Shadow Trackers: Graphing a Day of Shadows

Teacher		**Class**	Grade 5
Subject	Science	**Topic**	Shadows and daylight
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students learn how daylight changes shadow length and direction. They model the sun and graph three readings to find the pattern.

Curriculum links

- 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.

Learning objectives

- Students will measure shadow length and direction and plot them in a bar graph.
- Students will describe the daily shadow pattern using evidence from their graph.
- Students will explain how spin makes day and night and shifts seasonal stars.

Success criteria

- I can plot shadow length for morning, noon, and afternoon.
- I can describe the short-noon, long-morning shadow pattern with direction.
- I can explain spin makes night and stars shift with seasons.

What students already know

Hold up a pencil upright. Ask: Where is its shadow now and where would it be after lunch? Listen for sun position ideas.

Key words

shadow	dark shape on the ground where light is blocked [7]
opaque	letting no light through, so a dark area forms behind [7]
direction	where something points, like east, west, north, or south
graph	drawing with thick columns that compares amounts across times
solstice	day with the most or fewest daylight hours in the year [5]
spin	turning around in one spot, which makes day and night

Materials

- desk lamp with shade
- small clay ball
- pencil for upright pole
- tape measure in inches
- compass card marked N-E-S-W
- graph paper

Before the lesson

- Print Worksheet Task B copies and compass cards marked N-E-S-W
- Test Video clip 2 (0:00-3:20) on Slide 8 with sound and captions
- Set up desk lamp with shade, test three positions, tape cords down

- pencils
- Slides 1-2, 3-5, 7-11 projected
- Worksheet Task B copies, one per student
- class bar-graph poster and markers
- Make clay ball with pencil pole, graph paper, and tape measures at pairs tables
- Draw class bar-graph axes for 9:00 a.m., 12:00 p.m., 3:00 p.m. in inches

Lesson outline

0–5 min **Starter** 5 min · Whole class

Hook interest and set the graphing goal for the day.

YOU DO

1. Show Slide 1 title Sun Shadows and Starry Nights and read the focus on graphing daylight.
2. Hold up the pencil pole and say the hook question to the class.
3. Show Slide 2 objectives and point to plot, describe, and track shadows.
4. Ask for quick predictions of morning versus noon shadow length.

STUDENTS DO

1. Look at Slides 1-2 and listen to the challenge.
2. Turn and tell a partner a prediction for noon shadow.
3. Share one prediction with the class.

Say: If we left this pencil standing in the sun all day, where would its shadow go? Let's find out without waiting all day. Today we will plot shadow length and direction on a graph to find the hidden daylight pattern.

Ask: Where do you think the shadow will be longest, morning or noon? (Morning, because the sun is low.) · What will we make to prove the pattern? (A bar graph of shadow length and direction.)

Check understanding: Show thumbs up, sideways, or down for explaining the goal. Reteach Slide 2 if many are unsure.

Support: Point to the pencil and its real shadow while repeating the hook slowly. **Stretch:** Ask students to predict the shadow direction if the sun is in the east.

Use: Slides 1-2

5–15 min **Teaching** 10 min · Whole class

Explain how shadows form and how they change through the day.

YOU DO

1. Show Slide 3 and model with flashlight and hand how blocked light makes a shadow.
2. Show Slide 4 timeline for 9:00 a.m., 12:00 p.m., and 3:00 p.m. sun and shadow positions.
3. Think aloud the noon example with numbers and direction arrows.
4. Run Slide 5 think, pair, share on why noon is shortest.

STUDENTS DO

1. Watch the light demo and trace light path with a finger.
2. Repeat the rule: low sun long shadow, high sun short shadow.
3. Discuss Slide 5 with a partner and share why noon wins.

Say: Light travels in straight lines until an opaque object blocks it, which makes a dark shadow behind it [7]. When the light is to one side the shadow appears on the opposite side, and when the light is directly above the shadow is directly underneath [8]. So a low sun makes a long shadow and a high sun makes a short shadow.

