letters.

Extension:
Students can use the Internet to research the economic and environmental issues associated with products made from recycled content and virgin material. Books are also useful but may be outdated in terms of correct data.

Useful sites:

- http://www.ciwmb.ca.gov/Schools/WasteReduce/Purchasing/
- http://www.mass.gov/epp/info/whyepp.htm
- http://www.buyrecycled.com/facts.htm
- http://www.americarecyclesday.org/

Business Letter Template

Your street address
Your city, state, and zip
Date
-----Leave one blank line------
First and last name of the person to whom you are writing
Their street address
Their city, state, zip
-----Leave one blank line-----
Dear Mr./Mrs./Ms./Miss first and last name:
-----Leave one blank line-----
The text will be typed here. Business letters typically are not indented. You should maintain a professional tone throughout the letter, while still sounding persuasive and passionate about the topic. Explain why you are writing to this business and why you chose to write to them. Express your feelings toward buying recycled and why you think it is important for individuals and businesses to buy recycled.
-----Leave one blank line between each paragraph-----
Your second paragraph should offer assistance in some way. You could give opinions and suggestions for how the business could use recycled content products, or list examples of products that company could use. End on a positive note by thanking the company for their time.
-----Leave one blank line-----
Sincerely,

Your signature

If your letter is typed, leave three blank lines between the closing and your typed name. This space will be where you sign your name.**

Close the Loop

112 Elm Street
Anytown, NC 27987
May 2, 2005

Mr. David Smith
4378 Main Street
Anytown, NC 27897

Dear Mr. Smith:

Our seventh grade environmental education class recently had a speaker talk about recycling and buying recycled products. It is important to buy products with recycled material so that the recycling cycle works. I'd like to see our school begin buying recycled products for our students and staff.

Some of the products that we use in our school that could be made from recycled products include notebook paper, pencils, rulers, bleachers, bathroom tissue and playground equipment. You can be sure that you are purchasing materials made from recycled products if you see the three arrow recycling symbol or the company indicates on the product that it is made from recycled materials. I think we could save trees and energy and reduce the amount of trash our schools produce if we make a commitment to buy recycled products. I do hope you will give this idea some serious consideration. Thank you for your time and please contact me if I can help you get this project underway.

Sincerely,

Mary Jones

Mary Jones

Close the Loop

Editing Marks:	Examples:
Add a word or words	
Omit a word or words	
Add a period	
Add a comma	
Start new paragraph	
Correct the spelling	
Make a capital letter	
Close space	
Add space	
Take out word	
Transpose words	

Close the Loop

Grading Rubric

CATEGORY	4	3	2	1
Writing Process	Work shows evidence of all stages of the writing process: prewriting, drafting, revising, editing, and publishing.	Work shows evidence of some stages of the writing process: prewriting, drafting, revising, editing, and publishing.	Work shows evidence of few stages of the writing process: prewriting, drafting, revising, editing, and publishing.	Work shows little or no evidence that the writing process was used.
Neatness	The final draft of the letter is readable, clean, neat and attractive. It is free of erasures and crossed-out words.	The final draft of the letter is readable, neat and attractive. It may have one or two erasures and/or crossed out words, but they are not distracting.	The final draft of the letter is readable and may have several erasures and/or crossed out words, but they are not distracting.	The final draft is not neat or attractive.
Organization	The letter is very well organized. One statement follows another in a logical sequence with clear transitions.	The letter is fairly well organized. One statement may seem out of place. Clear transitions are used.	The letter is difficult to follow. The statements and transitions are sometimes not clear.	Ideas and statements seem to be randomly arranged.
Spelling and Punctuation	There are no spelling or punctuation errors in the final draft. Businesses and names are spelled consistently throughout.	There are few spelling or punctuation error in the final draft.	There are several spelling and punctuation errors in the final draft.	The final draft has many spelling and punctuation errors.
Purpose and Audience	Demonstrates a clear understanding of purpose and audience. The student uses specific vocabulary to provide a persuasive tone.	Demonstrates a general understanding of purpose and audience. The student uses a persuasive tone.	Demonstrates little understanding of purpose and audience. The student uses a somewhat persuasive tone.	Demonstrates no understanding of purpose and audience. The student lacks use of a persuasive tone.
Point of View and Sentence Structure	Maintains consistent point of view and organization. Uses a variety of sentence types.	Maintains a mostly consistent point of view with a variety of sentence types.	Maintains inconsistent point of view with little variety in sentence types.	Lacks a clear point of view with no sentence variety.
Requirements	All of the written requirements were met. Format is indicative of a business letter	Almost all (about 90%) the written requirements were met. Format is indicative of a business letter	Most (about 75%) of the written requirements were met, but several were not. Format is somewhat indicative of a business letter.	Many requirements were not met. Format is not indicative of a business letter.

Close the Loop

Buy Recycled Public Service Announcement
Grades 9-12

Materials: Computers with Internet access, list of websites for creating Public Service Announcements (PSAs) (included), list of websites for extension activity, video camera or digital camera (optional), NEED Project books
Activity Time: 2-4 class periods
Concepts Taught: environmental issues, recycling, computer skills, research skills
Correlations to NCSCOS: English I: Objective 4.01, Competency Goal 2, Competency Goal 3; **English II:** Objectives 2.01, 2.02, Competency Goal 3; **English III:** Objectives 2.03, 2.04, Competency Goal 3; **English IV:** Objectives 2.01, 2.03, 2.04, Competency Goal 3; **AP English:** Objective 2.01; **Earth/Environmental Science** Objectives 1.06, 2.07; **AP Earth/Environmental Science:** Objectives 5.04, 7.02, 7.04; **Civics and Economics**: Objective 4.04, Competency Goals 7, 8; **Contemporary Issues in NC History:** Competency Goals 1, 5; **Computer Technology Skills: Visual Arts Education** Competency Goal 3; **English** Objectives 3.02, 3.03, 3.04; **Social Studies** Objectives 3.03, 3.04, 3.05.

Objectives:

- Students will understand the phrase "Buy Recycled" and realize its importance.
- Students will work collaboratively to produce a Public Service Announcement to persuade others to buy recycled.
- Students will present their PSA to a classroom audience.

Background:

- The three-arrow recycling symbol represents the three steps of recycling: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled.
- The phrase "Close the Loop" refers to the idea that buying products with recycled content finishes the loop made by the three arrows in the recycling symbol.
- **The three-arrow recycling symbol does not always indicate that a product is made from recycled content.**
    - It can simply be a reminder to recycle or can indicate that the product is recyclable.
    - There may also be labels on the product that describe the amount of post-consumer material included in the product. Post-consumer content is material that has been through consumer hands, or material that people have used and recycled. Other recycled content is usually factory leftovers such as material left over after a box has been cut from a pattern or items reclaimed from the factory floor.
- Buying recycled content material saves natural resources such as trees, land, and energy.
- Buying recycled encourages companies to use recycled materials in their products.
- Some examples of recycled content products include: newspapers, bathroom tissue, or notebook paper made from recycled paper; aluminum cans, pie tins, or bleachers made from recycled aluminum cans; fleece jackets, toys, T-shirts, lumber and playground equipment made from recycled plastic bottles.

Close the Loop

Lesson:

1. Review the concepts above with students. Remind them that they must make a choice each time they recycle. There is also a choice involved with buying products made with recycled content. Some information about recycling and how recycled materials are used in new products is available in the National Energy Education Development Project (NEED) book Museum of Solid Waste and Energy, pages 22-32.
2. Many educators believe that the best way to learn about a topic is to prepare oneself to teach or explain the topic to others. Students will work in groups to create a Public Service Announcement to explain the importance of buying recycled and recycled content. Students could create a skit to present to their class, a lower grade, or other assemblies, a spot for morning announcements (either intercom or television), or a short video. The project should focus not only on why recycling is important, but should explain why buying recycled is also important.
3. Using the bulleted items in the box above, students should explain what "recycled content" means and how to determine whether or not a product contains recycled content. Also, the Public Service Announcement should explain why buying recycled is important and how the three-arrow recycling symbol consists of three steps: 1) collection of recyclables, 2) manufacturing new products from recyclables, and 3) buying recycled. They should also explain the phrase "close the loop." The presentation should be brief yet extensive enough to convey the topic adequately.
4. Students should then present their teaching tool to the class and receive comments from the class as to how it could be improved.

Extension

- Students may also create a webquest or marketing campaign.
- Explain to students that a webquest contains six major elements that guide the user through an exploration of a given topic. These elements must all be utilized in order to create a successful and exciting webquest.
- Websites detailing the webquest creation process are listed below.
- Marketing campaigns are used to promote a product or service and use persuasion and tools such as symbols, logos, jingles, or phrases that are catchy and easy to remember. Marketing campaign websites are also listed below.

]

Close the Loop

Information about Buying Recycled

- http://sunnyvale.ca.gov/Departments/Public%2BWorks/Solid%2BWaste%2Band%2BRecycling/School/Buy%2BRecycled.htm
- http://www.metrokc.gov/dnr/kidsweb/buying_guide_main.htm
- http://www.col.lake.il.us/swalco/buyrecycled.asp

Public Service Announcement Development Website

- http://ctb.ku.edu/tools/en/sub_section_main_1065.htm

Webquest Construction Websites

- http://www.education-world.com/a_tech/tech/tech011.shtml
- http://webquest.sdsu.edu/LessonTemplate.html
- http://www.spa3.k12.sc.us/WebQuests.html
- http://www.trip1.org/webquest_design.htm

Other Useful Sites

- http://ibuydifferent.com/

Public Service Announcement Rubric

CATEGORY	4	3	2	1
Research/Statistical Data	Students include 4 or more high-quality examples or pieces of data to support their campaign.	Students include at least 3 high-quality examples or pieces of data to support their campaign.	Students include at least 2 high-quality examples or pieces of data to support their campaign.	Students include fewer than 2 high-quality examples or pieces of data to support their campaign.
Campaign/Product	Students create an original, accurate and interesting product that adequately addresses the issue and is very persuasive as evidenced by persuasive language and accurate product knowledge.	Students create an accurate product that adequately addresses the issue and is persuasive as evidenced by use of some persuasive language and some accurate knowledge of the product.	Students create an accurate product but it does not adequately address the issue. The product is somewhat persuasive.	The product is neither accurate nor persuasive.
Brainstorming-Identifying the Need for Change	Students identify more than 4 reasonable, insightful barriers/problems that need to change.	Students identify at least 4 reasonable, insightful barriers/problems that need to change.	Students identify at least 3 reasonable, insightful barriers/problems that need to change.	Students identify fewer than 3 reasonable, insightful barriers/problems that need to change.
Brainstorming-Solutions for Change	Students identify more than 4 reasonable, insightful possible solutions/strategies to encourage change.	Students identify at least 4 reasonable, insightful possible solutions/strategies to encourage change.	Students identify at least 3 reasonable, insightful possible solutions/strategies to encourage change.	Students identify fewer than 3 reasonable, insightful possible solutions/strategies to encourage change.
Oral Presentation	Interesting, well-rehearsed with smooth delivery that holds audience attention.	Relatively interesting, rehearsed with a fairly smooth delivery that usually holds audience attention.	Delivery not smooth, but able to hold audience attention most of the time.	Delivery not smooth and audience attention lost
Knowledge Gained	All students in the group can accurately answer all questions related to facts in the campaign and to technical processes used to create the campaign.	All students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Most students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Several students in the group appear to have little knowledge about the facts or technical processes used in the campaign.
Workload	The workload is divided and shared equally by all team members	The workload is divided and shared fairly by all team members, though workloads may vary from person to person.	The workload was divided, but one person in the group is viewed as not doing his/her fair share of the work.	The workload was not divided OR several people in the group are viewed as not doing their fair share of the work.

Webquest Grading Rubric

CATEGORY	4	3	2	1
Engaging Scenario & Tasks	The scenario and task are engaging for students. The task provides sufficient background information to excite the interest of students and the procedures are clearly outlined.	The scenario is interesting and the tasks are clearly defined. The background information is sufficient to be interesting to most students, and the procedures are clearly outlined.	The scenario is somewhat interesting but the task requires a student to research only at the knowledge or comprehension level. The directions are somewhat vague.	The scenario is not interesting and the task requires a student to research only at the knowledge level. The directions are not clear.
Relevant Internet sources at appropriate grade level for students	All information listed is relevant. The quest puts meaning of the problem in personal, social or community perspectives and sources are at an appropriate reading level for students.	All information listed is relevant but the quest uses a limited number of sources. The sites do encourage some reflection and are at an appropriate reading level for students.	Some material listed is relevant but the quest uses few sources. The sites encourage minimal reflection and may be developmentally inappropriate.	The links to sites and materials are not directly connected to the assignment or only one source is used. The quest does not provide information for students to analyze or interpret.
Presentation Style	The group consistently used graphics, sounds, and links in a way that kept the interest of the user.	The group usually (85% of the time) used graphics, sounds, and links in a way that kept the interest of the user.	The group sometimes (70% of the time) used graphics, sounds, and links in a way that kept the interest of the user.	The group rarely used graphics (50% or less of the time), sounds, and links in a way that kept the interest of the user.
Organization	All sites were clearly tied to an idea (premise) and organized in a tight, logical fashion. All elements of a webquest are present.	Most sites were clearly tied to an idea (premise) and organized in a tight, logical fashion. All elements of a webquest are present.	All tasks and sites were clearly tied to an idea (premise) but the organization was sometimes not clear or logical. One element of a webquest is missing.	Tasks and sites were not clearly tied to an idea (premise). The product is not clearly connected to the question. Two or more elements of a webquest are missing.
Knowledge Gained	All students in the group can accurately answer all questions related to facts in the quest and to technical processes used to create the quest.	All students in the group can accurately answer most questions related to facts in the quest and to technical processes used to create the quest.	Most students in the group can accurately answer most questions related to facts in the quest and to technical processes used to create the quest.	Several students in the group appear to have little knowledge about the facts or technical processes used in the quest.
Creativity	User would be able to generate multiple approaches of looking at the problem. The user would be challenged to demonstrate different approaches.	The user would be able to demonstrate a few clear approaches to understanding the problem. The Webquest requires users to come to limited conclusions.	The user may be able to demonstrate a single approach to understanding the problem. The user can only come to one trite conclusion.	Student copies and pastes from the Internet without discrimination; product demonstrates little connection to the question; product does not show reflection.
Workload	The workload is divided and shared equally by all team members	The workload is divided and shared fairly by all team members, though workloads may vary from person to person.	The workload was divided, but one person in the group is viewed as not doing his/her fair share of the work.	The workload was not divided OR several people in the group are viewed as not doing their fair share of the work.

Marketing Campaign Rubric

CATEGORY	4	3	2	1
Research/Statistical Data	Students include 4 or more high-quality examples or pieces of data to support their campaign.	Students include at least 3 high-quality examples or pieces of data to support their campaign.	Students include at least 2 high-quality examples or pieces of data to support their campaign.	Students include fewer than 2 high-quality examples or pieces of data to support their campaign.
Accuracy and Originality	Students create an original, accurate and interesting product that adequately addresses the issue. Product shows a large amount of original thought. Ideas are creative and inventive.	Students create an accurate product that adequately addresses the issue. Product shows some original thought. Work shows new ideas and insights.	Students create an accurate product but it does not adequately address the issue. Uses other people's ideas (giving them credit), but there is little evidence of original thinking.	The product is not accurate. Uses other people's ideas, but does not give them credit.
Technical Elements	Students use more than 4 marketing tools (logos, jingles, etc.) efficiently in their campaign.	Students use at least 3 marketing tools (logos, jingles, etc.) efficiently in their campaign.	Students use at least 3 marketing tools (logos, jingles, etc.) somewhat efficiently in their campaign.	Students use fewer than 3 marketing tools (logos, jingles, etc.), possibly in an inefficient way.
Effectiveness of Campaign	The campaign is highly persuasive in convincing the audience to buy recycled, as evidenced by persuasive language and accurate product knowledge.	The campaign is persuasive in convincing the audience to buy recycled as evidenced by some persuasive language and some accurate knowledge of the product.	The campaign has some persuasive elements in convincing the audience to buy recycled.	The campaign is not persuasive in convincing the audience to buy recycled.
Attractiveness and Organization	The campaign has exceptionally attractive formatting and well-organized information.	The campaign has attractive formatting and well-organized information.	The campaign has well-organized information.	The campaign's formatting and organization of material are confusing to the reader.
Knowledge Gained	All students in the group can accurately answer all questions related to facts in the campaign and to technical processes used to create the campaign.	All students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Most students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Several students in the group appear to have little knowledge about the facts or technical processes used in the campaign.
Workload	The workload is divided and shared equally by all team members	The workload is divided and shared fairly by all team members, though workloads may vary from person to person.	The workload was divided, but one person in the group is viewed as not doing his/her fair share of the work.	The workload was not divided OR several people in the group are viewed as not doing their fair share of the work.

All About Plastics

Plastics Investigations
Grades K-5

Plastics Poetry
Plastics Sight Words
Living Bar Graph
Properties of Plastics

Materials: See individual lessons for materials needed.
Activity Time: PLEASE NOTE: The activities contained in this lesson packet can be conducted over the course of a week as a unit or the activities can also stand alone.

- Conducted as a unit: 4 periods of 30 minutes each
- Conducted individually: 30 minutes per lesson

Concepts Taught: Sorting/grouping objects, personal expression through poetry, recognizing sight words, graphing, density, temperature
Correlations to NCSCOS: Kindergarten: ELA Objectives 1.03, 4.03, Math Objectives 1.01, 2.01, 4.01, 4.02, 5.01, Science Objectives 3.01, 3.02, 3.03, 3.04; **Grade One:** ELA Objectives 4.02, 4.03, 4.06, Math Objectives 4.01, 5.01, Science Objectives 3.01, 3.02, 3.03, 3.04; **Grade Two:** ELA Objectives 4.05, 4.07, Math Objectives 1.03, 2.01; **Grade Three:** ELA Objectives 3.05, 4.04, 4.07, 4.08, 4.09, 5.07, Math Objectives 2.02, 4.01; **Grade Four:** ELA Objectives 1.05, 4.05, 4.07, 4.08, 4.09, 5.02, 5.06, Math Objectives 4.01, 4.03, Science Objectives 1.01, 1.04; **Grade Five:** ELA Objectives 4.07, 4.08, 4.09, 5.07, Math Objectives 2.01, 4.01, 4.02,

Objectives:

- Students will understand which kinds of plastics can be recycled at their school.
- Students will sort and identify plastics by their number.
- Students will recognize that plastics can be found in our homes and at school.
- Students will investigate some of the properties of plastics.

Preparation: Ask students to bring in different –numbered plastic items from home. These should be collected by the teacher and kept aside until the day of the lesson. Please be aware that you will likely receive more 1's and 2's since they are the most prevalent type. Have examples of numbers 3-7 in case those are not collected and brought in. Students should not bring in items that may be dangerous, such as motor oil containers.
Examples:

- One (PETE): soda bottle
- Two (HDPE): milk jug
- Three (PVC): coffee container, cooking oil bottle, shampoo bottle
- Four (LDPE): mustard container
- Five (PP, say "double P"): yogurt tub, syrup bottle, ketchup bottle
- Six (PS): coffee cup, some plastic flower pots
- Seven (Other): mixed plastics containers, some detergent bottles

There are seven main types of plastics. Most plastic items (not just bottles or cups) have a number within the three-arrow recycling symbol located somewhere on them. These numbers are used in different parts of the country to help people identify which items their recycling program will accept.

All About Plastics

If your school recycles cans and bottles through Feed the Bin, only plastic bottles can be recycled. Yogurt cups, margarine tubs, and other containers that do not have a neck cannot be recycled. Check with your school's recycling coordinator to determine where your can and bottle recycling bins are located.

Lesson One: Plastics Poetry

Materials Needed: "Puppy" cinquain (below); copies of cinquain graphic organizer sheet for each student; one plastic item per student.

Students will as a class create a type of poem called a cinquain to describe a plastic item. Students can choose from items such as a plastic bottle, plastic fleece, plastic ruler, or others. According to your grade level, you can simply write the poem as a class and count out syllables or look for patterns in the words, or write a class poem as well as individual poems.

1. Explain to students that a cinquain is a poem that has five lines and does not rhyme.
2. The structure of the poem is:
   First Line: One-word title (noun)
   Second Line: Two descriptive words (adjectives)
   Third Line: Three words that express action (verbs)
   Fourth Line: Four words that express feeling
   Fifth Line: One word that is a synonym or reference to the title in line 1.
3. Review parts of speech included in the poem: nouns, adjectives, verbs, adverbs, synonyms if appropriate.
4. Review the "Puppy" cinquain with students, classifying each word as one of the parts of speech as appropriate or with younger students, clap out the syllables in each line.
5. Using a plastic bottle as the subject, have students brainstorm words for Line 1, writing their suggestions on the board or an overhead. Continue brainstorming for all five lines, making sure to count out syllables for each word.
6. Select the appropriate number of words from each line of suggestions to create a model cinquain.

Extensions for Grades 3-5

1. **For older students**, use the "true" cinquain format:
   First Line: One-word title, two syllables
   Second Line: Two descriptive words, four syllables total
   Third Line: Three words that express action, six syllables total
   Fourth Line: Four words that express feeling, eight syllables total
   Fifth Line: One word that renames title, two syllables
2. Using the same poem, students should use a thesaurus to choose replacement words for the words in their poem. Instruct students to continue to be mindful of the number of syllables required in each line.
3. Divide students into groups to inspect different areas of the classroom. Students should sit in one location and without getting up, record all objects that are made of plastic.
   Write a haiku that describes how plastics are everywhere

All About Plastics

Name_____

Cinquain Poetry
A cinquain is a five – line poem that describes a person, place, thing, or animal.

Puppy
Fluffy, Playful
Jumping, Barking, Running
Always makes me laugh
Pet

Use the boxes below to write your own cinquain.

What is your poem about? (one word)	
Write two words that describe it.	
Write three words that describe something it does.	
Write four words that describe how you feel about it.	
Write one word that renames your poem.	

Lesson Two: Plastics sight words

Materials: Plastic items collected from students; number and color sight word cards (below), Unifix cubes (optional).

This lesson uses numbers commonly found on plastics to reinforce number and color sight words.

1. Arrange different-numbered plastic containers for students at their center.
   a. One: soda bottle
   b. Two: milk jug
   c. Three: coffee container, cooking oil bottle, shampoo bottle
   d. Four: mustard container
   e. Five: yogurt tub, syrup bottle, ketchup bottle
   f. Six: coffee cup, some plastic flower pots
   g. Seven: mixed plastics containers, some detergent bottles
2. Encourage students to look for the three-arrow recycling symbol with number.
3. Have students match the number they find with the appropriate sight word card (use cards below).
4. Show students that plastics can be many different colors, no matter what number they are. Have students match the color of the plastic item with the appropriate sight word card (use cards below).
5. Students can also use the worksheet below to count items and write the appropriate number word.

Extensions:

1. Have students draw pictures of an imaginary bottle for numbers 8-10 and make their own word card.
2. Have students count plastic Unifix cubes and match to word cards.

one	two
three	four

five	six
seven	white
green	blue
red	yellow
purple	orange
black	brown

Name_____

Count the  .

Write how many. Use words.

three

_____

_____

_____

_____

Lesson Three: Living Bar Graph Activity

Materials: Masking tape; plastic items collected from students; graphing sheet (below).

This lesson uses different numbered plastics as a subject to create a bar graph.

