

# **Middle School Investigations With the SmartMicroScope**

**By SmartSchool Systems**

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# Welcome to the Middle School Investigations with the SmartMicroScope

## Preface

Dear Instructor,

This investigation manual was designed specifically for your ease of use. It is written in such a way to make it easy to implement in your classroom.

These investigations will engage today's tech-savvy students and challenge them with a hands-on approach to science. We are confident that your students will enjoy the wonder of EXPLORING science.

As an educator your feedback and input is of tremendous value. Please feel free to contact us with comments or suggestions.

Sincerely,

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# Contents

<b>Welcome</b>	<b>2</b>
<b>Contents</b>	<b>3</b>
<b>1. Preparing Stained Microscope Slides</b>	<b>4</b>
<b>2. Take a Look Inside of a Drop of Water</b>	<b>15</b>
<b>3. What do Martians look like?</b>	<b>24</b>
<b>4. Can a Virus Sit on a Bacterium?</b>	<b>34</b>
<b>5. What's the Difference Between a Hypothesis and A Theory?</b>	<b>45</b>
<b>6. Start Your Own DNA Collection</b>	<b>53</b>
<b>7. I Will Survive!</b>	<b>61</b>
<b>8. Chemical and Physical Changes</b>	<b>67</b>
<b>9. How Important is pH?</b>	<b>73</b>
<b>10. How Do You Know if Bacteria is Breathing?</b>	<b>82</b>
<b>11. Why Don't Peas Grow in the Ocean?</b>	<b>87</b>
<b>12. You Can be a Horticulturist</b>	<b>93</b>
<b>13. How Do Seeds Know Which Way to Sprout?</b>	<b>100</b>
<b>14. Slow and Steady Wins The Race</b>	<b>105</b>
<b>15. Name That Rock</b>	<b>116</b>
<b>16. Take a Look Inside a Sedimentary Rock</b>	<b>123</b>
<b>17. What Did You Eat for Dinner?</b>	<b>131</b>
<b>18. Animal Activities</b>	<b>140</b>
<b>19. Design A Spacesuit</b>	<b>150</b>
<b>20. What is Friction?</b>	<b>156</b>



# What Did You Eat for Dinner Last Night?

## Information for the Teacher

**Activities:** Dissecting, reconstructing a skeleton, using a microscope.

**Overview:** Students will dissect an owl pellet to determine what foods owls eat and how much they eat. Students will reconstruct skeletons found in the pellets and/or identify the species based on skull and bone structure.

**Level:** Grades 6 - 8

**Time:** One or two 45-minute class periods

**Prerequisites:** Students should be familiar with the use and care of a digital microscope, and be able to measure and photograph objects with a microscope. Students should know basic laboratory techniques such as measuring volume with a graduated cylinder, and using a scale and weighing paper.

**Objectives:** Students will understand that there are levels of organization within an ecosystem. Students will understand that organisms have various relationships to each other, such as producer/consumer, predator/prey, and parasite/host, and that these relationships can be used to understand the ecosystem as a whole. Students will learn how to dissect owl pellets and use dichotomous keys to identify the skeletons inside.

**Materials** (for each student or group)

- SmartMicroScope 200X digital microscope with standard stand
- Computer with SmartMicroScope software
- Printer (optional)
- Flash drive for storing image files (optional)
- Prepared slides of rodent bone cross-sections (optional)
- Owl pellet(s)
- Bone identification charts of prey, including parts and whole skeletons
- Forceps or fine tweezers
- Dissecting needle or tooth picks
- Calipers
- Small brush (such as an old toothbrush)
- Disposable gloves
- Disposable mask (optional)
- White paper (can be collected from the recycling container near your photocopy machine)
- Tape
- Beaker with water and paper towels (optional, for wet dissection)
- Scale and weighing paper
- Graduated cylinder
- Velvet, dark color about 6" x 9" (helps to keep the tiny bones in place while Students examine them)
- Frame with glass (or plastic) and cardboard backing to frame the velvet, about 5" x 8"



- Student worksheet
- Pencil, eraser, and paper

### **Demonstration materials**

- Display screen, chart of the owl digestive system, and the other materials listed above.

### **Preparation**

If you buy the pellets from a supplier, ask where the pellets come from (type of owl, location, captive or wild owls), what they should contain, and how many, on average, are produced by each owl per day: This information is used for the student report. (If they don't know how many pellets are produced, assume one pellet per day for the activity.) You might want to consider buying pellets that contain a variety of species or collecting your own to make the activity more interesting. Pellets with more species work better for the skull identification activity, while pellets with one or two species work better for the skeleton reconstruction activity.

