THE BIG CHILL: TEACHER GUIDE

Subject: Earth Science
Grade Level: Middle School
Last Updated: November 6, 2008

Case Summary

A young British boy thinks his mother might be going crazy. She insists on buying lots of winter clothes when it's the middle of the summer, and she thinks it's because global warming will make Europe much colder! Could she be right, or is she completely batty?

Credits

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This case uses the following *NY Times* article as a springboard and central resource:

Revkin, Andrew C. Scientists Say Slower Atlantic Currents Could Mean a Colder Europe. *The New York Times*, December 1, 2005.

If you do not have free access to the NY Times, this article can be purchased for $3.95 from www.nytimes.com. Should teachers be interested in the case but unable or not inclined to pay for access to the article, see the **Resources** section for several free online articles that, while not as high profile, can be substituted.

Learning Objectives

At the end of the case, students should be able to:

1. List the names of the major oceanic currents
2. Explain how ocean currents are part of a global oceanic system
3. Describe the interrelatedness of oceanic and atmospheric processes.
4. Differentiate between deep and shallow currents, & the influence of temperature on both.
5. Discuss the current popular "debate" surrounding global warming and efforts such as the Kyoto Protocol.
6. Label and indicate the directions of major oceanic currents on a map.
7. Explain how the conveyor belt of oceanic currents moves water around the globe.
8. Distinguish between deep and shallow currents and their movements.
9. Describe the impact of global warming on oceanic currents & the "conveyor belt."
10. Describe both (i.e. household) and international (i.e. multinational) efforts to combat global warming.

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Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

S6CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters. (NSES Content Standard A)

a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts. (For example: El Nino's effect on weather)

S8CS9. Students will understand the features of the process of scientific inquiry. (NSES Content Standard A)

S6E3. Students will recognize the significant role of water in earth processes. (NSES Content Standard D)

c. Describe the composition, location, and subsurface topography of the world's oceans.

d. Explain the causes of waves, currents, and tides.

S6E4. Students will understand how the distribution of land and oceans affects climate and weather. (NSES Content Standard D)

Assessment

Students will work in groups to create a product, such as a poster, power point presentation or 3D model that describes the dynamic relationship between climate change and ocean currents. The poster must contain a concise description of the problem, definitions of key terms and an illustrated world map (1) identifying all ocean currents and (2) highlighting those discussed in the NY Times article. Finally, it must include some discussion of how both individuals and countries can combat global warming.

Grading will be based on a 5-point scale (5=excellent, 4=very good, 3=good, 2=fair, 1=poor) for each of three criteria:

- Accuracy and depth of descriptions
- Individual contribution/participation within the team
- Individual research ability and effort – online, print, investigative questioning

The second and third criteria (participation, individual effort) will be judged not only by facilitator observations, but by student evaluations to be completed at the end of the case (*see* ***Self-Evaluation Worksheet*** *in Student Materials*).

Implementation Strategy

This case is designed to take place over one 60-minute class session and four 90-minute class sessions. It has two scripted scenes. This case can be facilitated by two facilitators or even a single teacher, because rather than placing a facilitator with every group, the students spend time brainstorming with their group and then as a whole class.

The brainstorming session described below involves students reading, discussing and taking notes in their groups in 10 minute blocks (totaling about 25 minutes per scene), then reconvening as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their questions, and/or test their hypotheses) at the end of every 10-minute block. During the group brainstorming, the teacher/facilitators float from group to group, checking progress and helping students with any stumbling blocks they may have. During the whole-class volunteering time, the teacher/one of the facilitators takes notes on an overhead or with a Smart Board. In this way, students can learn to work as a team while still benefiting from sharing their information as a whole class or even competing with other groups for volunteering, while the teacher can make sure that all students are at the same point in the case at each step.

Implementation Schedule

Day 1 (60 min.): Read scene 1 and brainstorm; fill out box chart. Receive *Times* article as a handout; read and brainstorm; fill out box chart.
Homework: Reread article and finish article box chart
Day 2 (90 min,): Computer Lab – Students will work in groups exploring websites provided by facilitators through a specially-designed PRISM-Columbia Middle webpage (www.prism.emory.edu/columbia_middle)
Homework: Continue research and be ready to show notes and discuss findings for next class.
Day 3 (90 min.): Share findings within groups and in whole-class discussion; read Scene 2 and brainstorm; fill out box chart; receive product assignment.
Weekend Homework: Draw a product blueprint, finish independent research.
Day 4 (90 min.): Start product, dividing up tasks among group members.
Day 5 (90 min.): Complete and turn in product; fill out case evaluations.