1. Review graphing by asking each student to call aloud their eye color. Instruct all students to keep track of each response by making tally marks or other techniques.
2. Discuss different methods students used to collect data: tally marks, numbers, etc.
3. Explain that using a bar graph is one way of displaying information in an organized way.
4. Make a sample bar graph on the board or on a transparency of the eye colors.
5. Explain to students that bar graphs are a way to count numbers of different things.
6. Using a line drawn on the floor or a piece of masking tape, create a "baseline" or x-axis with the numbers 1-7 so that students can use their bodies to create a bar graph. Use the attached page 42 from the NEED book Trash Flipbook to identify common items with the different numbers.
7. Give each student a piece of plastic with a different number. The numbers on plastic are usually found on the bottom of the container inside the three-arrow recycling symbol.
8. Have students stand in a line at the number that matches their container.
9. Have students in each line count off and record numbers.
10. Ask students questions about the graph while still standing: Which line is longest? Shortest? Did any lines have the same number?
11. Have students return to their seats and use the worksheet below to graph the data generated by the activity if appropriate for their level.

Extensions for Grades 3-5:

1. Have students make another bar graph using favorite colors or foods of students.
2. Students can make Venn Diagrams using certain characteristics of plastics such as color, presence of a neck on the bottle, and etc.
3. Discuss which plastics were easiest to find in the classroom and at home. Why do you think this is?
4. Have students create another graph of favorite colors, foods, etc. using different colors of construction paper for the bars. Discuss how graphs visually depict data and the importance of neatness and simplicity in making a graph.

All About Plastics

Name_____

Shade in the boxes below to show how many of each kind of plastic you saw today.

Amount of Plastics

eleven							
ten							
nine							
eight							
seven							
six							
five							
four							
three							
two							
one							
	1	2	3	4	5	6	7

Kinds of Plastic

All About Plastics

Lesson Four: Properties of Plastics

Materials: Pieces of cut up plastic bottles number 1-7; container of water for each student group; prediction worksheet; aluminum foil; #1 2-liter plastic soda bottle with cap; #2 1-gallon milk jug; hot tap water; 4 thermometers; Styrofoam coffee cup; 1-liter plastic bottle with the neck cut off; paper cup; plastic picnic-style disposable cup; pieces of fabric-OPTIONAL (fur, flannel, silk, cotton, synthetic fabrics).

This lesson will allow students to investigate how different numbered plastics have different properties, among them the ability to sink or float and ability to change shape or be malleable when heated and insulate.

Sink/Float display:

1. Using some common objects found in the classroom and a clear container filled with water, demonstrate that some objects sink and some float. Those that have a greater density than water will sink and those that have less density than water will float. Plastics also behave the same way. Show students the cut up pieces of plastic. Explain to students that some of these plastics will sink and some will float. Using the attached chart, have students predict which pieces will sink and which will float. Allow students to examine the plastic in small groups.
    a. #1: sinks
    b. #2: floats
    c. #3: sinks
    d. #4: floats
    e. #5: floats
    f. #6: sinks if condensed (party cups, etc.); floats if “expanded” (polystyrene coffee cups, etc.)
    g. #7: some will sink and some will float since it is an unpredictable mixture of plastics
2. Put all plastic pieces in the water and record observations.
3. Have students answer the questions on the sheet.

Extensions for Grades 3-5:

1. Discuss with students how the shape of an item can affect its ability to float or sink. Demonstrate with an empty soda bottle with the cap on. Why does it float? Now take the cap off and fill it with water? Why does it sink?
2. Have students use pieces of aluminum foil and make “boats” that will float.
3. Discuss why floating litter would be a problem for aquatic animals.
4. How would the plastics behave if the water was very salty (like the ocean)? To test this, add several heaping tablespoons to the water and stir well. Retest plastics.
5. Discuss how to keep warm on a cold day. What kind of clothes do we wear? Investigate animals that must have insulation. How do you think they would adapt to a warmer climate considering the amount of insulation they have? How do humans adapt to a warmer climate?

All About Plastics

Heating and Cooling:

1. Explain to students that when heat is applied to substances, they can change state. When heat is applied to ice (a solid), it will melt into liquid water and will remain a liquid at room temperature. When wax is heated by the wick of a candle, it melts from a solid to a liquid. However, when it is allowed to cool at room temperature, it returns to a solid.
2. Plastics behave more like wax when heated. To demonstrate this, pour hot water (as hot as your tap allows) into a clean, empty, 2-liter soda bottle. Fill ¾ full and cap. Using gloves, demonstrate to the students that the bottle becomes more flexible when it is heated by gently squeezing the sides of the bottle.
3. Note that the plastic used in the above step was a number 1 plastic bottle.
4. Repeat the same experiment using a plastic milk jug, a number 2 plastic. Allow students to predict the results. The milk jug will not become as malleable when hot water is added.
5. Continue this line of thinking by arranging four containers for the students: a Styrofoam coffee cup, a 1-liter plastic bottle with the neck cut off, a paper cup, and a plastic picnic-style disposable cup.
6. Using hot tap water, fill each container with 50 mL of water. Immediately put a thermometer in each container and record the temperature.
7. Using the worksheet, have students predict which container will be the best insulator after 15 minutes and write one sentence to explain their reasoning.
8. During the 15 minute wait time, discuss with students the transfer of energy that occurs when something cools.
9. After 15 minutes, note the temperature in each container for students.
10. Have students complete the data collection and answer the critical thinking questions.
11. Discuss with students how to increase the insulation value of different plastics. They could wrap material around each one (fur, flannel, silk, cotton, synthetic fabrics) and retest results. Also, they could stack the cups in different ways to increase heat retention. Retest ideas if desired.

Name_____

Will it Float?

	Kind of Plastic						
	1	2	3	4	5	6	7
Do you think it will it float? Write yes or no.	yes						
Did it really float? Write yes or no.	no						

All About Plastics

Name_____

Will it Float?

	Kind of Plastic						
	1	2	3	4	5	6	7
Prediction: Will it float or sink?							
Results: Did it float or sink?							

1. Which pieces float: number 1 or number 2?_____
2. How many of your predictions were correct?_____
3. Did number 3 plastic sink or float? Why?_____

_____

Which cup insulates best?

	Plastic bottle	Coffee Cup	Paper Cup	Picnic Cup
Prediction: Put a check under which cup you think will keep the water warmest.				
Starting temperature				
Temperature after 15 minutes				

4. Which cup was the best insulator (kept the water warmest)?_____
5. Which cup was the worst insulator (did not keep the water warm)?_____
6. What was the difference in temperature between the best and worst insulator?_____
7. What is one way you could help the picnic cup keep the water warmer?_____

All About Plastics

Plastics Exploration
Grades 6-8
Sorting and Identification of Plastics
Polymer Fun

Materials: (see teacher notes for more information), samples of plastics 1-6, "Characteristics of Common Plastics" information sheet, student worksheets, answer keys, 5 beakers, water, salt, corn syrup, isopropyl alcohol, vegetable oil, wooden stirring sticks
Activity Time: 2 class periods (45 – 50 min. ea.) or 1 block period
Concepts Taught: Scientific investigations, chemical and physical properties of matter
Correlations to NCSCOS: Grade 6: Math Objectives 1.03, 1.07, 4.06; Science Competency Goal 1; Grade **7:** Math Objective 4.01 Science Competency Goal 1; Grade **8:** Math Objectives 1.02, 4.01; Science Competency Goal 1, 3.01, 4.01, 4.02, 4.04, 4.05, 4.10;

Objectives:

- Students will recognize there are differences between plastics.
- Students will sort and identify plastics by their number.
- Students will investigate the physical properties of plastics and evaluate differences between those properties for each type of plastic.

For background information about plastics and plastics recycling:

- NEED Project booklet Museum of Solid Waste & Energy, pp. 22-25
- Hands on Plastics™ Background Information for Teachers http://www.teachingplastics.org/hands_on_plastics/intro_to_plastics/teachers.html
- American Plastics Council: http://www.americanplasticscouncil.org/s_apc/index.asp

Lesson:
Prior to the lesson, have students bring in various plastics from home. These should be collected by the teacher and kept aside until the day of the lesson.

PART 1:

1. Place collected plastics in a location of the classroom that is accessible by the majority of students. Students will devise a method to sort and count the plastics of each type. Students will then record and graph the results.
2. Ask students to hypothesize why there are so many different types of plastics. Have them look at their results and identify any types that are more common than others. Ask them to provide reasons for why this might be so.
3. Pass examples of plastics 1-6 around the room. Students will record observations on the Observations Worksheet about the physical properties of each plastic as they view them.

PART 2:
Students will work in cooperative groups of 3-4 to complete this part of the activity. Enough materials should be prepared so that each group has a complete set OR materials should be distributed and set up at 5 stations so that student groups can rotate through the stations.

All About Plastics

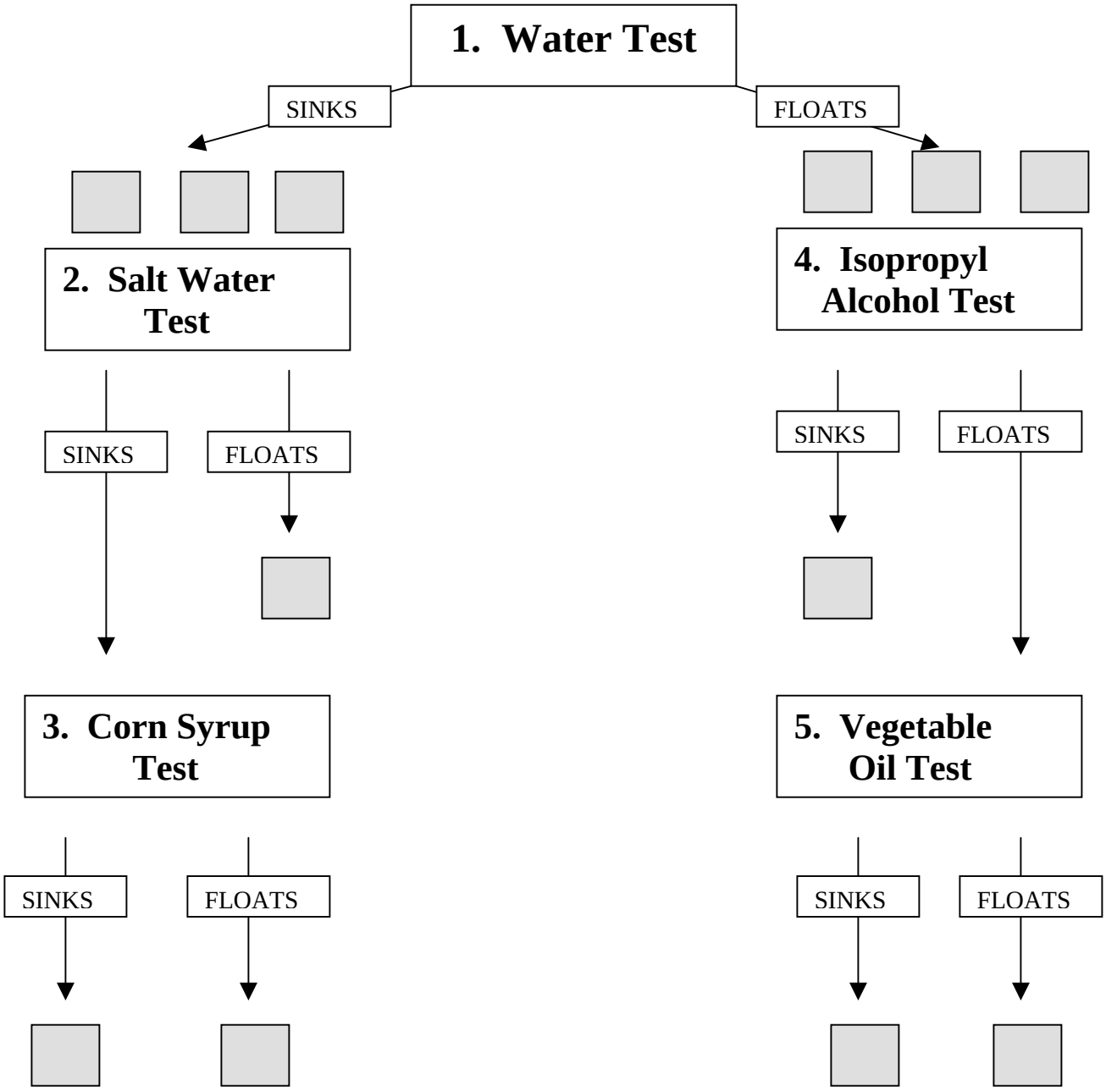
1. Instruct students that one of the easiest ways to classify plastics is by their densities. Density is the amount of mass an object or substance has divided by the volume of that object or substance. Each type of plastic has a specific density range, and by observing what a plastic does when placed in various liquids (float vs. sink), density ranges can be determined for identification of plastic types. This technique is used to sort plastics during the recycling process.
2. Review safety procedures for working with chemicals and equipment.
3. Distribute materials and worksheets to students.
4. Students will then follow the flow chart to perform density tests on all plastic samples using the following liquid substances: Water (Density=1.0 g/mL), Salt Water -1200g salt per 1 L of water - (D= 1.2 g/mL), Corn Syrup (D= 1.36 g/mL), Isopropyl Alcohol (D=0.94 g/mL), Vegetable Oil (D=0.90 g/mL). Students will use their observations and the density range values given on the Characteristics of Common Plastics information sheet to identify the plastics and fill-in the shaded boxes on the flow chart worksheet with the appropriate plastics number as they complete the tests.
5. Students will answer questions using the information they have gained during the experiment.

Extensions:

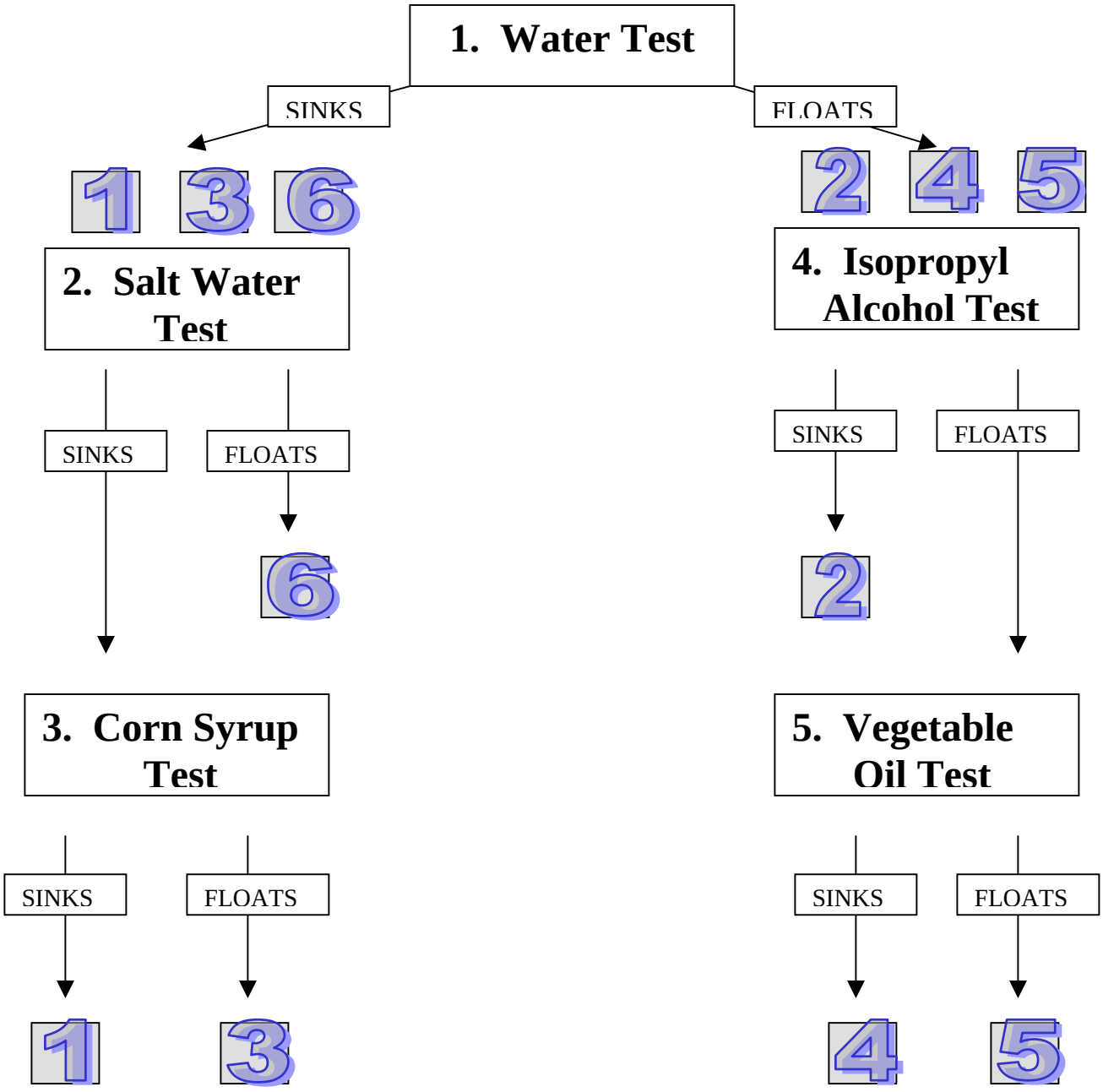
- Plastic Type # 7(Other) is used to categorize any plastic that does not fit into one of the other types (1-6). It is often a multi-layer plastic made by combining two or more of the other plastic types.
- Provide students with several different samples of Plastics #7.
- Have them try different variations of the density tests to find out if each of the #7 samples produce the same results. For example, did each #7 sample float in water? Sink? What about in the isopropyl alcohol?
- Ask students to try to provide a density range value for Plastic #7.

All About Plastics

Follow the flow chart, performing each test as numbered in order. Please note that you will NOT use all 6 plastic samples for each test. After completing each test, determine which plastics (of the ones used for that particular test) sink and which float. Then record the answers in the appropriate shaded boxes or continue on to the next test.



ANSWER KEY


1. Water Test
SINKS
FLOATS
1 3 6
2 4 5
2. Salt Water Test
4. Isopropyl Alcohol Test
SINKS
FLOATS
SINKS
FLOATS
6
2
3. Corn Syrup Test
5. Vegetable Oil Test
SINKS
FLOATS
SINKS
FLOATS
1
3
4
5

Name_____

Observations Worksheet

Plastics Type (#)	Observations
1 PETE	
2 HDPE	
3 PVC	
4 LDPE	
5 PP	
6 PS	

Name_____

Application & Conclusion Questions

1. A lifeguard sees a young child fall into the neighborhood pool. There are 6 plastic life preservers labeled 1, 2, 3, 4, 5, and 6. If the labels identify the type of plastic each is made of, which three would be the best to grab to save the child? Why?

2. A ship carrying empty milk jugs down the Mississippi River has a spill, and the jugs go overboard. What will happen to the jugs when they hit the water?

3. What do you think would happen to the jugs when they reach the salt waters of the Gulf of Mexico? Explain your answer.

4.A local water park has a new ride called the Slime Flume. The slime used in the ride has a density of 1.15 g/mL. What type(s) of plastic would be best to use for making the floats for the ride?

Application & Conclusion Questions

ANSWER KEY

1. A lifeguard sees a young child fall into the neighborhood pool. There are 6 plastic life preservers labeled 1, 2, 3, 4, 5, and 6. If the labels identify the type of plastic each is made of, which three would be the best to grab to save the child? Why?

The life preservers made from plastics 2, 4, and 5 would be best since they float when placed in water.

2. A ship carrying empty milk jugs down the Mississippi River has a spill, and the jugs go overboard. What will happen to the jugs when they hit the water?

The jugs will float. Milk jugs are made from HDPE (plastic #2) which floats when placed in water.

3. What do you think would happen to the jugs when they reach the salt waters of the Gulf of Mexico? Explain your answer.

The jugs would still float. The density range of HDPE is 0.95 – 0.97g/mL. The density of salt water is 1.20 g/mL. Therefore, the HDPE is less dense and will float on the more dense salt water.

4.A local water park has a new ride called the Slime Flume. The slime used in the ride has a density of 1.15 g/mL. What type(s) of plastic would be best to use for making the floats for the ride?

Plastics 2, 4, 5, and 6 could all be used to make the floats since they all have density ranges less than the density of the slime.

All About Plastics

Characteristics of Common Plastics

Plastic Type	Name	Properties	Density Range	Common Uses
	Polyethylene Terephthalate	Tough, rigid, shatter-resistant, softens if heated	1.38-1.39 g/mL	Soda, water, juice, and cooking oil bottles
	High Density Polyethylene	Semi-rigid, tough, flexible	0.95-0.97 g/mL	Milk and water jugs, bleach bottles
	Polyvinyl Chloride	Strong, semi-rigid, glossy	1.16-1.35 g/mL	Detergent bottles, shampoo bottles, shrink wrap, pipes
	Low Density Polyethylene	Flexible, not crinkly, moisture-proof	0.92-0.94g/mL	Garbage bags, sandwich bags, 6-pack rings
	Polypropylene	Non-glossy, semi-rigid	0.90-0.91 g/mL	Yogurt cups, margarine tubs, screw-on lids/caps
	Polystyrene	Often brittle, sometimes glossy, often has strong chemical reactions	1.05-1.07 g/mL	Styrofoam, egg cartons, packing pellets, take-out containers

All About Plastics

Polymer Fun

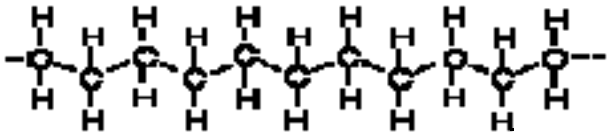
Materials Needed: water, glue, Borax, food coloring, plastic cups, wooden stirring sticks, plastic sandwich bags
Correlations to NCSCOS: Grade 6: Science Competency Goal 1, Science Competency Goal 2; **Grade 7:** Science Competency Goal 1, Science Competency Goal 2; **Grade 8:** Science Competency Goal 1, Science Competency Goal 2, Science Competency Goal 4 (especially 4.01, 4.02, 4.05, 4.06, 4.07, 4.10)

Objectives:

- Students will understand that plastics are polymers.
- Students will model plastic polymer formation.
- Students will create a polymer substance.

Lesson:
PART 1:

Plastics are made of polymers. A polymer (poly = many) is a chemical substance created when multiple basic units known as monomers (mono=one,single) are joined together to form complex molecular structures. Most plastics are hydrocarbon polymers which means they are constructed of mainly hydrogen and carbon atoms.



polyethylene

For more detailed background information:
http://www.americanplasticscouncil.org/s_apc/sec.asp?TRACKID=&CID=309&DID=919

Activity:
Have students stand together in an area of the room where there is open space and enough room to spread out. Each student in the classroom will act as a monomer. Then have students link arms to create one long polymer chain. See if they can come up with ways to create more complex structures by forming more linkages.
For a seated activity option: have students make paper chains or link paper clips into chains.

PART 2: Polymer Slime

Recipe: (to make one portion of slime – prepare enough materials for each student to make their own individual portion)

30 mL glue-water solution
10 mL Borax – water solution
2 drops food coloring

To make glue-water solution
500 mL water : 500 mL glue

To make Borax – water solution
60 mL Borax powder dissolved in 1000 mL water

Directions:

Pour glue-water solution in plastic cup.
Put 2 drops of food coloring. Stir with wooden stirring stick.
Pour Borax – water solution into mixture. Begin stirring immediately.
Mixture should begin to thicken. Keep stirring until formation of a semi-solid. Final substance should have the consistency of Silly Putty™.
Store in plastic sandwich bag. Keep in refrigerator when not in use.

Have students reflect on the slime-making process by recording their experience in their science journals or science notebooks. They should describe the ingredients used and the steps they took. They should also write a brief description of their final product.

Then have them answer the following question:
Q: How does this explain and model polymer formation?
A: A polymer (slime) is a complex molecular structure made from combining simpler molecular structures (water, glue, and Borax) together.

Extension:
Plastic polymers are very important; plastic is used in hundreds of ways in our daily life.

