Teaching High Schoolers About Ocean Currents and Heat Capacity Transcription

Now we have pressure taken care of, pressure in the atmosphere, pressure in the ocean. What I am going to do next is I am going to show you what are the mechanisms? How are we going to equilibrate the temperatures that we saw earlier through pressure and motions in the sea? We're going to talk about surface currents, and then we're going to talk about deep density current.

Let's go this way first: surface currents. These are rivers of water that are pushed across the ocean by global winds. So now we have another connection between the atmosphere and the ocean. It transfers heat from the equator to the poles, and cold water from the poles goes towards the equator. A couple of pictures that are worth showing briefly, we talked about Ben Franklin who was the ultimate scientist. He recognized that his trip from the U.S. to England every time was a little bit faster than the other way going from England to the U.S. He was wondering why. So he came up with an experiment to try to investigate this. He realized that we have a Gulf Stream, this river of water that pushes the water across the ocean. You're actually fighting it coming back.

So there's a little bit of an explanation again getting the kids thinking, how do you answer these questions about these discrepant events? Why would it take more time? Now we realize of course we realize we have a whole series of surface currents being pushed across the oceans by the wind, being effected by the Coriolis effect, and being guided by the different continents. You can see we have warm equatorial currents being pushed north; we have cold currents from the poles being pushed towards the equator. This is how we're going to equilibrate things. That's a map we spend a fair amount of time with.

That's the mechanism. That's how things are going to move. Now we're going to get into another physical property, and that's heat capacity. There's a couple different definitions for heat capacity. Essentially it's the ability of a substance to hold heat. How do we get that across to 9th graders? One of the things we explain is places like Lofoten, Norway which is well above the Arctic Circle, the harbors never freeze. Like I say, it is much further up than is Bangor and it stays fairly warm. That is because the Gulf Stream gets pushed toward it. This is an example of these mechanisms affecting local climate.

Bringing in technology, we'll show them satellite photographs. Instead of Ben Franklin's map of the Gulf Stream, we'll show them how satellites today can provide infrared images showing how the Gulf Stream kind of snakes its way across the North Atlantic towards England. In fact London is north of Bangor and has a warmer climate than us largely because of these impacts from surface currents.

All right, laboratories, well what do we do? We have what we call the *Heat the Earth* lab. The reason this isn't quite as orange as the other one is it's similar to this one. We actually do this lab in the atmosphere segment. This lab is performed during the Meteorology unit. Students investigate the rise in temperature a heat lamp produces on three different types of media: dark soil, light soil, and water. They think about how this models an earth system. Again, this is also from that COSEE manual I showed you earlier Activity 4.1.

To show you what this looks like, this is a picture of the setup where we have dark soil here, light soil, water; we have temperature probes here. This is kind of another part of the process, getting the students to use technology. We could use standard thermometers and plunk them in the beakers, but here we're going to use a fairly high-powered laboratory. It is called a LabQuest by Vernier. We can hook up 4 different sensors. We only have 3 here. The nice part about this—here's our heat lamp that we're going to turn on here—is it graphs it. They can watch it graph. Then you can download all of the information onto a computer if you want to.

But the point here is the kids are going to predict which one is going to get hotter, and more importantly which one is going to lose its heat the fastest. The red bar is the dark soil. Most of them predicted the dark soil is going to get the hottest, and it did. Here's the light soil, and here's the water as we had the heat lamp on. Then what they do is they turn the heat lamp off, and they're supposed to predict which one will cool off the fastest. What they found was not exactly what they had predicted, is that you can see down here that dark soil lost all of its heat faster than the water did. The water held onto its heat more than the soils. That's a great visual for them to realize that water is going to have some sort of impact later on when we talk about oceans. I don't tell them about that yet, but we come back to this lab when we do this *Sulfur Spreadsheet* lab.