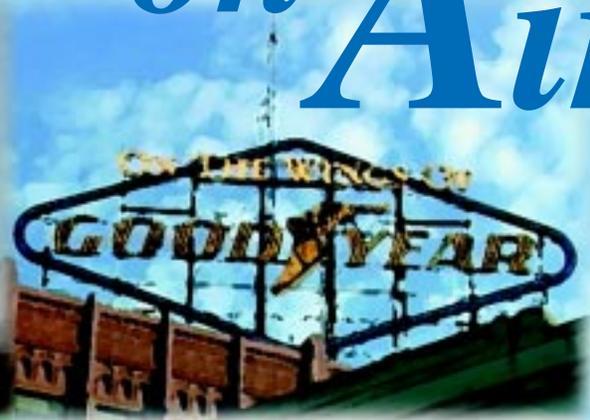


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# Floating on Air



Teachers Guide

# *Floating on Air*



## Program Summary

If you were raised in Akron during the latter half of the 20th century, the sight and sound of blimps floating overhead probably holds a place in your childhood mental scrapbook. In **Floating on Air**, a PBS 45 & 49 production, lighter-than-air enthusiasts share their fond memories and the fascinating history of Akron's unofficial mascot of the skies.

The blimp's history is populated by a menagerie of interesting characters like Crazy Legs Johnson, who fell out of an airborne blimp and lived to tell about it, and Walter Wellman, whose dream to fly a blimp to the North Pole never materialized.

Over the years the blimp assumed many roles. Its gig in the transportation industry was brought to an end by more efficient means of moving products. During World War II, the blimp served military duty in surveillance. Today, the blimp is primarily a promotional vehicle and the unofficial mascot of Akron's skies.



# Floating on Air



## Pre-Viewing Activity

### Objective

- Students will discuss their perceptions and sightings of blimps.
- Students will make a presentation of research topic.

### Procedure

1. Have students go to the Internet and log on to <http://www.vidicom-tv.com/tohiburg.htm>. They are to read the article, view the video and scan through the pictures.
2. Students will then participate in a discussion addressing the following questions:
  - a. What type of airship was the Hindenburg? Have you ever seen airships like this? Where?
  - b. Why did the Hindenburg catch fire so easily?
  - c. Would it be fair to call the Hindenburg a “flying bomb?”
3. Ask the students if they know how this problem was corrected.
4. Discuss the fact that helium is used in “modern-day” blimps.
5. Discuss other ways helium is used today.
6. Break the students into groups of three. Each group will become an expert in one of the areas below. They are to find four important facts about their topic and report those facts to the class. They can present their facts in any way they would like — a slide show, a poster, a skit, etc.
7. Assign “expert groups” in the following areas:
  - a. **Airships History & Tactics** <http://www.magweb.com/sample/snnav/sn10airs.htm>
  - b. **What Are Blimps Made Of?** [http://www.goodyearblimp.com/q\\_construct.html](http://www.goodyearblimp.com/q_construct.html)
  - c. **How Airships Fly** <http://www.americanblimp.com/fly.htm>
  - d. **How Blimps Work — Inside a Blimp** <http://travel.howstuffworks.com/blimp1.htm>
  - e. **How Are Blimps Used Today?** [http://www.goodyearblimp.com/q\\_business.html](http://www.goodyearblimp.com/q_business.html)
  - f. **How Fast and How Far Can Blimps Go?** [http://www.goodyearblimp.com/q\\_construct.html](http://www.goodyearblimp.com/q_construct.html)

### Materials

- Computer with Internet connection
- A large screen projection system, if available

### Assessment

The student presentations will be evaluated using the rubric on the next page.



# Floating on Air



## Pre-Viewing Activity

### Assessment

The student presentations will be evaluated using the following rubric:

CATEGORY	10	8	6	4
<b>Content</b>	Four facts presented and explained.	Three facts presented and explained.	Fewer than three correct facts are presented.	Does not seem to understand the topic very well.
<b>Preparedness</b>	Student is completely prepared and has obviously rehearsed.	Student seems pretty well prepared, but might have needed a few more rehearsals.	The student is somewhat prepared, but it is clear that rehearsal was lacking.	Student does not seem at all prepared to present.
<b>Collaboration With Peers</b>	Almost always listens to, shares with and supports the efforts of others in the group. Tries to keep people working well together.	Usually listens to, shares with and supports the efforts of others in the group. Does not cause "waves" in the group.	Often listens to, shares with and supports the efforts of others in the group, but sometimes is not a good team member.	Rarely listens to, shares with and supports the efforts of others in the group. Often is not a good team member.

