

# Earth Science Project: Create an Ocean Weather Forecast

Adapted from:

[http://www.coolclassroom.org/cool\\_projects/lessons/earth\\_science/earthscience.html](http://www.coolclassroom.org/cool_projects/lessons/earth_science/earthscience.html)

## Focus on Inquiry

Students will focus on science inquiry by studying data from satellite temperature images and underwater sensors (CTDs) to look for evidence of an upwelling off the coast of New Jersey. Based on this new knowledge, students will use real-time ocean data from the COOLroom to create their own "Ocean Weather Forecast" for the local newspaper.

## Lesson Overview

Students use real-time data to monitor changes to the ocean surface looking for upwelling events. Students will use the data to create a beach day forecast. The Institute of Marine and Coastal Sciences at Rutgers University provides the necessary data.

<b>Duration</b> 5 50-minute class periods	<b>Setting</b> Classroom/computer lab	<b>Grouping</b> Small groups of 2-3	<b>PTI Inquiry Subskills</b> <b>1.3, 3.1, 3.7, 3.8, 4.2, 4.3, 4.4, 5.2, 5.3, 5.7, 7.2, 7.3</b>
--	--	--	---

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
<b>Engage</b>	20 minutes	1.3	Computer/Internet	3	Students interact in a class discussion about ocean temperature and form a hypothesis about the relationship of temperature changes in the ocean to the change in seasons.
<b>Explore</b>	2 class periods	3.1, 3.7, 3.8, 4.2, 4.3, 4.4	Computer/Internet	3	Students complete online tutorials, gather and analyze ocean weather and ocean temperature data, and graph their findings.
<b>Explain</b>	2 class periods	1.3, 5.2, 5.3, 5.7, 7.2, 7.3	Computer/Internet	3	Students answer questions regarding their findings, make ocean weather predictions, and propose explanations for their findings.
<b>Expand</b>	1 class period	1.3, 3.1, 3.7, 3.8, 5.2, 5.3, 7.2, 7.3	Computer/Internet	3	Students gather real satellite temperature and wind data for the New Jersey coast and create a weather forecast to present to the class.
<b>Evaluate</b>					Answers to the questions and graphs on the student worksheets and a teacher generated rubric for the class presentation.

### Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

### National Science Education Standards – Inquiry

Design and conduct a scientific investigation.  
Use appropriate tools and techniques to gather, analyze, and interpret data.  
Develop descriptions, explanations, predictions, and models using evidence.  
Think critically and logically to make the relationships between evidence and explanations  
Communicate scientific procedures and explanations



### National Science Education Standards – Earth Science

Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

<p><b>Louisiana Grade Level Expectations – Inquiry</b></p> <p>Gr. 8, Inquiry GLE#6-Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)</p> <p>Gr. 8, Inquiry GLE#7-Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)</p> <p>Gr. 8, Inquiry GLE#9-Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3)</p> <p>Gr. 8, Inquiry GLE#11-Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)</p> <p>Gr. 8, Inquiry GLE#12-Use data and information gathered to develop an explanation of experimental results (SI-M-A4)</p> <p>Gr. 8, Inquiry GLE#13 – Identify patterns in data to explain natural events (SI-M-A4)</p> <p>Gr. 8, Inquiry GLE#16 – Use evidence to make inferences and predict trends (SI-M-A5)</p> <p>Gr. 8, Inquiry GLE#19-Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)</p> <p>Gr. 8, Inquiry GLE#22 - Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)</p>	
<p><b>Louisiana Grade Level Expectations Earth Science</b></p> <p>Gr. 8, GLE 25- Explain and give examples of how climatic conditions on Earth are affected by the proximity of water (ESS-M-A11)</p> <p>Gr. 8, GLE 29- Make predictions about future weather conditions based on collected weather data (ESS-M-A12)</p>	

### Materials List (per group)

- Copies of all worksheets:  
<http://www.coolclassroom.org/pdfs/oceantempworksheet.pdf>  
<http://www.coolclassroom.org/pdfs/understandingwinddirection.pdf>  
<http://www.coolclassroom.org/pdfs/windspeedactivity.pdf>  
<http://www.coolclassroom.org/pdfs/windspeedworksheet.pdf>.  
<http://www.coolclassroom.org/pdfs/forecastworksheet.pdf>  
<http://www.coolclassroom.org/pdfs/forecastdatasheet.pdf>
- Notebook to answer questions
- Compasses
- Full-circle or semicircular protractors
- Calculators (optional)

### Advance Preparation

#### **Steps 1 and 2**

1. Before completing this activity with your class, review and print the Teacher Guide ([http://www.coolclassroom.org/teachers\\_guide/tg\\_earthsci.html](http://www.coolclassroom.org/teachers_guide/tg_earthsci.html)) for help to answers to all the worksheets and extra explanation for each step.
2. Print copies of the Ocean Temperature Worksheet (one copy for each group of students). This worksheet is found here: <http://www.coolclassroom.org/pdfs/oceantempworksheet.pdf>
3. Make sure each group has a notebook to answer questions.

