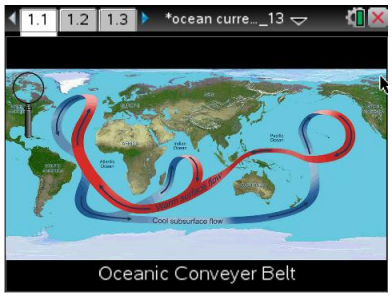
Science Objectives

- Students will investigate and discover relationships between temperature and salinity as the driving force behind the global conveyor belt.
- Students will differentiate the differences between surface currents and deep water currents.



Vocabulary

- thermohaline circulation
- upwelling
- density
- oceanic conveyor belt

About the Lesson

- As a result of this lesson, students will:
  - Discover that there is a global oceanic current system that is driven by changes in temperature and salinity.
  - Explain the process of upwelling and what effect it has on the current system.
  - Understand the impact thermal energy from the sun has on the current system.

TI-Nspire™ Navigator™

- Send out the *Ocean_Currents.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software
- *Note: Students should use the TI-Nspire computer software or TI-Nspire™ Apps for iPad® for an optimal experience with this lesson. Some images may be difficult to read on the handheld.*

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Ocean_Currents_Student.doc
- Ocean_Currents_Student.pdf

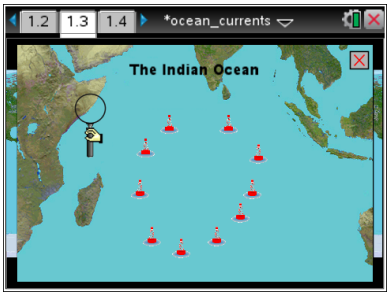
TI-Nspire document

- Ocean_Currents.tns

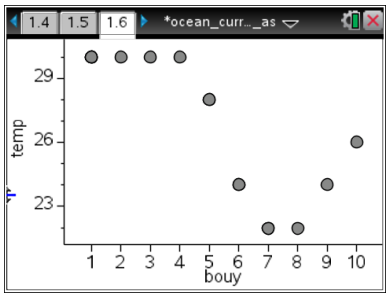
Discussion Points and Possible Answers

Have students read the background information stated on their activity sheet or in pages 1.2 - 1.3.

Move to pages 1.4 – 1.6.



1. Students should select the magnifying glass and then hover over the Indian Ocean. When doing so, a question mark will appear. Students should select to zoom in on the area. Doing so will bring up a series of buoys on their screen.
2. Using the same process as before, students should select the magnifying glass and select each of the buoys that appear on the screen. As the students select each buoy, a series of information will pop up displaying key data points. Students will record the data they collect onto their student activity sheet.

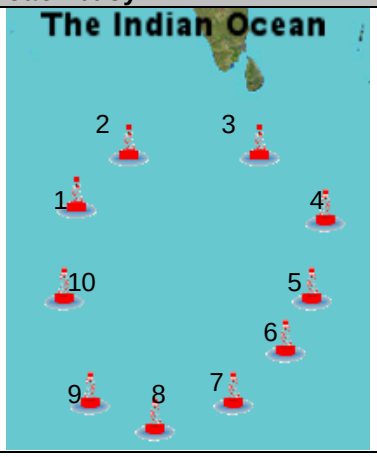


Note: The buoy data will be captured on the spreadsheet on page 1.5. It will also be graphed on page 1.6. If a student selects the reset function on page 1.3 (**Menu > Oceanic Circulation > Erase Measurements**), the data will be cleared from the spreadsheet and the graph.

Tech Tip: To access the Directions again, select > **Directions**

Tech Tip: To scroll through data in the spreadsheet on screen 1.5, students can press their finger anywhere on the screen and drag it up or down.

Tech Tip: To access the Directions again, select menu or **Document Tools ( ) > Ocean Currents > Directions.**

Buoy	Temp (° C)	Salinity (ppt)	pH	Wind	Place the number next to each buoy.
1	30°	35.4	8.06	SSE	
2	30°	35.2	8.08	ESE	
3	30°	34.4	8.07	ESE	
4	30°	34.4	8.02	ESE	
5	28°	34.4	8.08	ESE	
6	24°	34.8	8.10	ESE	
7	22°	33.8	8.08	ESE	
8	22°	33.8	8.10	SSW	
9	24°	35.0	8.12	SSE	
10	26°	35.0	8.09	SSE	

Move to pages 2.1 to 2.13.

Have students answer questions 1 - 13 in the .tns file, the activity sheet, or both.

Q1. On page 1.5, set the *y*-axis to temperature and the *x*-axis to buoy. What pattern do you notice?

Sample Answer: As you get closer to the equator, the temperature of the water increases. The further south you go, the temperature decreases.

Q2. Examine the oceanic conveyor belt shown on the main screen of page 1.3. When looking at the current located towards the west, closer to the coast of Africa, we can determine that this is a water current.

Answer: B. cold

Q3. As you increase the temperature of water (and keep other variables constant), what happens to the density of water?

Answer: B. The density decreases.

Q4. Why would temperature have an effect on the current system?

Sample Answer: Cold water will sink due to it being denser, while warm water will rise to it being less dense.

Q5. Upwelling is the process where cold, deep water returns to the surface and then becomes a shallow current. From examination of the ocean conveyor belt and buoy data, at which buoy is this process most likely to occur at?

Answer: A. buoy 2

Q6. Is there any observable pattern with the pH numbers from the different buoys?

Answer: B. no

Q7. Where is the cold water directly coming from before it gets close to the equator?

Answer: C. the south, near Antarctica

Q8. Does the wind pattern match the overall flow of the current?

Answer: B. no

Q9. What type of current is guided by wind?

Answer: B. surface current

Q10. Deep ocean currents flowing into the Indian Ocean are very salty. When these currents upwell to the surface, which of the following would likely increase in the region of water around the upwelling?

Answer: D. salinity

Q11. The water in an arctic region is very dense, causing it to sink down towards the ocean floor. This process is called **downwelling**. Which of the following best describes this water?

Answer: D. cold salty water

Q12. Which factors have an effect on upwelling and downwelling in ocean currents? (select ALL that apply

Answer: temperature and salinity

Q13. The current system is driven by a process known as **thermohaline circulation**. Using what you have learned throughout this simulation, explain what is meant by that term.

Sample Answer: Ocean currents are driven by changes in ocean temperature and salt concentration.

TI-Nspire Navigator Opportunities

Make a student a Live Presenter to illustrate show how to move use the magnifying glass. Throughout the activity, monitor student progress. At the end of the activity, collect the .tns file and save to Portfolio.

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment could consist of questions/problems on the chapter test or a performance assessment involving collecting local, buoy data online and analyzing it.