South Carolina Aquarium

3-5 Decomposers are Recyclers Activity

Overview

Focus Question
Have you ever seen fuzzy or slimy stuff growing on food that has been left in the refrigerator for too long? What in the world is that stuff? What does it do?

Activity Synopsis
Students will conduct an experiment on decomposition by placing different types of food sprayed with water in glass jars, sealing the jars and observing what happens to the food over time.

Time Frame
Initial set-up of experiments will take students approximately 30-50 minutes. Students will need to record observations, daily or every other day, for two weeks. Students will need 15-30 minutes to record observations.

Objectives
The learner will be able to:

- Plan and conduct a simple experiment on decomposition and use the sense of sight to gather information and collect data.
- Describe the important role that decomposers play in communities.
- Explain that decomposers, primarily bacteria and fungi, use wastes and dead organisms for food, but are unable to decompose certain man-made materials.

Student Key Terms

- bacteria
- decay
- decomposer
- decomposition
- fungus
- organism
- waste

Teacher Key Terms

- spores

Standards

2014 Academic Standards and Performance Indicators for Science

3rd Grade: 3.S.1A.1, **3.S.1A.3**, 3.S.1A.4, 3.S.1A.6, 3.S.1B.1, 3.L.5A.2
4th Grade: 4.S.1A.1, **4.S.1A.3**, 4.S.1A.4, 4.S.1A.6, 4.S.1B.1, 4.L.5B.3
5th Grade: 5.S.1A.1, **5.S.1A.3**, 5.S.1A.4, 5.S.1A.6, 5.S.1B.1, 5.L.4A.1, 5.L.4A.2, **5.L.4B.1**, **5.L.4B.2**, 5.L.4B.4

*** Bold standards are the main standards addressed in this activity**

Third Grade Performance Indicators
3.S.1A.1 Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.
3.S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
3.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.
3.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

3.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
3.L.5A.2 Develop and use a food chain model to classify organisms as producers, consumers, and decomposers and to describe how organisms obtain energy.

Fourth Grade Performance Indicators

4.S.1A.1 Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.
4.S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.
4.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
4.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
4.L.5B.3 Construct explanations for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.

Fifth Grade Performance Indicators

5.S.1A.1 Ask questions used to (1) generate hypotheses for scientific investigations or (2) refine models, explanations, or designs.
5.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
5.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.
5.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
5.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
5.L.4A.1 Analyze and interpret data to summarize the abiotic factors (including quantity of light and water, range of temperature, salinity, and soil composition) of different terrestrial ecosystems and aquatic ecosystems.
5.L.4A.2 Obtain and communicate information to describe and compare the biotic factors (including individual organisms, populations, and communities) of different terrestrial and aquatic ecosystems.
5.L.4B.1 Analyze and interpret data to explain how organisms obtain their energy and classify an organisms as producers, consumers (including herbivore, carnivore, and omnivore), or decomposers (such as fungi and bacteria).
5.L.4B.2 Develop and use models of food chains and food webs to describe the flow of energy in an ecosystem.
5.L.4B.4 Construct scientific arguments to explain how limiting factors (including food, water, space, and shelter) or a newly introduced organism can affect an ecosystem.

Cross Curricular Standards

South Carolina College and Career Standards for ELA

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Inquiry (I) – 3-1.1, 3-2.1, 3-3.1, 3-3.2, 3-4.1, 3-4.2, 3-4.3, 3-5.1, 3-5.2, 3-5.3, 4-1.1, 4-2.1, 4-3.1, 4-3.2, 4-4.1, 4-4.2, 4-4.3, 4-5.1, 4-5.2, 4-5.3, 5-1.1, 5-2.1, 5-3.1, 5-3.2, 5-4.1, 5-4.2, 5-4.3, 5-5.1, 5-5.2, 5-5.3

Common Core ELA Standards
Writing – 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3
Speaking/Listening – 3.1, 4.1, 5.1

Background

Key Points
Key Points will give you the main information you should know to teach the activity.