#### **Step 3**

1. Print copies of the Understanding Wind Direction Worksheet (one copy for each group of students). This worksheet is found here: <http://www.coolclassroom.org/pdfs/understandingwinddirection.pdf>
2. Print copies of the Wind Speed and Direction Activity (<http://www.coolclassroom.org/pdfs/windspeedactivity.pdf>) and Worksheet (<http://www.coolclassroom.org/pdfs/windspeedworksheet.pdf>).
3. Make sure each group has compasses and full-circle or semicircular protractors (a full-circle protractor works better and is preferred, but a semi-circular one will work as well).
4. Students may use a calculator in this step (optional).
5. Make sure each group has a notebook to answer questions.

#### **Steps 4 and 5**

1. Print copies of the Ocean Forecast Worksheet (<http://www.coolclassroom.org/pdfs/forecastworksheet.pdf>) and the Ocean Forecast Data Sheet (<http://www.coolclassroom.org/pdfs/forecastdatasheet.pdf>).
2. Make sure each group has a notebook to answer questions.

### Other Information

#### Learning Objectives

##### **Step 1 and 2**

- Form a hypothesis about the relationship of temperature changes in the ocean to the change in seasons
- Interpret and analyze sea surface temperature maps
- Interpret and analyze CTD data

**Step 3**

- Understand how wind direction is measured using a compass
- Learn how to graph the direction and speed of wind
- Understand that wind impacts the motion of ocean surface water

**Step 4 and 5**

- Interpret satellite images off the New Jersey coastline and describe an upwelling event
- Analyze wind speed and direction during an upwelling event
- Interpret real-time data and create a local ocean weather forecast

**Prior Knowledge Needed by the Students**

- How winds are formed
- How to convert degrees Centigrade to and from Fahrenheit
- Directions on a map compass
- Degrees of a circle

**Procedure**

**Engage:**

1. Ask students the following questions:  
*Have you ever jumped into the surf during the summer and been surprised to find that the water is too cold to swim? Wouldn't it be nice to know the water temperature of the ocean before you even left for the beach? What if you could predict the water temperature a few days into the future?*
2. Allow for class discussion to familiarize students with the vocabulary review the website with students including the Control Room. Allow students time to explore the website.
3. As a class, listen to the interview with Mike Crowley, a COOLroom scientist -- listen to him explain how the ocean temperature is affected by the seasons. The link is found here:  
[http://www.coolclassroom.org/cool\\_projects/lessons/earth\\_science/formahypothesis.html](http://www.coolclassroom.org/cool_projects/lessons/earth_science/formahypothesis.html)

**Step 1: Form a Hypothesis**

4. Have students form a hypothesis that explains why temperature varies with the seasons and also with depth (from surface to the deep ocean depths). Have students record their hypothesis in their notebook.

**Explore/Explain:**

**Step 2: Analyze Data**

1. First the students will **A. Learn how satellites are used to monitor ocean temperature.** From the website, have students visit the Remote Sensing Satellites page in the "What's COOL?" section to learn how satellites are used by oceanographers to study ocean temperature. ([Go to Remote Sensing Satellites in "What's COOL?"](#)) Then students will learn how to read satellite images for themselves by doing the SST (Sea Surface Temperature) tutorial in the Control Room. ([Click on the yellow SST button in the Control Room to do the SST Tutorial.](#))
2. Pass out copies of Ocean Temperature Worksheet. Students may want to record their answers in their notebooks.
3. Next the students will **B. Test satellite image reading skills.** Look at the four satellite images on the website and answer the questions in the "Satellite Images" section of the "Ocean Temperature" Worksheet. Record your answers in your notebook.
4. Next the students will **C. Learn how underwater sensors (CTDs) monitor ocean temperature and salinity.** Students can visit the CTD Tutorial in the Control Room to learn more about how scientists use underwater sensors and probes. ([Click on CTD slide in the Control Room to do the CTD Tutorial.](#))
5. Finally, students will **D. Test CTD data reading skills.** Have students look at the four CTD data graphs on the website. Have students answer the questions in the "CTD Data" section of the Ocean Temperature Worksheet. Students may want to record their answers in their notebooks.
6. Review answers to worksheet. Collect student worksheets to check for understanding.

