Module 5 • Overview • What Happens to Dead Stuff?

Brief Overview

This module continues the process of decomposition. Children will review the process of decomposition and the important ecological role decomposers play in the environment. They will further their understanding of the interconnectedness of all biotic things big and small, dead and alive. Microbes will be introduced as a type of decomposer. Students will perform the investigation: 1) Do microbes prefer to feed on biotic or abiotic things and why?

Time

15 sessions (Each session is 1-1.5 hours)

Desired Outcomes

Students will:

- Develop an understanding of the decomposition process as it relates to molds, fungi, and microorganisms.
- Be able to indentify a variety of decomposers in the environment
- Perform and analyze the results of a scientific investigation

What You'll Need

Materials

- Journals for each student

- Pens and pencils
- Markers and/or crayons
- Clipboards with pencil attached
- Squash
- Ziploc bags
- Hand lenses
- Masking tape
- Clear tape
- Permanent markers
- Ruler
- Digital camera
- Petri dishes (3 per group)
- Jello
- Mixing bowl
- Mixing spoon
- Boiling water
- Paper towels
- Measuring cup
- Gloves
- Bleach bucket
- Glue
- Posterboard
- Book: The Magic School Bus Meets the Rot Squad
- Paints
- Construction paper
- Drawing paper
- Trowel
- Soil corer

Worksheets and Handouts

- *Mad About Microbes*
- *Picture of Dr. Ingham*
- *Britney's Soil Study*
- *Al's Algae Study*

Posters

- Decomposition Stages on newsprint
- What Happens to Plants After they Die?
- What Happens When you add Extra Food in With a Non-living Item that has a lot of Microbes and With an Item that has Fewer Microbes
- Predictions of Which Items Will Have 'Many' and Which 'Few' Microbes
- Dead Leaf Story Board Challenge

People Power

- Contact Pearline Tyson at the Parks and People Foundation to confirm a date/time for the speaker in Lesson 6.

New Vocabulary

Bacteria
Living things that have only one cell, and are so small that they can only be seen with a microscope

Break down
The process where something larger is made into smaller pieces

Control
The item that stays unchanged in an experiment

Culture
To grow in a container with a prepared solution

Decomposer
An animal or microbe that uses dead plants and animals as food

Decomposition
The natural process of dead things breaking down into the basic materials they are made of; the breakdown of matter into simpler compounds

Fair Test
An experiment where everything stays the same except for one thing

Fungi
The plural for fungus, more than one fungus

Fungus
An organism that uses other living or dead organisms as food by secreting (squirting out) chemicals that break it down, and then absorbing the substances into its cells

Hyphae
Threadlike strands of a fungus that absorb food

Interpret
To explain or tell the meaning of information or data

Landfill
An area of land where trash is stored.

Matter
The substance that something is made of

Medium
A substance in which an organism grows

Microbe
A kind of living thing (or microorganism) whose individuals are too small to see with the naked eye; fungi and bacteria are two kinds of microbes

Microorganism
An organism of microscopic size

Mold
A fungus that produces a fuzzy growth

Nutrient
A substance that does not provide energy, but supplies minerals that living things need to stay healthy

Organic
Something that comes from plants and animals

Prediction
A forecast or declaration of what is going to happen (it is NOT necessarily expressed as a testable statement)

Recycle
To send something through a process in which to make it into something new. For example, a plastic water bottle can go through a recycling process to make it into carpet for your floor.

Reduce
To use less of something.

Reuse
To use something over again instead of throwing it away.

Soil Ecologist
An ecologist who studies the interactions among soil organisms and interactions between biotic and abiotic aspects of the soil environment

Spores
Structures that can grow into new individuals, and can often survive in very harsh conditions

Standardization
To follow a standard or rule about doing things the same way; adding the same amount of water, measuring for accuracy, etc

Treatment
The item or group that has been changed or manipulated in an experiment

Variable
The thing that is changed in a fair test

Careers

- **Soil Ecologist**

Preparing for the Lessons

Leaders will:

- Review the lesson sequences and the lesson preparation directions
- Prepare areas in the classroom and hallways for hanging student work
- Clean/remove "unsafe" objects from outdoor areas where students will investigate
- Review the information found in Leader Tools including sample answer sheets
- Prepare posters for lesson
- Identify potential parent or school adult volunteers
- Identify possibilities for a culminating activity and arrange for any field trips or classroom visitors
- Gather materials for the Investigations

Module 5 • Lesson 1 • Molds & Fungus & Bacteria: Oh My!

Action Synopsis

Students will continue to think about decomposition and "what makes a dead thing disappear." They will observe mold.

Time

1 -2 sessions.

Desired Outcomes

Students will:

- Describe one benefit of decomposition
- Describe two kinds of decomposers

What You'll Need

For Each Student

□ Journal
□ Pens and pencils

For Each Small Group (Pairs)

□ Sandwich-size ziplock baggie
□ Squash or pumpkin cut into small chunks
□ Two hand lenses

For Whole Class

□ Book: The Magic School Bus meets the Rot Squad
□ Poster: What Happens to Plants After They Die?

Preparing for the Lesson

Leaders will:

- On poster paper, write heading only: *What Happens to Plants After They Die?*
- Grow the mold specimens. About **five days before the lesson,** seal small moist chunks of squash or pumpkin in sandwich-size ziplock baggies. You'll need one baggie for every two students. Keep the baggies in a warm place to encourage mold to grow.

- Review sample responses to *What Happens to Plants After They Die* found in Leader Tools
- Review *Facts about Fungi and Bacteria* found in Leader Tools
- Review sample responses to *Explain What makes Dead Things Disappear* found in Leader Tools

New Vocabulary

Bacteria
Living things that have only one cell, and are so small that they can only be seen with a microscope

Break down
The process where something larger is made into smaller pieces

Decomposer
An animal or microbe that uses dead plants and animals as food

Decomposition
The natural process of dead things breaking down into the basic materials they are made of; the breakdown of matter into simpler compounds

Fungi
The plural for fungus, more than one fungus

Fungus:
An organism that uses other living or dead organisms as food by secreting (squirting out) chemicals that break it down, and then absorbing the substances into its cells.

Hyphae
Threadlike strands of a fungus that absorb food

Microbe
A living thing (or microorganism) whose individuals are too small to see with the naked eye; fungi and bacteria are two kinds of microbes

Mold
A fungus that produces a fuzzy growth

Spores
Structures that can grow into new individuals, and can often survive in very harsh conditions

Assessments

- Responses in journal to: What will happen to dead leaves on the ground over three years time?
- Responses in journal to the three probes mentioned in sequence 9.

Lesson Sequence

1. Ask the children to think about what happens to fallen leaves and other types of vegetation.

2. Have the children take their journals out and get setup to work with a partner. Give the Partner Teams their challenge:
We've put the dead leaves we looked at on the ground outside. Think about what will happen to them over the next three years. Working together with your partner, write down your predictions in your journals. Think about <u>every</u> possible thing that would happen, from the smallest to the biggest. Be sure to include <u>every</u> detail you can think of. Do you think they will look different in three years? <u>Why</u> would they look different?