You will need to obtain bone identification charts of prey. You should get several comparing single bones types of several different species, such as a femur chart showing the femurs of mice, rats, squirrels, etc. You will also need a few charts showing complete skeletons. Some common owl prey animals are mice, voles, shrews, rats, chipmunks, squirrels, and rabbits. If you buy the pellets from a supplier, they may be able to supply you with the relevant charts. General charts of small animal bones can be found in textbooks or on the Internet, but more specific charts for your area may be available from your local Forest Service station or university. A basic skull identification chart is included below; you can use it as it is, or add to it to include the names of species found in the area where your pellets were collected.

Bacteria from prey animals are usually killed by the owl's stomach acids, but pellets can still contain microbes, so if you collect your own pellets, place them in an oven at 250° F for 4 hours and then store them in the freezer for 24 hours or until you need them. Pellets from a biological supply house are usually pre-sterilized.

The frames make a nice specimen for Students to take home and share, but if you cannot get them, Students can mount the velvet on a piece of heavy cardboard and glue the bones to the cloth.

For more information, see: 'Mammal Remains in Owl Pellets', by Ernest C. Driver, in the *American Midland Naturalist*, Vol. 41, No. 1 (Jan., 1949), pp. 139-142.

### **5E Plan**

#### **Engage**

Ask Students how to determine what foods wild animals eat. Use examples such as whales, bears, birds, etc. Students may suggest following the animal, setting up cameras, or studying animals in captivity (these are all methods used by scientists.) Tell Students that scientists sometimes examine excrement to determine what animals are eating. Discuss advantages and disadvantages of each method.



Show Students an owl pellet and tell them what it is and why it is formed. Use a chart of an owl digestive system to show Students how it is formed. Talk about some of the differences between raptors and other birds (carnivorous, no crop, different digestive system, etc.) Ask Students how examining pellets can help wildlife biologists learn about owls and other species in the owls' environment. Discuss information about prey species and introduce the charts.

Demonstrate the activity. Use the microscope and display screen to show the details.

Have Students make organization "trays" by drawing a large grid on a piece of white paper and writing, in the boxes, the names of the bones they may find in the pellets. (Make sure they put their names on it because it is part of the evaluation.) Include the categories *skulls, jaws, scapulae, forelimbs, hind limbs, pelvic bones, ribs, vertebrae, fur, and other*.

### **Explore**

In this activity, Students will dissect (pull apart) an owl pellet and organize the components on the Organization Tray sheet. Students will record images using the microscope and/or make sketches for use in their reports. They will weigh and measure the components and record the data on the Owl Pellet Components chart and use the Owl Pellet Report sheet to analyze their results. Next, Students can identify the skulls and other bones using the Skull Identification Flow Chart and the charts you supply. Finally, they can reconstruct one prey skeleton on a piece of velvet and make a framed display to take home.

Have Students follow the procedure in the student handout to dissect and analyze the pellets.

### **Notes**

If you plan to evaluate Students on this part of the activity, be sure to check their Organization Tray sheets before they start assembling their skeletons.

To cut down on the dust and mess, especially for Students with allergies, you can have Students dip the pellet in water before dissection -- Let it sit on a paper towel to soak up excess moisture. There are two drawbacks to this method: First, the bones must be dried before putting them on the velvet because the mounted display should not contain any moisture; and second, some samples, such as fur and tiny bones, are harder to analyze if wet.

Some pellets may not contain complete skeletons. In this case, Students can make an owl pellet display showing the different types of bones and/or animals found in pellets. Students should include labels or a key.



## **Explain**

Engage Students in a class discussion including:

- How indicator or key species are used to determine information about ecosystems.
- Why the number of animals in an owl's pellets may not be the same as the number of animals the owl actually eats. (Some may be eaten by offspring; Owls eat some things that may not leave any remains in the pellets such as insects, worms, and flesh from larger animals, etc.)
- What could be in a pellet that is not eaten by owls (things that entered the pellet after it was dropped such as insects, fungi, etc.)
- How the contents of pellets from captive owls might be different from that of wild owls.
- How the dichotomous keys used by scientists vary depending on the area being studied. For example, large mice are found in some areas. These would have skulls as large as some rats and have to be identified by means other than skull size.
- Review Students' work and have class work together to solve any problems with or questions about the skeletons.