1. Have students keep a log for one day that lists everything they do or use that involves plastic. Include use of products that are made of plastic and/or have plastic parts. (Example: brushing teeth – toothbrush and toothpaste tube are made of plastic, riding to school – vehicle parts are made of plastic, CD player – cord is covered in plastic, etc.)

2. Have students research one of the following areas where plastics are being widely used in new and innovative ways to improve life:

Medicine & Health	Industrial Safety	Packaging
Automotives	Building Materials	Clothing

All About Plastics

Physical and Chemical Properties of Plastics
Grades 9-12

Materials: see teacher notes following instructions for more information: samples of plastics 1-6, "Characteristics of Common Plastics" information sheet, student worksheets, teacher notes, 6 beakers, water, isopropyl alcohol, vegetable oil, copper wire, acetone, Bunsen burner, glass Petri dishes, forceps, tongs, wooden stirring sticks, plastic spoons, safety goggles, fume hood (optional)
Activity Time: 1 block period or 2 class periods (45-50 min. each)
Concepts Taught: Chemical reactions, chemical and physical properties of matter, scientific investigations
Correlations to NCSCOS: Chemistry: 1.01, 1.03, 2.04, 5.01, 5.03, 5.04, 5.06; **Earth/Environmental Science:** 1.01, 1.02**; Physical Science:** 1.02, 1.03, 1.04, 5.03, 6.03, 6.04; **AP Chemistry:** 1.01, 1.03, 5.01; **AP Environmental Science:** 1.01, 1.02, 1.03, 1.04, 5.04

Objectives:

- Students will recognize there are differences between plastics.
- Students will identify plastics by their number.
- Students will investigate the physical properties of plastics and evaluate differences between those properties for each type of plastic.
- Students will investigate chemical properties of plastics .

For background information about plastics and plastics recycling:

- NEED Project booklet Museum of Solid Waste & Energy, pp. 22-25
- Hands on Plastics™ Background Information for Teachers http://www.teachingplastics.org/hands_on_plastics/intro_to_plastics/teachers.html
- American Plastics Council http://www.americanplasticscouncil.org/s_apc/index.asp

Lesson:
Prior to the lesson, have students bring in various plastics from home. These should be collected by the teacher and kept aside until the day of the lesson.

PART 1:

1. Place collected variety of plastics in a location of the classroom that is accessible by the majority of students.
2. Ask students to hypothesize why there are so many different types of plastics. Have them look at the plastics and identify any types that are more common than others. Ask them to provide reasons for why this might be so.
3. Pass examples of plastics 1-6 around the room. Students will record observations on the Observations Worksheet about the properties of each plastic as they view them.

All About Plastics

PART 2:
Students should work in cooperative lab groups of 3 or 4 to complete this activity. Materials should be distributed and set up at 6 stations (one for each test) so that student groups can rotate through the stations.

1. Instruct students that plastics can be sorted and identified by physical and chemical properties.
2. One of the easiest ways to classify plastics is by their densities. Density is the amount of mass an object or substance has divided by the volume of that object or substance. Each type of plastic has a specific density range, and by observing what a plastic does when placed in various liquids (float vs. sink), density ranges can be determined for identification of plastic types. This technique is used to sort plastics during the recycling process.
3. Some plastics also react chemically with other reactants. By observing whether a reaction takes place, chemical properties of some plastics can be identified.
4. Discuss safety procedures specific to each test.
5. Distribute materials and worksheets to students.
6. Students will then follow the instructions to perform density tests and chemical tests on the plastic samples.
   NOTE: The following densities should be used and provided to students:
   Water (Density=1.0 g/mL), Isopropyl Alcohol (D=0.94 g/mL),
   Vegetable Oil (D=0.90 g/mL).
7. As they complete the tests, students will record their observations in the provided data table and then use their observations and the information located in the "Characteristics of Common Plastics" information sheet to identify the plastics and fill-in the shaded boxes on the flow chart worksheet with the appropriate plastics number.

Extension:
Have students examine the "Characteristics of Common Plastics" information sheet to identify common uses for each of the 6 major types of plastic. Have them choose 1 or 2 types of plastic and using what they have just learned about their physical and chemical properties, explain why certain plastics are used to package certain items.
Then have students share their explanations and discuss in small groups why plastics have become the number one choice for packaging.

All About Plastics

Instructions for Plastics Testing

NOTE: Make sure plastic safety goggles are worn at all times during completion of this activity!

Water Test

Place one piece of each plastic sample in 100 mL of water. Tap the samples with a wooden stirring stick to knock off any bubbles. Determine which samples float and which samples sink. Record results in data table. Scoop samples out with plastic spoon and allow to dry on paper towels.

Copper Wire Test

Use one sample of each of the plastics that ***sank*** in the water for this test. Using forceps, hold a small (5cm) piece of copper wire in the flame of a Bunsen burner until hot. After removing from the flame, and before having a chance to cool, touch the hot wire to one of the plastic sample pieces to melt a small piece onto the wire. You may need to use another pair of forceps to pull the sample away from the wire if the entire piece sticks. Place the wire, making sure there is a small amount of the plastic sample attached, back in the flame. Observe the color of the flame (it should be orange or green). A green flame indicates presence of chlorine in the sample. Place the sample and wire in a beaker of water to stop all burning and cool. Repeat test for remaining plastic samples set aside for this test. Record results in the data table.

Acetone Test

NOTE: Acetone is highly flammable and should be done in a different area of the room from where the copper wire and heat tests are being performed!

Use one sample of each of the plastics that ***sank*** in the water for this test. Place one sample of plastic in 50 mL of acetone. Leave for 40 seconds. Remove the sample with tongs and press firmly between your fingers. Try to scrape off some of the plastic with your fingernail. A reaction has occurred if the sample feels soft and sticky and can be easily scraped. This indicates that the structure of the polymer chains that make up the plastic has changed. Repeat test for the remaining plastic samples set aside for this test. Record results in the data table.

Heat Test

Note: Make sure that the water is boiling before performing this test!

Use one sample of each of the plastics that ***sank*** in the water for this test. Using tongs, place one sample of plastic in boiling water and hold there for 30 seconds. Remove from water and carefully press firmly between your fingers to see if the sample feels softened after heating. Repeat test for the remaining plastic samples set aside for this test. Record results in the data table.

All About Plastics

Isopropyl Alcohol Test

Use one sample of each of the plastics that ***floated*** in the water for this test. Place one piece of each plastic sample in 100 mL of isopropyl alcohol. Tap the samples with a wooden stirring stick to knock off any bubbles. Determine which samples float and which samples sink. Use density range values to identify samples. Record results in the data table. Scoop samples out with plastic spoon and allow to dry on paper towels.

Vegetable Oil Test

Use one sample of each of the plastics that ***floated*** in the water for this test. Place one piece of each plastic sample in 100 mL of oil. Tap the samples with a wooden stirring stick to knock off any bubbles. Determine which samples float and which samples sink. Use density range values to identify samples. Record results in the data table. Scoop samples out with plastic spoon and allow to dry on paper towels.

After all tests have been performed and all results have been recorded, examine and use the results and the information provided on the "Characteristics of Common Plastics" information sheet to fill in the shaded boxes on the flow chart worksheet.

All About Plastics

Teacher Notes:

Materials for each test should be set up in separate areas of the room. Student groups can then rotate through these stations to complete the activity.

Water Test

Materials needed:
100 mL of water in a 250 mL beaker
samples of each type of plastic (1-6)
- **samples can be reused by each group**

wooden stirring stick
plastic spoon
paper towels

Copper Wire Test

NOTE: If available, you may want students to perform this test underneath a fume hood.

Materials needed:
Bunsen burner set up
forceps
3 pieces (5 cm length) copper wire for each group
samples of plastics 1, 3, and 6 for each group
- **samples cannot be reused for each group**

100 mL of water in a 250 mL beaker

Acetone Test

NOTE: Acetone is highly flammable and should be done in a different area of the room from where the copper wire and heat tests are being performed!

Materials needed:
50 mL acetone in a 250 mL beaker covered with glass Petri dish when not in use
***Note: fingernail polish remover can be used if pure acetone is not available – students may need to leave samples in longer to get a reaction**
samples of plastics 1, 3 ,and 6 for each group
- **samples cannot be reused for each group**

tongs
paper towels

All About Plastics

Heat Test

Materials needed:
100 mL of water in a 250 mL glass beaker
samples of plastics 1, 3, and 6
- **samples cannot be reused by each group**

Bunsen burner set up OR hot plate
tongs
paper towels

Isopropyl Alcohol Test

Materials needed:
100 mL of isopropyl alcohol in a 250 mL beaker covered with glass Petri dish when not in use
samples of plastics 2, 4, and 5
- **samples can be reused by each group**

wooden stirring stick
plastic spoon
paper towels

Vegetable Oil Test

Materials needed:
100 mL of oil in a 250 mL beaker
samples of plastics 2, 4, and 5
- **samples can be reused by each group**

wooden stirring stick
plastic spoon
paper towels

Name_____

Observations Worksheet

Plastics Type (#)	Observations
1 PETE	
2 HDPE	
3 PVC	
4 LDPE	
5 PP	
6 PS	

All About Plastics

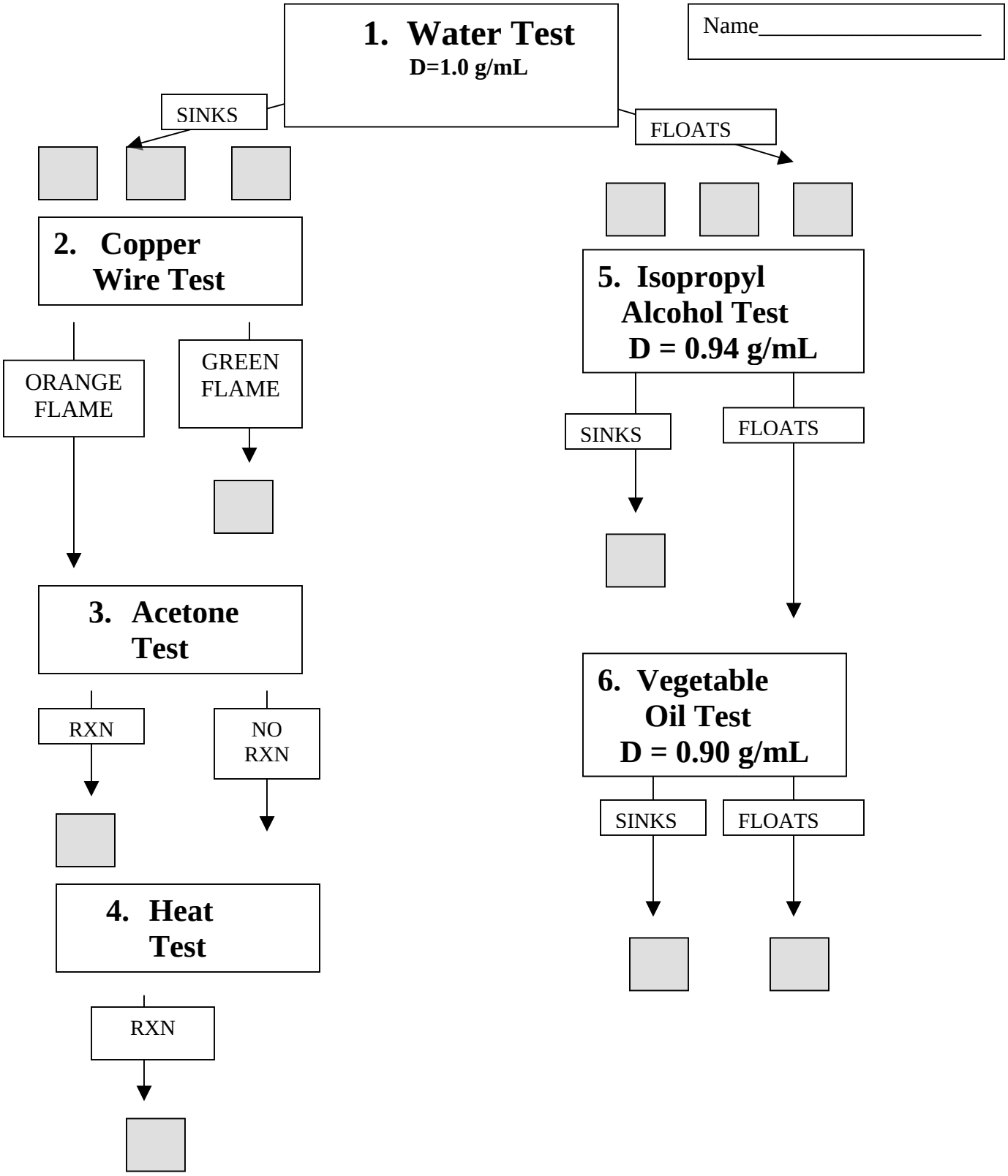
Test	Water Float or Sink	Copper Wire Rxn or No Rxn	Acetone Rxn or No Rxn	Heat Rxn or No Rxn	Isopropyl Alcohol Float or Sink	Vegetable Oil Float or Sink
						
						
						
						
						
						

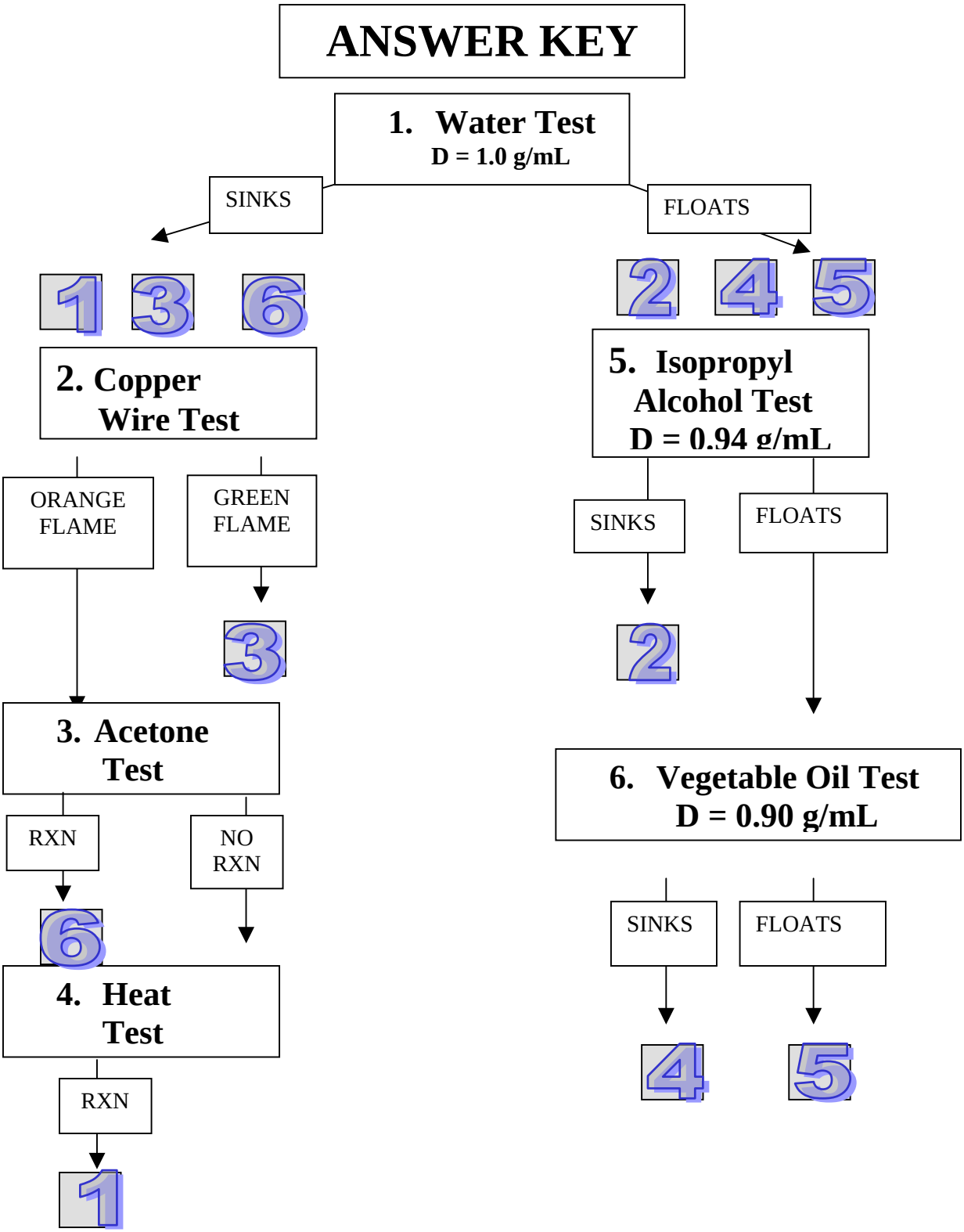
All About Plastics

Characteristics of Common Plastics

Plastic Type	Name	Properties	Density Range	Common Uses
	Polyethylene Terephthalate	Tough, rigid, shatter-resistant, softens if heated	1.38-1.39 g/mL	Soda, water, juice, and cooking oil bottles
	High Density Polyethylene	Semi-rigid, tough, flexible	0.95-0.97 g/mL	Milk and water jugs, bleach bottles
	Polyvinyl Chloride	Strong, semi-rigid, glossy	1.16-1.35 g/mL	Detergent bottles, shampoo bottles, shrink wrap, pipes
	Low Density Polyethylene	Flexible, not crinkly, moisture-proof	0.92-0.94g/mL	Garbage bags, sandwich bags, 6-pack rings
	Polypropylene	Non-glossy, semi-rigid	0.90-0.91 g/mL	Yogurt cups, margarine tubs, screw-on lids/caps
	Polystyrene	Often brittle, sometimes glossy, often has strong chemical reactions	1.05-1.07 g/mL	Styrofoam, egg cartons, packing pellets, take-out containers

Name_____


1. Water Test
D=1.0 g/mL
SINKS
FLOATS
2. Copper Wire Test
ORANGE FLAME
GREEN FLAME
3. Acetone Test
RXN
NO RXN
4. Heat Test
RXN
5. Isopropyl Alcohol Test
D = 0.94 g/mL
SINKS
FLOATS
6. Vegetable Oil Test
D = 0.90 g/mL
SINKS
FLOATS


ANSWER KEY
1. Water Test
D = 1.0 g/mL
SINKS
FLOATS
1 3 6
2 4 5
2. Copper Wire Test
5. Isopropyl Alcohol Test
D = 0.94 g/mL
ORANGE FLAME
GREEN FLAME
SINKS
FLOATS
3
2
3. Acetone Test
6. Vegetable Oil Test
D = 0.90 g/mL
RXN
NO RXN
SINKS
FLOATS
6
4. Heat Test
4
5
RXN
1

The Bottle Bill Battle
Grades: 9-12

Materials: Computers with Internet access, list of websites for creating Power Point presentation (included), video camera or digital camera (optional), presentation grading rubric
Activity Time: 3-4 class periods
Concepts Taught: Environmental Science, Recycling, Computer Skills, Research Skills
Correlations to NCSCOS: English I Objectives 2.01, 2.02, 2.03, 2.04, 3.01, 3.02, 3.03, 3.04, 6.01, 6.02; **English II** Objectives 2.01, 2.02, 2.03, 3.01, 3.02, 3.04, 6.01, 6.02; **English III** Objectives 2.01, 2.03, 3.01, 3.02, 3.03, 3.04, 4.03, 6.01, 6.02; **English IV** Objectives 2.01**,** 2.03, 2.04, 3.01, 3.02, 3.03, 6.01, 6.02; **Computer Technology Skills** Objectives **2.01**, 2.02 **CT Science** Objectives 3.02, 3.03, 3.05, 3.06 and **CT Social Studies** Objectives 3.01, 3.03, 3.04, 3.05; **Biology** Objective 5.03; **Earth/Environmental Science** Objective1.06; **AP Biology** Objective 7.03; **AP Environmental Science** Objectives 5.04, 7.01, 7.02, 7.03, 7.04; **Civics and Economics** Objectives 2.04, 2.09, 3.04, 3.07, 3.09, 4.03, 4.04, 4.05, 4.06, 4.07, 4.08, 4.09, 5.01, 5.04, 5.05, 5.06, 6.04, 6.05, 6.06, 7.01, 7.02, 7.03, 7.04, 7.05, 8.03, 8.04, 8.05, 8.07, 8.08, 9.01, 9.02, 9.04, 9.08, 10.01, 10.04, 10.05, 10.06; **US History** Objectives 11.03, 12.03; **American Government** Objective 4.02; Contemporary **Issues in North Carolina History** Competency Goals 1, 6, and 10.

Objectives:

- Students will review the process of creating, introducing, and approving legislation for local and national governments.
- Students will investigate bottle bill legislation by completing a webquest.
- Students will form an opinion regarding bottle bill legislation and develop a presentation to state their position.

Lesson:
Prior to introducing the lesson, review with students the process by which a bill becomes a law.

1. Idea - ideas for legislation can come from individuals (legislators themselves or citizens) or groups (advocacy groups, lobbyists, business alliances, etc.)
2. Draft – a draft is written and approved by the legislator who is introducing the bill
3. Committees – the bill is sent to the appropriate committees for approval
4. Assembly & Senate – the bill must be approved by both houses
5. President / Governor – they can decide to make the bill into a law or veto the bill - if the bill is vetoed, it goes back to the Assembly & Senate – if both houses again approve the bill by 2/3 majority, the veto is overridden and the bill becomes a law.

All About Plastics

PART 1: Webquest
Students will visit the following websites to research bottle bill legislation and answer the questions on the student worksheet:

http://www.bottlebill.org
http://toolkit.container-recycling.org/GetTheFacts/index.htm
http://www.bottlebill.org/resources/news/thisyear.htm
http://www.bottlebill.org/resources/slideshows.htm - "Bottle Bills:Past, Present, & Future"
http://www.cra-recycle.org/HHW/bottle%20bill.pdf
http://en.wikipedia.org/wiki/Bottle_bill
http://www.container-recycling.org
http://grrn.org/beverage
http://www.americanrecycler.com/oct03/plastic.html
http://www.ameribev.org/pressroom/2002_consumerchoose.asp

PART 2: Campaign/Presentation
1. Many educators believe that the best way to learn about a topic is to prepare oneself to teach or explain the topic to others. After completing the webquest and examining a variety of resource material, students are to be encouraged to develop an informed opinion about bottle bill legislation.

2. It has been suggested that NC should pass a bottle bill. Have students read the News & Observer editorial "Trails of Trash."
They will then work individually or in groups to create a multimedia presentation to present their position on bottle bills and campaign for or against bottle bill legislation in the state of North Carolina. The project should focus not only on general information about bottle bills, but also examine and describe the impact in our state. The presentation should be brief yet extensive enough to convey the topic adequately.

3. Students should then present their teaching tool to the class and receive feedback comments from the class.

Extension:
- The North Carolina General Assembly recently passed House Bill 1518 (Session Law 2005-348) which requires all holders of Alcoholic Beverage Control permits to recycle all recyclable beverage containers.
- H1518 is viewable at http://www.p2pays.org/ref/38/37334.pdf.
- Business owners will have several options for how to handle their recyclable materials to be in accordance with this legislation. They could contract with and pay for another company to handle the materials and take them off-site. Or they could haul it off-site themselves, in which case they would have to pay for on-site storage containers and transportation to/from drop-off facilities.
- Have students briefly research these and any other options, and then generate discussion concerning students' opinions about the "best" option for a business to recycle these containers.

All About Plastics

Bottle Bill Legislation Webquest

Use the following websites to research bottle bill legislation and gather information.

http://www.bottlebill.org
http://toolkit.bottlebill.org/facts.htm
http://www.bottlebill.org/resources/news/thisyear.htm
http://www.bottlebill.org/resources/slideshows.htm - “Bottle Bills:Past, Present, & Future”
http://www.cra-recycle.org/HHW/bottle%20bill.pdf
http://en.wikipedia.org/wiki/Bottle_bill
http://www.container-recycling.org
http://grrn.org/beverage
http://www.americanrecycler.com/oct03/plastic.html
http://www.ameribev.org/pressroom/2002_consumerchoose.asp

Then answer the following questions. Answer in complete sentences and provide thorough responses including relevant details from your research.

