Time-keeping Devices

Concept:

For as long as we have recorded history, time-keeping has been an integral part of the human condition.

We have smart phones that automatically tell us what time it is. It can be easy to forget all of the engineering and science that went into building time keeping devices throughout history.

Having your students design and build a time-keeping device can help them understand the many processes required to make a functional device.

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Prep:

First, you will need to decide or have your students decide what time of time-keeping device they will be making. We will outline how to make a water clock as an example, but there are many types of time-keeping models.
These include:

Water Clocks
Involve critical thinking with water pressure, aerostatics and engineering.

Pendulum Clocks
Involve critical thinking with physics, design, and engineering.

Hourglasses
Involve critical thinking with physics and engineering.

Precise Marble Runs
Involve critical thinking with physics, design, and engineering.

Gardens With Seasonal Flowering Plants
Track times of year by when they bloom. Relates to ecology, history, the science of seasons, and biology.

Star Charts
Monitor the seasonal changes in the sky. Relates to astronomy, history, and phenology (the science of seasons).

Another thing to keep in mind is the time scale you and your students want to measure. Are you trying to accurately time 30 seconds? What about 10 minutes? 1 hour? This can greatly impact how your students should design their device.

Example: A Water Clock

What you need:

- Two containers

  These can be plastic bottles, tin cans, anything that can hold water and you can poke holes into.
- Box

  This is to hold the top container away from the bottom container.
- Scissors
- Scratch awl or ice pick
- Cork
- Marker
- Plumbers putty or tape
- Stopwatch

Process:

1. Decide what time frame you want to measure.
2. Design and build a stand for your top container to be held several inches above your bottom container.
3. Poke a small hole in the bottom of your top container.
   (For a shorter time frame you want a high flowrate at first that slows down over time, and then stops once the hydrostatic pressure equalizes with the air pressure.)
4. Place the second container underneath the first, and measure out a starting water amount. This can be measured in ounces, quarts, or cups. As long as you know what your starting amount is (e.g. one cup of water)
5. Now plug the hole (in the bottom of your top container) with your finger and be ready to use your stopwatch.
6. Make sure that the hole in the top container is plugged with the starting amount of water in it until you are ready to start your timer.
7. Unplug the hole and start the timer immediately.
8. Measure the time it takes for the water to stop flowing from the top container to to bottom.
9. Carefully refill it and add more water from the top until you can reach your goal time.
10. If the flow rate is too fast or sudden, you can always use tape or plumbers putty to seal the first hole you made and make a smaller hole.

Take it Further

Giving students a base time frame with some parameters, such as useable materials, lets them research and explore what options are available that would work for the time frame given to them.

Oklahoma Academic Standards

- PS.PS2.1 Analyze and interpret data to support the claim of a causal relationship between the net force on an object and its change in motion, as described in Newton's second law of motion.
- PS.PS3.1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.