Owl Pellet Contents

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Science Content Standards: Grade 4, 2b — *Students know* that producers and consumers are related in food chains and food webs and may compete with each other for resources in an ecosystem.

Lesson Concept: Carnivores and herbivores have different teeth structures that are adapted for the type of food they eat.

Conceptual Flow:

- The sun is the ultimate source of energy entering the food chain.
- All organisms need energy to live and grow.
- Living things have different roles in energy transfer.
  a) A food chain represents the movement of food energy and food matter through a sequence of living things.
  b) A food web is the overlapping of food chains in an ecosystem.
  c) There are producers, consumers, and decomposers in nature.
    - Producers, consumers (herbivores, carnivores, and omnivores) and decomposers interact in food chains and food webs in an ecosystem.
    - A producer makes its own food (plants).
    - A consumer must eat other living things.
      - All animals are consumers.
      - A carnivore is an animal that eats only other animals.
      - An herbivore is an animal that eats only plants.
      - An omnivore is an animal that eats plants and animals.
      - A decomposer consumes plant and animal waste, a step that returns nutrients to the soil (fungi, bacteria).
      - A scavenger is an animal that eats dead plants and animals.
- Owls are consumers who are carnivores.
    - Owls and their prey are part of a food chain
    - Owls are predators that eat carnivores, omnivores, and herbivores.

- Owl pellets show what an owl eats.
  - Owls have a physical mechanism for producing a pellet.
  - Bones inside the pellet can be identified.
  - Decomposers will break down a pellet once it is regurgitated.
- Based on the contents of the owl pellet (and what we can find out about its prey), we can begin drawing a food web of the owl's ecosystem. (For example: grass, vole, owl; grass, insects, shrew, owl)

- Living things interact and depend on each other.

- Living things compete with each other within an ecosystem.

Teacher Background:

The flow of energy and matter through an ecosystem is called a food chain. The combination of several interconnected food chains in an ecosystem is called a food web. To determine the place of an owl in a food web, a scientist looks at what an owl eats, and asks "Is the owl an herbivore, carnivore, or omnivore?" A scientist can tell what an owl ate by looking at the owl pellets that the owl regurgitates. By looking at the bones in an owl pellet, a scientist can tell if the owl ate an herbivore or a carnivore by identifying the skulls in the owl pellet. Carnivores and herbivores have different teeth structures that are adapted for the type of food they eat.

Rodents, like the vole, have a pair of upper and lower incisors (front teeth). These teeth are long and curved and continue to grow throughout a rodent's life. The presence of grinding molars (teeth in the back) and no canines indicate that the vole is an herbivore. Herbivore teeth have a space between the incisors and the molars (called the diastema).

Carnivores require a more stable jaw with upper and lower teeth which fit closely together for grasping and tearing meat. They have a fewer number of molars than herbivores. Shrews and moles, both insectivores, have many small pointed teeth with very little difference between the incisors, canines, and premolars. As specialized carnivores, their teeth help them to break into the hard exoskeletons of insects.

The figures below provide numbers of prey of a Barn Owl's general diet, based on 100 skulls found in owl pellets. The numbers of prey species vary according to the time of the year, type of ecosystems, and populations of prey and predators.

	California	Oregon	Washington	Texas
Rats	2	1	1	32
Voles	50	58	55	2
Mice	32	20	30	40
Shrews	1	11	5	15
Mole	1	1	1	1
Gophers	9	7	6	4
Rabbits	1	1	1	3
Birds	4	1	1	1

Data from: *Resource Manual for Owl Pellet Labs* by James P. Key

How Owl Pellets Are Formed[1]

Birds (including owls) do not have teeth, so they cannot chew their food. Birds swallow their food whole or tear it into small pieces to swallow.

Unlike seed-eating birds, owls do not have a crop (a sac in the esophagus that can hold swallowed food before it enters the stomach)[2]. In owls, the food goes down the esophagus directly into a two-part stomach. The first part of the stomach is glandular and has enzymes that digest (break down) soft tissue. The second part of the stomach is muscular and is called the *gizzard*[3].

The swallowed food enters the glandular stomach where the soft tissue is digested, but the bones, feathers, and hair are not digested. The food then moves into the muscular gizzard, which pushes the digested soft tissue through to the intestine (to be absorbed as nutrients into the blood stream) and retains the indigested bones, feathers, and hair. The muscles of the gizzard then compress the indigested food into a pellet (that is the shape and size of the gizzard). This pellet is eventually pushed back up into the glandular stomach, and (after a few hours) regurgitated (coughed up).