1. Define and describe a “bottle bill.”
   What responsibilities fall on the consumer? On the retailer?
2. How does a bottle bill reduce waste and encourage recycling initiatives?
3. What US states currently have bottle bill legislation in place?
   What state was the first to pass a bottle bill?
   What state has the highest deposit amount?
   What states are currently campaigning for new bottle bill legislation?
4. List some countries that have national deposit laws.
5. What is the name of the US Senator who has advocated for a national bottle bill?
   From what state is he?
   What is the name he proposed for this bill?
   What year did he introduce this bill?
6. What are some of the major advantages of having bottle bill legislation in place?
7. What are some of the major disadvantages of having bottle bill legislation in place?
   Who are some of the principal opponents of bottle bills? Why?
8. How do you think bottle bills are enforced? What are some issues that could arise with enforcement?

Bottle Bill Legislation Webquest – ANSWER KEY

http://www.bottlebill.org
http://toolkit.bottlebill.org/
http://www.bottlebill.org/resources/news/thisyear.htm
http://www.bottlebill.org/resources/slideshows.htm - "Bottle Bills:Past, Present, & Future"
http://www.cra-recycle.org/HHW/bottle%20bill.pdf
http://en.wikipedia.org/wiki/Bottle_bill
http://www.container-recycling.org
http://grrn.org/beverage
http://www.americanrecycler.com/oct03/plastic.html

Note: Answers printed here represent only one possible web source. Student responses may vary slightly depending on the sites used for webquesting.

1. **Define and describe a "bottle bill."**
   The term "bottle bill" is actually another way of saying "container deposit law." A container deposit law requires a minimum refundable deposit on beer, soft drink and other beverage containers in order to insure a high rate of recycling or reuse. (www.bottlebill.org)

   What responsibilities fall on the consumer? On the retailer?
   When a retailer buys beverages from a distributor, a deposit is paid to the distributor for each can or bottle purchased. The consumer pays the deposit to the retailer when buying the beverage. When the consumer returns the empty beverage container to the retail store, to a redemption center, or to a reverse vending machine, the deposit is refunded. The retailer recoups the deposit from the distributor, plus an additional handling fee in most U.S. states. The handling fee, which generally ranges from 1-3 cents, helps cover the cost of handling the containers. (www.bottlebill.org)
2. **How does a bottle bill reduce waste and encourage recycling initiatives?**
   In response to the growing litter problem of the 1960's and 1970's, activists and policymakers in Oregon and Vermont fought successfully to secure mandatory refundable deposits on throwaway beverage containers. Encouraged by their success, advocates in dozens of other states campaigned for deposit laws, and by 1986, bottle bills were in place in 10 states. Today, litter prevention is still a potent motivation for activists, although many bottle bill efforts are also being driven by the desire to increase recycling and promote producer responsibility. Government-funded studies conducted pre- and post-bottle bill in seven states showed reductions in beverage container litter ranging from 69% to 84%, and reductions in total litterranging from 30% to 65%. (http://toolkit.bottlebill.org/facts.htm)
3. **What US states currently have bottle bill legislation in place?**
   California, Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont (www.bottlebill.org)

   What state was the first to pass a bottle bill?
   Oregon, 1972 (http://en.wikipedia.org/wiki/Bottle_bill)

What state has the highest deposit amount?

Michigan, 10¢ (http://en.wikipedia.org/wiki/Bottle_bill)

What states are currently campaigning for new bottle bill legislation?

Arkansas, Illinois, Tennessee, West Virginia (www.bottlebill.org)

4. **List some countries that have national deposit laws.**

   Canada, Austria, Belgium, Denmark, Finland, Germany, Switzerland, the Netherlands, etc. (www.bottlebill.org**)**

5. **What is the name of the US Senator who has advocated for a national bottle bill?**

   Jim Jeffords

   From what state is he?

   Vermont

   What is the name he proposed for this bill?

   NATIONAL BEVERAGE PRODUCER RESPONSIBILITY ACT

   What year did he introduce this bill?

   2002

   (http://www.cra-recycle.org/HHW/bottle%20bill.pdf)

6. **What are some of the major advantages of having bottle bill legislation in place?**

   Reduces waste, encourages recycling initiatives, reduces litter, creates jobs (www.bottlebill.org)

7. **What are some of the major disadvantages of having bottle bill legislation in place?**

   The arguments bottle bill proponents encounter most frequently include the following: deposits duplicate curbside recycling, are a public health threat, are inefficient, are outdated, are a regressive "tax," and will damage local businesses and lead to closures or layoffs. This section includes rebuttals to the most comment industry arguments, as well as reports and legislative testimonies written by bottle bill opponents. (http://toolkit.bottlebill.org/facts.htm)

   Who are some of the principal opponents of bottle bills? Why?

   The Coca-Cola Company, PepsiCo and Anheuser-Busch and their bottlers and distributors are the biggest opponents of bottle bills. Retail grocers and liquor storeowners also oppose deposit laws. They know that there is a cost to disposal, recycling and cleanup of littered beverage bottles and cans, and they don't want to be saddled with those costs. They would rather have government and taxpayers pick up the tab. This is not the story they tell in committee rooms or to the press, however; instead they paint a picture of community-mindedness, purporting to be in favor of "comprehensive recycling," and maintaining food safety and sanitation. (http://toolkit.bottlebill.org/facts.htm)

8. **How do you think bottle bills are enforced? What are some issues that could arise with enforcement?**

   Answers will vary.

Trails of trash

Too many North Carolina roadsides look like landfills. It's time to require a minimum refundable deposit on bottles and cans.

Nothing about the genetic makeup of North Carolinians explains the volume of trash we unload along public roads. Some of the same people who cheerfully spend their tax dollars dressing up highway vistas with wildflowers turn right around and ruin the mood with their garbage.

As The N&O's Matthew Eisley reported Sunday, the state has battled this boorish behavior for years. The Department of Transportation has set up a hotline for reporting litterbugs and taken thousands of scofflaws to court where they've been slapped with fines and community service. Still, over the last decade, the harvest of litter has doubled.

That didn't happen in Iowa, Oregon and several other states where laws require a minimum refundable deposit on bottles and cans. As a consequence, legislators in Tennessee, Arkansas, West Virginia and Illinois are considering so-called bottle bills, too. North Carolina lawmakers should do the same.

A bottle bill, when approved to become a container deposit law, works this way: The state sets a minimum deposit, usually a nickel, on all bottles and cans. When stocking shelves with soft drinks, beer or other beverages, the retailer pays the deposit to the distributor. The consumer pays the deposit to the retailer and earns the money back by returning the container for recycling.

States count on retailers, redemption centers or, most recently, reverse vending machines to receive empty containers and reimburse consumers. Retailers recoup the deposit from distributors, in addition to a handling fee in most states.

Distributors cover their costs by selling the scrap containers and, in some states, chalk up profits when consumers forfeit their refunds. In Michigan and Massachusetts, though, courts have ordered these profits back to the public, and they are now used to support environmental programs.

Where penalties and PR have failed to stop litter, money motivates -- even in communities that pick up recyclables at the curbside. Government studies in seven of the 11 container-law states

found that the volume of bottles and cans littering public spaces dropped 70 percent or more in comparison to volumes recorded before the laws took effect. Not only that, all seven states reported reductions in all forms of litter and trash buried in landfills.

North Carolina is especially well equipped to recycle containers, with some of the nation's largest plastic recyclers located here. To those companies, empty plastic drink bottles are the raw materials needed to keep hundreds of North Carolinians employed making countless other products.

In fact, Governor Easley and the General Assembly could use a bottle bill to put even more Tar Heels to work in recycling, as well as to protect the state's vital tourist industry. Surely more travelers could be lured off our highways for a visit if they saw more wildflowers than trash.

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Presentation and Campaign Rubric

CATEGORY	4	3	2	1
Research/Statistical Data	Students include 4 or more high-quality examples or pieces of data to support their campaign.	Students include at least 3 high-quality examples or pieces of data to support their campaign.	Students include at least 2 high-quality examples or pieces of data to support their campaign.	Students include fewer than 2 high-quality examples or pieces of data to support their campaign.
Accuracy and Originality	Students create an original, accurate and interesting product that adequately addresses the issue. Product shows a large amount of original thought. Ideas are creative and inventive.	Students create an accurate product that adequately addresses the issue. Product shows some original thought. Work shows new ideas and insights.	Students create an accurate product but it does not adequately address the issue. Uses other people's ideas (giving them credit), but without paraphrasing or re-stating.	The product is not accurate. Uses other people's ideas, but does not give them credit.
Technical Elements	Students use more than 4 marketing tools (logos, jingles, etc.) efficiently in their campaign.	Students use at least 3 marketing tools (logos, jingles, etc.) efficiently in their campaign.	Students use at least 3 marketing tools (logos, jingles, etc.) somewhat efficiently in their campaign.	Students use fewer than 3 marketing tools (logos, jingles, etc.), possibly in an inefficient way.
Effectiveness of Campaign	The campaign is highly persuasive in convincing the audience to make a decision for / against bottle bill legislation, as evidenced by persuasive language and accurate product knowledge.	The campaign is persuasive in convincing the audience to make a decision for / against bottle bill legislation, as evidenced by some persuasive language and some accurate knowledge of the product.	The campaign has some persuasive elements in convincing the audience to make a decision for / against bottle bill legislation.	The campaign is not persuasive in convincing the audience to make a decision for / against bottle bill legislation.
Attractiveness and Organization	The campaign has exceptionally attractive formatting and well-organized information.	The campaign has attractive formatting and well-organized information.	The campaign has well-organized information.	The campaign's formatting and organization of material are confusing to the reader.
Knowledge Gained	All students in the group can accurately answer all questions related to facts in the campaign and to technical processes used to create the campaign.	All students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Most students in the group can accurately answer most questions related to facts in the campaign and to technical processes used to create the campaign.	Several students in the group appear to have little knowledge about the facts or technical processes used in the campaign.
Workload	The workload is divided and shared equally by all team members	The workload is divided and shared fairly by all team members, though workloads may vary from person to person.	The workload was divided, but not equally.	The workload was not divided OR several people in the group are viewed as not doing their fair share of the work.

Composting in the Classroom

Soils and Composting Explorations
Grade 3

What Can We Compost?
Compost is Hot!
Compost Card Game
Planting With Compost
Diary of a Worm
Building a Mini-Composter

Materials: See individual lessons for materials needed.
Activity Time: PLEASE NOTE: The activities contained in this lesson can be conducted over the course of a week as a unit or the activities can also stand alone.

- Conducted as a unit: 6 periods of 30 minutes each
- Conducted individually: 30 minutes per lesson

Concepts Taught: Sorting, composting, measuring temperature, sentence writing, plant growth
Correlations to Grade 3 NCSCOS: ELA Objectives 2.02, 2.03, 3.01, 3.03, 4.02, 4.03, 4.09, Math Objectives 1.01, 2.02, Science Objectives 1.01, 1.02, 2.01, 2.02, 2.03, 2.04, 2.05, 2.06, 4.05, Visual Art Objective 2.07

Objectives:

- Students will sort and identify items that can be composted.
- Students will recognize that composting is a way to recycle plant and animal material.
- Students will investigate some of the properties of compost, including the relationship between temperature and active composting, and how compost can be used to improve poor soils.
- Students will identify soil types and investigate their properties.

Background:
There are three main types of soil: sand, silt/humus, and clay. Sand has the largest particle size, followed by silt/humus, and then clay. Clay has the greatest capacity to hold water, whereas sand has the lowest capacity. Although clay has the greatest capacity to hold water, it actually absorbs water at a much slower rate than the others. The best soils are those that have a mixture of the types. Poor soils are usually those that are only clay or sand.

Compost is valuable because it can be added to soils to help in plant growth. Rich in nutrients and microorganisms, compost can be added to poor soils. Composting is a natural way to amend soils, rather than adding chemical fertilizers. Composting is a way to recycle plant and animal material into a soil-like product and can keep food waste and/or yard waste from going to the landfill. Rather than breaking down as compost does and helping our soils, food scraps in the landfill decompose very slowly and will not be used again. Composting happens when the right mixture of ingredients are brought together.

There are two important types of household composting: backyard composting and vermicomposting. Backyard composting usually involves mixing together items such as sticks, leaves, grass clippings, wood ashes, and small amounts of plant-based food waste. Backyard

compost piles must be watered and turned over on a regular basis to keep the compost process active. Water and oxygen are vital to the decomposition process. Vermicomposting uses worms (usually in enclosed bins) to turn plant-based food waste into plant food. As the worms eat the leftover food, they turn it into compost. Small organisms such as insects and other tiny organisms called microbes also live in compost piles and help turn the organic materials into compost.

Lesson 1: What Can We Compost?

Materials: Copies of the worksheet below for each student or on one transparency

Students will sort and identify items that can be composted.

1. Have each student name one thing they throw away each day and write each item on half of the board.
2. Explain to students that not all the items must go into the trashcan. Some can be recycled, reused, or composted.
3. Using the background information above, explain to students that composting is a way to recycle organic (plant or animal) material. Items that can be composted include food waste such as orange peels, banana peels, potato peelings, bread crusts, eggshells, coffee grounds, and other non-food items such as shredded newspaper, teabags, leaves, grass, and sticks.
4. On the other half of the board, make four column headings: recycle, reuse, compost, and trash. Go back through the list of brainstormed trash items and have the students name where each item should go.

Extensions:

1. Using the worksheet below, have students identify which items can be composted and which cannot.
2. Using old magazines or catalogs, have students create a collage showing items that can be composted.

Key:
Can be Composted: Leaves, branches, banana peel, vegetables, grass, hay, sticks, apple core

Cannot be Composted: Oil, can, boots, books, cheese, bones, turkey, paint (PLEASE NOTE: animal products such as cheese, bones, and turkey should only be composted in large-scale or commercial-type composting processes, not in classroom or residential compost bins)

Composting in the Classroom

Name_____

What can we compost?

Make an X on things that do not go in a compost pile.
Circle the things that can go in a compost pile.


leaves


oil


branches


banana peel

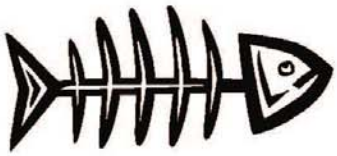

can


vegetables


boots


books


cheese


bones


grass


hay


sticks


turkey


apple core


paint

Composting in the Classroom

Lesson 2: Compost is Hot!

Materials: Copies of the worksheet below.

Students will investigate some of the properties of compost, including the relationship between temperature and active composting.

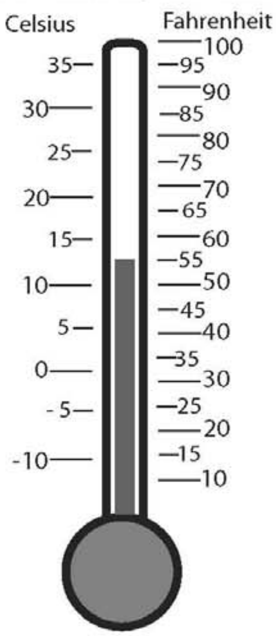
1. Explain to students that as the compost pile begins to work and break down, the inside of the pile heats up. When the material breaks down, or decomposes, it releases energy in the form of heat. The heat is important because it sterilizes, or makes safe, the compost for people to use it later.
2. We use different tools to measure things. For weight, we use scales, for length, we use rulers, and for temperature, we use thermometers. Review how to read a thermometer with students. The thermometer sheet below can either be used as an overhead for review or for individual student assessment.
3. The temperature of an active compost pile is usually about 140 degrees Fahrenheit, or about 60 degrees Celsius. Students will use the sheet below to practice reading a thermometer and making comparisons using <, >, and =.

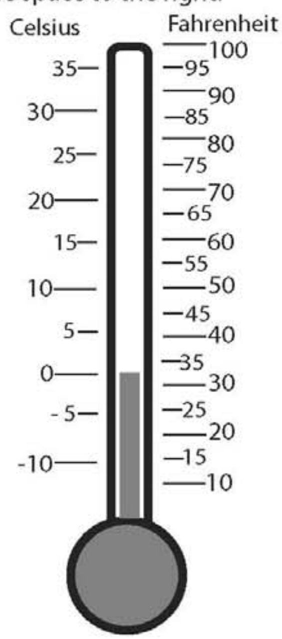
Extensions:

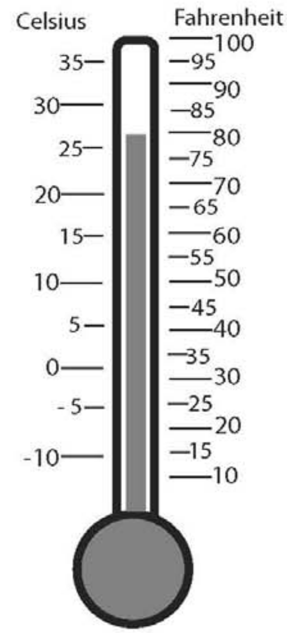
1. Students can use thermometers to measure various items in the classroom including soil in potted plants, water, and cups of ice. Are these things colder or hotter than a compost pile?
2. Students can make a bar graph of the items measured above to visually compare the data.

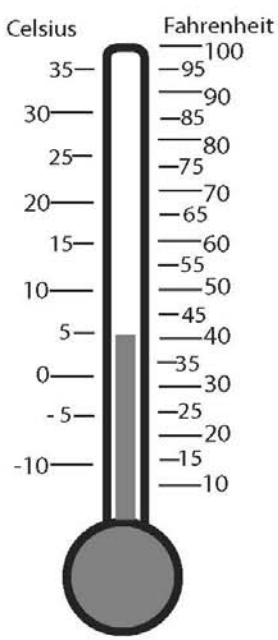
Read the thermometer.
Write the temperature in Celsius on the space to the left.
Write the temperature in Fahrenheit on the space to the right.

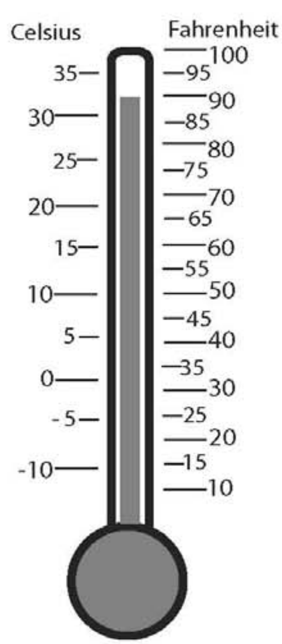
Name________________________

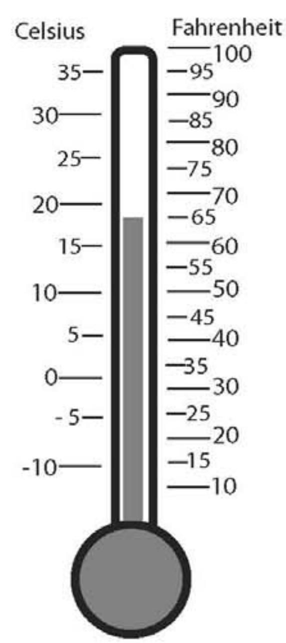








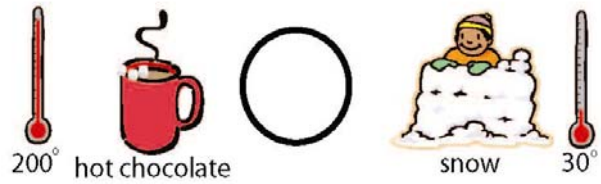


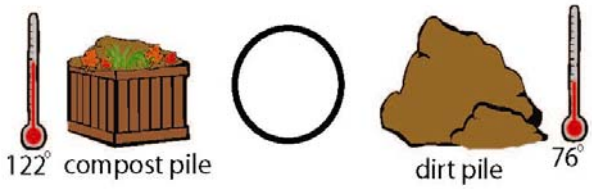


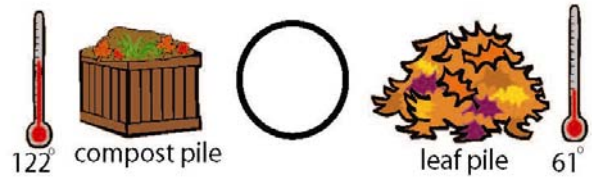
Composting in the Classroom

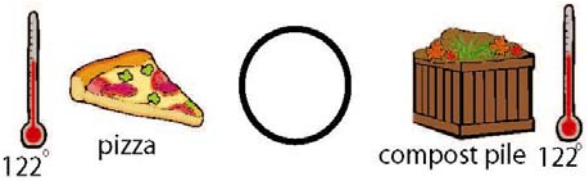
Name_____

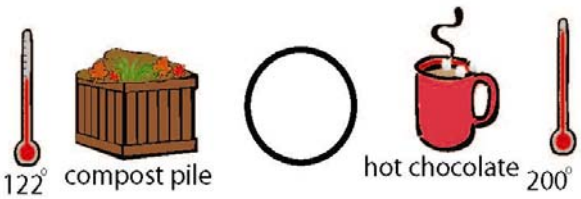
Compost gets hot! Look at the thermometers to see which of each group is hotter.
The temperatures are in Fahrenheit. Write <, >, or = in the circle.

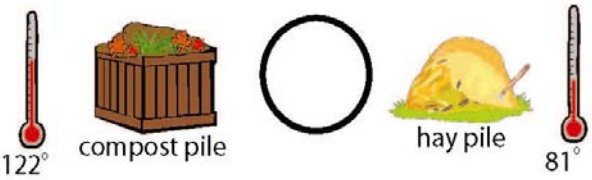












Composting in the Classroom

Lesson 3: Compost Card Game

Materials: Compost cards (below), 1 of each type for each student

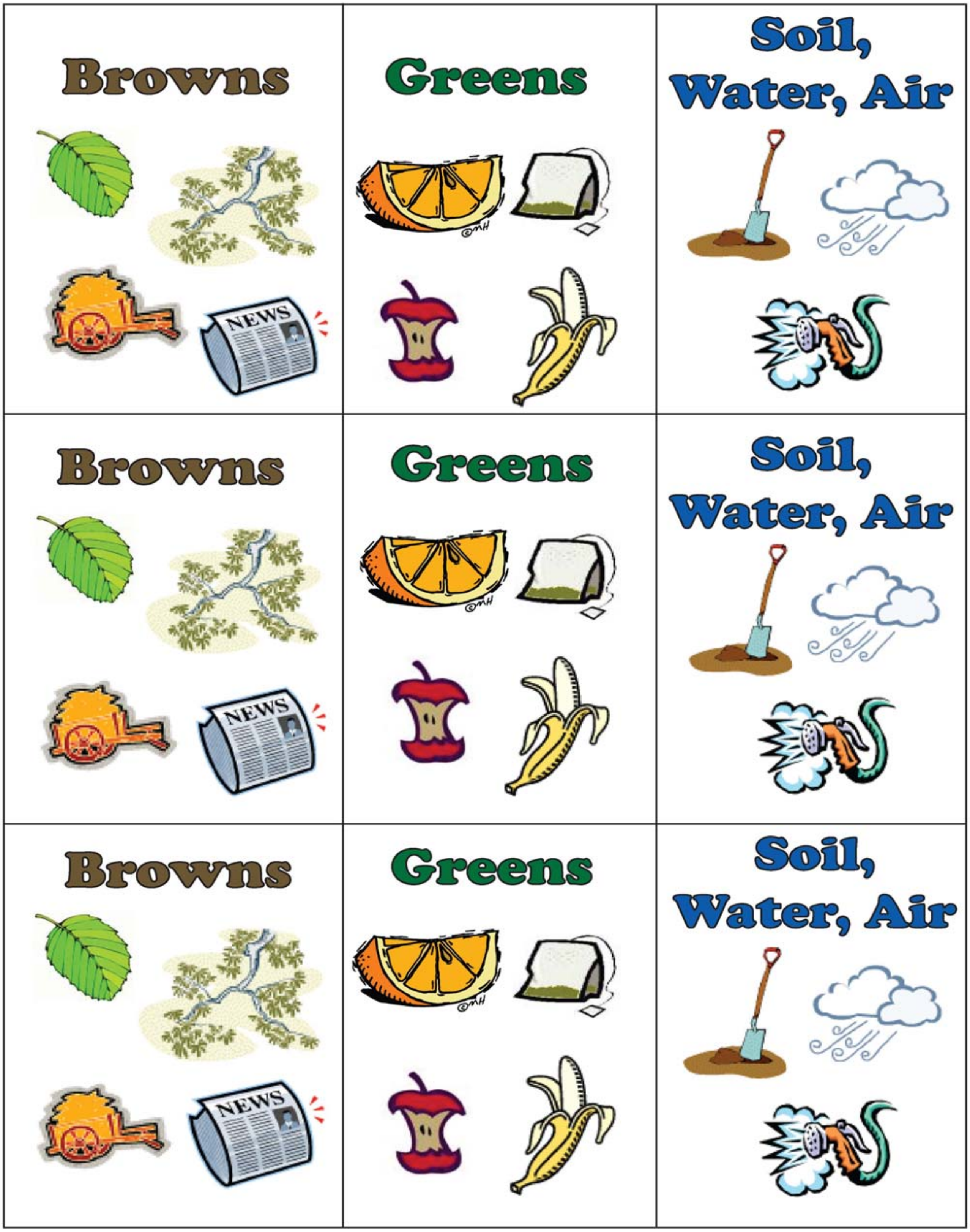
Students will utilize a card game to recognize the ingredients necessary to successfully make compost.

