Currents and Climate Lab: NYSSLS Alignment

Teacher guide for the student worksheet at mrsajdak.com/currents (two pages, 16 questions; a low-write version has the same numbering). Environmental Science, Lesson 6.1: What Factors Influence Climate? (SE pp. 161-166). Plan-book objective ES.2.6.4: students will be able to explain how solar energy, air circulation, and ocean currents produce climate patterns. It is the virtual version of the lesson's hands-on lab, Currents in a Box: Tab 1 is the same box (ice at one end, hot red water at the other), and Tabs 2 and 3 carry it out to the real Atlantic. © 2026 Ryan Sajdak. Free to use, share and change under CC BY-NC-SA 4.0 (creativecommons.org/licenses/by-nc-sa/4.0): give credit, do not sell it, share your version the same way.

Objectives

The three statements printed at the top of the worksheet, each with a box to tick, are the lesson's own I-can statements (the third is shortened; the lesson's version adds greenhouse gases, which the lesson teaches and this lab does not).

I can	Questions
use a model to show how uneven heating makes water move in a loop.	1 to 6
explain how an ocean current carries heat and changes the climate of a coast.	7 to 11, 16
explain how Earth's spin bends the winds.	12 to 15

Performance expectations

The plan book tags this lesson with the first two. The lab gives evidence toward them; it does not fully assess any one.

> **HS-ESS2-5**
> *"Plan and conduct an investigation of the properties of water and its effects on earth materials and surface processes."* Worksheet link: Part 1 is a planned comparison of four setups with a control (Q1 to Q3), and its Learn It is about a property of water: cold and salty water is denser and sinks, which drives currents.

> **HS-ESS2-7**
> *"Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth."* Worksheet link: light. Students argue from evidence (Q16), and the climates they find set up the next lesson, where climate decides which biome grows where.

> **HS-ESS2-4**
> (an addition: not in the plan book's tags, but the closest fit for what the lab does) *"Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate."* Worksheet link: Tab 1 and Tab 3 are models of how heat is carried from warm places to cold ones; Tab 2 shows the result in real January temperatures.

DCI ESS2.D Weather and Climate: *"The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space."* ESS2.C The Roles of Water in Earth's Surface Processes (water's properties, density and the ocean's role in moving heat).

The district section

The BPS Unit 2 doc lists for 6.1 the teacher's edition Demo: Convection (cold food coloring in heated water), the Quick Hands On: Coriolis Effect, Interpret Visuals: Influence of Ocean Currents (the United Kingdom against eastern Canada), Ready To Go: Factors that Affect Water Circulation, Science Talk: George Hadley, Scientific Factors (the conveyor belt) and the Misconception: The Greenhouse Effect. Tab 1 is the convection demo, Tab 2 is the UK-and-Canada question with real data, Tab 3 is Hadley cells and the Coriolis effect. **Additions** beyond the district list: the real January sea temperature map, the seven city climates and the satellite winds. The greenhouse effect and the paper-plate Coriolis activity stay in the lesson, not the lab.

Opening: pick a phenomenon

The slideshow opens with a menu. Pick one opener per class, or run two back to back. All three end at the same Observe, Wonder, Predict slide and the same driving question (“Why are some coasts mild and others frozen, at the same distance from the equator?”), and the revisit at the end works with any of them.

Option	What happens
A. Video The Ocean on the Move, 1 to 3 min	1. Perpetual Ocean: “NASA | Perpetual Ocean”, NASA Goddard, 0:00 to 2:00 (youtube.com/watch?v=CCmTY0PKGDs); 2. Currents and temperature: “Sea Surface Currents and Temperature”, NOAA SOS, 0:00 to 0:25 (youtube.com/watch?v=2_EVJAi_Hrs); 3. An iceberg in Labrador: “Ice Berg grounded Lanse au Loup, NL.”, Mark Normore, 0:00 to 0:31 (youtube.com/watch?v=32Y_D2B5hTk). No narration on Clip 1 (music only). Do not name the currents yet; the lab and the lesson do. Clip 1 opens on the Gulf Stream off North America; stop it at 2:00. Clip 3 is a phone video (tall, with bars) of an iceberg at L’Anse au Loup, Labrador, near 51.5° N, the same latitude as London; preview it first. All three were checked only by title and length when this menu was written: watch them before class.
B. Try it Hot Over Cold, 4 min	Fill one small jar to the brim with hot tap water and 3 drops of red food coloring. Fill a matching jar to the brim with ice water and 3 drops of blue food coloring. Lay an index card over the cold blue jar. Hold the card, turn the jar over, and set it on top of the hot red jar. Hold the jars over a tray. Slide the card out slowly. Watch for one minute. **You need:** Two matching small jars (baby food or spice jars); hot tap water and ice water; red and blue food coloring; an index card and a tray or towel. Do not explain it. Cold blue water on top sinks into the hot red water and the jars turn purple within a minute. If time allows, run it the other way (hot on top) with a second pair of jars: the colors stay apart. Ask "Which water is heavier?" and leave it for the box. Have towels ready; a teacher or the aide does the flip.
C. Photos Two Coasts in Winter, 3 min	Hyde Park, London (51.5° N) in January, green grass and no snow, beside a NASA satellite view of the Labrador coast (near Cartwright, 53.7° N) in late February, packed with sea ice. A quiet minute to look, then Observe, Wonder, Predict.

