

LESSON PLAN: BAY DRIFT



TRACKING OCEAN POLLUTION

Objective: To introduce students to ocean currents and the transport of marine debris, spilled oil, and other pollutants in the ocean. Students will be able to:

- Analyze real drifter data
- Describe the 2 types of drifters used in the study and compare/contrast the pros and cons of each
- Predict where drifters/pollutants will travel based on local currents

Students will work with real data collected by citizen scientists to understand the movement of ocean pollution.

STANDARDS: OLP 1,7; SC.912.N.1.7, SC.912.N.1.6, SC.912.P.12.2

Time Required: One class period

Keywords: drifter, currents, buoyancy, CARTHE, GPS, STEAM

Materials:

- Student Packet (pages 5-8)
- Computer with sound and projector to watch videos
- CARTHE KML data files or list of coordinates (obtained by contacting lbracken@miami.edu)

BACKGROUND

On April 20th, 2010, an explosion on BP's Deep Water Horizon (DWH) drilling rig resulted in the death of 11 men and caused the Macondo wellhead to burst. Millions of gallons of oil were discharged into the Gulf of Mexico. On May 24th, 2010, BP committed to fund \$500 million in broad, independent scientific research in the Gulf, through the Gulf of Mexico Research Initiative (GoMRI). The Consortium for Advanced Research on Transport of Hydrocarbon in the

Environment (CARTHE) was funded by GoMRI for the purpose of studying the oil spill and its impact on the Gulf's delicate ecosystems. CARTHE studies ocean currents to be able to predict where oil or other toxins may go in the event of a future spill.

Oil is not the only pollutant in the ocean that negatively impacts our environment. Marine debris (trash) has become a major issue throughout the world, including in our own backyard – Biscayne Bay. Trash gets transported by the currents that move into and within Biscayne Bay. Computer models and previous localized experiments give an estimate of how those currents behave but we wish to give the greater Miami area a better sense of how the currents are affecting the way trash moves in the Bay.

The original idea for this project arose when Vizcaya Museum & Gardens approached researchers at CARTHE to discuss the large amount of debris they regularly find in their mangroves and along their shore line. Trash is not only unsightly, it can cause serious harm to animals that get entangled in it or eat it. Where is the trash coming from? CARTHE could not provide a specific answer, so we partnered with Vizcaya, Frost Science, Miami Waterkeeper, and many more agencies and organizations across South Florida to develop the **Biscayne Bay Drift Card Study (#BayDrift)**.

While in the planning stages for this project, South Florida was also dealing with a tritium leak from the Turkey Point nuclear power plant, a wastewater (sewage) leak from an old pipe near downtown Miami directly into our study area, sargassum and red tide traveling here from other areas, and a blue-green algae bloom prompting the Governor to declare a state of emergency for Martin, St. Lucie, Palm Beach, and Lee Counties due to the toxic effects it can have on people and animals. A better understanding of the currents in these areas can assist decision makers and managers in addressing their response to such events.

PROCEDURE

1. Preparation:

- Locate and queue the following animations of drifters: <https://vimeo.com/183528897>
- Contact lbracken@miami.edu to obtain the KMZ files or a spreadsheet of coordinates for the drift card data
- Load data files onto the computers
- Break students into groups and assign each group one of the Bay Drift release sites

2. Introduction:

- A. Open the class by asking if anyone ever sees trash on the ground in their neighborhoods or at the beach.
 - i. Ask what happens to that trash? Where will it go?
 - ii. Make the connection that what we drop on land may end up in the Bay.

- iii. If you live inland, point out that the trash could go into rivers or channels that lead to the bay/ocean.
- B. Discuss as a class the negative impacts trash has on the ecosystem. These could include:
- i. harm to animals
 - ii. harm to people who eat seafood
 - iii. harm to people who swim in the bay and ocean
 - iv. bad for economy
 - v. makes the view ugly/unpleasant
- C. Walk through the Student Packet together
- i. Begin by learning about the 2 types of ocean current tools used by CARTHE
 - i. Drifters – expensive, precise
 - ii. Drift cards – inexpensive, less precise, only received data when cards found
 - ii. Ask students to think about the pros and cons of each tool. Students can share and write the pros/cons on the board.

3. Data exploration and analysis:

- A. Divide the class into groups. Assign each group a different release site. Look at the map.
- B. First have them make predictions about where they think drift cards will be found, consider the tides and the shape of the bay and the land.
- C. Explain to the students that they will track the Drifters and Drift Cards released from their assigned site.
 - a. Show the animation of the drifters during the first week of the experiment, <https://vimeo.com/183528897>. Replay if needed, allowing each group to see where their drifters went.
 - b. Students can also review the screen shot of the drifter tracks and points of recovery of drift cards from each location, visit <http://carthe.org/blog/?p=764>
- D. Have students open the KML and/or KMZ files for the students to work with the data in Google Earth, or have them plot the coordinates into Google Earth or whatever program you wish to use.
- E. They can look up the tides at the time of the release, as well as wind direction and speed.
- F. They should discuss in their group why they think their cards traveled to the areas where they did, then have them present this to the rest of the class.
- G. As a class, discuss the patterns:

- a. Were many drift cards reported that originated from your site? What are some reasons many/few were found (was the area populated, was the area easy to access, such as a beach vs seawall)?
- b. How did the tides and wind impact where the cards were found?
- c. What might be some sources of marine debris? (canals, marinas, beaches, etc)

EXTENSIONS

- Create a PSA about marine debris prevention
- Do a beach cleanup and create art with the materials you collect
- Write a poem about ocean movement, or your relationship with the ocean (consider submitting your poem to the Piano Slam youth poetry competition).

