

# 57 Oceans and Climate



**Y**ou have learned that the sun's energy heats the earth, including the earth's oceans. In this activity, you will find out how climate is influenced by ocean temperatures.

## CHALLENGE

How do oceans affect climate?

### MATERIALS

*For each student*

- 1 Student Sheet 57.1, "Intra-act Discussion: Oceans and Climate"



## PROCEDURE



*Benjamin Franklin*

1. Assign one of the following roles to each person in your group.
  - Benjamin Franklin, 18th century scientist, inventor, and statesman
  - Dr. Tansy Makya, climatologist
  - Bo Nye, student moderator of “Time Travel News”
  - Dr. Leena Reddy, hydrologist
2. In your group, read the role-play aloud. As you read, think about what each character is saying.
3. Discuss how you think oceans affect climate.
4. Mark whether you agree or disagree with the statements on Student Sheet 57.1, “Intra-act Discussion: Ocean and Climate.” Predict what you think other members of your group will say.
5. Discuss the statements with your group. Have each person share his or her opinion about each statement and explain why he or she agreed or disagreed.

## MAPPING OCEAN CURRENTS

**Bo Nye:** In today’s episode of “Time Travel News,” we will focus on ocean currents and climate. Our guests include a scientist, inventor, and statesman from the 18th century, Mr. Benjamin Franklin. Joining him are Dr. Leena Reddy, a hydrologist, and Dr. Tansy Makya, a climatologist.

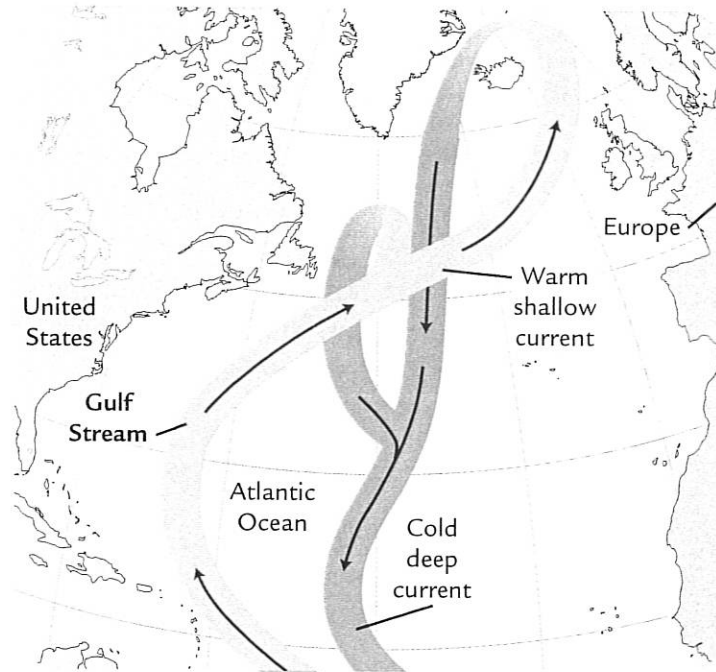
I have heard that there is a current in the Atlantic Ocean that is slowing down. Some scientists say that this may cause changes to the climate of Ireland. How can that be?

**Dr. Leena Reddy:** All around the world, there are regular movements of large amounts of ocean water called **currents** (KUR-unts). Some of these currents move warm water from one place to another, while other currents move cool water.

**Bo:** It sounds like you’re talking about rivers, not oceans!

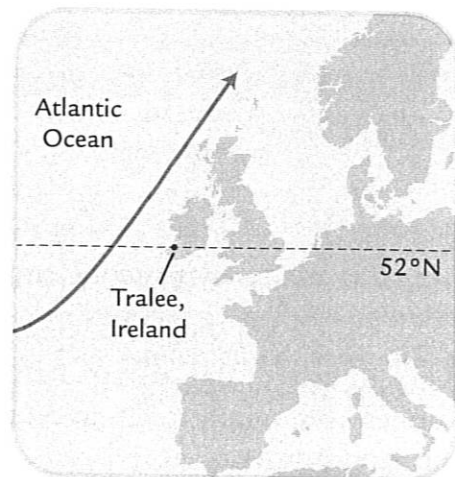
**Dr. Reddy:** Some people describe currents as rivers that run through the ocean. Like rivers, these currents vary in width and depth, but you can’t see them the way that you see rivers that run through land. They may be 100 to 1,000 kilometers wide, and flow on the ocean’s surface or a couple of kilometers below the surface.

