POLAR TREC
Learning Resources

Details

Completion Time: About one period

Permission: Download, Share, and Remix

Bioaccumulation of Toxins

Overview

Students will use marshmallows to simulate toxins in the environment. Concentrations of these toxins will be modeled and calculated as they bioaccumulate up the food chain. Methylmercury and POPs are substances that bioaccumulate in the Arctic food chain. OASIS scientists studied these in Barrow, Alaska. (See Ocean Atmosphere Sea Ice and Snow (OASIS) Project at www.polartrec.com)

Objectives

After completing this lesson students will be able to:

• Define toxin

• Understand the terms dosage and duration in relation to toxicity

• Model and calculate bioaccumulation of toxins throughout a food chain

Lesson Preparation

1. Print out a student worksheet and student diagram for each student.
2. Print out a set of 10 phytoplankton cards for each group of student. (Use the option for printing 9 wallet size pictures per sheet.) Cut out and place 10 cards in a Ziploc bag for each group of students.
3. Count out 110 marshmallows (10 extra) into a Ziploc bag for each group of students.

Procedure

1. Students will read through the "Background" section of the assignment and write down in their notebooks definitions for:

a. Bioaccumulation
b. Toxin
c. Ingestion
d. Dosage
e. Duration
f. Methylmercury

Materials

- Student Worksheet
- Student Diagram
- SMART Notebook Interactive Lesson
- 10 phytoplankton cards per group of students
- 100 mini marshmallows per group of students (1-2 one pound bags total)
- 2 Ziploc sandwich bags per group of students
- Calculators

g. POPs

2. Discuss the definitions with the students after they finish reading and recording them.

3. Break the students up into groups of 2-3 and hand each of them a set of phytoplankton cards and marshmallows.

4. Point out that the marshmallows are going to represent a toxin concentration of "1".

5. Explain the "Bioaccumulation in the Food Chain" diagram to the students.
a. Point out that in this simplified version of a food chain that phytoplankton is at the bottom and birds and mammals are at the top of the food chain.
b. As you move up the food chain the toxin concentration increases in each organism.
c. On the "Concentration of Toxins" chart, students will record the calculated concentrations from the lesson.

6. If you have a SMARTboard available, you can show these two charts in the "Bioaccumulation_Lesson.notebook file.
a. On page 3 of this file is an interactive lesson where the students can touch each picture in the diagram to flip it over and reveal the concentration of toxin.

7. Work as a whole group with the students to answer questions #1 and #2 on the worksheet and on the "Concentration of Toxins" Chart.

8. Have the students work with their partners on questions #4 and #5.

9. Students may come up to the SMARTboard and check their answers for the concentrations of toxins.

10. You can help the students with the math in question #6 as needed. Show them a one-pound bag of marshmallows so that they can get an understanding of the quantity of toxins being discussed.

11. When the students get to questions #9 and #10 you can start a classroom discussion to help them answer the questions. See answer key.

Extension
The concepts in this lesson can be continued in the "Bioaccumulation WebQuest" Lesson. Students will research bioaccumulation of toxins in their life and in the Arctic.

Resources
N/A

Learning Resources

Assessment
Students will be graded on correct answers according to the answer sheet. I have assigned 3 points for each question that is answered correctly in a complete sentence. The toxin concentration chart receives a total of 10 points. Each line of boxes for the individual organisms is worth 2 points each.

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard C: Life Science
d. Populations and ecosystems

Content Standard F: Science In Personal and Social Perspectives
a. Personal health
b. Populations, resources, and environments

Content Standards, Grades 9-12

Content Standard F: Science In Personal and Social Perspectives
d. Environmental quality
e. Natural and human-induced hazards

Other Standards
N/A

Name_____ Period_____

Bioaccumulation of Toxins-Student Handout

Background:

Bioaccumulation refers to the accumulation of a substance in an organism. If this substance harms the organism it is considered a ***toxin***. A common way toxins enter an organism is through ***ingestion***, or eating food that contains this substance. Toxins are stored in the fat of the organism. The concentration of the toxin that bioaccumulates in an organism depends on several factors. Two of those factors are dosage and duration. ***Dosage*** means how much toxin is ingested; and ***duration*** means over what period of time it is consumed.

