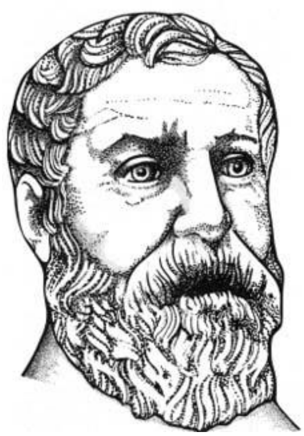
Introduction

This activity demonstrates the laws of force and motion by creating a simple Hero Engine.

Image Reference

Photo of Hero’s Engine replica courtesy of John Whitehouse, Sussex Steam Company (http://www.sussexsteam.co.uk/).

The Hero Engine



Hero of Alexandria
- Ancient Greek mathematician and engineer
- Lived 10–70 AD, in the Ptolemaic Egyptian city of Alexandria

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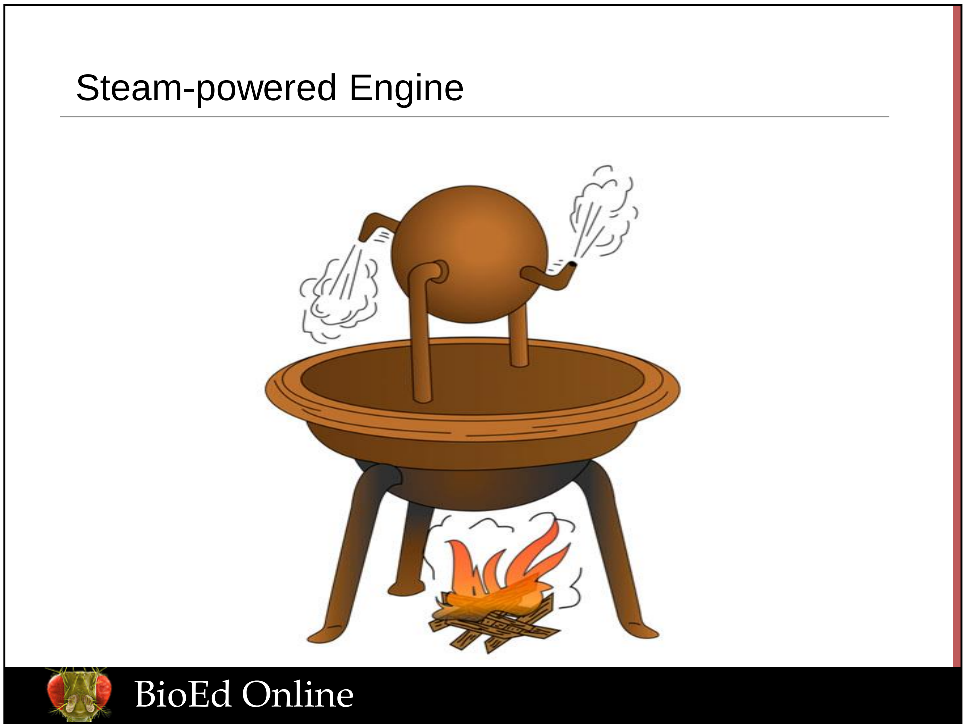
The Hero Engine

Hero of Alexandria was a mathematician and engineer who created the first known version of the steam engine termed the Hero Engine.

Image Reference

Hero (1688). *Heron of Alexandria*. Retrieved 1-12-10, from http://en.wikipedia.org/wiki/File:Heron.jpeg



Steam-Powered Engine

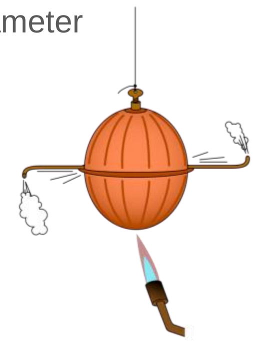
The Hero Engine was composed of a kettle or metal pot filled with water. The device also included two L-shaped tubes which projected from the kettle opposite each other. Heat was applied to the bottom of the kettle, which caused the water within to convert into steam. The steam then exited through the two tubes, providing a force to rotate the kettle.

Image Reference

Vogt, G.L. (2009) *Hero Engine Force & Motion*. Center for Educational Outreach. Houston, Tx: Baylor College of Medicine.

Modern Steamed-Powered Engine Construction

- Copper toilet tank float
- 12” copper tubing with 3/16” diameter
- Thumbscrews
- Metal file
- 3/16” drill bit
- Solder
- Propane torch
- String
- Water
- Eye protection



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Modern Steamed-Powered Engine Construction

A modern version of the Hero engine can be created by obtaining a copper toilet tank float. Holes can be drilled into either side of the tank float. Copper tubing can be wound through the holes so that they are projecting from either side of the tank float and then soldered into place.

Make sure that the drill bit and diameter of the copper tubing used are equivalent. Fill the tank float with water and suspend the tank float from a string. Use a propane torch to apply heat to the bottom of the tank float. Steam will begin to form and as it exits through the copper tubing the tank float will begin to rotate. Be sure to wear eye protection and follow school safety guidelines.