Part by part

Part	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	What students do
1. Currents in a box Q1 to 6	SEP 3 Planning and carrying out investigations SEP 2 Developing and using models	ESS2.C; ESS2.D	Stability and Change	Run four setups (ice + hot water, ice only, hot water only, neither) to 6 minutes and one to 20 minutes. Explore: Q1 to Q3 (times, temperatures, loop speed, the control). Learn It: density, convection, the loop needs a cold end, salt, the box as a model. Apply: Q4 to Q6.
2. Two coasts Q7 to 11	SEP 4 Analyzing and interpreting data SEP 6 Constructing explanations	ESS2.D	Patterns; Stability and Change	Record seven real places (three same-latitude pairs plus Buffalo) on a real January sea temperature map. Explore: Q7 and Q8 (the east side is warmer in every pair; the sea next to it is warmer). Learn It: ocean currents, the Gulf Stream and North Atlantic Drift, the Labrador Current, latitude is not the whole story, the conveyor belt. Apply: Q9 to Q11, including the Bergen prediction.
3. Winds on a spinning Earth Q12 to 15	SEP 2 Developing and using models SEP 4 Analyzing and interpreting data	ESS2.D	Cause and Effect	Record real satellite winds at 15°, 30°, 43° and 66° N, then compare a no-spin model and a spinning model with them. Explore: Q12 and Q13. Learn It: Hadley cells, sinking air at 30°, the Coriolis

				effect, trade winds, westerlies and polar easterlies, winds pushing the currents. Apply: Q14 and Q15.
Wrap it up Q16	SEP 7 Engaging in argument from evidence	ESS2.D	Energy and Matter	Argue against “how warm a place is depends only on how far it is from the equator” with one real pair and one way heat is carried.

Also in play

- **Explore, then explain, then apply:** each part opens with data questions (Q1 to 3, Q7 and 8, Q12 and 13). A READ FIRST line then sends students to the green **Learn It** box, which opens once they have the data (Tab 1: four runs and the 20-minute run; Tab 2: the six coast cities, Buffalo and the currents shown; Tab 3: four latitudes and both models). Density, convection, ocean current, the conveyor belt, Hadley cell, Coriolis effect and prevailing wind are all taught there before they are asked. In Tab 2 the currents are labelled only “warm” or “cold” until the Learn It opens; then they carry their names.
- **With the hands-on lab:** run the real box first; the lab's Tab 1 then checks the class's numbers against a fixed model and adds the 20-minute run the class has no time for. For absent students, Tab 1 stands in for the box. The lab does not use the lesson's exit items (a bottle off Florida; “the greenhouse effect is all bad”), so they stay fresh.
- **Misconceptions:** “latitude alone decides how cold a place is” (Q8, Q10, Q16: London is 35°F warmer than Cartwright in January); “heat rises” (Q4: warm water rises because the denser cold water sinks under it); “the wind blows from the south because it is going north” (Q14: the Coriolis effect bends it to come from the west).
- **Nature of models:** Tab 1 is a fixed model shaped to behave like the classroom box, not a measured run; its times and temperatures are realistic, not exact. Tab 2 is measured. The current arrows are drawn by hand from standard maps. Tab 3's model views are the simple three-loop picture; the real winds are measured and show where it holds (the trade winds and westerlies) and where it does not (weak, variable winds near 30° N; land is not in the satellite record).
- **Builds on:** the Chapter 6 introduction (sun angle, latitude, weather and climate). **Leads into:** 6.2, terrestrial biomes, where these climate patterns decide what grows where.

Standards text quoted from the New York State P-12 Science Learning Standards (NYSED). Data: World Meteorological Organization climate normals 1991-2020, NOAA National Centers for Environmental Information archive (accession 0253808): London Heathrow, Bordeaux-Mérignac, Yarmouth, Cartwright, Reykjavík, Iqaluit, Bergen (Florida) and Buffalo; NOAA Optimum Interpolation Sea Surface Temperature v2.1 (Huang and others, 2021), January 1991-2020, every sixth day, 0.5° grid, through NOAA CoastWatch ERDDAP (ncdcOisst21Agg); NASA/JPL QuikSCAT SeaWinds monthly 10 m winds, 2000 and 2002-2008, through NOAA CoastWatch ERDDAP (erdQSwindmday). Gulf Stream speed: NOAA National Ocean Service, “How fast is the Gulf Stream?” (about 6.4 km/h on average). Conveyor belt: NOAA National Ocean Service currents tutorial (about 1,000 years for one trip). The answer key is a separate file, kept off the public site.