Niagara River Current Lab: NYSSLS Alignment

Teacher guide for the student worksheet at mrsajdak.com/niagara (two pages, 16 questions). Environmental Science: water resources and renewable energy. It also fits Earth science (surface water) and physics (flow rate, energy conversion). Plan on one class period, or two if students do every calculation by hand. © 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 same two statements are printed at the top of the worksheet, each with a box to tick.

I can	Questions
use width, depth and speed to explain why a river runs fast in some places and slow in others.	1 to 6, 14, 15
use flow numbers to weigh the costs and benefits of sending river water through power plants.	7 to 13, 16

Performance expectations: building toward

The lab and worksheet give students evidence for these performance expectations. They are one step on the way, not a full assessment of either.

> **HS-ESS3-1**
> *"Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity."* Worksheet link: a 99 m drop between two Great Lakes and a steady 5,800 m^3/s make Niagara one of the best hydropower sites on Earth; students find the missing water (Q6), trace it through the plants (Q7, Q8, Q12) and turn it into megawatts and homes (Q10, Q11).

> **HS-ESS3-2**
> *"Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios."* Worksheet link: students compare the daytime and overnight splits and the two extremes (Q7, Q10), name who is affected when the gorge runs low (Q9), and argue for a split of their own with numbers and a stated cost (Q16).

DCI ESS3.A: *"All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors."* The 1950 Niagara Treaty is the social regulation here: two countries agreed on how much water the falls must keep.

Part by part

Part	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	What students do
1. Measure the river Q1 to 6	SEP 5 Using mathematics and computational thinking SEP 4 Analyzing and interpreting data	ESS2.C the roles of water in Earth's surface processes	Scale, Proportion, and Quantity; Patterns	Read width, depth and speed at six lines across the river, compute area and flow, and find that flow stays the same while speed changes 18-fold: a small cross-section means fast water. Find that about half the river is missing between Grand Island and Lewiston.
2. Share the water Q7 to 11	SEP 4 Analyzing and interpreting data SEP 5 Using mathematics and computational thinking	ESS3.A natural resources PS3.B conservation of energy and energy transfer	Energy and Matter; Cause and Effect	Compare the treaty daytime flow with a typical night, read how the gorge changes, set the two extreme splits, and check the lab's power figure by hand.

3. Ride the river Q12 to 15	SEP 2 Developing and using models SEP 4 Analyzing and interpreting data	ESS2.C	Systems and System Models	Release ten floats that each carry a tenth of the flow, count how many reach Lake Ontario, and compare with the percent diverted. Time one float through three stretches and compute its speed in each.
Wrap it up Q16	SEP 7 Engaging in argument from evidence	ESS3.A	Cause and Effect	Choose a split, defend it with two numbers and name its cost.

Running it

- **Timing:** Part 1 takes the longest (12 multiplications). With calculators, about 20 minutes for Part 1 and 10 to 12 each for Parts 2 and 3. Pairs work well: one reads the screen, one computes.
- **It is deterministic.** Tab 1, the Daytime and Overnight buttons and the floats give every student the same numbers every time, so the answer key is exact. Only **Right now** (live gauges, Tab 2) changes; it is not on the worksheet.
- **Sticking points:** students multiply width by speed and skip depth (point to the cut-open river under the map); they expect the widest place to be the slowest (Station 2 is the widest, Station 4 is the slowest: it is area, not width); in Q14 they divide the checkpoint numbers themselves and forget to subtract first.
- **Units:** the lab is in metric. The treaty is written in cubic feet per second: 100,000 cfs is 2,832 m^3/s and 50,000 cfs is 1,416 m^3/s. 1 m/s is about 2.2 mph, so the Whirlpool Rapids run about 11 mph.
- **Tap the water.** Any spot on the river gives a speed and a depth. A good extra: who can find the fastest water on the map?

Also in play

- **Explore, then explain, then apply:** each part starts with data questions (Q1 to 3, Q7, Q12). A READ FIRST line on the sheet then sends students to the blue **Learn It** box in the lab, which opens once they have the data, before the questions that use the ideas (Q4 to 6, Q8 to 11, Q13 to 15; Q14 is data again). The slideshow has a matching Learn It slide at each point. Taught there before they are asked: conservation of matter, flow = area × speed, the intakes and tunnels, potential to kinetic to electrical energy, costs and benefits, tracers, sample size and average speed.
- **Misconceptions:** "fast water means more water" (Q4 to Q6: the fastest station carries half the flow of the Peace Bridge); "a river speeds up as it goes downhill, like a ball" (the pool below the falls is the slowest water on the river); "the falls are natural, so nobody controls them" (Q7: people turn them down every night).
- **Nature of models:** nobody publishes the currents of the Niagara, so this is a computed flow field. The bed comes from NOAA chart soundings; the model was checked against the measured split around Grand Island and the measured drop between two gauges. Rapids depths are worked out from the slope of the water surface and are good to about a quarter. Station speed is flow divided by area, the standard definition, so area × speed returns the flow. The overnight flow (1,850 m^3/s) is what the gauge below the falls usually reads at night, a little above the treaty minimum. The power figure (0.8 MW for each m^3/s) is 90 m of fall at 90% efficiency for both countries' plants; real output depends on each plant. In Part 3 the floats stop at the intakes. The American and Horseshoe falls are not counted apart, because ten floats are too few to split a 10% share.
- **Extensions:** the live map at ryansajdak.com/greatlakes/niagara/current; how far the falls have moved and where they are headed at ryansajdak.com/greatlakes/niagara/future; why the water level in the gorge is a safety issue for people fishing below the plants.

Standards text is that of the Next Generation Science Standards, which the New York State P-12 Science Learning Standards follow for these performance expectations. Sources: the Niagara River Water Diversion Treaty (1950), Article IV, for the flows the falls must keep; International Niagara Board of Control reports for the split between the two countries' plants; NOAA electronic navigational charts for depths; Environment and Climate Change Canada gauge 02HA013 (Fort Erie) and NOAA gauge 9063007 (Ashland Avenue) for flow; USGS 3DEP lidar for the water surface in the gorge. The answer key is a separate file, kept off the public site. Teachers can ask for it by email: rsajdak@buffaloschools.org.