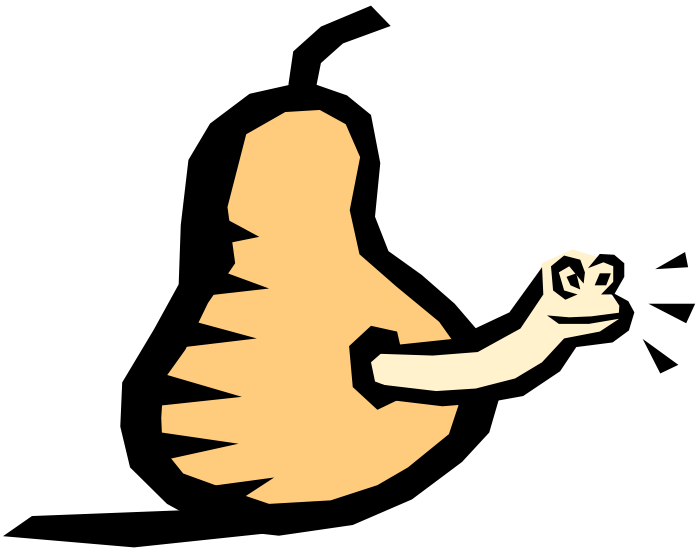
Lesson 3
A Decomposer's Dilemma



A Decomposer's Dilemma

The 5 – Step Learning Cycle

Engage

Students discuss how much trash they generate at home. The teacher summarizes a current event article – "Garbage comes into Michigan, but none goes out."

Explore

1. Students will observe how long it takes for different types of packing peanuts to decompose in a classroom worm bin.
2. Students sort through a variety of discarded products and decide if it is biodegradable or not.
3. Students will then create a "decomposition timeline."

Explain

The teacher explains that products made from animal and plant parts are naturally biodegradable; this is an example of a circular life cycle because the items decay and can be reused by plants. However, some products made by humans do not biodegrade (like synthetic fibers and plastics). This is an example of a linear life of a product because these items have a dead end – they end up in a landfill.

Elaborate

Students categorize their clothing as biodegradable and decomposable or non-biodegradable.

Evaluate

1. Pre-test on biodegradable and non-biodegradable items.
2. Post-test on biodegradable and decomposable clothing materials.

Title:
A Decomposer's Dilemma

A Decomposer's Dilemma

Enduring ideas: **Students will understand that . . .**	• Nature's products have a **circular life cycle**; all materials are chemically broken down into simple elements that are reused again and again. • A plant or animal product from nature can decompose into reusable elements; this is called **biodegradable**. • Human-made products that contain plant or animal materials will decompose. This item is called **biodegradable** and the product has a circular life cycle. • Human-made products not made from plant or animal materials may not decompose easily (products made from metals or glass) or never decompose (products made from plastic). This is called **non-biodegradable** because the materials are not broken down into simple elements that are reused again and again by nature. This represents a **linear** life cycle; the product goes to a landfill and the life of the product ends there.
Lesson Objective 1 **Lesson Objective 2**	Students will observe the properties of Styrofoam and cornstarch packing peanuts as they decomposes (or not) in a classroom compost bin. Based on their observations, students will explain if the item is biodegradable or not. Students will observe various household items, infer how long the items will take to decompose (if at all), and place the items on a decomposition timeline.
Michigan Benchmarks	I.1.MS.6 Follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches. II.1.MS.1 Evaluate the strengths and weakness of data.
NSE Standard	Science As Inquiry – Abilities necessary to do scientific inquiry: Use data to construct a reasonable explanation.
Process skill	Observing; inferring
5E step	Explore
Thinking Level	Cognitive memory and Divergent Thinking - from Skills for Thinking or Knowledge Level and Synthesis - Bloom's Taxonomy
Lesson Objective 3	Students will list a product that has a "Designed by Nature" or circular life cycle; students will list a product that has a linear life.
Michigan Benchmark	IV.2.MS.2 Describe common chemical changes in terms of properties of reactants and products.
NSE Standard	Physical Science - Properties and changes of properties in matter.
5E step	Explain and Evaluate
Thinking Level	Cognitive memory - from Skills for Thinking or Knowledge Level - Bloom's Taxonomy
Lesson Objective 4	Students will classify their clothing as biodegradable or not and discuss what happens to clothing that is non-biodegradable (man-made materials).
Michigan Benchmark	III.5.MS.6. Describe ways in which humans alter the environment.
NSE Standard	Science in Personal and Social Perspectives – Populations, resources, and environments.
5E step	Elaborate and Evaluate
Thinking Level	Structuring, Organizing, and Relating – from Skills for Thinking or Application level – Bloom's Taxonomy

