Owl Pellet Biomagnification

Contributors

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Intended Audience

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<td>K-4</td>
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<td>5-8</td>
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<td>9-12</td>
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Activity Characteristics

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<tbody>
<tr>
<td>Classroom Setting</td>
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<tr>
<td>Requires special equipment</td>
<td>X</td>
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<tr>
<td>Uses hands-on manipulatives</td>
<td>X</td>
</tr>
<tr>
<td>Requires mathematical skills</td>
<td>X</td>
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<tr>
<td>Can be performed individually</td>
<td>X</td>
</tr>
<tr>
<td>Requires group work</td>
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<tr>
<td>Requires more than one (45 min class) period</td>
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<tr>
<td>Appropriate for special needs student</td>
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Introduction

Description

Students dissect owl pellets and use a skeleton key to identify prey species and number. Then, given pesticide levels in each potential prey species, students calculate the dose of DDT consumed by their owl.

Abstract

This activity adds depth to the classic owl pellet dissection activity. Students will dissect owl pellets and use a skull and bone key to identify prey species and numbers. Students will then be given levels of DDT that are contained in each prey species as well as a threshold amount of DDT that an owl can consume before her eggs will be unviable. Based on the bones found in their own owl pellets, students will determine whether their owl will be able to produce viable offspring. This activity shows students that even small amounts of contaminants biomagnify as they move up the food chain and exert their harshest effects on organisms at the top of the food chain (like owls and humans!).

Core Themes Addressed

<table>
<thead>
<tr>
<th>Microbial Cell Biology</th>
<th>Microbial Genetics</th>
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<tbody>
<tr>
<td>Microorganisms and Humans</td>
<td>Microorganisms and the Environment</td>
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<tr>
<td>Microbial Evolution and Diversity</td>
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<tr>
<td>Other -specify</td>
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Keywords

DDT, Food chain, food web, human impact, pesticides, pollution

Learning Objectives

At completion of this activity, students will be able to:
1. Define biomagnification.
2. Explain the implications of biomagnification for ecosystems.
3. List several consequences of biomagnification for humans.
4. Describe how human activities affect non-target organisms.
National Science Education Standards Addressed

**Standard A: Science as Inquiry**
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

**Standard C: Life Science**
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

**Standard F: Science in personal and social perspectives**
- Environmental quality
- Natural and human induced hazards
- Science and technology in local, national, and global challenges

**Standard G: History and nature of science**
- Historical perspective
Student Prior Knowledge

In introducing this activity, it is important to inform students about the history of the pesticide DDT and the effects it was found to have on bird eggs and the bald eagle population. Students should also have basic knowledge of tropic levels and food chains. The term ‘biomagnification’ should be introduced and discussed. Owl pellets should be explained thoroughly to students. A common student misconception is that owl pellets are “poop.” Showing pictures of owls and their prey is helpful as well. The importance of owls and other predators in the control of grazing species, especially rodents, and the diseases they carry, is also important. All of this information and photos are included in the accompanying powerpoint presentation.

Teacher Background Information

Owl pellets are the undigestible remains of food eaten by owls which, instead of being excreted with other wastes, are regurgitated through the mouth as a compact mass of hair, bones, teeth, claws, bird's beaks, and chitinous remains of insects. Owls swallow all of their meals completely whole. This means that their pellets contain the entire skeleton of the animals they eat. Therefore, by identifying the bones contained in the pellet, we can tell exactly what an owl has eaten that day. The best way to tell the number of animals eaten and their species is to count and identify the skulls found in the pellet. Owls are top level nocturnal predators and can be secondary or tertiary consumers.