1. Print out enough copies of the compost cards below so that each student has one of each card (Browns, Greens, and Soil, Water, and Air). Cards should be printed on colored or thick paper so that students cannot see through the back of the card.
2. Discuss with students how materials are recycled in nature through a variety of means: decomposers, detritivores, and composting. Decomposers, such as mushrooms, get their nourishment from leaf litter or decaying matter. Detritivores are animals that eat decaying organic matter (leaves, bark, trees, etc.) such as earthworms or beetles.
3. Remind students of the three basic things that are necessary to make compost:
    a. Greens: Nitrogen-rich materials such as grass clippings and food scraps (items such as peelings, bread, rinds; but no cheese, meat, or bones)
    b. Browns: Carbon-rich materials such as dried leaves, straw, and newspaper
    c. Soil, Air, and Water: Compost piles often need "starter" soil rich in microorganisms, frequent turning of the pile to allow air in, and watering to encourage decomposition
4. Arrange students in groups of three and give each student one of each card: Browns, Greens, and Soil, Water, & Air.
5. This game will be played similarly to "Rock, Paper, Scissors." The object of the game is for the group of three students to make compost with their cards. In order to make compost, each player will have to show a different card. For example, two "Greens" cards and a "Soil, Water, Air" card will not make compost. Most groups like to count "One, two, three, go!" and then all players show a card without looking at which card they are choosing. When a group has one of each card played, they can say "Compost!"

Extension:

Groups can count how many times they get compost and compare with other groups' results. Probability and statistics can be calculated as well.

Note: This lesson is adapted from an activity originally developed by Brooke Smitherman.


Browns
NEWS
Greens
Soil, Water, Air
Browns
NEWS
Greens
Soil, Water, Air
Browns
NEWS
Greens
Soil, Water, Air

Lesson 4: Planting With Compost

Materials: Soybean seeds, two identical pots or cups, soil (NOT potting soil-you may want to use soil dug from your school's grounds), compost, water, permanent markers

Compost can be obtained at municipal yard-waste facilities and many gardening or hardware stores.

Students will investigate some of the properties of compost, including how compost can be used to improve poor soils. Students will compare a plant grown in soil only with a plant grown in compost-amended soil.

Information about soybean plants:

- Will germinate 3-6 days after planting. If they have not germinated after 7 days, throw out both pots and start over.
- Flowers will appear 4-5 weeks after planting

1. **Soil only pot:** Fill pot or cup with soil up to ½ inch from the top. Dig small hole in soil (approx. 1 in. deep) with fingertip. Place 1 seed in the hole. Re-cover with soil. Add water to moisten soil. Explain to students that this is the "control" pot since it has only soil. Using a permanent marker, label this pot "Control."
2. **Compost-amended pot:** Prepare amended soil by filling the pot or cup two-thirds full with soil. Fill the rest of the pot with compost. Mix thoroughly to distribute compost throughout soil (this may be done by emptying the contents of the pot into a zip-top bag and shaking well). Explain to students that this is the experimental pot since it contains soil and compost. Using a permanent marker, label this pot "Experimental."
3. Return the compost-amended soil to the pot. Dig small hole in soil (approx. 1 inch deep) with fingertip. Place 1 seed in the hole. Re-cover with soil. Add water to moisten soil.
4. Place seeded pots in an area where they will get sunlight (or in a grow-lab if available). Water daily or every other day, making sure that each planting gets the same amount of water each time.
5. Have students make predictions based on their knowledge of compost as to which plant will grow best.
6. Observe changes and measure growth of the plants (using a ruler) every day for 3 weeks. Record all observations and measurements on the observation worksheet.

Extensions:

1. Discuss with students how they will measure which plant grew "best." Should they measure plant height only? Should they measure the number and size of leaves or roots?
2. If the plant grown in compost showed better growth, why? By process of elimination, have students conclude that the nutrient supply was different in the pot with compost since the plants were watered the same and were exposed to the same amount of light.

Planting #1 – Soil Only

DAY	OBSERVATIONS	PLANT HEIGHT (in.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Planting #2 – Soil + Compost

DAY	OBSERVATIONS	PLANT HEIGHT (in.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Composting in the Classroom

Lesson 5: *Diary of a Worm*

Materials: Copy of Diary of a Worm by Doreen Cronin, small brown paper bags (lunchbag-sized) for each student, glue, scissors, construction paper, crayons or colored pencils

After reading (or listening to) Diary of a Worm, students will create their own diary of a worm and recognize the importance of worms in creating soil and compost.

1. Read aloud Diary of a Worm to students, paying attention to the following details:
    a. March 20-how does the worm help the earth breathe? (by turning the soil over, allowing air into the soil so that roots can get oxygen)
    b. April 15-at the bottom of the left-hand page, the worm has a note to "eat all your trash." Why is the worm eating trash?
    c. June 5-the worm is now eating macaroni. What does this tell us about their diets? (They are opportunistic feeders, meaning that they'll eat just about anything.)
    d. July 28-Why can't the worm chew gum? (Even though he's "eaten" just about everything else, there are some foods that worms don't like, and they also don't have teeth. This is reinforced on July 29.)
    e. Look back at the various references to worm anatomy-May 15, May 28, June 15, July 29.
2. Discuss how the worm moves. Like our muscles, a worm's muscles help it to move. The worm contracts one section of muscles after another, moving down its body, to make its body move. This can be compared to sports fans doing the "wave." The muscles contract one after the other sequentially down its body.
3. Using the side of the paper bag that does NOT have the flap, have students pick three days of the year to write a diary from a worm's perspective. They will pretend that they are worms and in one or two sentences for each day, describe what they are doing. Emphasize that their writing should be from a worm's point of view and have activities and comments that a worm would have. Sentences should demonstrate correct grammar, punctuation, point of view (first-person), and tone.
4. On the reverse side of the bag (the side with the flap), have students create their own worm puppet using the flap as the worm's mouth.

Extensions

1. Students can share their diaries with the class, and diaries can be hung in the classroom from the ceiling or a string so that both sides are visible.
2. Students can examine live worms obtained at a bait shop or dug from the ground. Have students measure the length of their worm and identify their parts. Can you find eyes, ears, nose, or a mouth? Why or why not?
    a. Worms do not have eyes. Instead, they have special cells near their head that can sense light.
    b. Worms do not have noses. That might be why they eat just about anything.
    c. Worms do not have ears. In order for them to detect danger and to help them move, worms have tiny hairs called setae all over their body. When a predator such as a bird walks over them, the tiny hairs can sense the vibrations as the bird walks, and they are sometimes able to get away.

   d. Worms do have mouths that are covered by a flap of skin that looks like a big upper lip.
3. Have students visit http://www.urbanext.uiuc.edu/worms/index.html to learn more about worms and their life histories.

Lesson 6: Building a Mini-Composter

Materials: Two emptied and cleaned water bottles (one for mini composter, one for mini landfill), soil (can be dug from school grounds or potting soil), a handful of food scraps such as orange peels or lettuce leaves chopped into small pieces, ruler, scissors, masking tape

Students will recognize that composting is a way to recycle plant and animal material.

1. Explain to students that they will be able to view composting in the classroom on a small scale. Show students the materials collected.
2. Using scissors and following the diagram, cut off the top two inches (below the mouth) of the bottle. Save this portion for later. It will be used in step 6.
3. In the bottom of the bottle, place 1" of soil. Do not compact the soil.
4. Place the food scraps on top of the soil and cover with another 1" of soil.
5. Using scissors, carefully poke 5-7 air holes in the top (cut off) portion of the bottle.
6. Use the masking tape to secure the two sections of the bottle, being careful not to cover the air holes with the tape.
7. Place the bottle in a sunny place that is not too hot or too cold.
8. Over the next 1-2 weeks, shake the bottle once daily to mix the soil and food scraps, being careful not to spill the contents. This represents the turning that would ordinarily occur in a backyard compost pile and allows air and moisture to circulate through the soil and scraps.
9. Discuss with students what they observe each week. Is the food decomposing? Why or why not?
   a. What would happen if the bottle was not shaken?
   b. What would happen if there were no air holes in the bottle?
   c. Why was the soil added?

Extensions

1. Build a mini-landfill with students. Follow steps 1 and 2 above.
2. In the bottom of the bottle, place 2" of soil. Compact the soil by pressing it down into the bottom of the bottle.
3. Place the same amount and type of food as in the mini-composter and repeat step 2.
4. Do not make air holes in the top portion. Tape the top back onto the bottle.
5. Place the bottle in a dark place in the room or cover the sides with a dark material such as construction paper or black plastic.
6. After a few weeks, ask students what they expect to happen. Remind them that the mini-

landfill was not shaken, had no light, and had no air holes.

7. Remove the tape from the bottle and examine contents. Did the material decompose as much as the material in the mini-composter? (It should not.)
8. This is what happens when food scraps are thrown away instead of composted. Rather than breaking down as compost does and helping our soils, food scraps in the landfill decompose very slowly and will not be used again.

Composting in the Classroom

Soils and Composting Explorations
Grade 6

What Can We Compost?
Compost Card Game
Planting With Compost
Building a Mini-Composter

Materials: See individual lessons for materials needed.
Activity Time: 30-45 minutes per lesson
Concepts Taught: Sorting, composting, probability, ratios, scientific method, plant growth, soil analysis
Correlations to Grade 6 NCSCOS: Math Objectives 2.01, 4.06, Science Objectives 1.01, 1.02, 1.03, 1.04, 1.05, 1.06, 3.05, 3.08, 4.01, 4.05

Objectives:

- Students will sort and identify items that can be composted.
- Students will recognize that composting is a way to recycle plant and animal material.
- Students will investigate some of the properties of compost, including how compost can be used to improve poor soils.
- Students will identify soil types and investigate their properties.

Background:
There are three main types of soil: sand, silt/humus, and clay. Sand has the largest particle size, followed by silt/humus, and then clay. Clay has the greatest capacity to hold water, whereas sand has the lowest capacity. Although clay has the greatest capacity to hold water, it actually absorbs water at a much slower rate than the others. The best soils are those that have a mixture of the types. Poor soils are usually those that are only clay or sand.

Compost is valuable because it can be added to soils to help in plant growth. Rich in nutrients and microorganisms, compost can be added to poor soils. Composting is a natural way to amend soils, rather than adding chemical fertilizers. Composting is a way to recycle plant and animal material into a soil-like product and can keep food waste and/or yard waste from going to the landfill. Rather than breaking down as compost does and helping our soils, food scraps in the landfill decompose very slowly and will not be used again. Composting happens when the right mixture of ingredients are brought together.

There are two important types of household composting: backyard composting and vermicomposting. Backyard composting usually involves mixing together items such as sticks, leaves, grass clippings, wood ashes, and small amounts of plant-based food waste. Backyard compost piles must be watered and turned over on a regular basis to keep the compost process active. Water and oxygen are vital to the decomposition process. Vermicomposting uses worms (usually in enclosed bins) to turn plant-based food waste into plant food. As the worms eat the leftover food, they turn it into compost. Small organisms such as insects and other tiny organisms called microbes also live in compost piles and help turn the organic materials into compost.

Composting in the Classroom

Lesson 1: What Can We Compost?

Materials: Copies of the worksheet below for each student or on one transparency

Students will sort and identify items that can be composted.

1. Have each student name one thing they throw away each day and write each item on half of the board.
2. Explain to students that not all the items must go into the trashcan. Some can be recycled, reused, or composted.
3. Using the background information above, explain to students that composting is a way to recycle organic (plant or animal) material. Items that can be composted include food waste such as orange peels, banana peels, potato peelings, bread crusts, eggshells, coffee grounds, and other non-food items such as shredded newspaper, teabags, leaves, grass, and sticks.
4. On the other half of the board, make four column headings: recycle, reuse, compost, and trash. Go back through the list of brainstormed trash items and have the students name where each item should go.

Extensions:

1. Using the worksheet below, have students identify which items can be composted and which cannot.
2. Using old magazines or catalogs, have students create a collage showing items that can be composted.

Key:
Can be Composted: Leaves, branches, banana peel, vegetables, grass, hay, sticks, apple core

Cannot be Composted: Oil, can, boots, books, cheese, bones, turkey, paint (PLEASE NOTE: animal products such as cheese, bones, and turkey should only be composted in large-scale or commercial-type composting processes, not in classroom or residential compost bins)

Composting in the Classroom

Name_____

What can we compost?

Make an X on things that do not go in a compost pile.
Circle the things that can go in a compost pile.


leaves


oil


branches


banana peel

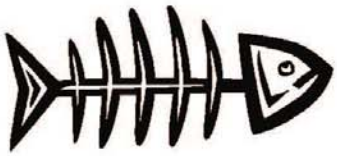

can


vegetables


boots


books


cheese


bones


grass


hay


sticks


turkey


apple core


paint

Lesson 2: Compost Card Game

Materials: Compost cards (below), 1 of each type for each student

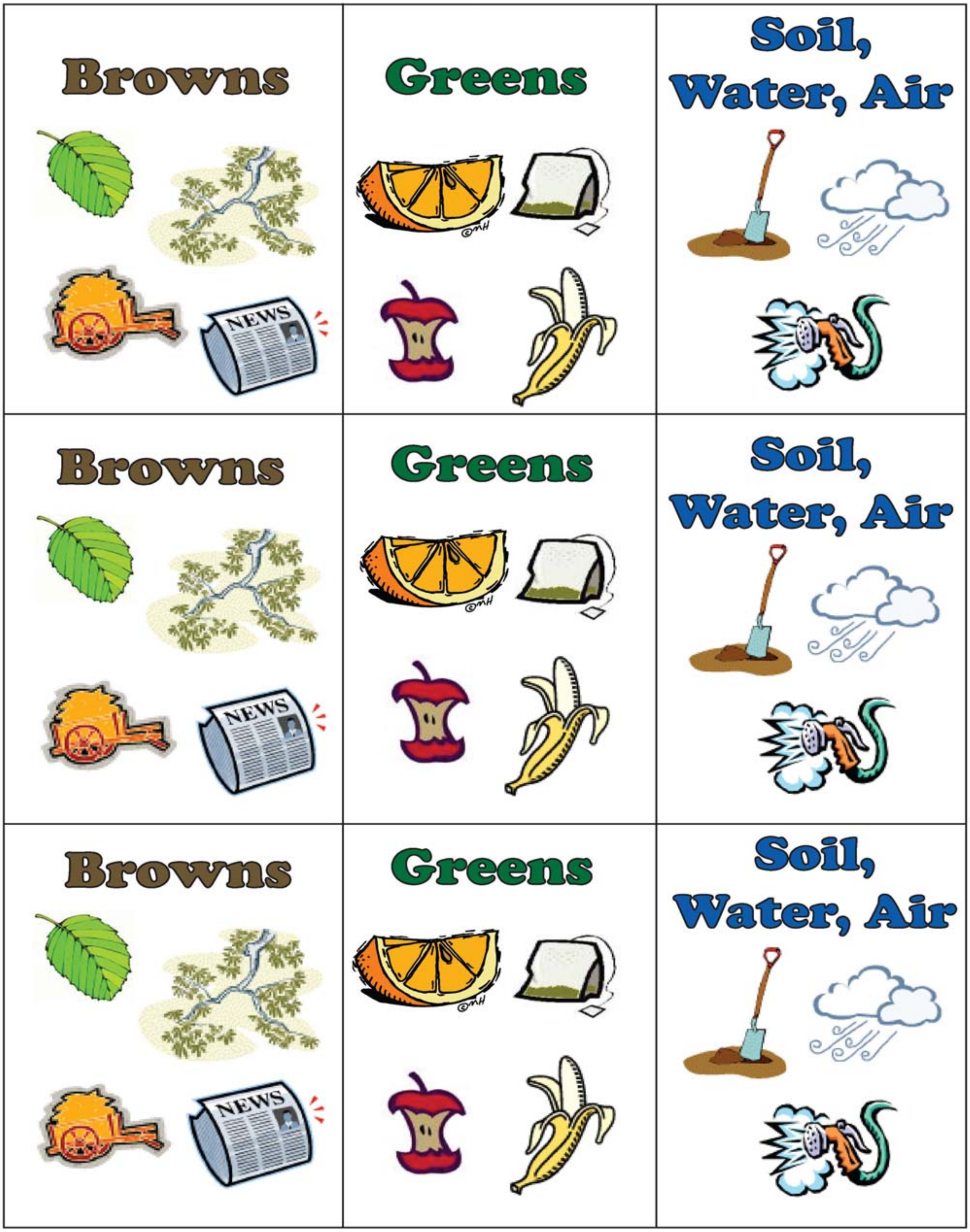
Students will utilize a card game to recognize the ingredients necessary to successfully make compost.

1. Print out enough copies of the compost cards below so that each student has one of each card (Browns, Greens, and Soil, Water, and Air). Cards should be printed on colored or thick paper so that students cannot see through the back of the card.
2. Discuss with students how materials are recycled in nature through a variety of means: decomposers, detritivores, and composting. Decomposers, such as mushrooms, get their nourishment from leaf litter or decaying matter. Detritivores are animals that eat decaying organic matter (leaves, bark, trees, etc.) such as earthworms or beetles.
3. Remind students of the three basic things that are necessary to make compost:
    a. Greens: Nitrogen-rich materials such as grass clippings and food scraps (items such as peelings, bread, rinds; but no cheese, meat, or bones)
    b. Browns: Carbon-rich materials such as dried leaves, straw, and newspaper
    c. Soil, Air, and Water: Compost piles often need "starter" soil rich in microorganisms, frequent turning of the pile to allow air in, and watering to encourage decomposition
4. Arrange students in groups of three and give each student one of each card: Browns, Greens, and Soil, Water, & Air.
5. This game will be played similarly to "Rock, Paper, Scissors." The object of the game is for the group of three students to make compost with their cards. In order to make compost, each player will have to show a different card. For example, two "Greens" cards and a "Soil, Water, Air" card will not make compost. Most groups like to count "One, two, three, go!" and then all players show a card without looking at which card they are choosing. When a group has one of each card played, they can say "Compost!"

Extension:

Groups can count how many times they get compost and compare with other groups' results. Probability and statistics can be calculated as well.

Note: This lesson is adapted from an activity originally developed by Brooke Smitherman.


Browns
NEWS
Greens
Soil,
Water, Air
Browns
NEWS
Greens
Soil,
Water, Air
Browns
NEWS
Greens
Soil,
Water, Air

Composting in the Classroom

Lesson 3: Planting With Compost

Materials: Soybean seeds, three identical pots or cups, soil (NOT potting soil – you may want to use soil dug from your school's grounds), compost, water, permanent markers

Compost can be obtained at municipal yard-waste facilities and many gardening or hardware stores.

Students will investigate some of the properties of compost, including how compost can be used to improve poor soils. Students will compare a plant grown in soil only with a plant grown in compost-amended soil with a plant grown in compost only.

Information about soybean plants:

- Will germinate 3-6 days after planting. If they have not germinated after 7 days, throw out both pots and start over.
- Flowers will appear 4-5 weeks after planting

1. **Soil only pot:** Fill pot or cup with soil up to ½ inch from the top. Dig small hole in soil (approx. 1 in. deep) with fingertip. Place 1 seed in the hole. Re-cover with soil. Add water to moisten soil. Explain to students that this is the "control" pot since it has only soil. Using a permanent marker, label this pot "Control."
2. **Compost-amended pot:** Prepare amended soil by filling the pot or cup two-thirds full with soil. Fill the rest of the pot with compost. Mix thoroughly to distribute compost throughout soil (this may be done by emptying the contents of the pot into a zip-top bag and shaking well). Return the compost-amended soil to the pot. Dig small hole in soil (approx. 1 inch deep) with fingertip. Place 1 seed in the hole. Re-cover with soil. Add water to moisten soil. Explain to students that this is an experimental pot since it contains soil and compost. Using a permanent marker, label this pot "Experimental 1."
3. **Compost only pot:** Fill pot or cup with compost up to ½ inch from the top. Dig small hole in compost (approx. 1 in. deep) with fingertip. Place 1 seed in the hole. Re-cover with compost. Add water to moisten compost. Explain to students that this is another experimental pot since it has only compost. Using a permanent marker, label this pot "Experimental 2."
4. Place seeded pots in an area where they will get sunlight (or in a grow-lab if available). Water daily or every other day, making sure that each planting gets the same amount of water each time.
5. Have students make a hypothesis based on their knowledge of compost as to which plant will grow best.
6. Observe changes and measure growth of the plants (using a ruler) every day for 3 weeks. Record all observations and measurements on the observation worksheets.

Extensions:

1. Discuss with students how they will measure which plant grew "best." Should they measure plant height only? Should they measure the number and size of leaves or roots?

2. If the plant grown in compost + soil showed better growth, why? By process of elimination, have students conclude that the nutrient supply was different in the pot with compost-amended soil since the plants were watered the same and were exposed to the same amount of light.
3. The ratio of soil to compost (in planting #2) was 2:1. Have students investigate what occurs when this ratio is changed by adding varied amounts of compost to prepare the amended soil mixture. Seed pots as before and monitor the plantings for a 3 week period.
4. Have students investigate the effect mixing the compost has on plant growth by setting up an experiment where the compost is mixed in completely with soil in one pot, and the compost is layered on top of the soil in another pot. Seed pots as before and monitor the plantings for a 3 week period.
5. Have students investigate the effect compost has on soil quality by setting up an experiment where the compost is added to varied types of soil (eg. clay, sandy soil, commercial potting soil, etc.). Seed pots as before (using 2/3 soil and 1/3 compost) and monitor the plantings for a 3 week period.

Student Observation Worksheet

Name_____

Planting #1 – Soil Only

DAY	OBSERVATIONS	PLANT HEIGHT (in.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Planting #2 – Soil + Compost

DAY	OBSERVATIONS	PLANT HEIGHT (in.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Planting #3 – Compost Only

DAY	OBSERVATIONS	PLANT HEIGHT (in.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Composting in the Classroom

Lesson 4: Building a Mini-Composter

Materials: Two emptied and cleaned water bottles (one for mini composter, one for mini landfill), soil (can be dug from school grounds or potting soil), a handful of food scraps such as orange peels or lettuce leaves chopped into small pieces, ruler, scissors, masking tape

Students will recognize that composting is a way to recycle plant and animal material.

