

## **Ocean Layering: Density, Salinity, Temperature, and Circulation**

Sylvia Cole, Scripps Institution of Oceanography, San Diego CA

Maureen Quessenberry, University City High School, San Diego CA

### **Day 2 Overview: Global Vertical Layering**

Warm up: 5 min

Activity: 20 min

Info: 15 min

Activity: 12 min

Conclude: 3 min

#### **Warm up:** How do temperature and salinity affect density?

This is a review from yesterday, and students should give a good answer. Cold water is denser, and salty water is denser.

Leading questions:

Describe the water on the bottom of the ocean, is it cold or warm, is it fresh or salty?

Which is more dense, cold water or warm water?

Which is more dense, fresh water or salty water?

#### **Activity:** Stirring and mixing

See '02t.activity.stirmix' (<http://earthref.org/cgi-bin/erda.cgi?n=1011>)

Goal: Students will make their own model of the ocean and how water can be stirred around and mixed together. Students are introduced to what a horizontal or vertical slice through the ocean might look like.

Transition: We know there are different types of water in the ocean, such as warm water and cold water or fresh water and salty water. We're going to do an activity to see how different types of water can interact.

#### **Info:** Vertical ocean sections

See '01c.handout.notes' page 2 (<http://earthref.org/cgi-bin/erda.cgi?n=999>)

See '01t.handout.notes.answers' page 2 (<http://earthref.org/cgi-bin/erda.cgi?n=1004>)

See '02c.slides.globallayers' (<http://earthref.org/cgi-bin/erda.cgi?n=1009>)

See '02t.slides.globallayers' (<http://earthref.org/cgi-bin/erda.cgi?n=1014>)

Goal: Introduce students to how ocean data is collected. Students see how the ocean is layered on the global scale.

Transition: We're going to take a look at one way oceanographers measure the ocean, which is to observe slices of it.

#### **Activity:** Global vertical layers

See '02c.handout.atlsections.color' (<http://earthref.org/cgi-bin/erda.cgi?n=1008>)

or '02c.handout.atlsections.gray' (<http://earthref.org/cgi-bin/erda.cgi?n=1007>)

See '02t.handout.atlsections.answers' (<http://earthref.org/cgi-bin/erda.cgi?n=1012>)

Goal: Students interact with observations in the Atlantic to help them understand deep ocean currents and vertical layering.

Transition: We've talked about the structure in the Pacific, and you are now going to take a look at a slice through the Atlantic.

**Conclude:** How are the layers or currents in the Atlantic and Pacific similar or different?

Similar:

- Both are warmest at the surface. Both are coldest at the bottom.
- Both vary the most at the surface (biggest differences in temperature or salinity). Both have about the same temperature at bottom everywhere.
- Both have warm water near the equator. Both have temperature near the surface that changes quickly with depth.

Different:

- Salinity is higher in the North Atlantic near the surface and the bottom.

See also answers to #1 and #2 on the quiz '04t.handout.quiz.answers' (<http://earthref.org/cgi-bin/erda.cgi?n=1025>). It asks students to compare salinity in the Atlantic and Pacific.