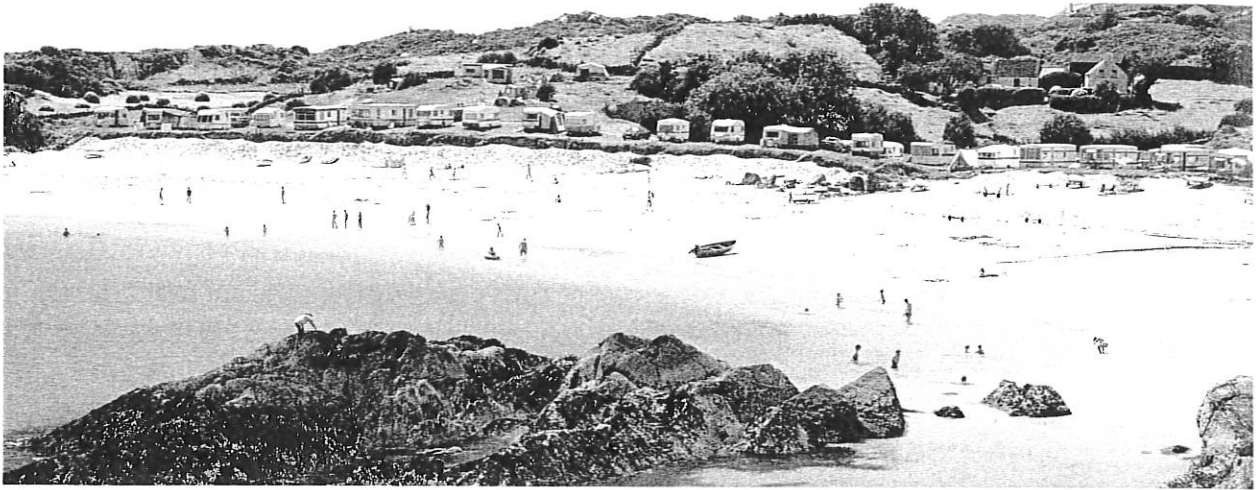
Ocean Currents:  
The Northern  
Atlantic Ocean



- Dr. Tansy Makya: One really important ocean current is called the Gulf Stream. It is one of the strongest ocean currents in the world. It flows on the surface of the northern Atlantic Ocean and carries warm water from the Gulf of Mexico to northwestern Europe.
- Dr. Reddy: The warm water begins to cool as it travels north and eventually sinks. It becomes part of a cold deepwater current that then flows south from the northern Atlantic toward the equator.
- Dr. Makya: Measurements taken in 2005 show that this cold deepwater current appear to be slowing down. Ocean currents are like huge conveyor belts that move heat from one place to another. The slowing of one part of the belt may cause another part to slow down too.
- Bo: Let me see if I understand this idea. If the cold deepwater current is slowing, that could slow down the Gulf Stream. And if the Gulf Stream slows down, less warm water will reach Ireland and northern Europe.
- Dr. Reddy: Yes, but saying that this will lead to significant climate change in Ireland is an extreme prediction. There are no data showing that this will happen.
- Bo: Mr. Franklin, you were one of the first people to chart the Gulf Stream. What do you think?
- Benjamin Franklin: I'm afraid that I don't have enough information. In my day, we didn't have enough data to tell if ocean currents were speeding up, slowing down, or staying the same.

- Bo: I still don't understand how ocean temperatures near Florida could result in a change in the climate of Ireland.
- Dr. Reddy: The sun's energy heats both land and water. You probably know that water heats and cools more slowly than land. As a result, oceans retain a large amount of heat. Ocean currents move some of this heat around the earth.
- Dr. Makya: Wind blows some surface currents away from the equator toward the poles. A warm current like the Gulf Stream warms and moistens the air above it. The warm, moist air makes climates warmer and wetter than they would otherwise be.
- Bo: Even to places that are far from the start of the current? Ireland is thousands of miles from where the Gulf Stream begins in the Gulf of Mexico.
- Dr. Makya: Yes. Since the Gulf Stream carries warm water, it makes the climate of countries in northwestern Europe, like Ireland and England, warmer and wetter than other places of the same latitude.
- Mr. Franklin: So you are saying that these countries have milder winters and warmer summers because of the Gulf Stream. If the Gulf Stream slowed down, less heat would be transferred, and both winters and summers in these places would be colder.
- Dr. Makya: Exactly. The city of Tralee (TRAY-lee), Ireland has a mild climate because of the Gulf Stream. In January, it has an average temperature of  $5^{\circ}\text{C}$  ( $41^{\circ}\text{F}$ ). In comparison, Petropavlovsk (pet-ro-PAV-lofsk), a city of similar latitude in Russia, has a severe climate because it is





*These two places are at similar latitudes, but have very different climates.*

cooled by a cold ocean surface current that comes down from the North Pole. It has an average January temperature of  $-8^{\circ}\text{C}$  ( $18^{\circ}\text{F}$ ).