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# Floating on Air



## Timeline

- 1783** Two French brothers, Jacques Etienne and Joseph Michel Montgolfier, invent the hot air balloon and send it to an altitude of 6000 feet.
- 1783** French physicist makes the first manned balloon flight.
- 1852** Henri Giffard builds the first powered airship (cigar-shaped, gas-filled bag with a propeller-powered by a steam engine).
- 1900** Count Ferdinand von Zeppelin of Germany invent the first rigid airship containing hydrogen-as-filled rubber bags (it carried five people).
- July 2, 1912** Melvin Vaniman, an airplane mechanic from Akron, Ohio, tries the first flight across the Atlantic in a new craft created by Goodyear called the "Akron." Something goes wrong at takeoff and the ship bursts into flames, crashing into the ocean. Everyone aboard is killed.
- 1915** The term "blimp" is allegedly coined by an English airman, Lieutenant A. D. Cunningham, who flicks a finger against the envelope (the ship's covering) and then mimics the sound — "blimp."
- 1925** P. W. Litchfield flies his "air yacht." He thinks this will be applied in a much greater realm and plans to fill the skies with blimps.
- 1920s** Blimps become a trendy way to advertise.
- 1928** Goodyear wins a contract to build two huge new airships for the U.S. Navy.
- November 1928** The Goodyear airdock is built, becoming the world's largest building without interior supports (22 stories high and 1200 feet long).
- August 1931** The first of the new rigid airships is named "Akron."
- April 1933** The second airship named for Akron crashes into the Atlantic (three people survive).
- 1935** The second of Goodyear's rigid airships, the USS Macon, crashed in the Pacific (two fatalities occur).
- May, 1937** The Hindenberg crashed, thus ending the dream of passenger travel by airship.
- After 1937** Airships start to use helium instead of hydrogen. Helium has less lift but is not flammable.
- 1941** The Navy calls on Goodyear to build massive blimps to watch over America's fleet and coasts as we go to war. Blimps become "aerial battleships" with a squadron of planes as part of their cargo.
- By 1942** Goodyear is churning out blimps with a production goal of one airship every two days.
- By 1944** Production is slowed as the Navy decides there are enough blimps to protect the homeland.
- 1958** Goodyear puts a TV camera in a blimp to get an aerial shot of a sporting event. Because the camera and equipment are so large and heavy, it is impossible to have anyone aboard.
- By 1980s** Goodyear operates three blimps with new high-tech cameras and a microwave system that allows the TV directors to call the shots from the ground.
- October 1999** The third airship named for Akron crashes just minutes away from the hangar.

# Floating on Air



## Glossary

**Airship** Lighter-than-air craft. These ships are able to fly because they contain a substance that is lighter than the air around them. Generally includes hot-air balloons and blimps.

**Aerostat** Generic term for the two forms of lighter-than-air crafts, the hot-air balloon and the airship (blimp).

**Anatomy of a Blimp** (<http://rbmn03.waika9.com/blimps6.htm>)

- **Tail** Aligned in an X formation. Guides the vertical and horizontal movement. The tail is a combination of rudders and elevators and is therefore called a “ruddervator.”
- **Envelope** Holds the helium. Made of two-ply polyester fabric.
- **Ballonets** Air bags inside the envelope — helps to maintain a constant pressure.
- **Catenary curtain** Cemented to the inside of the envelope — it supports the blimp with cables.
- **Nose Cone Battens** Supports the blimp’s nose. Also helps when anchoring to the ground.
- **Secondary Mooring** Used to secure the blimp to the top of the ground crew’s bus.
- **Air valves** Allows air to escape from the ballonets to maintain envelope pressure.
- **Gondola** Holds the passengers and the pilots.

**Dirigible** French synonym for “airship.” The term generally means “to control” or “steer.”

**Helium** The second lightest inert gas. It is colorless, tasteless and odorless. Has a somewhat inferior lifting power than hydrogen, but will not burn or explode.