Two of the toxins we are going to study are methylmercury and POPs. When elemental mercury (Hg) enters the environment it is converted by bacteria and microscopic organisms into the more toxic organic form called ***Methylmercury.*** ***POPs*** is an abbreviation for Persistent Organic Pollutants. These are chemicals that get into the environment from industrial chemical processes, pesticides and other consumer products. Both Methylmercury and POPs can bioaccumulate up the food chain. These are two of the substances that were studied by scientists in the Arctic as part of the OASIS project (www.polartrec.com).

Purpose:

Students will use marshmallows to simulate toxins in the environment. Concentrations of these toxins will be modeled and calculated as they bioaccumulate up the food chain.

Materials:

Marshmallows, Bioaccumulation in Food Chain handout, Concentrations of Toxin, Phytoplankton picture cards, and calculator

Procedure & Data Analysis:

Follow the directions and answer the questions as you go along.

Each marshmallow represents one unit of concentration of a toxin such as methylmercury or POPs.

Data Analysis Question: Answer in Complete sentences.

Place 10 phytoplankton cards (picture side up) in a line on your desk and put 10 marshmallows on top of each of the phytoplankton cards to represent the intake of a toxin.

1. What is the toxin concentration (how many marshmallows) in each phytoplankton?

Write the concentration from question number 1 into each of the squares under Phytoplankton on the "Concentrations of Toxins" worksheet.

2. If each insect eats 10 phytoplankton. What is the toxin concentration that each insect ingests? (Multiply 10 x answer from question #1)

Write the concentration in scientific notation from question number 2 into each of the squares under Insects on the "Concentrations of Toxins" worksheet.

3. If each small fish eats 10 insects. What is the toxin concentration that each small fish ingests? (Multiply 10 x answer from question #2)

Write the concentration in scientific notation from question number 3 into each of the squares under Small Fish on the "Concentrations of Toxins" worksheet.

4. Each predator fish eats 10 small fish. What is the toxin concentration that each predator fish ingests? (Multiply 10 x answer from question #3)

Write the concentration in scientific notation from question number 4 into each of the squares under Predator Fish on the "Concentrations of Toxins" worksheet.

5. If an eagle or a person ate 10 predator fish in a month, what is the toxin concentration that they would be eating? (Multiply 10 x answer from question #4)

Write the concentration in scientific notation from question number 5 into each of the squares under Birds/Mammals on the "Concentrations of Toxins" worksheet.

6. If each 453 g (1 pound) marshmallow bag contains 826 mini marshmallows, how many bags would you need to show the concentration in a mammal that eats 10 predator fish? (Remember each marshmallow is equivalent to 1 toxin. Plug in the answer from #5 to the equation) Round to the nearest whole number.

$$\left(\frac{Bag}{826 marshmallows}\right)(\_\_\_\_\_\ marshmallows) = \quad \text{Bags}$$

7. If you eat 10 marshmallows (not toxins) are they going to harm you? Explain.

8. If you eat the amount of marshmallows (not toxins) in question #6 how might they affect you?

9. There are many factors that determine how people are affected by toxins. Dosage and duration are two of the factors that were discussed in the introduction to this activity. Explain what that means in terms of eating a predator fish like tuna in your diet?

10. What are some other factors that might make certain people more sensitive to toxins?

Name_____ Period_____

Bioaccumulation of Toxins - Student Handout Answers

Background:

Bioaccumulation refers to the accumulation of a substance in an organism. If this substance harms the organism it is considered a ***toxin***. A common way toxins enter an organism is through ***ingestion***, or eating food that contains this substance. Toxins are stored in the fat of the organism. The concentration of the toxin that bioaccumulates in an organism depends on several factors. Two of those factors are dosage and duration. ***Dosage*** means how much toxin is ingested; and ***duration*** means over what period of time it is consumed.

