



Symbiotic Relationships

Teacher Instructions

Overview:

Students explore a squirrel's role in seed dispersal through experiential learning about mutualism between squirrels and oak trees. Students practice science and math skills as they discover the effects of dispersal and retrieval to both the squirrels and oaks.

Learning Objectives:

The students will:

- Experience mutualism between gray squirrels and oak trees.
- Calculate retrieval success to simulate the relationship.
- Infer scientific connections between experimental findings and real world occurrences.

Materials List:

- Bowtie pasta
- Calculators
- Cups (**teacher provides**)
- Large cup or bowl (**teacher provides**)
- Permanent markers

Grade Level Expectations:

Science

Sixth Grade

- Generate testable questions about objects, organisms and events that can be answered through scientific investigation (SI-M-A1).
- Identify problems, factors and questions that must be considered in a scientific investigation (SI-M-A1).
- Design and predict outcomes and conduct experiments to answer guiding questions (SI-M-A2).
- Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3).
- Use consistency and precision in data collection, analysis and reporting (SI-M-A3).
- Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3).
- Construct, use and interpret appropriate graphical representations to collect, record and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4).

Grade Level:

Middle school

Subject Areas:

English, math, science

Duration:

2 class periods

Setting:

Classroom and outdoors

Vocabulary:

Commensalism
Dispersal
Germination
Mutualism
Parasitism
Symbiosis

- Use data and information gathered to develop an explanation of experimental results (SI-M-A4).
- Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7).

Seventh Grade

- Generate testable questions about objects, organisms and events that can be answered through scientific investigation (SI-M-A1).
- Identify problems, factors and questions that must be considered in a scientific investigation (SI-M-A1).
- Design and predict outcomes and conduct experiments to answer guiding questions (SI-M-A2).
- Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3).
- Use consistency and precision in data collection, analysis and reporting (SI-M-A3).
- Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3).
- Construct, use and interpret appropriate graphical representations to collect, record and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4).
- Use data and information gathered to develop an explanation of experimental results (SI-M-A4).
- Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7).
- Identify the various relationships among plants and animals (e.g., mutualistic, parasitic, producer/consumer) (LS-M-C4).
- Distinguish the essential roles played by biotic and abiotic components in various ecosystems (SE-M-A1).

Eighth Grade

- Generate testable questions about objects, organisms and events that can be answered through scientific investigation (SI-M-A1).
- Identify problems, factors and questions that must be considered in a scientific investigation (SI-M-A1).
- Design and predict outcomes and conduct experiments to answer guiding questions (SI-M-A2).
- Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3).
- Use consistency and precision in data collection, analysis and reporting (SI-M-A3).
- Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3).
- Construct, use and interpret appropriate graphical representations to collect, record and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4).

- Use data and information gathered to develop an explanation of experimental results (SI-M-A4).
- Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7).
- Use evidence and observations to explain and communicate the results of investigations (SI-M-A7).

Common Core State Standards:

Math

Sixth Grade

6.RP.A.3c. Find a percentage of a quantity as a rate per 100 (e.g., 30 percent of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percentage.

Seventh Grade

7.SP.A.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample represents that population. Understand that random sampling tends to produce representative samples and support valid inferences.

Eighth Grade

8.SP.A.4 Understand that patterns of association also can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

ELA – Science and Technical Subjects

Sixth-Eighth Grades

Literacy.RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements or performing technical tasks.

Literacy.RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph or table).

Literacy.RST.6-8.9. Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic.

Vocabulary Definitions:

Commensalism – Symbiotic relationship in which one species benefits and the other neither benefits nor is harmed.

Dispersal – Spread of organisms over a wide area by various methods.

Germination – The process of the beginning of developing or growing.

Mutualism – Symbiotic relationship in which both species benefit in terms of growth and reproduction.

Parasitism – Symbiotic relationship in which one species (the parasite) benefits in terms of growth and reproduction to the detriment of the other species (the host).

Symbiosis – Relationship that occurs when two different species live together in a unique way; it may be beneficial, neutral or detrimental to one and/or the other.

Background Information:

When different populations of organisms cohabitate in the same ecosystem, a community is formed, but different relationships also are formed in that community. These different interactions between different organisms are called symbiosis. **Symbiosis** refers to a close relationship/interaction between members of two populations.

There are three different types of symbiotic relationships. The first is **parasitism**, in which one organism, the parasite, benefits, and the other organism, or host, is harmed. An example of parasitism is a deer tick on a deer or human. The second relationship is **commensalism**, in which one organism benefits, and the other is not deprived of any nutrients or harmed. An example of this relationship would be Spanish moss growing on a live oak tree. The Spanish moss is able to absorb water and nutrients from the air through the long moss hairs, not from the tree. The third relationship is **mutualism**, in which both parties benefit from one another. An example of mutualism is the relationship between squirrels and oak trees. Squirrels store acorns in the ground and use them as food, but some of the acorns are not found again. The acorns left by the squirrel lead to the **dispersal** of acorns, which grow and thus increase oak tree populations.