After a pellet is formed, but before it is regurgitated, the owl cannot eat because the pellet partially blocks the digestive tract. It must wait for the pellet to be expelled. Owls usually wait to cough up their pellets at their home roost. Consequently, when you find a pile of owl pellets at the base of a tree, you know that an owl lives there.

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[1] Based on material in: Lewis, DP (2008) Digestion in owls. *The Owl Pages.* (www.owlpages.com/articles.php?section=Owl+Physiology&title=Digestion) and Warhol, T (2008) *Animal Ways: Owls*. Marshall Cavendish Benchmark. Tarrytown, New York.

[2] See www.earthlife.net/birds/digestion.html for more information on bird digestive tracts

[3] Diagram in www.owlpages.com/image.php?image=articles-Owl+Physiology-Digestion-1.5

Owls tend to eat their food whole, whereas other birds of prey usually tear their food into small pieces, thereby avoiding most of the feathers and hair. Hawks and eagles also regurgitate pellets, but the pellets are small because hawks and eagles have very acidic enzymes in their glandular stomachs, which can partially digest the feathers, bones, and hair that they might swallow.

Grade 4 Science Framework — Life Science

"Food chains and food webs represent the relationships between organisms (i.e., which organisms are consumed by which other organisms). Generally, food chains and food webs must originate with a primary producer, such as a plant that is producing biomass. Herbivores and omnivores eat the plants; carnivores (secondary consumers) in turn eat the herbivores and omnivores." (*Science Framework for California Public Schools: Kindergarten Through Grade Twelve, 2003*)

Materials Needed for the Lesson:

Owl pellets may be obtained from the following sources (other sources may be found by searching the web for other websites that feature owl pellets):

- Genesis, Inc., PO Box 2242, Mount Vernon, WA 98273; 1-800-473-5538; www.pellet.com
- Nature's Classroom, PO Box 546, Garden Valley, CA 95633; www.owlpellets.com
- Discount Owl Pellets, 11317 North East 87th Ave, Vancouver, WA 98662; 360-573-5327; www.discountowlpellets.com

NOTE: Because most owl pellets are fumigated to kill insects, the owl pellets should be allowed to "air out" for several hours or overnight in a well ventilated place that is away from animals and small children and out of the weather.

Most commercially bought owl pellets will contain voles and/or mice (herbivores). It is rare to find skulls of moles or shrews (carnivores – insectivores) even when pellets are collected in the "wild". However (depending on the ecosystem) gophers may be more readily found in owl pellets found in the "wild".

OPTIONAL: The day before doing owl pellet activity, have students read the "Introduction to Owls and Owl Pellets" in the *Resource Manual for Owl Pellet Labs* by James P. Key (this manual can be purchased from Obtain from Acorn Naturalists; 1-800-422-8886; www.acornnaturalists.com for $17.95.

Teacher Materials

- Transparency of "Identifying Animals Found in Owl Pellets" (charts and illustrations from "Elementary Owl Pellet Pak" by Genesis, Inc. 1-800-473-5538)
- Skulls — herbivore (e.g., deer, cow, horse, beaver) and carnivore (e.g., fox, Mt. Lion, mink, otter); optional: omnivore (e.g., brown bear; raccoon) (borrow from museum, high school, or college).

Student Hands-on Materials

- If possible, get enough skulls (one herbivore and one carnivore) for each group of students.
- Hand lenses
- (1 per set of partners): Owl pellet, tweezers, extra long toothpicks, latex gloves, paper plate, Zip-lock bags

Student Handout

- "Owl Pellet Dissection Results"
- "Identifying Animals Found in Owl Pellets"
- Optional: Provide a copy of the background information in this lesson "How Owl Pellets Are Formed" for students to read.

5E's TLC Lesson: Owl Pellet Contents

Teacher Does	Student Does	Concept
ENGAGE: If available, provide one herbivore and one carnivore skull to each group of students. Otherwise have students come to the table where you have a variety of animal skulls displayed. ▸ *What do you observe about the skulls in front of you? Remember that observing is more than looking, it is noticing details.* Hold up one herbivore and one carnivore skull: ▸ *How are they the same and how are they different?* ▸ *Let's focus on the teeth: how are they the same?* *How are they different?*	**Expected Student Response (ESR):** They are both skulls, they have teeth, they are white, they have cracks. **ESR:** Different sizes, different shape **ESR:** One set of teeth is flat in the back and the other is sharp and pointy in the back.	Carnivores and herbivores have different teeth structures that are adapted for the type of food they eat.

