Same Sun, Different Climates Lab: NYSSLS Alignment

Teacher guide for the student worksheet at mrsajdak.com/sunangle (two pages, 16 questions; a low-write version has the same numbering). Environmental Science, Chapter 6 introduction and Lesson 6.1: What Factors Influence Climate? Plan-book objective ES.2.6.1. It is the virtual version of Day 1, "Same Sun, Different Climates": Tab 1 is the paper-tube flashlight test, and Tab 3 uses the same five cities and the same Houston prediction as the lesson. © 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 objectives, word for word.

I can	Questions
measure how the angle of light changes the area it covers.	1 to 5
explain why the equator is warm and the poles are cold.	3, 4, 6 to 11, 16
tell weather from climate and use data to predict a city's climate.	12 to 15

Performance expectations

The district unit doc lists these for Chapter 6, and the Day 1 plan cites 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 fair test (Q2: one variable changed, two held). The water piece is small on Day 1: the Learn It in Part 3 uses Anchorage, which sits by the ocean and has a smaller summer-to-winter gap than Buffalo (42.7°F against 46.2°F), to show water evening out temperature. Ocean currents are previewed, then taught later in Lesson 6.1.

> **HS-ESS2-7**
> *"Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth."* Worksheet link: context only. Students argue from evidence (Q10, Q16), and the climate zones they find in Part 3 set up Day 2, where climate decides which biome grows where.

> **HS-ESS2-4**
> (an addition: not in the district list, 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 2 is a model of incoming sunlight by latitude and season; Q9 separates the distance effect (about 6%) from the angle effect (about 1.9 times) in Buffalo.

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."*

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, and the revisit at the end works with any of them.

Option	What happens
A. Video The Midnight Sun, 2 to 4 min	1. Alaska, June night: "Midnight Sun in the Arctic (Time-Lapse)", PolarTREC, 0:00 to 0:34 (youtube.com/watch?v=Sl6DbRoX9X4); 2. Honolulu, noon: "Time-lapse, Lahaina Noon, Honolulu May 26, 2020", Custom Island Tours, 0:04 to 2:06 (youtube.com/watch?v=DO1AvNAqv18); 3. Norway, June and December: "Winter and summer solstice, Tromsø, Norway", atomsmurf, 0:00 to 0:29 (youtube.com/watch?

	v=XNiX1kZhd5c). No narration on Clips 1 and 3; mute Clip 2 if it has music you do not want. Do not explain. Clip 1 is Toolik Field Station, Alaska (68° N), June 15 to 16: the sun skims the horizon and never sets. Clip 2 is "Lahaina Noon": the sun is straight overhead, so the shadow of the ring falls right under it. Clip 3 shows Tromsø, Norway at the same hour on June 21 and December 21 (midnight sun and polar night). Clips 1 and 2 together are the best pair: one low sun, one overhead sun.
B. Try it Light on a Ball, 3 min	Dim the room. Hold a ball at the front: a globe, a basketball or any light-colored ball. From about 2 meters away, shine one phone flashlight straight at the middle of the ball. Look at the light in the middle of the ball. Then look near the top. Tip the top of the ball a little away from the light. Watch the top again. **You need:** A ball, light-colored if you have one; one phone flashlight; the room lights off or down. Do not explain it. Students say what they see; the lab measures it. Same light, same ball: the middle is bright and the top is dim and smeared. Tipping the top away is a preview of seasons and the dark Arctic winter. Ask "Which part of the ball is like the equator? Which part is like Utqiagvik?"
C. Photos Two Beaches, One Sun, 3 min	A warm beach and an icy beach under the same sun. The original opener: 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. The flashlight test Q1 to 5	SEP 3 Planning and carrying out investigations SEP 5 Using mathematics (ratios)	ESS2.D	Scale, Proportion, and Quantity	Hold a 5 cm light 8 cm from an X and tilt it to 90°, 45°, 20° and an angle of their choice. Count the squares more than half lit (19, 28, 58), compare to straight down, and see the light on each square fall. Learn It names energy per square meter and links the angles to a high and a low sun.
2. A tilted Earth Q6 to 11	SEP 4 Analyzing and interpreting data SEP 2 Developing and using models SEP 5 Using mathematics	ESS2.D; ESS1.B (Earth's orbit and tilt)	Cause and Effect; Patterns	Record Buffalo in January and July, and three latitudes in March: distance, sunlight reaching Earth, noon sun and sunlight on each square meter. Learn It teaches latitude, the round Earth, the tilt and seasons, and that Earth is closest to the sun in January. Students divide to compare the two effects and explain polar night.
3. Five cities Q12 to 15	SEP 4 Analyzing and interpreting data	ESS2.D	Patterns; Stability and Change	Plot real 1991 to 2020 normals for Singapore, Miami, Buffalo, Anchorage and Utqiagvik against the March noon sun; read a real year of Buffalo weather against its normal line. Learn It teaches weather, climate and the three climate zones (shown on the map once it opens). Predict Houston, then check.
Wrap it up Q16	SEP 7 Engaging in argument from evidence	ESS2.D	Cause and Effect	Argue against "the poles are cold because they are farther from the sun" with one number from the model and one from real data.