1. Explain to students that they will be able to view composting in the classroom on a small scale. Show students the materials collected.
2. Using scissors and following the diagram, cut off the top two inches (below the mouth) of the bottle. Save this portion for later. It will be used in step 6.

3. In the bottom of the bottle, place 1" of soil. Do not compact the soil.
4. Place the food scraps on top of the soil and cover with another 1" of soil.
5. Using scissors, carefully poke 5-7 air holes in the top (cut off) portion of the bottle.
6. Use the masking tape to secure the two sections of the bottle, being careful not to cover the air holes with the tape.
7. Place the bottle in a sunny place that is not too hot or too cold.
8. Over the 1-2 weeks, shake the bottle once daily to mix the soil and food scraps, being careful not to spill the contents. This represents the turning that would ordinarily occur in a backyard compost pile and allows air and moisture to circulate through the soil and scraps.
9. Discuss with students what they observe each week. Is the food decomposing? Why or why not?
    a. What would happen if the bottle was not shaken?
    b. What would happen if there were no air holes in the bottle?
    c. Why was the soil added?

Extensions

1. Build a mini-landfill with students. Follow steps 1 and 2 above.
2. In the bottom of the bottle, place 2" of soil. Compact the soil by pressing it down into the bottom of the bottle.
3. Place the same amount and type of food as in the mini-composter and repeat step 2.
4. Do not make air holes in the top portion. Tape the top back onto the bottle.
5. Place the bottle in a dark place in the room or cover the sides with a dark material such as construction paper or black plastic.
6. After a few weeks, ask students what they expect to happen. Remind them that the mini-landfill was not shaken, had no light, and had no air holes.
7. Remove the tape from the bottle and examine contents. Did the material decompose as much as the material in the mini-composter? (It should not.)
8. This is what happens when food scraps are thrown away instead of composted. Rather than breaking down as compost does and helping our soils, food scraps in the landfill decompose very slowly and will not be used again.

Composting in the Classroom

Decomposition and Microorganisms
Grade 6

Decompose This!
Deciphering Decomposers

Materials: See individual lessons for materials needed.
Activity Time:
Decompose This!: 1 class period for set-up and initial observations, 3 weeks experiment time / observation, 1 class period for follow-up and analysis
Deciphering Decomposers: 2-3 class periods
Concepts Taught: decomposition, observation, data collection, biodiversity
Correlations to Grade 6 NCSCOS: Science Objectives 1.01, 1.02, 1.03, 1.04, 1.05, 1.06, 1.08, 3.08, 4.01, 4.02, 4.05, 7.01, 7.02, 7.03, 7.05, Visual Art Objective 1.02, 1.03, 4.03, ELA Objectives 2.01, 2.02, 6.01, Math Objectives 2.01, 4.06

Objectives:
- Students will investigate the conditions needed for decomposition to occur.
- Students will explore and identify common microorganisms found in compost.
- Students will understand the roles that decomposers play in compost.

Background:
There are three main types of soil: sand, silt/humus, and clay. Sand has the largest particle size, followed by silt/humus, and then clay. Clay has the greatest capacity to hold water, whereas sand has the lowest capacity. Although clay has the greatest capacity to hold water, it actually absorbs water at a much slower rate than the others. The best soils are those that have a mixture of the types. Poor soils are usually those that are only clay or sand.

Compost is valuable because it can be added to soils to help in plant growth. Rich in nutrients and microorganisms, compost can be added to poor soils. Composting is a natural way to amend soils, rather than adding chemical fertilizers. Composting is a way to recycle plant and animal material into a soil-like product and can keep food waste and/or yard waste from going to the landfill. Rather than breaking down as compost does and helping our soils, food scraps in the landfill decompose very slowly and will not be used again. Composting happens when the right mixture of ingredients are brought together.

There are two important types of household composting: backyard composting and vermicomposting. Backyard composting usually involves mixing together items such as sticks, leaves, grass clippings, wood ashes, and small amounts of plant-based food waste. Backyard compost piles must be watered and turned over on a regular basis to keep the compost process active. Water and oxygen are vital to the decomposition process. Vermicomposting uses worms (usually in enclosed bins) to turn plant-based food waste into plant food. As the worms eat the leftover food, they turn it into compost. Small organisms such as insects and other tiny organisms called microbes also live in compost piles and help turn the organic materials into compost.

Composting in the Classroom

Lesson One: Decompose This!

Materials: fresh leaves or grass clippings, 2 plastic re-sealable bags, soil (NOT potting soil – you may want to use soil dug from your school grounds), water, eyedropper, magnifying glasses, microscope, forceps

Students will investigate the conditions needed for decomposition to occur. Students will explore and identify common microorganisms found in compost.

1. Provide students with a small sample of fresh leaves or grass clippings to be divided into 2 plastic re-sealable bags. Have students punch 2 small holes near the top of each bag and, using an eyedropper, add a few drops of water to each bag.
2. Have the students take one of the bags and label it "No Soil." Then have them add a small amount of soil (1-2 Tbsp.) to the other bag and label that bag "Soil."
3. Set bags aside for 3 weeks, adding a few drops of water to each bag every few days or as needed. Do not allow contents to dry, but they also should not be sopping wet.
4. After the third week, have students open the bags and dump contents out onto 2 separate clean, white surfaces.
5. Using forceps and magnifying glasses, have students search through each pile for microorganisms.
6. Provide students with a microscope to further analyze any microorganisms found.
7. Discuss with students the following:
    a. Did decomposition occur more rapidly in one of the bags? How could you explain this?
    b. Were more microorganisms found in one of the bags? If so, which one?
    c. Where did the microorganisms come from?
    d. How would the number of microorganisms change if the bags were left for another three weeks?
    e. How can the variety of microorganisms be explained?

Extension:

1. Repeat the above experiment, adding objects such as paper or a small piece of plastic to each bag to check the rates of decomposition of these objects.

Composting in the Classroom

Lesson Two: Deciphering Decomposers

Materials: Internet / online resources, decomposer matching sheets

Students will explore and identify common microorganisms found in compost. Students will understand the roles that decomposers and detritovores play in compost. (Decomposers, such as mushrooms, get their nourishment from leaf litter or decaying matter. Detritivores are animals that eat decaying organic matter (leaves, bark, trees, etc.) such as earthworms or beetles.)

1. Provide students with template sheets that list the names of the following decomposer / detritovore microorganisms commonly found in compost: actinomycetes, bacillus, saprophytes, protozoa, rotifer, and nematode.
2. Students should choose or be assigned one of the microorganism names.
3. Using imagination and creativity, students should then develop a written and artistic description for the chosen microorganism. Written descriptions should include what role they think the microorganism plays in the compost pile.
4. Then using the Internet and/or online encyclopedias, have students find factual information about the chosen microorganism and prepare a brief report. Students should include a picture or sketch of what the microorganism actually looks like.

Extensions:

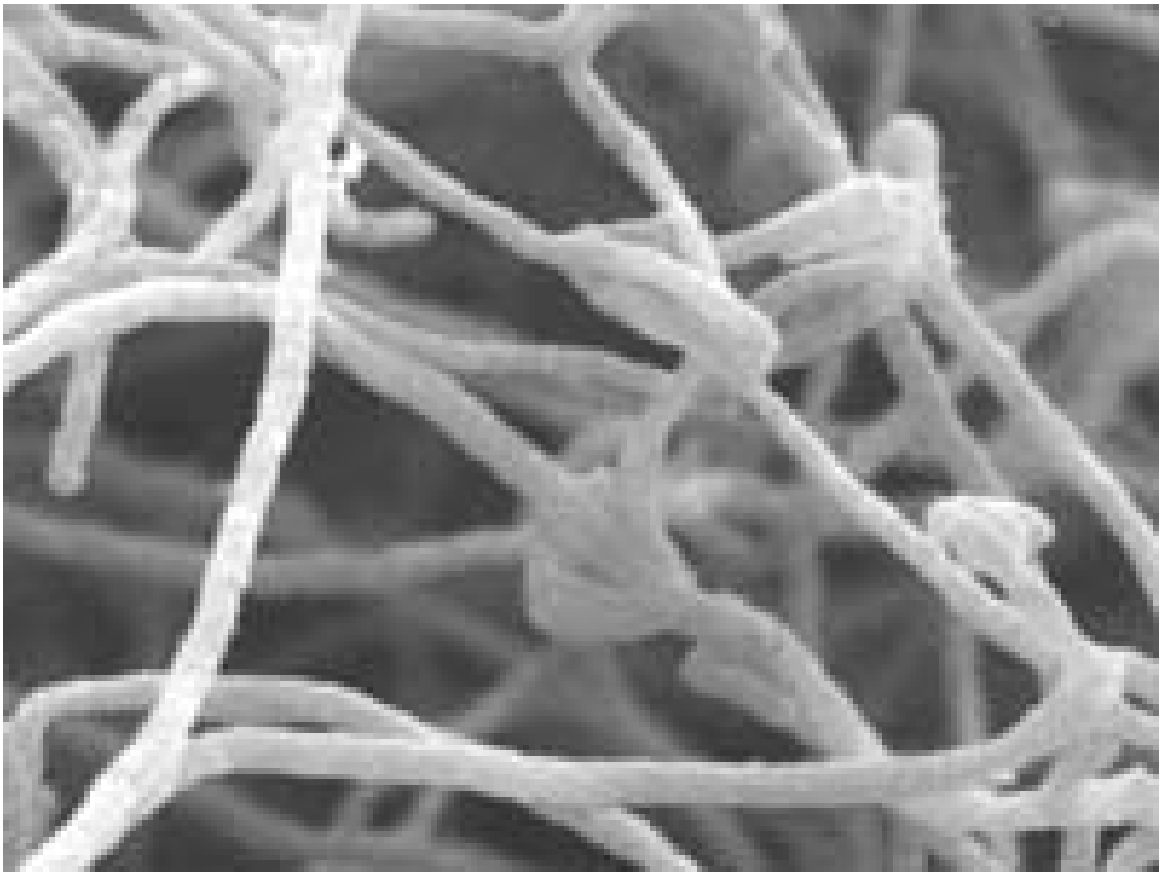
1. Have students prepare a display or presentation based on their creative written and artistic compost microorganism description OR their brief factual report.
2. Have students write a skit, based on the roles that each microorganism plays in the compost pile.
3. As a follow-up activity: cut apart the pictures, names, and descriptions of compost microorganisms printed on the following pages. Then have students match each name and description to the correct picture.

Composting in the Classroom

Name_____

Name of organism:_____

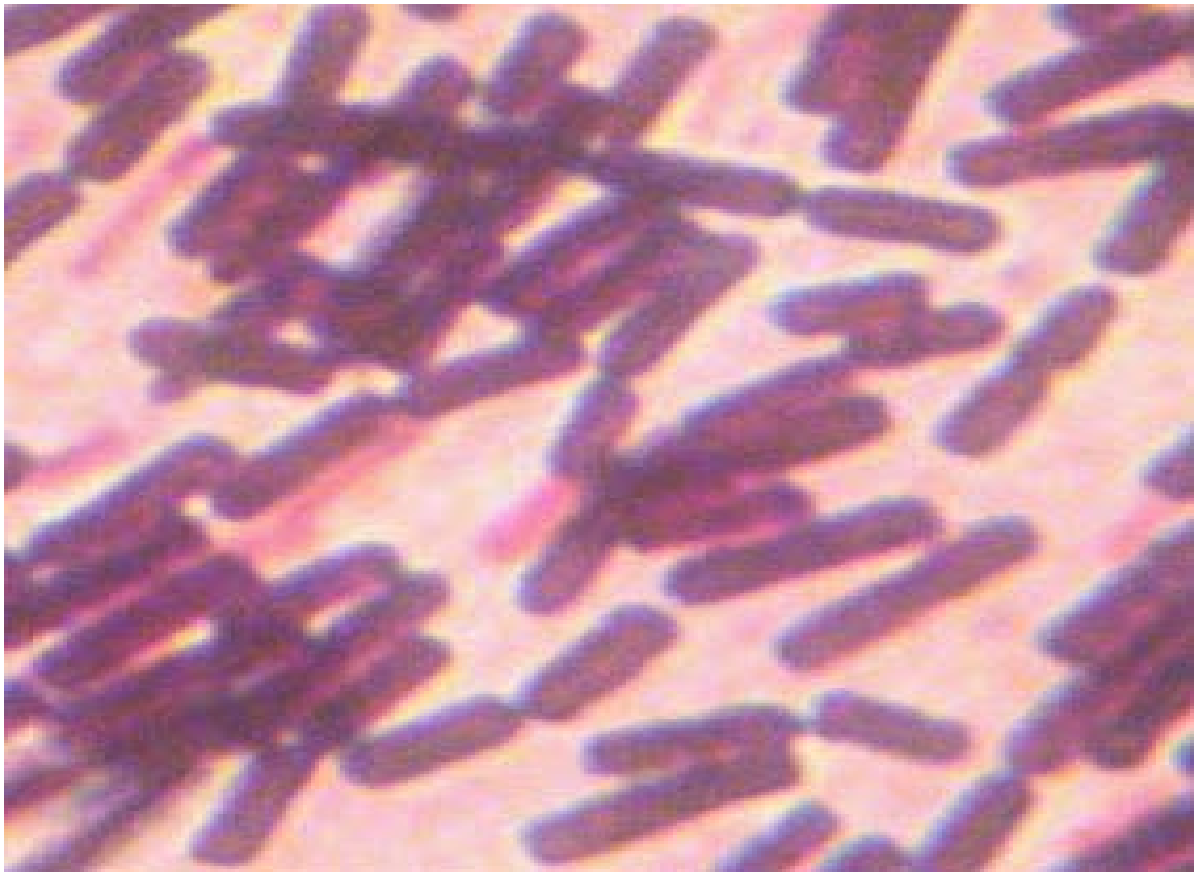
Description of organism (including its role in the compost pile):



www.antibiotics.riken.go.jp/.../nocardia.jpg

ACTINOMYCETES

Bacteria that grow in multicellular filaments similar to fungi. They contain enzymes that break down tough woody materials in the compost pile.



www-micro.msb.le.ac.uk/video/graphics/Bcereus.jpg

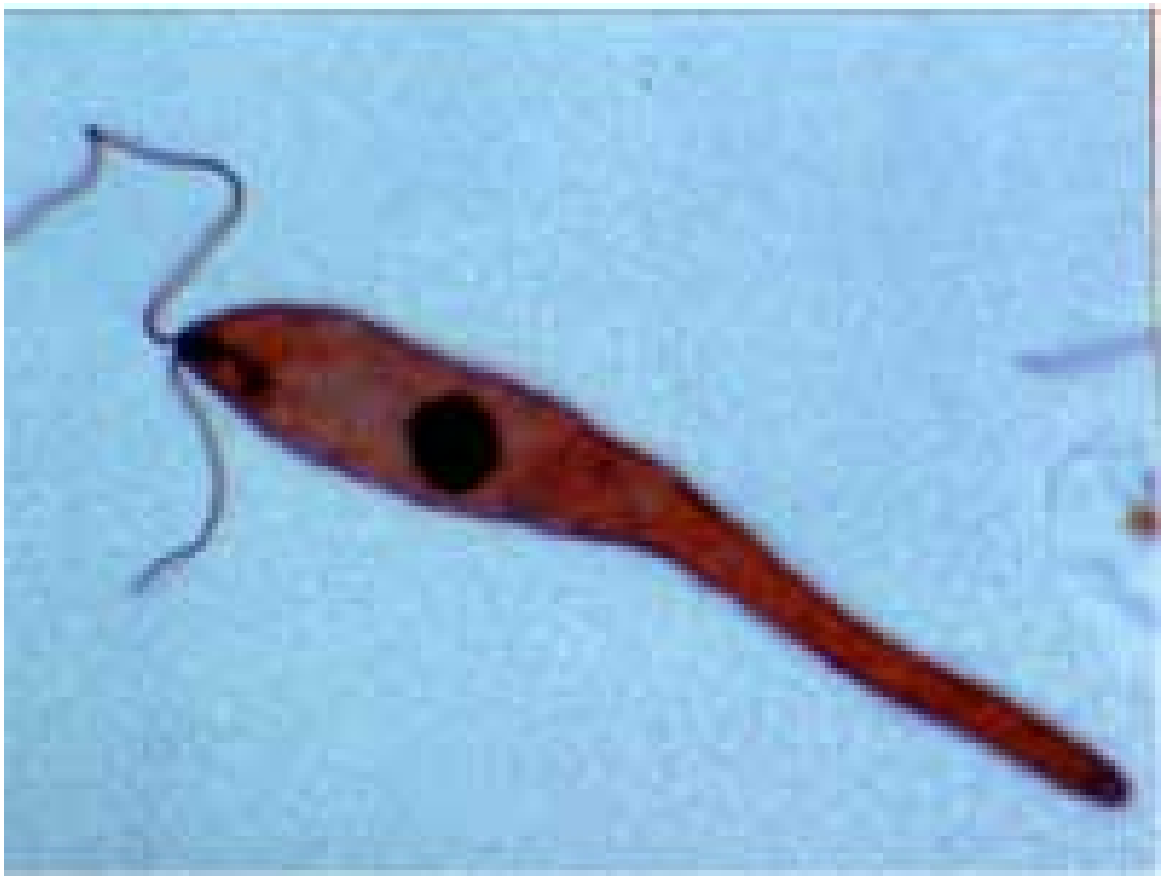
BACILLUS

Rod-shaped bacteria that use enzymes to break down organic matter. They reproduce in high numbers as the compost pile's temperature begins to rise.

http://www.niaes.affrc.go.jp/inventry/microorg/eng/z59e-Arth-st.html

SAPROPHYTES

Fungi that grow and spread quickly throughout the outer layers of the compost pile. They digest organic material that bacteria cannot break down.



http://soils.tfrec.wsu.edu/mg/flagella.jpg

PROTOZOA

Microscopic unicellular organisms that feed on organic matter and bacteria and fungi in the compost pile.

http://www.ycy63.dial.pipex.com/freshwater/rotifer.html

ROTIFER

Microscopic multicellular organism found in water droplets throughout the compost pile. These organisms feed on organic matter and bacteria and fungi in the compost.

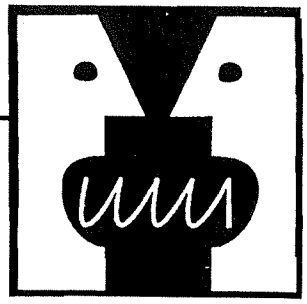
http://www2.una.edu/microaquarium/images/Nematodes/nema03cm.jpg

NEMATODE

Microscopic, cylinder-shaped worm that feeds on decaying matter, bacteria, fungi, and protozoa in the compost pile.

Deciphering Decomposers Grading Rubric

CATEGORY	4	3	2	1
Written Description - Imaginative & Creative	The physical description is adequate and the role of the microorganism is addressed.	The physical description is adequate but the role of the microorganism is not addressed.	The physical description is not adequate but the role of the microorganism is addressed.	The physical description is not adequate and the role of the organism is not addressed.
Illustration - Imaginative & Creative	The illustration matches the physical description given in the written portion and features many creative elements of design.	The illustration matches the physical description given in the written portion and features some creative elements of design.	The illustration matches the physical description given in the written portion but does not attempt to be creative in design.	The illustration does not match the physical description given in the written portion.
Written - Factual	Information clearly relates to the assigned microorganism. The report includes several supporting details and/or examples.	Information clearly relates to the assigned microorganism. The report includes 1-2 supporting details and/or examples.	Information clearly relates to the assigned microorganism. No details and/or examples are given.	Information has little or nothing to do with the assigned microorganism.
Illustration - Factual	The illustration is accurate and adds to the understanding of the topic.	The illustration is accurate but does not add to the understanding of the topic.	The illustration is inaccurate.	No illustration is included.
Overall Achievement	All products completed and products indicate understanding of the topic.	Some products completed and products indicate understanding of the topic.	Some products completed, but products do not indicate understanding of the topic.	No products completed.



LET'S BE VOCAL

Objectives

Students will be able to improvise definitions of vocabulary words associated with solid waste.

Method

Taking turns within a small group, students will develop vocabulary definitions, one word at a time.

Materials

Waste-In-Place glossary or selected list of solid waste terms and definitions

Vocabulary

selected entries or entire *Waste-In-Place* glossary

Procedure

1. Background: Improvisation (improv) is the action of inventing or composing without preparation from materials at hand. In the hands of the educator, improvisation becomes a bridge to self-confidence, responsibility, acceptance of others, and most frequently, creativity. Improv deprograms the standard student response and allows the innate creative sense to flourish. Its essence is that of divergence. Viola Spolin, the master of the improvisational game, speaks of talented behavior as a "greater capacity for experiencing." Like few other activities, improv creates these new experiences while allowing talents to unfold naturally. The student learns from the process by being the process.

2. Let's Be Vocal is a game in which 3 to 6 students act as one person to define solid waste vocabulary words given by the teacher. Answers are created as each member in order gives one word of the definition without prior collaboration. Each single word response follows the previous player's response until a final definition is obtained.

3. The teacher explains the rules of the game.
   a. The group must improvise a definition of the word given them without discussing it with each other.
   b. The definition is composed by each student giving one word following the previous student's word until the group has made a complete sentence.

4. The teacher calls 3 to 6 students to the front of the room.

5. Using selected solid waste terms and definitions or the *Waste-In-Place* glossary, the teacher gives a word from the list to the students.

6. The first person in the group begins the response by speaking one word of a definition.

7. The person to his/her left will give the next word, and so on until the group is satisfied with their response.

8. After the group has finished, the teacher will compare their definition to the one given with the vocabulary word.

9. Continue the game with different groups of students until all the students have taken at least one turn.

Assessment

The game itself can be used to pretest, to review, or to check for understanding of any or all waste related terms.

Enrichment

Have students make their own lists of words related to solid waste issues to be used for the game.

Play the game as suggested in the procedure, but do not let the "audience" (students not defining the term) know what the term is that is being defined. Have the "audience" write down the term they think is being defined, or have them call it out as it soon as they know what it is.

Timely Trash Date Strips

Citizens of Troy dumped waste on floors and streets.

Citizens of Athens, Greece, designated a dump outside city walls.

English Parliament banned waste disposal in public waterways and ditches.

Garbage piled up so high outside the gates of Paris, France, that it interfered with the city's defenses.

Colonial Americans used corralled pigs to eat garbage.

Philadelphia paper mill recycled waste paper and rags.

First incinerator in the US is built on Governor's Island in New York.

Colonel George E. Waring, Jr., the "Apostle of Cleanliness," pioneered the first comprehensive system of refuse management in New York City.

New York City's rubbish was delivered to a "picking yard" where it was separated into paper, metal, carpet, bagging, twine, rubber, and horsehair.

Aluminum recycling began on a large scale in Chicago and Cleveland.

Approximately 300 garbage incineration plants were in operation in the US and Canada.

Sanitary landfills introduced layering organic wastes with dry rubbish to reduce odors, but still had leachate problems

Americans collected rubber, paper, scrap metal, fats and tin cans to help the war effort. Recycling was essential to the war effort so tanks, ships, guns, ammunition, and clothing could be made.

Keep America Beautiful was founded.

American Civil Engineers published the standard guide to sanitary landfilling. The guide suggested compacting refuse and covering with a layer of soil each day.

The Solid Waste Disposal Act created funds for states and municipalities for research, planning, and developing waste disposal programs.

Resource Recovery Act provided funds to construct waste/disposal facilities and was the first Federal legislation to encourage recycling.

The US Environmental Protection Agency was created.

The Resource Conservation and Recovery Act empowered EPA to regulate the disposal and treatment of municipal solid and hazardous wastes.

