

Ocean Acidification: Exploring Math Models to Draw Conclusions



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Subject/Grade: Common Core 8

Lesson Summary (1-2 Sentences)

How are you going to share Ocean Acidification with your students? How will this fit into your regular scope and sequence?

Common Core 7: I can share Ocean Acidification as the context to run a simulation on ocean acidification and its impact on coral reefs. We will collect and use the data not only to learn math content standards related to statistics (patterns of association in bivariate data), but also draw conclusions of human impact on the environment.

NOAA's Mission: Awareness of careers related to NOAA's mission (understanding and predicting changes in climate, weather, the ocean and coasts)

The lesson can be connected to careers in oceanography, marine biology, and other research science related fields that use statistical models to make predictions and inform decisions.

Ocean Literacy Education Framework Standards To which standard(s) does your lesson connect most closely?

- 5. The ocean supports a great diversity of life and ecosystems.
- 6. The ocean and humans are inextricably interconnected.

Learning Goals: Make sure to address how your lesson will:

- Involve your students in a [Community Environmental Action](#)
- Use the [Science and Engineering Practices](#)

NGSS Science and Engineering Practices:

- [Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. \(MS-LS2-2\)](#)
- [Analyze and interpret data to determine similarities and differences in findings. \(MS-ESS3-2\)](#)
- [Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. \(MS-ESS3-4\)](#)

Mathematics Standards:

- 8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
- 8.SP.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

- 8.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Mathematical Practices:

- MP.2 - Reason abstractly and quantitatively
- MP.4 - Model with mathematics

At the conclusion of the lesson, students will have to create one of the follow:

1. Write an article for the school or local newspaper/website
2. Write a letter to the editor of a local newspaper
3. Create a social media post to raise awareness of local environmental activities or concerns

Learning goals:

- Collect bivariate data from an experiment.
- Summarize bivariate data in a scatter plot.
- Recognize patterns in scatter plots.
- Determine if a function is linear or non-linear.
- Find a trend line to represent data.
- Use a trend line to make predictions.
- (Extension) Describe association between two numerical variables in terms of direction, form and strength.
- (Extension) Represent functions with tables, graphs, and equations.

Materials/Resources: Of the [hands-on activities](#) explored, which will you use in your classroom?

Ocean Acidification Effects on Coral Reefs by the Oak Ridge Institute for Science and Education.

The materials that may be purchased: 4 cups (per team), acetic acid, water, chalk, timer

Instructional Outline: This should be the bulk of your writing. Bullets of what the students will do throughout the lesson to reach the learning goals you have set.

You may link to the [hands-on activity](#) you will use, but also explain any modifications you might need to make to it, as well as pre- or post- activities you will do with your students around it.

Follow lesson outline provided by the following lesson on Ocean Acidification for one 90 minute class or two minute classes:

<https://orise.orau.gov/resources/k12/documents/lesson-plans/ocean-acidification.pdf>

Modifications:

In addition to the Lesson Objectives, the following Learning Goals will be added if implemented in math classes:

- Collect bivariate data from an experiment.
- Summarize bivariate data in a scatter plot.
- Recognize patterns in scatter plots.
- Determine if a function is linear or nonlinear.
- Find a trend line to represent data.
- Use a trend line to make predictions.

- (Extension) Describe association between two numerical variables in terms of direction, form and strength.
- (Extension) Represent functions with tables, graphs, and equations.

Materials: Instead of supplying student groups with the same four concentrations, provide four to five random acid concentrations for each group from the following percentages: 20%, 30%, 40%, 50%, 60%, 70%, 80%. This will allow the class to create a class scatter plot.

Warm up: In addition to reading the passage and answering related questions, have students sketch three graphs: positive slope, negative slope, zero slope. Have them explain their reasoning.

Results Table: Leave the left column blank. Students will record their given concentration of acid.

Graph: Scale the x-axis (acid concentration) prior to lesson. Scale Time (seconds) as a class. The maximum will be dependent on the longest time for the chalk to dissolve. Have students plot data on a class table and class graph.

Additional (Math) Analysis Questions:

- Based on the scatter plot you constructed, is there a relationship between acid concentration and the time it takes the calcium carbonate to dissolve? Justify your response.
- Does the relationship (if any) appear to be linear or nonlinear? If linear, informally draw a line of best fit.
- Using the linear of best fit, how long would it take a 45% acid concentration to dissolve the chalk?
- How long would it take 0% acid concentration to dissolve chalk? Does this answer make sense?
- How long would it take 100% acid concentration to dissolve chalk? Does this answer make sense?
- (Extension) Would you describe the relationship between acid concentration and the time it takes the calcium carbonate to dissolve as positive or negative?
- (Extension) Would you describe the relationship between acid concentration and the time it takes the calcium carbonate to dissolve as strong or weak?
- (Extension) Does there appear to be any outliers?

Optional: You can have students determine the equation algebraically or by run linear regression on a graphing calculator. Talk about the meaning of the slope and y-intercept in these cases. Examine the correlation coefficient.

Post Activity: Show video on Ocean Acidification to summarize lessons.

What is Ocean Acidification?

<https://www.youtube.com/watch?v=daUQg-WHDIM>

Assessment: How will you check your students' understanding? Check out these [creative assessments](#) if helpful.

At the end of the lesson, have students respond the following prompt:

Problem Statement

You are a doctoral candidate conducting research in a Monterey Bay laboratory in Carmel, California. You have been asked by the National Ocean and Atmospheric Administration to create a mathematical model to determine the impact of acid levels

rising in the ocean. Your clients/stakeholders especially want the mathematics model to have the ability to make multiple predictions. In order to complete this task, you will need to incorporate your knowledge of mathematics statistics, human impact and earth system science. You will also need to demonstrate use of appropriate tools and collaboration. Your clients/stakeholders want a written explanation of your work in the form of a written report or video recording.