

## SIMPLE MACHINE: ARCHIMEDES' SCREW

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Next Generation Science Standards: **MS-PS1-1, MS-PS2-2, MS-PS2-4, MS-PS3-1, MS-PS3-5, HS-PS2-1, HS-PS2-2, HS-PS2-3**

Vocabulary:

**Simple Machine** – a device that reduces the overall work by providing a mechanical advantage for the user. A device that makes work easier to do.

**Force** – a push or pull on an object.

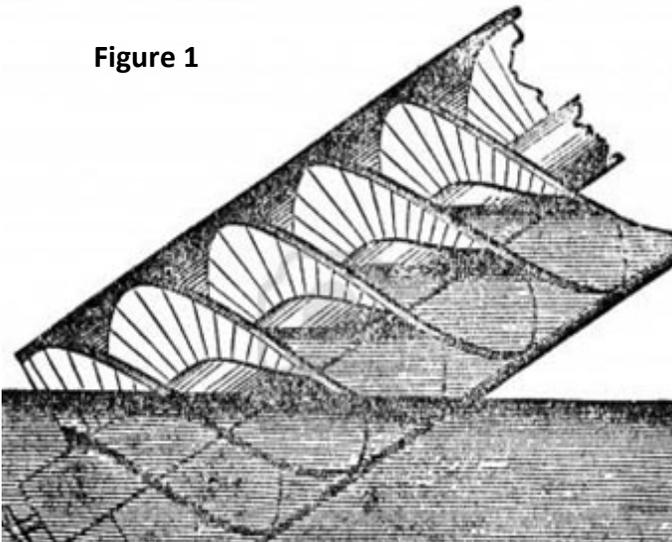
**Screw** – simple machine using circular/rotational motion to lift or secure a load.

Background:

An Archimedes' screw is a simple machine that is used to lift water when the screw is turned. The Archimedes' screw has been used since ancient times. It is used mainly for lifting water from a lower to higher level, such as rivers or lakes, to irrigate fields, and also for draining water out of mines. It is named for the person believed to have invented it, Archimedes. Archimedes was an ancient Greek scientist, engineer and mathematician. He is famous for many inventions and discoveries.

The lowest portion of the screw is placed in the water, and as it is turned, a small quantity of water is scooped up into the tube. As the screw turns, the water slides along and up the tube. Meanwhile, more water is scooped into the end of the tube and it slides along, and so on until the

water comes out the top of the tube. [See Figure 1]



**Figure 1**

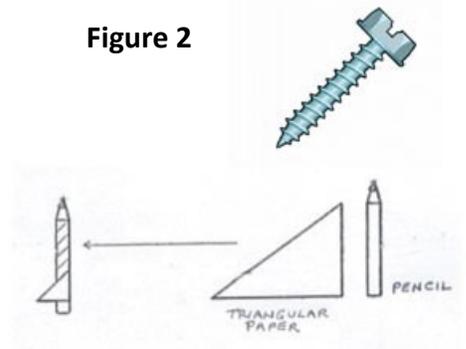
Asking Questions/Class Discussion:

**Is a screw a simple machine?** Answer: Yes

**How does a screw work?** Answer: You have to turn a screw around and around to get it into wood or a wall, but this is easier than pushing it straight in.

**If you uncurled a screw what would it look like?** Answer: A right triangle. It's like a ramp going round in a spiral shape. In an Archimedes' screw, the water goes up in a spiral path, rather than straight up.

You can demonstrate this by wrapping a right triangle shaped paper cut out around a pencil. [See Figure 2]



Supplies (per group):

- 24 oz. unopened bottle of water
- Narrow plastic tubing (approximately three feet long, 4-7mm diameter)
- Two plastic bowls
- Roll of duct tape
- Water (obtained from the unopened water bottle)
- Food coloring
- Stacked books (or other objects) to lift one bowl off ground level

**Activity Preparation:** This is a wet activity, so place down plastic sheets to protect table or floor surfaces, or conduct the activity outdoors.

**Preparing the Bowls**

Open the water bottle, and mix a few drops of food coloring (group's choice). Pour water into the one bowl at ground level. Place the other (empty) bowl on a book (or anything to raise it up from ground level). Place it where it will easily catch the water which will come out the top of the tube. Remove any remaining water from the bottle until empty then cap the plastic bottle.

**Building Procedure:**

Using the duct tape, tape one end of the narrow tubing onto the plastic bottle base end, leaving about a half inch hanging over the end. [See Figure 3] Carefully wrap the tubing around the bottle at regular intervals in a spiral shape until you reach the capped end. (You will probably need to use pieces of duct tape to tape down the tubing at intervals as you go along).

Cut off the excess tubing, leaving about a half inch hanging out over the capped end. Tape down the narrow tube to the bottle at this end also. *There should be about a half inch of tubing hanging off both ends, past the part that you have taped down.*



**Figure 3**

Operating Procedure:

Submerge one end of the Archimedes' screw in the bowl of colored water, with the other end resting just above the elevated bowl. [See Figure 4]

Turn the screw slowly.

**Teacher Question to Class: What do you see?**

**Answer: Water goes into the tube.\*If water is not entering the tube, have the students turn the Archimedes' screw in the opposite direction.**

Keep turning the screw.

**Teacher Question to Class: What happens after a while? Water comes out the top of the tube and falls into the bowl. [See Figure 5]**

The children should be asked to turn the screw in one direction, and then the other.

**Teacher Question to Class: Does the direction make any difference? It does! The screw only works when it is turned in one direction - in the opposite direction to the winding of the tubing. Otherwise, the water will not get scooped up.**

Supplement Activity & Talking Points:

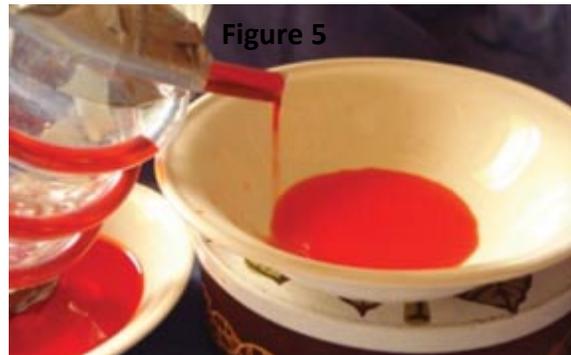
Stopwatches can be used to record the time it takes to move the contents of one water bowl to the other. This can be compared to how fast water flows from a sink.

**Teacher Question to Class: How does this ancient pump relate to modern water movement? Give examples.**

**Figure 4**



**Figure 5**



*This lesson was designed by the U.S Space and Rocket Center*