Case Notes

What Went Well

1. The topic: Global warming is all over the news, and so this was an issue that is already on students' radar, whether they take a major interest in it or not. It was therefore easy to incorporate a more complicated, oceanic perspective on global warming, and students were quick to pick up on the paradox of gobal warming making a region colder.
2. The webpage: We found that organizing online resources that we'd found during case design on the PRISM Columbia webpage (http://www.prism.emory.edu/columbia) allowed the students to conduct online research that, while free-form and independent, still provided some structure and expedience to the process. The fact that the students can access the webpage from any internet-capable computer also meant that students could continue their research at home, at the library, or other places outside of school.
3. The scene length: The scenes were short, easy to read and permitted the students to fill up their box charts quickly. This helped make for more time reading the article, which ended up being a lengthy process (See *What Could Have Gone Better #1*).
4. The posters: Students ended up working in their groups to produce a single poster describing the issues and oceanic mechanisms contributing to a colder Europe. They also

included some tips on how to slow or even stop global warming before the Atlantic conveyor currents slow beyond reversal.

What Could Have Gone Better

1. Pacing: The article's writing style was a little more advanced than what many of the students were used to reading, and so we ended up spending more time reading through the article for comprehension and connection to the case than we had allotted in the implementation plan. We would therefore recommend adding another day of implementation to allow for more time with the article.
2. Scene Reading: We had the students read the scenes aloud to each other in their groups, but given the scene layouts, the students would likely have enjoyed acting out the scenes as a whole class better.

Facilitator Guide:

Scenes with key concepts underlined:

Scene 1

Collin walked through a department store in downtown London with his mother, a confused look on his face. "Mum," he asked, "tell me again why we're here?"

Collin's mother replied, "You see, poppet, we need to buy plenty of nice warm sweaters and blankets for when the weather gets cold. Hurry along now, before all the warm woolens are gone." She grabbed his hand and led him down the store aisle to the winter clothes department.

"But Mum," Collin protested, "it's not winter. It's June, and it's really hot out! We've got plenty of sweaters at home. Can't we go to the beach instead?"

"Oh no, poppet, I'm afraid we can't. I read it in the newspaper. The weather in all of Europe is going to get quite cold before long. It's something to do with global warming, you see."

Global warming making Europe *cold*? Now Collin was really confused.

Scene 2

Collin logged off the internet, where he'd been reading the news, and shook his head. "Well Mum, it seems you were right after all. Global warming really might make the European climate much colder. And just think of the other damage it will cause to marine life and the climate elsewhere! It's just terrible."

Collin's mother nodded her head. "You see now why we need all of those sweaters, poppet. It's going to be very cold, and what with oil becoming so scarce, we'll need to keep warm somehow."

"But Mum," Collin said, "the article says that the cooling won't happen for at least ten years. That means we can stop it before it happens."

Collin's mother asked, "Well, that's all very well and good, but how do we do that?"

Collin thought for a moment, and then replied, "For one thing, maybe we should buy some compact florescent light bulbs instead of more sweaters. It's a good start."

Faciliator Box Charts With Key Concepts/Issues Included:

Scene 1 Facilitator Box Chart

Facts	Questions
1. Collin and mother are in department store 2. Department store is in downtown London 3. Collin's mom says they need woolens 4. Collins' mom says the weather will get cold soon 5. It is June, and it's hot out 6. Collin wants to go to the beach 7. Collin's mom says #4 is because of global warming (GW) 8. #4 is also because of ocean currents 9. Collin's mom says she read #7 in the newspaper 10. Collin wonders how global warming could make it cold 11. Collin wonders how ocean currents could make it cold	1. Where is London? (Latitude, Longitude) 2. What are woolens? 3. What is a poppet? 4. Why would the weather get cold? 5. Why would GW make it cold? 6. What newspaper did Collin's mom read? 7. Why would ocean currents make it cold?
Hypotheses	**Learning Issues**
1. GW would not make a region cold; Collin's mom is nuts 2. GW could make it cold; Collin's mom is right 3. Collin's mom read this in a tabloid	1. London's latitude & longitude 2. woolens 3. Poppet 4. global warming 5. ocean currents 6. Newspaper articles on global warming and ocean currents

Scene 2 Facilitator Box Chart

Facts

1. Collin logged out of internet news
2. Collin tells his mom she was right
3. GW could make European climate much colder
4. GW could also damage marine life & climate elsewhere
5. Collins' mom says they still need those sweaters
6. Mom says that oil is becoming scarce
7. Mom says they'll need to keep warm somehow
8. Collin says the climate change won't be for ~10 yrs.
9. Collin says there is still time to do something to help
10. Collin says they should buy compact fluorescent light bulbs (CPF)

Questions

1. What kind of damage to marine life?
2. What kind of damage to climate elsewhere?
3. Why is oil becoming scarce?
4. How will they keep warm if it gets cold?
5. What can be done to help prevent GW?
6. What are compact fluorescent light bulbs?
7. What do #6 have to do with preventing GW?