**Hydrogen** The most abundant element in the universe, making up more than 90% of its atoms. Hydrogen is the lightest element and therefore has the most lifting power. It is also highly flammable.

**Types of Airships** (<http://www.howstuffworks.com/blimp4.htm>)

All airships have solid gondolas, engine-powered propellers and solid tailfins.

**Rigid** Usually long (greater than 360 ft/120 m) and cigar-shaped with an internal metal frame and gas-filled bags (such as the Hindenburg).

**Semi-rigid** Pressurized gas balloon (envelope) attached to a lower metal keel.

**Non-rigid (blimp)** Large gas-filled envelopes (such as the Goodyear blimps).

**Zeppelin** A proprietary or trade name applied to those airships made by the Luftschiffbau Zeppelin G.m.b.H. The term is often used as a generic term to mean a blimp.



# Floating on Air



## Hotlist

**Airship and Blimp Resources Hotlist** <http://www.hotairship.com/reference/index.html>

**Anatomy of a Blimp** <http://rbmn03.waika9.com/blimps6.htm>

**Big, Beautiful Blimps** <http://www.kidscastle.si.edu/channels/air-space/articles/air-spacearticle1.html>

**Boyle's Law** <http://dbhs.wvusd.k12.ca.us/GasLaw/Gas-Boyle.html>

**Charles' Law** <http://www.aquaholic.com/gasses/charles.htm>

**FAQ About Flying** [http://www.goodyearblimp.com/q\\_flying.html](http://www.goodyearblimp.com/q_flying.html)

**FAQ Blimp Construction** [http://www.goodyearblimp.com/q\\_construct.html](http://www.goodyearblimp.com/q_construct.html)

**FAQ Business of Blimps** [http://www.goodyearblimp.com/q\\_business.html](http://www.goodyearblimp.com/q_business.html)

**FAQ Historical Questions** [http://www.goodyearblimp.com/q\\_hist.html](http://www.goodyearblimp.com/q_hist.html)

**Helium** <http://pearl1.lanl.gov/periodic/elements/2.html>

**How Airships Fly** <http://www.americanblimp.com/fly.htm>

**How Blimps Work** <http://www.howstuffworks.com/blimp.htm>

**Hydrogen** <http://pearl1.lanl.gov/periodic/elements/1.html>

**Image Archive** <http://www.goodyearblimp.com/archive/index.html>

**The Lighter-Than-Air Society** <http://www.naval-airships.org/ltas.html>

**A List of Airship Books Hotlist** <http://www.hotairship.com/reference/books.html>

**Special Feature: Dirigibles, Airships, Zeppelins and Blimps** <http://www.ttkool.ut.ee/aef/dirigibles.html>

## Lesson Plans

**Principles of Aeronautics (Blimps)** <http://wings.avkids.com/Book/Vehicles/beginner/index.html>

# Floating on Air



## Laws of Science

### Boyle's Law

In 1662, Robert Boyle discovered Boyle's Law.

His law explains the relationship between pressure (p) and volume (v) if temperature and amount are held constant (k).

**If the volume of a container is increased, the pressure decreases.**

**If the volume of a container is decreased, the pressure increases.**

The mathematical form of Boyle's Law is  $PV = k$ , where P is pressure, V is volume and k is a constant.

### Important Points

- This is an inverse proportion. As one value goes up, the other goes down.
- If the temperature and the amount remain the same, P times V must always equal k.
- So, if  $P_1 \text{ times } V_1 = k$  and  $P_2 \text{ times } V_2 = k$ , THEN  $P_1 \text{ times } V_1 = P_2 \text{ times } V_2$

For a fuller explanation of Boyle's Law, go to <http://dbhs.wvusd.k12.ca.us/GasLaw/Gas-Boyle.html>.

For problems to solve, go to <http://dbhs.wvusd.k12.ca.us/GasLaw/WS-Boyle.html>.

### Charles' Law

In 1802 Joseph Louis Gay-Lussac discovered what became known as Charles' Law. It was called this because of Gay-Lussac's reference to Jacques Charles' work

This law explains the relationship between volume (v) and temperature (t) if pressure and amount are held constant (k).

**If the volume of a container is increased, the temperature increases.**

**If the volume of a container is decreased, the temperature decreases.**

The mathematical form of Charles' Law is  $V/T = k$ .

