Daylight Hours

OVERVIEW —

Students reinforce their understanding of seasonal dynamics by analyzing graphs of day-length data to match them to cities on a world map.

Grades: 6 to 12

Duration: 15-45 minutes

OBJECTIVE —

Students will:

- Analyze graphs depicting how the number of daylight hours changes over a year.
- Apply their understanding of seasons to match graphs to cities at different latitudes.

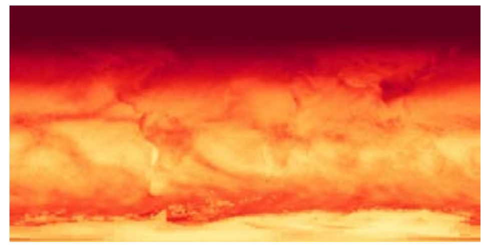
MATERIALS —

For the class:

- A map from NASA Earth Observations' Solar Insolation, projected

For each student or pair of students:

- Daylight Hours map
- Daylight Hours graph
- Colored pencils or markers



Map of sunlight reaching Earth's surface (solar insolation) for January 2016

ACTIVITY —

Facilitator's Note: This activity can be conducted to assess student understanding of seasons after other activities have allowed students to investigate patterns of change over time for different locations. The students should already have a basic understanding of why Earth experiences seasons, and how the seasons and temperatures differ for different latitudes. Conducting the Heating Things Up graphing activity before this activity may assist with this.

This activity has a high level of rigor, requiring students to analyze graphs and apply their understanding of seasons. Teachers may want to encourage struggling students to work in pair for some or all of the cities.

1. Project a map of the NASA Earth Observations' Solar Insolation, ideally for the current month. Invite the students to use the colors to compare the amount of sunlight for different parts of the world.

2. Find out what the students know about changing daylight hours through the year.
   - *Will the number of daylight hours affect how much sunlight we receive?*
   - *How do the number of 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?*

3. Use NASA Earth Observations' Solar Insolation to continue exploring the amount of sunlight across our Earth for different months, inviting students to predict how the amount of sunlight will change for different parts for specific months, then test their predictions.

4. Let the students know that they will be examining and analyzing daylight hour data for cities around the world. Invite the students to share their own knowledge and experiences but do not correct them or add to their ideas; they will be discovering the answers for themselves.

- *Which months have the most daylight where they live? Which months have the shortest amount of daylight?*

5. Hand out copies of the daylight graphs to each student or group of students. Remind them how to interpret the graphs:
   - *Is each graph different or are some of them the same?* (Some are the same)
   - *What units are the numbers of daylight hours?* (Number of hours)
   - *Is a day with 5 hours of daylight a short day or a long day?* (very short) *Is a day with 19 hours short or long?* (very long)
   - *Invite the students to describe what time the Sun might rise and set to make a day with 17 hours.* (The Sun could rise at 5 am and set at 10 pm, for instance.)
   - *In the United States, which time of year do we have long days?* (Summer, peaking in June.)

6. Hand out copies of the Daylight Hours map. Let the students know that they will be matching up the graphs to each city. Optional: to help students understand the process, match one city together as a class. For instance, examine the graph for City 2.
   - *When does City 2 have the most hours of daylight?* (In June)
   - *How does the number of hours of daylight in June for City 2 compare with the number in other cities in June?* (City 2 has more daylight hours in June than any other city)
   - *Are cities with longest days in June closer to the equator, closer to the North Pole, or closer to the South Pole?* (Closer to the North Pole)
   - *So which city on our map is most likely to have the longest days, with the most daylight hours, in June?* (Anchorage, Alaska)
   - Instruct the students to write "Anchorage" in the line next to "City 2" on the graph sheet, and to write a number "2" in the circle next to Anchorage on the map.

7. Assign students (individually or in pairs or groups) to match each graph to a city, writing the name of the city on the space above the graph, and the number of the city on the spot on the map. Optional: have the students cut apart the graphs so that they can manipulate them in order from highest to lowest latitudes, or move them around on the map.