DDT (dichloro-diphenyl-trichloroethane) was a widely used pesticide to control mosquitoes worldwide in the mid-twentieth century. It was later determined that this chemical was biomagnifying and killing off many bird species by causing their egg shells to be too brittle to survive to hatching. Many songbirds went extinct and the American Bald Eagle population dropped dangerously low. The harmful effects of DDT were brought to the attention of the public by Rachel Carson’s book Silent Spring, published in 1962. DDT has since been banned in most countries (including the US), but still exists in storage and is still somewhat extensively used to control mosquitoes in Africa. DDT is now known to be a human carcinogen and likely contributes to neurodegenerative diseases such as Alzheimer’s and Parkinson’s.
**Class Time**

This activity will require a minimum of one 50-minute class period.

1. Introduction powerpoint: 10 minutes
2. Owl pellet dissection and identification of prey items: 30 minutes
3. Calculation of DDT accumulation, conclusions, and discussion: 10 minutes

**Teacher Preparation Time**

This lesson will require approximately 5 minutes of preparation time.

1. Have the owl pellets, dissection equipment, and identification keys ready ahead of time.

**Safety Precautions**

Dissection can really be performed with bare hands. Sharp tools are not necessary. Also, commercially available owl pellets will have been baked in order to kill any pathogens and should be safe to handle, but some students may prefer to wear gloves.

**Materials and Equipment**

1. Owl Pellet (one per 2-4 students- depending on preferred group size)
2. Dissection equipment (not really necessary, but can be used as a vessel to teach dissection techniques if desired).
3. Paper towels to lay down on desks (this can get messy, there is a lot rodent hair in owl pellets).
4. Identification keys (skull photos are the most useful).

**Methods**

1. Place students in groups and have them pull their desks together and spread paper towels over the surface. Pass out ID keys, worksheets, and owl pellets.
2. Instruct students to pick out all of the bones. Look for insect remains. Lay out the bones from the head of each prey animal in an organized fashion as demonstrated on the identification sheet.
3. Walk around and help students use the provided sheets to identify the skulls of prey animals. Be sure that they are getting all of the prey items uncovered. Most pellets will contain the skeletal remains of multiple rodents. Tell the students that there should be no clumps of hair left at all because they might miss something.

4. Record your results.

**Tips/Suggestions**

1. BEFORE they begin dissecting, inform students that it is best to keep bones intact. Stress that intact skulls make identifying prey species much easier and the dissection should be done gently and carefully.
2. Encourage students to lay the skulls they find in the pellets on top of the printed key and identify differences between rodent prey species. For counting number of prey items in the pellet, it is best to simply count the number of skulls discovered.
3. Once students identify and count all of the prey items in their pellet, guide them through the calculation of DDT exposure to the owl and ask them if their owl can have viable offspring.
4. Remind the students to be neat (the pellets contain a lot of rodent hair and can make a mess if this point is not stressed).

**References**

I used owl pellets purchased from Flinn Scientific and ID keys were included in the kit. The biomagnifications component/scenario is original. ID keys can also be found online.


**Extension/Additional Resources**

Places to buy owl pellets (Last accessed: April 23, 2013):

http://www.obdk.com/?gclid=COHUg_qp4LYCFUWo4AodoRgAMg

http://landing.carolina.com/owlpellets?s_cid=ppe_gl_owlpellets_ion&gclid=CNLs7Juq4LYCFQFx4Aod7iMAWw

**Pellets can also often be obtained more cheaply, or even for free, if asked for with enough advance notice from zoos and raptor centers, but may have to be sterilized by the teacher prior to student handling. This is done by wrapping each pellet in metal foil and baking at 400 degrees Fahrenheit for 1 hour.**
**Answers to Student Handouts**

Answers to student handouts will vary with each owl pellet and teachers should walk around the classroom and ensure that students are filling in the worksheets accurately based on their pellet.

**Learning Assessment: Follow Up Questions:**

1. Explain what the term biomagnification means.

   Student answer should explain that biomagnification involves organisms at low tropic levels coming to contain small amounts of a pollutant and then many of them are eaten by one organism at a higher tropic level and this consumer now has a magnified amount of pollutant in its tissues. If an ever higher consumer then eats several of this organism, it will contain an even higher level of pollutant.

