3M Young Scientist Lab

WHELMERS Student Activity | Grades 3–5

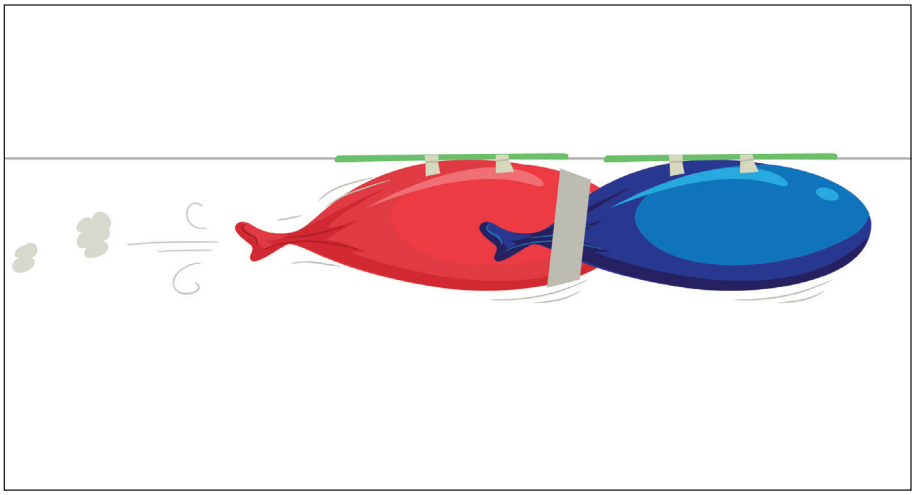
Two-Stage Balloon Rocket

WHAT YOU NEED:

- Spool of fishing line or fine string, 500 to 100 feet long
- Drinking straws
- Tape (masking or scotch)
- Scissors
- Three long skinny balloons
- Three or four styrofoam drinking cups

DESCRIPTION

Build a multistage rocket from two balloons!



NEXT GENERATION SCIENCE STANDARDS

- **PS1.A: Structure and Properties of Matter**
  - Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model shows that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (5-PS1-1)
- **PS2.A: Forces and Motion**
  - Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)

- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

- **PS3.A: Definitions of Energy**
  - Energy can be moved from place to place by moving objects or through sounds, light, or electric currents. (4-PS3-2), (4-PS3-3)
- **PS3.B: Conservation of Energy and Energy Transfer**
  - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2), (4-PS3-3)

WHAT YOU DO

1. Cut several short lengths from drinking straws and thread them on a long line of string.
2. Tie the line taut between two firmly anchored objects, such as two trees or chairs. Try to keep the line as level as possible.
3. Cut a circular hoop from the open end of a foam cup.
4. Inflate one balloon. While holding it shut, use tape to attach it to straws on the string. Release the balloon and watch it shoot down the line. How far does it go?
5. Next, retrieve the straws and balloon and slide them back to the starting point. It's time to create a two stage-balloon rocket.
6. Inflate two balloons. While holding the balloons shut, use tape to attach them to straws on the string. Use one of the foam hoops to hold the mouth of one balloon tightly against the front end of the other balloon.
7. Release the balloon. It will deflate as it shoots down the line, eventually releasing the next balloon or stage of your rocket. How far did they go?

WHAT HAPPENS

Space travel requires an enormous amount of energy. Much of that energy is used to lift fuel that will be used later in flight. To avoid the engineering problems related to extremely large single-stage rockets, engineers developed multistage rockets. Engineers involved in the design and flight of rockets encounter problems similar to those encountered by students flying balloon rockets. The added fuel provided by additional staging tanks allows a rocket to travel farther. However, added tanks bring added weight and complication to the rocket. Your simple balloon rocket demonstrated that releasing one balloon is easy. A two-stage rocket is much more complicated. Isn't it? Want to try for three stages?