

THINKING AND ACTING
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TEACHER'S GUIDE

Matter and Energy Flow in Ecosystems

What can we discover about the cycling of matter and energy in an ecosystem by exploring owl pellets?

GRADE 5

Life Science





Matter and Energy Flow in Ecosystems

Grade Level/Content	5/Life Science
Lesson Summary	Students will explore owl pellets to collect and present evidence about how matter and energy flow through ecosystems.
Estimated Time	3, 45-minute class periods
Materials	1 Large sorting mat for each team, 1 owl pellet per team, a variety of tools to dissect the owl pellet (probes, sharpened pencils or forceps, rubber gloves, magnifying lens); paint brushes (optional), rubber gloves (optional), magnifying lens, owl pellet identification keys, Investigation Plan , journal
Secondary Resources	Female barn owl regurgitates pellet - YouTube Video Barn Owl reading The Diet of Owls reading All about Owl Pellets reading Owl pellet identification keys <i>Who Goes There</i> by Jennifer Dricsson <i>White Owl, Barn Owl</i> by Nicola Davies
NGSS Connection	5-PS3-1 Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. 5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
Learning Objectives	<ul style="list-style-type: none"> • Students will describe the relationship between predators and prey after observing direct evidence of prey species consumed by an owl. • Students will provide an explanation of how matter and energy are cycled within the owl's ecosystem. • Students will develop models to describe the cycling of matter and energy within ecosystems.
Cross-Curricular Project Connections	<ul style="list-style-type: none"> • Of Mice and Men; Exotic Snake Invasion

What can we discover about the cycling of matter and energy in an ecosystem by exploring owl pellets?

While almost all food energy can be traced back to the sun and the source of all matter contained within living organisms can be traced back to air, water, and decomposed materials in soil, the concepts of matter and energy cycling can be difficult for students to conceptualize. Providing students with opportunities to directly observe a step in the cycling of matter is a powerful strategy to support understanding of this phenomenon. Owl pellets provide direct evidence of relationships between a top predator and its prey species. In this lesson, these relationships come to life through the construction of a model describing the cycling of matter and energy within the owl's ecosystem.

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science.

In all investigations:



Students don't know the "answer" they are supposed to get.



Students play a driving role in determining the process for learning.



Teachers and students construct meaning together by journaling.



Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Obtain owl pellets for use by groups of students. Due to the detailed nature of this work, and how easy it would be for students in larger groups to sit back and let other students do the majority of the work, we encourage you to obtain enough materials to allow students to work in pairs. Review the [Investigation Plan](#) to identify strategies to ensure success within your classroom setting.

Obtain the following materials for each student group.

- 1 sorting mat (can use a large piece of white construction paper)
- 1 owl pellet
- Tools to dissect an owl pellet (probes or sharpened pencil, forceps, rubber gloves, magnifying lens)
- Paint brushes (optional)
- [Owl pellet identification keys](#)
- [Investigation Plan](#)
- Journal

Notes: The sorting mat keeps the contents of the owl pellet contained and provides an organized way to group similar items. Other sorting mat options include a [PDF download available for a nominal fee from Lighthouse Educational Products](#) or a [laminated, reusable option from Carolina Biological Supply Company](#).

There are a variety of sources for owl pellets including [Carolina Biological Supply Company](#), [Pellets Inc.](#), and [Pellet.com](#).

Your students will need identification keys for common items found within owl pellets. You can get everything you need from the [Carolina Biological Supply Company "All About Owl Pellets"](#) page. Scroll down to the five bone charts near the bottom of the page.

Part 2

INVESTIGATION FACILITATION



Question

Introduce the investigation question.

What can we discover about the cycling of matter and energy in an ecosystem by exploring owl pellets?

CURIOSITY

Choose one of the two suggested texts ([Who Goes There](#) by Jennifer Dricsson or [White Owl, Barn Owl](#) by Nicola Davies) to introduce the role of owls in ecosystems.