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Materials:

Handouts for Students and Transparencies
(Templates are found in the Appendix)

- *For Pre-Assessment*
  - Lesson 3 Pre-Assessment Student Handout (make 1 copy per student)
- *For Explore*
  - Decomposition Worm Bin Observation Sheet (make 1 copy per student)
- *For Engage*
  - Decomposition Items and Times for Decomposition Timeline Transparency
- *For Explain*
  - "What is Biodegradation?" Transparency and Student Handout (make 1 copy per student)
  - "What is Non-Biodegradable?" Transparency and Student Handout (make 1 copy per student)
  - "Linear Life of a Styrofoam Peanut" Transparency and Student Handout (make 1 copy per student)
  - "Life Cycle of a Cornstarch Peanut" Transparency and Student Handout (make 1 copy per student)
- *For Elaborate*
  - Categorization of Clothing Activity Student Handout (make 1 copy per student)
- *For Post-Assessment*
  - Lesson 3 Post-Assessment Student Handout (make 1 copy per student)

For Explore 1

For the packing peanuts teacher demonstration:

- Styrofoam packing peanuts — quart-size zip-lock bag full
- Corn starch peanuts — quart-size zip-lock bag full
- Transparent plastic cup in which to dissolve the cornstarch peanut
- Something to stir with chop-stick or plastic spoon or swizzle stick (a pencil or pen would even work…)

For Explore 2

For the Decomposition Timeline activity:

- 10 sheets of paper or large (at least 5"x7") cards
- 2-3 pieces of cotton cloth (a rag or t-shirt or sock would do)
- 2-3 pieces of paper (any kind)
- 2-3 pieces of cotton rope (size doesn't matter – just a few inches is fine; even a cotton shoelace would do)
- 2-3 oranges (or dried orange peels)
- 2-3 pieces of wool or wool socks or some wool yarn would work
- 2-3 pieces of nylon fabric

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For the Decomposition Timeline activity:	• 2-3 soup (tin) cans • 2-3 aluminum (pop) cans • 2-3 plastic 6-pack rings • 2-3 glass bottles or jars • 2-3 plastic bottles or containers • 10-12 paper grocery bags • roll of masking tape • 2-3 cigarette butts — cut off the rest (make sure these are fresh, not smoked) • 2-3 plastic coated paper milk cartons • 2-3 old leather (gym?) shoes
For the Composting Worm Bin:	• One 2-gallon size plastic container with lid • Plastic screen material cut to fit at the bottom of the plastic container • Shredded newspaper to fill the container • Spray bottle filled with water • Kitchen scraps – vegetables and fruit, coffee and tea grounds (no meat or fat) • 1 cup Red Worms (ordered from "Worms Eat My Garbage") • 1 Tray that fits under the bin • several pairs of disposable non-latex gloves

Preparation before the lesson:	• Make copies of the pre- and post-assessments and all student handouts.
	• Make sure you have transparencies of everything you might want to talk about/illustrate.
	• Explore - Decomposition Timeline Prep:
	  o Make the decomposition time markers from the ten sheets of paper or 5"x7" cards for the Decomposition Timeline with the following times printed clearly on them: 1 month, 6 months, 1 year, 5 years, 10 years, 25 years, 50 years, 100 years, 450 years, 1 million years.
	  o Separate "clean trash" into paper sacks for student groups (see Explore 1 activity directions below).
	• Set-up the Decomposition Timeline on the floor at the front of the classroom (see Explore 1 activity directions below). Tape the sheets or cards of decomposition times on the floor.

Explore – Decomposing Worm Bin	• Follow the directions from "Worms Eat My Garbage" reference • Set-up at least **three** weeks before teaching this lesson.

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Engage and Pre-Assessment

Materials

- Garbage comes into Michigan Student Handout
- Lesson 3 Pre-Assessment Student Handout

Approximate Time

10 minutes

Procedure

Designed by Nature — Student Handout

Garbage comes into Michigan, but none goes out

More trash from other states, Canada comes to Michigan. Article published Feb 2, 2007
Article from the South Bend Tribune

Associated Press Writer: TIM MARTIN

LANSING – The amount of trash coming into Michigan from other states and Canada increased by about 3 percent last fiscal year, according to a report from the state released Wednesday. But the overall amount of trash burned in Michigan landfills declined for the first time since at least 1996, mostly because state residents and businesses are dumping less.

