Whale Disappearance: A Slippery Slope

Subject: Math

Grade Level: 5th – 8th Grade

Rational or Purpose: This activity introduces the concept of slope, relates mathematics to real life situations, and will raise students' awareness of how whaling affects whale populations.

Materials:
- Graph paper
- Ruler

Lesson Duration: 45 minutes

Source of Lesson: *Hot Science – Cool Talks* CD-ROM # 45: "The History and Future of Whales"

TEKS Objectives:

§111.17. Mathematics, Grade 5.
(3A) use addition and subtraction to solve problems involving whole numbers and decimals;
(3B) use multiplication to solve problems involving whole numbers (no more than three digits times two digits without technology);
(3C) use division to solve problems involving whole numbers (no more than two-digit divisors and three-digit dividends without technology), including interpreting the remainder within a given context;
(3D) identify common factors of a set of whole numbers; and
(3E) model situations using addition and/or subtraction involving fractions with like denominators using concrete objects, pictures, words, and numbers.
(5A) describe the relationship between sets of data in graphic organizers such as lists, tables, charts, and diagrams;
(13A) use tables of related number pairs to make line graphs;
(13C) graph a given set of data using an appropriate graphical representation such as a picture or line graph.

§111.22. Mathematics, Grade 6.
(2A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers;
(2B) use addition and subtraction to solve problems involving fractions and decimals;
(2C) use multiplication and division of whole numbers to solve problems including situations involving equivalent ratios and rates;
(2D) estimate and round to approximate reasonable results and to solve problems where exact answers are not required;
(2E) use order of operations to simplify whole number expressions (without exponents) in problem solving situations.
(12A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models;
(12B) evaluate the effectiveness of different representations to communicate ideas.

§111.23. Mathematics, Grade 7.
(2A) represent multiplication and division situations involving fractions and decimals with models, including concrete objects, pictures, words, and numbers;
(2B) use addition, subtraction, multiplication, and division to solve problems involving fractions and decimals;
(2C) use models, such as concrete objects, pictorial models, and number lines, to add, subtract, multiply, and divide integers and connect the actions to algorithms;

(2D) use division to find unit rates and ratios in proportional relationships such as speed, density, price, recipes, and student-teacher ratio;
(2E) simplify numerical expressions involving order of operations and exponents;
(2F) select and use appropriate operations to solve problems and justify the selections; and
(2G) determine the reasonableness of a solution to a problem.
(11A) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection
(11B) make inferences and convincing arguments based on an analysis of given or collected data.

§111.24. Mathematics, Grade 8.
(2A) select appropriate operations to solve problems involving rational numbers and justify the selections;
(2B) use appropriate operations to solve problems involving rational numbers in problem situations;
(2C) evaluate a solution for reasonableness;
(2D) use multiplication by a constant factor (unit rate) to represent proportional relationships.
(3A) compare and contrast proportional and non-proportional linear relationships;
(3B) estimate and find solutions to application problems involving percents and other proportional relationships such as similarity and rates.
(5A) predict, find, and justify solutions to application problems using appropriate tables, graphs, and algebraic equations;
(5B) find and evaluate an algebraic expression to determine any term in an arithmetic sequence (with a constant rate of change).
(13A) evaluate methods of sampling to determine validity of an inference made from a set of data;
(13B) recognize misuses of graphical or numerical information and evaluate predictions and conclusions based on data analysis.

Background Information:

The international whaling industry grew rapidly after the creation of factory vessels in 1926[1]. In 1931, the number of catches climbed to an historical high. During 1950s and 1960s, catches of Fin Whale were *constantly* kept at high quantity.

The number of catches is inversely related to the number whales. In other words, as the number of whales caught increases, the population of whales in the oceans decreases. Often, the decrease of population follows a trend. In order to recognize the trend of the population, it is very important to understand the concepts of slope.

Slope is used to measure the steepness of an incline or decline of a straight line. The method to measure a slope of a straight line is to divide the change of *y*-value by the change of *x*-value. (If there are only points on a graph, link two desired points with a straight line and follow the same procedure.) Slope is usually represented by alphabet letter *m*. A positive slope represents an incline of the line, and a negative slope represents a decline.