Two of the toxins we are going to study are methylmercury and POPs. When elemental mercury (Hg) enters the environment it is converted by bacteria and microscopic organisms into the more toxic organic form called ***Methylmercury.*** ***POPs*** is an abbreviation for Persistent Organic Pollutants. These are chemicals that get into the environment from industrial chemical processes, pesticides and other consumer products. Both Methylmercury and POPs can bioaccumulate up the food chain. These are two of the substances that were studied by scientists in the Arctic as part of the OASIS project (www.polartrec.com).

Purpose:

Students will use marshmallows to simulate toxins in the environment. Concentrations of these toxins will be modeled and calculated as they bioaccumulate up the food chain.

Materials:

Marshmallows, Bioaccumulation in Food Chain handout, Concentrations of Toxin, Phytoplankton picture cards, and calculator

Procedure & Data Analysis:

Follow the directions and answer the questions as you go along.

Each marshmallow represents one unit of concentration of a toxin such as methylmercury or POPs.

Data Analysis Question: Answer in Complete sentences.

Place 10 phytoplankton cards (picture side up) in a line on your desk and put 10 marshmallows on top of each of the phytoplankton cards to represent the intake of a toxin.

1. What is the toxin concentration (how many marshmallows) in each phytoplankton?

Each phytoplankton has a toxin concentration of 10.

Write the concentration from question number 1 into each of the squares under Phytoplankton on the "Concentrations of Toxins" worksheet.

2. If each insect eats 10 phytoplankton. What is the toxin concentration that each insect ingests? (Multiply 10 x answer from question #1)

Each insect ingests a toxin concentration of 100 or 10^2.

Write the concentration in scientific notation from question number 2 into each of the squares under Insects on the "Concentrations of Toxins" worksheet.

3. If each small fish eats 10 insects. What is the toxin concentration that each small fish ingests? (Multiply 10 x answer from question #2)

Each small fish ingests a toxin concentration of 1000 or 10^3.

Write the concentration in scientific notation from question number 3 into each of the squares under Small Fish on the "Concentrations of Toxins" worksheet.

4. Each predator fish eats 10 small fish. What is the toxin concentration that each predator fish ingests? (Multiply 10 x answer from question #3)

Each predator fish ingests a toxic concentration of 10,000 or 10^4.

Write the concentration in scientific notation from question number 4 into each of the squares under Predator Fish on the "Concentrations of Toxins" worksheet.

5. If an eagle or a person ate 10 predator fish in a month, what is the toxin concentration that they would be eating? (Multiply 10 x answer from question #4)

In a month each person would ingest a toxic concentration of 100,000 or 10^5.

Write the concentration in scientific notation from question number 5 into each of the squares under Birds/Mammals on the "Concentrations of Toxins" worksheet.

6. If each 453 g (1 pound) marshmallow bag contains 826 mini marshmallows, how many bags would you need to show the concentration in a mammal that eats 10 predator fish? (Remember each marshmallow is equivalent to 1 toxin. Plug in the answer from #5 to the equation) Round to the nearest whole number.

$$\left(\frac{Bag}{826 marshmallows}\right)(\_\_\_\_\_\ marshmallows) = \quad \text{Bags}$$

10^5 marshmallows 121 bags

7. If you eat 10 marshmallows are they going to harm you? Explain.

Ten marshmallows would probably not harm you. They have sugar in them, but the quantity of marshmallows is low. They might affect the health of someone whose body is unable to process sugar or solid food.

8. If you eat the amount of marshmallows in question #6 how might they affect you?

If you ate 121 bags of marshmallows they would affect your health. You might become nauseous, have an elevated blood pressure, become hyperactive, or vomit.

9. There are many factors that determine how people are affected by toxins. Dosage and duration are two of the factors that were discussed in the introduction to this activity. Explain what that means in terms of eating a predator fish like tuna in your diet?

