

ACORN ALIVE

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*****Note: Figures may be missing from this format of the document**

As summer turns into fall, oak trees share their bounty acorns. While the number varies with the age, size, species, and weather, a single tree can have as many as 15,000 acorns in a single year, but less than one percent of them will germinate. That's good for the parent oak because competition from all those offspring would create serious problems. The role of the acorn in the microhabitat around the tree is an excellent lesson for student investigators.

Inside each acorn that fails to germinate is a complex community of animal and fungal organisms that demonstrate intricate biotic relationships. Even before the acorn hits the ground, it may fall victim to insects. Once on the ground, it becomes a potential home to many types of insects and other invertebrate larvae, snails, worms, and fungi. What better way to introduce students to habitats, communities, and ecosystem dynamics than to have them dissect their own acorns?

What you may find in acorns

Before you begin your acorn dissection, help students become familiar with some of the organisms they might find. The larvae of the acorn weevil, acorn moth, and filbert worm will most likely be found. Students should also look for the parasitic braconid wasp. They may also find larvae of the fall wasp, fungi, springtails, sowbugs, centipedes, millipedes, fly maggots, ants, and slugs. You can do a teacher-guided review of these organisms or ask students to research them on their own.

- Acorn weevils --After mating in the summer, acorn weevils seek out developing acorns in which to lay their eggs. They use their long snouts to drill a hole in the shell of the acorn and lay their eggs inside. One or two weeks later, the larva (legless grubs) hatch inside the acorn and feed on the nutmeat until the acorn falls to the ground. Once the acorn hits the ground, the larvae may take up to three days to exit. Then they tunnel underground to spend the winter. They will emerge within the next five summers as adult acorn weevils, beginning the lifecycle again.
- Acorn moth--The acorn moth caterpillar has a long body with three pairs of legs near its head. The female lays eggs in a damaged acorn. After hatching from the egg, the caterpillars create a web across the shell which prevents other insects from entering. The shell is then a shelter during the winter, as the caterpillars undergo metamorphosis.
- Filbert worm--The caterpillar of the filbert worm moth looks much like the acorn moth caterpillar. It gnaws its way into acorns where it feeds on the nutmeat. If it is a small acorn, the caterpillar eats and moves on. Later it may become lunch for the larvae of a braconid wasp.
- Braconid wasp—The braconid wasp lays its eggs on the developing eggs of the filbert worm moth. As the moth larvae develop, the braconid larvae develop right inside the worm and burst through its body.

Draw a web

You'll also want to review the ways that organisms interact with one another in a community: predation (one organism kills and eats another), mutualism (two organisms help one another), parasitism (one organism is helped and one is hurt), and commensalism (one is helped and one is unaffected.) All organisms also compete for resources. As you discuss these ideas with your students and draw food webs, you will discover that these

ideas are seldom clearcut. If every acorn grew around the parent tree, the parent could not survive. So, are the animals in the acorns helping the parent oak or hurting it?

Investigating acorns

Investigating acorns will help students learn the ecological concepts defined in the National Science Education Standards (NRC [1996]):

- Students will learn about ecological relationships by studying the infestations of acorns,
- Students will identify biotic and abiotic factors that affect acorn production and acorns as microhabitats,
- Students will apply skills of observing, measuring, predicting, dissecting, deducing, classifying, analyzing, and concluding in their inquiry.

In addition, your students will do Internet research, practice using tools such as computer spreadsheets to analyze data, and draw conclusions. Finally, the experience helps students appreciate the complex biodiversity in the microhabitat of the oak tree as they observe and propagate their fruit.

This activity should take three or four class periods, more if you do extensions. Begin with a literature experience (see page 16). Have students brainstorm what they already know about acorns and what they would like to learn. Cooperative learning groups work well, with students assuming the roles of leader (organizes and keeps the group on task), recorder (maintains the data and spreadsheet), technician (gathers materials for each activity), and researcher (supports identification with field guides, keys, and Internet research).

To begin the investigation, each group will need at least five or six acorns. As students collect their nuts, they should identify the trees from which the acorns fell with dichotomous keys, and place the acorns in paper bags for later study.

In class, each group will need a metric ruler, small containers with lids, a nut cracker or rock hammer, plastic bags, hand lenses, dissecting needles or toothpicks, string, forceps, sand or soil, and a tray or paper towels. Every student will need eye protection, and each group will need access to a balance, water, and references. Be aware that students with nut allergies may be affected by contact with the acorn oils.

