Two Numbers Make a Biome Lab: NYSSLS Alignment

Teacher guide for the student worksheet at mrsajdak.com/biomes (two pages, 18 questions; a low-write version has the same numbering). Environmental Science, Chapter 6 introduction (SE pp. 156-157), Lesson 6.1: What Factors Influence Climate? (pp. 161-166, the rain shadow) and Lesson 6.2: What Are the Major Types of Terrestrial Ecosystems? (pp. 167-179). Plan-book objective ES.2.6.1. It is the virtual version of Day 2, "Two Numbers Make a Biome": Tab 1 is the paper climate card sort with the same ten cards (A to J), the same 1991 to 2020 normals and the same six loops, and Tab 4 uses the same cards K (Buffalo) and L (Turpan) and the same 15-inch drier Buffalo. © 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, word for word.

I can	Questions
place real climate data on a grid and find the groups.	1 to 3, 6, 7, 14, 15
explain how temperature and precipitation decide which biome grows.	4, 5, 8, 9, 16 to 18
explain why rainforests and deserts are where they are.	10 to 13

Performance expectations

The district Unit 2 doc lists HS-LS2-2, HS-LS2-7, HS-ESS1-1, HS-ESS2-5, HS-ESS2-7 and HS-ESS2-8 for Chapter 6; the Day 2 plan cites HS-ESS2-7 and HS-ESS2-5. The lab gives evidence toward them; it does not fully assess any one.

> **HS-ESS2-7**
> *"Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth."* Worksheet link: the closest fit. Climate sets what can grow (Parts 1 and 2), plants are built for their climate (Q8), and students argue from evidence that a desert is about rain, not heat (Q9) and that latitude alone does not set a biome (Q18).

> **HS-ESS2-5**
> *"Plan and conduct an investigation of the properties of water and its effects on earth materials and surface processes."* Worksheet link: touched only through precipitation. Part 3 models rising air dropping its water as it cools and the rain shadow (Q10 to Q13).

> **HS-LS2-6**
> (an addition for Chapter 6: the district doc lists it under Chapter 5, in the same unit) *"Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem."* Worksheet link: the drier Buffalo (Q15 and Q17). A forest stays a forest while its climate holds; 15 inches a year for a century lands it in the grassland range. This is the plan's CCC 7 question.

DCI ESS2.D Weather and Climate, and ESS2.C The Roles of Water in Earth's Surface Processes (the district doc's DCIs for HS-ESS2-7 and HS-ESS2-5). District core ideas for Lesson 6.2: "Describe how climate and vegetation vary with latitude and elevation" and "Identify the types of deserts, grasslands, and forests." For Lesson 6.1: "Define the rain shadow effect and explain how it affects climate."

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 Over the Mountains, 2 to 4 min	1. Drive over the Cascades: “Cascade Mountains: Rain to Rain Shadow”, Patrick Budde, 0:00 to 2:30 (youtube.com/watch?v=0MjJdX_wovg); 2. On top of a ridge: “Rain shadow effect from the summit of Mt. Townsend”, ExploreOlympics.com, 0:00 to 0:23 (youtube.com/watch?v=WVUvK9WdNv8); 3. The Hoh Rain Forest: “Olympic National Park, America’s National Parks”, National Geographic, 1:16 to 1:42 (youtube.com/watch?v=NEMQdNYbBds). Mute the sound. Clip 1 is a phone video, so it is tall with black bars at the sides. Do not explain the rain shadow yet; the lab follows air over a mountain in Part 3. The drive ends in Yakima, next to Cowiche Canyon (the dry trail in the photos). Clip 3 is National Geographic: preview it first; stop at 1:42 before it moves on to otters.
B. Try it Cold Can, Warm Can, 4 min	Set two cans or bottles on a desk: one straight from ice water or the fridge, one at room temperature. Dry both with a paper towel. Wait one minute. Breathe slowly on each one from close up. Run a finger down each one. Which is wet? **You need:** Two cans or bottles that match; ice water or a fridge (20 minutes ahead); a paper towel. The water comes out of the air: when air cools, water vapor turns to drops. Do not say so yet. When the lab follows air up a mountain (rising air cools and drops its rain), point back to the cold can. Pacific air climbs the mountains above the Hoh Rain Forest and cools like the air beside the cold can.
C. Photos Two Trails, One State, 3 min	A mossy rainforest and dry hills, about 200 miles apart. 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 card sort Q1 to 5	SEP 4 Analyzing and interpreting data	ESS2.D	Patterns	Put Forks and Yakima on the grid, then place ten real climate cards by yearly temperature (across) and precipitation (up), by dragging or by tapping. Loop the cards that land together; the lab refuses mixed loops with the plan's own hints. Open the strips to read each place and what grows there. Learn It teaches biome, precipitation and the two numbers.
2. The biome map Q6 to 9	SEP 4 Analyzing and interpreting data SEP 7 Engaging in argument from evidence	ESS2.D; LS2.C	Patterns; Structure and Function	Show the biome regions on the same grid, pick each biome (a drawing, its temperature and precipitation range, what grows, which cards sit there), and look closer at the Gobi and Phoenix. Learn It teaches the six biomes, how a cactus, a spruce, a maple and tundra plants are built for their climate, and that a desert is defined by little precipitation.
3. Rising air, rain shadows Q10 to 13	SEP 2 Developing and using models	ESS2.D; ESS2.C	Cause and Effect	Follow a parcel of air up at the equator, across the top and down near 30° N, recording its temperature and the water it carries. Move a marker to read rising and sinking air. Then raise a mountain range from 0 to 6,000 ft and record rain on each side. Learn It teaches rising air and rain, sinking air and deserts, the rain shadow, and Forks and Yakima.
4. Buffalo and city L Q14 to 17	SEP 6 Constructing explanations	ESS2.D; LS2.C	Stability and Change	Place Buffalo and a mystery city at 43° N, read their biomes, then make Buffalo drier (30, 15, 5 inches) and see it move from forest to grassland to desert. Learn It

