Family edition

Sun and Seasons Lab: The Shadow Stick

Ages 11-14 · about 45 minutes, with 15 minutes outside on a sunny day

Your child follows a stick's shadow in Sun and Seasons Lab, then stands a real stick in the yard and checks its shadow against the app. The point is that the noon shadow tells you how high the Sun climbs, and it grows longer toward winter.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/sunseasonslab?lesson=the-shadow-stick&ref=fam-sunseasonslab-3. No account, no email and nothing to install.
- A straight stick about 1 meter long, a tape measure and a watch or phone. A sunny spot on flat ground.

Before you start: try it once yourself

Open mytekdev.com/try/sunseasonslab?lesson=the-shadow-stick&ref=fam-sunseasonslab-3. Denver on September 22, the equinox, at 9 in the morning, with every control showing. The white dots on the pad are where the shadow's tip is on each hour; the yellow ring is sun noon.

1. **A day.** Press `Play` (an hour a second) and watch the tip move along the dots, which on an equinox lie in a straight east-west line.
2. **Sun noon.** Press `Pause`, then `Sun noon`: 12:53 pm, the Sun 50 degrees up, the shadow 0.83 m long and pointing north.
3. **Noon marks.** Press `Mark this week's noon`, then `A week later` five times. Six orange marks, out to 1.31 m on October 27.
4. **A real shadow.** Press `Measure a real shadow`. Type a day, the clock time, the stick and the shadow, and press `Check against the app`. Within 2 degrees of the Sun's height is a match.

> Safety: nobody looks at the Sun, with or without sunglasses. Children look at the shadow and the tape measure. The app says so in the real shadow box.

The ideas, in plain words

A shadow points away from the Sun, and the lower the Sun the longer it is: the Sun's height is atan(stick / shadow). The shortest shadow of the day comes at sun noon and points due north in most of the United States. In Denver a 1 m stick's noon shadow is 0.29 m in late June, 0.83 m at the equinoxes and 1.97 m in late December.

A real stick is hard to run for a whole year: the school year has no June solstice, clouds can take weeks, and sun noon falls near 1 pm under daylight saving. The app's stick stands in the child's own town for every day of the year,

and one clear day outside checks it.

Why a real reading is off: the Sun is about half a degree wide, so the tip of a shadow is fuzzy; a stick that leans, ground that slopes, a clock a few minutes out, or a time written without daylight saving all move the answer. The app counts a reading within 2 degrees of its own Sun's height as a match, about as close as a stick and a tape can get.

Do it together

1. Open mytekdev.com/try/sunseasonslab?lesson=the-shadow-stick&ref=fam-sunseasonslab-3 together. Press `Play` and watch the shadow's tip, then press `Sun noon`.

   > **You'll know it worked when:** The shadow is shortest at sun noon, 12:53 pm in Denver on September 22, and points north.

2. Press `Mark this week's noon`, then `A week later` five times.

   > **You'll know it worked when:** Six orange marks, each a little farther from the stick.

3. Press `Find my town` and pick your own town, then go outside. Stand the stick straight, measure the stick and its shadow to the middle of the fuzzy edge, and note the time. Never look at the Sun.

   > **If you get stuck:** If the stick will not stand, push it into soft ground or hold it against a level.
   >
   > **You'll know it worked when:** Two lengths and a clock time on paper.

4. Back inside, press `Measure a real shadow`, type it in and press `Check against the app`. If it is cloudy, press `Too cloudy today` and try another day.

   > **You'll know it worked when:** Your child can say whether the reading matched within 2 degrees, and why a reading can be off.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- When is the shadow shortest, and which way does it point then?
- Why do the noon marks move away from the stick through the fall?
- Why is sun noon in Denver at 12:53 pm on September 22 and not 12:00?
- Your reading was off by 3 degrees. Name two things that could cause it.
- Where will the noon mark be in late June?

> The last question is the real test: a child who says "close to the stick, the shortest of the year" has linked the shadow to the Sun's height through the seasons.

For younger and older kids

Younger: For a younger child, trace your shadows with chalk at three times in one day, then compare with the app's hour marks.

Older: For a teenager, measure the shortest shadow of the day and work out your latitude: switch the level to High school and solve Find the town.

Keep going

- Measure again on another day, a week or more later, and log both readings. What changed?
- Switch the level to High school and solve Find the town: work out a latitude from a noon shadow.
- Pick Honolulu and find the weeks when its noon shadow points south.

Bring it into other subjects

- Math: from your stick and shadow, draw a right triangle to scale and measure the Sun's angle with a protractor.
- History: read how Eratosthenes used noon shadows in two cities to measure the size of Earth.
- Art: build a simple sundial and mark its hours against the app's hour marks.
- English: write instructions for measuring a shadow that a younger child could follow.

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Sun and Seasons Lab: The Shadow Stick
SUBJECTS	Earth and space science
TIME	45 minutes
WHAT WE DID	Followed a model shadow stick through a day and through the fall, then measured a real shadow and checked it against the model.
SKILLS PRACTICED	Shadows and the Sun; Measuring; Checking a model against real data

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/sunseasonslab?lesson=the-shadow-stick

Essential question: What can a stick's shadow tell us about the Sun and the seasons?

Warm-up: Where does a stick's shadow point at 9 am, at noon, at 4 pm? _____

1. **Vocabulary.** Shadow stick, sun noon, Sun's height, prediction, daylight saving time: write each in your own words.

2. **The virtual stick.** Denver, September 22: sun noon at _____, the noon shadow _____ m, pointing _____. The noon shadow five weeks later: _____ m.

3. **My real stick.** Day _____ Time _____ Stick _____ cm Shadow _____ cm. The app says _____ cm. A match? _____ (or: too cloudy, and the sample readings A and B)

1. Why does the noon shadow get longer from September to December?

2. Did your reading match the app? Name two things that could make a real reading differ.

Quick check

Name: _____

1. A stick's shadow is shortest (A) at 12:00 on the clock (B) when the Sun is highest (C) just before sunset

2. From September to December in Denver, the noon shadow (A) gets longer (B) gets shorter (C) stays the same

3. Your real shadow was 3 degrees off the app. Name one thing that could cause it.

Answers

QUESTION	ANSWER	WHY
1	B	Sun noon, when the Sun is highest. In Denver on September 22 that is 12:53 pm on the clock.
2	A	The noon Sun gets lower toward the December solstice: 0.83 m on September 22, 1.97 m in late December.
3	Any one	A leaning stick, sloping ground, the wrong time or a time without daylight saving, or measuring past the middle of the fuzzy edge.

If your state or umbrella school asks, this lesson covers NGSS MS-ESS1-1, Texas TEKS 112.26(b)(9)(A).

Terms of use

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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