Teacher Does	Student Does	Concept
▸ *What could teeth tell you about what an animal eats?* ▸ *Who can tell me something they know about owl pellets?* ▸ *Turn to your partner and tell how you think we can tell what an owl eats.*	**ESR:** Maybe whether they eat plants or animals. **ESR:** When an owl eats its prey, the bones are compressed with the hair & fur and the ball is spit up by the owl. **ESR:** We could look at the skulls in the pellet.	
EXPLORE: ▸ *Today you will explore the contents of an owl pellet.* ▸ *You and your partner will each receive an owl pellet, gloves, a paper plate, tweezers, and a toothpick.* ▸ *You will carefully break apart the pellet and look for skulls in the pellet. Take out the skull or skulls and set them aside on the paper plate and save the rest of the pellet and its contents by putting them into a zip-lock baggie.* ▸ *Use your tools to carefully clean off the skull or skulls. You most likely find that your skulls have become separated. The top part of the skull is the cranium and the bottom part is called the mandible. Each skull has a left and right mandible.* Show the mandibles using a skull from the skull collection. Ask students to turn to their partners and describe the directions. Distribute the owl pellets and tools for dissecting the pellets. ▸ *Use a hand lens to carefully observe the skull and draw it in your notebook.* Show the transparency "Identifying Animals Found in Owl Pellets" and distribute a handout to students. ▸ *Use "Identifying Animals Found in Owl Pellets" sheet to identify the skull you found. You will identify and record what kind of animal you have in the "Prey Found" box at the upper left side of your paper.* Point to the box on the overhead.	**ESR:** Students share directions. **ESR:** Students break apart pellet and find skulls. Separate the skull or skulls and put remaining contents in the zip lock baggie. They draw the skull(s).	The contents of an owl pellet can be used to identify what the owl has eaten.

Teacher Does	Student Does	Concept
▸ *Let's look at the kinds of animals that might be found in an owl pellet. Who thinks they have the skull of a vole? Who thinks they have a skull of a pocket gopher? What is your determining factor for deciding what animal the skull is?*	**ESR:** Because the skull is small.	
▸ *Is it the size of a rat or a gopher or the size of a field mouse (vole)?*	**ESR:** It is very small.	
On overhead, point to Class Findings and record Class Findings of skulls on the chart.		
NOTE TO TEACHER: Most commercially bought owl pellets will contain voles and/or mice (herbivores). It is rare to find skulls of moles or shrews (carnivores – insectivores).		
Show the skull of an herbivore (e.g., horse).		
▸ *What does this animal eat?*	**ESR:** Grass, other plants.	
▸ *Does anyone know what animals are called that eat only plants?*	**ESR:** No; vegetarians; herbivores.	
▸ *Animals that eat only plants are called herbivores.*		
Write "herbivore" on the board.		
▸ *Does anyone see a familiar word that would be a clue that these animals eat only plants?*	**ESR:** Herb	
▸ *What are herbs?*	**ESR:** Herbs are those plants (like basil, oregano) that are used in cooking (like in a spaghetti sauce).	
▸ *What do you notice about the teeth of this animal?*	**ESR:** There is a big gap between the front long tooth and the back teeth. The back teeth are (basically) flat on top.	
▸ *Using your hand lens look at the teeth of a skull you found in your owl pellet. What do you notice? Are these teeth similar or different from this large skull of an herbivore? (Are they sharp & pointy or are the teeth in the back flat on top? Is there a gap between the front and back teeth?)*	**ESR:** Similar. There is a big gap between the front long tooth and the back teeth. The back teeth are (basically) flat on top.	
Show a few carnivore skulls (mountain lion, etc.).		
▸ *What does a mountain lion eat?*	**ESR:** Deer, rabbits	
Point to the canine teeth.		
▸ *Describe these teeth. What do these teeth do?*	**ESR:** They are sharp and pointy. **ESR:** They tear meat.	
▸ *What are animals that eat mostly meat*	**ESR:** Carnivores	