If you ate an average serving of tuna fish (dosage) everyday over a month or a year (duration), you would start to accumulate toxins in your body.

10. What are some other factors that might make certain people more sensitive to toxins?

A person's age, weight, health and even genetics would make them more or less sensitive to toxins. Babies, young children and the elderly would be more sensitive to toxins. People who have an illness or chronic health condition would also be more sensitive to toxins.

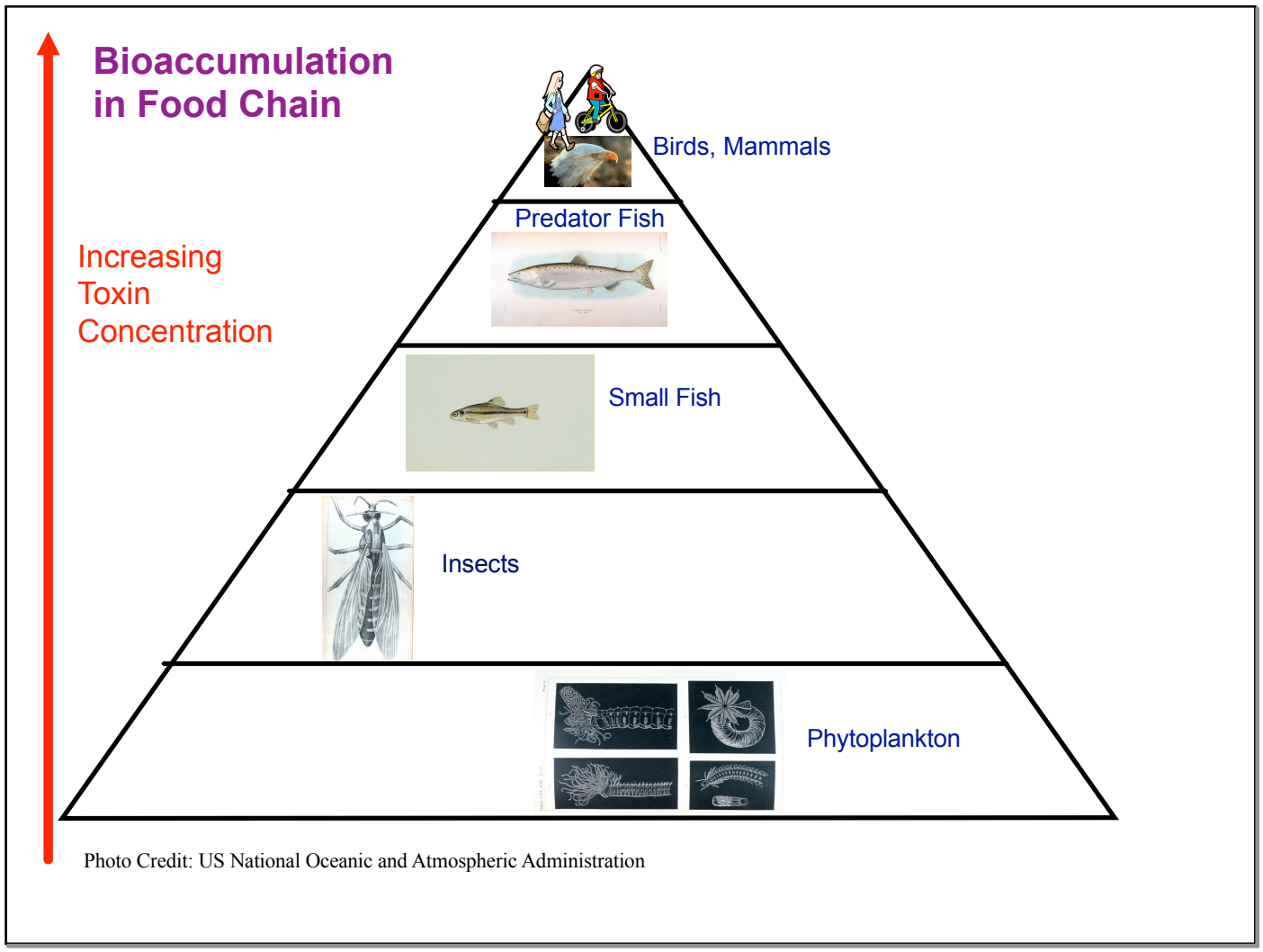
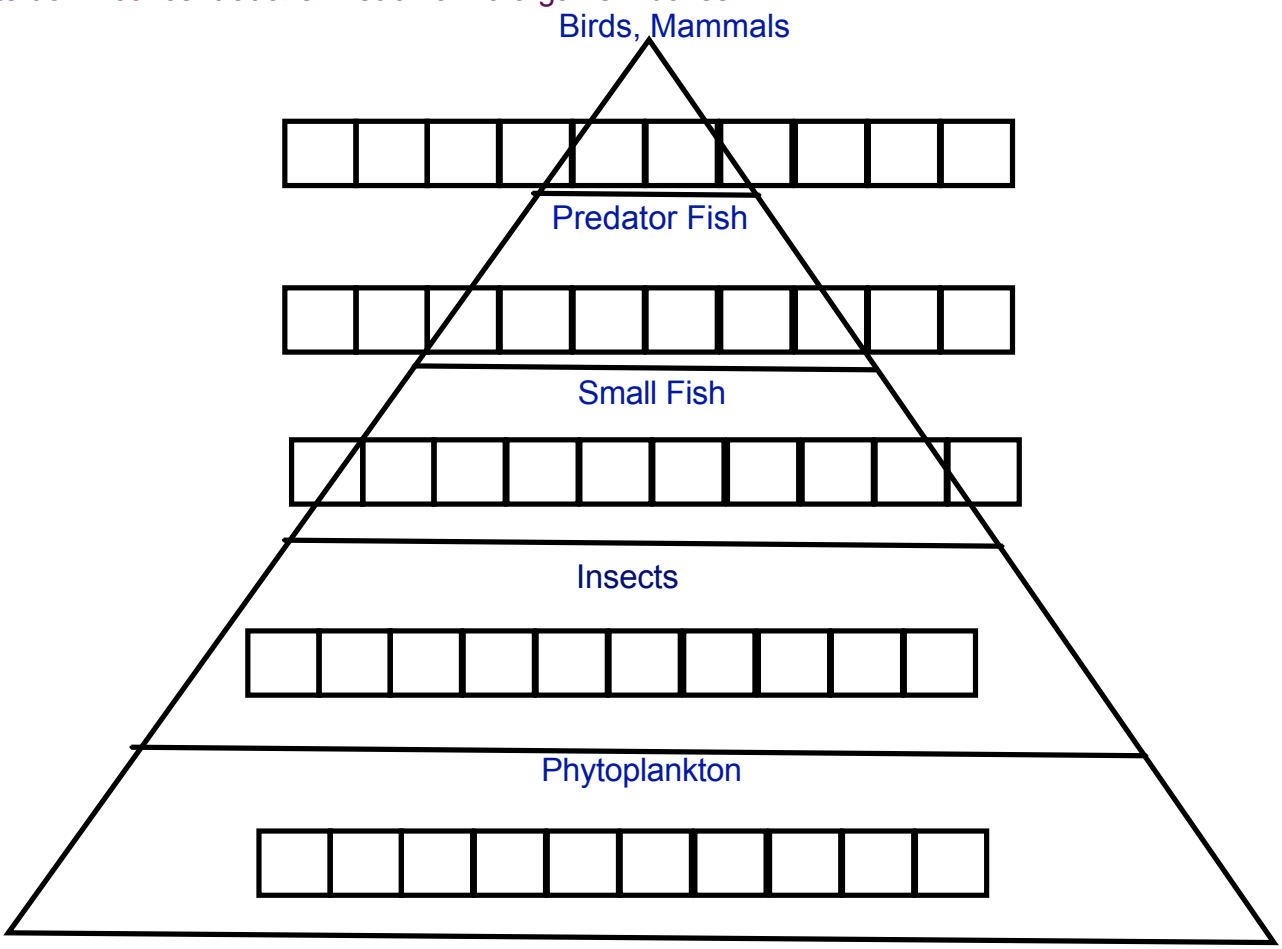


Photo Credit: US National Oceanic and Atmospheric Administration

June 29, 2009

Concentration of Toxins

Write down concentrations in each of 10 organism boxes.