## **Expand**

Have Students make a diagram of an owl's food chain. This can be a very simple picture of a few animals and plants or a more complex diagram including biotic and abiotic factors, and natural cycles. Ask Students to explain, based on their diagrams, what an owl's pellets can tell us about its environment (determine elements of food chains, numbers and health of prey species, etc.) Discuss how owl pellets help wildlife biologists determine the general health of forests.

Discuss how scientists often make several measurements and average them to get a better estimate of the true value. (One good way to do this is to have Students estimate the length of something in the classroom. Students should write their estimate on paper so they don't influence each other. They must make their estimate just by looking at the object, but it's OK if they look at a ruler. Individual guesses may not be very accurate, but the class average will probably come very close.)



Have the class work as a group to gather all of the data, organize it, and calculate better estimates for the owl pellet statistics.

### **Evaluate**

To meet expectations for this activity, each student should:

- 1) Be attentive and focused while participating in all class discussions and activities.
- 2) Complete own lab work and student worksheet.
- 3) Make an Organization Tray sheet that is neat and includes the listed categories spelled correctly.
- 4) Dissect a pellet and use the sheet to organize the components.
- 5) Identify the skulls and other bones based on the charts provided.
- 6) Assemble a skeleton based on the chart you provide. (Depending on the pellet, Students may have more or less complete skeletons.)
- 7) Include all relevant information on the student worksheets. (Depending on the pellets, Students may or may not be able complete everything.)







# Owl Pellet Report

Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Class/Period: \_\_\_\_\_

Type of owl: \_\_\_\_\_

Location: \_\_\_\_\_

Mass of pellet: \_\_\_\_\_

Percent mass of material =

(formula)

Sample calculation:

Material (bone, fur, plant material, etc)	Total Mass ( )	Percent Mass ( )

Number of individual animal remains found in the pellet:

Estimated number of animals eaten by the owl (or owl family) in one month (show your calculation):

\_\_\_\_\_

\_\_\_\_\_

Types of animals:

\_\_\_\_\_

\_\_\_\_\_

Notes and Pictures:



## Procedure for Dissecting an Owl Pellet

Remember: practice safe laboratory techniques, conserve resources, and recycle or properly dispose of materials. Wash your hands *before and after* the activity.

1. Tape a piece of plain paper on your desk or work table to use as a dissecting mat. Tape the Organization Tray paper to the table just above that so it doesn't get bumped.
2. Set up the microscope and obtain the pellet and the tools you will use for the dissection. Put on gloves and a mask (optional).
3. Weigh the pellet and record the mass on the worksheet; don't forget to record what unit you used.
4. Write the formula for percent mass of material (Percent mass of material = [mass of material/total mass of pellet] x 100) on the worksheet.
5. Place the pellet on the blank paper and pull it gently in half with the forceps. Use the dissecting needles and forceps to separate the bones from the fur and feathers. Clean the bones with the brush.
6. Organize and group the components of the pellet using your Organization Tray paper.
7. Analyze the components according to the Owl Pellet Components chart. Use the Skull Identification Flow Chart and other bones charts supplied by your teacher to identify the bones. The volume of a bone can be found by submerging it in water in a graduated cylinder: the difference in the water level is the volume of the sample. Use the calipers to find the diameters. Record your data on the chart.
8. Record images using the microscope and/or make sketches for use in your report.
9. Complete the Owl Pellet Report sheet.
10. Reconstruct one complete skeleton from your pellet using the following procedure:

First, decide which animal you will try to reconstruct. Look at your Owl Pellet Components chart and see what type of animal bone you have the most of; usually owl pellets contain many mouse bones, so you might want to try a mouse. Look on the chart for that animal and see if you have most or all of the bones required. Once you have decided on an animal, place the velvet on the table and smooth out the wrinkles. Use the forceps to pick up the bones and place them on the velvet in order according to the chart (the cloth helps to keep the tiny bones in place).

Once the skeleton is complete, place the glass and then the frame on top. Holding everything firmly together (so the bones don't fall out of place), turn the frame over. Write your name on the back of the frame and then put it in place. Attach it using the frame's hardware.

Make labels for the bones and a title for your display and glue them on the velvet in the appropriate places. If you don't want to have labels on your display, you can make a separate key; be sure to include some way for people to tell which bone goes with which name on the key.

If you are not using a frame, first attach the velvet to the cardboard using tacks and glue. Write your name on the back. Next, assemble the skeleton on the velvet. Finally, glue the bones on the velvet: One at a time, pick up a bone with tweezers and use a small paintbrush to apply glue to one side; then place it on the velvet glue side down. Allow it to dry overnight before you bring it home.



# Skull Identification Flow Chart