The annual increases of imported trash are smaller than they were earlier this decade. But the increases are still a concern to those who say Michigan remains a magnet for out-of-state trash, particularly from Canada, because it is relatively inexpensive to dump in state landfills.

"It's coming here because Michigan is the cheapest dumping ground in the Great Lakes region," said state Rep. Kate Ebli, a Democrat from Monroe who has introduced a bill to restrict the expansion of Michigan landfills in an effort to discourage imported trash.

Michigan's fees for dumping in landfills are about 21 cents per ton. House Democrats want to raise the fee to $7.50, which would be highest in the nation, to discourage the importation of out-of-state trash. Some of that money would go to boost recycling programs. But critics of raising the fees say it would hurt Michigan residents the most because they're the ones who dump most of the trash in state landfills.

"If the prices go up, who pays that? What you are really doing is increasing costs on your hometown team," Mike Johnston of the Michigan Manufacturers Association told the House Great Lakes and Environment Committee.

Matt Resch, a spokesman for House Republican Leader Craig DeRoche of Novi, likened raising the fees to slow the importation of trash to "punishing muggers by putting their victims in jail." Resch said it would amount to a tax increase on Michigan homeowners and businesses. The overall amount of trash buried in Michigan landfills in the 12-month period that ended last September, nearly 62 million cubic yards, decreased almost 3 percent from fiscal 2005 levels. Michigan residents sent about 6 percent less garbage to landfills.

The amount coming from out-of-state is becoming more stable, after much larger increases in previous years including double-digit percentage increases in 2002, 2003 and 2004.The largest source of imported trash for the 2006 fiscal year continued to be Canada, which increased dumping in Michigan landfills by about 2 percent during the period. Garbage also came to Michigan from 15 states, some as far away as Florida, Louisiana and Rhode Island. The biggest exporters to Michigan were Indiana, Illinois, Ohio and New Jersey. Overall, imported trash made up about 31 percent of all the garbage dumped into Michigan landfills. That percentage has climbed steadily in recent years. Based on the trends in the fiscal year 2006 report, the DEQ estimates Michigan has enough room in its landfills to last another 19 years.

Designed by Nature — Lesson 3 — Page 14

- Begin by asking some questions to stimulate the students' thinking. How much trash did you create last week (you personally or your family)? How much trash do you put out by the road? Does your family recycle? How? How much? Etc. You can connect this lesson to the real world by discussing the current events article "Garbage comes into Michigan, but none goes out" (see Appendix for a copy of the South Bend Tribune article).

- Administer Pre-assessment (see Appendix). Pass out the sheets and tell the students there are no right or wrong answers. Depending on the setting, you might adjust the pre-test; use your judgment as a teacher monitoring the learning environment. Then continue with Engage demo with packing peanuts.

Explore 1
Packing Peanuts Demonstration and Worm Bin

Materials

- Decomposition Worm Bin Observation Sheet (make 1 copy per student)
- Styrofoam packing peanuts -- quart-size zip-lock bag full
- Corn starch peanuts -- quart-size zip-lock bag full
- Transparent plastic cup in which to dissolve the cornstarch peanut
- Something to stir with – chop stick or plastic spoon or swizzle stick (a pencil or pen would even work…)
- One 2-gallon size plastic container with lid
- Plastic screen material cut to fit at the bottom of the plastic container
- Shredded newspaper to fill the container
- Spray bottle filled with water
- Kitchen scraps – vegetables and fruit, coffee and tea grounds (no meat or fat)
- 1 cup Red Worms (ordered from "Worms Eat My Garbage")
- 1 Tray that fits under the bin
- Several pairs of disposable non-latex gloves

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Approximate Time 15 minutes

Procedure

- Hold up a Styrofoam packing peanut and ask the students to identify it. What is the purpose of this product? What is it made of? Pass a few of them around. Is it biodegradable? Can it decompose? What do we mean by biodegradable and decomposable? Take answers from the students to pre-assess their knowledge of these terms and create a casual, "working definition" of these terms, depending on what they say. Then ask how this Styrofoam peanut can be disposed of? Some students might just say you throw them away, but some might know you can take them to a recycling station (some recycling centers do not accept Styrofoam, but mailing stores will accept donations of clean Styrofoam and other packing materials).

