Owl Pellet Food Webs: A Model of Energy and Mass Transfer

A Carolina Essentials™ Activity

Overview

You can use this resource as a stand-alone activity or as an extension of an owl pellet dissection. Students use the phenomenon of owl pellets to construct a model food web for barn owls. Using the food web and simple calculations, they track the flow of energy and biomass through the food web, enforcing the concept of matter and energy conservation.

Life Science
Grades: 5–8

Essential Question

How do energy and mass flow through a food web?

Activity Objectives

1. Use owl pellets to model a food web.
2. Calculate energy transfer and biomass at each trophic level of a barn owl food web.

Next Generation Science Standards* (NGSS)

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to describe the phenomenon of energy and matter transfer through a food web.	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level.	**Energy and Matter** • The transfer of energy can be tracked as energy flows through a natural system.

TIME REQUIREMENTS

PREP	ACTIVITY
.25 hr	45–60 min

Teacher Prep: 15 min
Student Activity: **45 min for owl pellet dissection (optional)**
45–60 min for food web activity

SAFETY REQUIREMENTS

MATERIALS (PER PAIR)

For owl Pellet dissection

Owl pellet
Wooden probe
Forceps
Hand lens
Disposable plate, tray, or newsprint to cover the work surface
Gloves

For food web activity

Calculator
Colored pencils (optional)

HELPFUL LINKS

Owl Pellet Explorer Set
Owl Pellet Chart Set
Carolina® Owl Pellet Dissection Mat
Owl Pellet Regional Variation Inquiry Kit
Owl Pellet Dissection Mini-Kit
Owl Pellets
Carolina® Owl Posters

REFERENCE KITS

Owl Pellet Study Kit

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Safety Procedures and Precautions

Individually wrapped owl pellets have been heat sterilized at 250°F for 2 to 4 hours. Use disposable plates or trays as well as large pieces of newsprint under the pellets during dissection to avoid working directly on tables and desks. Be sure students wash their hands thoroughly and sanitize their work area after handling the pellets. You may choose to have students wear disposable safety gloves during the dissection.

Ensure that students understand and adhere to safe laboratory practices when performing any activity in the classroom or lab. Demonstrate the protocol for correctly using the instruments and materials necessary to complete the activities, and emphasize the importance of proper usage. Model proper laboratory safety practices for your students and require them to adhere to all laboratory safety rules. Students may dispose of the pellet contents in the trash after completing the lab.

Teacher Preparation and Disposal

If you conduct the owl pellet dissection, wash and dry the probes, forceps, and hand lens after the dissection. The pellet contents can be disposed of in the classroom trash. Make sure students wash their hands with soap and water and sanitize their work area.

Activity Procedures

Student Procedure

1. Using the information in the overview or the owl pellet dissection results, construct a simple food web for a barn owl. Label the trophic levels and type of consumer. Include the sun as the energy source for plants.

2. A barn owl's diet is about 50% voles, 40% mice, 5% rats, and 5% shrews. Assume the barn owl is regurgitating 2 pellets a day and each pellet contains 4 skulls. Determine the number of each type of animal the owl consumes during a 24-hour period. Use only whole numbers. Place the numbers on the data table. *If you completed the owl pellet dissection, record the actual number and type of animal consumed. Get data from another group to represent the second pellet.

3. Use the diet chart and complete the calculations for the table below

Teacher Preparation and Tips

If you complete the owl pellet dissection first, you may find it helpful to generate several food webs as a class.

Check your students' math as the activity progresses. Remind them of the formula for percentages and how to convert percentages to decimal numbers.

If using dissection data, a single jaw can be counted as a skull.

