

Changing Shadow Patterns

Target Standard

Algebra

- Sort, classify, and order objects by size, number, and other properties
- Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns, and translate from one representation to another
- Model situations that involve the addition and subtraction or whole numbers, using objects, pictures, and symbols
- Describe qualitative change, such as a student's growing taller
- Describe quantitative change, such as a student's growing two inches in one year

Related Standard

Representation

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems
- Use representations to model and interpret physical, social and mathematical phenomena

Prior Knowledge

- K: sort a group of pictures by certain properties; recognize, describe, and

extend simple patterns (for example, the AB pattern)

- 1st grade: understand how to make and interpret graphs; measure and compare lengths
- 2nd grade: collect and graph data; describe and predict quantitative and qualitative changes over time

Teaching Plan

Implementation

Part 1 – Shadows

Read to the students the book “*Bear Shadow*” by Frank Asch or similar book about shadows. After reading the book, have the students go outside to examine their own shadows.

Teacher Questions:

1. What makes a shadow?
2. What happens to your shadow on a cloudy day?
3. What happens to your shadow at night?
4. What happens to your shadow when you are inside your house?
5. What happens to your shadow when you move your hand? Walk away from the sun? Move to the right of the sun?

Does your shadow ever get bigger or smaller?

Part 2 – Shadow measurement

Go outside during the early morning to a paved area.

With the students working in pairs, have them trace each other's shadows with chalk on the pavement. Have them write their name in their shadow, then measure the length of their shadow using the **spaceship** marked A.M. on the student activity page. Have them record this number on their **spaceship** (by the blank labeled “A.M.”).

At one point in the early afternoon, have the students return to the exact same spot where they stood and repeat the drawing and measuring of their shadow (this time using the second **spaceship**), recording the length of their shadow in the blank marked “P.M.”.

Teacher Questions:

1. How did your shadow change from morning to afternoon? Why do you think this happened?
2. Which shadow was longer, the one in the morning or afternoon?
3. Which shadow was shorter, the one in the morning or afternoon?
4. Compare your shadow length to your partner's shadow length. Who had a longer shadow in the morning? Who had a longer shadow in the afternoon? Did the taller person always have a longer shadow?

Part 3 – Graphing Shadows

Using the directions from Part 2, have students measure the length of their shadow once per hour throughout the school day and create a bar chart of their results using the **Student Shadow Length** activity page. Students can either measure in centimeters or, for younger students, measure lengths in terms of “number of space shuttles” by cutting out the shuttle on the last page of this activity.

Teacher Questions:

1. Which student(s) had the longest shadow(s) in the morning (and/or afternoon)? How do you know?
2. Which student(s) had the shortest shadow(s) in the morning (and/or afternoon)? How do you know?
3. Which column has the most spaceships? Which column has the fewest spaceships?
4. Are any columns the same? What does this mean?
5. Are any columns empty? What does this mean?
6. How does the morning part of the graph compare to the afternoon portion of the graph? How are they the same? How are they different? Why do you think this has happened?

Part 4 - Monitoring Shadows

This activity requires students to record measurements of shadow lengths once a month on the same day and time (the 22nd of each month would be ideal). With the students working in pairs, have them mark and measure each other's shadows. This could be done easily on pavement using chalk, but any similar system will work. Have the students record the length of their shadows on an “About My Shadow” sheet for the months they are in school. Note: because the December data point is very important, be sure to schedule several dates to measure shadows in case of cloudy days.

After recording the measurements over the year, ask some of these questions:

Teacher Questions:

1. How long was your shadow? Was it taller than you? Were you taller than your shadow? (you may have to measure the students beforehand).
2. Was your shadow longer last month? Was your shadow shorter last month? Why do you think this happened?
3. Which month has had the longest shadow? Which month has had the shortest shadow? Why do you think this is true?
4. What patterns have you seen in the lengths of the shadows so far this the year? How is this related to the seasons?

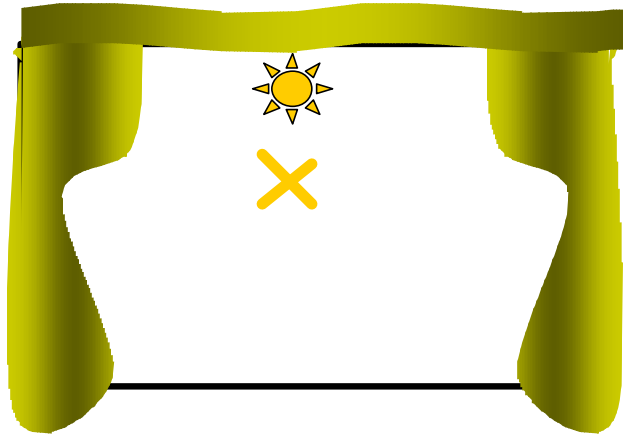
After the last recording for the school year, have the students make bar graphs representing the data they have collected throughout the year. After they have finished this, ask the students these questions:

Teacher Questions:

1. In what month (or season) was your shadow the longest? In what month (or season) was your shadow the shortest? Why do you think this happened?
2. Why do you think it was important that we always measured on the same day of the month?
3. Which was easier to read and understand ... the data sheet or the bar graph? Why?