3. When the students are finished with the challenge, ask them to share their responses. List what they say, verbatim, on the poster: *What Happens to Plants After They Die?* When all contributions have been made ask some probing or What/Why questions such as: *Jamal, you suggested that plants rot. <u>What</u> makes a dead leaf rot? Shamira, you said beetles make holes in them. <u>Why</u> would a beetle make holes in dead leaves?*

Leader Tip: You are probing for the "student thinking" behind their responses. For example, when mentioning the leaves rotting, does Jamal understand the role of fungi and bacteria in causing rot? Does Shamira understand that the beetle is eating the leaf material? Often, children pick up knowledge or facts without an understanding of the processes involved. A student might know that bugs eat dead things, but NOT understand that this is part of decomposition. They might know

about rot or decay, but be unaware of the role of microorganisms in the process. Be aware that the "physical" processes will be the easiest for children to grasp. The biological factors will likely be more difficult.

4. Next, ask the children to define **decomposition**. Write their ideas on the board. Pull their ideas together into the definition from New Vocabulary, making whatever additions are necessary.

5. Ask the children why they think that it is important to learn about decomposition? You are looking for a response that demonstrates understanding that: Decomposition is nature's way of recycling the materials all living things need to grow and stay alive.

6. Return to the definition of decomposition. Explain that an animal that eats dead things is called a *decomposer*. Ask the children if they know what kinds of living things break down and eat dead things. You are looking for a response that includes some of the following: Earthworms, beetles, termites, mites, millipedes, sowbugs, centipedes, etc.

7. Now explain that you will be looking at a different kind of decomposer. Tell the children that you will be passing out a sealed baggie with moldy material and two hand lenses to each Partner Team. **Emphasize that the baggie must be kept sealed because some children may be allergic to mold!** Ask each pair to use the hand lens to look at the material and write their observations and questions in their journals.

8. Ask the children to share their observations and their questions. If they don't use the word mold please introduce it. Explain: Mold is a kind of fungus. The white fuzz that they see is called hyphae. Hyphae are threadlike strands of a fungus that absorb food. Did anyone see any powdery or colored surfaces on the fuzz? These are **spores** and demonstrate the way that fungi reproduce.

Ask: Can you visualize how the material the fungi are feeding on would eventually disappear completely? (Think about how food looks that has been left in the refrigerator too long.)

Look at the baggie again. There is something else besides mold on the pumpkin/squash. There are bacteria. But even an entire colony of bacteria would be too tiny for us to see without a microscope. Fungi and bacteria are called **microbes** because they are too tiny to see with the naked eye. They are important decomposers. They eat things that animals won't eat. They also take other decomposers' leftovers and break them down into even smaller pieces.
Ask: What have you heard about fungi, bacteria, or microbes before?

Leader Tool: Share any of the information you feel is appropriate from:
Leader Tool: Facts About Fungi and Bacteria

When you have finished your discussion, walk around with the trash basket and collect and throw out the baggies WITHOUT opening them.

9. Write the following three prompts on the board:
    - What did I learn about microbes that I never knew before?
    - What would a day in the life of a decomposer be like?
    - I was surprised to learn that decomposition …..

10. Ask the children to respond to one or more of these prompts in their journal.

Maryland SC Standards (4th and 5th Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. (4)(5)1.B.1.c – Review different explanations for the same set of observations and make more observations to resolve the differences.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.

Module 5 • Lesson 2 • Mad about Microbes

Action Synopsis

Students will continue to explore decomposition by learning what kinds of materials attract microbes. Students will begin to think about conducting a microbe experiment.

Time

1 – 2 sessions

Desired Outcomes

Students will:

- Understand how to conduct a lab experiment on microbes.
- Be able to identify living and non living biotic things that would attract microbe communities.

What You'll Need

For Each Student

□ Journal
□ Pens and pencils

For Each Small Group (Pairs)

□ 2 Petri dishes

For Whole Class

□ *Mad about Microbes* Story
□ Trowel
□ Soil corer
□ Metric ruler

Preparing for the Lesson

Leaders will:

- Read the story *Mad about Microbes* found in Leader Tools
- Make a decision whether you or the children will read the story aloud
- Decide whether to make copies of the story for each child, and make copies if needed
- Make copies of the picture of Dr. Ingham to pass around
- Make a copy of the picture of Dr. Ingham to mount on Posterboard

- Review Possible Ideas for Non-Living Things to Compare for Microbes found in Leader Tools

New Vocabulary

Culture
To grow in a container with a prepared solution

Soil Ecologist
An ecologist who studies the interactions among soil organisms and interactions between biotic and abiotic aspects of the soil environment

Assessments

Responses in journal to: *What will happen to dead leaves on the ground over three years time?*

Lesson Sequence

1. Explain to the children that today the lesson will begin by reading and discussing a story about a soil ecologist. Does anyone know what a soil ecologist studies? What does a soil ecologist do? Have you ever met a soil ecologist? Is what soil ecologists do important? Why or why not?

2. Give the children a chance to share their thoughts. When the discussion slows down, suggest that they might have some new thoughts about these questions after reading a story.

3. Unless you are working with excellent and expressive readers, please read the story aloud to your class. You can use your judgment as to whether to make copies of the story for the students to follow along. If you choose not to make copies, please make a few copies of the picture of Dr. Ingham to pass around. There are spots in the story where you are directed to pause for discussion. However, feel free to pause as often as you think necessary.

4. Introduce the story "Mad About Microbes!" Explain to the children that it is about a woman who is in fact mad about microbes. Try to generate enthusiasm so the children will want to find out why!

5. Begin reading the story. At the first discussion pause feel free to ask the children questions about the story so far, or check to see if they have any questions. Then continue reading until you reach the second Pause for discussion. Follow these steps until you reach the conclusion of the story. (See Leader Tool: Mad About Microbes Discussion Guide)

6. At the conclusion of the story ask the children to think back to the initial questions you asked them. Go over the questions again and see if they have any additional points to make.

7. SWITCH GEARS! Explain to the children that in the next lesson, they will be going outside to do field work. They will be looking for evidence of decomposition. They will also collect items that might have decomposer microbes on them.

8. Ask the class, for their ideas of evidence that would tell us if decomposition is occurring. They likely will mention: dead leaves, leaves broken into smaller pieces, mushrooms, sowbugs, earthworms. Remind them of the hyphae they saw when they looked at mold. Explain that they might see thin white strands on dead leaves, on or just below the soil surface. They might also smell slightly strong odors in a pile of moist leaves.

9. Ask if some places might be more likely to have active decomposers. What are the characteristics or qualities of these places? Encourage the children to use great adjectives to describe the sites! (Students might think that decomposers like moist conditions, dark, shady spots.)

10. Inquire where students think are the best spots to look? (Probe to get the children to realize that decomposition happens where there is food for decomposers to eat.) Hopefully, students will say to look where there are dead plants. They may even suggest specific spots in the schoolyard. Some spots may be unlikely spots for decomposer action. However, let the children identify spots and explain why they think they will find evidence of decomposition there. They'll find out later whether they are right or wrong.

    If dead animals come up, be very clear that dead animals are off limits! Children should not go near, touch or collect a dead animal. Explain that dead animals and animal feces (poop) have the kinds of microbes that can make people sick.