- Hold up a cornstarch packing peanut. Ask the students to identify it. What is it made of? (If they don't know, try not to tell them…. they may also think it's Styrofoam; or tell them it's cornstarch, and go from there…). Pass a few around. Is it biodegradable? Is it decomposable? Then the teacher can either EAT this cornstarch packing peanut, or put it in a glass of warm water and stir it until it begins to dissolve (preferred). Try the same thing with the Styrofoam peanut; it won't dissolve. (Don't try to eat it.)


Designed by Nature — Student Handout

How to Make a Classroom Worm Bin[1]

Materials:
- One 2-gallon size plastic container with lid (worms don't like sunlight — pick a dark colored container if possible)
- Drill and medium-size drill bit
- Plastic screen material cut to fit at the bottom of the plastic container
- Shredded newspaper to fill the container (equivalent to one daily paper)
- Spray bottle filled with water
- 1 cup Red Wrigglers (ordering information is in "Worms Eat My Garbage")
- Kitchen scraps – about 4 cups of vegetables and fruit peels and coffee and tea grounds. (No meat or fat please, because this rots and smells!)
- Tray that fits under the bin

Procedure:
1. Remove the lid.
2. About 2 centimeters below the top of the container, drill holes about 3 centimeters apart and around the sides of the plastic container (this provides air holes).
3. Drill holes in the bottom of the container about 3 centimeters apart (this allows for excess fluid to drain out).
4. Place a tray under the container.
5. Line the bottom of the container with plastic screen material.
6. Shred newspapers into 1 centimeter wide strips and place inside the container – "fluff" up the newspaper and spray with water until paper is moist, but not soggy.
7. Add worms.
8. Add kitchen scraps.
9. Whenever more kitchen scraps are added gently mix the contents of the bin and wash hands afterward.
10. If too much liquid collects in the tray pour off the liquid outside in a grassy area and add dry shredded paper to help absorb some of the extra liquid.
11. Later: the compost can be used to fertilize plants.

[1] Applehof, Mary (1997) Worms Eat My Garbage, Flower Press: Kalamazoo, MI.

Designed by Nature — Lesson 3 — Page 12

- **Worm Bin** (see appendix for set-up directions) — Test whether packing peanuts are biodegradable: Place the worm bin on the floor and have students circle around. Pick several students and have them put on non-latex gloves. Instruct them to move around the contents of the worm bin so all students can see the worms, shredded newspaper, and kitchen scraps in various stages of decay. Have students add a few cornstarch and Styrofoam packing peanuts to a pre-made worm compost bin. Let students observe the worm bin and chart what happens after 1 minute, 1.5 hours (today's data), 2 weeks, and 3 weeks. They can record their data on the Decomposing Worm Chart (see Appendix).


Designed by Nature — Student Handout

Decomposition Worm Bin Observation Sheet

Name _____ Date: _____

Date and Time	Styrofoam Packing Peanut Observations:	Cornstarch Packing Peanut Observations:

Designed by Nature — Lesson 3 — Page 13

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Explore 2

Decomposition Timeline

Materials

In this activity groups of students will be given various items of "clean trash" (see materials list). Students will predict how long they think their items will take to decompose in a landfill. Tell them a timeline has been created at the front of the classroom (or in the hall) on the floor. You will have taped the sheets or cards with these "times to decompose" in a rough-scale timeline along the floor, thus:

1 month → 6 months → 1 month → 1 yr → 5 yrs → 10 yrs →

25 yrs → 50 yrs → 100 yrs → 450 yrs →→→→→ 1 m.y.

(place this as far away as you can)

Prior to this lesson: Separate these items (a few of each) into 10 or 12 grocery bags and give one bag to each group of two-three students. (Or separate the items into 5 grocery bags and give each bag to each group of five students; this scenario will mean there is more stuff in each bag.) Each group does not need to have the same items in the bag.

- pieces of cotton cloth (a rag or t-shirt or sock would do)
- pieces of paper (any kind)
- pieces of cotton rope (size doesn't matter – just a few inches is fine; even a cotton shoelace would do)
- oranges (dried orange peels)
- pieces of wool or wool socks or some wool yarn would work
- cigarette butts – cut off the rest (make sure these are fresh, not smoked)
- plastic coated paper milk cartons
- old leather (gym?) shoes
- pieces of nylon fabric
- soup (tin) cans
- aluminum (pop) cans
- plastic 6-pack rings
- glass bottles or jars
- plastic bottles or containers (It is important that some are of plastic 1 and 2 that can be recycled and some that are not.)

