



Hands-on

STAR[★]net

Tested & Approved STEM Activities

SIMPLE THERMOMETER

Activity Guide



Science-Technology Activities &
Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (STAR_Net) program.
Visit our website at www.starnetlibraries.org for more information on our educational programs.
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— SIMPLE THERMOMETER

Overview

Children construct a thermometer and use them to observe temperature changes at home!

Type of Program

- Facilitated hands-on experience
- Station, presented in combination with related activities
- Passive program
- Demonstration by facilitator

Activity Time

15 minutes

Intended Audience

School-aged children ages 8-9
Tweens up to about age 13

What's the Point?

- Changes to distant oceans, air moving freely around our globe, and all living things have an influence on our regional environment.
- Local changes in temperature can be observed with weather instruments.
- A simple thermometer can be made from common materials.

Facility Needs

- A ventilated location (for working with isopropyl “rubbing” alcohol)
- 2-3 tables
- Optional: 15–20 chairs arranged at the table(s) for groups or families to sit together
- Access to water

Materials

For the Facilitator

- Brief Facilitation Outline* page

For Each Group of 10-15 Children

- Materials to construct 10-15 simple thermometers:
- 2-3 (approximately 1-ounce) bottles of red food coloring
- 3-4 metric rulers (noting measurements in centimeters)
- 2 (32-ounce) bottles of isopropyl “rubbing” alcohol

- 2 pitchers, filled with water (at room temperature)
- 11-16 (12-ounce) clear, empty plastic bottles with the labels and caps removed
- 11-16 clear, straight plastic drinking straws
- 3-4 (5-ounce) containers of Play-Doh or modeling clay
- 3-5 (1/3 cup) measuring cups

Supporting Media

Consider setting up a digital media player (such as a computer), speakers, and access to the Internet to display websites or multimedia before, during, or after the activity.

Books

The Everything Kids' Weather Book: From Tornadoes to Snowstorms, Puzzles, Games, and Facts that Make Weather for Kids Fun!

Joe Snedeker, Adams Media, 2012, ISBN: 978-1440550362

Games, investigations, and engaging text bring aspects of weather and Earth's atmosphere — including air, water, clouds, the jet stream, weather stations, rainbows, and more — to life. Appropriate for ages 7-12.

National Geographic Kids Everything Weather: Facts, Photos, and Fun that Will Blow You Away

Kathy Furgang, National Geographic Society, 2012, ISBN: 1426310587

This book about weather – including wild weather – is appropriate for ages 8-12.

Handouts

Science Notebooks for Ongoing Weather Observations

The Michigan Reach Out! “Keeping a Daily Weather Log” activity at www.reachoutmichigan.org/funexperiments/agesubject/lessons/caps/log1.html includes a printable chart to record temperature, wind speed and direction, relative humidity, and other data. Alternatively, professional-grade journals, such as those manufactured by www.riteintherain.com, may serve as a valuable memento for the children.

Daily Forecast Flyer

www.wunderground.com/printer/cityforecast.asp

Customize a flyer of the weather forecast at your location and print it out. Children will appreciate the easy-to-understand graphics, and adults will find a wealth of local, regional, and global information on this single page.

Preparation

Beginning six months before the activity

- Prepare and distribute publicity materials for programs based on this activity. If possible, build on the children's knowledge by offering multiple science, technology, engineering,

art, and mathematics (STEAM) programs. See the STAR_Net resources listed at <http://community.starnetlibraries.org/resources> for ideas.

- Arrange two adults or teens to facilitate this activity and monitor the use of isopropyl “rubbing” alcohol. Or, conduct the investigation as a demonstration by the facilitator.

The day before the activity

- Construct an example thermometer by following the activity steps outlined below. Take the example thermometer outdoors and prepare to answer the children’s questions about using it by observing how the thermometer responds in sunlight and in shade.
- Set out the materials so that everyone has access to them, as well as space in which to work.

Activity

1. Share ideas and knowledge.

- Introduce yourself and the library. Help the children learn each other’s names (if they don’t already).
- Frame the activity with the main message: Changes to distant oceans, air moving freely around our globe, and all living things have an influence on our regional environment.
- Invite the children to talk about what they already know about weather, their direct experiences with it, and their ideas about what features of weather can be measured. Use open-ended questions and invite the children to talk with you and each other.

Weather is the conditions of the atmosphere at a given place and time. It changes daily and with the seasons.

Meteorologists collect measurements at Earth’s surface at weather stations or on ships or weather buoys. They typically collect temperature, wind direction and speed, precipitation, humidity, and pressure measurements using the corresponding instruments: thermometers, anemometer, rain gauge, hygrometer, and barometer, respectively. Meteorologists also need to understand what’s happening at higher altitudes in order to make weather forecasts. Weather balloons and aircraft (which are equipped with sampling and measuring instruments) gather data from aloft. Meteorologists use satellites to collect data about the atmosphere, including measurements of temperature, cloud cover, and winds, from space.

Information from many instruments is used to create the computer models that integrate data into a dynamic picture of Earth’s weather. High-speed computers make calculations of what the weather is likely to be the coming days, weeks, and years.

2. Invite the children to build a simple thermometer that they can use at home to monitor changes in temperature.

Caution the children that the bottle is NEVER to be used for drinking because it will contain isopropyl alcohol, which should not be inhaled or ingested. Have the children follow these steps:

- a. Pour equal parts of water and isopropyl alcohol into the bottle, filling it to about $\frac{1}{8}$ to $\frac{1}{4}$ full.

- b. Mix in two drops of food coloring.
- c. Suspend the straw in the bottle — without touching the bottom of the bottle — and secure it with Play-Doh or modeling clay around the bottle's neck. **DO NOT DRINK THE LIQUID!**
- d. Hold the bottle gently with your hands (without squeezing) and observe the changes in the straw.

