Up, Up and Away — Hot Air Balloon Activity

Introduction

How do hot air balloons lift from the ground towards the sky? Why do they stay afloat? Why do they eventually descend? Create your own hot air balloon and answer these questions!

Concepts

- Hot air balloons
- Gas laws
- Temperature

Materials (for each group)

Balloon launcher, iron tripod, metal ducts, and a heat source (shared)
Crayons or markers for decoration (optional)
Fire extinguisher (share)
Glue stick
Paper clips, 4
Ruler
Scissors
Tissue paper sheets, 20″ × 30″, 7
Transparent tape (optional)

Safety Precautions

Perform this activity in a large open area outdoors on a relatively calm day. Take extra caution if an open flame is used to heat the balloon. The tissue paper is very flammable and a fire could result. Be sure to have an operating fire extinguisher available. Students should be supervised at all times during this activity. Wear safety goggles and heat-resistant gloves. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Obtain a small iron tripod with a metal ring (see Figure 1).
2. Part A and Part B are pieces of metal ducts that fit together. The wide end fits over the tripod, the narrow end extends up into the balloon.
3. Place Part B of the balloon launcher inside Part A (see Figure 2).
4. Place assembled Parts A and B over the top of the iron tripod (see Figure 3).

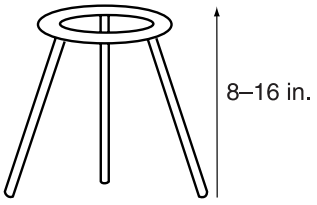

Figure 1.

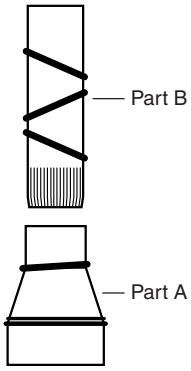

Figure 2.

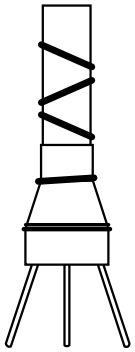

Figure 3.

Procedure

1. *(Optional)* Decorate four of the seven sheets, leaving three sheets undecorated. See Figure 1 on the Hot Air Balloon Diagram Sheet.
2. Fold in half width-wise two of the undecorated sheets one on top of the other, and cut along the fold to make four sheets 20″ × 15″. See Figure 2 on the Hot Air Balloon Diagram Sheet.
3. Fold these four pieces in half width-wise and in half again. See Figure 3 on the Hot Air Balloon Diagram Sheet.

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4. Open completely and fold each of the four pieces along a diagonal from the lower outside corner to the corner formed by the previous foldings. Cut along this diagonal to produce four trapezoids with one base of 20″ and a second base of 10″. Discard the triangles. See Figure 4 on the Hot Air Balloon Diagram Sheet.
5. Use a glue stick to glue the 20″ base of each of the four trapezoids to a 20″ edge of a separate full decorated sheet. Overlap the edges about an inch. See Figure 5 on the Hot Air Balloon Diagram Sheet.
6. Assemble the four panels to form the four sides of the balloon by gluing the long edges of each panel one to another, and the sides of the trapezoids one to another. See Figure 6 on the Hot Air Balloon Diagram Sheet.
7. Use the one remaining sheet (undecorated) to make the top of the balloon. Fold diagonally to form a square, 20″ × 20″. Cut off and discard the rectangle. Glue the square to the top of the four sides of the balloon. See Figure 7 on the Hot Air Balloon Diagram Sheet.
8. Add ballast to the bottom of the balloon by fastening four paper clips to the open bottom sides of the balloon. See Figure 8 on the Hot Air Balloon Diagram Sheet.
9. Turn on the heat source. Place the heat source under the balloon launcher assembly so the flame is shooting directly upwards through the balloon launcher. Hold the bottom of the balloon over the balloon launch assembly. *Be sure not to touch the heat source or the balloon launcher to the tissue paper. See Figure 9 on the Hot Air Balloon Diagram Sheet.*
10. Heat the air inside the balloon. Release the balloon once the air inside the balloon has been heated to the point where the balloon begins to hover on its own.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation

Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter, motions and forces, transfer of energy

Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, motions and forces, conservation of energy and increase in disorder, interactions of energy and matter

Tips and Extensions

- Flinn Scientific sells a kit that contains the balloon launcher and enough materials for the construction of 15 hot air balloons (Up, Up, and Away—Hot Air Balloon Activity, Catalog No. AP6310). Flinn also sells tissue paper for constructing additional hot air balloons (AP6329). Consult your current *Flinn Scientific Catalog/Reference Manual*.
- A heat gun or propane torch works very well as the heat source. Flinn sells a heat gun (AP6319) and a propane torch (AP1022) that works well for this activity. Heat guns may also be found in your school's wood shop or janitorial department. A launcher must be used or the heat souce will start the tissue paper on fire.
- As an extension, have students record the outside temperature of the air. Then have students punch a hole large enough for a thermometer to slip through at the top of the balloon. Note the temperature inside the balloon when it begins to hover. Allow the temperature to increase a few more degrees and then allow the balloon to launch. What effect does the outside temperature have on the balloon?
- Hot air balloon calculations may be found at www.overflite.com.
- Take all safety precautions if an open flame is used. The tissue paper easily catches on fire! Keep a fire extinguisher handy.

