NOVA

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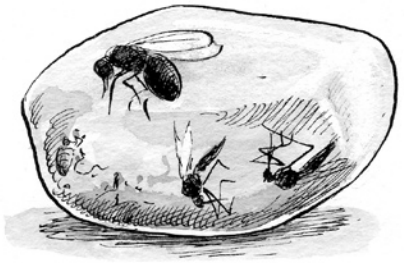
# Jewel of the Earth

## PROGRAM OVERVIEW



NOVA explores what plants and animals preserved in amber can reveal about the natural world of the past.

The program:

- notes that some plants produce resin to seal a wound and explains how amber forms when resin hardens.
- traces the importance of amber throughout history, including its importance during the Stone Age, the Bronze Age, and Imperial Roman times.
- shows how biologists study inclusions, well-preserved plants and animals that have become trapped in amber.
- states how scientists, by comparing amber animals to their modern-day counterparts, can determine what kind of forest they lived in.
- notes how 20-million-year-old Dominican amber has revealed what fossil evidence has not—that ancient tropical forests contained a vast diversity of life.
- recreates the lives and interrelationships of various organisms—such as the stingless bee, assassin bug, fig wasp, nematode worm, scale insect, and ant—based on evidence found in amber.
- suggests how animals like tadpoles, which are not normally found near trees, may have gotten trapped in amber.
- describes how seeds in amber can be analyzed to learn which mammals may have carried them on their bodies.
- conveys that an absence of change among plants and animals found in amber and those found today suggests that tropical forests have remained largely unchanged for at least 20 million years.
- shows how an amber-encased honey-pot ant provides evidence of Earth's rainfall patterns 20 million years ago and helps confirm that Australia and South America were joined together in one supercontinent.
- recounts early reports that DNA had been successfully harvested from an organism in amber but notes that when the studies could not be replicated, many scientists concluded that the original DNA discovered was contaminated.
- features scenes from the movie *Jurassic Park* and explains why it would be currently impossible to recreate an extinct species.



## BEFORE WATCHING

1 Scientists look to the fossil record to learn about the different kinds of plants and animals that lived millions of years ago. Ask students to describe some different ways that an organism's body may be preserved. *(Some ways an organism can be preserved include in tar, in amber, in ice, in peat, in arid regions where the body dries out quickly, or in dissolved minerals found in cave water.)*

2 Organize students into three groups and assign each group one of the following topics to track as they watch the program: how amber is formed and traps organisms, how amber has been viewed and used throughout history, and what organisms were found and what conclusions were drawn about each organism.

## AFTER WATCHING

1 Draw a three-column chart on the board and label each column with the categories students were tracking in the program. Fill in each column with the information students learned. Ask students how the use of amber has changed over time. When was it most valued? Why? What do the animals reveal about the ecosystem and the environments of 20 million years ago? What were some of the conclusions drawn about interactions between organisms?

2 Have students research where amber is found in the world. What are the necessary conditions for amber to form? How many different types of amber are there and how are they classified? How are scientists able to match amber to specific geographic locations? Have students write up a one-page summary answering these questions and any others they may have.

## CLASSROOM ACTIVITY

### Activity Summary

Students set sticky traps to collect organisms, identify and classify the organisms they find, and determine when the organisms first evolved.

### Materials for Each Team

- copy of the "Organism Hunt" student handout
- copy of the "Links and Books" student handout
- sticky traps or cardboard wrapped with packing tape (sticky side up)
- white paper
- magnifying glass
- access to Internet

### Background

Every school and home contains organisms. Many are too tiny to see with the naked eye but others are visible upon close inspection. Some of these inhabitants include insects, spiders, and other tiny animals. They have existed from prehistoric times and some of them have not changed much in millions of years. This activity will allow students to find and study some of these organisms.

Organisms will most likely be found in damp places like a basement, a locker room, or a teacher's lunchroom. Students will place sticky traps (often used for mice) to trap organisms over a 48-hour period. You may need to scout good locations by asking the custodian for helpful hints. If you are in a building that has mice or other small rodents, you will be less likely to trap them if you use cardboard wrapped with double-stick tape or packing tape (sticky side up).

Most of the organisms students find will be arthropods, such as insects, millipedes, centipedes, and spiders. Arthropods account for more than 75 percent of all known species and are part of the largest and most diverse animal phylum on Earth, Arthropoda. This phylum includes classes for insects, millipedes, centipedes, spiders, crabs, lobsters, shrimp, and others.

A dichotomous key can be used to identify the arthropods. These are available online or in print (several online keys are listed in a student handout). The key prompts the user to answer a question yes or no and then moves him or her on to another question until the organism is identified. The questions relate to the presence, absence, or number of various body parts on the organism and to adaptations.

