THE POWER OF STEAM

ACTIVITY DESCRIPTION

Children learn about the operations of a steam engine. They undertake their own steam energy experiment, identify, and create simple machines, describe their functions and the energy conversions involved. Children may need parental supervision for this experiment.

THEME

- Steam energy
- Energy conversions
- Simple machines

MATERIALS REQUIRED

- Unopened soft drink can (one can per experiment)
- Thumbtack or Nail
- Access to a sink
- Water
- 10-mL of clean water
- String
- Ring stand
- Ring
- Bunsen burner or hot plate
- Tongs
- Puffing Billy Railway Virtual Tour #1, meet driver Simon.

https://www.youtube.com/watch?v=dAWUosWpu8g

INSTRUCTIONS

With Parental supervision children carefully watch the steam energy experiment, assisting adults when required. To begin, children watch Virtual Tour #1: Meet Simon one of the steam train drivers at Puffing Billy Railway. Then with a grown up undertake the “Steam Energy in a Can” experiment.

"STEAM ENERGY IN A CAN" EXPERIMENT

INSTRUCTIONS

1. Working over a sink, create a hole in the middle of the side of an unopened soft drink can, using a thumbtack or nail. Continually shake the can, using the pressure generated by carbonation to force the liquid out through the hole.
2. When the can is empty, create a second hole on the side opposite the first.
3. Rinse the can out in the sink, squirting water into one of the two holes.
4. Once you have emptied and rinsed the can, carefully add about 10 mL water in the can through the small holes (or enough so you hear it sloshing around inside the can).
5. Use the thumbtack or nail to slant each of the two holes in the same direction, (when you pierce the can, the direction the nail is facing, is the direction the steam will come out). Make sure the needle is moved in a horizontal direction, towards the curvature of the can. These holes act as "jets" in order to propel the can.

DEMONSTRATION

1. Shake the can so that children can hear the water sloshing around inside the can. Allow them to observe that the pull tab is unopened and that there are two holes in opposite sides of the can.
2. Tie a string to the can's unopened pull tab and secure the can to a ring attached to a ring stand at a height that allows a Bunsen burner or hot plate to warm it.
3. While waiting for the can and water to heat, ask children to predict what will happen.
4. Gently warm the can and water. Water vapor will eventually exit both holes and should result in a net force that sets the can spinning.

DISCUSSION

1. Ask children to describe any energy transformations present in the demonstration.
2. Challenge children to explain why the soft drink can behaves as it does. As long as the water is heated gently, no condensed water vapor is visible as steam exits the can.
3. Does energy get used up or is it converted?
4. What other conversions are taking place?

EXPLANATION AND CONCLUSION

Energy may go through several conversions before we actually use it to do work. Energy is not "used up" in any conversion; it is simply changed from one form to another. Like matter, the total energy is conserved.

One of the most common conversions is to connect a steam engine to an electric generator, which converts mechanical energy into electrical energy. Discuss possible sources of energy for steam engines.

These include fossil fuels (which were originally produced by photosynthesis using electromagnetic energy from the sun, since these fuels are the remains of once-living plants and animals), wood (also a product of photosynthesis), nuclear reactions, or sunlight (one type of solar generator uses a parabolic mirror to focus the sunlight onto a pipe containing water that is heated to produce steam).

Several energy conversions are involved in the demonstration.

Chemical energy from the fuel used in the Bunsen burner or the source that produced the electricity (some possibilities are hydroelectric, solar, wind, geothermal, nuclear, and petroleum energy sources) powering the hot plate is used to warm the water and the can.

Some of the energy goes to overcoming the attractions among the liquid water molecules so they vaporize to produce warm water vapor. The molecules of the warm water vapor have high kinetic energy, which increases the pressure inside the can and thus forces some of the gas out through the holes in the sides of the can. As these jets of gas leave the can, they push on the air outside the can and create an opposite push on the can, which then is partially converted to kinetic energy as the escaping water vapor causes the can to rotate.

Some of the energy from the escaping water vapor is also partially converted to potential energy as the string attached to the spinning can twists.

BACKGROUND INFORMATION

The first operating steam engine was built in 1712 by English engineer Thomas Newcomen. Newcomen's engine was simple. The steam from the boiler was let into the space between the inside of the cylinder and the piston. The other end of the piston was attached to the pump by means of a rod. Water was sprayed onto the cylinder to cool the steam. As the steam cooled, its volume decreased, and caused a vacuum to form inside the cylinder. The piston was sucked down into the cylinder by the weight of the air on top of it, then was pulled back by the weight of the pump attached to the rod. Steam was let into the chamber again, and the cycle repeated.

REFERENCES

Visit http: //technology.niagarac.on.ca/people/mcsele/newcomen.htm for a description of the Newcomen engine.

The following u-tube clips also provide information on the working systems of a steam engine.

#Steam Engine- How does it Work | Steam Engine Working Function Explain | How Locomotive Engine Work - YouTube