OPENNESS TO NEW IDEAS

View the [YouTube video showing a barn owl regurgitating a pellet](#). Identify the materials found in owl pellets. Help students understand the difference between pellets and fecal matter.



Personal Knowledge

Students capture what they know about matter and energy flow.

- Find out what students already know about owl pellets, how organisms get energy, and the differences between omnivores, carnivores, and herbivores.
- Ask students to share their ideas with the class to get kids talking and thinking about these concepts. Record these ideas and encourage students to write them in their journal.

DISCOURSE

Conduct a *Think, Write, Pair, Share* to ensure all students participate. Ask them what they know and give adequate think time. Have them write down at least three things they know. Have them share their thoughts with a partner, then call on a few pairs to share with the class.

RISK-TAKING

Add all ideas, even misconceptions to the class list. If students challenge ideas from their peers, place a question mark next to it and explain that the class will come back to it later in the investigation. Resist telling students that their personal knowledge is incorrect as it is unlikely that they will change their basic understanding of the ideas or concepts being discussed. Instead, confront misconceptions at a time in the investigation that students are directly observing or analyzing data to formulate an explanation that is in conflict with their personal knowledge.



Prediction

Students communicate an expected outcome, based on personal knowledge.

- Have students predict what can be discovered about the cycling of matter and energy by examining owl pellets. Students present the prediction as a *I predict _____ because _____* statement in their journal.
- Have them discuss their predictions with their group partners.
- *Students may write something like, "I predict that observing owl pellets will provide information about the owl's sources of energy and matter because bones in the pellet provide clues of what the owl has eaten."*



Investigation Plan

Students review available materials and determine how to collect qualitative and quantitative data to answer the investigation question.

- Divide students into teams.
- Distribute the following materials to each group of students.
 - [Investigation Plan](#)
 - 1 owl pellet per team
 - Tools to dissect an owl pellet (probes or sharpened pencils, forceps, rubber gloves, magnifying lens)
 - 1 large piece of white construction paper to serve as a sorting mat. Alternatively, you could utilize sorting mats available from a variety of vendors.
 - Owl pellet identification key
- Review materials as a whole class.

INVESTIGATION PLAN MODELING ECOSYSTEM MATTER AND ENERGY FLOW	
1.	Obtain a sorting mat, dissection tools, and an owl pellet from your teacher.
2.	Place the owl pellet on the sorting mat.
3.	Using your fingers and dissection tools, gently pull apart the owl pellet. Rub small pieces of the pellet between your fingers until you have completely taken apart the entire pellet.
4.	Do an initial sort into piles of what you found in your pellet.
5.	Use the keys provided by your teacher to identify the sources of the items found in your pellet.
6.	Record your qualitative and quantitative data in a table in your journal.

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Investigation Plan

Continued

Note: Owl pellets contain highly compacted remains of food eaten by the owl. There is generally a tangled mess of hair that must be teased apart to reveal bones, feathers, and insect shells.

PERSEVERANCE

Discuss how persistence will be helpful for students as they explore the items contained in owl pellets.



Observation

Students record their qualitative and quantitative data observations in a table.

- Have students observe and catalog the items found in their pellet using their sorting mat and identification keys.
- Encourage students to record quantitative (numbers of similar items, etc.) and qualitative data (what the pellet looks or smells like) in an organized way within their journals. Have them determine the design of their own data tables.
- Remind students to determine how they will represent the owl pellet as a drawing in their qualitative observations.

Quantitative Data	Qualitative Data
7 skulls, 1 was a mouse and one was a rat	large pile of gray hair
10 jawbones, 8 jawbones were from mice and two were from rats	leg bones gray
1 wing	rib bones flexible
21 leg bones	some bones are black
24 rib bones	rib bones are smaller than leg bones
1 piece of grass	incisor teeth sharp
1 incisor tooth	grass piece flat and greenish
12 bone pieces	Some bones are soft
	the pellet smells musty

Sample student observations

CONSTRUCTION OF MEANING

After recording their observations, have two or three groups meet to compare their data. Encourage students to ask for assistance from their peers identifying unknown items found within their pellet.