				reveals Turpan and teaches that a biome lasts as long as its climate.
Wrap it up Q18	SEP 7 Engaging in argument from evidence	ESS2.D	Patterns	Argue against "latitude decides the biome" with a same-latitude pair and a far-apart, same-biome pair.

Also in play

- **Explore, then explain, then apply:** each part opens with data questions (Q1 to 3, Q6 and 7, Q10 and 11, Q14 and 15). A READ FIRST line then sends students to the green **Learn It** box under the lab, which opens, glows and offers "Take me there" once the steps listed in it are done. Biome, precipitation, the six biomes, built for the climate, desert, rising and sinking air, rain shadow and Turpan are all taught there before they are asked.
- **With the hands-on day:** the cards, numbers and loops are the paper sort's, so the lab works as a check after it, or in place of it for absent students and make-up work. It does not use the lesson's exit items (the 79°F, 95-inch place; the dry side of a mountain), so they stay fresh.
- **Misconceptions:** "deserts are always hot" (Q7, Q9: the Gobi at 42°F); "latitude alone sets the biome" (Q2, Q16, Q18); "far-apart places can't be alike" (Q5: Hilo and Manaus).
- **Additions beyond the district doc and the plan:** the lab names a seventh region, temperate rainforest, only because Forks sits in it (the plan holds it back; it is never asked on the sheet). The two Tab 3 models are the lab's own: their numbers are round values chosen to show the pattern (80°F, –100°F about 10 miles up, 75°F at 30°; water held halves for every 18°F of cooling) and a made-up rain-shadow rule (water left at the top = 0.2 to the power of height ÷ 6,000 ft; ocean side 40 + 100 × (1 – left) inches, far side 40 × left), set so 6,000 ft gives Forks's 120 and Yakima's 8. HS-LS2-6 is borrowed from Chapter 5's list. Hadley cells and the Coriolis effect stay unnamed, as in the plan.
- **Nature of models:** the biome regions are a straight-edged version of the book's Figure 6-9; real biomes blend, and east coasts near 30° (Florida, eastern China) are wet, which the simple air model does not show. The mountain model keeps both sides at the same temperature.
- **Builds on:** Day 1, "Same Sun, Different Climates" (latitude and temperature). **Leads into:** Explorers at Work, Chapter 6, and Lesson 6.2's desert, grassland and forest pages.

Standards text quoted from the New York State P-12 Science Learning Standards (NYSED); PE list and core ideas from the BPS 2026-2027 Environmental Science Unit 2 doc. Data: NOAA NCEI U.S. Climate Normals 1991 to 2020 (Hilo, Phoenix, Dodge City, Nashville, Buffalo, Forks, Yakima) and the WMO Climate Normals 1991 to 2020 held by NOAA NCEI (Manaus, Cairo, Dalanzadgad, Seoul, Sodankylä, Dikson, Turpan), converted to °F and inches, the same values as the lesson's climate cards. The answer key is a separate file, kept off the public site.