Dr. Reddy: You may have heard of El Niño (NEEN-yo). During El Niño years, the surface temperatures of the eastern Pacific Ocean become a few degrees warmer. This usually results in changes to local climates, like warmer air temperatures and more rain. It can also cause weather disasters, such as floods and droughts.



- Bo: I never knew that oceans are so important to climate and weather!
- Dr. Reddy: Ocean currents not only affect climate, they also affect businesses like shipping and fishing. Ocean engineers are always working on new and improved instruments to collect data about currents that make ocean navigation easier.
- Mr. Franklin: When I was a postmaster in the mid 1700s, we would send letters to England by ship. It took about two weeks for them to reach England. But it would take three to four weeks for letters from England to reach an American port. One day, I received a letter from the head of the British postal service, asking why it took so much longer for mail to travel to the United States.
- Bo: But didn't he already know about the Gulf Stream? I read that in the early 1500s, Juan Ponce De León of Spain explored the waters around Florida. He wrote about seeing ripples in the ocean moving faster than the surrounding water.
- Dr. Makya: I understand that during Mr. Franklin's time, sailors familiar with the area knew approximately where the Gulf Stream flowed, but there were no accurate maps of the current.
- Bo: So, Mr. Franklin, how did you investigate the Gulf Stream?
- Mr. Franklin: In 1775, 1776, and 1783, I was on ships crossing the Atlantic. I took measurements of the water temperature, speed, and depth of the current two to four times a day by dropping a thermometer in the ocean. Then I recorded the temperatures on a map. I started to see a pattern of areas where the water was warmer and moving faster.
- Dr. Reddy: Mr. Franklin's measurements were used to construct the first scientific map of the Gulf Stream.
- Mr. Franklin: I also took daily air temperatures to help make maps of the Gulf Stream more detailed. Adding to my findings, fishermen and sailors told me about what they saw and experienced while sailing the Atlantic Ocean.
- Dr. Makya: What did they tell you?
- Mr. Franklin: The most fascinating stories they told were about catching huge fish originally from the Gulf of Mexico up north near North Carolina in the United States. They also described the color of the water in the Gulf Stream as more blue than the rest of the Atlantic Ocean.
- Reddy: Today, new technology is used to measure ocean current temperatures more quickly and more often.

Bo: Are the measurements made with instruments on board ships?

Reddy: Some data are still collected that way. But most measurements are collected by instruments that scientists set afloat in the ocean. These instruments are dropped by boat or plane in specific places in different parts of oceans all over the earth.

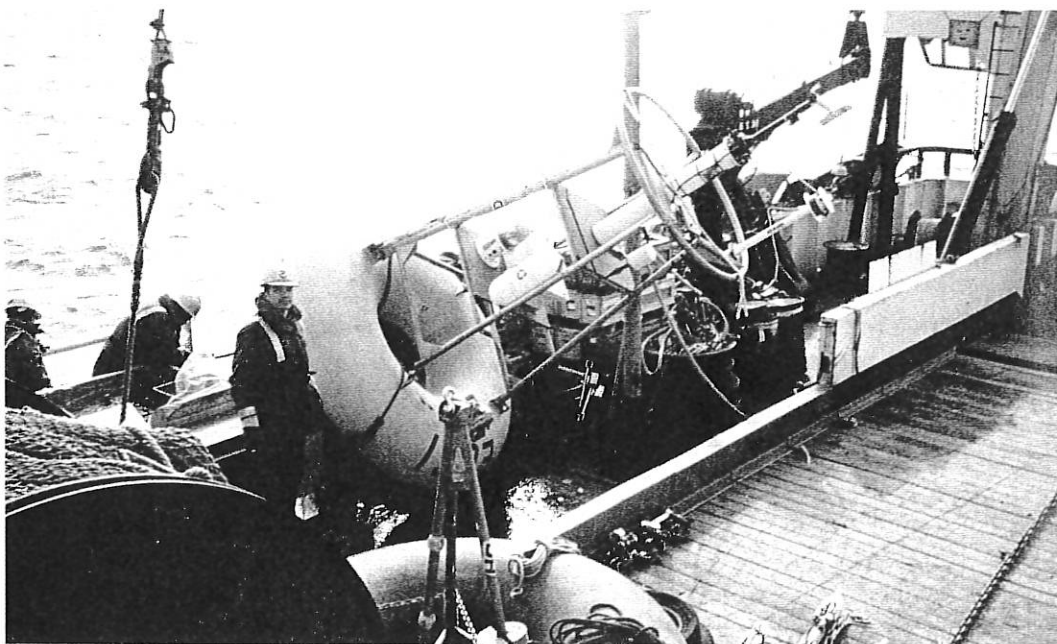
Dr. Makya: Satellites pick up signals from these instruments and relay the data to scientists. With this data, we now have maps of temperature, speed, and salt content of different ocean currents. These maps can be updated every week or month.