Approximate Time 20 minutes

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Procedure

- Have the students place the items from their grocery bag along the timeline on the floor to show how long they think the item will take to decompose in a landfill. (By specifying 'in a landfill', we're setting students up to think about other disposal options – especially for recyclables that are discussed in Lesson 4.)
- When the students are finished, the teacher then posts the transparency of these decomposition times (in Appendix) and students can make corrections in their original placement on the floor.
- As closure to this activity, ask what was most surprising to the students. Why? Perhaps list these surprising items on the board as the students offer them.
- Ask students what they think might account for the differences in decomposition times. See if they make any statements about decomposers (worms, bacteria, fungus).
- Ask students why they think some items won't decompose. See what they say, and then proceed to Explain, below.

Explain

Materials

- "What is Biodegradation?" Transparency and Student Handout (make 1 copy per student)
- "What is Non-Biodegradable?" Transparency and Student Handout (make 1 copy per student)
- "Linear Life of a Styrofoam Peanut" Transparency and Student Handout (make 1 copy per student)
- "Life Cycle of a Cornstarch Peanut" Transparency and Student Handout (make 1 copy per student)

Approximate Time

20 minutes

Procedure

Project the transparency (this is also a student handout) called "What is Biodegradation?". Read the bullet statements about decomposition and biodegradation. After reading these statements with the class, ask again which — the Styrofoam or cornstarch peanut — is biodegradable and why; decomposable and why. What is different about Styrofoam (petroleum-based, synthetic, man-made, processed) and cornstarch (vegetable/plant-based) in their ability to decompose?

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Procedure cont.

The most important element to cover in this 'Explain' section is the relationship between the material a product is made from and the ability of a decomposing organism to break down those materials. Bacteria, fungus (mold and mushrooms), and invertebrates, like worms, digest dead organisms; they have special enzymes that break apart tissues and cells into their simple chemical elements. These elements get returned back into the air and soil to be reused again by nature. Thus, these products have a **"Designed by Nature"** or **circular life cycle**. The rate of decomposition is dependent upon environmental factors such as temperature, availability of oxygen, and humidity or dryness. The dead organism's size and weight also affect how long it takes to decompose.

To apply the facts about decomposition to man-made products, project the transparency called "What is Non-Biodegradable?" (found in the Appendix). Products that are composed of plant and animal materials are decayed by decomposing organisms; products that contain man-made products (synthetic fibers, glass, and plastic) cannot be attacked by decomposers. The materials that make up these products cannot be broken down by the digestive enzymes of these organisms. These products have a **linear life** – the used up product dead-ends at a landfill.

The following websites contain useful information for you as a teacher:
http://www.bottlebiology.org/investigations/decomp_main.html
http://www.bottlebiology.org/investigationsdecomp_bkgreading.html
http://www.herbarium.usu.edu/fungi/FunFacts/Decay.htm

At this point, project the transparency (and student handout, both found in the Appendix) of the Linear Life of a Styrofoam Peanut. Go through the steps with the students. Then project the transparency (found in the Appendix) of the Life Cycle of a Cornstarch Peanut. Tie these ideas to the Decomposition Timeline (still on the floor). Ask the students which items along the timeline are likely to be biodegradable and decomposable vs. the synthetic, processed items. You are getting the students ready to understand the importance of recycling in Lesson 4. The next activity will help them to immediately apply what they have learned today.

A Decomposer's Dilemma

Elaborate Materials

- Categorization of Clothing Activity Student Handout (make 1 copy per student)

Approximate Time

15 minutes

Procedure


Designed by Nature — Student Handout

Categorization of Clothing Elaboration Activity

Name _____ Date: _____

Consider everything on your person and fill in the information below for TWO items only. For instance, if you were wearing a polyester sports jersey, the polyester and nylon components are made from processed petroleum that is not biodegradable. For a pair of wool socks, the materials are probably wool and cotton and nylon, where the wool and cotton are biodegradable, but the nylon is not. Probable disposal for old socks would be "landfill" (however, if they are not too far gone, you might give them away for "reuse").

ITEM #1: _____

RAW MATERIALS:

WHICH OF THESE RAW MATERIALS ARE BIODEGRADABLE?

HOW WILL YOU LIKELY DISPOSE OF THIS ITEM?

ITEM #2: _____

RAW MATERIALS:

WHICH OF THESE RAW MATERIALS ARE BIODEGRADABLE?