11. Continue talking about the field work the children will be doing. Explain that they will be working in pairs for the Challenge. This Challenge is a Microbe Search. The task will be: To find one non-living thing that you think has a lot of microbes on it, and one that you think does NOT have a lot of microbes on it.

12. Show the students a Petri dish and explain that whatever they find has to fit into a Petri dish. Be sure that they understand that they will get two dishes, one for each item.

13. Explain that once everyone has chosen their items, the class will bring them back inside. Then they'll be putting them in the Petri dishes to **culture** the microbes that are on the items. To culture means to make the microbes grow.

14. Remind the students of the discussion in Lesson 1 about classifying things. Remind the students of the two different kinds of non-living things: (1) things that were once alive but are now dead, and (2) things that are <u>not</u> alive and were <u>never</u> alive. Scientists call the first group biotic. Remember that biotic is the word for things that are alive or, are dead, but used to be alive. The second group is abiotic. That's the word for things that are <u>not</u> alive and were <u>never</u> alive.

15. Practice this classification system with the children to make sure that they understand it. Have them think about some non-living things that they might find in the schoolyard and classify each item as either biotic or abiotic. Bring out the poster from Lesson 1 and add to it if necessary.
    Possible examples:

Biotic	**Abiotic**
dead leaves	rocks
dead grass	grocery bags
sticks	chip bag
seed pods	coins

16. Ask the children what they are thinking about collecting from the schoolyard? Remind them they will be looking for two kinds of things: (1) A non-living thing that will have a lot of microbes on it. And (2) A non-living thing that will NOT have a lot of microbes on it

17. On the board, make two columns with these headings:
    Will have microbes **Will NOT have microbes**

18. Have the children share the items they expect to find in each of these categories. Write their responses on the board, asking WHY for each item. Why will it have lots of microbes? Why will there not be microbes? (If necessary, remind the children that microbes only grow on things that they are using for food.)

19. Explain to the children that they can choose their own strategy. They can either:
    - Compare microbe growth on two different biotic items
    - Compare microbe growth on a biotic and an abiotic item
    - Discourage them from the third possible comparison; microbe growth on two different abiotic items.

Leader Hint: If the children choose abiotic items such as bottle caps or candy wrappers, there may be residues of sugar, oil, or soil with dead plant particles. Therefore some microbes might grow. If this happens you'll need to explain this to the children.

20. Have the children divide into pairs. Have them work together and list some possible comparisons in their journals. While they are doing this partner work, circulate around the room reviewing students' ideas for the investigation. (See Leader Tool: Possible Ideas for Non-Living Things to Compare for Microbes)

Maryland SC Standards (4th and 5th Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. (4)(5)1.B.1.c – Review different explanations for the same set of observations and make more observations to resolve the differences.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.

Unit 5 • Lesson 3 • Microbe Search

Action Synopsis

Student pairs do field work in the schoolyard. Based on previous work, they identify and collect two non-living things; one with lot of microbes on it and one with hardly any microbes.

Time

1 session

Desired Outcomes

Students will:
- Demonstrate good field behavior
- Select items that meet their investigation criteria
- Show an understanding of microbe habitat requirements

What You'll Need

For Each Student
□ Journal
□ Pens and pencils

For Each Small Group (Pairs)
□ 2 sandwich size Ziploc baggies
□ Masking tape or permanent marker
□ 2 hand lenses
□ ruler

For Whole Class
□ Decomposition Stages Sheet on newsprint
□ Camera (preferably digital)

Preparing for the Lesson

Leaders will:
- Prepare a long sheet of newsprint or similar paper. On the bottom left write "Least Decomposed". On the bottom right corner, write "Most Decomposed."
- Check the schoolyard for "unsafe" objects such as broken glass, needles, bottles, etc
- Identify a cool and dark place to store each pair's two baggies

- Make arrangements to borrow a digital camera for the lesson

Assessments

- Student selections of items to culture
- Responses in journal to probes at the end of the lesson

Lesson Sequence

1. Have the children sit with their partner. Partners should take a few minutes to review their journal entries regarding possible items to select for this investigation.

2. Remind the students of Field Work Behavior Expectations. Then explain that there is a special way that you want them to pick up their items outside. Demonstrate by laying a piece of chalk on a table. Take a sandwich size ziplock baggie and turn it inside out. Put your hand inside and pick the chalk up, using the inverted baggie like a glove. Then invert the bag back and zip it closed. All of this should be done without your hands touching the chalk.

3. Explain to the students that it is very important that they NOT touch their items or the inside of the bags. Why? Decomposer microbes feed on people's dead skin flakes and body oils. Protecting the hands with plastic will prevent microbes, skin and oils from getting inside the bags.

4. Explain that they will be taking their journals outside to record data. Ask the students: What kind of information do you think you should record? Possibilities include: name, date, name of item, description of location where item was found.

5. Pass out the baggies (2 for each pair) and masking tape or permanent markers. The children should write their initials on the tape or directly on the outside of both bags. On one bag they should write "MANY" and on the other bag "FEW."

6. Before going outside ask for a volunteer to come up and remind the group what the task is for the field work. (Collecting one non-living thing that will have a lot of microbes on it and one that will have only a few microbes on it.)

7. Before going outside set up any special rules that are specific to your setting. Make sure everyone has their baggies, hand lenses, journals and pencils/pens with them. Remind them to take field notes as well.

8. Once outside, have the children start looking for their items. Circulate among the student pairs, listening to their discussions. Encourage their efforts to find items and to write descriptive field notes about the items they select. Remember it is very important that students describe in detail where they found their item, including what was around the spot where the item was found.

9. After about 15 – 20 minutes gather the children together. Have them take turns showing their bagged items and reading their field notes to the whole group.

Leader Hint: Example of a thorough field note:
Date
Blue jay feather *– I found it underneath some dead leaves over by the fence. It was kind of wet and looked old. It looked like it had been sitting there for a long time.*

10. Have the children put their baggies down on the ground. Explain that there is one more activity to do before going back inside; a Leaf Decomposition Study. Lay your Decomposition Stages Sheet on the ground and anchor it with rocks on all four corners. Ask each pair to bring back a leaf that has fallen to the ground. Tell them the goal is to have leaves that run from "least decomposed" to "most decomposed." Point to where you have these titles written on the bottom of the sheet.

11. As each pair brings back a sample have them place it gently on the Sheet in the position they think the leaf belongs, in relation to the leaves already on the sheet. If there is a difference of opinion have the children discuss it and reach a consensus.

12. When the group has agreed on the leaf placement, take a picture. Then, have the children describe how leaves change as they decompose. What are the differences from the least decomposed leaf and a leaf in the middle, or a leaf near the most decomposed end? Student descriptions might include: more holes, eaten edges, smaller pieces, spots, thinning.

13. Ask the children whether these changes are mainly due to physical things, like rain, or wind, or the actions of decomposers. The answer is decomposers! The breakdown is mainly caused by small animals and microbes that are using the dead leaves as food.

14. Have the children put the leaves laying on the Decomposition Sheet back on the ground. Then remind them to pick up their supplies (journals, pencils, lenses and baggies) and return to the classroom.