Allow students to discuss the best way to measure the length and circumference of their acorns. (They should use the combination of string and ruler.) Collect that data, plus mass, color, and other details on a spreadsheet (see Figure 1). Have students make comparisons of their findings among groups, and see if the average size from different trees or species differs.

Based on the appearance of the acorns, ask students to predict which acorns will be infested. Then ask them to do two tests to support their prediction. First, test each acorn to determine if it floats. Acorns that float are hollow and have probably been infested. (Acorn tissue is more dense than water.) Next, bounce the acorns off a hard surface such as a sidewalk. (Eye protection is necessary for this activity.) Those that don't bounce very high are probably infested, since living tissue is elastic. Have students record the results on the spreadsheets, and revise their predictions if needed.

Next, students should take the acorns that are to be dissected outside to a paved area. Wearing eye protection, they should gently open them with a rock hammer or nut cracker. Demonstrate how to crack the nut gently to avoid harming the organisms inside. On a paper towel, paper plate, or cafeteria tray, students can carefully pull apart the broken pieces of the acorns with dissecting tools or toothpicks. As they locate larvae or other organisms, they should identify them and record the results on their spreadsheets. Accumulate the results of student dissections on a large spreadsheet for the entire class, and help students draw conclusions based on their data. Ask them what they have learned from their study.

Assessing and extending

Many teachers find a formal laboratory report a good assessment for an organized inquiry such as the acorn lab. There are also many follow-up activities that can serve as assessments or help students extend their knowledge and skills.

FIGURE 1 **Sample student data collection table**

Acorn	Length (cm)	Circumference (cm)	Cap present	# of larva	Type of larva	Holes	Fungi	Other
1	2.5	5	no	1	moth	yes	yes	yes
2	3	4.5	no	0	none	yes	yes	no
3	2.5	5	no	1	moth	yes	yes	no

Drawing of acorn 1	Contents	Drawing of acorn 2	Contents	Drawing of acorn 3	Contents
	 fungi larvae		 fungi		 fungi larvae

- Graph the data on acorns, to see if they vary around a median or mean. Does the average change based upon the kind of tree? On the age of the tree? On the amount of sunlight or water the tree gets?
- Ask groups to exchange acorns and measure them again. Did each group come up with about the same data? Or did their technique affect the reliability of the lab?
- Collect acorns at different times of the year. Graph the percentage of acorns that are affected during different seasons. (Maintain the graphs as class data during the year.)
- Have students classify each organism into predator, prey, parasite, host, or mutualistic or commensalistic partner.
- Draw a food web illustrating how this community works in the deciduous forest ecosystem.
- Have students view the insects leaving the acorn. They can place some floater acorns on wet paper towels inside a covered jar with air holes poked in it. Inspect the jar the next day to identify organisms.
- Collect the larvae from the acorns and raise them in soil.
- Compare the reliability of the two "infestation tests" to predict which acorns have been invaded.
- Have students do an art activity showing the tree community.
- Investigate how Native Americans used acorns for food and flour. Ask an expert in wild foods to demonstrate acorn flour preparation.

A sense of wonder

Take advantage of students' sense of wonder by making acorns an ecological mystery! What could be inside? Why is such a small area so important to the tree and the organisms around it? Acorns are very abundant and a great way to get your students involved in the important biotic relationships that make up the vital role of every ecosystem. This is also a great way for students to begin individualized investigations of other seeds and nuts as they explore the role of trees and forests in their local environments.

Internet resources

The Michigan Entomological Society—insects.ummz.lsa.umich.edu/MES/MES.html
 Reproduction of Northern Red Oak: Effects of Curculio Weevils on Acorn Viability—
www.forestrv.caf.u.ru.edu/facult_y/gribkol
 Acorns for Rent www.ukv.edu/Agriculture/Entomology/ythfacts/allyr/yj804.htm

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Literature extensions

Take a Tree Walk

by Jane Kirkland

Stillwater Publishing, 2001

This is one of a series designed to get students outdoors in a meaningful way. This durable, soft cover manual helps students understand what trees are, why they are important to people, the kinds of habitat they provide, how to determine the age of a tree, and how to make careful observations of leaves, flowers, fruits, cones, seeds, and nuts.