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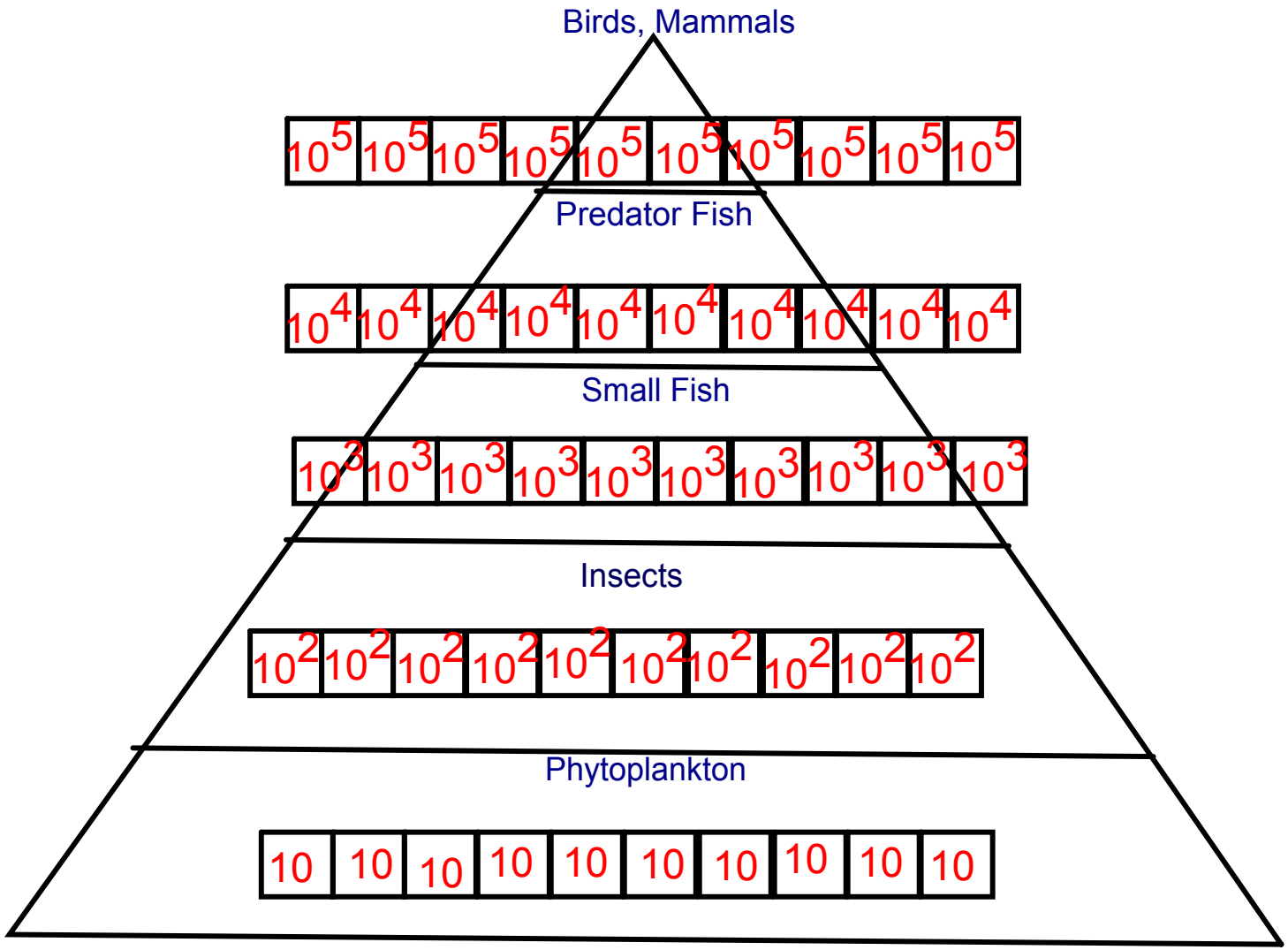