Heat from the children's hands will warm the thermometer. The air and liquid inside the bottle expand as they grow warmer. This builds pressure inside the bottle, which makes some of the liquid rise in the straw.



Thermometer at room temperature.



Thermometer warmed by holding its sides.

- 3. Discuss how the thermometer works and the limitations — and possibilities — for using their new thermometers at home.** Explain that the gas and liquid inside the bottle, like air in a bag of popcorn in the microwave, expand as they grow warmer. This increases the pressure inside the bottle, which makes some of the liquid rise in the straw.

Invite the children to predict what will happen to the level of the liquid in the straw when they leave, and whether it will be higher in shade or in sunlight.

Share that thermometers from the store work slightly differently. They are completely closed, and are calibrated to accurately measure the temperature.

Caution that the thermometer is not recommended for use in cold locations. The thermometer works best at room temperatures and at warmer temperatures. It should be stored indoors while the children are using it at home, and only taken outdoors for a few minutes each day to observe temperature changes. Over time, the alcohol will evaporate and the bottle contents will need to be replaced with a new mixture of water, food coloring, and isopropyl alcohol.

Tell the children to cut the bottle in half (to prevent accidental reuse for drinking) and recycle it when they have completed their extended weather observations at home.

- 4. Conclude.** Summarize that while it is the nature of weather to be highly variable, the children can keep track of it using their new weather instruments!

Correlation to Standards

National Science Education Standards

Grades K–4

Science as Inquiry – Content Standard A

Understandings About Scientific Inquiry

- Scientists use different kinds of investigations depending on the questions they are trying to answer. Types of investigations include describing objects.
- Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.

Earth and Space Science – Content Standard D

Changes in the Earth and Sky

- Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation.

Science and Technology – Content Standard E

Understandings About Science and Technology

- Tools help scientists make better observations, measurements, and equipment for investigations.

Grades 5–8

Science as Inquiry - Content Standard A

Abilities Necessary to Do Scientific Inquiry

Understandings about Scientific Inquiry

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events.

Earth and Space Science - Content Standard D

Structure of the Earth System

- Global patterns of atmospheric movement influence local weather.

Extensions

Weather Measurements

If desired, expand this station to include other weather tools. Find instructions and materials lists at websites such as:

Make an Anemometer! Measure how fast the wind blows, California Energy Commission Science Projects

www.energyquest.ca.gov/projects/anemometer.html

Building a Wind Gauge: Measure how strong the wind blows, California Energy Commission Science Projects
www.energyquest.ca.gov/projects/windmeasure.html

Build Your Own Weather Station

<http://celebrating200years.noaa.gov/edufun/book/BuildyourownWeatherStation.pdf>
Includes instructions for building six weather instruments. Appropriate for ages 8 to 13 with adult assistance.

Be A Citizen Weather Reporter

<http://celebrating200years.noaa.gov/edufun/book/BeCitizenWeatherReporter.pdf>
Instructions and a weather journal data form for recording regular measurements from a weather station's instruments. Over time, children may be able to observe patterns and trends and use the included tips for making their own weather forecasts.

CoCoRaHS: Community Collaborative Rain, Hail, and Snow Network

www.cocorahs.org

Collaborate with others to measure and map precipitation from your registered location. Appropriate for all ages, although children will require adult assistance in getting started.

References

Make a Thermometer: Watch how a simple thermometer works, California Energy Commission Science Projects, www.energyquest.ca.gov/projects/thermometer.html

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Brief Facilitation Outline

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- Frame the activity with the main message: Changes to distant oceans, air moving freely around our globe, and all living things have an influence on our regional environment.
- Invite the children to talk about what they already know about weather, their direct experiences with it, and their ideas about what features of weather can be measured. Use open-ended questions and invite the children to talk with you and each other.

2. Invite the children to build a simple thermometer that they can use at home to monitor changes in temperature. Caution the children that the bottle is NEVER to be used for drinking because it will contain isopropyl alcohol, which should not be inhaled or ingested. Have the children follow these steps:

- a. Pour equal parts of water and isopropyl alcohol into the bottle, filling it to about $\frac{1}{8}$ to $\frac{1}{4}$ full.
- b. Mix in two drops of food coloring.
- c. Suspend the straw in the bottle — without touching the bottom of the bottle — and secure it with Play-Doh or modeling clay around the bottle's neck. **DO NOT DRINK THE LIQUID!**
- d. Hold the bottle with your hands and observe the changes in the straw.

3. Discuss how the thermometer works and the limitations — and possibilities — for using their new thermometers at home. Explain that the air inside the bottle, like the air in a bag of popcorn in the microwave, expands as it gets warm. The increased air pressure makes some of the liquid rise in the straw. Add that while thermometers from the store (which are calibrated to accurately measure temperature) can be used to note the temperature in degrees, their thermometers demonstrate how a thermometer works and responds to warmer temperatures. Invite the children to predict what will happen to the level of the liquid in the straw when they leave, and whether it will be higher in shade or in sunlight.

Caution that the thermometer is not recommended for use in cold locations. The thermometer works best at room temperatures and at warmer temperatures. It should be stored indoors while the children are using it at home, and only taken outdoors for a few minutes each day to observe temperature changes. Over time, the alcohol will evaporate and the bottle contents will need to be replaced with a new mixture of water, food coloring, and isopropyl alcohol.

Ask the children to cut the bottle in half (to prevent accidental reuse for drinking) and recycle it when they have completed their extended weather observations at home.

4. Conclude. Summarize that while it is the nature of weather to be highly variable, the children can keep track of it using their new weather instruments!