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Ocean Gazing
Networked Ocean World

CoSEE
CENTERS FOR OCEAN SCIENCES
EDUCATION EXCELLENCE

Follow That Bloom
A Classroom Activity for Ocean Gazing Episode 25: A green ocean

Grade Level: 9-12

Lesson Time: Four 45-50 minute classes

Summary

In this Lesson Cluster, students will learn how to use vectors to graphically calculate Sea Surface Currents. Then, using real-time data collected by Rutgers University, students will predict the eventual location of a plankton bloom adrift at sea. They will extrapolate over an 18-hour period. Finally, they will examine the surface current CODAR (Coastal Ocean Radar) data for the 18-hour period to determine the actual location of the bloom as compared to their predicted location.

Objectives

✓ **Step #1: Learn the Tools Studying Ocean Currents with Coastal Radar (CODAR).** Students visit the control room and learn about ocean currents and the Doppler shift theory.
✓ **Step #2: Practice Calculations Using Vectors to Calculate Sea Surface Currents.** Students use an interactive program to learn about vector addition.
✓ **Step #3: Analyze Data Interpreting Information Gathered by CODAR.** Students will graphically calculate the component vectors of one or more resultant vectors on a sea surface current map. They will resolve the vectors into both magnitude and direction. Then, given the components calculated at CODAR stations off the coast of New Jersey, they will calculate the resultant vector represented on the map.
✓ **Step #4: Predict Motion Find the Plankton Bloom.** Students will work with real-time data collected by Rutgers University to predict the eventual location of a plankton bloom adrift at sea over an 18-hour period. They will also consult archival data to determine if there are any patterns in the movement of the water that may effect their predictions.

Introduction

Plankton and ocean currents
Plankton, the microscopic plants and animals floating in the ocean, are the base
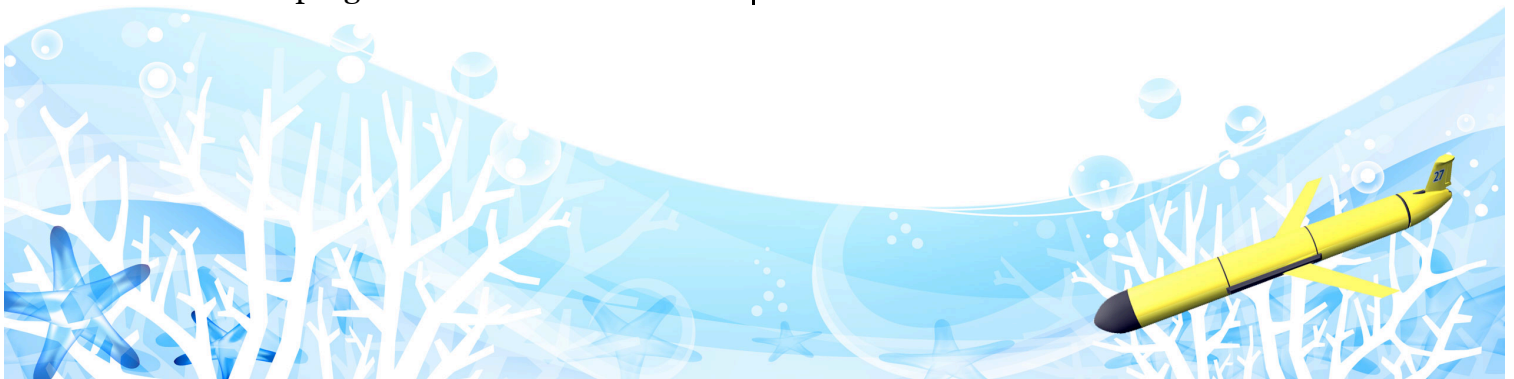
of the complex food webs that support life in the ocean. Small fish and invertebrates feed on the plankton, and in turn, they become food for larger fish and animals. For this reason, scientists are interested in how and where blooms of plankton occur and how they move over time. Fishermen are also interested in knowing this because if they can locate the plankton, they can often find fish feeding in the same area. The location of plankton in the ocean is often associated with ocean currents.

But how can the movement of plankton that appears to be drifting randomly around in the ocean be monitored? In this project, you will learn how to read vector images of real-time CODAR (Coastal Radar) data. Then you will use your knowledge to predict the movement of a phytoplankton bloom off the coast of New Jersey.

Step 1: Learn the Tools; Studying Ocean Currents with Coastal Ocean Radar (CODAR)

Learn more about CODAR. Visit the CODAR page in the "What's COOL?" section to learn how CODAR is used to study ocean surface currents and conditions; and read the Follow That Bloom Science Background. Then learn for yourself how surface currents are measured by doing the CODAR tutorial in the Control Room. When you're done close the windows to continue with this project.

