

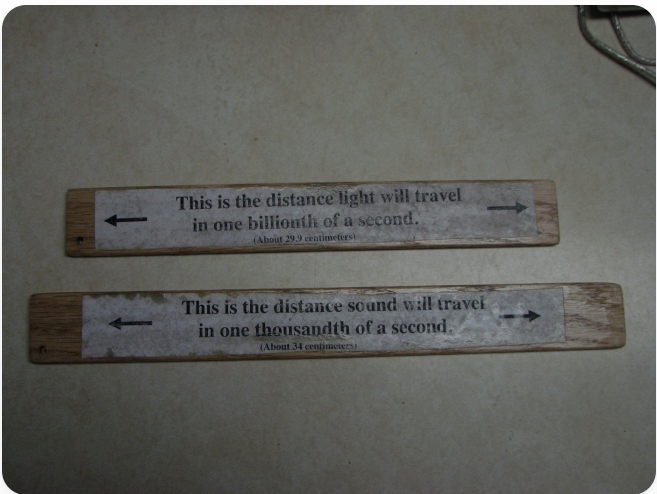
EQUIPMENT BUILD PLAN

SOUND & WAVES

Nanosecond of Light and Millisecond of Sound Sticks

Two labeled wood strips hang in the classroom. One is about 30 cm long, the distance light travels in one nanosecond; the other is about 34 cm, the distance sound travels in one millisecond. Because the sticks look nearly identical, they make the huge difference in speed hard to forget.

Written from Bruce's original workshop handout. Bruce's final review of this plan is in progress.



<div>DIFFICULTY</div> <div>Beginner</div>	<div>BUILD TIME</div> <div>1 hour plus drying time</div>
<div>COST</div> <div>About \$5</div>	<div>SAFETY</div> <div>Everyday care</div>
<div>GOOD FOR</div> <div>Teachers, Families</div>	

What it shows

Two sticks of almost the same length: one shows a billionth of a second of light, the other a thousandth of a second of sound.

Key ideas: speed of light, speed of sound, metric prefixes, scientific notation

Safety (Everyday care). An adult should cut the wood. Use varnish in a ventilated area.

CONSTRUCTION

Build it

Materials

- ☐ **Wood strip for the light stick** · about 30 cm long
Light travels about 29.98 cm in one nanosecond
- ☐ **Wood strip for the sound stick** · 34.3 cm long
Sound travels about 34.3 cm in one millisecond at room temperature
- ☐ **Printed labels** · 2 sets
- ☐ **Clear varnish** · small can
Or white glue thinned with water
- ☐ **Small screw eyes or nails for hanging** · 2-4

Tools

Saw
Sandpaper
Paintbrush
Computer and printer
Scissors
Small drill bit (for hanging holes)

1

Cut the sticks

Cut one wood strip about 30 cm long for light and one 34.3 cm long for sound. Measure carefully: the lengths are the point of the project.

2

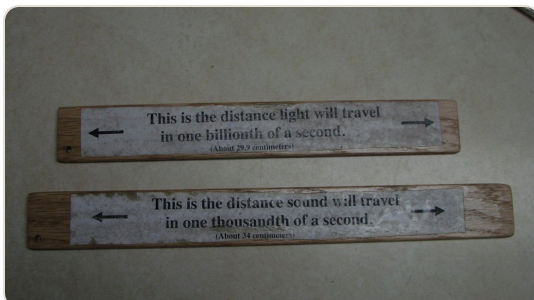
Sand the sticks

Sand the faces and ends smooth.

3

Print the light label

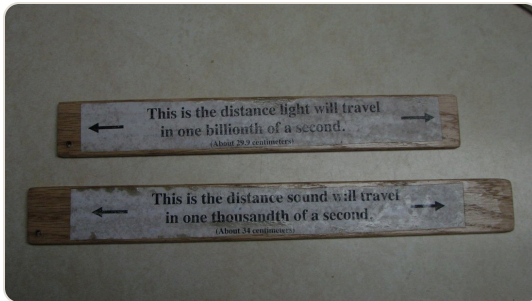
Print a label reading: One nanosecond of light. This is the distance light will travel in one billionth of a second (about 30 centimeters). Add arrows pointing to each end of the stick.



4

Print the sound label

Print a label reading: One millisecond of sound. This is the distance sound will travel in one thousandth of a second (about 34 centimeters). Add arrows pointing to each end.



5

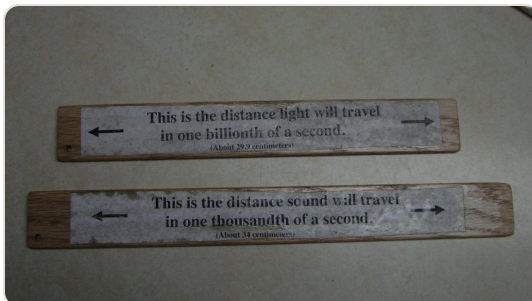
Varnish on the labels

Brush varnish on the stick, lay the trimmed label onto the wet varnish, and smooth it flat. When dry, brush one or two more coats over the paper to seal it.

6

Hang them

Drill a small hole near one end of each stick or add a screw eye, and hang the two sticks side by side in the room.



THE PHYSICS

How it works

Light travels about 300,000,000 meters per second. In one billionth of a second (a nanosecond) it covers about 0.30 meters, or roughly 30 centimeters.

Sound in room-temperature air travels about 343 meters per second. In one thousandth of a second (a millisecond) it covers about 0.343 meters, or 34.3 centimeters.

Using it

- Ask: Which stick represents the faster traveler? Most students guess the longer one. Then look at the time units.
- Have students calculate how many light sticks laid end to end would reach the distance light travels in one second (one billion).

Light covers nearly the same distance in a time one million times shorter, so it is close to a million times faster than sound (more precisely, about 870,000 times).

- Connect to thunder and lightning: count seconds between the flash and the thunder and divide by 3 to estimate the distance in kilometers.
- Use the sticks to practice metric prefixes: nano, micro, milli and their powers of ten.
- Discuss why the sound stick would be a little shorter on a cold day, since sound travels more slowly in cold air.

GO FURTHER

Variations

- Add a third stick showing how far sound travels in one millisecond in water (about 1.5 m).
- Make student-sized cardboard versions for other speeds: a walking person, a car on the highway, or a sprinter in one second.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

The paper wrinkles or bubbles.

TRY THIS

Use thinner coats of varnish and smooth the paper from the center outward with a soft brush.

IF THIS HAPPENS

The ink smears under the varnish.

TRY THIS

Laser-printed labels hold up better than inkjet; or seal inkjet labels with a light coat of clear spray first.