15. When back inside, have the children double-check that their baggies are sealed, and labeled with their initials and "Many" and "Few". Then have the children put their baggies in a place that is cool and dark.

16. Write the following prompts on the board:
    - I think being a scientist who studies microbes would be _____ , because _____ .
    - The best part of doing field work is _____ .

17. Ask the children to respond to one or both of these prompts in their journal.

Maryland SC Standards (4th and 5th Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Constructing Knowledge:** (4)(5)1.A.1.b – Select and use appropriate tools **hand lens** or microscope (magnifiers), centimeter ruler (length), spring scale (weight), balance (mass), Celsius thermometer (temperature), graduated cylinder (liquid volume), and stopwatch (elapsed time) to augment observations of objects, events, and processes. (4)(5)1.A.1.e – Follow directions carefully and keep accurate records of one's work in order to compare data gathered. **Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. (4)(5)1.B.1.c – Review different explanations for the same set of observations and make more observations to resolve the differences. **Communicating Scientific Information** (4)(5)1.C.1.c – Submit work to the critique of others which involves discussing findings, posing questions, and challenging statements to clarify ideas. (4)(5)1.C.1.d – Construct and share reasonable explanations for the questions asked.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.

Module 5 • Lesson 4 • Performing a Microbe Laboratory Experiment

Part 1 – Culturing

Action Synopsis

Students conduct a controlled experiment to culture microbes living on the items they collected in the schoolyard. They do observations for 4 – 7 days noting microbe growth and changes. They analyze and critique their own studies as well as case studies.

Time

1 session

Desired Outcomes

Students will:
- Demonstrate good lab behavior
- Follow steps of experiment
- Demonstrate understanding of a "fair test"
- Write detailed observation notes

What You'll Need

For Each Student
□ Journal
□ Pens and pencils

For Each Small Group (Pairs)
□ 3 petri dishes (8 cm in diameter)
□ clear tape
□ masking tape
□ ruler
□ The two items collected and bagged from the previous lesson

For Whole Class
□ Poster: *What Happens When You Add Extra Food In With A Non-Living Item That Has A Lot Of Microbes, And With An Item That Has Fewer Microbes.*
□ 3 oz. boxes of flavored jello (lemon, lime or orange)
You will need to figure out how many boxes to buy. Each box should make enough "medium" for 8 students
□ large mixing bowl

□ mixing spoon
□ boiling water
□ paper towels
□ measuring cup

Preparing for the Lesson

Leaders will:

- On poster paper, write heading only: *What Happens When You Add Extra Food In With A Non-Living Item That Has A Lot Of Microbes, And With An Item That Has Fewer Microbes.*
- Identify a warm (but NOT hot and sunny) place to store each pair's three Petri dishes.
- Make arrangements to use the school kitchen to prepare Petri dishes with jello. You will need a stove, sink, and refrigerator. The dishes will need to be in a cool place (ideally a refrigerator). Do this as close to the day of the lesson as possible.
  - Boil water and pour over mixing bowl, spoon, measuring cup and Petri dishes
  - Lay them upside down on paper towels to dry
  - Add 1 box of jello to the bowl. Then add 1 cup of boiling water and stir.
  - When the jello is dissolved, add 1 cup of cold water (cold tap water is fine)
  - Spoon the liquid into the Petri dishes until they are half full and cover them immediately.
  - Keep the filled dishes in a cool place (a refrigerator is best) until the jello has jelled
  - Repeat until you have enough filled dishes for your group.

New Vocabulary

Control
The item that stays unchanged in an experiment

Fair Test
An experiment where everything stays the same except for one thing

Medium
A substance in which an organism grows

Treatment
The item or group that has been changed or manipulated in an experiment

Variable
The thing that is changed in a fair test

Assessments

- Behavior during lab work
- Predictions and explanations
- Observations recorded in journal

Lesson Sequence

1. Explain that the group will be starting the "laboratory" part of the microbe study today. The children will be "culturing" the microbes that are on the non-living things they collected from the schoolyard. The culturing will be done in a petri dish filled with a medium made of jello. A medium is simply something with food that microbes can eat. Explain that you used jello because it is full of sugar, protein, minerals, and water, which are all thing that microbes eat. (Sugar is also something that living plants make.)

2. Ask a student to review the criteria they used to select items from the schoolyard (collecting one non-living thing that will have a lot of microbes on it and one that will have only a few microbes on it).

3. Then pose the question: What do you predict will happen if you put extra food in with a non-living item that has a lot of microbes, and with an item that has fewer microbes?

4. Write the students ideas on the *Poster: What Happens When You Add Extra Food In With A Non-Living Item That Has A Lot Of Microbes, And With An Item That Has Fewer Microbes.*

5. The children will likely think that the item with more microbes will still have more microbe growth. Add some other possibilities to the mix for them to consider:
    a. Microbe growth might be the same for both items. (This could happen because despite their efforts, both items had the same amount of microbes

to begin with, or, because microbe growth expands to the same level if extra food is added.)

b. It might take longer for microbe growth on some items than on other items.

c. Students might see different kinds of microbes NOT different amounts.

6. Have the children take out their journals and write a prediction of what will happen when their two items are cultured. (Which item will have more microbe growth, etc?) Ask them the <u>why</u> behind their prediction.

7. Go over the experiment procedure with the children but do not have them complete the procedure at this time.
   - Each pair gets 3 petri dishes with the jello medium and their two baggies with their items from the schoolyard.
   - One child will take the top off one Petri dish. Then he/she will put the item from the "MANY" baggie on top of the jello. This needs to be done <u>very carefully</u>, without touching the item, jello, or inside of the dish. The item must touch the jello completely. Then the top should be put right back on, and taped on with clear tape. Write "MANY" and the name of the item on a piece of masking tape and tape it to the side of the dish.
   - The second child repeats this process with another Petri dish and the baggie labeled "FEW."

8. Ask if anyone has any thoughts about what the third dish is for. Note the children's' ideas and pull whatever "kernels" you can into your comments. Explain:

   The third dish is what scientists call a "control." We need to have a "control" dish because there might be microbes in the air, the dish, or even the jello. You could say that whatever microbes grow in the control dish, are the "background" level of microbes. You would need to think about the background level when you look at the microbe growth in your other 2 dishes. Part of that growth might be because of background microbe levels.

If students are confused, explain that this will be clearer as they observe their results over the next few days.

9. Have the students complete the culturing activity.

10. Discuss that going through this detailed process makes our experiment a "fair test." Ask: Who knows what fair means? The children are likely to have clear ideas of fairness.

11. After they share their ideas make clear that to make an experiment fair, you have to do everything the same to the control and the treatment. In our experiment the control is the third dish and the treatments are the other two dishes. The only thing that can be different is the variable you are testing.

12. Ask: Who can explain what our variable is? (Answer: the non-living items each pair found on the schoolyard.)

13. Have the student pairs get their baggies and give them three Petri dishes each.

14. Remind them of the procedure and have them go ahead and set up their items in the dishes. Move around the room to provide clear tape and masking tape for the pairs.