Teacher Does	Student Does	Concept
called? ▸ *Animals that eat mostly meat are called carnivores.* ▸ *How are these teeth similar or different to the teeth in the skull you found in the pellet?* ▸ *Did any of you find a skull of a carnivore? Use a magnifying lens to look at the skulls found in the owl pellet. The carnivores that could have been there are actually insectivores (they eat insects) and they include moles and shrews.*	**ESR:** Different. The teeth in our skull are not pointy. **Note that it is possible for students to find a mole or shrew and in that case the teeth would be similar to that of the large skull of a carnivore.**	
EXPLAIN: ▸ *Remember when we compared these two skulls* (show examples of herbivore and carnivore) *we noticed the kind of teeth each animal uses to eat its food. What did you notice about the teeth in the skull you found? Describe to your partner what type of teeth it has.* ▸ *Turn to your partner and tell how you think we can tell if an owl eats herbivores, carnivores, or both?* ▸ *Are owls herbivores or carnivores? How do you know? Do you know this because of the "teeth" that owls have?* ▸ *Is there more than one way to find out whether an animal is an herbivore or a carnivore?*	**ESR:** There is a big gap between the front long tooth and the back teeth. The back teeth are (basically) flat on top. **ESR:** We can look at the teeth of the skulls found in the owl pellets. **ESR:** Carnivores because they eat meat – mice and stuff like that. **ESR:** No. Owls don't have teeth. **ESR:** Yes, you can look at what they eat.	
EVALUATE: ▸ *Look at your owl pellet skulls and decide whether your rodent (vole) is an herbivore or a carnivore and explain your reasoning.* Provide each student with a copy of "Owl Pellet Dissection Results" and ask them to complete it. ▸ *When finished looking at the skull(s), place it (them) into the baggie with the rest of the owl pellet.* ▸ *Could owls become herbivores? Why or why not?*	**ESR:** Students carefully look at the skull from the owl pellet and determine if it is a carnivore or an herbivore. Complete final assessment.	Carnivores and herbivores have different teeth structures that are adapted for the type of food they eat.

Teacher Does	Student Does	Concept
EXTEND: Have students separate and identify the rest of the bones from the owl pellets. Have students research what the owls' prey eat. Then have students make a food chain using the owl and the prey found in the owl pellets. Ask students to draw a food web which includes owls and its prey. From the "Teacher Background" provide data to students about a Barn Owl's general diet in various states in the US. Have students develop a graph of the data. Have students discuss in groups: If an owl could not find any voles to eat in its habitat, what could it do? Discuss with your partner what you think would happen to owls if voles were poisoned in the owls' habitat.	**ESR:** The owl could eat other small animals that are found in its habitat or fly to another area that might have the food it needs. **ESR:** The owls may die if they eat the poisoned voles; or the owls may eat other animals or fly somewhere else to find food.	

Input Question: Locate skulls in an owl pellet.

Process Question: Compare the teeth of an herbivore to a carnivore.

Output Question: Discuss what you think would happen to owls if voles were poisoned in the owls' habitat.

STUDENT HANDOUT

Owl Pellet Dissection Results

Was the skull you found in the owl pellet an herbivore or a carnivore?

_____

Explain how you know:

_____

_____

_____

_____

_____

Name: _____

STUDENT HANDOUT

Owl Pellet Dissection Results

Was the skull you found in the owl pellet an herbivore or a carnivore?

_____

Explain how you know:

_____

_____

_____

_____

_____

STUDENT HANDOUT

Identifying Animals Found in Owl Pellets

The best way to identify prey found in an owl pellet is to look at the skull that you find present. Compare your skull with the skulls below.

What was in your pellet?

Number of skulls or pairs of jawbones found in your owl pellet._____

Prey Found	Numbers

Class Findings

Prey Found	Vole	Mole	Shrew		
TOTALS					

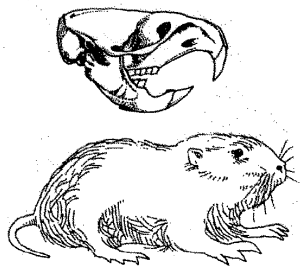
Total number prey items found _____

Total number of pellets dissected _____

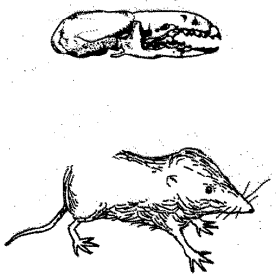
Average number of prey items per pellet _____

1. Vole (Field Mouse)

2. Pocket Gopher

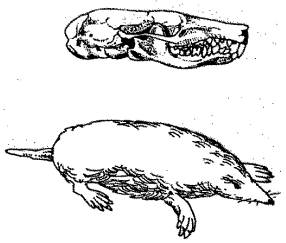


3. Shrew



4. Rat

5. Mole



6. Bird