RESOURCES & REFERENCES

Biscayne Bay Drift Card Study (Bay Drift)

<http://carthe.org/baydrift/>

The CARTHE I program (2012-2014) includes 26 principal investigators from 12 research institutions in eight states. The CARTHE II program (2015-2017) includes 40 principal investigators from 27 research institutions. The CARTHE III program (2018-2019) includes 19 principal investigators from 12 institutions. Together these scientists are engaged in novel research through the development of a suite of integrated models and state-of-the-art computations that bridge the scale gap between existing models and natural processes.

For more information about CARTHE, please visit www.carthe.org.

STUDENT PACKET: BAY DRIFT



TRACKING OCEAN POLLUTION

Introduction

On April 20th, 2010, an explosion on BP's Deep Water Horizon (DWH) drilling rig resulted in the death of 11 men and caused the Macondo wellhead to burst. Millions of gallons of oil were discharged into the Gulf of Mexico, posing a threat to communities living along the coastlines of five Gulf states – Louisiana, Alabama, Florida, Mississippi and Texas, as well as their fisheries and marine ecosystems. America's Gulf Coast experienced the largest oil spill in the history of the American petroleum industry.

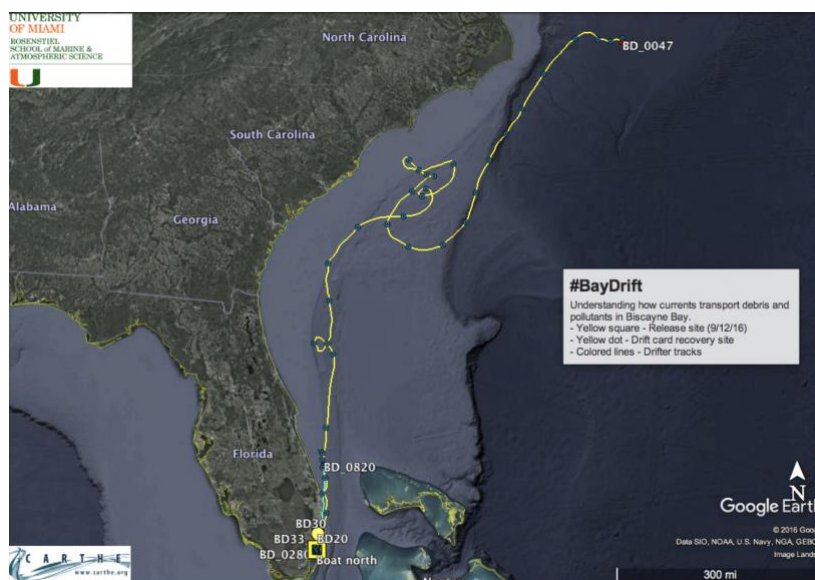
BP committed \$500 million to fund broad, independent scientific research in the Gulf, through the Gulf of Mexico Research Initiative (GoMRI.org). After undergoing a competitive peer-review process for the purpose of studying the oil spill and its impact on the Gulf's delicate ecosystems, GoMRI selected the Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE.org). The CARTHE team is comprised of over 100 scientific researchers, postdocs, students and administrative staff from over 20 universities and research institutions across the United States and Europe, hosted at the University of Miami Rosenstiel School of Marine & Atmospheric Science.

CARTHE is a research team dedicated to predicting the fate of oil and other pollutants released into our environment to help inform and guide response teams, thereby protecting and minimizing damage to human health, the economy, and the environment. Simply put, CARTHE scientists study ocean currents in the Gulf of Mexico in hopes of gaining the ability to predict where oil or other toxins may go in the event of a future spill.

Oil is not the only pollutant in the ocean that negatively impacts our environment. Marine debris (trash) has become a major issue throughout the world, including in our own backyard – Biscayne Bay. Trash gets transported by the currents that move into and within Biscayne Bay. Scientists and educators from CARTHE, Vizcaya, and Frost Science Museum came together to give the greater Miami area a better sense of how the currents are effecting the way particles move in beautiful Biscayne Bay.

For this experiment, the project team selected 11 locations around the Miami area to release their 2 different types of ocean current research equipment.

1) **DRIFTERS** – CARTHE released 15 biodegradable, custom-made, GPS-equipped drifters. These drifters provided their location to the scientists every 5 minutes for weeks, resulting in a precise track of its movements.



2) **DRIFT CARDS** – 300-400 small, inexpensive, eco-friendly wood cards were released during each experiment. They are brightly painted and float along the water’s surface, moved by the currents. Each card is coded so the Project Team can identify where it was deployed. Additionally, the drift cards are labeled with information that introduces the project and instructs the finder how to report where it was found. By tracking the location where drift cards are released and found, we will learn how the currents distribute debris in Biscayne Bay.



Map of release sites