## LEARNING OBJECTIVES

Students will be able to:

- collect and analyze organisms.
- use a dichotomous key to identify organisms.
- classify organisms according to order.
- trace organisms back to when they first evolved.

## STANDARDS CONNECTION

The "Organism Hunt" activity aligns with the following National Science Education Standards (see books.nap.edu/html/nses).

GRADES 5–8
**Science Standard C**
Life Science
Diversity and adaptations of organisms

GRADES 9–12
**Science Standard C**
Life Science
Biological evolution

*Video is not required for this activity.*

**Classroom Activity Author**
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## CLASSROOM ACTIVITY (CONT.)

If students do not collect any arthropods, describe five classes under the phylum Arthropoda and have student teams choose an organism in each class for further research. Have teams find images of each organism in their class on an arthropod Web site. Then ask students to make a chart that describes the organism's class and includes information about the time period the organism dates to, the organism's habitat, and adaptive features and body parts that allow each organism to live in particular habitats.

**Arthropod Classes**

**Diplopoda** or millipedes (30 or more pairs of jointed legs)
**Chilopoda** or centipedes (15 or more pairs of jointed legs)
**Arachnida** or spiders and their relatives (4 pairs of walking legs)
**Insecta** or insects (3 pairs of jointed legs)
**Crustacia,** which includes lobsters, shrimp, and crabs (5 pair of walking legs)

### Procedure

1. List on the board the types of insects students have seen. Ask students if everything on the list is an insect. *(Chances are students will have mentioned spiders, and maybe even centipedes or millipedes, which are not insects.)* Clarify for students that insects are only one of a number of classes within the phylum Arthropoda, which also includes spiders, millipedes, and centipedes, as well as crabs and lobsters. All arthropods have an exoskeleton, paired and jointed appendages, and segmented bodies. Insects are characterized by a hard external skeleton, three body sections, six legs, a single pair of antennae, wings, and compound eyes.
2. Ask students where they found the organisms they listed. Why might they be found there?
3. Organize students into teams and distribute the student handouts and other materials to each team (sticky traps or sheets of sticky tape are available at hardware stores).
4. Review instructions on the student handout with the class before conducting the activity. Have students decide where they want to place the traps and then place them there. If traps are placed outside of the classroom, add a note with the trap explaining to others who may see it why it is there.
5. After 48 hours, check the trap locations yourself before students gather them to see what has been collected (if a mouse becomes trapped, remove the trap and properly dispose of the mouse). If particular traps have not collected enough organisms, either brainstorm with students new places to situate the traps or restructure teams to work with the traps that do have organisms.

## CLASSROOM ACTIVITY (CONT.)

6 Once all the traps have been collected, have each team catalog, research, and identify the organisms on its trap according to the instructions on the student handout. Review how to use a dichotomous key for those students who may not have used one before. Once identifications have been made, ask for student volunteers to describe the organisms they found. Make a list on the board of each organism discovered.

7 After all teams have presented their reports, have each team choose one of the organisms on the board for further study. Make sure that the organism is part of the phylum Arthropoda. Ask each team to create a tree that includes all the major orders within the phylum and to categorize its chosen organisms into the correct order (class if possible) within the phylum.

8 Have teams conduct research to determine the evolutionary history of their organisms. Teams should then create a time line showing the eons, eras, and periods of geologic time and note on the time line the approximate time period when their organism evolved. How long has their organism been on Earth? What are the similarities and differences between today's organism and its ancestor?

9 As an extension, have students create correctly sized papier-mâché models or drawings of one of the prehistoric counterparts to their organism. Ask students to label each of the organism's parts.

## ACTIVITY ANSWER

Students will usually trap more organisms near plants and carpeting or windows. In traps used to test the activity, the following arthropods were found:

- ants
- book or dust lice
- boxelder bugs
- clothes moths
- crickets
- fruit flies
- houseflies
- Japanese beetles
- midges
- plaster beetles
- spiders (assorted)
- thrips
- white flies

When testing this activity, the following organisms were collected:

| Location | Total Organism Count |
|---|---|
| Beneath refrigerator in teacher's lounge | 26 |
| Beneath the plants in the library | 52 |
| Behind the bookcase | 4 |
| Boys' locker room in the equipment area | 43 |

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## LINKS AND BOOKS

**Links**

**NOVA—Jewel of the Earth**
www.pbs.org/nova/jewel
*Find out what is so compelling about insects in amber, follow a bee's journey from when it first became trapped in amber millions of years ago until now, see photos of amber inclusions, and learn where amber can be found worldwide.*