Worked example: At 9:00 a.m. the sun is low in the east, so the shadow is long to the west. We measure 24 in. At 12:00 p.m. the sun is high in the south, so the shadow is short to the north. We measure 6 in. At 3:00 p.m. the sun drops in the west, so the shadow is long to the east. We measure 20 in. Bars go tall, short, tall.

Ask: Why is the noon shadow the shortest of the day? (The sun is highest, so light is more overhead and shadow is short underneath.) · If the sun is in the east, where is the shadow? (On the opposite side, in the west [8].) · What happens if the object moves closer to the light? (The shadow gets bigger because the object is closer to the light, so its shadow spreads out larger [8].)

Check understanding: Use mini whiteboards to draw sun high with short shadow. Scan and correct opposite-side errors.

Support: Hold the light low then high while students point to the shadow and say long or short. **Stretch:** Ask why larger blockers make larger shadows because they block more light [7].

Use: Slides 3-5

15–40 min **Main activity** 25 min · Pairs

Collect model data and graph length and direction to reveal the daily pattern.

YOU DO

1. Show Slide 9 task and hand out Worksheet Task B, graph paper, and measuring tools.
2. Model one reading: set lamp at 9:00 a.m. east low, mark tip, measure in inches, note west.
3. Guide pairs to test 12:00 p.m. south-high and 3:00 p.m. west-low and plot three bars.
4. Circulate to check bar heights, direction arrows, and U-shaped pattern.

STUDENTS DO

1. Set up pole, move lamp to three spots, and measure each shadow in inches.
2. Record time, length, and direction on Worksheet Task B and plot three bars with arrows.
3. Compare graph to a neighbor pair and state the pattern in one sentence.

Say: In pairs, make a bar graph of our three shadow readings to find the pattern. Draw time across and shadow inches up. Keep the pole straight, move only the lamp to the labeled spots, and measure to the shadow tip.

Worked example: Student A holds the pencil in clay on the north mark of the compass card. Student B puts the lamp low on the east side for 9:00 a.m. Mark the tip, measure 24 in, draw the first tall bar and add an arrow pointing west. Repeat for 12:00 p.m. south-high for 6 in with arrow north, and 3:00 p.m. west-low for 20 in with arrow east. The bars show tall-short-tall.

Ask: What pattern do your three bars show? (Tall in morning, short at noon, tall in afternoon, a U shape.) · How did direction change? (From west in morning to north near noon to east in afternoon, opposite the light [8].)

Check understanding: Hold up graphs. Check for 24 in tall, 6 in short pattern and correct arrows. Pull one strong example to the class poster.

Support: Give a table with time labels and axes already drawn so students only plot three bars and add direction arrows. **Stretch:** Have students predict and then test a 5:00 p.m. western low-sun position and explain why the bar would be tallest.

Use: Slide 9, Worksheet Task B

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40–50 min **Discussion** 10 min · Whole class

Link daily shadows to day and night spin and seasonal daylight and stars.

YOU DO

1. Play Video clip 2 on Slide 8 and tell students to spot spin and seasonal star change.
2. Show Slide 7 360-degree polar sun and explain 24-hour daylight in summer.
3. Lead talk on June versus December daylight bars using solstice facts.
4. Connect back to graphs: high summer sun means shorter noon shadows.

STUDENTS DO

1. Watch the video and raise a hand when day flips to night.
2. Compare June tall daylight bar and December short bar in pairs.
3. State one sentence linking sun height to shadow length in summer.

Say: Spinning turns us toward light for day and away for night. Solstices occur twice a year and feature the year's shortest and longest daylight hours depending on hemisphere [5]. In summer the sun loops around for 24-hour daylight at the poles, and night stars shift because we face a different part of space each season.

Worked example: In regions outside the tropics the summer solstice is when the sun reaches its highest point at solar noon and observers have the longest daylight of the year, while the winter solstice is when the sun is lowest at solar noon and observers have the least daylight and longest night [5]. Northern polar regions get 24-hour sunlight during the June solstice while southern polar regions get 24-hour night, with the reverse in December [5].