Hypotheses

1. GW will heat up ocean water and kill marine life
2. Other areas of the world will get cold as well
3. Some other areas of the world will get very hot
4. Conveyor currents could slow in other oceans
5. Oil is becoming scarce because it is non-renewable
6. GW could be prevented by
    a. Using cleaner fuels
    b. Driving less
    c. Using less energy
    d. Recycling
7. CPF bulbs help prevent GW because they use less energy

Learning Issues

1. GW damage to marine ecosystems
2. GW alteration of other oceanic currents
3. Oil scarcity
4. Preventing GW
5. Compact fluorescent light bulbs

Resources

Assembling the most useful of the following online sources as links on a webpage that the students can access in the computer lab or at home is a very efficient way to structure group or independent research. Also, the students should be encouraged to utilize their textbooks or other resources. These are some helpful resources that were included on our "The Big Chill" page of the PRISM website under 6th grade Cases (www.prism.emory.edu/columbia).

The New York Times Article (Given as a handout with Scene 2)

Revkin, Andrew C. (2005) Scientists Say Slower Atlantic Currents Could Mean a Colder Europe. *The New York Times*, December 1.

Helpful links

Gradwohl, Judith (2006) Ocean Currents: We all go with the flow. Retrieved November 6, 2008 from http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_currents_1.html

Scott, Lowell (2006) Ocean Currents and Climate. Retrieved November 6, 2008 from http://earth.usc.edu/%7Estott/Catalina/Oceans.html

Lippsett, Laurence (1997) Lamont's Broecker Warns Gases Could Alter Climate: Oceans' Circulation Could Collapse. Columbia University Record, Vol. 23, No. 11. Retrieved November 6, 2008 from http://www.columbia.edu/cu/record/23/11/13.html

Pew Center on Global Climate Change (2006) Global Warming – Kids Page. Retrieved November 6, 2008 from http://www.pewclimate.org/global-warming-basics/kidspage.cfm

U.S. Environmental Protection Agency (2004) Global Warming Kids Site. Retrieved November 6, 2008 from http://www.epa.gov/globalwarming/kids/gw.html

Sriniwasan, Margaret (2005) Ocean Surface Topography From Space: Topex/Poseidon Online Tutorial. Retrieved November 6, 2008 from http://topex-www.jpl.nasa.gov/education/tutorial.html

Wikipedia (2005) Gulf Stream. Retrieved November 6, 2008 from http://www.physicsdaily.com/physics/Gulf_stream

Office of Naval Research (2005) Ocean In Motion. Retrieved November 6, 2008 from http://www.onr.navy.mil/focus/ocean/motion/default.htm

University Corporation for Atmospheric Research (2001) Oceans and Seas. Retrieved November 6, 2008 from http://www.windows.ucar.edu/tour/link=/earth/Water/ocean.html&edu

Natural Hippie (2004) Global Warming or Ice Age??? Retrieved November 6, 2008 from http://www.naturalhippie.com/iceage.html

Finfacts Team (2005) Global Warming May Make Ireland Colder. Retrieved November 6, 2008 from http://www.finfacts.com/irelandbusinessnews/publish/article_10004110.shtml

Union of Concerned Scientists (1999) Global Warming: Early Warning Signs – The Impact of Global Warming in North America. Retrieved November 6, 2008 from http://www.climatehotmap.org/namerica.html

Energy Star (2006) Buy Products that Make a Difference: Compact Fluorescent Light Bulbs. Retrieved November 6, 2008 from http://www.energystar.gov/index.cfm?c=cfls.pr_cfls

Alliant Energy (2006) Saving Energy: Lighting. Retrieved November 6, 2008 from http://www.powerhousetv.com/stellent2/groups/public/documents/pub/phtv_se_li_bu_000562.hcsp

Product Resources

A blank world map can be printed and used as a template onto which students can draw in and label warm and cold ocean currents:

Ritter, Michael (2006) The Physical Environment: an Introduction to Physical Geography. Retrieved November 6, 2008 from http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/title_page.html

Primary greenhouse gas data over time for students to plot as a line graph and include in their posters (or brochures, power point presentations, etc.):

California Institute of Technology (2005) Analyzing Greenhouse Gases and Global Temperature Data Over Time. Retrieved November 6, 2008 from http://topex-www.jpl.nasa.gov/education/activities/ts1pcac1.pdf