- **Decomposers** are **organisms** that feed on organic material that is no longer living such as leaves, animal **wastes** and dead plant and animal carcasses.
- Most decomposers, particularly the ones that would be on the surface of the food in this activity, are **bacteria** and **fungi**. Bacteria are microscopic single cell organisms. Fungi are organisms such as mushrooms, mold and yeast.
- Both bacteria and the **spores** that produce fungi are easily dispersed and can be found almost anywhere. Both are microscopic and can be carried by wind and water. When landing on a moist organic surface, the bacteria begin feeding and reproducing and the fungal spores develop into their adult fungal form. Both break down the organic matter for food.
- Decomposers feed on organic compounds. Inorganic compounds cannot be broken down easily by decomposers and, in some cases, can take hundreds of years to decompose. Plastics and foods with preservatives are both examples of items that decomposers have difficulty breaking down.
- Decomposers are very important to a wildlife community. They remove organic wastes and the remains of plants and animals. By breaking down these remains, they return nutrients to the soil that can be used by plants. Without decomposers, the soil would become so nutrient poor that it could not sustain plant life and soon the whole wildlife community would collapse.

Detailed Information
Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

Decomposers play a crucial role in communities; they cause plant and animal matter that is no longer living (i.e. leaves, carcasses, and feces) to **decay** or rot and thus return nutrients to the soil. This process helps to recycle the nutrients that are available within communities. **Fungi** and **bacteria** are the principal decomposers that keep communities filled with nutrients that are essential for plant growth. Fungi and bacteria decompose complex molecules like sugars and proteins (that are trapped in falling leaves or in the bodies of dead **organism**) to nitrate, carbon dioxide, and other simple inorganic compounds that plants can use and need. Without decomposers, nitrogen, carbon and other elements would remain in **wastes** and corpses and would not be available for other organisms. Without decomposers, the land and the ocean would be filled with animal waste and corpses. Yuck!

Bacteria are the most effective and numerous decomposers and are the first to start the process of decay. Fungi soon join the bacteria, followed later in the cycle by organisms like centipedes, beetles, millipedes, and earthworms.

Many items in your refrigerator or growing in your yard are potential food for decomposers. Organic materials contain carbon and nitrogen – nutrients that provide energy and growth to microorganisms, like bacteria.

All organic materials have a ratio of carbon to nitrogen (C:N) in their tissues. Leaves are high in carbon while vegetable scraps are higher in nitrogen. The C:N ratios are significant because tiny decomposers need about 30 parts of carbon for every 1 part of nitrogen in the organic material. If the ratio is greater than 30:1, nitrogen will be lacking, and materials will decompose more slowly. Anything organic will decay, however it may take longer when the C:N ratio is too high. Note that foods with synthetic preservatives or foods containing natural preservatives (like vinegar or salt) will decay more slowly than foods that do not contain any type of preservative. Inorganic materials, like plastics and other human made synthetic materials, can take months to hundreds of years to decompose.

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Average Carbon to Nitrogen Ratios (C:N) for Organic Materials

Vegetable scraps	12-20:1
Coffee grounds	20:1
Grass	12-25:1
Leaves	30-80:1
Bark	100-130:1
Paper	150-200:1

From Clemson Extension's Recycling Yard Trimming: Home Composting. Information Leaflet 48. Revised April 1996.

The fuzzy stuff that grows on foods that have been left in the refrigerator or out on the shelf for too long is mold. Mold, mushrooms, truffles, yeast, and the blue streaks in blue cheese are all types of fungus. The pharmaceutical industry grows fungi to make antibiotics, chemicals that are produced by one organism that inhibits the growth of or kills another organism. In 1928, Alexander Fleming was studying bacteria and accidentally contaminated one of his bacterial cultures with a strain of the *Penicillum* fungus. He observed that the fungus killed his bacteria. We now know that many fungi secrete antibiotics as weapons against bacteria that may be competing with the fungus for food or attacking the fungus. Ten years later, Howard Florey purified penicillin and began marketing it as an antibiotic to treat bacterial infections in people.

Unlike green plants, fungi do not grow from seeds they grow from **spores**. Also unlike plants, fungi have no chlorophyll and cannot make their own food by harvesting energy from the sun. Fungi feed by producing chemicals that make things, like food, rot. As the food rots, the fungus grows. Remember that mold is a type of fungus and there are many different types of mold. The mold that grows on bread initially looks like white, fuzzy cotton, but after a week will turn black. The black color is due to the presence of hundreds of tiny spores.