Extension

Place a masking tape *X* on a south facing window and mark the shadow on the floor at the same time (beware of daylight savings time!) every month. Monitor how the Sun changes its position in the sky over the year.



Summer

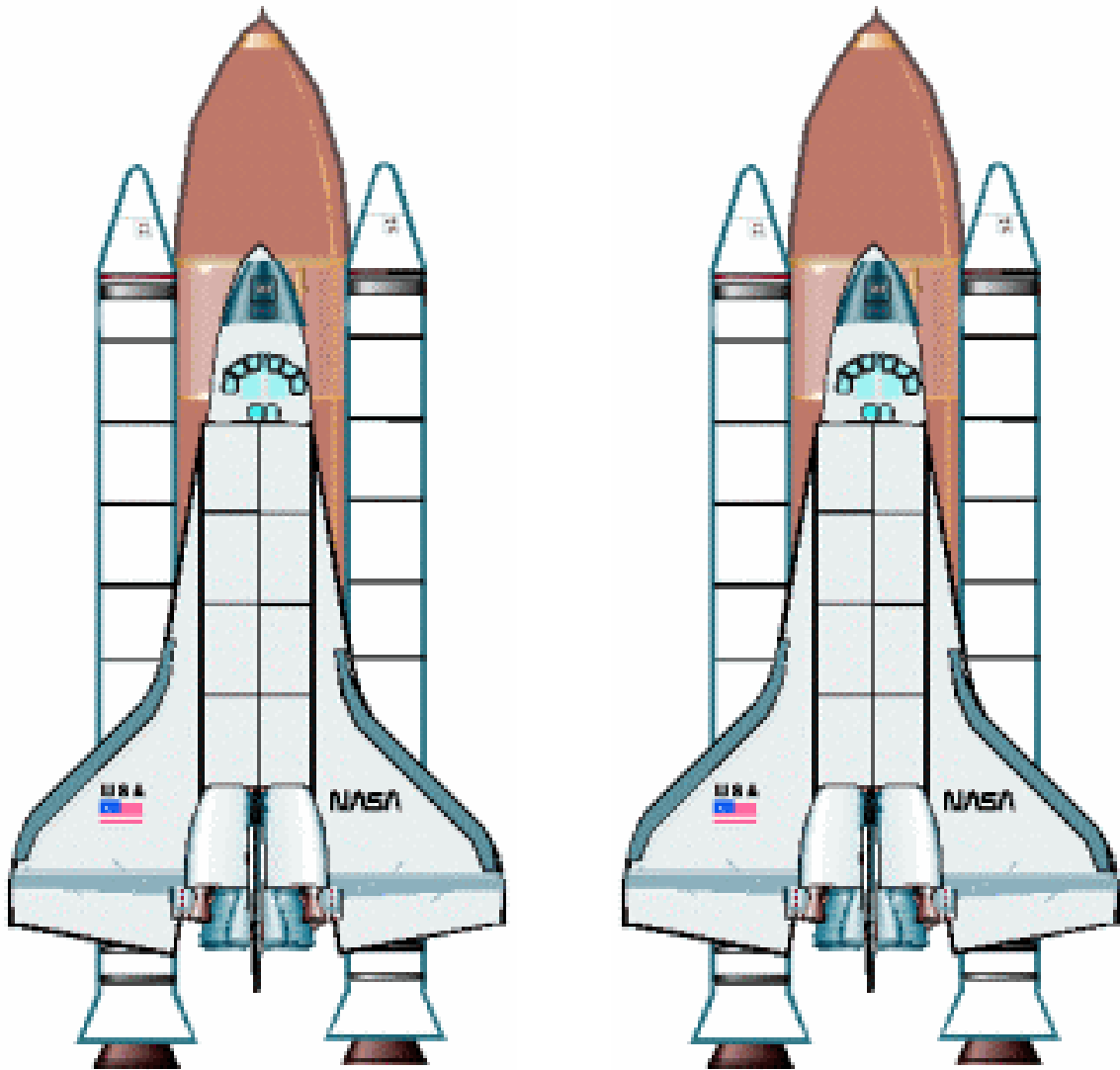


Fall *then* spring



Winter

Cut-Out Space Shuttles for Length Measurement



Name

Changing Shadow Lengths Activity Page

Height	9am	10am	11am	12pm	1pm	2pm	3pm
15 Shuttles							
14 Shuttles							
13 Shuttles							
12 Shuttles							
11 Shuttles							
10 Shuttles							
9 Shuttles							
8 Shuttles							
7 Shuttles							
6 Shuttles							
5 Shuttles							
4 Shuttles							
3 Shuttles							
2 Shuttles							
1 Shuttles							
0 Shuttles							