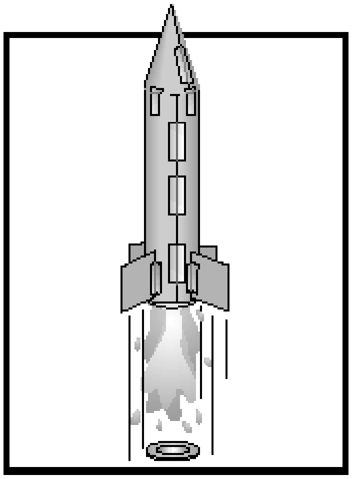
3-2-1 POP!



Teacher Overview:
Students construct a rocket powered by the pressure generated from an effervescing antacid tablet reacting with water.

Objective:
To demonstrate how rocket liftoff is an application of Newton's Laws of Motion.

Next Generation Sunshine State Standards:

SC.6.N.1.1: Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.6.N.1.4: Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.6.N.3.4: Identify the roles of models in the context of the sixth grade science benchmarks.

SC.6.P.11.1: Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

SC.6.P.13.1: Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.

SC.6.P.13.2: Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

SC.6.P.13.3: Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.

Materials and Tools:

- Heavy paper (card stock, construction)
- Student sheets
- Scissors
- Paper towels
- Eye protection
- Plastic 35 mm film canister*
- Cellophane tape
- Effervescing antacid tablet
- Water

* The film canister must have an internal-sealing lid, i.e. Fuji.
Canisters with a lid that wraps around the canister rim) will not work.
These are usually opaque canisters.

Management:

For best results, students should work in pairs. It will take approximately 40 to 45 minutes to complete the activity. Make samples of rockets in various stages of completion available for students to help them visualize the construction steps. A single sheet of paper is sufficient to make a rocket. Be sure to tell the students to plan how they are going to use the paper. Let the students decide whether to cut the paper the short or long direction to make the body tube of the rocket. This will lead to rockets of different lengths for flight comparison. The most common mistakes in constructing the rocket are: forgetting to tape the film canister to the rocket body, failing to mount the canister with the lid end down, and not extending the canister far enough from the paper tube to make snapping the lid easy. Some students may have difficulty in forming the cone. To make a cone, cut out a pie shape from a circle and curl it into a cone. See the pattern on the next page. Cones can be any size. Film canisters are available from camera shops and stores where film processing takes place. These businesses recycle the canisters and are often willing to donate them for educational use. Be sure to obtain canisters with the internal sealing lid. These are usually translucent canisters.

Space Knowledge:

This activity is a simple but exciting demonstration of Newton's Laws of Motion. The rocket lifts off because it is acted upon by an unbalanced force (Newton's First Law). This is the force produced when the lid blows off by the gas formed in the canister. The rocket travels upward with a force that is equal and opposite to the downward force propelling the water, gas, and lid (Third Law). The amount of force is directly proportional to the mass of water and gas expelled from the canister and how fast it accelerates (Second Law).

Action:

Refer to the Student Sheet.

Discussion:

- How does the amount of water placed in the cylinder affect how high the rocket will fly?
- How does the temperature of the water affect how high the rocket will fly?
- How does the amount of the tablet used affect how high the rocket will fly?
- How does the length or empty weight of the rocket affect how high the rocket will fly?
- How would it be possible to create a two-stage rocket?

Assessment:

Ask students to explain how Newton's Laws of Motion apply to this rocket. Compare the rockets for skill in construction. Rockets that use excessive paper and tape are likely to be less efficient fliers because they carry additional weight.

Extensions:

- Hold an altitude contest to see which rockets fly the highest. Launch the rockets near a wall in a room with a high ceiling. Tape a tape measure to the wall. Stand back and observe how high the rockets travel upward along the wall. Let all students take turns measuring rocket altitudes
- What geometric shapes are present in a rocket?
- Use the discussion questions to design experiments with the rockets. Graph your results.

Teacher Suggestions:

1. Use Fuji brand film canisters.
2. Ask your local film developer to save canisters for you; they are getting harder to come by now that most people use digital cameras.
3. Make sure effervescing antacid tablets are fresh.
4. Be sure to read Management on pg. 37 in the "MISSION: KSC Space Week Teacher's Guide for Launch Specialists 2007-2008" for common mistakes.
5. Plan to have enough antacid tablets and time for several trials.
6. Using denture cleaning tablets have produced mixed results.