Also in play

- **Explore, then explain, then apply:** each part opens with data questions (Q1 and 2, Q6 and 7, Q12 and 13). A READ FIRST line then sends students to the green **Learn It** box in the lab, which opens once they have the data (Tab 1: three angles counted; Tab 2: Buffalo in January and July, three places in March; Tab 3: five cities plotted and the 2025 weather viewed). Energy per square meter, latitude, tilt, weather, climate and the climate zones are all taught there before they are asked.
- **With the hands-on day:** use the lab after the paper-tube test as a check (the model's 19, 28 and 58 squares match the plan's typical 20, 28 and 58), or in place of it for absent students and make-up work. It does not use the lesson's exit items (the tilted solar panel, Punta Arenas), so they stay fresh.
- **Misconceptions:** "the poles are cold because they are farther from the sun" and "summer is when Earth is closest" (Q9, Q10, Q16: closest on January 3, and the angle swing is about 1.9 times against a 6% distance swing); "a cold day means the climate is changing" (Q13: Buffalo's 2025 had days 20°F off normal but the year came out 0.7°F above it).
- **Nature of models:** Tab 1's "100 units of light" is made up; the squares are real geometry. Tab 2 sunlight is at the top of the air at noon, before clouds and a long path through the air take their share, so ground values are lower, especially at a low sun (the Learn It in Part 1 says so). Noon sun heights are for the 21st of each month. Tab 3 is measured.
- **Numbers that differ from the lesson's table:** the lesson lists Singapore at about 82°F (the National Environment Agency's daily mean). The lab averages the high and the low, the way NOAA does for the US cities, which gives 82.9°F. Houston comes out 70.5°F (the lesson says about 71).
- **Builds on:** the Chapter 5 unit. **Leads into:** Day 2, how temperature and rainfall decide which biome grows where, and the rest of Lesson 6.1 (air and ocean currents, rain shadows).

Standards text quoted from the New York State P-12 Science Learning Standards (NYSED). Data: NOAA NCEI U.S. Climate Normals 1991 to 2020 (Miami, Buffalo Niagara, Anchorage, Utqiagvik/Barrow and Houston Intercontinental airports) and Buffalo's 2025 daily temperatures, both through the Applied Climate Information System (rcc-acis.org); National Environment Agency, Singapore, Changi Climate Station monthly mean daily maximum and minimum temperatures, 1991 to 2020 (data.gov.sg). Earth's tilt 23.44°, orbital eccentricity 0.0167, solar constant 1,361 W/m^2. The answer key is a separate file, kept off the public site.