Daylight Hours

Ages:
4th grade – high school

Duration:
45 minutes

Materials:
- 1 Student Graph sheet per group
- Colored pencils or markers
- Globe
- Table of Daylight Hours Across the Globe
- Index cards
- Tape

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Overview —

Students reinforce their understanding of seasonal dynamics by reading and graphing annual day-length data to determine the relative north or south latitude, and name, of their "mystery city."

Objective —

Students will reinforce their knowledge of the seasons by applying it to data of daylight hours for cities at various latitudes on Earth.

Before You Start: The students should have a basic understanding of why Earth experiences seasons.
Write the names of the different cities from the Table of Daylight Hours onto individual index cards.

Activity —

Clarify any misconceptions about hours of daylight being the only cause of seasons. Relative seasonal temperatures are caused by Earth's axial inclination and angle of incoming sunlight, as well as by day length (how many hours our Sun is above the horizon and how long it spends at its highest elevation).

Find out what the students know about changing daylight hours through the year. Gather their ideas — correct and incorrect — to revisit at the close of the activity.

- *Ask the students how daylight hours change through the year.* ("Longer days" in the summer and fewer hours of daylight in the winter)
- *Do the number of daylight hours change the same way throughout the year everywhere on our Earth?*
- *When is it summer at the north pole?* (July)
- *South pole?* (January)
- *What is day length like in the summer at the north pole?* (24 hours of light)

Invite the students to explore daylight duration in different cities across our Earth during the year.

- *Do they have any predictions for day length trends?* Note their predictions.

Divide students into groups of 3 or 4. Provide each group with a copy of the *Daylight Hours Across the Globe* table, graph paper, and colored pencils. Assign each group a different letter (city) to plot. The groups are going to compare their data for the different locations. Have the groups plot the number of daylight hours in their city for each month of the year on their graph.

- *How might they best illustrate the changes throughout the year?* (Graph the number of hours)
- *What should they consider when making their graphs to compare?* (Scales and axes should be the same; work with the groups to determine the appropriate scale)
- *What should each graph have?* (Labels on axes, title)

After completing their graph, groups should be able to determine at what times of year particular seasons occur in the city they plotted.

- *Which seasons have more daylight hours?* (spring and summer)
- *Fewer daylight hours?* (fall and winter)
- *How does this compare with the time of year the seasons occur where they live?* (Seasons in their hometown may provide clues to the approximate location of their unknown city)
- *Which groups have cities in the northern hemisphere?* (groups A, C, E, F, and H)
- *The southern hemisphere?* (groups B, D, G, and I)
- *How do they know?* (Northern hemisphere summer months — such as July — have more hours of daylight; southern hemisphere summers also have more hours of daylight, but occur "opposite" the northern hemisphere summer. Some cities just north or south of the Equator will only vary slightly throughout the year in their number of daylight hours)

Ask the groups to post their graphs and discuss the patterns they observe.

Invite the students to use the model of Earth's seasons to illustrate the distribution and duration of light for their city.

- *What trends or patterns do they observe as they look at all the graphs?*
- *Based on their model of what causes Earth's seasons, what can they conclude about the placement of the cities?* (those cities without extreme differences in day length are located near the equator, whereas locations at the poles do experience extreme differences in day length. Cities north or south of the equator experience longer days in summer and shorter days in winter)
- *Are there times when all the cities experience approximately the same number of daylight hours?* (Spring and fall)
- *Why?* (because during spring and fall, the Earth is tilted neither toward nor away from the Sun)
- *Which cities are in the northern hemisphere?* (Miami, Nairobi, Nome, Singapore, and Seattle)
- *The southern?* (Brisbane, Punta Arenas, Cape Town, and Vostok)
- *Which are closer to the equator?* (Those with smaller differences between the summer and winter day lengths i.e. Nairobi and Singapore)
- *Which are closer to the polar regions?* (Those with more extreme differences in summer and winter day length, i.e. Nome and Vostok)

If the students are unclear about any of these concepts, revisit a model of Earth's seasons to illustrate the differences between the timing of northern and southern hemisphere seasons, and the duration of summers versus winters in the polar regions compared to the equator.

Tape the index cards with the city names onto a wall in random order. Invite the groups to place their graph by the name of the city they think their graph represents. Have them refer to the globe and use the patterns of daylight hours they discussed to try to discover which city is theirs. They may alter their conclusions as they get more information and compare to other teams.

After all graphs have been correlated with a city, have the children place the graphs in order from the northernmost city to the southernmost city.