15. When everyone has finished ask if anyone thinks we need to do something with our control, the third dish. Listen to the students ideas and probe for the <u>why</u> behind their suggestions. (Answer: each pair should expose the control dish to the open air for the same amount of time your experimental dishes were opened when you put your items in them.)

16. Have each pair open their control dish for the appropriate amount of time and then tape it shut.

17. After the petri dishes are properly stored, have the students open their journals and write a journal entry. Have them record:
    - The procedure they just followed
    - New observations
    - Prediction of what they think will happen in the control dish of plain jello

See MD Standards following Lesson 4 Part IV.

Module 5 • Lesson 4 • Performing a Microbe Laboratory Experiment

Part 2 - Making Observations

Action Synopsis

Students will continue to conduct their controlled microbe experiment. They will begin to make observations of their petri dishes.

Time

1 session

Desired Outcomes

Students will:

- begin to make observations about their microbes

What You'll Need

For Each Student

□ Journal
□ Pens and pencils

For Each Small Group (Pairs)

□ 2 hand lenses

For Whole Class

□ Poster: Predictions of which items Will Have "MANY" and only a "FEW" microbes

Preparing for the Lesson

Leaders will:

- On poster paper, write heading only: *Predictions of which items Will Have "MANY" and which "FEW" microbes.* Then make headings for 3 columns: *(1) Pairs' Initials (2)MANY microbes, and (3) FEW microbes*
- Review sample *Observation Log* found in Leader Tools

Assessments

- Student predictions about microbe growth in their petri dishes
- Student observations about their microbe growth

Lesson Sequence

1. Explain that today's lesson will begin with a discussion about predictions that we've made about what is going to happen in our study.

2. Have each pair come up and talk about each of their items (non-living item with "MANY" microbes, non-living with "FEW" microbes) and their predictions about microbe growth on these items and in their control dish. Ask for a volunteer to remind the group about exactly what the control dish is for.

3. Have the pairs come up. Fill in the poster as each pair presents. Point out differences in thinking among the pairs.

4. When everyone has presented, as a class, go over the items on the poster and label each as biotic (B) or abiotic (A). NOTE: Soil and water (with exception of tap or hose water) can be categorized as both biotic and abiotic. WHY? They contain living and dead plants and animals, and minerals.

5. Discuss the children's ideas and thinking. Ask the children if there are more abiotic or biotic items in one of the columns. If so, ask for ideas about explanations.

6. SWITCH GEARS. Tell the children that they are going to make observations for their experiment. Before you pass out the hand lenses and each pairs' Petri dishes, or have the children carefully get them from their storage spot, talk a bit about setting up an Observation Sheet.

7. You can have the children come up with their own plans or make a recommendation. Either way, the observations should all be together and each observation should be dated. At each observation, comments and drawings should be made for each of the 3 dishes.

8. Be sure children understand that they are not to open or turn over the dishes. They can gently hold them up to look at the bottom and look at the top and sides. Pass out the dishes and lenses. While students are working, circulate around the room and make suggestions or help children with their Observation Chart, as needed. Encourage the children to note any ideas or thoughts they have beyond just observations.

9. When everyone has finished, put the dishes back in their storage place.

See MD Standards following Lesson 4 Part IV.

Module 5 • Lesson 4 • Performing a Microbe Laboratory Experiment

Part 3 - More Observations & Critiquing Investigation Stories

Action Synopsis

Students will continue to make observations about microbe growth.

Time

1 session (Each session is 1-1.5 hours)

Desired Outcomes

Students will:

- Critique experiment procedures for 2 mock experiments

What You'll Need

For Each Student

□ Journal
□ Pens and pencils

For Each Small Group (Pairs)

□ 2 hand lenses
□ Copy of *Britney's Soil Study* (Ecology Investigation 1)
□ Copy of *Al's Algae Study* (Ecology Investigation 2)

Preparing for the Lesson

Leaders will:

- Review *Britney's Soils Study* and *Al's Algae Study* found in Worksheets and Handouts

New Vocabulary

Standardization

To follow a standard or rule about doing things the same way, adding the same amount of water, measuring for accuracy, etc.

Assessments

Student responses to Ecology Investigations 1 & 2.

Lesson Sequence

1. Tell the children that the day will begin with making observations for their microbe experiment. Distribute the hand lenses and petri dishes by whichever method you have decided to use. Remind the children to be careful handling the dishes.

2. Remind the children that they should make observations in their journal Observation Chart. While students are making observations circulate around the room. Again, encourage the children to note any ideas or thoughts they have beyond just observations.

3. After about 15 – 20 minutes have everyone finish up and put their dishes back in their storage place.

4. SWITCH GEARS! Explain to the children that they are now going to be "critics." That means they will be providing constructive criticism in response to two stories of children doing ecology investigations. What does it mean to give constructive criticism? Constructive criticism is a comment or feedback that is helpful. For example: I like your procedure, but did you think about measuring the amount of soil mixture? Or, this will be a neat experiment, but maybe you should have fewer samples.

5. Pass out Ecology Investigation 1 & 2. Have the children work individually on written responses to the stories. If they are stuck, or want to discuss an idea they can engage their partner.

6. Here are some things to look for as you circulate in the room. These are also good class discussion points to make after the children finish their individual work.

Ecology Investigation #1 – Britney's Soil Study

Britney needs to have some **standardization** in her study. She needs to be clear about how much soil will go into each funnel, how much other material will be added, etc. She should be sure to add the same amount of water to each funnel/jar.

She should wait the same amount of time after pouring the water into each funnel before measuring how much water came through.

She needs to also measure the amount of water that comes through the funnel and subtract it from the amount of water she added to the funnel.

Challenge the children to explain the **Why** behind each constructive suggestion they make and **How** it will improve the experiment.

Ecology Investigation #2 – Al's Algae Study

Al needs to pay attention to standardization as well. He needs to be sure that: all of his jars are the same size, and that he puts the same amount of water and algae in each jar. He must also keep all the jars in the same place. They should probably be in sunlight part of the day, to make the experiment like a real pond.

See MD Standards following Lesson 4 Part IV.

Module 5 • Lesson 4 • Performing a Microbe Laboratory Experiment

Part 4 – Concluding Microbe Observations

Action Synopsis

Students will make conclusions about their microbe experiment.

Time

1-2 sessions

Desired Outcomes

Students will:

- Understand their experiment results

What You'll Need

For Each Student

□ Journal
□ Pens and pencils

For Each Small Group (Pairs)

□ 2 hand lenses
□ Copy of Britney's Soil Study
□ Copy of Al's Algae Study

For Leader Only

□ Gloves for washing Petri dishes
□ plastic bucket
□ bleach

Preparing for the Lesson

Leaders will:

- Gather materials for lesson

Assessments

- Student conclusions about microbe growth
- Student response to *Ecology Investigation*

Lesson Sequence

1. Continue working with the children on the two ecology stories if they need additional time.

2. When finished make your third set of observations. Again, distribute the hand lenses and Petri dishes by whichever method you have decided to use. Remind the children to handle them carefully.

3. By now the children should be able to move on to writing their observations on their own, or with a gentle reminder.

4. Explain to the children that this will be the last set of observations they will make. Give them some time to review their observation notes and the predictions they made at the beginning of the experiment.

