



Bag Balloon

DESCRIPTION

The students construct a working model of a hot air balloon.

OBJECTIVES

Students will

- Investigate how heat can change air
- Observe that hot air rises
- Construct a hot air balloon

NASA SUMMER OF INNOVATION UNIT

Physical Science

GRADE LEVELS

4 – 6

CONNECTION TO CURRICULUM

Science, Mathematics, and Technology

TEACHER PREPARATION TIME

3 hours

LESSON TIME NEEDED

2 hours

Complexity: Basic

NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry

- Understanding of scientific concepts
- An appreciation of “how we know” what we know in science
- Understanding of the nature of science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

Physical Science Standards

- Properties of objects and materials
- Position and motion of objects
- Properties and changes of properties in matter
- Motions and forces

Science and Technology Standards

- Abilities to distinguish between natural objects and objects made by humans
- Abilities of technological design
- Understanding about science and technology

History and Nature of Science Standards

- Science as a human endeavor

Common Core State Standards for Mathematics (NCTM)

Geometry

- Solve real-world and mathematical problems involving area, surface area, and volume

ISTE NETS and Performance Indicators for Students (ISTE)

Creativity and Innovation

- Apply existing knowledge to generate new ideas, products, or processes
- Create original works as a means of personal or group expression
- Use models and simulations to explore complex systems and issues

Communication and Collaboration

- Contribute to project teams to produce original works or solve problems

Research and Information Fluency

- Plan strategies to guide inquiry

- Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
- Evaluate and select information sources and digital tools based on the appropriateness to specific tasks

Critical Thinking, Problem Solving, and Decision Making

- Identify and define authentic problems and significant questions for investigation
- Plan and manage activities to develop a solution or complete a project
- Use multiple processes and diverse perspectives to explore alternative solutions

Technology Operations and Concepts

- Understand and use technology systems
- Select and use applications effectively and productively
- Troubleshoot systems and applications

MANAGEMENT

A heavy duty trash bag is too heavy. Use lighter bags, such a large kitchen trash bag or a thin, plastic dry cleaning bag. A hotter heat source than a hair dryer, such a Sterno can or propane torch, works best. For safety have a fire extinguisher nearby. Have students wear safety goggles.

CONTENT RESEARCH

Hot air balloons are one of four types of aircraft. The others include airplanes, gliders, and rotorcraft. There are two ways a balloon can rise: (1) it can be filled with a gas that is lighter than air, such as helium, or (2) it can be inflated with air that is heated sufficiently to make it "lighter" than the air outside of the balloon. Gas balloons and hot air balloons float because they are lighter than the air they displace. Helium is the second-lightest element, and the main sources for helium are natural gas fields (especially those in the states of Texas, Oklahoma, and Kansas). Heating air makes it less dense, rendering it essentially "lighter."

MATERIALS

- Plastic bag ("dry cleaners" bag or 5-gallon trash bag)
- Paper clips (used for weight)
- Small pieces of paper or stickers (decorations)
- String
- One hair dryer per classroom (heat source)
- Party balloons (helium filled) tied to string.

Key events in the history of ballooning:

1783

- June: The Montgolfier brothers, Joseph and Etienne J., began experimenting with small-scaled hot-air balloons built out of paper or light fabric.
- 27 August: Jacques A. C. Charles launched an unmanned hydrogen balloon, The Globe, which travelled 15 miles (24 km) and reached an altitude of 3000 feet (915 m).
- 19 September: The Montgolfier brothers launched an unmanned hot-air balloon from Versailles. A duck, a sheep, and a rooster became the first air travelers.
- 21 November: For the first time in recorded human history, we leave the confines of the Earth's surface and take flight among the birds. Marquis François d'Arlandes and Jean-François Pilâtre de Rozier flew in the very first flight in a Mongolfier-built hot-air balloon. This flight lasted 25 minutes and covered 7 miles (11 km).
- 1 December: Just 10 days after the Montgolfier flight, J.A.C. Charles piloted the first gas balloon flight. Also launched in Paris, this flight lasted 2 1/2 hours and covered a distance of 27 miles (43 km). The first recorded change out of a passenger occurred on this flight when Charles landed and dropped off his passenger Professor Robert, then took off again. Charles then flew to height of 9000 ft (2750 m).

1784

- 19 January: Joseph Montgolfier made his only recorded flight in Le Fleusselles. This balloon is believed to have had a passenger-carrying capacity of more than 30, and the envelope must have been over 700,000 cf (20,000 cubic meters). The flight originated in Lyon, France.
- 15 September: Vincenzo Lunardi, a minor Italian diplomat, piloted the first balloon flight outside of France. Lunardi launched his 18,200 cf (515 cubic meters) hydrogen balloon from Moorfields, England. He ultimately touched down near Ware.

- 30 November: Frenchman Jean-Pierre Blanchard and American John Jeffries make their first flight. This flight was from Rhedarium Garden, London, to the banks of the Thames.

1785

- 7 January: Blanchard and Jeffries make the first crossing of the English Channel by balloon. This flight included the very first airmail letter.
- July: Jean-François Pilâtre de Rozier attempted an English Channel crossing in a hybrid gas/hot-air balloon. This flight ended in disaster as a fire caused the hydrogen to explode. de Rozier and his passenger Romain were killed. This was the first aviation accident.
- ????: Jean-Pierre Blanchard became the first skydiver as he parachuted out of a gas balloon. The exact date for this stunt is unknown.

1793

- 9 January: After moving to America, Jean-Pierre Blanchard piloted the first known balloon flight in North America in Philadelphia, PA. George Washington witnessed this flight.

LESSON ACTIVITIES

- Hot air balloon activity

http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Bag_Balloons.html

RELATED RESOURCES

Websites:

How a hot air balloon works, parts of a hot air balloon, history and timeline of hot air balloons, and hot air ballooning images

<http://www.eballoon.org/>

Construction of a hot air balloon with a dry cleaning bag

http://www.grc.nasa.gov/WWW/k-12/TRC/Aeronautics/Hot_Air_Balloon.html

The Courage to Soar Educator Guide

Activity Seven—The Matter of Air

Lesson 14—Discovering the Properties of Air

Optional Activity—Hot Air Balloons

Construction of a hot air balloon from tissue wrapping paper

http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/The_Courage_to_Soar.html (page 118)

DISCUSSION QUESTIONS

- Why do hot air balloons rise? *The hot air balloon rises when the air inside the balloon becomes heated. The heated air is lighter than the classroom air and enables the balloon to float.*
- Why do helium balloons rise? *Helium is a gas that is lighter than air, even when it's not heated. Helium though, just like heated air, floats in the surrounding air because it's lighter.*

ASSESSMENT ACTIVITIES

- Have students describe how a hot air balloon works, listing the parts of a hot air balloon.
- Report on the history and timelines of hot air balloons.
- Role play a reporter interviewing one of the Montgolfier brothers. Refer to background information included in the guide about the Montgolfier brothers.

ENRICHMENT

Students will

- Construct another hot air balloon using different sizes and types of plastic bags.
- Experiment with paper clips—different sizes and numbers—to see the effects of weight on their model balloons.