Discussion

The basic idea of creating a "flying machine" has been around for centuries. Archimedes figured out the principle of buoyancy over 2000 years ago and may have even imagined the phenomenon of flight. The first recorded balloon flight occurred on September 19, 1783. Two French brothers, Joseph and Etienne Montgolifer, sent a duck, a sheep and a chicken on an eight-minute flight before King Louis XVI. All three passengers survived the flight. A few months later, a major, Marquis Francois d'Arlaneds, and a French physics professor, Pilatre de Rozier, became the first humans to fly with a twenty-eight minute flight. Rozier later attempted to cross the English Channel in a gas (hydrogen) balloon. In flight, the hydrogen ignited, the balloon burst and Rozier was killed. More recently, on July 2, 2002, American adventurer Steve Fossett became the first man to achieve solo circumnavigation of the world in a hot air balloon! Fosset completed the trip in 14 days and 20 hours.

Most modern air balloons are composed of the following parts: the envelope (which is composed of gores, panels and a parachute valve), a skirt, burners, a parachute valve cord, propane tanks, and a wicker basket (see Figure 4).

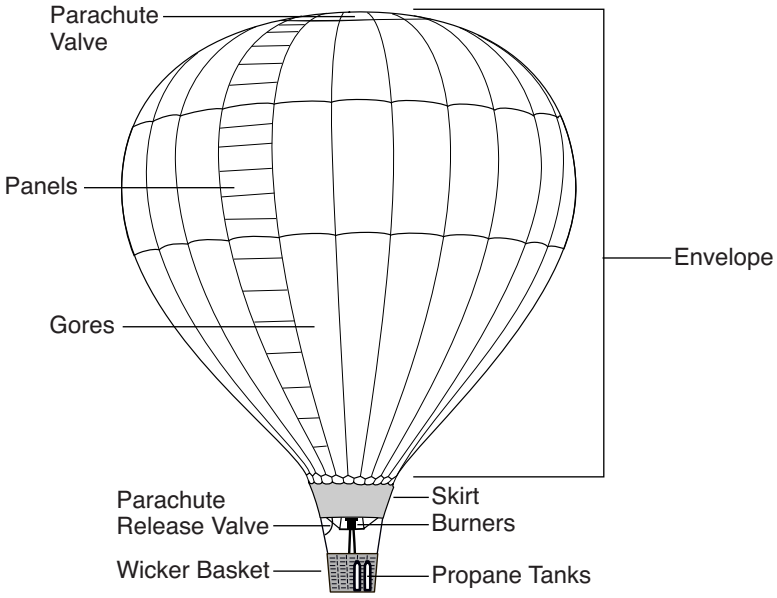


Figure 4.

The envelope is constructed from long nylon gores. Nylon is used because it is lightweight and sturdy and has a high melting point. The gores extend from the base of the balloon to the very top of the balloon. The gores are reinforced by horizontal pieces of nylon known as panels. The skirt at the base of the balloon is attached to every gore and is sprayed with a highly fire-resistant material to keep the flame from igniting the balloon. The basket is generally composed of a wicker material. Wicker is very durable and lightweight and absorbs a lot of energy when the balloon makes contact with the ground upon landing.

Propane is stored in a highly compressed form in containers in the basket of the balloon. The propane is led to burners where the propane is ignited and heat is produced. As the air inside of the air balloon heats up, the molecules of gas in the balloon move more rapidly. The air within the balloon becomes less dense as the temperature rises. Eventually the pressure difference between the air inside the balloon and the air outside the balloon allows the balloon to inflate and rise. When the parachute valve cord is pulled, hot air is released from the top of the balloon and the balloon will begin to descend slowly back towards the ground.

Acknowledgment

Special thanks to Mike Roadruck, Ottawa Hills High School, Toledo, OH for providing the instructions for this activity.

The *Up, Up and Away—Hot Air Balloon Activity* is available from Flinn Scientific, Inc.

Catalog No.	Description
AP6310	Up, Up and Away—Hot Air Balloon Activity
AP6319	Heat Gun
AP1622	Propane Burner

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Hot Air Balloon Diagram Sheet

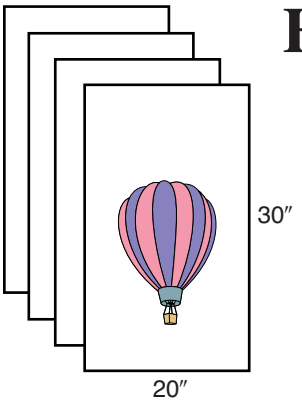


Figure 1.