5. Tell them that each pair will be sharing their results with the class. They will be showing the class their petri dishes. They will need to talk about:
   - Their original predictions
   - Their observations
   - Their final results
     Was their prediction correct?
     Did their "MANY" dish have more microbes than their "FEW" dish?
     Which dish had more <u>different kinds</u> of microbes?
     What about the control dish?
   - What did they learn from doing this experiment

6. Have all the pairs take turns making their presentations. Perhaps the class members can get up and look at the presenters' petri dishes before each presentation.

7. As the children share their experience, ask thoughtful questions to help deepen their understanding. Questions could include:

   - **What do you think is going on with the control dish which only has the jello medium? If something grew, why?**

     Students didn't do their experiments in a sterile environment, so the jello dish likely had some microbes from the air, fingers or even the dishes. Students can think about the type and amount of microbe growth in the control dishes as the background amount for all the dishes. That means to be able to say that the microbe growth in the other dishes is due to the decomposers on the selected non-living things, the growth needs to be greater or more varied than the growth in dishes with only jello.

   - **What were your original predictions, and why?**
     There should have been more decomposer microbes on the items high in energy and minerals and easiest to digest. The dishes with soft plant tissue should have more microbe growth than the dishes with tough, woody items. The dishes with metal or plastic items should have no microbe growth. (If there is some growth it's likely because the items had sugars, oils, or residues on them.) Be sure that students understand that microbes are like all living things, they grow best on high quality food sources.

   - **How did your results compare with your predictions?**
     Asking students to explain any results different from their predictions is a good way to assess their understanding of concepts and processes. Help

them understand that results that don't match predictions are very common and important in science.

- **What do you think would happen to the items on which the microbes are growing after several weeks or months?**
  The microbes will eat them all up. Also, different types of microbes will take over at different stages in the decomposition process. Some eat fresh materials, while others eat the less easily digested materials. Eventually the materials that were once alive will get so small that they can no longer been seen. The basic chemicals they were made of will be inside the microbes, or in the wastes they pass.

8. Ask the children what they think the most important thing is about microbes. Answers:
   - Dead things decompose because microbes use them for food.
   - The matter dead things were made of disappear from sight. But they don't disappear from existence. They are just in a different form and different place.

9. To save the petri dishes, submerge them, unopened, in a bucket of hot water and 2 cups bleach. After they've soaked for a day or two, take them out, empty them and wash with hot water. Use gloves!

Maryland SC Standards (4th and 5th Grade):

Standards are presented in the following format:
(Grade)Standard.Topic.Indicator.Objective – Objective Statement

Science

Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Constructing Knowledge:** (4)(5)1.A.1.b – Select and use appropriate tools **hand lens** or microscope (magnifiers), centimeter ruler (length), spring scale (weight), balance (mass), Celsius thermometer (temperature), graduated cylinder (liquid volume), and stopwatch (elapsed time) to augment observations of objects, events, and processes. (4)(5)1.A.1.d – Recognize that the results of scientific investigations are seldom exactly the same, and when the differences are large, it is important to try to figure out why. (4)(5)1.A.1.e – Follow directions carefully and keep accurate records of one's work in order to compare data gathered. **Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. (4)(5)1.B.1.b – Offer reasons for their findings and consider reasons suggested by others. (4)(5)1.B.1.c – Review different explanations for the same set of observations and make more observations to resolve the differences. (4)(5)1.B.1.d – Keep a notebook that describes observations made, carefully distinguishes actual observations from ideas and speculations about what was observed, and is understandable weeks or months later. **Communicating Scientific Information** (4)(5)1.C.1.c – Submit work to the critique of others which involves discussing findings, posing questions, and challenging statements to clarify ideas. (4)(5)1.C.1.d – Construct and share reasonable explanations for the questions asked.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.

Module 5 • Lesson 5 • The Story of Leaves

Action Synopsis

Students create a story board to communicate what happens to leaves after falling to the ground. This lesson will pull together the concepts discussed in all previous lessons.

Time

1 – 3 sessions

Desired Outcomes

Students will:

- Demonstrate how a leaf looks at points over time
- Explain that decomposition happens because of microbes eating dead things
- Understand that matter never vanishes, it just changes form

What You'll Need

For Each Small Group (3 – 4 children)

□ poster board
□ markers
□ paints
□ construction paper
□ leaves
□ glue
□ tape

For Whole Class

□ Poster: Dead Leaf Story Board Challenge

Preparing for the Lesson

Leaders will:

- Gather all materials
- Prepare *Dead Leaf Story Board Challenge* Poster (See Leader Tool: Dead Leaf Story Board Challenge)

New Vocabulary

Matter

The substance that something is made of

Assessments

Student poster designs.

Lesson Sequence

1. Explain to the children that they have a new challenge to begin today. This challenge will give them a chance to show off their understanding of decomposition as well as their creativity and teamwork

2. Read the *Challenge Poster* to the children and leave it hanging in a place where the children can refer back to it.

3. Talk a bit about what a story board is. Explain that it is a display that usually has written information or a story and pictures or samples of things. Ask them if they have seen any story boards before. (You can probe by asking about things your group has seen together, or ask about a visit to the Science Center or African American History Museum.) The combination of words and pictures is a very good way to express your ideas to other people.

4. Show the children the materials they will have to use. Suggest that they talk with their team about planning their group story board. Suggest they bounce ideas off each other. There are some questions your group can try to answer to start the process.
    - **Who knows what a decomposing leaf looks like as it becomes more and more decomposed?**
    - **What makes leaves decompose?**
    - **Where does the stuff the leaf was made of end up?**

    While the teams are brainstorming circulate around the room and check to be sure the children are thinking, exchanging ideas and planning.

5. Give the children newsprint and have them do a layout of what they want to show on their poster. Then they can divide up sections and work on individual pieces. For example if the first part will show a tree with a leaf falling to the ground; one child can draw and label a picture on a separate sheet of paper. You might want them to work on small sheets of paper which are then pasted/taped in sequence on the poster board.

6. Have the children work on their boards.

7. When the children have finished give each team an opportunity to share their story boards with their classmates. Complete any other Open House, displays, invited guest sessions that you have planned.

8. After presentations have been completed, lead a closing discussion:

   What changes in decomposing leaves do the storyboards show?
   Leaves change a lot. They might dry up, wither, get holes in them, get nibbled around the edges, have just the veins and stems left, break into smaller and smaller pieces, turn brown, get black spots, get slimy, get white fuzz on them, smell rotten or strong or bad.

   What did the storyboards show as the causes of decomposition?
   The main cause of decomposition is the organisms that use dead leaves as food. Invertebrates are one kind of decomposer; like earthworms, termites, beetles, sow bugs, and millipedes. They are called soil organisms. They eat leaves and also sometimes chew leaves and leave these on the ground.

   Microbes and fungi are another kind of decomposer. They eat the particles of leaves in the soil organism's droppings (poop) and chewed leaf leftovers. They break these down even more into smaller pieces.

Wind, rain and trampling are also a factor. But their role in decomposition is TINY compared to the biological (living) decomposers like soil organisms and microbes and fungi. Other physical factors, like moisture and heat make it a little easier for microbes to eat dead material.

