

# BALLOONS

## Lesson Plan: Math with the Montgolfier Balloon

**Grade Level:** 5-8  
**Subject Area:** Science, Math  
**Time Required:** *Preparation:* 2-4 hours  
*Activity:* 2-3 hours

**National Standards Correlation:**

**Science (grades 5-8)**

- Physical Science Standard: Motions and forces.
- Physical Science Standard: Properties and changes in properties of matter.
- History and Nature of Science Standard: Nature of science.
- History and of Science Standard: History of science.
- Science as Inquiry Standard: Understanding about scientific inquiry.
- Unifying Concepts and Processes: Evidence, models, and explanation.
- Unifying Concepts and Processes: Change, constancy, and measurement.

**Math (grades 6-8)**

- Number and Operations Standard: Compute fluently and make reasonable estimates.
- Data Analysis and Probability Standard: Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them.
- Measurement Standard: Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Measurement Standard: Apply appropriate techniques, tools, and determine measurements.



**Summary:** Students will use a Montgolfier Hot Air Balloon (from previous lesson) to accomplish this lesson. Students will hypothesize on the rate of ascent and then proceed to launch the balloon. During this lesson they will learn the history of balloons, properties of gases used to launch the balloons, and the relationship between air temperature, air pressure, and volume.

**Objectives:** Students will:

- Reinforce knowledge and understanding of previously introduced terms.
- Apply knowledge to formulate a hypothesis.
- Test and evaluate their hypothesis.
- Time the rate of balloon ascent, calculate volume, and determine the relationship of volume to temperature.

**Materials:** You will need:

- See “Up, Up and Away With the Montgolfier Balloon” lesson for materials list and directions to construct the balloon (<http://www.nationalmuseum.af.mil/shared/media/document/AFD-090710-014.pdf>)
- Stopwatch
- Notebook paper



- Pencil
- Calculator (optional)

**Special  
Instructions:**

Use caution when operating the hair dryer; it can get very HOT and may ignite the paper balloon. Have a fire extinguisher available. Use caution when operating the camp stove. Make sure students stand away from the stove when the teacher is heating the balloon. When launching the balloon outdoors, use a fishing rod and reel and attach the line to the balloon's metal ring, so the balloon can be easily retrieved. Free flights can carry the balloons for miles and result in safety hazards.

**Procedure:**

**A. Warm-up**

1. Discussion of the history of balloons to show the evolution and uses of balloons from past to present day.
2. Review with students how to use a stopwatch.
3. Review concepts of air pressure, temperature, and volume.
4. Have students write a hypothesis on the balloon's rate of ascent relative to its size.

**B. Activity**

1. Have students work in groups of four to build a Montgolfier Hot Air Balloon, using instructions in "Up, Up and Away With the Montgolfier Balloon" lesson (see <http://www.nationalmuseum.af.mil/shared/media/document/AFD-090710-014.pdf>).
2. Timekeepers should check to make sure watches are clear and ready.
3. Countdown and release inflated balloons. At the moment of release, the timekeeper should start his/her stopwatch. They should stop their stopwatch when the balloon touches the ceiling. Record the time of ascent.
4. Each group's balloon should be inflated and released in the same manner. Each group will time the balloon's ascent and record the time.
5. Compare the actual time of ascent to the hypothesis.

**C. Wrap-up**

1. Have students take time to compare their results to that of the other groups. Special attention should be given to the results based on the size of the balloons. As a class discuss the results, making sure to relate it to the properties of air including pressure, temperature, and volume.

**Assessment/  
Evaluation:**

Students should be evaluated on their ability to follow directions and work cooperatively with other students. Accuracy of recorded data and ability to formulate and evaluate a hypothesis should be checked.

**Extensions:**

1. Give each group of students a ruler, yard stick, ball of string, pencil and worksheet. Students can determine the radius, diameter and circumference of the opening of the balloon. Record the data.



2. Determine the radius, diameter and circumference of the balloon at its widest point. Record the data. Share with class.
3. Make an approximate calculation for the volume of the hot air balloon. This can be done using the formula for the volume of a sphere which is  $\frac{4}{3}\pi r^3$ . Discuss as a class.
4. Apply Charles' Law to this activity. Discuss the relationship of volume to temperature. Charles' Law — When any gas at 0°C is heated and kept at constant pressure, it is found that it expands by  $\frac{1}{273}$  of its volume for every centigrade degree that its temperature rises. Thus if a gas is at 0°C, its new volume will be  $\frac{10}{273}$  larger than it was before. The French scientist Jacques Charles embodied this fact in a law which bears his name. It is stated as follows: If the pressure of a gas is kept constant, its volume will always be directly proportional to its absolute temperature. Take  $V_1$  as the volume of a gas when its absolute temperature is  $T_1$ , and  $V_2$  as the volume of the same gas when its absolute temperature is  $T_2$ . Then, if the pressure of the gas is kept constant, we have the following relationship:
5. Time the balloon's ascent and calculate the rate of speed (you will have to know the height of the ceiling in the room you are using).

**Resources/  
References:**

The World Book Encyclopedia, Vol. 8, pp 48-49, 1988.