Part 3

INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM



Data Analysis

Students make sense of their data by organizing it and representing it visually.

- Have students analyze their data. They may wish to use the [Data Analysis](#) prompt as a guide.
- Have students **evaluate** their data for trustworthiness. Caution them against assuming that all items found in the pellet come from animals. For items that were not identifiable during the initial sort, encourage students to compare ideas with their classmates and possibly conduct additional research to support the identification of insect or plant materials.
- Then, have them analyze their data to find patterns and trends. They may **organize** the data and/or **represent** it visually to construct meaning. They may use math as appropriate (*total number of identified species or bones, number of skulls, feathers, etc.*).
- Have students **interpret** what the identified patterns or trends mean.
- Ensure they have enough data for use as evidence to support a claim.

CREATIVE THINKING

Having students apply their learning to create a simple, written explanatory model for energy flow using the owl pellet investigation will engage them in higher level thinking and processing. They will use creativity to develop a meaningful visual that makes sense to others.



Secondary Knowledge

Students use secondary sources to understand the species that owls consume.

- Provide copies of the three suggested informational text readings ([Barn Owl](#), [The Diet of Owls](#) and [All about Owl Pellets](#)) to provide additional background and information about the prey species consumed by owls.
- Remind students that they are thinking about the overall ecosystem that the owls live in. As they identify these species, encourage them to also think about the foods that these prey species eat so they can develop a broader understanding of the cycling of matter and energy within the owl's ecosystem.

COLLABORATION

Conduct an *Expert Jigsaw* with expert groups assigned to each informational text or additional online resource you identify for student use. After expert groups read their provided materials and review with student peers, regroup students in a collaborative group (consisting of one student from each expert group) and ask students to share their understanding of the subject matter from the expert group resource.



Explanation

Students write a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from the analyzed data to write an explanation that answers their investigation question. Students may wish to use the [Explanation](#) prompt as a guide. Have them write their claim in their Lab Journal.
- Have students develop a **Claim** to answer the question: What can we discover about the cycling of matter and energy in an ecosystem by exploring owl pellets?
- Then, have them add **Evidence** (the analyzed data) to support their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned by exploring secondary knowledge sources.

Claim

I claim an owl eats small rodents like mice and rats for the matter and energy it needs to live. The matter and energy from the mice and rats was provided by plants and smaller animals that they ate.

Evidence

My evidence is I found mostly rodent bones in my owl pellet (1 mouse skull, 1 rat bone, 8 jaw bones of mice, 2 jaw bones of rats, 3 teeth, 21 rib bones, 20 leg bones, and 8 bone fragments).

Reasoning

Investigation: *I am very confident my investigation was a fair test. I followed the plan very carefully and did not skip any steps. I took a long time to dissect the owl pellet, so I think I found everything in it. We also checked with the other groups in our class who made similar observations.*

Science: *The science articles I read back up my claim. They indicated that owls eat a variety of animals like mice, rats, voles, smaller birds, and insects. The animals that were eaten by the owl also ate smaller animals, insects, and plants to obtain the matter and energy they needed to survive.*

- Once the explanation is written, have students discuss their results using a [Present and Defend](#).

Continued

DISCOURSE

Have students conduct a [Present and Defend](#) to develop presentation skills as well as audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning.

Part 4

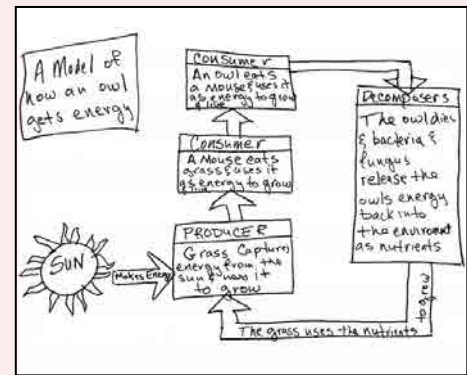
INVESTIGATION ASSESSMENT AND EXTENSION



Application

Students demonstrate understanding by developing a model of the cycling of matter and energy in an owl's ecosystem.

