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http://www.lhsgems.org/GEMSSeasons.html

Activity 6: Days and Nights Around the World

Overview

By graphing the number daylight hours per day in cities around the world, students find a very symmetrical pattern of daylight hours that is exactly opposite for the Southern and Northern Hemispheres. Students discover months when the Sun never sets in Alaska, and never rises in Antarctica. They also discover the meaning of the equinoxes, as they find day and night hours are equal in September and March everywhere on Earth.

This activity focuses on seasonal variations in day length, and not the Sun's position in the sky from sunrise to sunset. If you would like your students to also explore seasonal changes in the Sun's position, see Going Further Activity #2 outlined at the end of this session, with student sheets in the back of the guide.

As in the prior session, graphing and reflecting on these interesting data can help give students a global perspective, and shuld prepare them to better understand the explanations for the seasons brought together in Activity 8.

It may seem like a lot of graphing to have this activity and the one before it, back to back. But we have seen great benefits resulting from this practice. One student, who initially had great difficulties graphing the temperatures and was the "slowest" in the class, experienced a breakthrough in this second graphing exercise and miraculously finished these graphs among the first in the class!

What You Need

For each student:
- ❒ 1 "Seasonal Changes in Day Length" data sheet (page 14 of Seasons Lab Book)
- ❒ 1 "Day Length" graphing sheet (page 15 of Seasons Lab Book)
- ❒ 1 pencil

For each group of 4-6 students:
- ❒ 3–4 colored pens—assorted colors

For the class:
- ❒ 1 transparency of Day Length Data Sample (master in Getting Ready; on bottom half of next page, page 66)
- ❒ 1 transparency of World Map or a large World wall map (master in Season Lab Book, page 11)
- ❒ 1 transparency of Day Length Graph (blank; master in Seasons Lab Book, page 15)
- ❒ 1 transparency of Day Length Graph (complete; master on page 67 in teacher's guide)
- ❒ Optional: photograph of a sunset

Getting Ready

1. Make an overhead transparency of the blank Day Length Graph (page 15 of the Lab Book).

2. Make an overhead transparency of the completed Day Length Graph (master on page 67 of teacher's guide) and color code the lines with colored pens.

3. Make an overhead transparency of the sample "Day Length" data on the bottom half of this page.

Seasonal Changes in DAY LENGTH

All dates are the 21st day of the month.