Trees, Leaves, and Bark

by Diane L. Burns

NorthWood Press, 1995

This handy nature guide helps students identify 16 common North American trees. A nice selection of trees is covered in the book; well-known trees such as the oak and maple are included, as are the Eastern larch, the Douglas fir, the American sycamore, and the Ponderosa pine. The book also includes four nature activities. The leaf mobile has easy-to-follow directions and is cleverly done. The pinecone bird feeder, grow-a-tree project, and bark rubbing are also quite simple and could be done by a single student or used as classroom activities. The edge of the back cover is cleverly designed as a ruler that children can use to measure leaf and seed size, and several blank pages are set aside for notes, drawings, or samples of material gathered in the field.

Biomes: Forests

by Julie Nelson

Steck-Vaughn Company, 2001

Forests, part of the five-book Biomes series, is designed for teachers to read aloud to elementary students. Full-page photographs are associated with one or two short paragraphs of text. The three main types of forests (deciduous, coniferous, and tropical) are described, and their locations are plotted on a world map. Geographic and scientific factors that create and affect various biomes are explored. The author does a great job of describing the three main layers of the forest, a concept that is often overlooked.

The Great Kapok Tree: A Tale of the Amazon Rain Forest by Lynne Cherry

Harcourt General, Inc., 2000

The Great Kapok Tree is a vividly colored, realistic narrative of the amazing rain forest. The outstanding illustrations in Lynn Cherry's tale invite children and adults alike to read this book. Striking drawings and watercolors enhance every page. The story details the ecology of a tropical rainforest as described by the various forest inhabitants.

Someday a Tree

by Eve Bunting

Clarion Books, 1993 .

This story evokes emotions that will enhance classroom discussion on environmental issues. Alice finds out that the tree near her house, where she spent time with her mother and her dog, is dying. A tree doctor determines that someone has dumped chemicals near its roots. When the tree dies, Alice uses the acorns she has gathered to plant a new tree.

The Enchanted Tree

by Flavia M. Weedn and Lisa W. Gilbert

Hyperion Books for Children, 1998

A story about an enchanted tree that helps a pink giraffe see that being different is not so bad. The enchanted tree introduces the pink giraffe to other animals that are different and helps her see that each of us is uniquely special.

Grandmother Oak

by Rosi Dagit

California Native Plant Society, 1997

Grandmother Oak is a story about a real, 200 year-old tree that lives in Topanga State Park in California. This book is a natural history of the tree beginning with her germination during the time of the Tongva Indians, through her growth and development during the time of the Spanish rancheros, to the present day.

Lemur Landing: A Story of a Madagascan Tropical Dry Forest by Deborah Dennard

Soundprints, 2001

Children will love this story about the ring-tailed lemurs living in the tropical dry forest of southern Madagascar. The graphics and illustrations throughout the book provide additional insight into the habitat of the lemurs. The colors are warm and inviting, and a surprising number of other animals and plants are tucked into the pictures. A two-page foldout in the back of the book lists these other forest inhabitants, and children will enjoy going back through the pages to find the ones they may have missed on first reading. A world map with Madagascar identified and some accompanying facts support the text.

The Northern Forest

by Greg Breining

Marshall Cavendish Corporation, 1999

The focus of this publication is the interaction of the organisms with the environment. Emphasis is placed on the energy flow of the various ecosystems and on how abiotic factors, such as fire and acid water, affect the habitat. *The Northern Forest* concludes with a challenge to readers to consider the future of these remote lands and the organisms that live there. Societal demands for wood and pulp, for recreational areas, for power plants—all have an effect on these ecosystems. An informed citizenry must decide the future of these forests. Informational books like this one help to educate and develop awareness of potential conflicts of interest.

The Giving Tree

by Shel Silverstein

Harpercollins Juvenile Books, 1964

This classic allegory tells the story of a tree through the life of a boy and man. The tree provides food, shelter, wood and finally, a place of rest for the main character. Readers of every age find inspiration and food for thought in this memorable tale from the well-known children's author.

The People Who Hugged the Trees

by Deborah Lee Rose, Birgitta Saflund

Roberts Rinehart Publishers, 2001

This environmental parable is based on a folk tale from India. It helps convey the message that conservation is everyone's concern.