



## Education and Research: Testing Hypotheses

# Lesson Plan—Ocean Front Property: An Immerging Market

### Summary

This lesson is designed as an introductory activity to an exploration in global climate change. Students will access real scientific data and follow the scientific method to investigate and compare long-term changes in sea level from different coastal locations around the United States.

### Key Concepts

- Identify questions that can be answered through scientific investigations
- Use ocean observing systems to gather, analyze, and interpret data
- Think critically and logically to make the relationships between evidence and explanations
- Communicate scientific procedures and explanations

### Objectives

Students will be able to do:

- **Locate** ocean observing data using computer skills and the Internet.
- Use spreadsheet software to enter the correct formula and **calculate** the average sea level change for a given location.
- **Generate** a line graph to illustrate sea level trends for a given location.
- **Observe** and **identify** variations in sea level trends across the United States.
- **Develop** hypotheses and inferences to consider in sea level trends.
- **Communicate** results during class discussion.

### Materials

- Sea Level Data (Student copy and Teacher copy) for various coastal locations in the United States.
- Data Instructions Handouts for accessing and importing "Fast" and "Research" Data Sets.
- Computers with Internet access and spreadsheet and presentation software
- Computer projection system

### Procedure

**Background Information** – The article, *Understanding Sea Level Change*, (pdf file) provides background information for this activity.

**Demonstration:** Use the computer presentation system to demonstrate the following:

1. access to and the layout of the Sea Level Trend Data Sheet in spreadsheet software;
2. the procedures for entering the correct formula to calculate the average sea level change for each year in the data set; and

3. the procedures for generating a graph of the Average Sea Level Change.
4. Expectations for completion of the assignment.

**Investigating Sea Level Trends in the United States –** (Students may work independently or in small teams to complete this activity.)

1. **Hypothesis** – Assign each team a location in the United States and instruct them to develop a hypothesis that addresses their prediction on sea level changes for their location.
2. **Procedures** – Students should following the spreadsheet directions provided in the Handout – DATA INSTRUCTIONS
3. **Data Collection** – See DATA INSTRUCTIONS Handout
4. **Data Analysis** –
  - a. Teams should use their completed data table and graph to address the following analysis questions:
    - i. What was the Year and measure recorded for the starting point of your data set?
    - ii. What was the Year and measure recorded for the ending point of your data set?
    - iii. Were there any missing data points in your data set? If so, what period(s) of time was missing?
  - b. Teams should print the completed graph for classroom display and discussion.
5. **Conclusion** –
  - a. Teams should address the following in their conclusion:
    - i. Original hypothesis and prediction
    - ii. Results of sea level changes shown in your data set, including numerical data to support your findings
    - iii. Any anomalies shown in your data set
    - iv. Inferences based on the results of your team’s data and the class discussion

#### Assessment

- **Performance**—Students will demonstrate their ability to use real scientific data to determine current and historical trends in sea level for the United States and to make appropriate inferences that may explain their observations.
- **Product**—Students will use spreadsheet formulas to accurately determine changes in sea level for a given location in the United States. Students will also accurately complete a lab report that follows the scientific methodology used to complete the investigation.

#### Additional Resources

##### Websites:

- <http://uhscl.soest.hawaii.edu/uhscl/data.html>

- <http://tidesandcurrents.noaa.gov/>

#### Information Resources and Tutorials:

- Understanding Sea Level Changes (pdf file)
- Instructions for Working with the Sea Level Activity Data (Fast Delivery Data)
- Instructions for Working with the Sea Level Activity Data (Research Quality Data)

#### National Standards

- National Science Education Standards:  
<http://www.nap.edu/readingroom/books/nses/html/6a.html>
  - Unifying Concepts and Processes:
    - Evidence, models, and explanation
    - Change, constancy, and measurement
  - Science as Inquiry:
    - Understanding of scientific concepts
    - Skills necessary to become independent inquirers about the natural world
  - Science in Personal and Social Perspectives:
    - Populations, resources, and environments
    - Natural hazards
    - Risks and benefits
- Science skills (using the Essential Science Skills grid on the EARTH Web site:  
<http://www.mbari.org/earth/skills.htm>
  - Observatories – Ocean Observations
    - Ask questions
    - Communicates with others
    - Makes predictions
    - Makes inferences
    - Uses evidence to construct explanations
    - Uses charts and tables to interpret or formulate simple hypotheses
    - Analyzes data
    - Draws conclusions
    - Produces written reports of lab or field activities

- Ocean Literacy Standards:
  - <http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf>
  - The Earth has one big ocean with many features:
    - Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools.
  - The ocean and life in the ocean shape the features of the Earth:
    - Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land.
    - Tectonic activity, sea level changes, and force of waves influence the physical structure and landforms of the coast.
  - The ocean is a major influence on weather and climate:
    - The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.
  - The ocean and humans are inextricably interconnected:
    - The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.
    - Much of the world's population lives in coastal areas.
    - Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).
  - The ocean is largely unexplored:
    - New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

## STUDENT HANDOUT – DATA INSTRUCTIONS

1. Open the spreadsheet, "Sea Level Changes" for the location assigned to your team.
2. Find the yearly average sea level value by averaging the January through December values for each year.
3. Create a line chart of your average yearly values.
  - Highlight your yearly values and click on the chart wizard icon in toolbar.
  - Select the *Line chart, Sub-type with data points*. Next.
  - Select **Series in columns**. Under the *Series* tab, click on the icon by the *Category (x) axis labels* and highlight the year's values from your data sheet. Next.
  - Select your chart options. Next.
  - Place your chart as a new sheet. Finish.
4. On your chart, adjust the axis as necessary. Recommend major gridlines every 25 mm and minor tick marks at 5 mm. Reduce the y-axis scale to only what is necessary.
5. Right click on your data line and select **Add Trend line, Linear**. OK.
6. Calculate the average annual sea level change.
  - Approximate the sea level value at the start of your trend line (Start Value)
  - Approximate the sea level value at the end of your trend line (End Value)Subtract the Start Value from the End Value then divide by the number of years. This gives you the average annual sea level change in millimeters.