Gray Squirrels and Oak Trees

The gray squirrel (*Sciurus carolinensis*) is a mammal in the rodent family. Its range encompasses most of the eastern United States and southern parts of Canada.

Squirrels are best known for their ability to plant for the future. In the fall and winter months, their diet consists mainly of seeds and nuts, especially acorns from 32 different oak tree species that grow in the squirrel's North American range. In the fall, gray squirrels spend most of the day gathering nuts and seeds and storing them to have enough food for the winter. The nuts and seeds are buried by each squirrel in hundreds of different locations, a behavior which is known as scatter hoarding or caching. Before each nut or seed is hidden, the squirrel cleans it, which leaves its scent on it. That scent is necessary for the squirrel to find what it stored again during the winter.

Not all the stored food is recovered by the squirrel, however. The nuts and seeds not recovered by the squirrel remain buried, increasing their chances of **germination** and therefore dispersing the oak trees' offspring to new areas. This mutualistic relationship enables the squirrels to have food and the oak trees' acorns to be dispersed.

Advance Preparation:

Day 1:

1. Make one copy of Seed Dispersal Data Sheet for each group.

2. Have four different colors of permanent markers (multiple markers of one color for each group; dark colors are best).
3. Have bowtie pasta, as needed for class size (50 pieces of pasta per group).
4. Have a large container to place pasta in.

Day 2:

1. Designate an outdoor area to be used for pasta dispersal.
2. Disperse pasta pieces randomly throughout area (tossing them).
Note: If you are performing this lesson for multiple classes, designate a different area to disperse the pasta for each class.

Procedure:

Day 1:

1. Tell students they will be learning about symbiotic relationships today. Can anyone define what a symbiotic relationship is? (*It's a relationship that occurs when two different species live together in a unique way. It may be beneficial, neutral or detrimental to one and or/ the other.*)
2. Tell students they will be exploring three different types of symbiotic relationships in Louisiana's wetlands. Ask the following questions to assess their current knowledge:
 - a. What is the type of relationship between a tick and a deer? (*Parasitism*)
 - b. What is the type of relationship between Spanish moss and an oak tree if the moss isn't hurting the tree? (*Commensalism*)
 - c. What is the type of relationship between honeybees and a southern Magnolia? (*Mutualism*)
3. Review background information with the students to ensure they understand the relationships.
4. Tell students they will be focusing on the mutualism, a type of symbiotic relationship, and its role in dispersal. Can the students define dispersal? (*Spread of organisms over a wide area by various methods*)
5. Ask a few discussion questions to give examples of mutualistic relationships and dispersal.
 - a. What is the symbiotic relationship between the eastern bluebird and blackberries? How do both organisms benefit? (*Mutualism – The bird benefits by eating the fruit, and the blackberry benefits by having its seeds dispersed in the birds' excrement.*)
 - b. What is the symbiotic relationship between squirrels and oak trees? How do both organisms benefit? (*Mutualism – The squirrel benefits from the tree by supplying it with food, and the tree benefits from the squirrel by having its acorns planted and dispersed in different areas.*)
6. Tell the students they will be focusing on mutualism between oak trees and squirrels – two common Louisiana wetland organisms.
7. Review the background information about squirrels and oak trees with the class. Review the terms dispersal and germination. See key points below:
 - a. Squirrels can be thought of as the “planters of the future,” due to them hoarding acorns in times of abundance.

- b. As squirrels gather acorns, they clean acorns, mark acorns with their scent, and bury acorns for later. When they hide more than they need, or they forget where they buried acorns, the seeds may germinate.
 - c. This dispersal allows the acorns from different oak trees to travel to new areas, where they might not otherwise have been able to disperse.
- 8. Tell the students that in the next class they will conduct a dispersal experiment to illustrate how seeds are left behind by squirrels and the dispersal of seeds that results.
- 9. Divide the class members into four equal groups – one for each color of permanent marker (black, blue, red, green or whatever colors you have chosen)
- 10. Pass out one Seed Dispersal Data Sheet (see Blackline Master) to each group.
- 11. Assign a specific color permanent marker to each group, and pass out multiple markers of that color to each group.
- 12. Have one student from each group come to the front of the class to count out 50 pieces of bowtie pasta. Tell them these pasta pieces represent acorns.
- 13. Direct each group of students to color both sides of their 50 pasta pieces with their group's color. Tell them the color represents the scent mark of the squirrel.
- 14. Have each group fill out Day 1, Part 1 on the Seed Dispersal Data Sheet
- 15. Call for volunteers to share their responses to Day 1, Part 1.
- 16. Tell the students that for this experiment they need to write a hypothesis about the expected results. Direct them to Day 1, Part 2 on the Seed Dispersal Data Sheet. Encourage them to think in terms of success rates and percentages but to also include variables such as color.
- 17. Once all of the pasta pieces are marked, collect them in a large container to be used on Day 2. Collect the Seed Dispersal Data Sheet from each group to be redistributed on Day 2.