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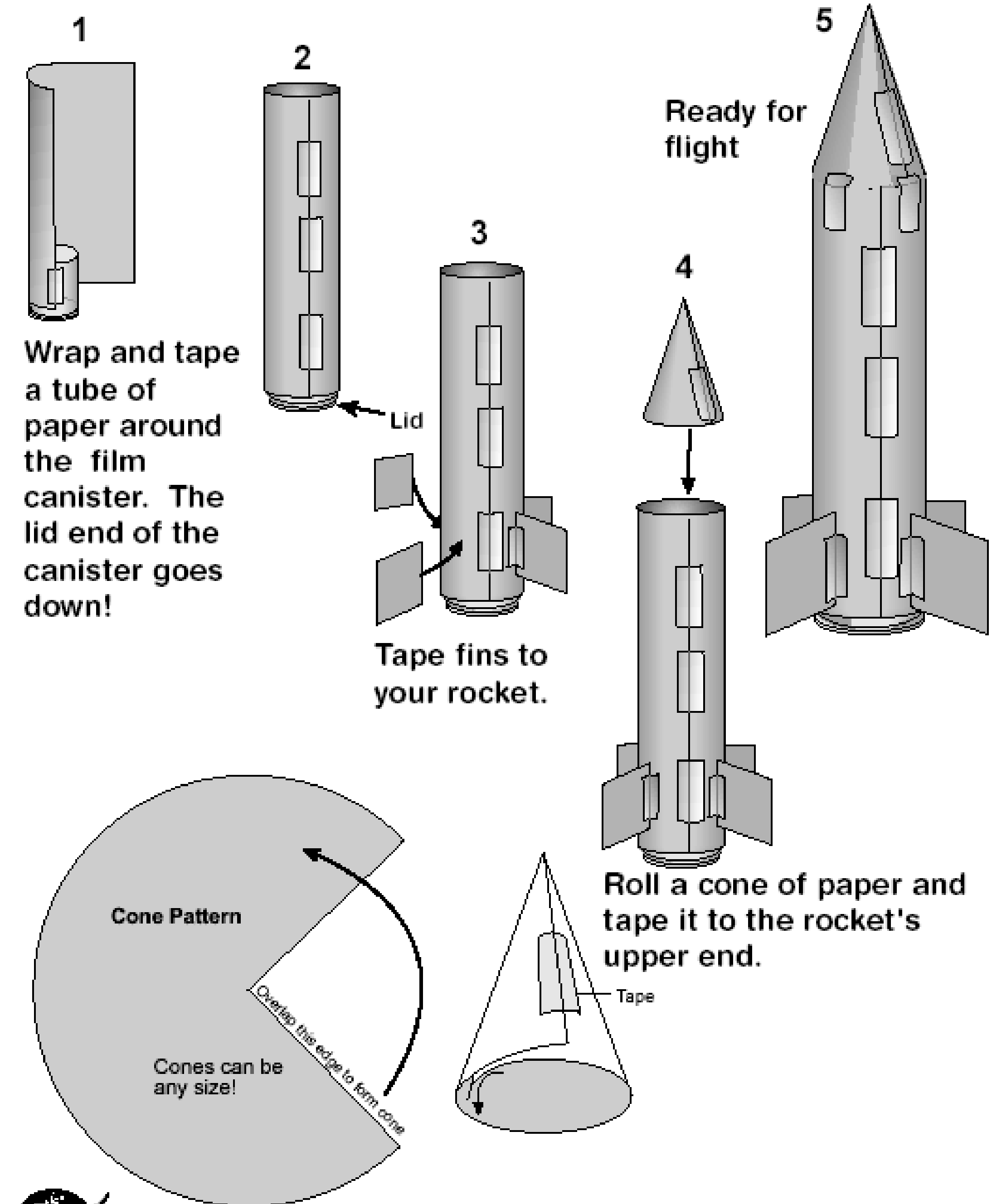
1
Wrap and tape a tube of paper around the film canister. The lid end of the canister goes down!
2
Lid
3
Tape fins to your rocket.
4
Roll a cone of paper and tape it to the rocket's upper end.
5
Ready for flight
Cone Pattern
Cones can be any size!
Overlap this edge to form cone
Tape