8. When the students are finished, discuss their work as a class. The students should observe that cities further north of the equator have increasing hours of daylight in June, while cities further south of the equator have decreasing hours of daylight in June and increasing hours in December, and that the cities near the equator have relatively flat graphs.

9. Possible extensions: students can predict the shapes for graphs for additional cities, then gather the data online and test their predictions.

IN CONCLUSION —

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)

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.

BACKGROUND INFORMATION

This activity requires students use their understanding of seasons to identify and match patterns of data. Cities in the northern hemisphere have longer days and shorter nights (longer daylight hours) in June, with those cities closest to the North Pole having the longest days. Cities in the southern hemisphere have longer days and shorter nights (longer daylight hours) in December, with those cities closest to the South Pole having the longest days. Those cities one the equator have days and nights of equal length all year round.

RESOURCES

Additional information about temperatures and seasons

- NASA Now: Reasons for the Seasons is a YouTube video about seasons on Earth and other planets.
- My NASA Data has global data on temperatures, solar radiation, and other variables that can be used in designing follow-up activities and extensions.
- NASA Earth Observations has global maps of average land surface temperatures and many other variables for different dates.
- NASA SciJinks has information and games about weather.
- NASA Wavelength has a variety of activities and articles about seasons, searchable by topic, grade level, resource type, and more.

CORRELATION TO STANDARDS

Next Generation Science Standards

Assessment Standard:

- 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Disciplinary Core Ideas

- ESS1.B: The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

Science and Engineering Practices

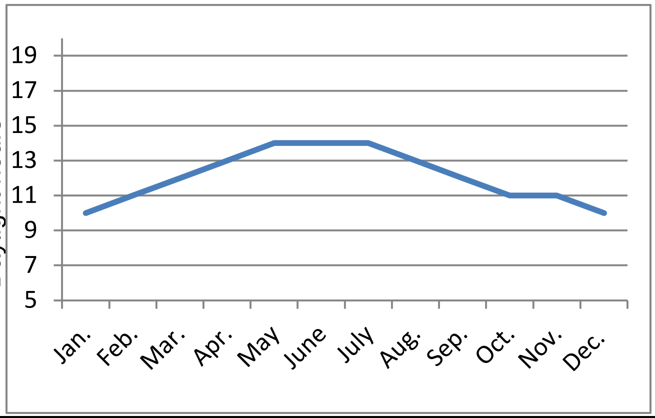
- Asking Questions and Defining Problems: Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- Analyzing and Interpreting Data: Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Analyzing and Interpreting Data: Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
- Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.
- Using Mathematics and Computational Thinking: Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

Crosscutting Concepts

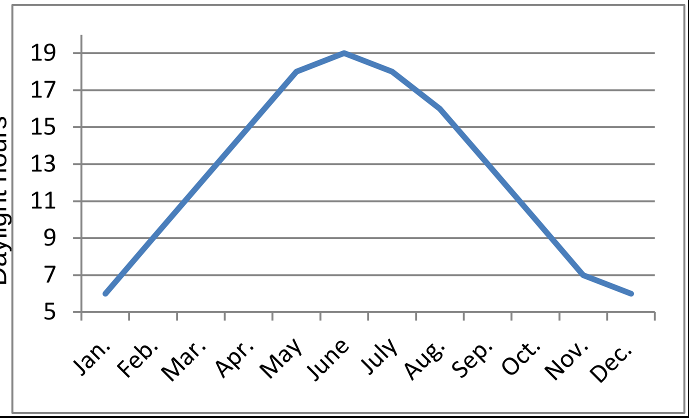
- Patterns: students identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
- Patterns: Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

Graphs for Daylight Hours

City 1: ______________________________________



City 2: ______________________________________



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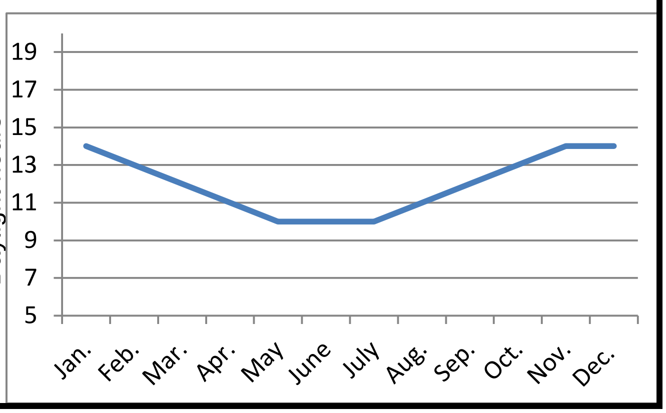