Day 2:

- 1. Before class, randomly disperse the noodles by tossing them in the designated area. (See **Note** in Advance Preparation if you have more than one class.)
- 2. Spreading them out within leaf litter underneath a large tree works well to camouflage the noodles.
- 3. Tell students they will be retrieving their “acorns” from an area outside. Review how squirrels disperse the acorns for oak trees. (See background for more information.)
- 4. Pass out each group's Seed Dispersal Data Sheet.
- 5. Ask for volunteers to share their hypotheses from yesterday. (Examples include: *All the acorns will be found, half of the acorns will be found, more acorns will be found in areas with less vegetation;, etc.*)
- 6. Pass out a plastic cup to each student.
- 7. Have the class members follow you outside to the designated area.
- 8. Count to three and allow the students 45 seconds to pick up as many acorns OF THEIR GROUP'S COLOR as they can. (No running, pushing or horseplay during collection.)
- 9. Return to the classroom and have students work in groups to total their retrieved acorns.

10. Using their Seed Dispersal Data Sheets, have each group of students fill in Day 2, Part 1 and calculate the percentage success of their retrieval by using the formula:

$$\frac{\textit{Number found}}{\textit{Total marked}} \times 100 = \textit{Percentage Retrieved}$$

Example: $(35 / 50) \times 100 = 70$ percent retrieval success

11. While the students are working on calculations, draw the following class data table on the board

Group Color	Acorns Found	Acorns Not Found	Percentage Retrieved

12. Have students fill in the class data table for comparison.
13. Once the table is completed, hold a class discussion about observations from the table. Prompt questions using the following ideas and others you come up with:
- Did the color of your “scent” influence your retrieval rate?
 - Did the amount of color on the noodle influence your retrieval rate?
 - If you had to do it all over again, how would you change what you did?
14. After a short class discussion, direct students to complete Day 2, Part 2 of their work sheet as a group. Call on volunteers to share their answers.
- Was your hypothesis correct? Why or why not? (*Answers will vary.*)
 - Did anything influence your ability to find your “acorns”? If so, what? Why are these factors significant? (*Color of marker, amount colored, environmental factors, etc.*)
 - What percentage of the acorns were retrieved? Why is this important to squirrels? (*High retrieval means squirrels collected the stored acorns, which they will use for food during the winter.*)
 - Why is this important to oak trees? (*The acorns NOT retrieved may germinate; acorns may be buried in new areas where the acorns may not have otherwise been dispersed.*)
 - Explain how this relationship between squirrels and oak trees is mutualistic. (*The squirrel benefits from the tree that supplies the food, and the tree benefits from the squirrel that plants the acorns in different areas.*)

Blackline Masters:

- Seed Dispersal Data Sheet

Resources:

Gray Squirrels Have Complex Relationships With Oak Trees. Accessed September 26, 2013, from: <http://treewatchvictoria.blogspot.com/2009/11/gray-squirrels-help-oak-trees.html>.

Symbiotic Relationships. Accessed September 26, 2013, from: <http://www.buzzle.com/articles/symbiotic-relationships/>.

Indiana Government Fish and Wildlife. 2011 Wildlife Diversity Report – Mammals and Seed Survival. Accessed September 26, 2013, from: <http://www.in.gov/dnr/fishwild/files/fw-11WildlifeDiversityReportResearchMammalsSeeds.pdf>.

Lowery, George. The Mammals of Louisiana and Its Adjacent Waters. Louisiana State University Press. 1974.

Seed Dispersal Data Sheet

Group names: _____

Group color: _____

Day 1

Part 1: Count out 50 pieces of bowtie pasta. These will represent acorns. Mark both sides of each “acorn” with your group’s color. Then answer the questions below.

What does the mark represent? Why is it important to squirrels?

Part 2: Tomorrow you will be conducting an experiment on the dispersal of acorns. You will attempt to retrieve your “acorns” after they have been scattered outside. With your group, write a hypothesis about how successful you will be in retrieving your acorns. Consider weather, vegetation and other variables when forming your hypothesis.

Group hypothesis:

Day 2

Part 1: When instructed, collect only the “acorns” marked with your color. Record the results below.

Total number of “acorns” marked: _____ (*the number you marked on Day 1*)

Number of “acorns” your group found: _____

Number of “acorns” not found (*number marked minus number found*): _____

Percentage retrieved: _____

$$\frac{\text{Number found}}{\text{Total marked}} \times 100 = \text{Percentage Retrieved}$$

Seed Dispersal Data Sheet

Part 2: Answer the following questions.

1. Was your hypothesis correct? Why or why not?
2. Did anything influence your ability to find your “acorns”? If so, what?
3. What percentage of the acorns were retrieved?
4. Why is this important to squirrels?
5. Why is this important to oak trees?
6. Explain how this relationship between squirrels and oak trees is mutualistic: