

A Teacher's Guide to **Science Detectives** Grades 3-6

Description: Students will design and execute their own experiments as they investigate a live mystery animal. From inquiry to results, students follow a scientific process that develops creative experiments to answer their own questions.

Outcomes: Students will be able to differentiate between objective and subjective observations. Students will be introduced to the experimental process. Students will recognize and use the elements of scientific inquiry to conduct investigations and build explanations. Students will design and implement an experiment using observation, communication, and comparing and organizing skills. Students will understand that science is a way to ask and answer questions that are testable.

Suggested Activities Before Your Visit

- **Hunt for classroom objects other students have described:** Tell the students to observe something, but not a person, in the classroom for five minutes and write a description of it without naming the object. Make sure that they have a clipboard, book, or binder to write on so they can move about the classroom freely. Collect the observations and pass them out to different students. Now they need to hunt for the new object. Once they find it, they should stand as close to it as possible. Next, tell them to write their own name on the new paper along with at least one new observation that makes the description better. Try repeating the exercise with each student choosing a different object.
- **Play a quick game of “I Spy”:** “I Spy” is a simple observation game that can be played anywhere, anytime. Tell your students, “I spy something red,” “I spy something that used to be a living thing,” etc. The students get to look around the room and guess what the object is. You can make the game as easy or as difficult as you want.
- **Play “The Classification Game”:** see attachment

Vocabulary

Observation
Experiment
Variable
Control
Fact
Law
Hypothesis
Theory

Suggested Activities After Your Visit

- **Make experiment posters:** Have students create a poster based on the data from their experiments at the Academy. Make sure to take your data sheets back to school. The poster can detail their questions, experimental setup, data, conclusions, and ideas for future experiments. They can present their posters to the rest of the class or display the posters in the library or hallway for other classes to view.
- **Make real life observations:** Tell your students to observe something at home every day for a week and write down their observations. They can choose anything—an animal, a plant, the weather, a glass of water left on a window sill, the moon, or even a family member as long as they agree to it. Encourage them to make quantitative and qualitative observations—How many times did the dog bark on Saturday? How many inches of water were left in the glass on

Tuesday? Have several students read their previous day's observations every day in order to check their progress and give other students ideas about things to observe. Encourage them to graph quantitative data, if they are able to collect it. At the end of the week, wrap it up with class presentations where students summarize their observations, relay any especially interesting observations, and report their overall findings.

- **Research Madagascar hissing cockroaches:** This activity is recommended for older students. Brainstorm questions about Madagascar hissing cockroaches. Have students develop individual reports, posters, or presentations on one of the questions they ask about the roaches. Or, divide students into groups and have each group research something related to Madagascar hissing cockroaches. If students have difficulty coming up with topics, these ideas may be useful:
 - How do hissing cockroaches make noise?
 - Where in the forest do they live? What are their natural food sources and predators?
 - What is their life cycle like, from egg to adulthood?
 - What is their social behavior? Are they territorial?
 - What are the differences between a male Madagascar hissing cockroach and a female Madagascar hissing cockroach?
 - Where is Madagascar, and what is the climate like there?
 - Have any hissing cockroaches ever escaped and survived?
 - Is it legal everywhere to keep hissing cockroaches as pets? Why or why not?
 - How should you take care of a hissing cockroach in captivity?
 - How big do these invertebrates get, and how does their size compare to the size of cockroaches in the U.S. and the size of other bugs in Madagascar?

Pennsylvania Academic Standards in Environment and Ecology

4.6.4 A Understand that living things are dependent on nonliving things in the environment for survival.

Pennsylvania Academic Standards in Science and Technology

3.2.4 B Describe objects in the world using the five senses.

3.2.4 C Recognize and use the elements of scientific inquiry to solve problems.

3.2.7 A Explain and apply scientific and technological knowledge.

3.2.7 B Apply process knowledge to make and interpret observations.

3.2.7 C Identify and use the elements of scientific inquiry to solve problems.

3.3.4 A Know the similarities and differences of living things.

The Classification Game

Divide the class into pairs and give each pair an item from the classification grid on the next page. Tell them to observe the object and write a description of their item without actually naming the item.

Tell the class you are thinking of one of these objects. Tell them that you are going to describe the item and that you want them to raise their hands if their item qualifies and put their hands down when the description no longer applies to their item. For example, if you say the item you're thinking of is red, students with red items should put their hands up. But then if you say that it is also flat; they should put their hands down unless their item is flat.

The classification scheme below is designed to get many students raising their hands at the beginning and end up with only one pair left raising their hands. The entries that are filled in uniquely identify each object in the table, but you should use the other descriptors as well.

Disagreement is good! If a pair disagrees about a quality their item possesses, have them each explain their reasoning, and put it to a class vote. If you end up with too many hands raised at the end, talk about ways to make the description more specific. Do the same if everyone's hand goes down. If no one is disagreeing, cause some dissent by asking questions! For example, "Is a piece of paper really bigger than your fist? What if you crumple it up?"

(Optional) Observe the same object again, and find each other's objects:

After playing the game with several different items, have the students describe their objects again, perhaps including observations of qualities they thought about during the game. Tell them not to name their objects, but make sure they remember to write their own names on these second descriptions. Collect these papers and shuffle them. Then hand them out again to different pairs of students and instruct each pair to stand by the desk or table with their new object on it. Some students may try to find their object by remembering where another student was sitting—if you like, you can swap several objects around to different desks or tables in order to prevent this. Sort out pairless items or itemless pairs by asking the original author of the description what his or her object was. Afterward, ask students what they would have added to their descriptions to make them better.

	<i>round?</i>	<i>flat?</i>	<i>Can wrap food in?</i>	<i>Used to be alive?</i>	<i>Has hole or holes?</i>	<i>Bigger than fist?</i>	<i>color?</i>	<i>Holds papers together?</i>
baseball	yes	no				yes		
golf ball	yes	no				no		
tinfoil	no	yes	yes				silver	
saran wrap	no	yes	yes				clear	
waxed paper	no	yes	yes				white or cream	
red piece of paper	no	yes	no	yes			red	
leaf		yes		yes			leaf's color	
piece of scotch tape	no	yes	no				clear	
piece of masking tape	no	yes	no				white or tan	
plain metal key ring	yes	yes			yes		silver	
paper clip	no	yes			yes		silver	yes
coke can tab	no	yes			yes		silver	no
milk bottle top		yes	no	no	no		bottle top color	
clear button	yes	yes			yes		clear	
white button	yes	yes			yes		white	
black button	yes	yes			yes		black	
dime	yes	yes			no		silver	
penny	yes	yes			no		copper	

Animals in the Classroom Observation Lesson

Introduction: This activity offers an engaging way to practice observation and data management skills. Careful observation is an important skill in science. Good observation includes having a question in mind as well as a hypothesis, while looking and recording information in a clear and accurate way. After observing, scientists analyze their data results to generate conclusions and more questions. Scientists may redesign an experiment or change the involvement of testable items, or the variables. This lesson is easily adaptable to a variety of animals that are kept in a classroom setting.

What to expect: Each pair of students should plan to observe at the same time every day. Different pairs of students should compare their results after several days to look for daily patterns.

Materials:

Observation Data Sheet

Compilation Data Sheet

Watch or Clock with second hand

Procedure:

1. Have the students identify and name individual animals in the enclosure. Be sure each student can recognize the animals they are observing. If necessary, you can mark invertebrates with a small dot of nontoxic paint. Have the students describe and record the enclosure setup; they may draw a picture if necessary. Maintain the enclosure's state during the first few days of observation.
2. Divide the students into pairs or small groups. Each group of students should watch their animal for three to five minutes at a time, recording the behavior of the animal every 10 to 20 seconds.
3. After observing the animal's behavior for three to four days, students should have baseline data on normal patterns of behavior for each animal. Have students discuss results so far and describe their animal's habitat use.
4. Students should now change one factor in the animal's enclosure or habitat. For instance, they may add a new toy, change the feeding dish, or change the feeding schedule. Before making the change, students should predict, or hypothesize, how the change will affect the animal's behavior.
5. As soon as the habitat or routine is changed, the groups should begin observing the animals again. Students should determine whether the animal changed its behavior in response to the new configuration in its habitat or routine. Observations using these same conditions should be made for three to four days. New changes should be made one at a time, with students recording observations about their effects over the course of a few days.
6. Groups should report their results to the class. The class should then draw conclusions about the ways animals use habitats.

Evaluation: Reports presented to the class; each group will create a poster, graph, or other display to illustrate results. Each student will hand in individual observation sheets, and each student will contribute to the group report.

Extensions:

1. Using the knowledge gathered from the research project, students should modify the animal's enclosure to suit the needs of the animal.
2. Have students research the animal and its behavior—in captivity and in the wild—using reference books and the internet.

Compilation Data Sheet

Using the table below, compile data regarding the animal you are observing. For each given time, note the behavior of the animal using the codes below and observe its activities.

Name: _____

Date: _____

Group: _____

Time of day observations began: _____

Start Time (Minutes: Seconds)	Location of animal	Behavior (Eating, scratching, sleeping, etc.)	Other observations
SAMPLE: 0.15(start time is 15 seconds into observation)	In hide box	Sleeping	Early morning when began observations

Fun Websites for further investigation

Madagascar hissing cockroach links:

uky.edu/Agriculture/Entomology/entfacts/misc/ef014

zoo.org

entomology.unl.edu/k12/croach/roachinfo/roachpage.html

thebigzoo.com/Animals/Madagascar_Hissing_Cockroach.asp

pueblozoo.org/archives/feb00/feature.htm

Insects of the World: biologycorner.com/projects/insects/world.html