1. Read about CODAR in What's COOL.
2. Visit the Control Room and click on the CODAR lever.

Based on what you've learned about CODAR, answer the following questions. Record the answers in your notebook.

1. Why is it hard to locate a floating object in the ocean?

2. What are the major forces acting on an object floating in the ocean?
3. What is the Doppler Shift? Give an example of how it works.

## Step 2: Practice Calculations Using Vectors to Calculate Sea Surface Currents

Scientists use vectors to represent the speed and direction of currents. By adding together individual vectors, scientists can create resultant vectors, which are used to represent a sum of forces being applied to a certain location

Learn how to get sea surface current vectors from CODAR data. Let's take a closer look at how sea surface current vectors are measured using CODAR along one area of the New Jersey coast.

1. **Click on the thumbnail below to enlarge the map**. The green and yellow circles represent two different CODAR antennae (green = Brant Beach, yellow = Brigantine), and the green and yellow arrows are vectors measured by the antennae. The green vector is measured by the green antenna, and the yellow vector by the yellow antenna.

2. Using the cursor, click and drag the green arrow to a size and position of your choice, and then repeat with the yellow arrow.

3. Click on the "resultant" button to the right to add the two vectors together into a resultant vector.

4. Once you have created a resultant vector, you can click and drag either of the component vectors to see how changes in their magnitude and direction affect the resultant vector.

## Step 3: Analyze Data; Interpreting Information Gathered by CODAR

Now let's apply your knowledge of vectors to some real CODAR images. The image below is data collected from CODAR antennae on three beaches along the New Jersey coast: Sandy Hook, Loveladies, and Wildwood. The arrows on the image are resultant vectors calculated by adding together the individual vectors collected by two or more of the antenna. The direction of each arrow shows the direction that the water is moving at that location, and the color of the arrow indicates the speed of the water.
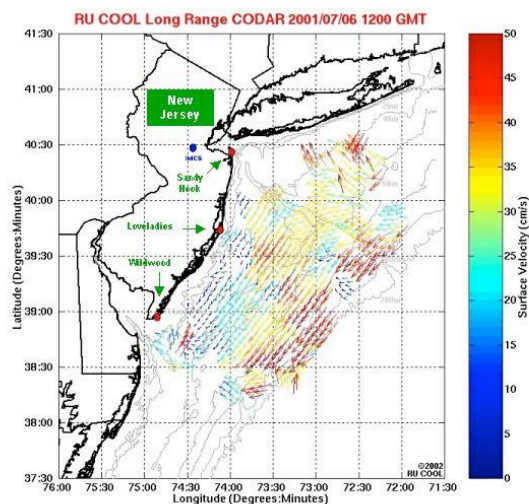
In what direction is most of the surface water moving in this image?

    a. Southwest
    b. Northwest
    c. Southeast

Now let's zoom in and take a closer look at this data. The image below shows a close-up of the same data for the area between Sandy Hook and Loveladies. Using the image below, you will identify a vector on the image and calculate the component vectors.
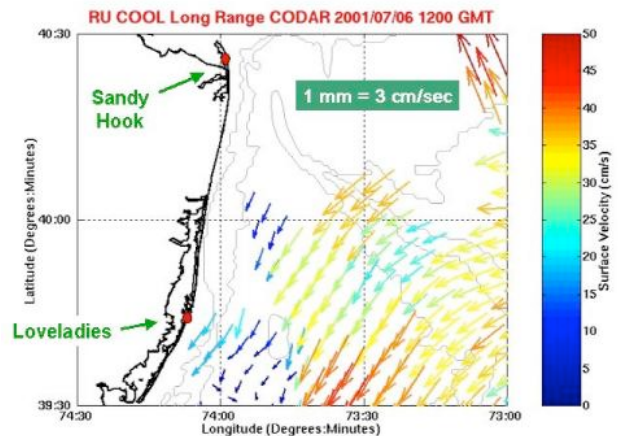
[Download the "Vectors Mark the Location" Worksheet](#), and follow the instructions to complete the activity.

Step 4: Predict Motion; Find the Plankton Bloom

Now use real-time data collected by COOLroom scientists to locate a hypothetical plankton bloom and predict its motion over a 24-hour period. Using live Ocean Surface Current Data, complete the "Find the Plankton Bloom" Worksheet.

- ✓ Go to the latest [Ocean Surface Current data in the COOLroom](#).
- ✓ [Download the "Find the Plankton Bloom" Worksheet](#) and follow the instructions to find the plankton bloom.

Then check back the next day to see how well you predicted the location of the bloom.

- ✓ Check the [Ocean Surface Current data](#) again in 24 hours to see if you predicted correctly.

Sources

To access an online version of this activity, you can go to the following URL:

http://coolclassroom.org/cool_projects/lessons/physics_highschool/physicshighschool.html

The related podcast episode for this activity can be found by going to the podcast section of www.oceangazing.org