Dr. Reddy: There are also instruments kept on board ships that link to satellites. People with smaller ocean-going boats sometimes buy these instruments so that they can download images of ocean currents to use for navigation.

Mr. Franklin: Amazing! Such accurate and up-to-date information must make sailing easier and safer.

Bo: I think so. How has this information changed people's understanding of ocean currents?

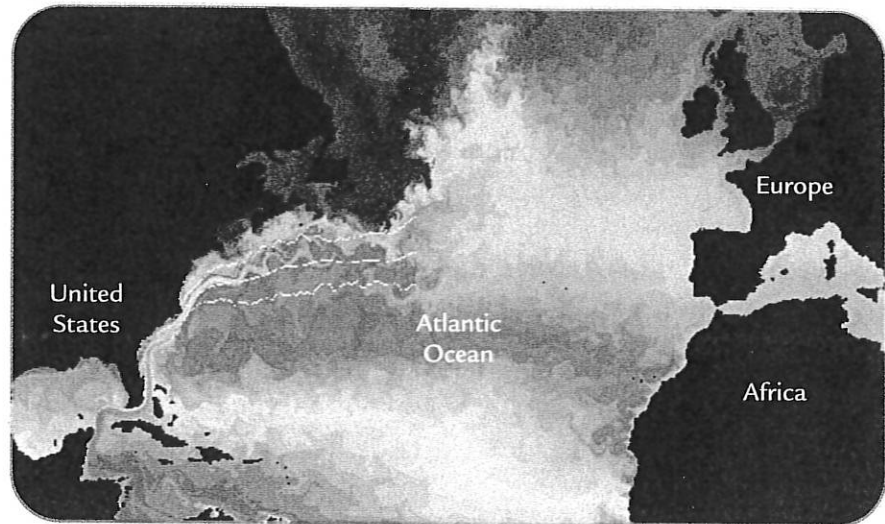
Dr. Reddy: Now we can see the details within large ocean currents. There may be smaller currents and different temperatures within a larger current as well, as you can see on this temperature map I brought.



*Scientists prepare a buoy for release at sea. Instruments attached to buoys collect data about the earth's oceans.*

### Surface Temperatures in the Atlantic Ocean

*Red areas represent warmer water temperatures.*



Dr. Makya: We can also compare the speed, temperature and salt content of currents from year to year and tell, for example, if currents are slowing down.

Bo: So the information collected from these instruments shows that the climate of Ireland may change?

Dr. Makya: Not exactly. Temperature and water-speed measurements were collected in 1957, 1981, 1992, 1998, and 2004. In one study, scientists compared the five sets of data and concluded that the cold deepwater current flowing from the North Atlantic toward the equator has slowed down.

Bo: So that's why they're projecting that the climate will change in Ireland?

Dr. Makya: A slowing of the cold water current could result in the slowing of the Gulf Stream. This would mean less heat and a cooler climate for northern Europe.

Dr. Reddy: That's one way to interpret the data. Another interpretation is that the slowing of ocean currents is a part of a cycle that reverses itself every 100 years or so. If that is the case, the current may again speed up, and the climate of Ireland would not change so much.

Mr. Franklin: It sounds like we more data needs to be collected.

Bo: So it does. We'll have to keep an eye on the latest news. In the meantime, a big thank you to our guests. Join us next week for another episode of "Time Travel News."