PCS edventures!™ EXPERTS IN HANDS-ON STEM EDUCATION

Outdoor Science Experiments

Keeping Time Without Modern Technology

If you lived in ancient Egypt and Babylonia, you didn't have microwave clocks, wrist watches or cell phones — you had to rely on what was around you to tell time. From recognizing where the sun was in the sky to depending on your internal clock, actually knowing the time was a difficult task. That is, until sundials were invented.

While the time-telling technology of Egypt was nowhere near as precise as today's tech, it was advanced, with different versions of sundials able to tell everything from the hours left in a day to how close the summer and winter solstices were.

In this activity, students return to their ancestral roots as they build sundials to keep track of the hours in the day!

HANDS-ON STEM EDUCATION

For over 25 years, PCS Edventures has inspired students to develop a passion for Science, Technology, Engineering and Mathematics (STEM), focusing our efforts on making learning and discovery a fun and interactive process for grades K-12.

- CLASSROOM
- AFTER-SCHOOL
- HOME LEARNING

Before heading outside for this Spectacular Sundial Experiment, lead your learners through a group discussion to get the technology-free time-telling thoughts flowing. Use these questions below to help stimulate the conversation:

- What are ways you can keep time? (Allow students to come up with as many answers as possible.)
- Are there ways to tell what time it is without using modern technology? (Yes.) Can you think of any ways to do this?

In ancient Egypt and Babylon, citizens kept track of time with a device called a sundial. These sundials were unique, relaying information such as the time of day, the day of the year, and how close the next solstice was.

Spectacular Sundial Experiment

MATERIALS NEEDED:

- **Crayons/Markers**
- **Paper Plate (1 per student)**
- **Plastic Straw (1 per student)**
- **Pushpins or Paperweights**
- **Ruler (1 per student)**
- **Sharpened Pencil (1 per student)**

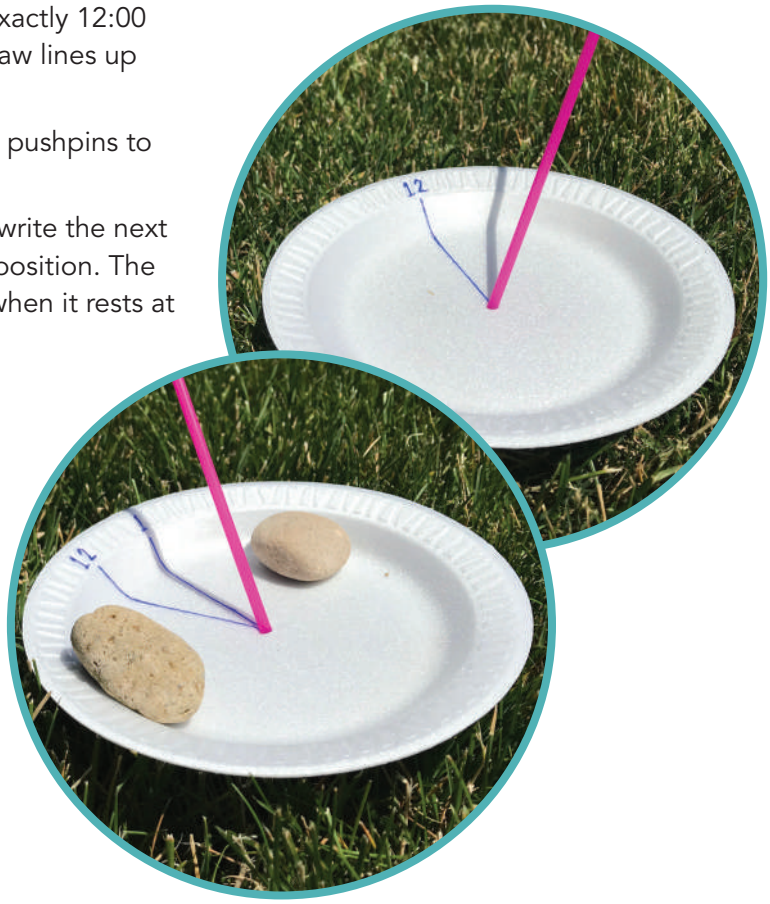
Sundial Build

After reading through the experiment, decide if this activity is something your learners would be able to handle on their own or in small groups. If your learners are young, you may benefit from building a classroom version of a sundial as opposed to an individual one that they can take home.

To begin the Sundial Build, pass out the paper plates, sharpened pencils, rulers, markers and straws to your students. Then, jump into a demonstration of how to get started.

- For this activity, you should start prepping around 11:30 on a sunny day.
- Start by writing the number 12 on the edge of the plate with one of the markers.
- Now, take the sharpened pencil and push a hole through the center of the paper plate, leaving a small hole in the center.

- Use the ruler to draw a straight line from the number 12 to the hole in the center of the plate. This line represents noon on the sundial.
- Next, head outside with students, bringing all the remaining supplies.
- Use a compass (any smartphone has an accessible compass) to locate the closest celestial pole. Your shadow maker (the straw, also called a gnomon) needs to point to towards the closest celestial pole — either the north or south pole.
- Place the plate on the ground in an area that gets all-day sun exposure.
- Stick the straw through the hole in the center of the plate so that it slants towards the closest celestial pole.
- Using a watch, rotate the plate at exactly 12:00 PM so that the shadow from the straw lines up with the pre-drawn line.
- You can use rocks, paperweights or pushpins to secure the plate to the ground.
- Every hour, return to the plate and write the next consecutive number in the correct position. The shadow of the straw will move, so when it rests at 1 PM, write the number 1 at the edge of the plate. Continue doing this through the rest of the day, every hour available.