Do the materials that a decomposed leaf was made of still exist?

This is the $64,000 question that gets to the concept of the conservation of matter. You'll probably have some students who don't completely understand this concept; that matter can neither be created or destroyed. Some may still think that the leaf pieces that have gone into the soil still exist, but that the rest of the leaf disappears.

Do dead leaves really disappear?

You might not be able to still see a decompose leaf, but the material it was made of does not stop existing. Decomposition is an example of the conservation of matter. This means that the matter is conserved or stays. In our example, the leaf matter becomes part of the organisms that ate it. Or it is released from that organism's waste (poop) into the soil, water or air. All matter can be accounted for. Nothing has vanished.

Maryland SC Standards (4th and 5th Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. **Communicating Scientific Information** (4)(5)1.C.1.d – Construct and share reasonable explanations for the questions asked.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.

Module 5 • Lesson 6 • Culminating Activity

This is a great opportunity to develop a recycling program in your school. However, it takes an entire school to develop a program successfully. Coordinate this effort with your school principal if you are interested in this opportunity. More information on recycling in Baltimore can be found on the following web site:

http://www.ci.baltimore.md.us/government/dpw/recycle/govBizRecycling.php

Action Synopsis

Students engage with a speaker from Baltimore City's Department of Public Works to discuss recycling in their community. Students will choose to create an informative sign that encourages recycling or a decorative recycling container for use at school or at home.

Modification: If unable to arrange a speaker, students can complete the activity as directed making signs, posters, or personalized recycling bins. Students can also use this as a theatric opportunity, developing a rap or skit to teach others about the importance of recycling. Students can perform in front of their school principal or other students.

Time

2 - 3 sessions

Desired Outcomes

Students will:
- Explain recycling as it relates to reducing, reusing, and recycling items
- Identify ways to recycle
- Develop an informative sign or recycling bin to encourage recycling in the community.

What You'll Need

For Each Student
□ Pens and pencils
□ Drawing paper or a found container (storage box) to decorate as a recycling bin
□ Crayons and markers

Preparing for the Lesson

Leaders will:

- Discuss arranging a recycling presentation with the school principal. Baltimore City Dept. of Public Works requires this as part of the process of establishing a recycling program at the school. Arrange a date/time with the principal to have the speaker come to your school
- Ask the students to bring in any containers such as buckets or boxes from home that would otherwise get thrown in the trash.
- Gather all needed supplies for the signs/recycling bins.

New Vocabulary

Reduce
To use less of something.

Reuse
To use something over again instead of throwing it away.

Recycle
To send something through a process in which to make it into something new. For example, a plastic water bottle can go through a recycling process to make it into carpet for your floor.

Landfill
An area of land where trash is stored.

Assessments

Student work should be used as an evaluative tool.

Lesson Sequence

1. Explain to the students that they are going to apply what they know about decomposers by learning about recycling! Inform the students that a visitor from Baltimore City's Department of Public Works is coming to speak with them about recycling.

2. Review the meaning of recycling. Ask the students to explain how recycling and decomposers are related. *Students should explain that decomposers are recyclers because they take dead stuff and turn it into nutrients for soil.*

3. Brainstorm with the students some questions they may have about recycling in their community. Write these down on the chalkboard and/or a sheet of paper to bring to the speaker.

4. Following the speaker, have students create signs to inform others of the importance of recycling. Students may choose to post these signs in their neighborhood or school

Students who have brought in found containers such as cardboard boxes or plastic buckets may choose to decorate them as recycling bins.

5. Additional Opportunity: Arrange a field trip to a recycling plant to see the recycling process from start to finish.

Maryland SC Standards (4th and 5th Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	**Applying Evidence and Reasoning** (4)(5)1.B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. **Communicating Scientific Information** (4)(5)1.C.1.d – Construct and share reasonable explanations for the questions asked.
Standard 3.0 Life Science: Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.	**Ecology** (4)3.F.1.a – Identify and describe the interactions of organisms present in a habitat. • Roles within food chains and webs: scavengers, decomposers, producers, and consumers (5)3.E.1.b – Cite evidence from observations and research that some insects and various other organisms depend on dead plant and animal material for food.
Standard 6.0 Environmental Science: Students will use scientific skills and processes to explain the interactions of environmental factors (living and non-living) and analyze their impact from a local to a global perspective.	**Environmental Issues** (5)6.B.2.a – Explain how human activities may have positive consequences on the natural environment. • **Recycling centers** • Native plantings • Good farming practice

Module 5:

Decomposition

Worksheets and Handouts

Grades 4 and 5

Module 5 - Lesson 2

DOES THIS WOMAN LOOK MAD …

ABOUT MICROBES?

Dr. Elaine Ingham

Module 5 - Lesson 7 - Part 3

Ecology Investigation #1: Britney's Soil Study

Britney loves soil. She wanted to study how much water soil could hold. First she had to think about what she wanted to compare. She talked with her Mom and visited a garden shop and talked with a sales person.

She came up with the idea to compare plain soil with soil that had things added to it. She chose three things to add (1) peat moss (2) sand, and (3) pebbles. Here is her plan.

I'll get 4 funnels and 4 jars. I'll put a funnel in each jar and then put each of the samples in the funnel in a different jar. I'll pour water in each of the funnels and then see how much comes out the other end.

Can you think of how to help Britney set up a more "Fair Test"?

First jot down the suggestions you think of right away:

_____

_____

_____

_____

_____

1. If Britney put 1 cup of plain potting soil in the first funnel, how much should she put in the other three funnels? _____

_____

2. What else can she do exactly the same to be sure she does a Fair Test?

_____

_____

3. What should she measure to find out which material held the most water?

_____

_____

Module 5 - Lesson 7 - Part 3

Ecology Investigation #2: Al's Algae Study

Al loves to spend time at his Uncle Sam's house because there is a pond out back. He wants to study the algae that grow in the pond. His uncle says that neighbors are using too much fertilizer on their lawns. He thinks the fertilizer is making too much algae grow in the pond. Al wants to test out his Uncle's theory.

He came up with the idea to compare pond water with algae plus fertilizer to just pond water with algae in it. Here's what he did.

He found 6 jars in his Aunt's recycling bin. He filled each jar with pond water and put in some algae. Then he added a teaspoon of fertilizer to 3 of the jars. Then he took these jars to the kitchen windowsill. He put the other 3 jars (with pond water and algae) on a bookshelf in the living room.

What is wrong with Al's experiment?

_____

_____

_____

List specific things he should do to make his experiment a Fair Test?

_____

_____

_____

_____

_____

Module 5:

Decomposition

Leader Tools

Grades 4 and 5

Background Information on Decomposition

When plant die, bacteria break down the dead leaves and stems through a process known as **decomposition**. The left over decomposed matter is then available to other animals in a form they can eat. Decomposition is nature's way to recycle organic, or living, material. Organic material is broken down into nutrients that can be reused by plants as they grow. Some inorganic, or nonliving, material is broken down as well, but usually at a slower rate. Bacteria, fungi, worms, and microorganisms all help to break down these materials.

