

Title: Hot Air Balloon Design Lesson Plan

Problem to be studied: This is the first lesson in the physical science unit. Properties of matter and forces and motion will be covered. This inquiry lesson's purpose is to motivate and engage students. As a result of this experience students should develop abilities to do scientific inquiry. Ultimately students develop their own thinking based on their experiment conducted and choices made in constructing their hot air balloon.

Using the materials provided, your team must design, construct, and launch a hot air balloon that will lift to the specified elevation (height of school roof top). A "Height-O-Meter" (clinometer) will be used to quantify this information.

Following this lesson, students will explore the concept of buoyancy to answer the question, "What causes a hot air balloon to rise?"

Content Standard(s):

3.4 Physical Science, Chemistry, and Physics

3.4.7A Describe concepts about the structure and properties of matter.

3.4.7B Relate energy sources and transfers to heat and temperature.

3.4.7C Identify and explain the principles of force and matter.

Process Standard(s):

3.2 Inquiry and Design

3.2.7A Explain and apply scientific and technological knowledge.

3.2.7B Apply process knowledge to make and interpret observations.

3.2.7C Identify and use the elements of scientific inquiry to solve problems.

3.8 Science, Technology, and Human Endeavors

3.8.7B Explain how human ingenuity and technological resources satisfy specific human needs and improve the quality of life.

Science Process Skills

Observing

Measuring

Experimenting

Communicating

Safety

Inquiry

Assessment Strategies: (Evaluation)

Formative Evaluation: (Discover what your students are learning and modify as necessary) Students will use the 4 step problem solving model during lesson. Students will keep a science log to record all steps and data. All design modifications must be included

Summative Evaluation: (After teaching... assess how much students learned) Student teams will discuss the pros and cons of their design plan using height data to explain flight success or failure due to design flaws. The team will collaborate and select a spokesperson. The spokesperson will share the team's final design plan with the class. The height data will be discussed. Student teams will use the rubric to assess their understanding of the concepts. Upon completion of the activity students will complete an individual assignment reporting their findings back to Gore Industries. Each employee must state their material recommendation for hot air balloon production and explain why it is the best manufacturing choice.

Suggested Grade Level:

Level: 6

Materials:

For Students:

Tissue paper (numerous 20" by 30" sheets and smaller)

Newspaper sheets

Construction paper

Plastic bags

Plastic dryer bags

Glue sticks/white glue

Hot glue gun

Rubber cement

Transparent tape

Scissors

22-24 gauge flexible wire (preferably aluminum or steel)

Wood strips

Drinking straws

Kite string

Paper clips or pennies (for ballast)

Marking pens

For Teacher:

Single burner propane camping stove

2 large restaurant style cans with tops and bottoms cut out

duct tape

pot holder

matches

Procedures:

Engage: The teacher will provide student teams with a myriad of materials and pose the problem. What is the best design to build a hot air balloon that will lift successfully? Students will ask questions, such as: “What do I know about hot air balloon construction?” (KWL chart completion or use of graphic organizer) Part of motivation will include visiting <http://www.hot-airballoons.com> to take a virtual hot air balloon ride.

Explore: The teacher will distribute the design brief, which will encourage students to work together to solve the problem. The students will use the 4 Step Problem Solving Model. Cooperatively students will think up ideas to solve the problem. Collectively they will choose one design to build.

Design Brief Format
Up, Up, & Away
Hot Air Balloon Design Challenge

The Context:

In 1783 the Montgolfier brothers observed a shirt hanging out to dry over a fire. It billowed upward and looked to be inflated. With many questions in mind, they began experimenting with materials building larger and larger balloons. In no time, a sheep, duck, and rooster went on an eight minute tethered balloon flight. Oct. 15, 1783, Francois Pilatre de Rozier flew in the tethered Montgolfier balloon. This event was identified as the first manned lighter-than-air flight.

The Situation:

You are employed by Gore Industries, the leading manufacturer of ballooning supplies. You are a member of a materials engineering team. The company wants a new design to offer customers. This design must be durable yet offer high-flying capabilities.

The Challenge:

You must design, construct, and test a hot air balloon design. It must be durable and lift to the specified elevation (height of the school roof top).

Limitations:

- ✓ Materials are supplied by teacher
- ✓ Opening at base of balloon must fit over opening in chimney
- ✓ Balloon must lift on its own power
- ✓ Lift must meet specified elevation

The Rules:

- ✓ Your team will have 1 day to construct your design and 1 day to test and modify the design
- ✓ Each team member must record entries in their logbook. All design modifications, the test results of these changes, conclusions, and ideas should be included
- ✓ You may use any materials supplied by teacher to construct the balloon
- ✓ All balloons will be launched using the provided propane launcher
- ✓ Each balloon will be held at the launch pad until balloonist feels tugging at base
- ✓ Each member of the group must take part in the construction of the hot air balloon, a rubric will be provided as an evaluative measure

Explain: After constructing the hot air balloon using the engineering team's design plan, testing will occur. Students analyze and explain their design solution using their lift (observational) data.

Elaborate: Students draw reasonable conclusions from evidence using provided rubric.

Rubric
Up, Up, & Away
Hot Air Balloon Design Challenge

Objectives

Students should be able to:

1. Design and construct a hot air balloon that will lift to the specified elevation (height of school roof top).
2. Using a "Height-O-Meter" (clinometer) observe to see if balloon lifts to height of school roof top and record the elevation.

	Advanced	Proficient	Basic	Below Basic
Rubric for Objective 1	Balloon is well-designed and constructed	Balloon is sturdy but with some flaws	Balloon has major flaws	No balloon constructed
Rubric for Objective 2	Student demonstrates and clearly explains balloon design, using observational lift data	Satisfactory demonstration and explanation of balloon design, using observational lift data Explanation may be incomplete	Unsatisfactory demonstration and/or explanation of balloon design.	No attempt to demonstrate and explain the balloon design

Related Web Sites:

<http://www.aimsedu.org>
<http://www.wings.avkids.com>
<http://www.educ.drake.edu>
www.balloonfest.com
www.blastvalve.com
www.geocities.com/capecanaveral/hanger/5290/faq.htm
www.balloonzone.com
<http://www.nat.k12.la.wf/upup2.htm>

Sources consulted in developing this lesson:

<http://www.hot-airballoons.com>
[Http://www.explorium.org](http://www.explorium.org)
<http://www.overflite.com>

Submitted by: Jo-Ann Delaney 2003 GIPSE Participant