**Amber: Window to the Past**
www.amnh.org/exhibitions/amber/index.html
*Explains how amber preserves organisms and describes different kinds of amber.*

**Jurassic Park—Fact or Fiction?**
www.nhm.ac.uk/science/features/amber.html
*Considers the question of whether it is possible to extract dinosaur DNA from insects and recreate these creatures from ancient history.*

**Welcome to the World of Amber**
www.emporia.edu/earthsci/amber/amber.htm
*Provides information about amber, including its physical properties, uses, and geologic and geographic occurrences.*

**Books**

**Amber: The Natural Time Capsule**
by Andrew Ross.
Harvard University Press, 1998.
*Describes the properties of amber and includes sections on insect identification.*

**Amber: Window to the Past**
by David A. Grimaldi.
Harry N. Abrams, 2003.
*Discusses the properties of various types of amber, its most common localities, and the types of life it typically preserves. Includes numerous photographs.*

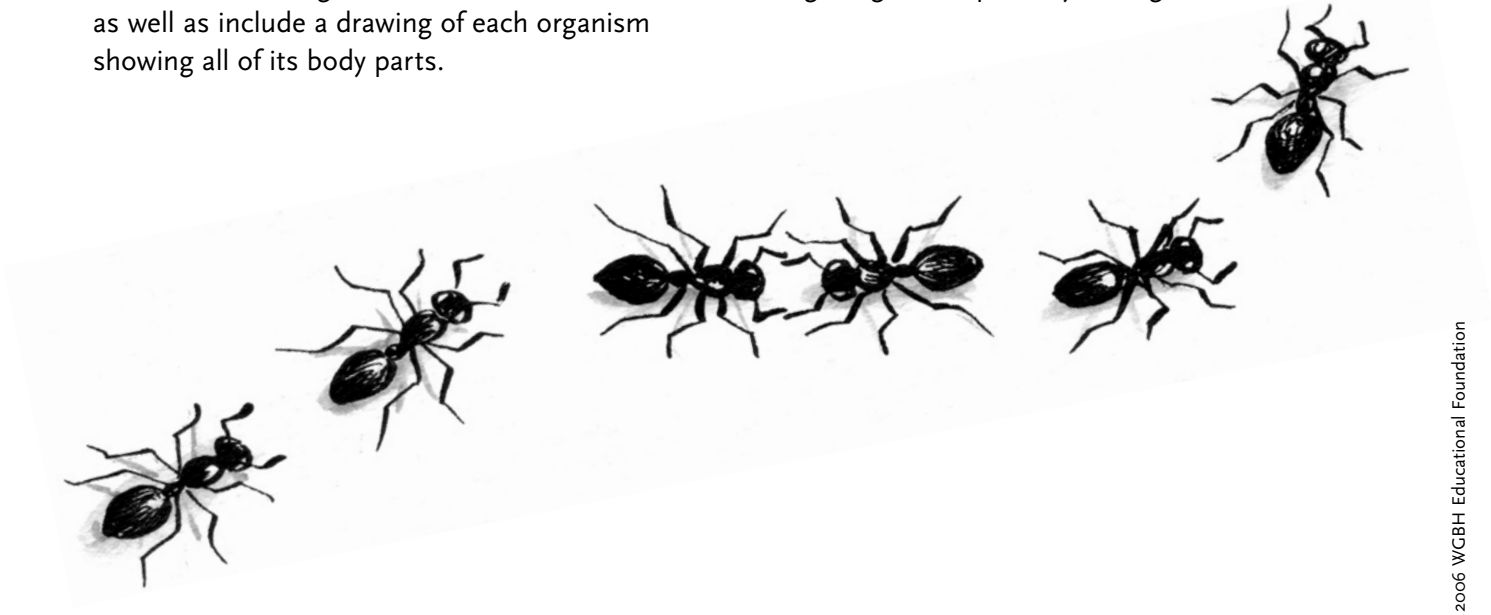
**Life in Amber**
by George O. Poinar.
Stanford University Press, 1992.
*Surveys life-forms that have been found in amber and includes numerous photographs of them.*

# Organism Hunt

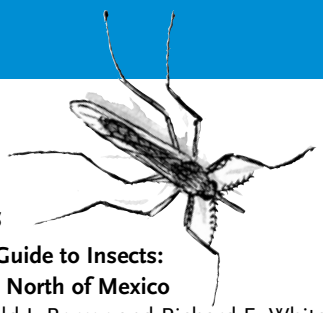
All sorts of organisms can be found in and around your school. In this activity you will set your own traps and find out just what kinds of organisms occupy your space. Then you will determine what your organisms are and when their relatives first appeared on Earth.

