

Shadow Clock Cycle

Graph shadows, daylight, and stars to find repeating patterns.

GRADE 5 • 5-ESS1-2

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..."

NAME _____

DATE _____

LET THE DATA SHOW

These simplified classroom records represent a midlatitude Northern Hemisphere site. Use titles, labels, units and equal steps on graphs. Keep times and months in order. Daily patterns relate to Earth's rotation; yearly patterns relate to its orbit. Describe patterns without explaining the causes of seasons.

WORKED EXAMPLE

Read this example from a different day. How did the shadow length change?

1. Use the key: $9 \times 8 = 72$ cm, $3 \times 8 = 24$ cm, $7 \times 8 = 56$ cm.
2. Compare the rows in time order: the length falls, then rises.
3. The shortest measured shadow is at noon.

Answer: The shadow shortened toward noon and lengthened afterward.

Example Shadow Lengths

9 a.m.	● ● ● ● ● ● ● ● ● ●
noon	● ● ●
3 p.m.	● ● ● ● ● ● ●

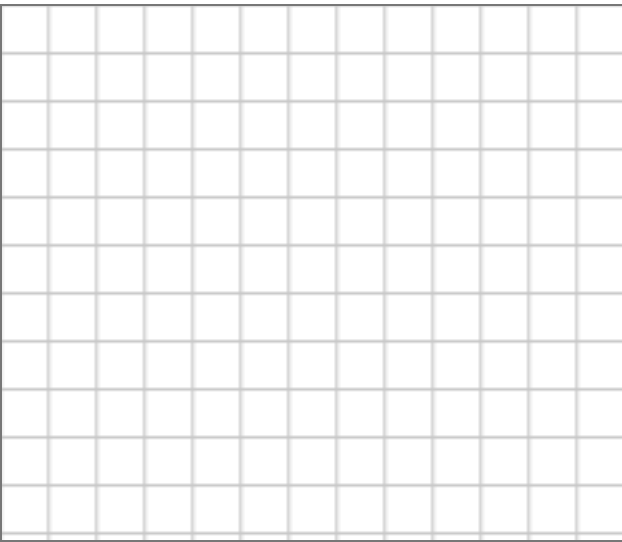
Key: ● Each dot = 8 cm

PRACTICE 4 problems

- 1** Graph shadow length from the table. Put time across the bottom and length (cm) up the side, from 0 to 100 in equal steps of 10. Draw one bar per time. Write the shadow direction above each bar.

ONE DAY: SAME UPRIGHT STICK

Time	Length (cm)	Direction
8 a.m.	90	NW
10 a.m.	50	NW
noon	30	N
2 p.m.	50	NE
4 p.m.	90	NE



ANSWER _____

- 2** Use the sunrise and sunset records. Find daylight hours and subtract from 24 for night hours. Make two bars per month: daylight and night. Use an hour scale from 0 to 16 in steps of 2 and a key to distinguish the bars.

FOUR DATES AT THE SAME SITE

Month	Sunrise	Sunset
March	6 a.m.	6 p.m.
June	4:30 a.m.	7:30 p.m.
September	6 a.m.	6 p.m.
December	7:30 a.m.	4:30 p.m.



ANSWER _____

3

Use your shadow graph and direction labels. Describe how shadow length and direction change from morning through noon to afternoon.

ANSWER

4

Use your paired-bar graph. Which recorded month has the most daylight? Which has the least? Describe how the daylight and night bars change together.

ANSWER

APPLY IT

Show your work

1

A class records clear-sky observations at the same evening time. Make a picture chart: months across the top, Orion, Cygnus and Polaris down the side. Put a filled circle for Seen and a dash for Not seen; add this key. Which objects appear in every recorded month?

SIMPLIFIED EVENING STAR RECORDS

Month	Orion	Cygnus	Polaris
January	Seen	Not seen	Seen
April	Seen	Not seen	Seen
July	Not seen	Seen	Seen
October	Not seen	Seen	Seen

ANSWER

2

Use your picture chart. A student says, "Because Orion is not seen in July, its stars no longer exist." Explain why the records do not support that claim.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Compare your three displays. Which patterns happen within one day, and which change across the year? Use one fact from each display. Connect the daily pattern to Earth's rotation and the yearly patterns to its orbit.

WORK SPACE AND ANSWER

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Graph shadow length from the table. Put time across the bottom and length (cm) up the side, from 0 to 100 in equal steps of 10. Draw one bar per time. Write the shadow direction above each bar.	Bars: 90, 50, 30, 50, 90 cm in time order; labels NW, NW, N, NE, NE. Axis starts at 0 and steps by 10 cm. NW means northwest; NE means northeast.
2	Use the sunrise and sunset records. Find daylight hours and subtract from 24 for night hours. Make two bars per month: daylight and night. Use an hour scale from 0 to 16 in steps of 2 and a key to distinguish the bars.	Day/night bar heights in hours: March 12/12; June 15/9; September 12/12; December 9/15. Key distinguishes the two bars in each pair.
3	Use your shadow graph and direction labels. Describe how shadow length and direction change from morning through noon to afternoon.	Length decreases toward noon, then increases. Direction changes from northwest to north to northeast. Shadows point generally west in the morning and east in the afternoon.
4	Use your paired-bar graph. Which recorded month has the most daylight? Which has the least? Describe how the daylight and night bars change together.	June has the most daylight (15 hours); December has the least (9 hours). As daylight increases, night decreases; each pair totals 24 hours.

PART 2 • APPLY IT

- Polaris appears in every recorded month. Orion: Seen in January/April, not seen in July/October. Cygnus: not seen in January/April, Seen in July/October.** Check all 12 chart cells and its key. Orion and Cygnus are constellations (groups of stars); Polaris is one star.
- Not seeing a group of stars at one evening time does not mean its stars disappeared. The chart shows visibility changing with the time of year.** Contrast Orion's recorded January/April visibility with July/October. Earth's changing position in its yearly orbit changes our nighttime view.

CHALLENGE

The shadow graph changes within a day: 90 cm in the morning, 30 cm at noon, then 90 cm in late afternoon, while direction shifts NW to N to NE. Earth rotates once per day. Across the year, June has 15 daylight hours and December 9; Orion is recorded in January/April but not July/October. Earth's orbit takes about one year. No explanation of the causes of seasons is required.

Data are simplified teaching examples, not a local sky forecast or actual class measurements. Check student-created displays against all data, labels, zero baselines and keys. Use NW=northwest, N=north, NE=northeast. Sunrise/sunset times use one consistent clock convention. Star records assume a clear sky, a fixed evening time and a midlatitude northern site; visibility depends on place and time. Assess graphing and patterns, not causes of seasons. Sources for scientific context: NGSS 5-ESS1-2 Evidence Statements (2015); NASA Space Place, What Are Constellations?