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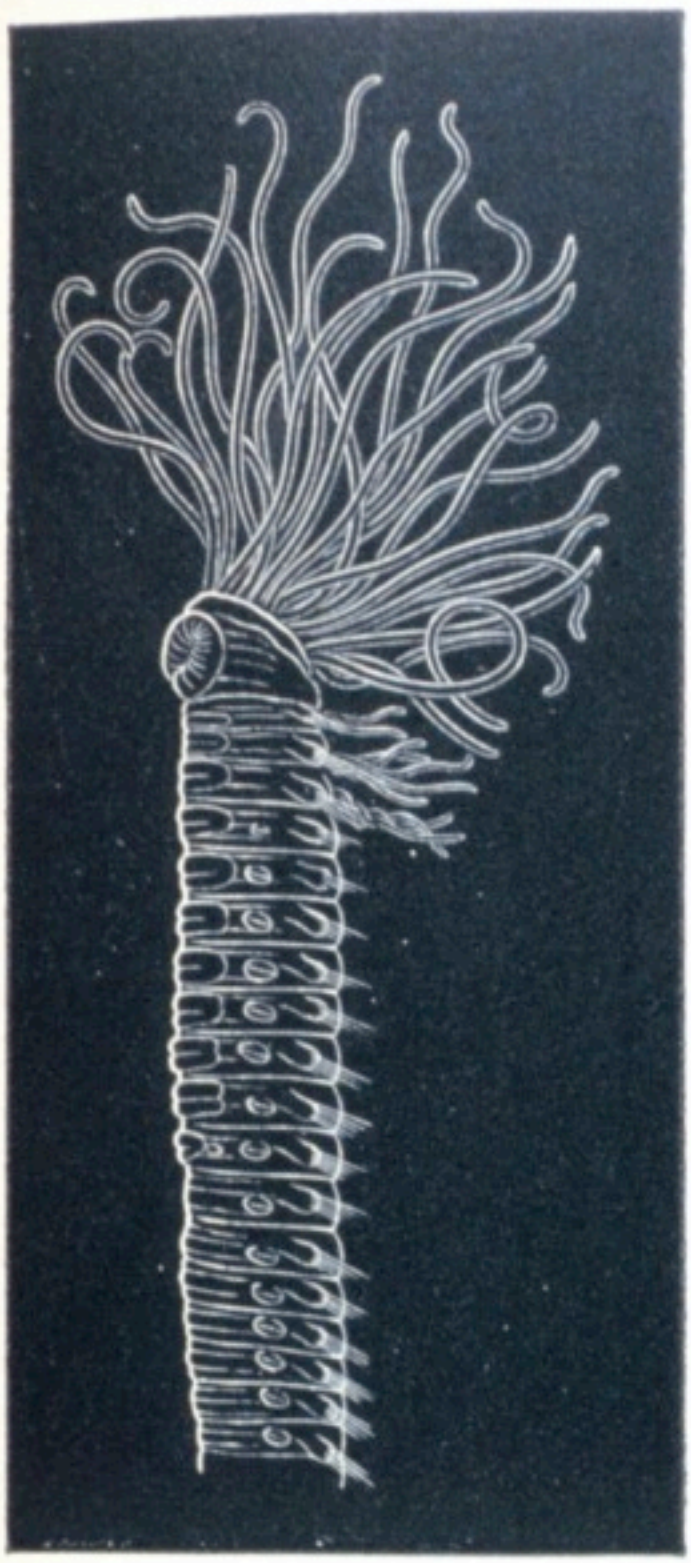