Image Reference

Vogt, G.L. (2009) *Hero Engine Force & Motion*. Center for Educational Outreach. Houston, Tx: Baylor College of Medicine.

Pop Can “Hero Engine”

Materials

- Empty aluminum soft drink can with tab still attached
- Nails of different sizes
- String
- Water-filled tub or container
- Water
- Paper towels

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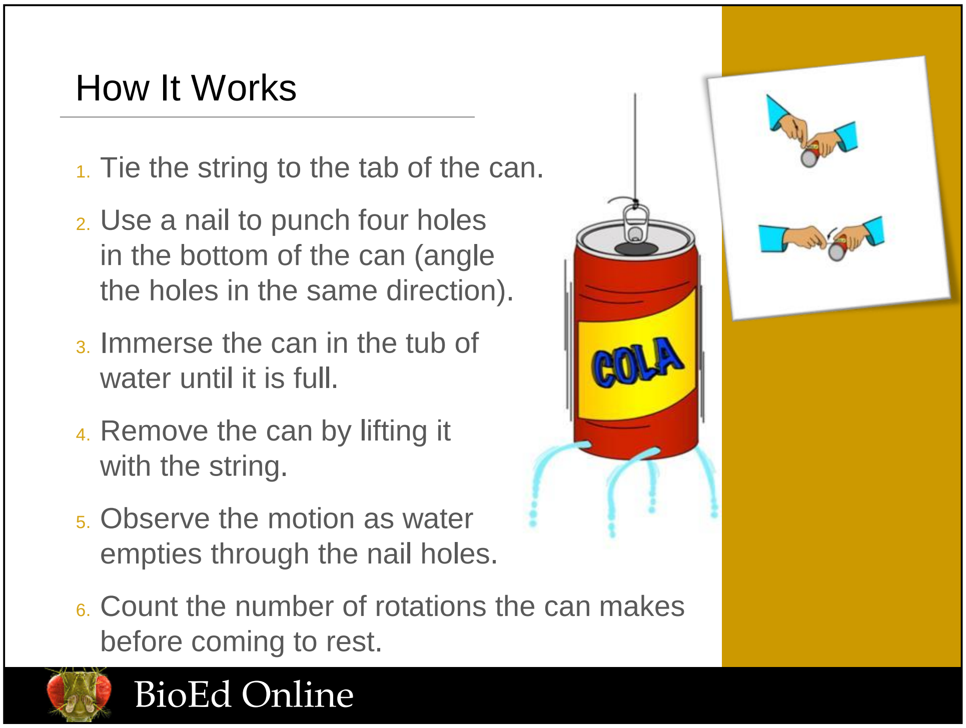
Pop Can “Hero Engine”

A simple version of the Hero Engine can be created using a soft drink can. This version expels water instead of steam, so be equipped to clean up any water spills.

Image Reference

Vogt, G.L. (2009) *Hero Engine Force & Motion*. Center for Educational Outreach. Houston, Tx: Baylor College of Medicine.



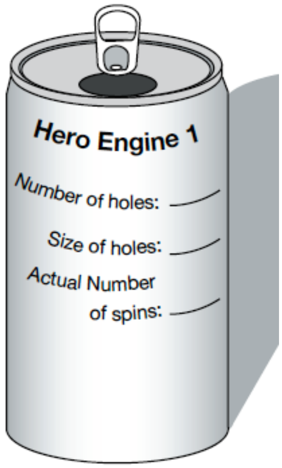
How It Works

Empty out an aluminum can with the tab still attached. Tie a piece of string through the tab of the can. Use a nail to pierce the bottom of the can and then turn the nail gently towards one side to bend the hole. Rotate the can ¼ turn and create another hole, turning the nail in the same direction as the previous hole. Rotate the can another ¼ turn two more times to create four holes total, making sure to bend the nail in the same direction each time. Submerge the can in a container filled with water to fill up the can. Lift the can up using the piece of string and observe the number of rotations made by the can.

Image Reference

Vogt, G.L. (2009) *Hero Engine Force & Motion*. Center for Educational Outreach. Houston, Tx: Baylor College of Medicine.

Extensions



Design an experiment to find ways to increase the number of rotations the Pop Can Hero Engine makes before it comes to rest.

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Extensions

Different versions of the experiment can be conducted to observe the increase or decrease in the number of rotations made. Different diameter nails can be used to create larger or smaller holes. Holes that are too large will cause water to rush out too quickly, while very small holes will only create a small trickle of water so there will not be enough force to rotate the can.

Holes can also be placed in different positions on the can. Holes further up on the can will not produce as much rotations as those placed lower due to a lesser amount of water available to be emptied. After the water level reaches below the holes, what is left remains in the can and is unable to flow out. The number of holes and angle of the holes an also be varied in different trials.

This activity provides an example of action and reaction, also known as Newton's Third Law. As water flows out of the can, this action creates a force on the can that is equal in magnitude but opposite in direction. The reaction is that the can rotates in a direction opposite from the water flow.

Image Reference

Vogt, G.L. (2009) *Hero Engine Force & Motion*. Center for Educational Outreach. Houston, Tx: Baylor College of Medicine.