Believe it or not, the air is so loaded with spores from fungi that as soon as an animal dies or a leaf falls, it is covered with spores from fungi. Spores can be carried by wind or water, but need to land in a moist place to germinate (to begin to grow). Therefore, the best way to protect materials from mold is to keep them as dry as possible. Some fungi can be detrimental to humans. The British, during the Revolutionary War, lost more ships to wood rot caused by fungus than they did to enemy attack. In the humid environment of South Carolina, wooden homes are attacked by mold. Ringworm and Athlete's foot are examples of diseases that fungi cause in humans.

South Carolina Aquarium Spotlight Organisms

Bacteria & Fungi

Decomposers can be found not only in each and every exhibit within the Aquarium, but just about everywhere, though you would need a microscope to be able to see most of them. One type of decomposer, bacteria, is living all around us. Anton van Leeuwenhook, the inventor of the microscope, said, "There are more [things] living in the scum in a man's mouth than there are men in a whole kingdom." Though too small to be seen, bacteria are abundant across the earth. Though some bacteria are photosynthetic or cause diseases, many are decomposers helping to break down dead plant and animal matter.

Fungi are not as hard to see. Anyone who has seen a mushroom or seen mold on bread has seen a fungus. Like bacteria, most fungi are decomposers. Fungi have the potential to be just about anywhere, because they reproduce by spores. Spores are microscopic and easily dispersed by wind or water. When a spore lands on a moist organic surface, it will begin to germinate and then will develop into an adult mushroom or mold, feeding as it grows. In the South Carolina Aquarium, fungi will likely grow in exhibits that contain soil, that is moist, and that contain dead material, like leaves. Look for fungi in the mountain forest aviary and the blackwater swamp exhibit.

Procedures

Materials

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- 4 glass jars with lids (or other see through containers with lids) for each student group
- Tape
- Three different food items (one with preservatives, two without preservatives) that do not contain meat or fish
- Water
- Spray bottle
- Plastic six pack rings, cut up into small pieces
- Decomposers are Recyclers Observation Sheet

Procedure

1. Ask students to work in teams (3-5 per group).
2. Give each group four glass jars, four lids, one piece of each of the three different food items, a few small plastic six pack ring pieces and access to tape and water.
3. Ask each team to take a food item, spray it with water, place the food item in the jar, place the lid securely on the jar, and then seal the lid to the jar with tape. Label each jar.
4. Spray plastic pieces with water, place them in the jar, and seal the lid to the jar with tape. Label the jar.
5. Place jars in a secure location to reduce the possibility of breakage, but in a location where students can readily observe the contents of each jar.
6. Over the course of two weeks, ask students to observe what is happening in each jar and to record their observations in their *Decomposers are Recyclers Observation Sheet*. Students should record how the color of the object changes, how the shape of the object changes, how the amount of moisture in the jar changes and what if anything appears that is new, either on the object or in the jar.
7. At the end of two weeks, students will make their final observations and then discuss what they observed. Students should consider record answers to these questions:
    - Which items decomposed the quickest?
    - Which items decomposed the slowest?
    - Why do they think some items decomposed faster than others?
    - Which items might benefit a wildlife community if they were left to decompose in its environment?
    - Which items might be harmful to a wildlife community?
    - How do decomposers help the other organisms in a community?
8. At the end of two weeks, throw the jars containing food items away. Do not open them. Some types of mold can be harmful for some people to breathe. The jar containing the plastic pieces, and the plastic pieces themselves, can be recycled.

Experiment variations

For advanced students or students in the fifth grade, investigate how temperature impacts the experiment detailed above. Place four jars in full sunlight, and four jars in the refrigerator. Record observations over time and compare results. If you were a fungus fearing scientist, would you want to study animals in the tropics or at the North Pole?

For advanced students or students in the fifth grade, investigate how water impacts the experiment detailed above. Spray food items with water and seal in jars and compare to food items that are not sprayed with water and sealed in jars. If you were an Athlete's foot fungus fearing athlete, would you rather run regular marathons during the summer in the Sonoran Desert or in the Congaree Swamp?

Follow-up questions

- Why do you think people living in the 1800s and early 1900s salted and dried their meats?
- How does fungus suddenly appear on the week old loaf of bread in the kitchen? Where does it come from?
- What would happen if there were no decomposers and nothing ever decomposed?

Assessment

3-5 Decomposers are Recyclers Activity

Assessment #1:

Your finished product for this activity will be the *Decomposers are Recyclers Observation Sheet*. Have them keep a record of their observations every other day for each jar and then answer the questions.

