Curiosity Guide #307
Rockets

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

Air Rockets

Investigation #6

Description

Can you create a working rocket out of limited materials? Come on, take the dare! You'll have a blast!

Materials

- Construction paper
- Masking tape
- Clay
- Digital scale
- PVC launch pad built from plans found online
- Air compressor
- Bucket, to be used as a target
- 100-foot measuring reel

Procedure 1: Design the rocket

1) Use only construction paper, masking tape and clay to make several paper-rocket prototypes.
2) Try various combinations of the following design elements:
    - How much clay mass will you use? Keep the mass between 0 and 4 grams.
    - Which will fly better, a short or long body?
    - What shape will the rocket be?
    - What angle of launch will work best between 30 and 40 degrees?

- How much air pressure will you use? Keep the range between 25 and 40 PSI.

Procedure 2: Build the rocket

1) Roll a piece of construction paper around the shaft of the launch tube to make either a long body or a short body.
2) Securely tape the overlapping edge of the paper with masking tape.
3) Cut out a circle about twice the diameter of the paper tube.
4) Cut the circle in half so you have two hemispheres.
5) Roll and tape the paper hemisphere into a cone so that the open circle matches the size of the tube.
6) Tear off a small piece of clay and measure its mass in grams. Keep the mass somewhere between 0 and 4 grams.
7) Press the clay into the nose cone.
8) Tape the cone securely to the rocket top.

Procedure 3: Test the rocket

1) Set a bucket target approximately 200 feet away.
2) Slide the paper rocket on the PVC launcher.
3) Attach the compressor to the launcher and fill it with air. Stop the air flow when the pressure gauge shows the desired amount.
4) Set the angle of the launcher according to the attached protractor.
5) Open the ball valve.
6) What happens?

Procedure 4: Adjust the design

7) Rethink your design, make a new prototype, and do another test.
8) What happens?
9) How close does your rocket come to the bucket target?
10) Continue modifying your design by building new prototypes until you are satisfied with your rocket's performance.

My Results

Explanation

In this example, compressed air is used as the propellant. When the compressed air fires into the paper rocket, the blast of air ricochets off the nose cone and gains velocity as the air drives back around the surface area of the launch shaft. The paper rocket launches forward in the opposite reaction.

After coming up with a beginning prototype, the rocket engineer tests the prototype and collects data on its performance. The engineer then makes changes to the design, which can include changing the mass or weight in the cone, changing the shape and size of the rocket or its fins, trying different launch angles, and adjusting the force of the air that is the propellant. The engineer tests, collects data, modifies the prototype, and retests until the rocket has an accurate flight pattern that hits the target.

For example, if the engineer increases the air pressure too much during launch, the paper rocket could come apart, and the fins could distort during flight. Distorted fins may increase the drag and make the flight less successful. Lowering the pressure would maintain the structure of the rocket and keep the shape of the fins.

Think about this: Our paper rocket launch was impressive, but the energy involved in a large rocket engine is incredible! A large rocket has more than 1 million pounds of thrust going up and travels at 22,000 miles an hour. If you compare that energy to the energy produced by the Hoover Dam, that one rocket would use a similar amount of energy as the output from 13 Hoover Dams. I suppose traveling 15 times faster than a speeding bullet does require some big energy!

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