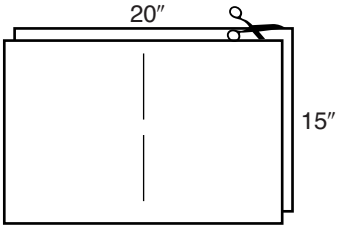


Figure 2.

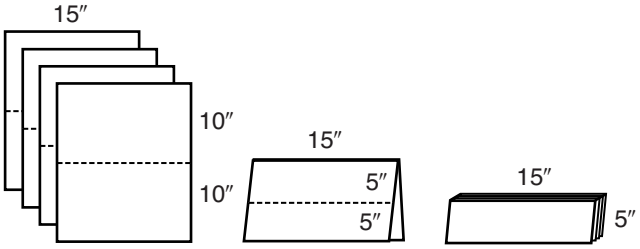


Figure 3.

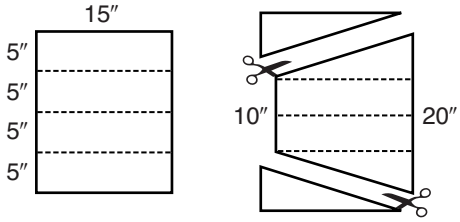
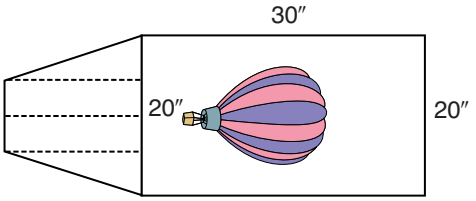
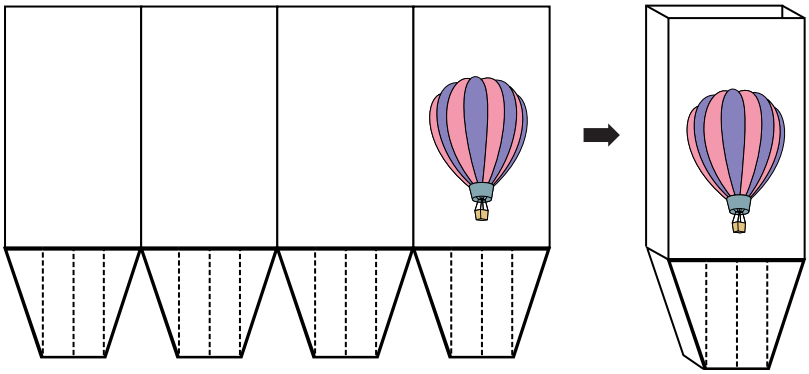


Figure 4.



Repeat four times.

Figure 5.



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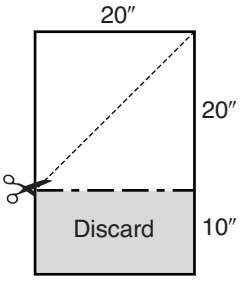

Figure 7.

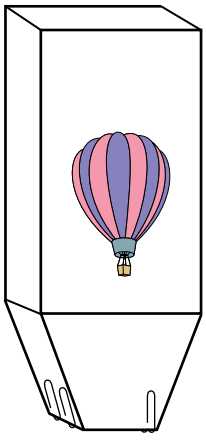

Figure 8.

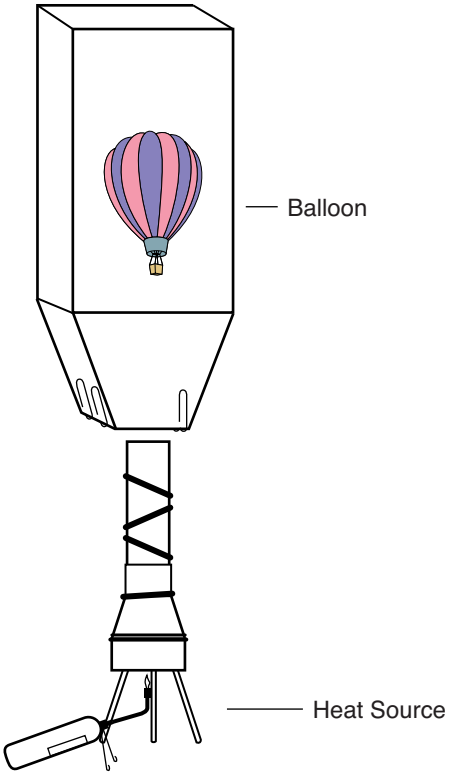

Figure 9.