Curiosity Guide #307
Rockets

Accompanies Curious Crew, Season 3, Episode 7 (#307)

Designing a Water-Bottle Rocket

STEM Challenge

Description

Work with a team to create 2 rocket prototypes that have great flight stability.

Materials for each team

- 2-liter bottles
- 20-ounce plastic soda bottles
- Pitsco water bottle launch pad, or homemade pad from online plans
- Tire pump
- Clay
- Cardboard
- Scissors
- Hot glue gun
- Glue sticks
- Water
- Measuring cups
- Altitude tracking device built from plans found at NASA
- Construction paper
- Digital scale

Teams will work together to create 2 prototypes with nose cones and fins to establish greater flight stability.

Procedure 1: Establish the behavior of a non-engineered bottle rocket

1) Fill a plastic bottle one-third to one-half full of water.
2) Launch the bottle and notice the bottle's erratic flight.

Procedure 2: Design and engineer nose cones and fins for stability

1) Nose cones can be made from construction paper or cut bottles.
2) Weight should be added to the nose cone with clay to balance the rocket.
3) How much clay will you add?
4) Fins can help improve stability. What material will you use? How many fins will you attach? What shape of fin will you make?
5) Build two rocket prototypes.

Procedure 3: Test and improve the prototypes

1) Launch the rockets.
2) Record and analyze results.
3) Can each rocket fly relatively straight?
4) How high can the rockets fly?
5) Experiment with different quantities of water. Does this change your results?
6) Improve the design and retest.

My Results

Explanation

Adding fins to a rocket improves the rocket's flight stability. Without fins, the bottle will tumble out of control. Adding a nose cone helps to reduce the air friction against the rocket, as well improving its overall performance. For rockets to lift off the ground, there must be an imbalance of forces, in which the action of material exiting the rocket causes a reaction of the rocket moving in the opposite direction. This relates to Isaac Newton's third law of motion that states, "Every action produces an equal and opposite reaction." The energy exiting the rocket comes from propellant. Different rockets use different types of propellant. In this case, the propellant is the pressurized air and water. Pumping air into the bottle increases the proportion of air molecules. It also increases the collisions of the air molecules with one another and against the water. When the stopper is removed, the pressurized air and water quickly shoots out of the narrow nozzle, picking up velocity and thrusting the rocket into the air.

Important precautions to consider: Rocketry is a lot of fun, but be sure to take some precautions if you decide to launch a water bottle or model rocket. Make sure you have plenty of space outside, and that the weather isn't too windy. Rockets can easily get carried away in strong winds or end up in trees, and you will struggle to get the rockets down again. Having an adult supervise is a great idea, just to make sure everything goes smoothly. Rocket science sure is a blast!

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