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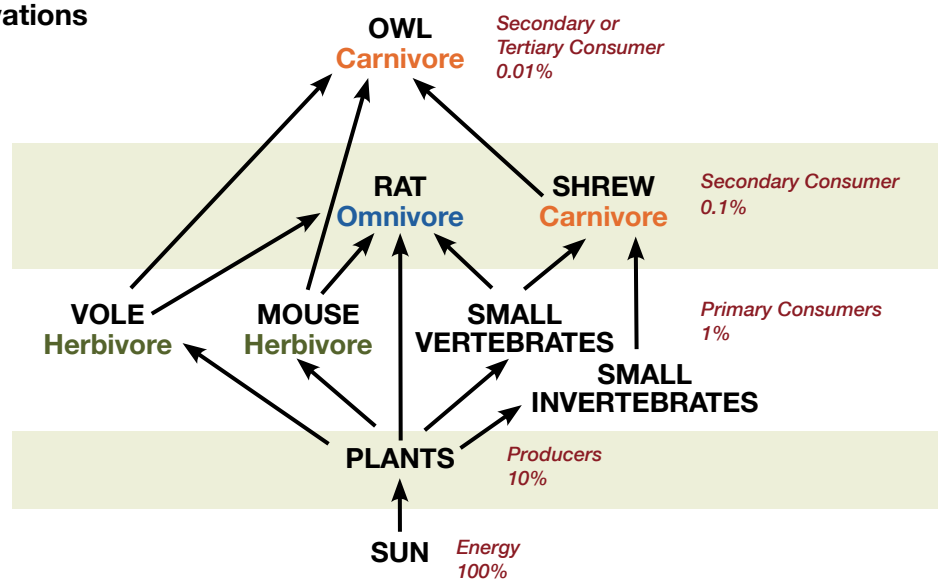
Data and Observations



1. Using the information in the overview or the owl pellet dissection results, construct a simple food web for a barn owl. Label the trophic levels and type of consumer. Include the sun as the energy source for the plants. *See food web above.*
2. Based on the data in the overview, a barn owl's diet is about 50% voles, 40% mice, 5% rats, and 5% shrews. Assume the barn owl is regurgitating two pellets a day and each pellet has four skulls. Determine the number of each type of animal the owl consumes during a 24-hour period. Use only whole numbers. Place the numbers on the data table. **If you completed the owl pellet dissection, record the actual number and type of animal consumed. Get data from another group to represent the second pellet. See the data table below.*
3. Use the diet chart and complete the calculations for the table below. *See the data table below.*

Data

Answers will vary depending on the actual animals selected for the food web.

Barn Owl Food Web					
Animal consumed	Number consumed	Average mass of animal (g)	Total mass (g)	Percentage of diet	Food consumption required
VOLE	*4*	*28 g*	*112 g*	*20.5%*	*112 g*
MICE	*3*	*45 g*	*135 g*	*24.7%*	*20.25 g*
RAT	*1*	*300 g*	*300 g*	*54.8%*	*24.0 g*
SHREW	*0*	*10 g*	*0 g*	*0%*	*0 g*
		Grand Total	*547 g*	100%	*156.25 g*

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Data Analysis

1. What is the total daily mass of food consumed by the owl (grand total)? *547 g*
2. Calculate the percentage of mass each type of animal contributes to the owl's total daily consumption and write it in the table above. See table above.
3. Assume the owl weighs 550 g. What percentage of the owl's body weight did the owl consume? *(547 g / 550 g) x 100 = 99.5%*
4. Use the consumption requirements column in the table above and calculate the mass of food each animal the owl consumed needs to eat. *See table above.*
5. Write the total mass of food consumed at each trophic level on the food web. *Primary and secondary consumers need about 156 g of food daily if shrews are not part of the food web. The owl, the secondary or tertiary consumer depending on the food web, needs to eat about 547 g of food daily.*

Analysis and Discussion

1. Use the food web to identify the pattern in food mass consumed for the primary and secondary consumer trophic level. *With each trophic level, mass consumed increases.*
2. The sun provides 100% of the energy needed by plants. Only 10% of energy is transferred from a lower to higher trophic level. What percentage of the initial energy does the owl receive? Show the calculations. *Answers will vary depending on the food web, but the sun is 100% energy, producer level is 10%, primary consumer is 1%, secondary consumer is 0.1%, tertiary consumer is 0.01%, and so on.*
3. Using the laws of conservation of matter and conservation of energy, how can the pattern be explained? *As an organism obtains food, the mass and energy of the food are used to produce cell growth and maintain cell functions. Waste mass is produced and eliminated by organisms and waste heat energy is often produced and released into the environment. Only 10% of energy consumed at a trophic level is available for consumption at the next higher level.*
4. If an owl were in a setting where it could consume only rats, how would that change the food web, the number of trophic levels on the web, and the percentage of initial energy that is transferred to the owl? *Rats weigh almost 10 times more than the average mouse or vole. Consequently, owls would need to eat fewer rats than they do voles and mice. A possible scenario could be 2 rats daily compared to 8 or 9 mice and voles. Since rats are omnivores, that means the rats would be eating on a higher trophic level. The higher trophic level decreases the available amount of energy again by 90%. If rats are eating herbivores, they receive a total of 0.1% of the initial energy input. If they eat rats, only 0.01% of energy is available.*

TEACHER NOTES