Up, Up, and Away

Introduction

After witnessing the ascent of a manned hot air balloon in Paris in 1783, Benjamin Franklin described the event as "a most beautiful spectacle." Watching these airships glide across the sky still evokes a sense of awe and inspiration today. Generate the same excitement in the science classroom with model hot air balloons!

Opportunities for Inquiry and Engineering Design

Constructing and launching a hot air balloon reinforces knowledge of gas laws, density, buoyancy, forces, thermal energy transfer, and even meteorology. This activity provides a wonderful opportunity for students to apply conceptual knowledge and reasoning skills to make connections between science and engineering. Opportunities to go deeper (or shall we say, higher?) are abundant!

- Add a mathematical component to the balloon launch! Students can construct their own clinometers and use triangulation to calculate the maximum height of their balloons. One student acts as "spotter" and sights the balloon with the clinometer; another is the "chaser" who walks below the balloon, while a third notes the angle on the clinometer. When the balloon reaches its maximum height and just begins to descend, the spotter tells the chaser to stop so the horizontal distance between the spotter and the balloon can be measured. For complete instructions on how to construct and use a clinometer, contact Flinn Scientific and ask for Publication No. 11115.
- An outdoor launch requires good weather conditions. Have students track wind speed (under 5 mph is good), visibility, precipitation, and temperature to determine the ideal launch day.
- For an indoor launch, choose a measurable dependent variable as a goal, such as the maximum height achieved or the fastest or slowest ascent time for the balloon to reach the ceiling of the gymnasium. Make a list of possible independent variables, e.g., volume, mass, or shape of balloon, adding a load to the balloon, temperature of hot air inside balloon, and ambient temperature. Choose an independent variable and describe how other variables that may affect the accuracy of the results can be controlled. Design a balloon with specific design criteria and within given design constraints that will achieve the goal.

Alignment to the NGSS

Disciplinary Core Ideas: Grades 6–8

Physical Science
- MS-PS1 Matter and Its Interactions
  - PS1.A: Structure and Properties of Matter
- MS-PS2 Motion and Stability: Forces and Interactions
  - PS2.A: Forces and Motion
- MS-PS3 Energy
  - PS3.A: Definitions of Energy
  - PS3.B: Conservation of Energy and Energy Transfer
  - PS3.C: Relationship between Energy and Forces
  - ETS1.A: Defining and Delimiting an Engineering Problem
  - ETS1.B: Developing Possible Solutions

Earth and Space Science
- MS-ESS2 Earth's Systems
  - ESS2.D: Weather and Climate

Disciplinary Core Ideas: Grades 9–12

Physical Science
- HS-PS3 Energy
  - PS3.A: Definitions of Energy
  - PS3.B: Conservation of Energy and Energy Transfer

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Engineering, Technology, and Applications of Science Performance Expectations

Students who demonstrate understanding can:

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Science and Engineering Practices

Asking questions and defining problems

Developing and using models

Planning and carrying out investigations

Analyzing and interpreting data

Using mathematics and computational thinking

Constructing explanations and designing solutions

Obtaining, evaluating, and communicating information

Crosscutting Concepts

Patterns

Cause and Effect

Scale, Proportion, and Quantity

Systems and System Models

Structure and Function

Stability and Change

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

Catalog No.	Description
AP6310	Up, Up, and Away—Hot Air Balloon Laboratory Kit

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