**Procedure**

1. Take a look around your classroom and school and select an area where you think you might find some organisms. This can be near a plant, on a sunny windowsill, near a garbage can, even outdoors near a tree. This is where you will be placing your trap. This should be out of the way of foot traffic so that no one will step on your trap.
2. Obtain a sticky trap from your teacher. Do not peel back the trap cover until you are ready to place it in its location. Before you place the trap, place a small amount of tape in the corners of the non-sticky side, take the cover off the sticky side, and tape the trap down **sticky side up**. Label the trap with the date, time, and location. Record the conditions of the area where you placed the trap.
3. After two days, remove the trap and place it on a sheet of white paper. Use a magnifying glass to look closely at each of the organisms your team collected. Catalog each organism. Your catalog should list each organism and its characteristics as well as include a drawing of each organism showing all of its body parts.
4. After cataloguing your organisms, conduct research to identify each organism you have collected. Use the resources listed on your "Links and Books" handout to aid in your research. Once all teams have identified their organisms, you will be asked to share what your team found.
5. You will now choose one organism for further study that belongs to the phylum Arthropoda. Create a tree that includes all the major orders within the phylum, and categorize your chosen organisms into the correct order (and if possible, class) level. Provide a short description of your organism's characteristics.
6. When you have finished classifying your organism, conduct research to determine your organism's evolutionary history.
7. Once you have discovered more about the evolutionary background of your organism, create a time line showing the eons, eras, and periods of geologic time. Note on the time line the approximate geologic time period your organism first evolved.



# Links and Books



## IDENTIFICATION AND CLASSIFICATION

### Links

**Dichotomous Keys: Arthropods**
www.amnh.org/learn/biodiversity_counts/ident_help/Text_Keys/arthropod_keyA.htm
*Provides dichotomous key and illustrations that provide identification of common arthropods to the order/class level.*

**Insect Identification**
www.kendall-bioresearch.co.uk/key1.htm
*Offers dichotomous key and extensive information and photos regarding the main orders of insects.*

**Key of the Identification of Insects to Order**
www.earthlife.net/insects/orders-key.html
*Describes how identification keys work and provides a key and additional information for arthropod orders.*

**Phylum Arthropoda**
animaldiversity.ummz.umich.edu/site/accounts/information/Arthropoda.html
*Provides information, pictures, sounds, and classification for the phylum Arthropoda.*

### Books

**A Field Guide to Insects: America North of Mexico**
by Donald J. Borror and Richard E. White.
Houghton Mifflin, 1998.
*Details insect orders and families. Many individual species are illustrated with 1,300 drawings with size lines that indicate the actual length of each insect.*

**Insects, Spiders, and Other Terrestrial Arthropods**
by George C. McGavin.
Dorling Kindersley, 2002.
*Defines what arthropods are and provides information on how to and how to identify them.*

## EVOLUTIONARY HISTORY

### Links

**A Brief History of Life**
www.pbs.org/nova/origins/life.html
*Explores the history of life on Earth, from the earliest bacteria to the first modern humans.*

**Insect Evolution**
www.fossilmmuseum.net/Evolution/evolution%20segues/insect_evolution.htm
*Provides background information on insect evolution.*

**Insect Fossils**
www.kendall-bioresearch.co.uk/fossil.htm
*Features a chart of various insects sorted into the period in which they lived.*

**Web Geological Time Machine**
www.ucmp.berkeley.edu/help/timeform.html
*Indicates when Earth's eons, eras, and periods occurred.*

### Books

**Bugs Before Time: Prehistoric Insects and Their Relatives**
by Cathy Camper and Steve Kirk.
Simon & Schuster Books for Young Readers, 2002.
*Provides an illustrated guide to the ants, spiders, cockroaches, and other organisms that lived millions of years ago.*

**Evolution of the Insects**
by David Grimaldi, Michael S. Engel
Cambridge University Press, 2005.
*Chronicles the complete evolutionary history of insects, including the relationships and evolution of each order of insect.*

**The Insects**
by Peter Farb.
Time-Life Books, 1977.
*Examines many aspects of insects and their evolution, including life cycles, physical characteristics, physical and social environments, and habits and behavior.*

**When Bugs Were Big, Plants Were Strange, and Tetrapods Stalked the Earth**
by Hannah Bonner.
National Geographic, 2004.
*Presents an overview of the Carboniferous and Permian eras (250 million to 355 million years ago), including the plants, insects, and fish and land animals that lived at the time.*