It is important to know that every point on a *straight line* has the same slope. The absolute value of the slope reflects the line's steepness (the greater of the absolute value of a slope, the greater steepness of a line). Slope is sometimes represented by terms such as rate of change, speed, velocity, or other terms that reflect a change of dependent variable in respect to an independent variable.

[1] Clark, C. W. and R. Lamberson. 1982. An economic history and analysis of pelagic whaling. *Marine Policy* 6 (2): 103-120.

Activity:

Engage the students by watching a microdocumentary on *The Secret Lives of Whales* (www.stanford.edu/group/Palumbi/microdocs.html#secret). Then, provide background information about Fin Whale catch records and how to calculate slope. Next, have students plot the data on a graph paper and answer questions.

Procedure:

Presented here is a set of data that describes the number of Fin Whales caught between 1925 and 1979 (Figure 1). Analyze the data and represent it graphically. Name the graph with a suitable title, and set up two axes with proper labels. Plot each point on your graph paper and connect the points with straight lines.

Year	# of Fin Whales	Year	# of Fin Whales
1925	2500	1951	17500
1927	4000	1953	22000
1929	3500	1955	26000
1931	8500	1957	26000
*1932	1000	1959	26000
1933	4500	1961	27500
1935	11500	1963	24000
1937	14500	1965	13000
*1938	26000	1967	3500
1939	19000	1969	3500
1941	7500	1971	3500
1943	500	1973	2500
1945	1000	1975	2000
1947	13000	1977	200
1949	17500	1979	200

Figure 1. The number of Fin Whales caught between 1925 and 1979.
(*) indicates the years with important information that are not included in the regular two-year interval.

1. Slope is measured by dividing the difference in y-axis by difference in x-axis. The equation is:

   $$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x}$$

   Remember the unit to write units along with your calculations. In the case, the unit for the slope would be: _____.

   Use the above equation to calculate the slope between 1931 and 1932, and between 1932 and

1932. Answer question 1 and 2.

2. Read the background information section carefully. Answer question 3 by interpreting what positive slope and negative slope mean.

3. To measure a slope over a time period (rather than consecutive years), connect two points together with a straight line and use the same equation to calculate the slope. Answer question 4.

4. Answer question 5 by calculating the slope between 1955 and 1959. Is it positive or negative? For question 6, try your best to provide a reasonable explanation of the slope.

5. *Social Awareness*. There is a reason to explain the low number of catch between 1943 and 1945. Do you know what major event occurred at that time? Answer question 7.

   There is another huge drop in the number of catch between 1961 and 1967. What happened during that time period? Answer question 8.

6. *Future Prediction.* What do you think will happen in the future? Answer question 9.

Questions: (Show your work for all calculations)

1. What is the slope between 1931 and 1932?

   _____

   _____

   _____

2. What is the slope between 1932 and 1933?

   _____

   _____

   _____

3. What do positive and negative slopes mean?

   POSITIVE_____

   _____

   NEGATIVE_____

   _____

4. What is the slope between 1945 and 1955?

   _____

   _____

   _____

5. What is the slope between 1955 and 1959?

   _____

   _____

   _____

6. Is the slope positive or negative between 1955 and 1959? Give a reasonable explanation of the slope.

_____

_____

_____

7. What historical event caused a significant reduction in the number of Fin Whales caught between 1943 and 1945?

_____

8. What caused the drop in number of Fin Whales caught between 1961 and 1967?

_____

_____

_____

Why does the number of Fin Whales caught remain low after 1967?

_____

_____

_____

9. What do you predict will happen to the Fin Whale population and number caught in the future? Why?

_____

_____

_____

Additional Facts:

From 1943 to 1945, almost all sailing in open oceans was stopped because of World War II. Countries required whaling industries to provide their fleets for military use, so only few ships could travel and whale. Although World War II caused a reduction in the number of whales caught, the whaling industries were able to recover shortly after the end of war. By 1961, the population of Fin Whale began to decrease dramatically, which made catching Fin Whales more difficult. This is reflected on the table by the significant drop in the number of Fin Whales caught.