HOW WILL YOU LIKELY DISPOSE OF THIS ITEM?

Designed by Nature — Lesson 3 — Page 24

- In this step, students will apply what they have learned about products that are biodegradable or not. Direct the students to the Categorization of Clothing activity handout (in the Appendix).
- Review the directions as a class before they get started in their groups.
- Monitor the student groups by walking around the room checking on their progress.
- Discuss the results of this exercise with the class. Who chose two items that were both biodegradable? *(Likely, none.)* How many people chose two items that would end up in a landfill? *(Likely, most.)*
- Ask students to name some raw materials in their clothing that cannot be broken down by decomposers (anything synthetic like nylon or polyester or something that would break down over a very long time like some metals).

Evaluate Materials

- Post Assessment

Approximate Time

10 minutes

Procedure

- The teacher should have the students fill out the post-assessment and turn it in before they leave.

A Decomposer's Dilemma

Safety Recommendations

Before teaching this lesson, we encourage all instructors to first visit the website of the Council of Science Safety Supervisors, CSSS, (http://www.csss-science.org/safety.shtml) and read the General Science Safety section including their safety check-list and recommendations. From the CSSS recommendation list we specifically call your attention to the following items:

- Always perform an experiment or demonstration prior to allowing students to replicate the activity. Look for possible hazards. Alert students to potential dangers.
- Safety instructions should be given orally and be posted each time an experiment is begun.
- Constant surveillance and supervision of student activities are essential.
- Never eat or drink in the laboratory or from laboratory equipment. Keep personal items off the lab tables.
- Teachers must set good safety examples when conducting demonstrations and experiments. They should model good lab safety techniques such as wearing aprons and goggles.
- Rough play or mischief should not be permitted in science classrooms or labs.
- All work surfaces and equipment in the chemical or biological laboratory should be thoroughly cleaned after each use.

In addition to the general safety advice from the CSSS, we recommend these specific guidelines for this lesson:

1. All materials used in the activities are non-toxic and safe for students to handle, however, students should be reminded to <u>wash their hands</u> at the conclusion of the lesson.

2. For the timeline activity the "clean-trash" has been washed. Students will be advised to hold items by the outside and not place their fingers near the top of containers in case there may be some sharp edges (e.g. tin cans).
   Students who explore the worm bin to observe the process of decomposition of the packing peanuts can wear disposable non-latex gloves.

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APPENDIX

- **Engage/Connection to the Real-World**
  - Article – South Bend Tribune, Feb. 2. 2007 – "Garbage comes into Michigan, but none goes out"

- **Pre-Assessment**
  - Lesson 3 Pre-Assessment Student Handout (make 1 copy per student)
  - Lesson 3 Pre- and Post-Assessment Answer Sheet

- **Explore**
  - Directions for making a Decomposing Worm Bin
  - Decomposition Worm Bin Observation Sheet (make 1 copy per student)

- **Engage**
  - Decomposition Items and Times for Decomposition Timeline Transparency

- **Explain**
  - "What is Biodegradation?" Transparency and Student Handout (make 1 copy per student)
  - "What is Non-Biodegradable?" Transparency and Student Handout (make 1 copy per student)
  - "Linear Life of a Styrofoam Peanut" Transparency and Student Handout (make 1 copy per student)
  - "Life Cycle of a Cornstarch Peanut" Transparency and Student Handout (make 1 copy per student)

- **Elaborate**
  - Categorization of Clothing Activity Student Handout (make 1 copy per student)

- **Post-Assessment**
  - Lesson 3 Post-Assessment Student Handout (make 1 copy per student)

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Article from the South Bend Tribune

Associated Press Writer: TIM MARTIN

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Pre-Assessment for Lesson 3: A Decomposer's Dilemma
"Show Us What You Already Know" questions:

Name _____ **Date:** _____

1. List three items you can see in this room that you think are biodegradable. (3 points)

   1)

   2)

   3)

2. List three items you can see in this room that you think are non-biodegradable. (3 points)

   1)

   2)

   3)

3. Do you have a compost pile, bin or jar at home? Circle one: YES NO

4. Do you know anyone with a compost pile? Circle one: YES NO

5. Look outside. What can you see out there that is decomposing right now?

6. List a product (or part of a product) that would be considered as having a "**Designed by Nature**" circular life cycle.