Scoring rubric out of 100 points

Complete each observation entry: 5 points each (8 daily entries, total 40 points)
Correctly answer questions: 10 point each (6 questions, total 60 points)

Assessment #2:

Show "Tomato vs Twinkie Time-lapse Video" (to find video, google "Tomato vs Twinkie Time-lapse Video") to students and then have them answer the following questions on a piece of paper or in their science journals (write questions on board).

- How many days did the video film?
- What happened to the tomato over time?
- What happened to the Twinkie over time?
- Were there any decomposers involved in what happened to the food over time?
- Was there a difference between what happened with the tomato compared to the Twinkie? Explain why or why not.

*You can also show them the "McDonalds Fries vs Homemade Fries Time-lapse Video" for fun.

Scoring rubric out of 100 points

For correctly answering video length:	10 points
For correctly answering what happens to the tomato:	20 points
For correctly answering what happens to the Twinkie:	20 points
For correctly choosing the decomposers involved:	20 points
For correctly explaining the difference:	30 points

Cross-Curricular Extensions

STEM Extension
Students should research composts. Have them design and build their own compost bin model out of materials in the classroom. Students should write out an instruction manual for potential buyers.

Language Arts Extension
Students should write a story from a plant's point of view. Each student is a plant that is looking for a place to settle down and grow quickly. There are two different gardens available in which they can choose to grow, however the dirt in each garden is the same and does not contain many nutrients that they can use. Everything about each garden is exactly the same, except what has been spread on top of the soil. They can choose to live in one of the following moist gardens:

1. A garden that has pieces of lettuce scattered on top of the dirt
2. A garden that has cupcakes, loaded with preservatives, scattered on top of the dirt
3. A garden that has pieces of plastic grocery bags scattered on top of the dirt

If they were a plant that needed to grow quickly, in which garden area would they choose to live in and why?

Social Studies Extension
Students should research different methods that have been used over time to prevent food spoilage. The student's research can have a broad focus or a narrow focus on an industry or a country. Examples of different methods that student groups can research include:

refrigeration and freezing, salting, smoking, bottling, canning, vacuum packing, and the use of preservatives. The results of each student's research can be written in a report or illustrated on poster board.

Resources

Teacher Reference Books

Appelhof, Mary, *Worms Eat My Garbage,* Flower Press, 1982.
Provides information on setting up and maintaining worm composting systems.

Larson, Gary, *There's A Hair In My Dirt!,* Harper Perennial, New York, 1998.
This book provides a hilarious look at a maiden's view of the surrounding forest and the recycler's role in the habitat through the eyes of Father Worm. The book is not suitable for children but an excellent resource for teachers.

McLaughlin, Molly, *Earthworms, Dirt, and Rotten Leaves,* Macmillian Publishing Co., New York, 1986.
Examines the earthworm and its environment, also includes experiments.

Teacher Reference Website

Cornell Composting
http://compost.css.cornell.edu/
Site provides information on composting for teachers and students.

Student Reference Books

Bailey, Donna, *Recycling Garbage,* F. Watts, New York, 1991
Discusses how waste materials are recycled and ways children can act more responsibly toward the environment.

Glaser, Linda, *Compost,* Millbrook Press, Connecticut, 1996
The book describes, from a child's perspective, what composting is, what it does, and how to go about it.

Handelsman, Judith F., *Gardens From Garbage ,*Millbrook Press, Connecticut, 1993
Instructions are provided for growing indoor gardens using kitchen scraps.

Pascoe, Elaine, *Slime Molds and Fungi,* Blackbirch Press, Connecticut, 1999
Experiments are used to explore and explain characteristics of different types of fungi.

Ring, Elizabeth, *What Rot! Nature's Mighty Recycler,* Millbrook Press, Connecticut, 1996
This book provides details on how rot and all the tiny organisms that cause it maintain the cycle of life.

Silverstein, Dr. Alvin, Virginia, and Robert, *Fungi,* Twenty-First Century Books, New York, 1996
Fungi varieties, characteristics, and role in the ecosystem are introduced.

Curricula

Aquatic Project WILD
Aquatic Project WILD is an interdisciplinary curriculum for K-12 teachers on aquatic wildlife and ecosystems. The activities cover a broad range of environmental and conservation topics.
For more information click on http://www.projectwild.org/ProjectWILDK-12AquaticcurriculumandActivityGuide.htm

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