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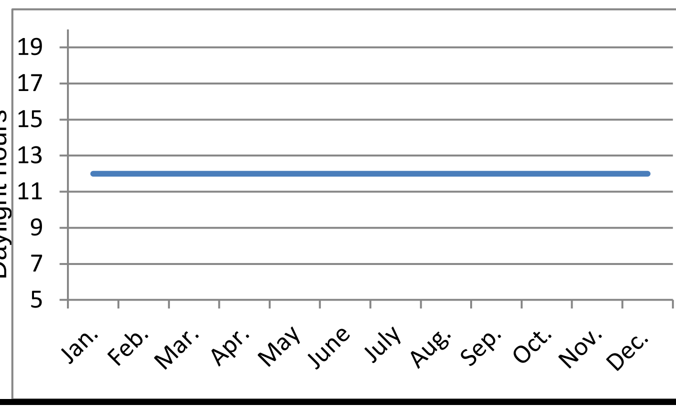
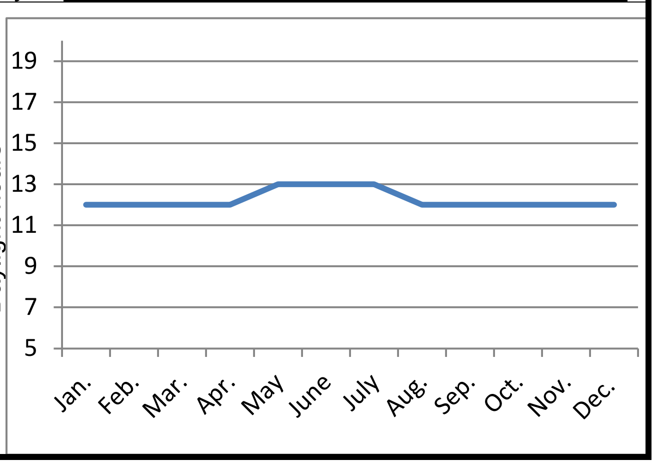
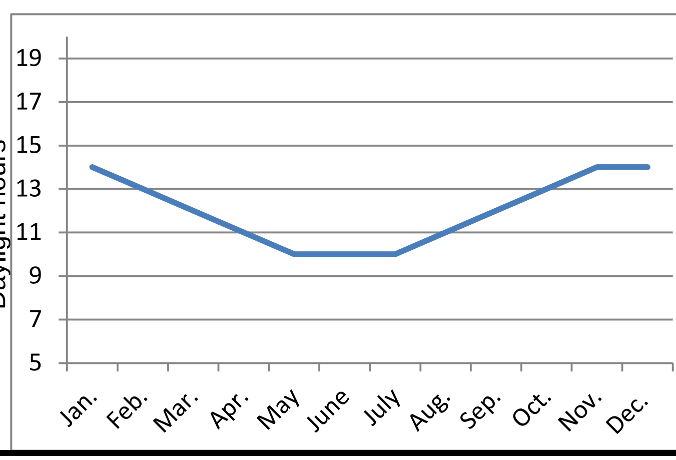


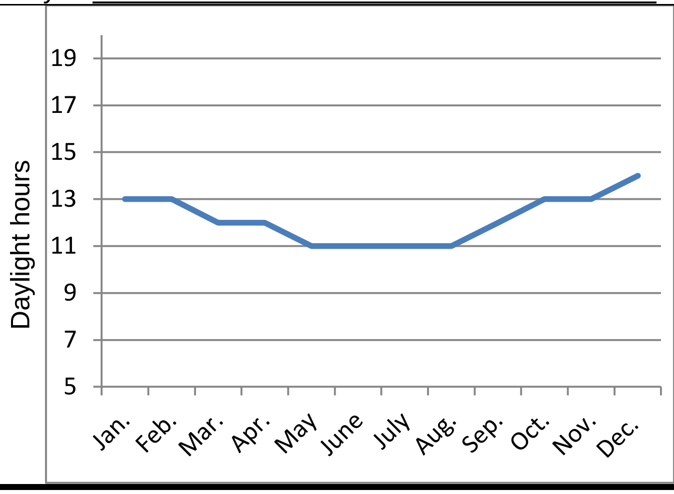
City 5: ______________________________________