The Public Utility Regulatory Policies Act was passed, guaranteeing markets for small energy producers, encouraging growth of the waste-to-energy industry and methane recovery from landfills.

Rhode Island became the first state to issue a mandatory recycling law for newspaper, glass, PET and HDPE plastics, aluminum, and tin.

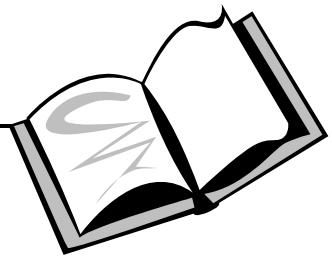
The Plastic Pollution Research and Control Act banned ocean dumping of plastic materials.

26 states have comprehensive laws making recycling an integral part of waste management; 7 states required curbside separation of recyclables.

The nation’s first two polystyrene recycling plants opened in New York and Massachusetts.

Researchers worked to reduce, reuse, and recycle waste from the Skylab space station.

Environmental Literature List



Easy Reader

Robinson, Fay. **Recycle That!** (1995) Scholastic Library Publishing. ISBN: 0516460331. **Ages 4-8**

Juvenile Non-fiction

Bowden, Rob. **Waste**. (2001). Steck-Vaughn Publishers. ISBN: 0739831801. **Ages 9-12**

Donald, Rhonda Lucas. **Recycling**. (2002). Children's Press. ISBN: 0516273566. **Ages 9-12**

Hall, Eleanor J. **Garbage**. (1997). Greenhaven Press. ISBN: 156006188X. **Young Adult**

Gibbons, Gail. **Recycle! A Handbook for Kids**. (1992). Little, Brown Publishers. ISBN: 0316309435. **Ages 6-12.**

Harlow, Rosie and Sally Morgan. **Garbage and Recycling**. (2002). Kingfisher Publishing. ISBN: 075345503X. **Ages 4-10. ***Included in FEED BUCKET**

Kohl, MaryAnn, and Cindy Gainer. **Good Earth Art**. (1991). Bright Ring Publishing. ISBN: 0935607013. **Ages 4-12. ***Included in FEED BUCKET**

MacGregor, Cynthia. **Recycling A Can**. (2002). Rosen Publishing Group. ISBN: 0823937445. **Ages 4-8**

Mitchell, Joyce Slayton. **Crashed, Smashed, and Mashed**. (2001). Tricycle Press. ISBN: 1582460345. **Ages 8-12**

Penny, Malcolm. **What do We Think About our Environment**. (2001). Hodder and Stoughton Children's Division. ISBN: 075023164. **Ages 4-8**

Ross, Kathy and Hank Schneider. **Look What you can Make with Newspapers, Magazines, and Greeting Cards**. (2002). Boyds Mill Press. ISBN: 1563975661. **Ages 4-8**

Ross, Kathy and Hank Schneider. **Look What you can Make with Plastic Bottles and Tubs**. (2002). Boyds Mill Press. ISBN: 156397567X. **Ages 4-8**

Showers, Paul and Randy Chewning. **Where Does the Garbage Go?** (1994). Harper Trophy Publishers. ISBN: 0064451143. **Ages 4-8**

Smith, Heather and Joe Ratigan. **Earth Friendly Crafts for Kids: 50 Awesome Things to Make with Recycled Stuff.** (2002). Lark Publishing. ISBN: 1579903401. **Ages 9-12**

Weber, Rebecca. **Waste not; time to recycle**. (2002). Compass Point Books. ISBN: 0756503876. **Ages 4-8**

Woods, Samuel G. **Recycled Paper from Start to Finish**. (2000). Blackbirch Press. ISBN: 1567113958. **Ages 9-12**

Juvenile Fiction

Bourgeios, Paulette and Kim Lafave. **Garbage Collectors (In My Neighborhood).** (1998). Kids Can Press. ISBN: 1550744402. **Ages 4-8**

Environmental Literature List

Madden, Don. **The Wartville Wizard**. (1993). Aladdin Publishing. ISBN: 0689716672. **Ages 9-12**

Murphy, Stuart J. **Earth Day – Hooray!** (2004). Harper Trophy Publishing. ISBN: 0060001291. **Ages 4-8, Math Focus**

Paulson, Rachel P. **Johnny and the Old Oak Tree**. (1995). Crestmont Publishing. ISBN: 0964229609. **Ages 9-12**

Paulson, Rachel P. Jackie Hutto, editor. **Sir Johnny's Recycling Adventure**. (1999). Crestmont Publishing. ISBN: 0964229625. **Ages 9-12**

Sensel, Joni and Christopher L. Bibins. **The Garbage Monster**. (2001). Dream Factory Books. ISBN: 0970119526. **Ages 4-8**

Wallace, Nancy Elizabeth. **Recycle Everyday!**. (2003). Marshall Cavendish. ISBN: 0761451498. **Ages 4-8. ***Included in FEED BUCKET**

Adult Fiction

Quinn, Daniel. **Ishmael: An Adventure of the Mind and Spirit.** (1995). Bantam Publishing. ISBN: 0553375407. **High school**

Adult Non-fiction/Teacher Resources

Anderson, Cathy & Andrea Reider, Eds. **Waste Reduction: E2: Environment and Education**. (1997). Dale Seymour Publications. ISBN: 0201495376. **Teacher Resource**

Goldbeck, Nikki and David. **Choose to Reuse: an Encyclopedia of Services, Businesses, Tools & Charitable Programs that Facilitate Reuse** (1995). Ceres Press. ISBN: 0960613862.

McVicker, Dee. **Easy Recycling Handbook**. (1994). Grassroots Books. ISBN: 0963842854. **High School, Teacher Resource**

Ryan, John C. and Alan T. Durning. **Stuff: the Secret Lives of Everyday Things**. (1997). Northwest Environment Watch Publishing. ISBN:1886093040. **Grade 9 and up, curriculum guide available: http://www.northwestwatch.org/publications/stuff.asp**

Smallwood, Carol. **Recycling Tips for Teachers and Librarians** (1995). McFarland and Company Publishing. ISBN: 0786400099. **Teacher resource**

Stein, Kathy. **Beyond Recycling: Re-user's Guide: 336 Practical Tips: Save Money and Protect the Environment.** (1997). Clear Light Publishers. ISBN: 0940666928. **High School, Teacher Resource**

Strasser, Susan. **Waste and Want: A Social History of Trash.** (2000). Owl Books. ISBN: 0805065121. **High School (Juniors and Seniors or AP-level classes)**

Online Recycling Resources and Links

ALL AGES

www.cleanup.org
Information by zip code; Activities and information about recycling, water quality, etc.
All levels, Teacher Resources

www.epa.gov/kids/
Environmental Protection Agency's site; Separate site for high school students; Games, activities, and information for younger students
All levels

www.gp.com
Website focusing on paper products; Recycling information
All levels, Educational in Nature curriculum gds 4-5

www.newdream.org
Info on buy recycled, etc.
All levels, teacher resource

www.recycle-steel.org
Steel recycling facts; Kids' page
All levels

www.tappi.org/paperu
Paper website; Information about paper making, field trip information, career information
All levels

www.afandpa.org/
Paper production and recycling info
All levels, Teacher Resources

ELEMENTARY AND MIDDLE GRADES

www.recycleguys.org
Games and activities for children with recycling and waste education message
Elementary School

MIDDLE AND HIGH GRADES

www.epa.gov/greenbuilding/
Resource and energy-efficient construction
Middle and High school

http://people.howstuffworks.com/landfill.htm
Explains how a landfill operates, trash composition, and where trash ends up; Features information on the North Wake Landfill
Middle and High School

www.myfootprint.org
Calculates an individual's "Ecological Footprint"
Middle and High School

HIGH SCHOOL GRADES

www.earthshell.com
Biodegradable food packaging
High School, Teacher Resources

www.itsrecycled.com
Recycled content products (benches, decks, tables)
High School, Teacher Resources

www.ofee.gov/recycled/cal-index.htm
Calculator shows wood and energy consumption for paper types; Life cycle of paper
High School

TEACHER RESOURCES

www.ee.enr.state.nc.us/
NCDENR, Office of Environmental Education; Certification information and excellent teacher resources

www.eenc.org
Environmental Educators of North Carolina

www.plt.org/
Project Learning Tree-curriculum and environmental education program

www.simputerusa.org
Old computer refurbishing for schools, special needs students and low-income families

www.wakegov.com/county/recycling/
Municipal web pages, statewide recycling programs, and recycling publications

C O M P O S T I N G

A Guide to Managing Organic Yard Wastes

America's waste disposal sites are filling up. Landfills across the nation are being closed at an alarming rate. Yet the volume of waste our society produces continues to increase.

Twenty percent of the solid waste placed in landfills consists of yard and garden wastes such as leaves and grass clippings. Many states, including North Carolina, are banning these wastes from landfills.

One step we can take toward solving our waste disposal problems is to make use of lawn and garden wastes instead of dumping them. Through the process of composting, these organic wastes can be recycled to produce a natural material that can be used in gardens, landscapes, and flower beds.

When mixed with soil, compost increases the organic matter content, improves the physical properties of the soil, and supplies essential nutrients, enhancing the soil's ability to support plant growth. Compost can also be applied to the soil surface to conserve moisture, control weeds, reduce erosion, improve appearance, and keep the soil from gaining or losing heat too rapidly.

One way to dispose of yard and garden wastes is to haul them to municipal or county composting facilities. Many homeowners, however, find it more convenient and economical to compost these materials in their own backyards. In either case, the finished compost can be mixed with soil or used as a mulch for gardens, landscape beds, or lawns. This publication explains how to build and maintain a compost pile and how to use compost in the yard and garden.

Why Compost?

Gardeners have used compost for centuries. Composting is an efficient method of breaking down organic materials into an end product that is beneficial to soil and plants. Adding yard and garden wastes directly to the soil without first composting them has some undesirable effects. For example, if large quantities of uncomposted leaves are incorporated into the soil, the microbes that work to decompose the leaves will compete with plant roots for soil nitrogen. This competition can result in nitrogen deficiency and poor plant growth. Increased populations of the microbes can also deplete most of the organic matter in the soil, leaving the soil with less structure than before.

When materials such as leaves and grass clippings are composted, however, a microbial process converts them to a more usable organic material. Adding composted material reduces the competition for nitrogen. Composted material is also much easier to handle and mix with soil than uncomposted material because of its finer texture. Furthermore, improvement of the soil's physical properties — such as increased infiltration, better drainage, and greater water holding capacity — usually occurs more rapidly when composted materials are added.

Requirements for Efficient Decomposition

Decomposition of organic material in a compost pile depends on maintaining the activity of decomposer microbes. Any factor that slows or halts the growth of these microbes also slows the composting process. Efficient decomposition occurs when aeration and moisture are adequate, when the particles of waste material are small, and when the proper amounts of fertilizer and lime are added. We will discuss each of these factors in more detail.

AERATION

Microbes require oxygen to decompose organic wastes efficiently. Some decomposition will occur in the absence of oxygen (that is, under anaerobic conditions); however, the process is slow and foul odors may develop. Because of the odor problem, composting without oxygen is not recommended in residential areas unless the process is conducted in a fully closed system (such as the plastic bag method described later under "Composting Structures"). Mixing the pile once or twice a month will provide the necessary oxygen and significantly hasten the composting process. A pile that is not mixed may take three to four times longer to produce useful compost. A well-mixed compost pile also reaches higher temperatures, helping to destroy weed seeds and disease-causing organisms (pathogens).

MOISTURE

Adequate moisture is essential for microbial activity. Materials in a dry compost pile will not decompose efficiently. If rainfall is limited, the pile must be watered periodically to maintain a steady decomposition rate. Enough water should be added to completely moisten the pile, but overwatering should be avoided. Excessive moisture can lead to anaerobic conditions, slowing down the degradation process and causing foul odors. The pile should be watered enough that it is damp but does not remain soggy. Approximately 50 to 55 percent moisture on a weight basis is a good starting point. The compost is within the right moisture range if a few drops of water can be squeezed from a handful of material. If no water can be squeezed out, the materials are too dry. If water gushes out, they are too wet.

PARTICLE SIZE

The smaller the organic waste, the faster the compost will be ready to use. Smaller particles have much more surface area for a given volume and thus are more rapidly broken down by microbes. Materials can be shredded before they are added to the pile. Shredding is essential if brush or sticks are to be composted. In addition to speeding up the composting process, shredding reduces the volume of the compost pile. A low-cost method of reducing the size of fallen tree leaves is to mow the lawn before raking it or to run the lawn mower over leaf piles after raking. Raked piles should be checked to ensure that they do not contain sticks or rocks that could cause injury during mowing. If the mower has an appropriate bag attachment, the shredded leaves can be collected directly.

FERTILIZER AND LIME

Microbial activity is affected by the ratio of carbon to nitrogen in the organic waste. Because microbes require a certain amount of nitrogen to live and grow, a shortage of nitrogen slows the composting process considerably. Materials high in carbon but low in nitrogen, such as straw or sawdust, decompose very slowly unless nitrogen fertilizer is added. Although tree leaves are higher in nitrogen than straw or sawdust, they still decompose more rapidly when nitrogen fertilizer or wastes that are high in nitrogen

are added. Grass clippings are generally high in nitrogen; when mixed properly with leaves, they speed decomposition. Poultry litter, manure, or blood meal can be used as organic sources of nitrogen. Otherwise, a fertilizer with a high nitrogen analysis (10 to 30 percent) should be used. Other nutrients such as phosphorus and potassium are usually present in adequate amounts.

During the initial stages of decomposition, organic acids are produced and the acidity (pH) of the compost drops. At one time it was believed that adding small amounts of lime in the early stages would maintain and enhance microbial activity during this period. However, lime converts ammonium-nitrogen to ammonia gas, removing nitrogen from the pile. Although adding lime may hasten decomposition, the loss of nitrogen from the pile often offsets the benefits. Lime is not necessary for degradation of most yard wastes. Finished compost is usually alkaline (with a pH between 7.1 and 7.5) without the addition of lime. In many areas, the water used to moisten the compost pile is alkaline and may also help to raise the pH (reduce the acidity) of the compost. If large quantities of pine needles, pine bark, or vegetable and fruit wastes are composted, additional lime may be necessary to reduce acidity.

Materials for Composting

Many organic materials are suitable for composting. Yard wastes such as leaves, grass clippings, straw, and nonwoody plant trimmings can be composted. Leaves are the dominant organic waste in most backyard compost piles. Grass clippings can be composted; however, with proper lawn management, clippings do not need to be removed from the lawn. If allowed to remain, they will decay and release nutrients, reducing the need for fertilizer. (See Cooperative Extension Service publication AG-69, *Carolina Lawns.*) If clippings are used, they should be mixed with other yard wastes; otherwise they may compact and restrict airflow. Branches and twigs greater than 1/4 inch in diameter should be put through a shredder or chipper first. Kitchen wastes such as vegetable scraps, coffee grounds, and eggshells may also be added.

Sawdust may be added in moderate amounts if additional nitrogen is applied. Approximately 1 pound of actual nitrogen (6 cups of ammonium nitrate) is required per hundred pounds of dry sawdust. Wood ashes serve as a lime source; if used, they should be added only in small amounts (no more than 1 cup per bushel or 10 pounds per ton of compost). Excessive amounts result in loss of nitrogen from the pile. However, wood ashes do contribute high levels of potassium to the compost. Crushed clam or oyster shells, eggshells, and bone meal also tend to reduce the acidity of composts. Ordinary black-and-white newspaper can be composted; however, the nitrogen content is low, slowing the decomposition rate. If paper is composted, it should make up no more than 10 percent of the total weight of the material in the compost pile. It is better to take newspapers to a community recycling center.

Other organic materials that can be used to add nutrients to the pile include blood and bone meal, livestock manure, prunings from nonwoody plants, vegetable and flower garden refuse, fruit and vegetable scraps from the kitchen, hay, straw, and lake plants. Livestock manure and poultry litter can be added to provide nitrogen. About 100 pounds of poultry litter provides 1.8 pounds of nitrogen.

Materials to Avoid in a Compost Pile

Some materials may pose a health hazard or create a nuisance and therefore should not be used to make compost. Human or pet feces should not be used because they can transmit disease. Although animal remains can be safely decomposed in commercial compostors, wastes such as meat, bones, grease, whole eggs, and dairy products should be avoided in home compost piles because they may attract rodents. Most plant disease organisms and weed seeds are destroyed during the composting process because temperatures in the center of the pile reach 150° or 160°F. In most compost piles, however, it is impossible to mix the contents thoroughly enough to bring all wastes to the center. Consequently, adding diseased plants or large amounts of weeds containing seeds can create problems if the compost is to be used in the garden.

Citrus rinds; corn cobs, stalks, and husks; palm fronds; and walnut, pecan, and almond shells break down very slowly and should be avoided unless they are shredded. Charcoal also resists decay and will not decompose in most compost piles. Coal ashes should not be added because they contain levels of sulfur and iron that may be toxic to plants. Automotive petroleum products should be taken to recycling centers, never put into a compost pile.

Although plants that have been treated with herbicides or pesticides should be avoided for composting, small amounts of herbicide-treated plants (for example, grass clippings) can be mixed into the pile as long as adequate time is allowed for thorough decomposition. Ideally, clippings from lawns recently treated with herbicides should be left

Table 1. Persistence of Herbicides in Soil

Common Name	Trade Name	Persistence in Soil (months)
Benefin	Balan, Balfin	4–8
DCPA	Dacthal	4–8
Bensulide	Betasan, Prefar	6–12
Glyphosate	Roundup, Kleenup	Less than 1
2,4-D	(Many formulations)	1–2
MCPP	(Many formulations)	1–3

on the lawn to decompose. Most agrichemicals, both pesticides and herbicides, degrade at varying rates. Table 1 lists common chemicals used on home lawns and gives their degradation rate in soil. Even if some treated grass clippings are used, the chemicals they contain should degrade at least as fast in a properly maintained compost pile as they do in the soil.

Composting Structures

To save space, hasten decomposition, and keep the yard looking neat, the compost pile can be contained in some sort of structure. If the quantity of leaves or garden wastes is limited, starting with a single holding pile constructed as materials are gathered may be the best approach. This method also works if minimizing the composting time is not of great concern.

Composting structures can be made from a variety of materials and can range from very simple to complex. The design can be tailored to individual needs.

Using plastic garbage bags is perhaps the simplest way to make compost. The bags are easy to handle and require little maintenance. Large (30- to 40-gallon) plastic bags should be filled with alternating layers of plant wastes, fertilizer, and lime. About 1 tablespoon of a garden fertilizer with a high nitrogen content (such as 10-10-10) should be used in each bag. Lime (1 cup per bag) helps counteract the extra acidity caused by anaerobic composting. After the bags have been filled, about a quart of water should be added and the bags closed tightly. Set them aside for six months to a year. The bags can be in a basement or heated garage to hasten decomposition during winter months. No turning is required and no water need be added after the bags have been closed. The main advantage of composting in garbage bags is that very little attention is required. Because the amount of oxygen is limited, however, the process is slow.

The barrel or drum composter generates compost rather quickly and provides an easy mechanism for turning the compost (Figure 1). A barrel of at least 55-gallon capacity with a secure lid is required. Be sure that the barrel was not used to store toxic chemicals. Drill six to nine rows of $^1/_2$-inch holes over the length and a few in the bottom of the barrel to allow for air circulation and drainage of excess moisture. Place the barrel upright on blocks to allow air to circulate below it. Fill the barrel three-fourths full with organic waste material and add about $^1/_4$ cup of a fertilizer high in nitrogen (approximately 30 percent nitrogen). Add water until the compost is moist but not soggy. Every few days, turn the drum on its side and roll it around the yard to mix and aerate the compost. The lid can be removed after

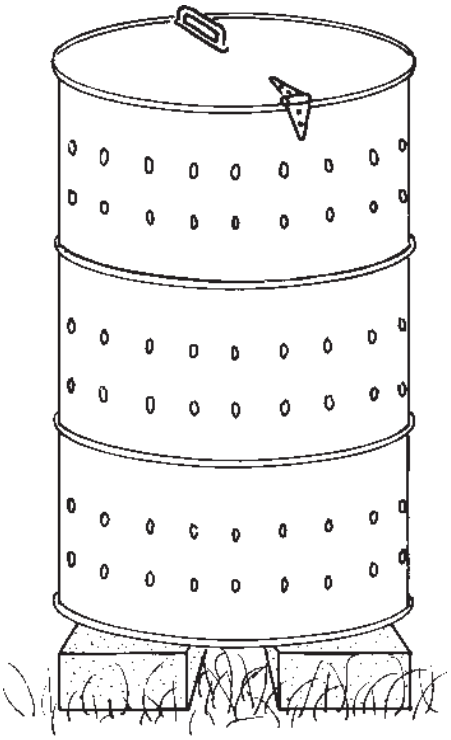


Figure 1. The barrel or drum composter.

turning to allow for air penetration. The compost should be ready in two to four months. The barrel composter is an excellent choice for the city dweller with a relatively small yard.

For larger quantities of organic waste, bins are the most practical composting structure. A circular bin can be made from a length of closely spaced woven-wire fencing held together with chain snaps (Figure 2). The bin should be about 3 to 5 feet in

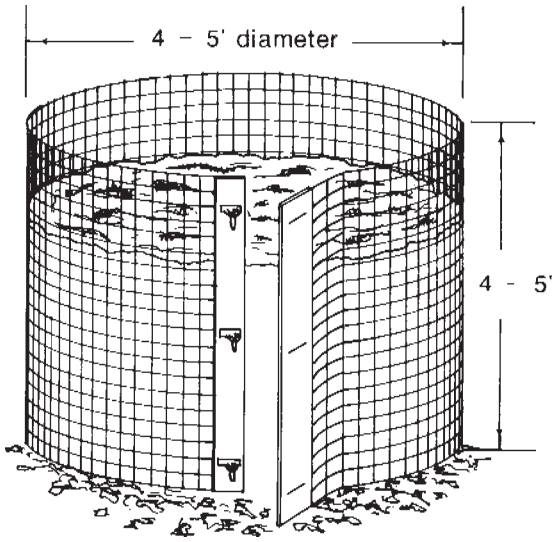


Figure 2. A cylindrical wire bin.