Sample Data

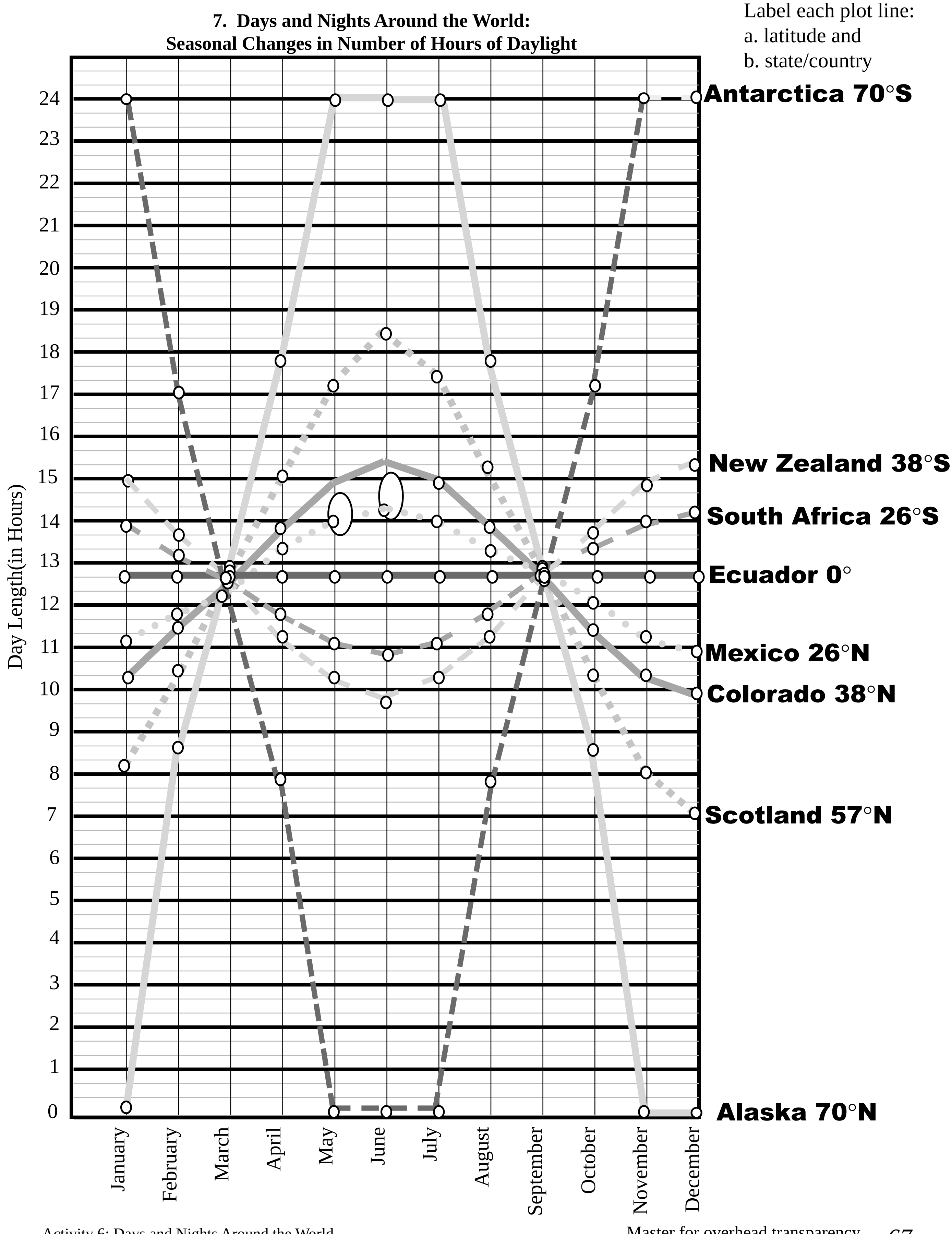
Latitude: 38° North

Date	Sunrise (AM)	Sunset (PM)	Day Length (hours)
Jan	7:22	5:21	9:59
Feb	6:52	5:55	11:03
Mar	6:12	6:23	12:11
Apr	5:26	6:51	13:25
May	4:55	7:18	14:23
Jun	4:47	7:36	14:49
Jul	5:04	7:28	14:24
Aug	5:30	6:55	13:25
Sep	5:57	6:08	12:11
Oct	6:24	5:24	11:00
Nov	6:57	4:54	9:57
Dec	7:22	4:54	9:32

All the following cities are at about 38 degrees North latitude:

San Francisco, California
Charleston, W. Virginia
Wichita, Kansas
St. Louis, Missouri
Louisville, Kentucky
Pueblo, Colorado
Richmond, Virginia
Sendai, Japan
Seoul, S. Korea
Tientsin, China
Izmir, Turkey
Athens, Greece
Palermo, Sicily
Cordoba, Spain
Lisbon, Portugal

Label each plot line:
a. latitude and
b. state/country



Hours of Daylight

We will sometimes refer to the number of hours of daylight as "length of day," even though technically a day is the time it takes Earth to spin once, which is always approximately 24 hours (23 hours and 56 minutes).

1. Have the students again think back to Activity 1, when they wrote about changes that occur with the seasons. Ask how many of them wrote about changes in the "length of day."

2. To review their experience with changes in the number of daylight hours, ask the following questions:

- Does the Sun always set at the same time each day? [No] Optional: show a photograph of a sunset to add a vivid element to this discussion.

- At what times of year does the Sun stay up latest (and rise the earliest)? [Summer. Don't reveal the answer if no one knows.]

- Is the number of hours of daylight the same each day?" [No]

- When are the "shortest days?" [Winter]

3. Ask, "Is the number of hours of daylight on a certain day the same all over the world?" Tell the students that in this session, they will look at day length data from different places around the world.

4. Show the sample "Day Length" data for Latitude 38 degrees north on the overhead projector. Explain what each column means: sunrise time, sunset time, and "Day Length," which is the number of actual hours of daylight on the 21st day of each month. Show on a world map or globe how all the cities in this list are on the same latitude, 38 degrees north.

5. Explain that these data are on page 14 of the lab book, along with data for seven other latitudes, with some cities listed for each. Model how to graph the day length for one of the latitudes on the blank graph transparency.

6. Assign the students to graph as many of the "Day Length" values from the eight latitudes as they can on the graphs on page 15 of their lab books. Have them color code the plot lines with a different color for each latitude.