- Have students demonstrate their knowledge by developing a more descriptive matter and/or energy flow diagram modeling how owls get the energy they need to survive.
- Remind students to consider how matter and energy from the owl is cycled back into the environment (possibly by decomposers when the owl dies). In this way, the complete matter and/or energy cycle of an owl can be modeled. See the sample energy flow diagram.



Sample energy flow diagram

STUDENT CHOICE

To provide variety, give students an option of choosing their preferred flow model (energy, matter, or combination of matter and energy).

Assessment

Determine students' understanding and ability to:

- describe the relationship between predators and prey after observing direct evidence of prey species consumed by a predator.
- provide an explanation of how matter and energy are cycled within an ecosystem.
- develop models to describe the cycling of matter and energy within an ecosystem.

Take This Lesson Across the Curriculum

Of Mice and Men

Local farmers and agriculture producers have been using a very effective weed chemical that appears to be having a negative impact on mice populations. Concerned residents have observed that the numbers of large bird predators like owls have also dramatically decreased. Your class has been asked to help communicate this issue with the community by the local chapter of the Audubon Society.

Reading/Language Arts	Math	Science	Social Studies
<p>Town Council Update</p> <p>Your town council is interested in hearing about this issue. Prepare a report to share the impact of lower mouse populations on owls.</p> <p>CCSS.ELA-Literacy.SL.5.4</p>	<p>Whoooo's There?</p> <p>Recent estimates indicate that owl populations have decreased by 225 individuals each of the last three years. If there were 1250 owls three years ago, how many are there today?</p> <p>CCSS.Math.Content.5.OA.B.3</p>	<p>Matter and Energy Flow in Ecosystems</p> <p>Complete this lesson to identify the critical role mice play in the diet of owls.</p> <p>NGSS: 5-PS3-1 and 5-LS2-1</p>	<p>Boom Town</p> <p>Investigate the connection between your rapidly growing town and the push by local farmers to grow more crops to feed an increased regional population.</p> <p>NCSS: D2.Geo.8.3-5</p>

Exotic Snake Invasion

A new snake species has been introduced to the woods and fields of your community as a result of recent floods. This predator loves to eat the same mice, rats, and small birds that make up the majority of the diet for local owls. This has taken a negative toll on the town's tourism economy that caters to bird lovers and photographers.

Reading/Language Arts	Math	Science	Social Studies
<p>Business Roundtable</p> <p>Identify a business role in the community. Share ideas from your business' perspective about the impact of losing tourists due to the decrease in owls and other bird predators.</p> <p>CCSS.ELA-Literacy.SL.5.1.d</p>	<p>It All Adds Up</p> <p>A local outdoor business that depends upon this tourism indicates that it lost $\frac{2}{3}$ of its equipment sales, $\frac{1}{2}$ of its food sales and $\frac{1}{3}$ of its fuel sales compared to last year. What fraction of sales has been lost by this business?</p> <p>CCSS.Math.Content.5.NF.A.1</p>	<p>Matter and Energy Flow in Ecosystems</p> <p>Complete this lesson to describe the impact of a new predator species on a top predator like owls.</p> <p>NGSS: 5-PS3-1 and 5-LS2-1</p>	<p>Snake in the Grass</p> <p>Describe how this natural catastrophe is having a negative impact on the local economy.</p> <p>NCSS: D2.Geo.12.3-5</p>

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.



Empowering Teachers. Engaging Students.

INVESTIGATION PLAN

MODELING ECOSYSTEM MATTER AND ENERGY FLOW

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