Marine DDT Simulation

Contributors

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Claxton High school, GA

Intended Audience

<table>
<thead>
<tr>
<th>Grade</th>
<th></th>
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<tbody>
<tr>
<td>K-4</td>
<td></td>
<td></td>
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<tr>
<td>5-8</td>
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<tr>
<td>9-12</td>
<td>X</td>
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Activity Characteristics

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

Students will learn how DDT accumulates in an ecosystem.

Abstract

This exercise demonstrates how DDT is passed from one organism and trophic level to another. Topics including biological communities, bioaccumulation, and energy transfer in an ecosystem are covered in this lesson. Students use bingo chips to represent DDT molecules and pass them from organism to organism to answer questions regarding bioaccumulation.

Core Themes Addressed

<table>
<thead>
<tr>
<th>Microbial Cell Biology</th>
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<tbody>
<tr>
<td>Microbial Genetics</td>
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<tr>
<td>Microorganisms and Humans</td>
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<tr>
<td>Microorganisms and the Environment</td>
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<tr>
<td>Microbial Evolution and Diversity</td>
<td></td>
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<tr>
<td>Other –Environmental Science</td>
<td>X</td>
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</tbody>
</table>

Keywords

DDT, Bioaccumulation, Trophic Level

Learning Objectives

At completion of this activity, learner will

1. Describe the movements of toxins within an ecosystem
2. Interpret a trophic pyramid in regards to energy transfer

National Science Education Standards Addressed

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry

Standard F: Science in Personal and Social Perspectives

- Natural resources
- Science and technology in local, national, and global challenges
Teacher Handout

Marine DDT Simulation

Student Prior Knowledge

Students should have a background in ecology with regards to food webs or trophic pyramids.

Teacher Background Information

Thermodynamics dictate an imperfect transfer of energy from one trophic level to the next as you move up the food chain. Only a small percentage of energy is retained from one level to the next. Another phenomenon related to food web dynamics is bioaccumulation. Some toxins, such as mercury and DDT can increase in concentration from one trophic level to the next. The end result is that top predators in the community are disproportionately affected by these toxins.

Class Time

This activity will require a minimum of one 45 min class period.

1. Present lecture on DDT and trophic pyramids. (5 min)
2. Run the simulation (10 min)
3. Record data (10 min)
4. Draw pie chart (10 min)
5. Wrap up questions (10 min)

Teacher Preparation Time

This lesson will require approximately 15 minutes of preparation time.

1. Print out worksheets. 10 minutes.
2. Lay out materials. 5 minutes

Safety Precautions  (none)

Materials and Equipment

Each group will need the following supplies:

1. 50 bingo chips
2. 5 medium styrofoam cups
3. 2 large plastic cups
4. 10 small Dixie cups
5. 1 paper bowl

Methods

1. Instruct some group members to move the chips in the simulation and others to records data
2. When everyone is finished moving chips, fill out table 1.
3. Students then go on to create a trophic pyramid and bar graph during analysis.

Tips/Suggestions

1. Explain briefly how a bar graph works if necessary.
2. You may want to do the analysis questions together.

Answers to Student Handouts

1. Draw a bar graph representing your data
   Answers will vary
2. How does Trophic level affect how much DDT is consumed? In your own words explain how toxins move through the trophic levels.
   Higher tropic level means more DDT consumed, the toxin is passed up the food chain.
3. Create a tropic pyramid using animals of your choice.
   Answers will vary
4. Only 10 percent of available calories are passed from one trophic level to the next. How many calories will be available at the top level if the bottom trophic level begins with 10,000 calories?
   Answer: 10

Example Graph:
Student Handout

Marine DDT Simulation

Introduction

DDT was a commonly used pesticide in the middle of the 20th century. It seemed to be a miracle solution to killing insects. DDT was used heavily on farms to kill crop pests. For decades, the ecological consequences of this chemical were unstudied. Finally in the 1970’s, enough evidence was gathered to restrict the use of this chemical.

Student Background Knowledge

As plants and animals are consumed, each level in the food chain loses 90 percent of the energy contained in each prey item. This inefficient transfer of energy allows for lots of producers and only a small amount of top level consumers. Toxins can also be passed up the foodchain. These toxins can build with each trophic level, reaching very high concentrations in the top predator. This is called bioaccumulation.

Vocabulary

Term1: Producer – Bottom of the food chain, makes energy from sunlight

Term2: Consumer – consumes the producers, gets its energy from producers

Term3: Bioaccumulation – The increase in concentration of a toxin as you move up the foodchain.

Safety Considerations

None

Materials Checklist

<table>
<thead>
<tr>
<th>Item</th>
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</thead>
<tbody>
<tr>
<td>50 Bingo Chips</td>
</tr>
<tr>
<td>10 Small cups</td>
</tr>
<tr>
<td>5 Medium cups</td>
</tr>
<tr>
<td>2 Large cups</td>
</tr>
<tr>
<td>1 Bowl</td>
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Student Worksheet

Marine DDT Simulation

Intro Questions

1. What is DDT?__________________________________________________

2. What animals are most affected by DDT?____________________________

3. Where are birds of prey (hawks, eagles, owls, etc.) located on the trophic pyramid?____________________________

Materials: one set needed for each lab group

50 bingo chips or pasta
10 small cups
2 large cups
1 bowl

1. Label your small cups “plankton”, your medium cups “minnows”, your large cups “eels” and your bowl “Osprey”. Bingo chips will be your DDT molecules trapped inside algae

2. Each of your plankton eat five pieces of algae, each with a molecule of DDT. Move five chips into each “plankton” cup. Also, write this value on the plankton below.
3. Each minnow eats 2 plankton, gaining their toxins. Move chips from 2 plankton cups to 1 minnow cup. Record this new number of toxin molecules on the minnows below.

4. Two eels come along and eat the minnows, along with the toxins the minnows are harboring! Eel #1 eats two minnows, and Eel #2 eats 3 minnows. Again, move the chips to your cups labeled “eels” and record this value on the eels below.
5. Lastly, an osprey swoops down and eats both of the eels. Move the toxin molecules from the eel cups to your final osprey bowl. Record this value on the osprey below.

6. Now, use the numbers you wrote down to calculate the average amount of DDT ingested at each trophic level.

<table>
<thead>
<tr>
<th></th>
<th>DDT Ingested</th>
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<tbody>
<tr>
<td>Plankton</td>
<td></td>
</tr>
<tr>
<td>Minnow</td>
<td></td>
</tr>
<tr>
<td>Eel #1</td>
<td></td>
</tr>
<tr>
<td>Eel #2</td>
<td></td>
</tr>
<tr>
<td>Osprey</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td></td>
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</tbody>
</table>
Analysis Questions

Name_____________________

1. Draw a bar graph of the data you recorded in column A. HINT: put the different animals along the bottom (x-axis) and the DDT amounts on the left hand side (y-axis). Don’t forget a title and axis labels!

2. How does Trophic level affect how much DDT is consumed? In your own words, explain how toxins move through the trophic levels.
3. Create your own trophic pyramid using animals of your choice! Use animals other than the ones in the example and in the lab.

4. Only 10 percent of available calories are passed from one trophic level to the next. How many calories will be available at the top level if the bottom trophic level begins with 10,000 calories?