

# Who Goes There?

## Estimating Ocean Populations in Chincoteague Bay

### Instructor Notes

**Mathematical Topics:** Quantitative reasoning, ratios, proportions, sum of a series

**Common Core State Standards in Mathematics:**

**Content Standards:**

N-Q.2: Define appropriate quantities for the purpose of descriptive modeling

**Mathematical Practices:**

MP1: Making sense of problems and persevere in solving them.

MP2: Reason Abstractly and Quantitatively

MP3: Construct viable arguments and critique the reasoning of others

MP6: Attend to precision

**Estimated Time for Completion Main Activity:** One 45-minute homework assignment + one 50-minute class period.

**Objective(s):** Estimate the number of individual organisms at a particular trophic level for Chincoteague Bay.  
Extension: Assessing population diversity in Chincoteague Bay.

**Group Size:** This activity can be used as an individual activity or can be completed in groups of 3-4 students. The introduction to the context should be conducted as a whole-class discussion. Students complete Part 1 for homework and then can come back together to work together in groups to compare their answers and continue to work on the rest of the assignment.

**Materials Required:** Each student needs:

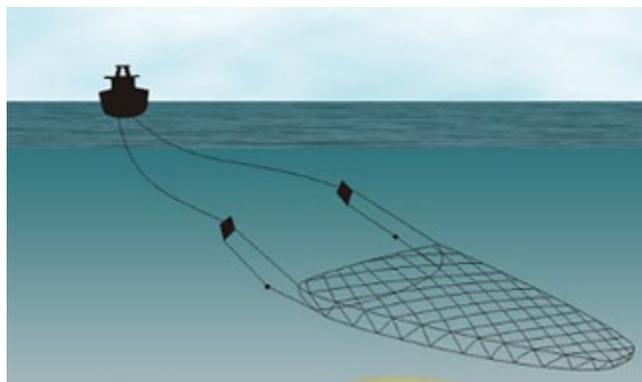
- student handouts (2): Homework Sheet and Activity Sheet
- calculator or computer
- access to the internet

#### Activity Overview

This material introduces students to the food chain in an ocean environment. They are given population data of various ocean species that was collected during an otter trawl in the Chincoteague Bay, VA in May 2014. An otter trawl is a net that has otter boards attached to the sides of the net. The boards pull away from each other while the net is under water so that the net opens in a horizontal direction (see the picture below taken from <http://www.ecomare.nl/en/encyclopedia/man-and-the-environment/fisheries/fishery-techniques/otter-trawling/>).

Using their knowledge of the food chain and data, students are asked to estimate the number of individual organisms at the 4th trophic level of the food chain and then estimate the number of individuals at the 4th trophic level in the entire bay.

After a brief whole-class discussion to introduce the activity, Part I could be completed as a homework assignment. In #1, students are asked to classify each individual organism into its appropriate trophic level using Internet resources. The suggested web sites are listed below:



## Overview of the Food Chain

To help lead the discussion about the food chain or food web, you could ask students the following questions and then provide them with the diagram on the following page.

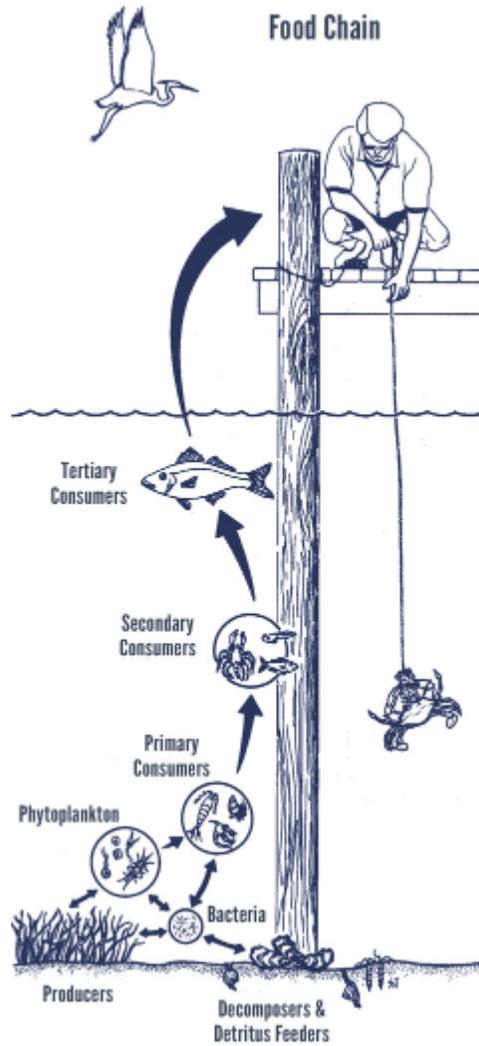
- What do ecologists mean when they refer to the food chain or food chain?
- Where are humans on the food chain?
- Name some of the organisms or animals in the ocean food chain?

After providing students with the diagram on the next page, you can share the following link to a website that describes the food chain more specifically. <http://www.chesapeakebay.net/discover/bayecosystem/foodwebs>  
This website will help students understand the various trophic levels for ocean organisms.

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**Food Chain Diagram of Ocean Life**

Diagram below taken from <http://www.chesapeakebay.net/discover/bayecosystem/foodwebs>



## **The More, The Merrier**

1) and 2)

One way to describe the interaction between the trophic levels in the food chain is to measure the amount of energy flow between the trophic levels. Students are asked to compare their calculated values of energy flow at each trophic level to the Linderman's Law estimates. Lindermann's ten percent law for energy transfer between trophic levels states that only 10-20% of the energy created at one trophic level is available to the next level. They are then asked to use Linderman's Law estimates to estimate the range of values for the 4<sup>th</sup> trophic level population in the sample. This estimate may be larger than the actual animal population values in trophic level 4, but students should consider that there are other factors to consider. For example, for this ecosystem, large mammals may not be so close to the coast. Also the trawl net is not big enough to catch large species and the trawl was conducted in a small range of depths. Other factors to consider could be the impact of fishing which would affect the larger fish populations found in trophic level 4

## **Is Anybody Out There?**

In this part of the activity, students are asked to use the data from the sample and the approximate volume of water sampled to scale up to the bigger body of water, that is, Chincoteague Bay. They will estimate the number of individuals at each of the 4 trophic levels and consider if their estimates are reasonable for trophic level 4. They should again consider the fact that our sample only tells a small part of the story of the sea life in each trophic level in the bay.