Hot Air Balloon

Category: Physics: Force and Motion

Type: Make & Take

Rough Parts List:

5	Large sheets of tissue paper
1	1” x 6” strip of normal paper

Tools List:

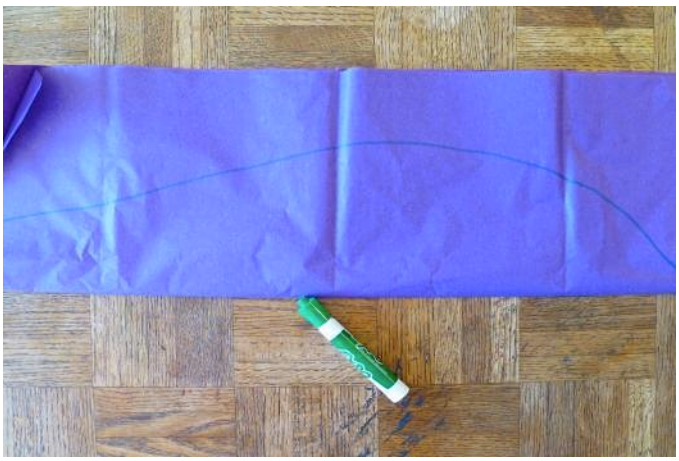
Scissors
Marker
Glue stick
Hair dryer

Video: http://www.youtube.com/user/OaklandCSW?feature=watch

Blog Link: www.oaklanddiscovery.blogspot.com

How To:

Stack the sheets of tissue paper and fold in them in half lengthwise.



Use a marker to draw a line similar to the one in the picture, making sure the folded edge of the tissue paper is on the bottom.

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Cut along the line with scissors and unfold the tissue paper. The resulting shape should be tear-drop shaped.

Look at the line drawn in this picture. Apply glue to this edge only, and lay another sheet of tissue paper directly on top.

Press down on the glued edges to create a strong and sealed connection between the 2 sheets.

Repeat the process, using all 5 tissue papers to create an enclosed hot air balloon shape.

Glue the strip of paper into a loop that fits around the edge of the hair dryer. Glue this loop into the opening of the hot air balloon, widening it a bit if necessary.

Place the balloon onto the hair dryer. Turn the hair dryer on to the lowest setting and fill the ballooon with hot air. The hot air balloon will rise and slowly drift down to the ground.

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Fine Points:

→ White glue can be used in place of a glue stick, but use a paintbrush to paint on a thin layer. Too much glue can weigh down the balloon.
→ It is important to make sure that all the edges are glued together so no air can escape. After gluing each piece together, carefully inspect for any gaps. By placing the seamed edges on the outside of the balloon, it is easy to repair and glue any holes together as needed.
→ Make sure that the glue has dried before filling the balloon with hot air or it may come undone.
→ When filling the balloon with hot air, it will be necessary to hold the base of the balloon onto the hair dryer.

Concepts Involved:

- Hot air rises because it is less dense than the cooler air around it.
- Volume increases with temperature.

Focus Questions:

1. Why do you think hot air balloons rise?
2. How is this hot air balloon similar to a real hot air balloon? How do you think they are different?
3. Is your hot air balloon able to carry a small basket? Try making a light basket out of paper and thread and find out!
4. Hot air balloons are weighed down by the materials used to build them and pulled up by the hot air inside the balloon. A very efficient hot air balloon would be built from a few lightweight materials and a large space, or volume, for the hot air to fill. What shapes do you think would make a good hot air balloon?

Elaboration:

The hot air balloon you built out of tissue paper works under the same scientific principle that enables real hot air balloons to fly: warmer air rises above cooler air. It might seem like air is just empty space, but the air around us is a type of matter called a gas. Matter comes in three states: solids, liquids, and gases. Each state is made up of tiny particles called atoms. In a gas, the atoms are spread out and bouncing around constantly. A gas will fill a container of any size or shape.

Real hot air balloons use a flame to heat the air inside, and you use a hair dryer to heat up the air inside this one. Gases behave in ways that can be predicted by a set of rules called the ideal gas laws. One of those laws, Charles's Law, states: $V1/T1=V2/T2$. This is just a mathematical way of saying that the volume of a gas increases with temperature. Higher temperatures mean more energy, so imagine the air molecules moving faster, bouncing into each other harder and spreading out to take up a larger space. When we heat the air inside the balloon, we increase the volume of the air. This can be shown by putting a balloon over the mouth of a dry can or glass bottle, and then heating the bottle with hot air, hot water or a small flame. The balloon will get bigger, even though no air has escaped from the bottle-balloon system.

Whether things float or sink in fluids – air or water for example – depends on their density. Density is mass per unit volume. You can decrease density by decreasing mass or increasing volume. Since we heat up the air, its volume increases. This leads to a decrease in density. In the hot air balloon, some of the air left the neck of the balloon when it expanded, so the mass went down as well. This leads to a further decrease in density. All this makes the balloon rise in the ambient air.

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Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:
1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
1.1 Use estimation to verify the reasonableness of calculated results.
1.2 2.2 Apply strategies and results from simpler problems to more complex problems.
1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 1 Standard Set 1. Physical Sciences:
1.b Students know the properties of substances can change when the substances are mixed, cooled, or heated.

Grade 8 Standard Set 3. Structure of Matter:
3.d Students know the states of matter (solid, liquid, gas) depend on molecular motion.
3.e Students know that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.

Grades 9-12 Standard Set 2. Chemistry. Gases and Their Properties:
4.c Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.

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