**Step 3: Outside Influences**

7. First students will **A. Learn how weather data is collected by sensors on the Meteorological Tower (or "Met" tower) at the Rutgers Marine Field Station.** Have the students visit the Met Tower links in the Control Room ([Click on the orange Met Tower button in the Control Room to do the Met Tower Tutorial.](#)) Students also will visit the "What's COOL?" site to learn how COOLroom scientists measure the wind and other weather. ([Go to Meteorological Tower in "What's COOL?"](#)).

8. Optional: As a class, listen to the **B. Interview with Mike Crowley**, a COOLroom scientist -- listen to his explanation of how the ocean and the atmosphere have an impact on one another. The link is found here:  
[http://www.coolclassroom.org/cool\\_projects/lessons/earth\\_science/outsideinfluence.html](http://www.coolclassroom.org/cool_projects/lessons/earth_science/outsideinfluence.html)
9. Next the students will **C. Learn how to calculate wind direction**. Pass out the printed copies of the "Understanding Wind Direction" Worksheet  
(<http://www.coolclassroom.org/pdfs/understandingwinddirection.pdf>).
10. Pass out compasses and have students practice plotting wind direction using a compass.
11. Collect and post student graphs.
12. Optional: Have students **D. Test Knowledge** by completing the Naming Wind Direction Quiz on the website.
13. Finally, have students **E. Learn How to Graph Wind Speed and Direction**. Pass out the printed copies of the Wind Speed and Direction Activity  
(<http://www.coolclassroom.org/pdfs/windspeedactivity.pdf>) and Worksheet  
(<http://www.coolclassroom.org/pdfs/windspeedworksheet.pdf>).
14. Have students create a hypothesis about the weather for each day in the activity. Engage students in a class discussion about how winds might affect the movement of ocean water.
15. Review answers to worksheet. Collect student worksheets to check for understanding.

**Step 4: Watch it Happen**

16. First, have students **A. Visit the upwelling links in the Control Room and "What's COOL?" to learn more about upwelling**. [Click on the Upwelling lever in the Control Room to do the Upwelling Tutorial.](#) [Go to Upwelling Index in "What's COOL?"](#)
17. Pass out the printed copies of the Ocean Weather Forecast Worksheet  
(<http://www.coolclassroom.org/pdfs/forecastworksheet.pdf>).
18. Next have the students **B. Use the Ocean Weather Forecast Worksheet to answer the questions in the "What Is an Upwelling?" section**. Have students record their answers in their notebook.
19. Next have the students **C. Use the four satellite images on the website to track the water temperature at the LEO-15 research site off the coast of New Jersey**. Have the students answer the questions in the "Seeing an Upwelling" section of the Ocean Weather Forecast Worksheet and record observations in their notebook.
20. Finally, have the students **D. Take a look at how scientists use CTD data to see if an upwelling is happening, or to predict if one might happen in the next few days**. Have students use the four CTD images on the website to answer the questions in the "Seeing an Upwelling" section of the Ocean Weather Forecast worksheet in their notebook.

***Expand:***

**Step 5: Create a Forecast**

1. Each group of students will **A. Write a weekly Ocean Weather Forecast for a major New Jersey newspaper**. Your students will need to use the [Sea surface temperature data](#) and [Wind data](#).
2. Pass out the printed copies of the Ocean Weather Forecast Data Sheet  
(<http://www.coolclassroom.org/pdfs/forecastdatasheet.pdf>). Have students color a water temperature map to represent the surface temperatures off the coast of New Jersey, and indicate how the colors relate to the temperatures. They should also plot the wind speed and direction on the wind data sheet.
3. Finally, have students **C. Create the Forecast, and write a weather report including the following:**
  - a. A description of the ocean weather for the week
  - b. A prediction based on your data about whether or not an upwelling would be expected to happen soon
  - c. An explanation of whether your data shows it would be (a) good or bad day(s) to visit and swim at the beach.
4. Have students present their forecast to the class. Finally, have students determine whether or not the class should go swimming, fishing, or neither off the coast of New Jersey over the coming days.

***Evaluate:***

1. Answers to student worksheets can be assessed throughout the lesson.
2. Teacher generated rubric for presentations.

**Blackline Masters**



## Supplementary Resources

### Credits

Lessons created by Tanya Podchaski - Bernardsville High School, and Lisa Koch - Ocean County Vocational School

Edited by Amy Pallant and Debra Kovacs - Turnstone Publishing

Scientific content reviewed by Michael Crowley, Dr. Scott Glenn, and Sage Lichtenwalner - IMCS-Rutgers University

Development supported with grant funds from the National Ocean Partnership Program