Worms in particular help to speed up the process of decomposition. They make extensive networks of tunnels that help air and water reach the roots of plants. The tunnels also provide air and water for other soil-dwelling insects and small organisms that help with the process of decomposition. Worms also turn the soil by moving deep soil up to the surface and by dragging plant materials underground. One cup (250 ml) of soil may contain more than 5 billion living creatures!

Module 5 - Lesson 5

Possible Student Responses To:
<u>What Happens To Plants After They Die?</u>

- they rot
- they get stepped on and crushed
- worms take them underground
- they blow away
- birds put them in nests
- rain and wind rip them into pieces
- they turn black
- they dissolve and go into the ground
- beetles make holes in them
- someone rakes them up and burns them
- dirt blows over them
- they get slimy, smelly and disgusting

A Sample of 5th & 6th Graders' Responses When Pressed:
<u>Explain what Makes a Dead Thing Disappear</u>

- Dead branches fall off of trees and you step on 'em and they break up
- When it's been dead a long time and gets real old it breaks up and disappears
- The dirt breaks it down. It's something I can't explain in words, but I know about it.
- When the rain and wind come the dead plant spreads out into the dirt.
- It takes a lot of years for a dead plant to disappear. Just like with a rock, the wind it hits it and breaks it down.
- When we die they put us in a coffin and bury us, and while we're in the coffin we dissolve.

Module 5 - Lesson 2

MAD ABOUT MICROBES: The Work of Ecologist Dr. Elaine Ingham

When Elaine Ingham was in her last semester of college, she took a class called Microbiology. Instantly, she knew that she wanted her career to be studying **microbes**. (Remember: Microbes are living things so tiny that you need a microscope to see them.) "The world of life under a microscope is fascinating, and the microbes are cute!" she says. "When you are able to recognize the different kinds of organisms, it's like saying hello to your old friends! But, there are always new things to look at too that you haven't seen before, so it's exciting!"

Dr. Ingham is now a soil ecologist at Oregon State University. The soil is a good thing to study if you are interested in microbes, because lots of microbes live there. Think about a teaspoon of soil. In that teaspoonful, there can be more microbes than there are people living on the earth!

Fungi and **bacteria** are microbes that live in soil. They are **decomposers.** They eat dead plants that fall to the ground. Then, other tiny soil **organisms** eat the fungi and bacteria. Dr. Ingham studies what kinds of microbes live in the soil in different places. She studies the microbes in forests, grasslands, and meadows. She figures out how many microbes there are and what they eat.

When Dr. Ingham gets to a site she needs to make a very important decision. She needs to decide where to collect soil samples. She may choose near a tree, under a dead log, beside a bush, or between patches of grass. Even areas very close to each other can have completely different microbes. That's because microbes are not all able to eat the same food. Bacteria are best at eating material that is easy to digest. Fungi are better at eating tough materials like bark and logs. **Do you think you would find more fungi or bacteria in the soil next to a dead tree?**

PAUSE FOR DISCUSSION

After she decides where to sample, Dr. Ingham uses trowels and soil corers to collect her soil samples. (**Show children a trowel and soil corer.)** She uses the top 5 cm of soil, because that's where the most microbes are found. **(Show children 5 cm on a metric ruler.)** She puts the soil samples in plastic bags. She keeps them stored in coolers with ice until she gets back to her lab.

At the lab, Dr. Ingham adds a set amount of sterilized water to a set amount of soil. She mixes it well and then looks at it under the microscope. She identifies the kinds of microbes she sees. She also wants to know how many of the microbes have been eating dead plant material and how many have been just resting. She helped invent a way to do this. It uses dyes that only turn color on

microbes that are actively using food they've eaten recently. Imagine being able to turn your brother green if he just ate your granola bar!

When Dr. Ingham stains her samples with dyes, she finds something that may surprise you! Only 2 – 20% of all the bacteria she sees are actually eating and breaking things down! This is because many bacteria are picky eaters. They are also particular about their living conditions. A lot of microbes are carried by wind, water or animals to new places. But they stay sleeping unless everything is just right. They might need a certain kind of plant or part of a plant, or food with a lot of iron in it. They might need a certain temperature to be active eaters. One kind of microbe might not like the food and conditions around it. But there are usually other microbes there that like it lots!

Dr. Ingham also studies how things people do to the land affect the microbes that live there. In one study, she compared un-cut forests to ones that people have clear-cut for lumber. (Clear-cutting is the removal of all the trees in a stand of timber.) She found out that after one year, the clear-cut forest had 10 times fewer fungi in its soil than the un-cut forest. After five years it had 100 times fewer fungi! This was because once the trees are gone; the forest floor is directly exposed to the sun. The soil dries out. The conditions become too harsh for fungi to live in. **How do you think this could affect the land where the forest once grew?**

PAUSE FOR DISCUSSION

When there are fewer fungi, dead leaves, branches and tree trunks don't get broken down. That means the nutrients in these materials don't get returned to the forest soil. The land in clear-cut forests might not be a good place for growing trees in the future.

Dr. Ingham has lots of adventures when she works, and some misadventures too! "Sometimes when I'm walking around a plot in a clear-cut forest," she says, "I'm carrying my cooler and looking ahead for my plot markers. The next thing I know 'BOOM!' ---- I fall over a log and spend the rest of the day hobbling around on a sprained ankle. It's quite a comical sight!"

One of the forests where Dr. Ingram works has trees that have big branches. They fall whenever the wind blows, creating a danger to anyone below them. Dr. Ingham has also been caught in mudslides while working in the mountains. "All of a sudden a heavy rain comes down, and the path gives way and you're zooming down the side of the bank along with the mud," she says.

Dr. Ingham likes all these outdoor adventures that are part of her field work. But most exciting to her, is the world under her microscope. She knows that her work is important! Why? Because she is helping forest managers and

communities understand that what they do to the land affects whether plants will get the nutrients they need to stay alive.

Module 5 - Lesson 2

Non-Living Things to Compare for Microbes

- Two different kinds of dead leaves
- Two soil samples; one from the surface and one from deeper down
- Two soil samples; one from under a plant and one from an area with no plants
- Two of the same kind of leaf; one that just fell (intact) and one partly decomposed
- Two of the same kind of leaf; one from a wet area and one from a dry area
- A pine needle and a leaf
- One pebble and one stick

One plastic food wrapper and one leaf

Module 5 - Lesson 7 - Part 2

SAMPLE OBERVATION LOG

(Remember there should be sketches too!)

DATE	"MANY" DISH	"FEW" DISH	CONTROL DISH
9/10/07	More wrinkled	Little spots	No change
9/12/07	Holes	More spots	Slight wrinkles

Module 5 – Lesson 5

Dead Leaf Story Board Challenge

MANY PEOPLE THINK THAT DEAD LEAVES JUST "MAGICALLY" DISAPPEAR AFTER THEY DIE!!!!

Your Challenge:

Make a story board that shows people what causes a dead leaf to break down.

Your story board should have:

1) Drawings, paper cut-outs and/or samples to show how a dead leaf looks from the time it falls, until it is too tiny to see.

2) Words that explain what is making the leaf change.

HAVE FUN!