Ask: What makes day change to night? (Earth spinning so our spot turns toward or away from sunlight.) · Why do we see different stars in winter and summer? (At night we face different directions as Earth moves through the year.) · Which month has longer daylight in our hemisphere and why? (June, because the sun is highest at solar noon [5].)

Check understanding: Cold-call three students for day-night cause, June versus December, and star shift. Replay last 30 seconds if confused.

Support: Provide sentence starters like In June the bar is ___ because the sun is ___. **Stretch:** Ask groups to connect tilt to the poles where northern regions get 24-hour sunlight in June while southern regions get 24-hour night [5].

Use: Slides 7-8, Video clip 2 (0:00–3:20)

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50–60 min **Plenary** 10 min · Whole class

Check the objectives and prove patterns with graph evidence.

YOU DO

1. Show Slide 10 mindmap and have pairs point to long morning, short noon, direction flip.
2. Add class data dots to the poster and circle tall-short-tall as proof.
3. Show Slide 11 exit ticket and model the first sentence stem.
4. Collect exit lines and preview tomorrow's 9:00 a.m. shadow sketch.

STUDENTS DO

1. Point to mindmap boxes and read their graph pattern aloud.
2. Write exit ticket lines and sketch tomorrow's 9:00 a.m. shadow.
3. Self-check against success: plot, describe pattern, explain spin and stars.

Say: Our graph proves the daily rule: long shadows morning and afternoon, short shadow at noon. Light cannot go through an opaque pole, so the dark area behind it is the shadow [7]. Direction flips because the shadow falls opposite the sun [8].

Worked example: My shadow pattern today is tall-short-tall. At 9:00 a.m. the bar is 24 in pointing west, at 12:00 p.m. it is 6 in pointing north, at 3:00 p.m. it is 20 in pointing east. Tomorrow at 9:00 a.m. I predict another long west shadow near 24 in because morning sun is low again.

Ask: What did your bars prove about length? (Shortest at noon, longer morning and afternoon.) · What did arrows prove about direction? (Shadow is opposite the sun and flips west to east.)

Check understanding: Read three exit tickets aloud. If arrows are wrong, re-model opposite-side rule with lamp before dismissal.

Support: Let students copy the model sentence and only fill numbers and arrows. **Stretch:** Ask students to write why a winter noon bar would be taller, since the sun is lower at solar noon [5].

Use: Slides 10-11

Common mistakes

Mistake	How to spot it	How to fix it
Thinking the sun moves around Earth to make shadows move	Arrows show sun circling the pole or shadows labeled as sun moving	Model spin with globe and still light to show our turn changes sun position and shadow to the opposite side [8]
Plotting noon as the tallest bar	Bar graph shows 12:00 p.m. higher than 9:00 a.m. and 3:00 p.m.	Re-measure high light versus low light to show high sun makes short shadow under the object [8]
Saying a shadow is light shining	Students describe shadow as made of light	Remind that light travels straight until blocked, so the dark area behind an opaque object is the shadow [7]

Support

- Give pre-drawn axes for Worksheet Task B so students only plot three bars and arrows
- Assign holder, measurer, and recorder jobs for each pair

Stretch

- Predict and test a 5:00 p.m. low western sun and justify the tallest bar
- Explain whether summer or winter noon shadows are shorter using high solar noon sun in summer [5]

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- Keep compass card and vocabulary bank on desks during graphing
- Predict which seasonal star window would be best next month if the pattern continues

For the LSE or teaching assistant

Sit with target pairs during main graphing. Help mark shadow tip, read tape in inches, and check west-north-east arrows.

Safety

- Do not touch lamp bulb or shade - it gets hot. Teacher moves lamp if hot.
- Keep cords flat and walkway clear so no one trips.

Check for understanding

Question	Answer
What pattern did your 9:00 a.m., 12:00 p.m., and 3:00 p.m. bars show?	Tall-short-tall; shortest at noon, longer morning and afternoon.
The sun is in the west. Where is the shadow and why?	In the east, on the opposite side from the light [8].
Why do we have day and night and different stars in different seasons?	Spin turns us toward and away from light; seasonal position changes night facing.

Sources

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