7. List a product that would be considered as having a **linear** life.

Answer Key Pre- and Post-Assessment

Pre-Assessment for Lesson 3: A Decomposer's Dilemma

"Show Us What You Already Know" questions:

Name _____ **Date:** _____

1. List three items you can see in this room that you think are biodegradable. (3 points)

    1) *This depends on the room...*

    2) *Cotton, food, plants.*

    3) *There may not be very many items...*

2. List three items you can see in this room that you think are non-biodegradable. (3 points)

    1) *Plastic chairs, paint on walls, computers, etc.*

    2)

    3)

3. Do you have a compost pile, bin or jar at home? Circle one: YES NO

4. Do you know anyone with a compost pile? Circle one: YES NO

5. Look outside. What can you see out there that is decomposing right now?

There might be some leaves or sticks...

6. List a product (or part of a product) that would be considered as having a "**Designed by Nature**" circular life cycle.

the leather in a shoe

7. List a product that would be considered as having a **linear** life.

glass or metal container

How to Make a Classroom Worm Bin[1]

Materials

- One 2-gallon size plastic container with lid (worms don't like sunlight — pick a dark colored container if possible)
- Drill and medium-size drill bit
- Plastic screen material cut to fit at the bottom of the plastic container
- Shredded newspaper to fill the container (equivalent to one daily paper)
- Spray bottle filled with water
- 1 cup Red Worms (ordering information is in "Worms Eat My Garbage")
- Kitchen scraps – about 4 cups of vegetables and fruit peels and coffee and tea grounds. (No meat or fat please, because this rots and smells!)
- Tray that fits under the bin

Procedure

1. Remove the lid.
2. About 2 centimeters below the top of the container, drill holes about 3 centimeters apart and around the sides of the plastic container (this provides air holes).
3. Drill holes in the bottom of the container about 3 centimeters apart (this allows for excess fluid to drain out).
4. Place a tray under the container.
5. Line the bottom of the container with plastic screen material.
6. Shred newspapers into 1 centimeter wide strips and place inside the container — "fluff" up the newspaper and spray with water until paper is moist, but not soggy.
7. Add worms.
8. Add kitchen scraps.
9. Whenever more kitchen scraps are added gently mix the contents of the bin and wash hands afterward.
10. If too much liquid collects in the tray pour off the liquid outside in a grassy area and add dry shredded paper to help absorb some of the extra liquid.
11. Later, the compost can be used to fertilize plants.

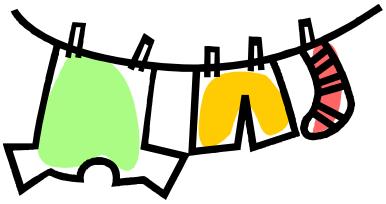
[1] Applehof, Mary (1997) Worms Eat My Garbage. Flower Press, Kalamazoo, MI.

Decomposition Worm Bin Observation Sheet

Name _____ Date: _____

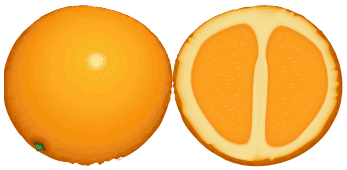
Date and Time	Styrofoam Packing Peanut Observations:	Cornstarch Packing Peanut Observations:

DECOMPOSITION ITEMS AND TIMES FOR THE DECOMPOSITION TIMELINE



Cotton rags (1-5 months)

Paper (2-5 months)



Rope (3-14 months)

Orange peels (6 months)

Wool socks (1 to 5 years)

Cigarette butts (1 to 12 years)

Plastic coated paper milk cartons (5 years)

Leather shoes (25 to 40 years)

Nylon fabric (30 to 40 years)

Tin cans (50 to 100 years)

Aluminum cans (80 to 100 years)

Plastic 6-pack holder rings (450 years)

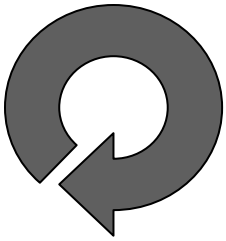
Glass bottles (1 million years)

Plastic bottles (probably won't decompose)

What is Biodegradation?

- ***Nature cycles*** materials back into basic simple elements; the building blocks of life.

This is an example of
a circular or "Designed by Nature" life cycle.



- This is the process of ***biodegradation; decomposition*** is another word for biodegradation (bio means 'life' and degrade means 'deteriorate').
- ***Biodegradation*** is a ***natural*** process performed by organisms called ***decomposers***.
- ***Fungi, bacteria***, and invertebrates like ***worms*** are examples of ***decomposers***.
- ***Biodegradation*** changes a product's ***physical*** and ***chemical*** characteristics. For example, in a compost pile, an ***apple core*** loses its form and turns into soil-like ***compost***. This happens as decomposers break apart the material using its digestive enzymes.
- Only materials composed of ***living things (coming from plant or animal products)*** can ***biodegrade*** and ***decompose***.