- *Do the patterns of day length follow the children's previous observations about which graphs were from cities closer to the equator, which were closer to the south pole, etc.?*

EXTENSIONS—

Provide the children with names of other cities and ask them to predict what the graph would look like for those cities relative to their graphs.

- *When does winter occur?*
- *Summer?*
- *Is there a significant amount of difference between winter and summer?*

Ties to Standards —

Connections to the National Science Standard(s)
Content Standard D Earth and Space Science, (grades 5—8): Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

Standards A&G (grades 9–12): Identify questions about seasonal changes using their own observations. Using logic and mathematical data, formulate an explanation about, and conceptual understanding of, how latitude affects seasonal variations. Critique and communicate explanations.

Texas TEKS
Scientific investigation and reasoning.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:
- (A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;
- (B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
- (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
- (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:
- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student

TEKS Science Content Standards

4(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to:
- (C) collect and analyze data to identify sequences and predict patterns of change in shadows, tides, seasons, and the observable appearance of the Moon over time.

Daylight Hours Across the Globe

Time is indicated as number of hours (h) and number of minutes (m)

City	1-Jan	1-Feb	1-Mar	1-Apr	1-May	1-Jun	1-Jul	1-Aug	1-Sep	1-Oct	1-Nov	1-Dec
A	10h 34m	11h 00m	12h 18m	12h 25m	13h 07m	14h 18m	14h 24m	14h 00m	12h 40m	12h 35m	11h 11m	11h 20m
B	14h 31m	13h 22m	13h 20m	12h 29m	11h 04m	11h 11m	11h 05m	11h 29m	11h 32m	12h 20m	13h 49m	14h 24m
C	12h 12m	12h 10m	12h 08m	12h 06m	12h 04m	12h 03m	12h 03m	12h 04m	12h 05m	12h 07m	12h 09m	12h 09m
D	17h 32m	15h 27m	13h 33m	11h 22m	10h 03m	8h 32m	8h 17m	9h 27m	11h 22m	12h 46m	14h 53m	16h 33m
E	4h 53m	7h 02m	10h 03m	13h 35m	17h 36m	21h 17m	22h 09m	18h 04m	15h 16m	11h 19m	8h 36m	5h 31m
F	12h 04m	12h 04m	12h 05m	12h 07m	12h 50m	12h 51m	12h 11m	12h 10m	12h 08m	12h 06m	12h 04m	12h 03m
G	15h 03m	13h 45m	13h 20m	12h 24m	11h 26m	10h 03m	10h 36m	11h 07m	11h 23m	12h 24m	14h 08m	14h 14m
H	9h 12m	10h 15m	11h 04m	13h 31m	15h 18m	15h 42m	16h 34m	15h 36m	13h 22m	11h 41m	10h 39m	9h 24m
I	24h 00m	24h 00m	19h 01m	14h 40m	0h 00m	0h 00m	0h 00m	0h 00m	7h 14m	15h 14m	24h 00m	24h 00m