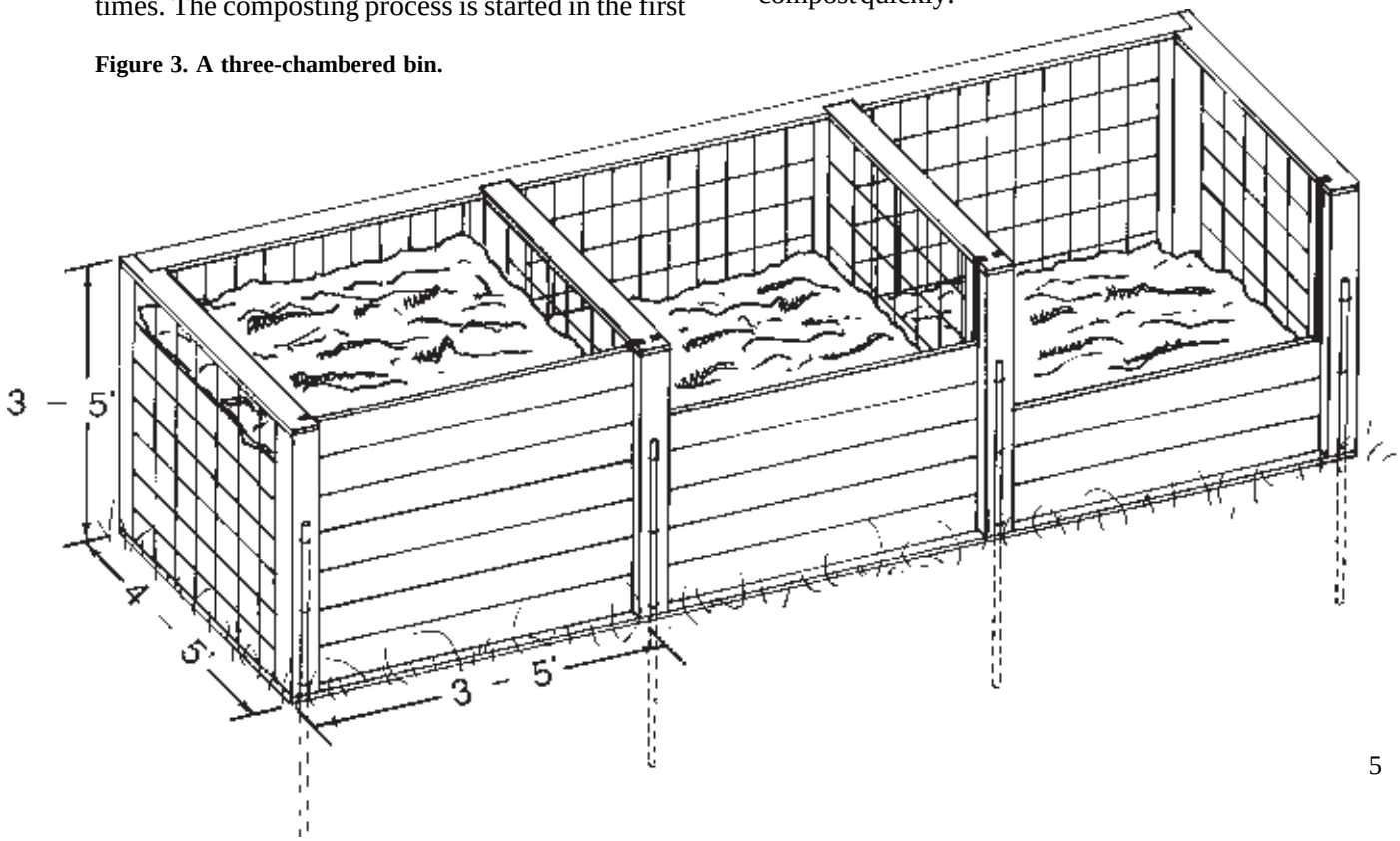
diameter and at least 4 feet high. A stake may be driven in the middle of the bin before adding material to help maintain the shape of the pile and to facilitate adding water. With this design, it is easiest to turn the composting material by simply unsnapping the wire, moving the wire cylinder a few feet, and turning the compost back into it.

A very efficient and durable structure for fast composting is a three-chambered bin (Figure 3). It holds a considerable amount of compost and allows good air circulation. The three-chambered bin works on the assembly line principle. Three batches of compost are in varying stages of decomposition at all times. The composting process is started in the first bin; waste material is placed in the bin and allowed to heat for three to five days. Then this material is turned into the middle bin for another four to seven days while a new batch of material is started in the first bin. Finally, the material in the middle bin is turned into the last bin as finished or nearly finished compost. The material in the first bin is turned into the second bin, and new material is once again placed in the first bin.

To make this structure, it is best to use rot-resistant wood such as redwood, salt-treated wood, wood treated with an environmentally safe preservative, or a combination of treated wood posts and metal posts. Unless the wood is treated or rot resistant, it will decompose within a few years. Each bin should be at least 3 to 5 feet in each dimension so that it will hold enough volume to compost properly. Using removable slats in the front of each bin provides easy access to the contents when they must be turned.

Many other structures can be used for composting. No one structure is best, and you may want to invent your own. For a more thorough description of different structures, see The Complete Book of Composting, by J. I. Rodale (Rodale Books, Inc., Emmaus, PA, 1971.) If you prefer not to build a structure, you may wish to purchase one of the commercial composting units available through local garden stores or mail-order catalogs. Most of these are similar to the barrel composter described previously and are intended for the city dweller who wants an easy way to make small amounts of compost quickly.

Figure 3. A three-chambered bin.



Location

The compost pile should be located near the place where the compost will be used. It should also be placed where it will not offend neighbors or interfere with activities in the yard. Composting is best done in a location screened from your view and that of neighbors. Good locations for the pile are near the garden or in a service area. Do not locate the compost pile near a well or on a slope that drains to surface water, such as a stream or a pond. Locating the pile too close to trees may also create problems, as roots may grow into the bottom of the pile, making turning and handling the compost difficult. The pile will do best where it is protected from drying winds and is in partial sunlight to help provide heat. The more wind and sun the pile is exposed to, the more water it will need.

Preparing the Compost Pile

When a compost pile is started, materials should be added in layers to ensure proper mixing. An example of the layering process is illustrated in Figure 4. Organic wastes such as leaves, grass clippings, and plant trimmings are put down in a layer 8 to 10 inches deep. Coarser materials will decompose faster if placed in the bottom layer. This layer should be watered until moist but not soggy. A nitrogen source should be placed on top of this layer. Use 1 to 2 inches of livestock manure or a nitrogen fertilizer such as ammonium nitrate or ammonium sulfate at a rate of $^1/_3$ cup for every 25 square feet of surface area. If these nitrogen sources are not available, 1 cup of 10-10-10 fertilizer per 25 square feet of surface area will suffice. Do not use fertilizer that contains any herbicide or pesticide.

A 1-inch layer of soil or completed compost can be applied on top of the fertilizer layer. One reason for adding soil is to ensure that the pile is inoculated with decomposing microbes. The use of soil in a compost pile is optional, however. In most cases, organic yard wastes such as grass clippings or leaves contain enough microorganisms on the surface to cause decomposition. Studies have shown that there is no advantage in purchasing a compost starter or inoculum. Microbes multiply as rapidly from the soil or from added organic wastes as from the inoculum. The microbes already in the soil and on organic materials are just as efficient in decomposing the waste as those provided by the commercial inoculum. However, one way to ensure that activator microbes are present in the new compost is to mix in some old compost as the pile is prepared. Adding soil does help reduce leaching of mineral nutrients such as potassium released during decomposition. Repeat the sequence of adding organic waste, fertilizer, and soil or old compost (optional) until the pile is completed, remembering to water each section.

Figure 4. Compost pile ingredients.

If only tree leaves are to be composted, layering is not necessary. Fallen leaves can be added as they are collected. The leaves should be moistened if they are dry. Since dead leaves lack adequate nitrogen for rapid decomposition, a high-nitrogen fertilizer (10 to 30 percent) should be added to hasten breakdown. Approximately 5 ounces (about $^1/_2$ cup) of 10 percent nitrogen fertilizer should be added for every 20 gallons of hand-compressed leaves.

The carbon-to-nitrogen (C/N) ratio determines how long decomposition takes. An initial C/N ratio of about 20 or 30 to 1 is needed for rapid composting. If the initial C/N ratio is above 50, the process will be

Table 2. Approximate Nitrogen Concentration and Carbon-to-Nitrogen (C/N) Ratio of Compost Materials

Material	Nitrogen (% dry weight)	C/N ratio
Grass clippings	2.15	20
Leaves	0.5–1.0	40–80
Sawdust	0.11	511
Wood (pine)	0.07	723
Fruit wastes	1.52	35
Paper	0.25	170
Table scraps	none	15
Livestock manure	1.0	20

considerably slower. The C/N ratio of common organic yard wastes is given in Table 2. Materials can be blended and mixed to achieve an initial C/N ratio of 25 to 30. Over time, the C/N ratio will generally decrease.

Maintaining the Compost Pile

To prevent odors and hasten decomposition, the pile must be turned occasionally. Turning also exposes seeds, insect larvae, and pathogens to lethal temperatures inside the pile. The pile may be turned by inverting segments of the compost or by shifting the pile into another bin. The pile should be kept moist but not waterlogged. Odors may arise either from adding excessive amounts of wet plant materials, such as fruits or grass clippings, or from overwatering. A properly mixed and adequately turned compost pile does not produce objectionable odors. The middle of an actively decomposing pile reaches temperatures of 150° to 160°F. If the pile does not heat sufficiently, it may be too small, there may not be enough nitrogen or oxygen, or it may be too wet or too dry. The pile should be turned when the center begins to feel cool to the touch. Turning the pile introduces oxygen and undecomposed material into the center, regenerating the heating process. Composting is essentially complete when mixing no longer produces heat in the pile.

Small amounts of fresh materials may be added if the pile is turned occasionally. Vegetable wastes should be buried inside the pile to avoid attracting rodents. If enough material is available, it is best to make a new pile instead of combining new material with old compost.

Generally, the compost from a well-managed pile made up of shredded material under warm conditions will be ready in about two to four months. Piles prepared in the late fall will not be ready for use the following spring because the weather is not warm enough to maintain proper decomposing temperatures inside the pile. A pile left unattended or made up of material that has not been shredded may take more than a year to decompose. When the compost is finished, the pile will be about half its original size and will have an earthy smell to it.

Use of Compost to Improve Soil

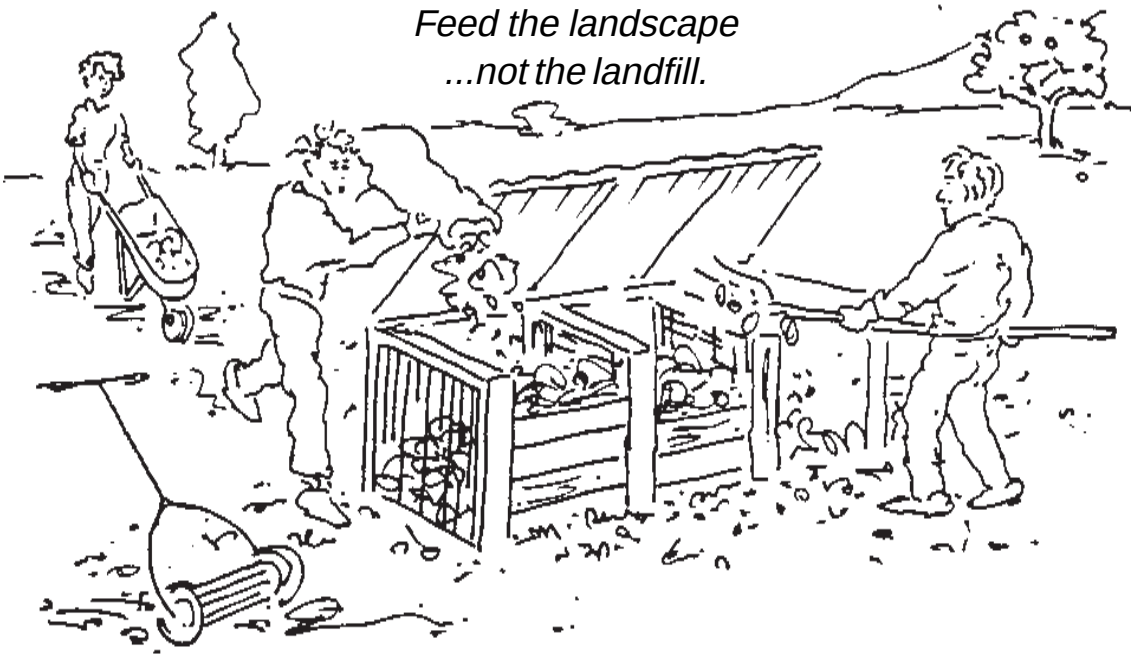
Compost is used as an organic amendment to improve the physical, chemical, and biological properties of soils. The compost adds air space to the soil, and incorporating it alleviates compacted conditions. Adding compost increases the moisture-holding capacity of sandy soils, reducing drought damage to plants. When added to heavy clay soils, compost improves drainage and aeration. (Note, however, that adding compost cannot solve drainage problems that result from poor surface contours or subsurface conditions. Such problems often must be solved by regrading, berming, or installing drainage tiles.)

All of these changes create a better environment for root growth. Adding compost increases the ability of the soil to hold and release essential nutrients. The activity of earthworms and soil microorganisms beneficial to plant growth is also promoted. Other benefits include improved seed emergence and water infiltration as a result of reduced soil crusting.

Amending soils with compost may also reduce the incidence of damping off disease and root rots. The microflora present in compost compete with disease microbes for the sugars and nutrients secreted from plant roots, preventing these pathogens from growing and keeping them inactive.

Over time, yearly additions of compost will create desirable soil structure, making the soil much easier to work. To improve the physical properties of the soil, incorporate 1 to 2 inches of well-decomposed compost into the top 6 to 8 inches of soil.

Though compost does enrich the soil, it releases nutrients slowly and often does not contain enough nutrients to supply all the needs of growing plants. Therefore, it is still important to conduct soil tests and fertilize your lawns and gardens accordingly. For more information on soil testing and composting, contact your county Extension Service agent.



North Carolina
Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Prepared by

Larry Bass, Extension Horticulture Specialist
T. E. Bilderback, Extension Specialist, Nursery Crops
M. A. Powell, Extension Horticulture Specialist

Consulting Technical Writer: Teri Houck
Graphic Artist: Karl E. Larson

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Worms Can Recycle Your Garbage

North Carolina's estimated 420,000 tons of food waste are buried or burned each year at considerable financial and environmental cost. Instead of discarding your food scraps, you can recycle them with the help of worms. Vermicomposting (worm composting) turns many types of kitchen waste into a nutritious soil for plants. When worm compost is added to soil, it boosts the nutrients available to plants and enhances soil structure and drainage.

Using worms to decompose food waste offers several advantages:

- It reduces household garbage disposal costs;
- It produces less odor and attracts fewer pests than putting food wastes into a garbage container;
- It saves the water and electricity that kitchen sink garbage disposal units consume;
- It produces a free, high-quality soil amendment (compost);
- It requires little space, labor, or maintenance;
- It spawns free worms for fishing.

Equipment and Supplies

The materials needed to start a vermicomposting system are simple and inexpensive. All you will need are a worm bin, bedding, water, worms, and your food scraps.

Worm Bin. A suitable bin can be constructed of untreated, non-aromatic wood, or plastic container to be purchased. A wooden box is better if you will keep the worms outdoors, because it will keep the worms cooler in the summer and warmer in the winter. An outdoor wooden bin can even serve double-duty as a bench. If a plastic container is used, it should be thoroughly washed and rinsed before the worms and bedding are added. The bin size depends on the amount of food produced by your household. The general rule of thumb is one square foot of surface area for each pound of garbage generated per week.

For two people (producing approximately 31/2 pounds of food scraps per week), a box 2 feet wide, 2 feet long, and 8 inches deep should be adequate. A 2-foot-by-3- foot box is suitable for four to six people (about 6 pounds of waste per week). Redworms (the type used for vermicomposting) thrive in moist bedding in a bin with air holes on all sides. For aeration and drainage, drill nine l/2-inch holes in the bottom of the 2-foot-by-2- foot bin or 12 holes in the 2-foot-by-3-foot bin. Place a plastic tray under the worm bin to collect any moisture that may seep out. Drilling holes on the upper sides of your bin will also help your worms get needed oxygen and prevent odors in your worm bin. Keep a lid on the bin, as worms like to work in the dark. Store the worm bin where the temperature remains between 55° and 77°F.

Bedding. The worms need bedding material in which to burrow and to bury the garbage. It should be a non-toxic, fluffy material that holds moisture and allows air to circulate. Suitable materials include shredded paper (such as black-and-white newspapers, paper bags, computer paper, or cardboard); composted animal manure (cow, horse, or rabbit); shredded, decaying leaves; peat moss (which increases moisture retention); or any combination of these. Do not use glossy paper or magazines. Add two handfuls of soil to supply roughage for the worms. Adding crushed eggshells provides not only roughage but also calcium for the worms, and it lowers acidity in the bin. About 4 to 6 pounds of bedding is needed for a 2- foot-by-2-foot bin (for two people), and 9 to 14 pounds of bedding should be used in a 2- foot-by-3-foot bin (for four to six people). Worms will eat the bedding, so you will need to add more within a few months.

Water. The bedding must be kept moist to enable the worms to breathe. To keep bedding moist, add 3 pints of water for each pound 7 of bedding. You will need about 1 1/2 to 2 1/4 gallons of water for 4 to 6 pounds of bedding. If the bedding dries out, use a plant mister to spritz some water on it.

Worms. It is important to get the type of worms that will thrive in a worm bin. Only redworms or "wigglers" (Eisenia foetida) should be used (do not use night crawlers or other types of worms). Worms can be obtained from bait shops, nurseries, or by mail from commercial worm growers; the commercial growers are the most reliable source. A directory of sources is available from the author. Add 1 pound of worms to the 2-foot- by-2-foot bin or 2 pounds of worms to the 2-foot-by-3- foot bin.

Food Scraps. Feed your worms any non-meat organic waste such as vegetables, fruits, eggshells, tea bags, coffee grounds, paper coffee filters, and shredded garden waste. Worms especially like cantaloupe, watermelon, and pumpkin. Limit the amount of citrus fruits that you add to the bin to prevent it from becoming too acidic. Break or cut food scraps into small pieces so they break down easier. Do not add meat scraps or bones, fish, greasy or oily foods, fat, tobacco, or pet or human manure. Be sure to cover the food scraps completely with the bedding to discourage fruit flies and molds. One pound of worms will eat about four pounds of food scraps a week. If you add more food than your worms can handle, anaerobic conditions will set in and cause odor. This should dissipate shortly if you stop adding food for a while.

Temperature. Redworms will tolerate temperatures from 50° to 84°F, but 55° to 77°F is ideal.

Starting the Process

To start your vermicomposting system, first select a location for your worm bin. Popular indoor spots are the kitchen, pantry, bathroom, mud room, laundry room, or basement. If you want to keep your worm bin outside, put it in the shade during the hot summer and shelter it from the cold in winter by placing it in a garage or carport, or putting hay bales around the bin to allow air to circulate

around the bin, and keep it protected from flooding, because the worms can drown.

Next, prepare the bedding. If you want to use newspapers, fold a section in half and tear off long, half-inch to inch wide strips (go with the grain of the paper and it will tear neatly and easily). Soak the newspaper in water for a few minutes, then wring it out like a sponge and fluff it up as you add the newspaper to your worm bin. Aim for the bedding to be very damp, but not soaking wet (only two to three drops of water should come out when you squeeze the bedding material). Spread the bedding evenly until it fills about three-quarters of the bin. Sprinkle a couple of handfuls of soil (from outdoors or potting soil) into the bedding to introduce beneficial microorganisms and aid the worms' digestive process. Fluff up the bedding about once a week so the worms can get plenty of air and freedom of movement.

Gently place your worms on top of the bedding. Leave the bin lid off for a while so the worms will burrow into the bedding, away from the light. The worms will not try to crawl out of the bin if there is light overhead.

Once the worms have settled into their new home, add food scraps that you have been collecting in a leak-proof container. Dig a hole in the bedding (or pull the bedding aside), place the food scraps in the hole, and cover it with at least an inch of bedding. After this first feeding, wait a week before adding more food. Leave your worms alone during this time to allow them to get used to their new surroundings. Bury food scraps in a different area of the bin each time. Worms may be fed any time of the day. Do not worry if you must leave for a few days, as the worms can be fed as seldom as once a week. *Note:* Do not be surprised to see other creatures in your worm bin, as they help break down the organic material. Most of the organisms will be too small to see, but you may spot white worms, springtails, pill bugs, molds, and mites.

Harvesting the Worms and Compost

After about six weeks, you will begin to see *worm castings* (soil-like material that has moved through the worms' digestive tracts). The castings can be used to boost plant growth. In three or four months, it will be time to harvest the castings. Mixed in with the castings will be partially decomposed bedding and food scraps, in addition to worms; this is called *vermicompost.* You may harvest the vermicompost by one of two methods:

- Method 1: Place food scraps on only one side of your worm bin for several weeks, and most of the worms will migrate to that side of the bin. Then you can remove the vermicompost from the other side of the bin where you have not been adding food scraps, and add fresh bedding. Repeat this process on the other side of the bin. After both sides are harvested, you can begin adding food scraps to both sides of the bin again.
    - **Worm Bin Troubleshooting**

Problems	Causes	Solutions
Bin smells bad	Over feeding Non-compostables present Food scraps exposed Bin too wet Not enough air	Stop feeding for 2 weeks Remove non-compostables Bury food completely Mix in dry bedding; leave lid off Fluff bedding; drill holes in bin
Bin attracts flies	Food scraps exposed Rotten food Too much food; especially citrus	Bury food completely Avoid putting rotten food in bin Don't overfeed worms
Worms are dying	Bin too wet Bin too dry Extreme temperatures Not enough air Not enough food	Mix in dry bedding; leave lid off Thoroughly dampen bedding Move bin where temp. between 55 and 77°F Fluff bedding; drill holes in bin Add more bedding and food scraps
Worms crawling away	Bin conditions not right	See solutions above Leave lid off and worms will burrow back into bedding
Mold forming	Conditions too acidic	Cut back on citrus fruits
Bedding drying out	Too much ventilation	Dampen bedding; keep lid on
Water collecting in bottom	Poor ventilation Feeding too much watery scraps	Leave lid off for a couple of days; bin add dry bedding Cut back on coffee grounds and food scraps with high water content

- Method 2: Empty the contents of your worm bin onto a plastic sheet or used shower curtain where there is strong sunlight or artificial light. Wait 20-30 minutes, then scrape off the top layer of vermicompost. The worms will keep moving away from the light, so you can scrape more compost off every 20 minutes or so. After several scrapings, you will find worms in clusters; just pick up the worms and gently return them to the bin in fresh bedding.

  Be on the lookout for worm eggs; they are lemon-shaped and about the size of a match head, with a shiny appearance, and light-brownish color. The eggs contain between two and twenty baby worms. Place the eggs back inside your bin so they can hatch and thrive in your bin system.

Using Worm Compost

You can either use your vermicompost immediately or store it and use it later. The material can be mulched or mixed into the soil in your garden and around your trees and yard plants. You can also use it as a top dressing on outdoor plants or sprinkle it on your lawn as a conditioner. For indoor plants, you can mix vermicompost with potting soil. For top dressing indoor plants, you may want to remove decaying bedding and food scraps from the castings. Make sure there are no worms or eggs in the castings, because conditions in a plant pot will not allow them to survive. You can also make a "compost tea" to feed to your plants. Simply add two tablespoons of vermicompost to one quart of water and allow it to steep for a day, mixing it occasionally. Water your plants with this "tea" to help make nutrients in the soil available to the plants.

Larger-Scale Vermicomposting

Vermicomposting can take place wherever food scraps are generated or delivered. Worm composting bins can be found in classrooms, apartments, offices, and other commercial locations. Large-scale worm farms are found in many states, including California, Rhode Island, Washington, and Oregon. Worms even compost the food waste produced at the Seattle Kingdome stadium. Vermicomposting is also being used to help solve North Carolina's hog waste problems.

Classrooms and outdoor centers are especially nice settings for worm composting. Children of all ages enjoy classroom activities involving worms. Several curricula on worms are available for classroom use, and activities in the books can be used in a multitude of disciplines, including science, mathematics, geography, language arts (vocabulary, poetry, and prose), and music.

Sources of Additional Information and Supplies

North Carolina Cooperative Extension Service

Contact your county Cooperative Extension Center or: Department of Biological & Agricultural Engineering North Carolina State University Box 7625 Raleigh, NC 27695-7625 Attention: Rhonda Sherman Telephone (919) 515-6770 e-mail: sherman@eos.ncsu.edu

Directory of Vermiculture Resources: Worms, Supplies, and Information

This guide lists resources nationwide and is available from Rhonda Sherman, address above.

North Carolina Worm Resources

This is a list of known worm suppliers in North Carolina. It is available from Rhonda Sherman, address above.

Division of Pollution Prevention and Environmental Assistance

North Carolina Department of Environment, Health, and Natural Resources
P.O. Box 29569
Raleigh, NC 27626-9569
(919) 715-6500
(800) 763-0136

Prepared by:

Rhonda Sherman, Extension Agricultural Engineering Specialist

E-mail: sherman@eos.ncsu.edu

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