What is Non-Biodegradable?

This is an example of a linear life. The product's life finishes in a dead end – at the LANDFILL!

- Human-made products not made from plant or animal materials may not decompose easily (products made from metals or glass) or may never decompose (products made from plastic).

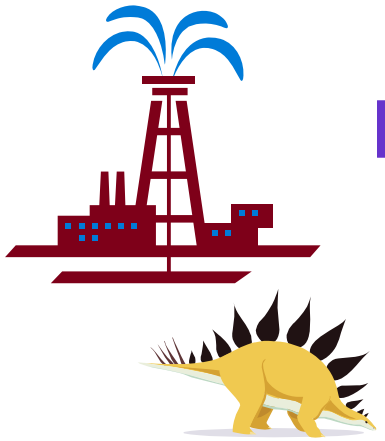
- These products are called ***non-biodegradable*** because the materials are not broken down into simple elements.

- The ***digestive enzymes*** of decomposers cannot break down these materials.

- These products sit in landfills for years and years. They may physically break down into smaller and smaller pieces, or rust (if it is metal), but they don't decompose into elements that nature can reuse again.

Linear Life of a Styrofoam Peanut

Raw Materials



Petroleum, also called crude oil, is a thick flammable liquid that formed millions of years ago, before the time of dinosaurs, from the decomposed remains of plants and animals.

Processing

Processing Styrofoam chemically and physically transforms crude oil and turns it into a polymer with strong chemical bonds. Manufacturing Styrofoam can have negative health effects for workers.

Consumption

Styrofoam peanuts are used in packaging. Styrofoam is also used for food containers, cups, and other products. Styrofoam is lightweight and insulates well, but it is not durable or easily reusable.

Disposal

In its natural state, crude oil is biodegradable, but manufacturing Styrofoam from crude oil results in it not being able to decompose. Styrofoam will take about 500 years to break apart into small pieces.

Life Cycle of a Cornstarch Peanut

Raw Materials

Starch is a white and odorless substance made by plants from the glucose they produce during photosynthesis. Wheat, corn, rice, and potatoes all store particularly high amounts of starch.

Processing

During the process, heat transforms the plant starch into a starch polymer, a long chain of simpler units called 'monomers'. Cornstarch peanuts are safe to eat, and there are fewer health risks for workers.

Consumption

Cornstarch peanuts are used in packaging, food containers, cups and other products. Cornstarch polymers are lightweight and insulate well, but are not durable or easily reusable.

Disposal

Cornstarch is biodegradable when exposed to oxygen, water, heat, and microorganisms.

Categorization of Clothing Elaboration Activity

Name _____ Date: _____

Consider everything on your person and fill in the information below for **TWO** items only. For instance, if you were wearing a polyester sports jersey, the polyester and nylon components are made from processed petroleum that is not biodegradable. For a pair of wool socks, the materials are probably wool and cotton and nylon, where the wool and cotton are biodegradable, but the nylon is not. Probable disposal for old socks would be "landfill" (however, if they are not too far gone, you might give them away for "reuse").

ITEM #1: _____

RAW MATERIALS:

WHICH OF THESE RAW MATERIALS ARE BIODEGRADABLE?

HOW WILL YOU LIKELY DISPOSE OF THIS ITEM?

ITEM #2: _____

RAW MATERIALS:

WHICH OF THESE RAW MATERIALS ARE BIODEGRADABLE?

HOW WILL YOU LIKELY DISPOSE OF THIS ITEM?

Post-Assessment for Lesson 3: A Decomposer's Dilemma
"Show Us What You Learned" questions:

Name _____ **Date:** _____

1. List three items you can see in this room that you think are biodegradable. (3 points)

   1)

   2)

   3)

2. List three items you can see in this room that you think are non-biodegradable. (3 points)

   1)

   2)

   3)

3. Do you have a compost pile, bin or jar at home? Circle one: YES NO

4. Do you know anyone with a compost pile? Circle one: YES NO

5. Look outside. What can you see out there that is decomposing right now?

6. List a product (or part of a product) that would be considered as having a "**Designed by Nature**" circular life cycle.

7. List a product that would be considered as having a **linear** life.