7. Tell them that the first two latitudes they plot should be in opposite hemispheres: one in the Southern Hemisphere and one in the Northern Hemisphere. For students who are not as proficient at graphing, you might hint that a latitude near 0° (e.g., Ecuador) might be a particularly easy place to start.

8. Allow the students to continue graphing as long as possible, but leave at least ten minutes for a discussion. Try to be sure all students have finished graphing at least three or four of the eight latitudes before the discussion.

Discussing the “Day Length” Graphs

1. Regain the attention of the class.

2. Tell them that you have prepared a graph that should look something like theirs. Put the “Day Length” graph transparency on the overhead projector. Ask, “What patterns do you see?” (Optional: have students discuss in small groups and then share their views in a whole class discussion.)

3. Point to the Ecuador data, and ask, “If the data make a straight horizontal line across the graph, what does that say about how the length of day changes at that latitude?” [Day length stays the same all year.] Ask, “What do the lines that go up and down steeply tell you?” [At that latitude, day length changes greatly with the seasons.]

4. Be sure that students notice that locations at opposite latitudes in northern and Southern Hemispheres have day lengths which are mirror images of each other. Ask, “What season is it in Scotland in July?” [summer] “What season is it in New Zealand in July?” [winter] Students should be able to perceive that there is a high degree of symmetry: Moreover, each plot line is highly symmetrical on either side of the month of June.

5. Ask, “Are there any places where the Sun never comes up (zero day length) in certain parts of the year?” [Yes. Antarctica, Alaska, Norway, Canada.] At what times of year does that happen? [It happens at opposite times of the year in the far north and far south. The Sun never comes up from November through January at latitudes north of 70° N. From May through July, the Sun never comes up at latitudes south of 70°S latitude.]

6. “Where and when does the Sun stay up for 24 hours?” [The Sun never sets from May through July above 70°N latitude (Alaska); also November through January at latitudes south of 70° S.(Antarctica) This is sometimes called the “midnight Sun.”]

7. If no one points out that all the lines converge at two points, ask, “Are there any places where all the lines come together?” [Yes, in March and September] “What seasons are in March and September?” [spring and fall, respectively]

8. Explain that there is a special name for the exact date where all the lines come together, when the number of hours of daylight equals the number of hours of night time. Ask if anyone knows what those special days are called. [*Equinoxes*—Spring equinox and fall or autumnal equinox] They occur near March 21 and September 21 each year.

Ask if any of your students have ever visited or lived in a place with very different day lengths than those in your school’s region. If time permits, allow some discussion of what it must be like to have no daylight or no darkness for 24 hours.

9. Remind students of question #3 in the Sun-Earth Survey. Ask, "Do your observations about the number of daylight hours help you rule out any of the answers?"

10. Tell the class the next activity will make clear for them why the day length changes with the seasons the way it does.

Going Further

1. Devise a Seasons Card Game. Each card could give a clue much like the ones students wrote in Activity 1, except now, the clues can include global season information. Have students make a pile of season clue cards with equal numbers of cards for each season. Then, in turn, students draw cards from the pile, trying to make matching pairs. The winner is the one with the most matching pairs. For example, these two cards could form a pair for *spring*:

"The kangaroos are everywhere, now that it's October."
"I saw the Sun today for the first time in months here in northern Alaska."

(In this case, the two "springs" are six months apart!)

Please Note: Data sheets for this "Going Further" activity can be found in the back of this guide, just after "Behind the Scenes," on pages 100–104. Some additional information appears on page 99.

2. Seasonal Changes in Sun Position. Another important seasonal change that students can explore is the variation in where the Sun rises and sets, and its elevation in the sky at noon. If you would like to give your students a homework / extra credit opportunity, challenge them to plot those data and summarize patterns that they find. In the back of the guide, pages 100–104, you'll find data sheets for:

(a) Sunset position (azimuth angle)
(b) Sunrise position (azimuth angle)
(c) Noon position (altitude or elevation angle)

Note: The noon position is especially relevant to explaining how the angle of sunlight affects seasons. This relationship is also explored through the models used in the next two activities.

Students can plot data on the three charts: "Sunset Positions," "Sunrise Positions," and "Sun Elevation Angles." On page 104 is a chart for drawing the path of the Sun on a single day—students can mark sunrise azimuth angle, noon elevation angle, and sunset asimuth angle on a particular day, then draw in the arc that is the approximate path of the Sun throughout that day.