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## HERO'S ENGINE: NEWTON'S THIRD LAW OF MOTION

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### CLASS DESCRIPTION

The course introduces learners to using simple materials to learn basic science and law of motion. It demonstrate Newton's third law of motion using thrust produced by falling water.

**TOTAL CLASS TIME:** 60 minutes

### CLASS OUTCOME

By the end of this class, students will understand the basic concept of Newton's third law of motion and gravity.

### INTRODUCTION

Hero's Engine is a simple way to construct water-propelled engines out of a plastic cup or soft drink cans and to investigate ways to increase the action-reaction thrust produced by water shooting out of holes punched in the can sides which demonstrate Newton's third law of motion using thrust produced by falling water.



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## MATERIALS NEEDED

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Plastic Cup

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Soft drink cans



2 plastics bendable straws



String or rope



Nail



Modeling clay



Water

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### PROCEDURES

1. Take a **plastic cup** or an empty **soft-drink can** and punch two small holes near the top rim on opposite sides from one another. Punch the hole without crushing the cup sides. Place the nail point near the bottom rim of the can. Apply pressure with the nail, turning it, if necessary, to make the hole.
2. Thread the **string** or **rope** through the holes and tie a knot so that the cup can be suspended from the string.
3. Make two slightly **larger holes** near the bottom of the cup as seen in the picture above (make sure the straws to fit through the hole perfectly)
4. Slide the **straws** into the holes. Make sure the straws are pointed in a clockwise direction.
5. Use your **modeling clay** to seal the space between the cup and the straw so that no water leaks out when you fill the cup.
6. Hold the finished **Hero engine** away from your body. Pour water into the cup and observe what you see.

### OBSERVATIONS

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The engine spins in a clockwise direction, gravity draws the water downward and out through each straw.



The water leaves the cup with the force by gravity and moves in a clockwise direction, which pushes back on the cup in a counter-clockwise direction, causing the cup to turn. This is the same principle is applied to a flying airplane, where two pairs of action-reaction forces influence its flight. Also, this principle enables a rocket to work—the gas that’s forced out of the nozzle pushes back on the rocket, propelling it forward!

Also note that with only one hole on the hero’s engine, the force of water can only be exerted through that hole, making the engine slower and vice versa. If there is more than one hole, the engine will go faster because the force of the water can be exerted through the multiple holes.

### DISCUSSION

- The force of gravity and other combinations of factors contributes to the force that causes the cup to rotate. It attracts the water in the can and causes it to flow from the holes. The shape of the hole directs the water flows. The diameter of the hole determines how fast the water flows out.
- Newton’s third law of motion explains why the can rotates in the opposite direction from the direction of the water flows.