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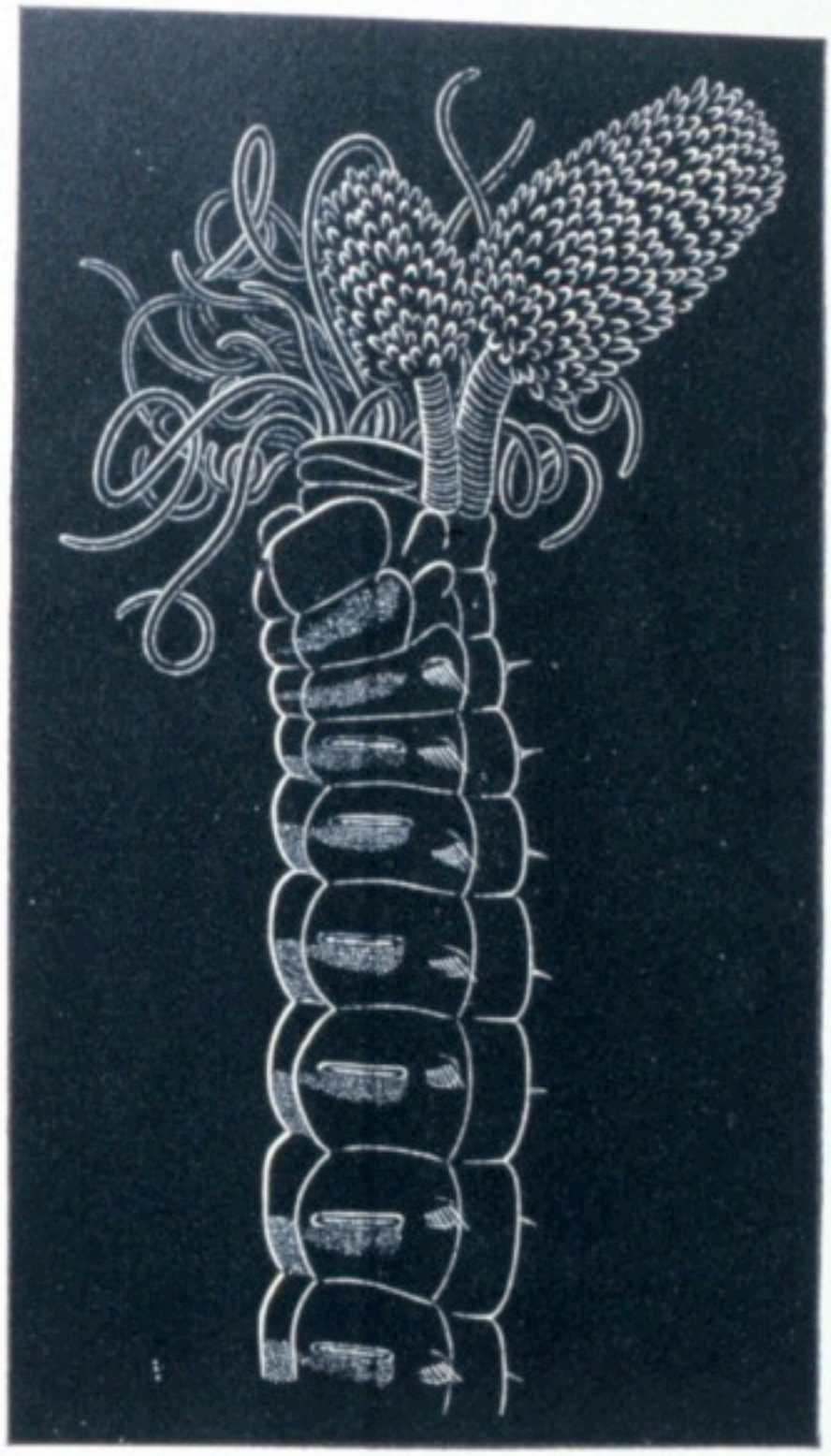

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