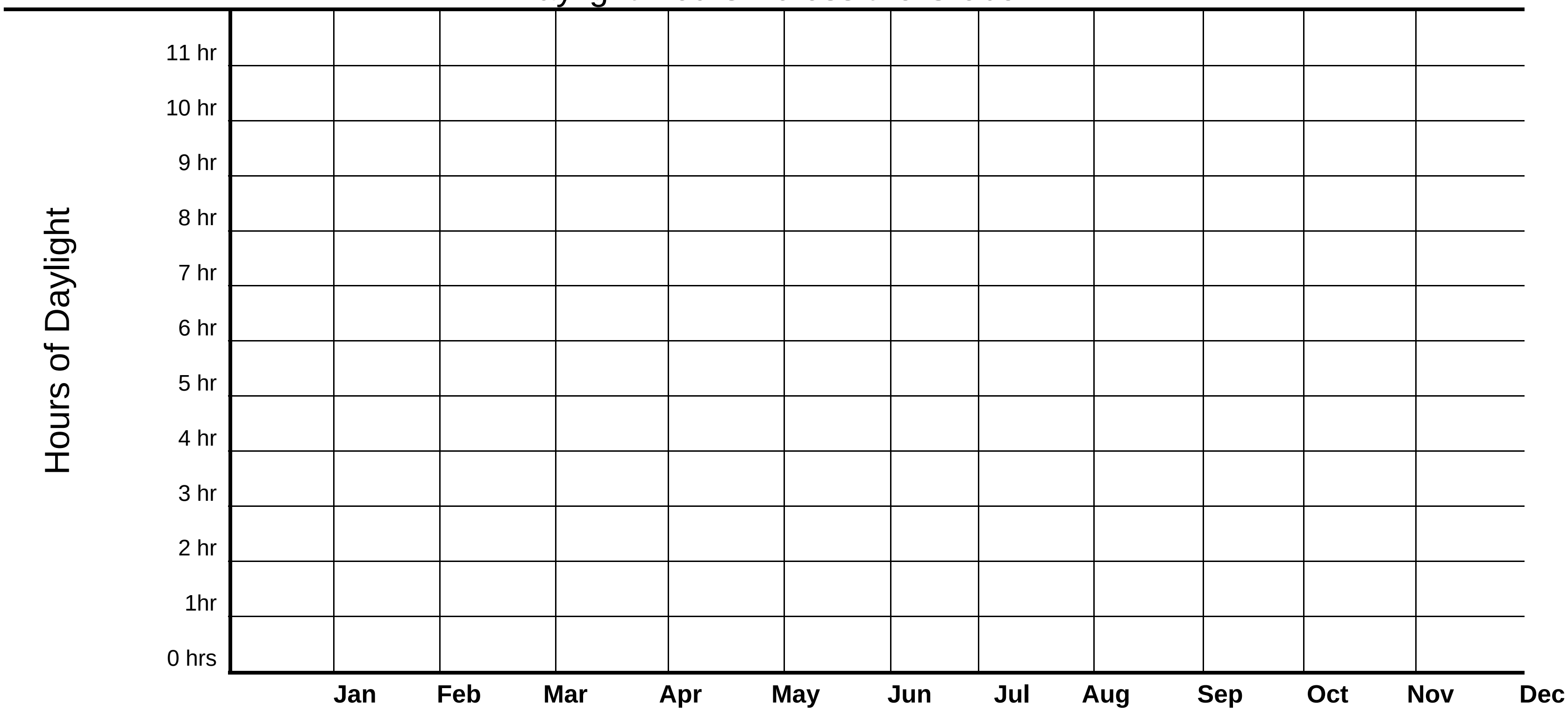
Key: Daylight Hours Across the Globe

Time is indicated as number of hours (h) and number of minutes (m)

City	1–Jan	1–Feb	1–Mar	1–Apr	1-–May	1–Jun	1–Jul	1–Aug	1–Sep	1–Oct	1–Nov	1–Dec
A. Miami, Florida	10h 34m	11h 00m	12h 18m	12h 25m	13h 07m	14h 18m	14h 24m	14h 00m	12h 40m	12h 35m	11h 11m	11h 20m
B. Brisbane, Australia	14h 31m	13h 22m	13h 20m	12h 29m	11h 04m	11h 11m	11h 05m	11h 29m	11h 32m	12h 20m	13h 49m	14h 24m
C. Nairobi, Kenya	12h 12m	12h 10m	12h 08m	12h 06m	12h 04m	12h 03m	12h 03m	12h 04m	12h 05m	12h 07m	12h 09m	12h 09m
D. Punta Arenas, Chile	17h 32m	15h 27m	13h 33m	11h 22m	10h 03m	8h 32m	8h 17m	9h 27m	11h 22m	12h 46m	14h 53m	16h 33m
E. Nome, Alaska	4h 53m	7h 02m	10h 03m	13h 35m	17h 36m	21h 17m	22h 09m	18h 04m	15h 16m	11h 19m	8h 36m	5h 31m
F. Singapore	12h 04m	12h 04m	12h 05m	12h 07m	12h 50m	12h 51m	12h 11m	12h 10m	12h 08m	12h 06m	12h 04m	12h 03m
G. Cape Town, South Africa	15h 03m	13h 45m	13h 20m	12h 24m	11h 26m	10h 03m	10h 36m	11h 07m	11h 23m	12h 24m	14h 08m	14h 14m
H. Seattle, Washington	9h 12m	10h 15m	11h 04m	13h 31m	15h 18m	15h 42m	16h 34m	15h 36m	13h 22m	11h 41m	10h 39m	9h 24m
I. Vostok, Antarctica	24h 00m	24h 00m	19h 01m	14h 40m	0h 00m	0h 00m	0h 00m	0h 00m	7h 14m	15h 14m	24h 00m	24h 00m

Student Graph Sheet

Daylight Hours Across the Globe



I think this city is

Near the North Pole

Way Above the Equator

Just Barely Above the Equator

At the Equator

Just Barely Below the Equator

Way Below the Equator

Near the South Pole

Circle One