The Ocean Influences Earth's Climate

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5th Grade NGSS Standards	**ESS2.A Disciplinary Core Idea:** Earth's major systems, the atmosphere, hydrosphere, geosphere, and biosphere, interact in multiple ways to affect Earth's processes. **ESS2.A Disciplinary Core Idea:** The ocean influences climate. **ESS2-1 Crosscutting Concept:** A system can be described in terms of its components and their interactions. **ESS2-1 Science & Engineering Practice:** A model can be used as an example to describe ways in which the atmosphere, hydrosphere, geosphere, and/or biosphere interact.
Materials	• Science notebooks and pencils for students • Water cycle physical models, American Educational Water Cycle Model, (or plastic salad container with lid), lids, "clouds", stands – ideally, 2 per table group of 4 students. • Before students arrive in room, set up each water cycle model. Label one model A, and the other model B, at each table. Pour cool water in the ocean section of Model B. Pour warmer water in A's ocean. (The warmer the water, the more evaporation, but be careful that it's a safe temperature for the children, and that it won't melt the plastic container.) Quickly place the lid on each model after adding the water. Tape closed. Place ice on the top of each lid above the ocean section. If using American Educational's model, place the plastic cloud above the ice to hide the ice from view and to slow the melting of the ice. If using a plastic salad container, just put a ZipLoc bag of ice on top of the lid. • Plastic salad container (if not using a purchased water cycle model) • Ice – 1 bag purchased from grocery store • Warm tap water • Blue food coloring – optional, if you want to color the ocean, a few drops in each ocean • Thermometers – optional, if you want the children to measure the ocean temperatures • Masking tape to tape lids closed and label the model A or B.

	• ZipLoc bags – 1 for each model, if not using American Educational Water Cycle Model • Small towels – 1 for each table group • Index cards – 1 for each child • Smartboard word splash: evaporation, condensation, precipitation, run-off, heat source • Computer: *NBC News, Flooding in Louisiana*, and *USGS Interactive Water Cycle*, accessed from class website: http://blogs.socsd.org/kchristieblick/science/earth-science/hydrosphere-all-washed-up/water-cycle/ (or any current news story about recent severe flooding)
Instructional Outcomes	**Teaching Points:** ● The atmosphere affects the hydrosphere, and the hydrosphere affects the geosphere and biosphere. ● Global warming is altering Earth's water cycle, which is having an impact on people. ● The ocean influences climate by altering the water cycle process. ● Creating and using models (physical, conceptual, computer) helps us understand complex concepts, such as the interaction between the atmosphere and hydrosphere. **Learning Objectives:** ● Students will draw and label a conceptual model of the water cycle. ● Students will create a cause-and-effect chain illustrating how global warming is increasing precipitation in some areas, due to warmer ocean water increasing evaporation.
Rationale	● If children understand how Earth's systems interact, they are better able to understand that when one system changes it causes a change in another of Earth's systems. ● If children understand that global warming is altering Earth's water cycle in ways that impact people's lives, they are more likely to take steps to help slow down global warming.
Introduction (5 min)	*(Physical water cycle models are set up at each table before beginning of class.)* **Today we're going to explore the hydrosphere more in depth.** Turn-and-talk: **What is the water cycle? How does it work?**

	Throughout today's lesson, I want you to think about how the water cycle impacts your life, in both good and bad ways. Turn-and-talk: **What if the cycle changes in some way? What might cause it to change? How could it change? How would it affect you?**
Lesson (16 min) Half-Way Teaching Point (12 min)	**1) Today, you're going to use physical models to look at a closed system at work. Keep the lids on. Look through the sides, or wherever you can see inside the miniature world the best. First let's observe model A. Discuss with your group what's happening inside and why.** **What do you observe in Model A? Look through the sides as you tap on the lid. What happens? What happens next?** It's difficult to see, due to the evaporation and subsequent condensation on the plastic, but children will recognize the water cycle: evaporation, condensation, precipitation, and run-off. **2) In your science notebook, draw a conceptual model of this water cycle. Be sure to use scientific labels.** Teacher points to word splash on Smartboard. **Draw arrows to show the action.** **Now write a one-paragraph description of what's happening at each stage. Discuss it with your table group. Make sure everyone agrees.** Formative Assessment: Teacher circulates, assessing who needs extra guidance. **3) Now observe Model B. Compare what's happening in Model B with Model A. Discuss possible reasons for the differences.** Teacher continues to circulate around the room prodding and questioning, making sure students are citing evidence and using valid reasoning. **4) How could we find out if your hypotheses are correct?** Teacher allows students to open the lids and compare the temperatures of the oceans, revealing that A's ocean water is warmer than B's ocean water. **How does water temperature affect the amount of rain we get**? (The warmer the ocean, the more evaporation, the more rain.) **What warms ocean water? Can you guess where this line of reasoning is headed? What does all of this have to do with global warming?**

	5) Show students the NBC News segment about a recent unusually severe flooding event. **This type of prolonged heavy rain is unusual for this area. Global warming is causing intense rainstorms like never before in many places around the world. It's causing climates to change because it's altering the water cycle.** **6) Draw another model that shows how this scientific phenomenon works. Create a 5-step cause-and-effect chain: global warming to flooding.** Formative Assessment: Teacher circulates, assessing who needs extra guidance. Review together: Global warming→warmer ocean→increased evaporation→increased precipitation→ flooding. Extension: If time, teacher may want to have students visit USGS's *Interactive Water Cycle* website. This extends information about the water cycle, and helps students to see the complexities of the water cycle. (See URL in Materials list.)
Closure & Student Self-Assessment (7 min)	**How can we reduce the number of fierce rainstorms? Think about the cause to come up with an answer.** Turn-and-talk. (Slow down global warming.) Teacher sums up the lesson and students' ideas. Teacher hands out an index card to each student. **Write your name. Explain why some parts of the U.S. are having this weird, wacky weather with torrential rainstorms. You can also write if you're confused about any part, or what else you wonder about the water cycle. It's your Exit Ticket.**