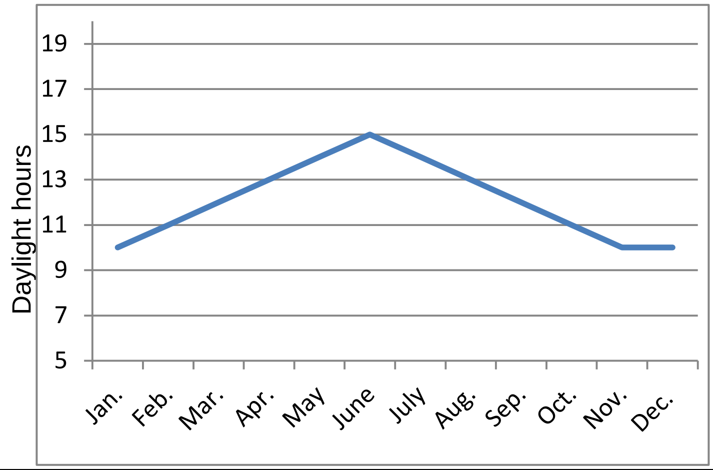
City 6: ______________________________________



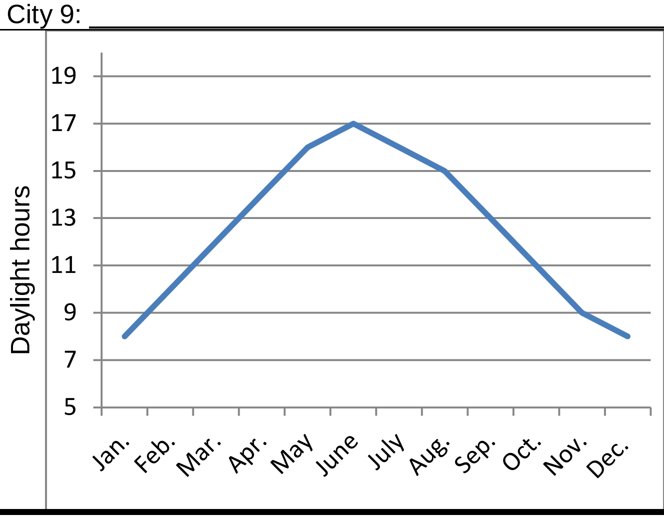
City 7: ______________________________



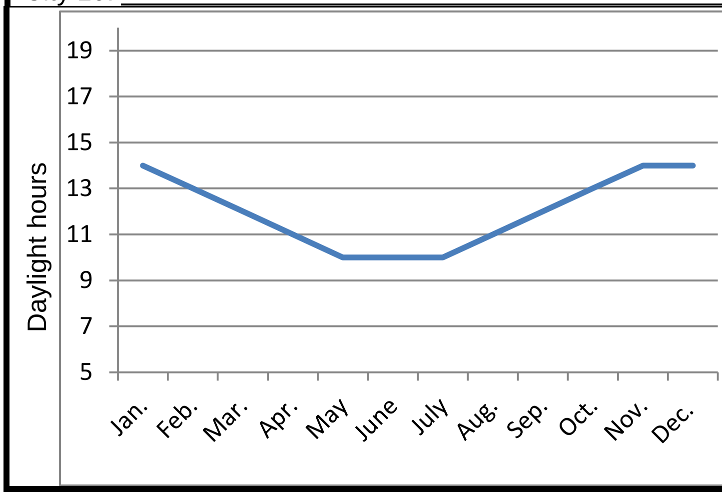
City 8: ______________________________



City 9: ______________________________



City 10: ______________________________



Daylight Hours: Map