2. Why is biomagnification especially dangerous for humans?

   Humans are secondary and tertiary consumers at the very top of the food chain, where biomagnification is at its highest.
Introduction

Owl pellets are the undigestible remains of food eaten by owls which, instead of being excreted with other wastes, are regurgitated through the mouth as a compact mass of hair, bones, teeth, claws, bird's beaks, and chitinous remains of insects. Owls swallow all of their meals completely whole. This means that their pellets contain the entire skeletons of the animals they eat. Therefore, by identifying the bones contained in the pellet, we can tell exactly what an owl has eaten that day. The best way to tell the number of animals eaten and their species is to count and identify the skulls found in the pellet.

Scenario: The animals these owls have eaten have been exposed to the harmful pesticide DDT that causes bird eggs to be too fragile and their babies to not survive. Your job is to calculate how much DDT your owl consumed in one day and to determine whether or not your owl's eggs will be affected by DDT.

Student Background Knowledge

In introducing this activity, it is important to inform students about the history of the pesticide DDT and the effects it was found to have on bird eggs and the bald eagle population. Students should also have basic knowledge of food chains.

Vocabulary

Biomagnification: also known as bioamplification or biological magnification, is the increase in concentration of a substance that occurs in a food chain causing higher trophic levels to be the worst affected by environmental contaminants.

DDT: (dichloro-diphenyl-trichloroethane) is a pesticide that began being widely used to control mosquitoes and their vectored diseases. It was later found to be detrimental to many bird species because it caused their eggs to be too brittle to reach hatching age. DDT is blamed for the sharp decline in the American Bald Eagle population and is now known to be a human carcinogen.
Owl Pellet: Owl pellets are the undigestible remains of food eaten by owls which, instead of being excreted with other wastes, are regurgitated through the mouth as a compact mass of hair, bones, teeth, claws, bird's beaks, and chitinous remains of insects.

Safety Considerations

Dissection can really be performed with bare hands. Sharp tools are not necessary. Also, commercially available owl pellets will have been baked in order to kill any pathogens and should be safe to handle, but you may prefer to wear gloves.

Materials Checklist

<table>
<thead>
<tr>
<th>1 per group (2-4 students)</th>
<th>Owl Pellets</th>
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<tbody>
<tr>
<td>1 per group</td>
<td>Dissection kits (optional)</td>
</tr>
<tr>
<td>2-3 per group</td>
<td>Paper towels</td>
</tr>
<tr>
<td>1 per student</td>
<td>Prey Identification key</td>
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</tbody>
</table>

Procedure

1. Place your owl pellet on a paper towel and gently pull it apart.

2. Pick out all of the bones. Look for insect remains. Lay out the bones from the head of each prey animal in an organized fashion as demonstrated on the identification sheet.

3. Use the provided sheets to identify the skulls of prey animals.

4. Record your results.
Introduction:

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Instructions:

Place your owl pellet on a paper towel and gently pull it apart. Pick out all of the bones. Look for insect remains. Lay out the bones from the head of each prey animal in an organized fashion as demonstrated on the identification sheet. Use the provided sheets to identify the skulls of prey animals. Record your results below.

How many total animals are in your pellet? ________________________________
# of shrew skulls: ________ X 6 micrograms DDT each = _________ micrograms DDT

# of mouse skulls: ________ X 8 micrograms DDT each = _________ micrograms DDT

# of vole skulls: __________ X 5 micrograms DDT each = _________ micrograms DDT

# of songbird skulls: ______ X 12 micrograms DDT each = ______ micrograms DDT

# of insect remains: ________ X 1 microgram DDT each = ______ micrograms DDT

**Total amount of DDT consumed by your owl on this day:** _________ micrograms DDT

An owl that consumes 25 micrograms or more of DDT in one day will lay eggs that are too soft for their babies to survive. Will your owl's babies survive?

**Follow Up Questions:**

1. Explain what the term biomagnification means.

2. Why is biomagnification especially dangerous for humans?