- Whenever students need to pack-up for the day, have them space the rest of their numbers out accordingly on the plate. Unless they are able to continue this process until dusk, having a general idea of where the shadow will fall over the next few hours is enough to write in the remaining numbers.
- When you're finished, your sundial should resemble a wall clock.
- Now, let students personalize their plates before sending them home. Every sundial should look spectacular!

After the sundial build, follow up with these discussion questions:

- Why does the straw's shadow move? (Because we were so careful to make sure our straws pointed towards the closest celestial pole, our sundials end up maintaining a parallel orientation to the Earth's Y-axis. As the Earth spins throughout the day on that Y-axis, our straw moves further away from the sun, relative to the Earth. This means that as we get further away from the sun, the straw's shadow stretches and moves across the paper plate. Because we've been tracking these movements for hundreds of years, we're able to recognize that they stay the same every day, which allows us to put time-keeping parameters on the movements!)
- Why are sundials useful? (Encourage creative thinking.)
- Would you rather use a sundial or a watch to keep track of time?
- Even though technology has advanced way past the point of sundials, why is it important to study our ancestor's technologies? (Encourage creative, reflective thinking. In short, these ancient technologies still seem incredibly advanced for the time, and a lot of the very unique sundials were able to predict events up to the minute. By learning from our ancestors, we're able to build upon their knowledge while still showing respect to the groundwork they laid.)

If your learners want to take their sundials home, provide them with these instructions so that they, or their guardians, can place the sundial in the correct path of the sun.

Take-Home Instructions For Parents

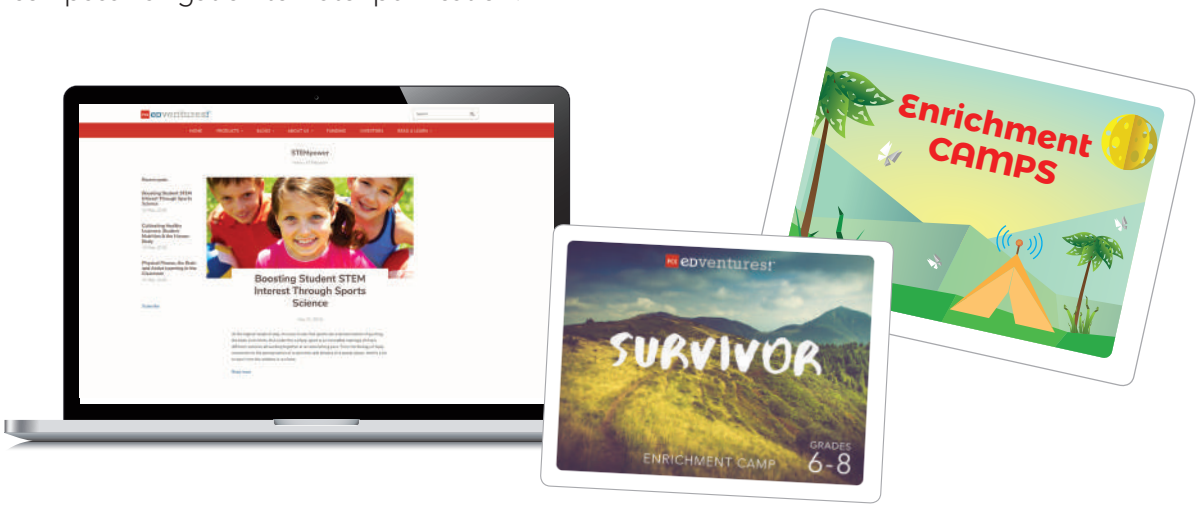
Sundial Installation

To correctly place your sundial at home:

1. Use a compass (any smartphone has an accessible compass) to locate the closest celestial pole. Your shadow maker (the straw, also called a gnomon) needs to point to towards the closest celestial pole — either the north or south pole.
2. Place the plate on the ground in an area that gets all-day sun exposure.
3. Stick the straw through the hole in the center of the plate so that it slants towards the closest celestial pole.
4. Using a watch, rotate the plate at exactly 12:00 PM so that the shadow from the straw lines up with the pre-drawn line.
5. You can use rocks, paperweights or pushpins to secure the plate to the ground.
6. At 1 PM, return to the plate to make sure the shadow lines up correctly with the number 1 drawn on the plate.

Summer is a great time for the outdoors. Do what you can to get your learners outside and spend the days appreciating everything Mother Nature has to offer.

Are you looking for more outdoor STEM ideas? Visit our website at edventures.com to learn about our *Survivor Enrichment Camp*, the 12-day curriculum package that teaches students everything from compass navigation to water purification!



Resources:

WikiHow. (2018, May 07). How to Make a Sundial. Retrieved June 20, 2018, from https://www.wikihow.com/Make-a-Sundial

1. This activity was adapted from WikiHow's peer-reviewed community of learners. For a full list of citations used or for more advanced sundial activites, head to: https://www.wikihow.com/Make-a-Sundial
2. All activity images are unaltered, and were created by Wikivisual and distributed under a Creative Commons Licence. For more information, head to https://creativecommons.org/licenses/by-nc-sa/3.0/