### Important Points

- This is a direct proportion.
- If the pressure and amount remain constant, the volume-temperature fraction will always be the same. Volume divided by temperature must always equal k.
- So, if  $V_1 \text{ divided by } T_1 = k$  and  $V_2 \text{ divided by } T_2 = k$ , THEN  $V_1 \text{ divided by } T_1 = V_2 \text{ divided by } T_2$ .
- Every temperature used in a calculation must be in Kelvin, not Celsius degrees.

For a fuller explanation of Charles' Law, got to <http://dbhs.wvusd.k12.ca.us/GasLaw/Gas-Charles.html>.

For problems to solve, go to <http://dbhs.wvusd.k12.ca.us/GasLaw/WS-Charles.html>.

# Floating on Air



## Helium Lesson Plans

### Helium Balloons (Middle School)

#### Objective

The student will:

- Relate the changes in volume of gases to changes in the temperature.
- Explain why the volume of a gas increases as the temperature increases.
- Predict the volume of a gas when its temperature is specified.

#### Procedure

##### Activity 1

**Materials Needed:** balloons, helium, freezer, heater

1. As a group, inflate two balloons with helium. Measure to see that they are the same size. Ask the students to predict (in writing) what they think will happen to each balloon.
2. Place one balloon in a freezer. Place the other balloon in a very warm place (near the heater or outside on a very hot day).
3. Take the balloons out and measure to see if the prediction was accurate.

##### Activity 2

**Materials Needed:** balloons, helium, freezer, heater, plastic bottle, dry ice, cooler

1. Partially fill a plastic two-liter bottle with hot water and cap it tightly.
2. Immediately put the bottle in a cooler with dry ice and close the cooler lid.
3. Have the students predict in writing what they expect to happen.
4. After a few minutes, take the bottle out of the cooler. (The bottle should have collapsed due to the cooling of the gas inside and the slowed molecular movement.)



# Floating on Air



## Helium Lesson Plans (con't)

### Assessment

With a partner, write a paragraph addressing the following questions:

1. Why is the following warning placed on most spray cans: "DO NOT place in hot water or near radiators or stoves. DO NOT incinerate, even when empty. DO NOT store at temperatures above 120° F."
2. Why does a car's tire pressure increase during summer months?
3. Why do car or bicycle tires seem under-inflated in winter months?

The following rubric will be used to evaluate the writing:

CATEGORY	10	8	6	4
<b>Accuracy of Facts (Content)</b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	NO facts are reported OR most are inaccurately reported.
<b>Focus on Topic (Content)</b>	There is one clear, well-focused topic. Main idea stands out and is supported by detailed information.	Main idea is clear, but the supporting information is general.	Main idea is somewhat clear, but there is a need for more supporting information.	The main idea is not clear. There is a seemingly random collection of information.
<b>Conclusion (Organization)</b>	The conclusion is strong and leaves the reader with a feeling that they understand what the writer is "getting at."	The conclusion is recognizable and ties up almost all the loose ends.	The conclusion is recognizable, but does not tie up several loose ends.	There is no clear conclusion; the paper just ends.

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**This activity was written by Meghan O'Leary & Jaci Kottman.**



# Floating on Air



## Helium Balloons (Graphing)

### Objective

Students will make a graph using data gathered in the balloon experiment.

### Materials Needed

6 balloons for each group (same size balloons), helium, thermometers

### Procedure

1. Put students into groups of two or three.
2. Students will blow up four balloons, making sure the circumference is the same on each balloon.
3. The four balloons will each be placed in a different location, each at a different temperature, for 15 minutes. Put a thermometer with the balloon so that the temperature can be noted.
4. The circumference will then be measured and graphed.
  - a. The graph will be a double line plot with temperature on the x axis and size on the y axis.
  - b. A line for the original circumference measurement should be displayed. A second line showing the circumference after changing the temperature should be drawn.
5. Follow the same procedure using helium as the inflating gas.
6. Using the same graph, display a third line in a different color that shows the circumference after changing the temperature.
7. Students will write an explanation telling what the graph shows them. They should use numbers in their explanation.

### Evaluation

The rubric on the next page will be used to evaluate the graphs.



# Floating on Air



## Helium Lesson Plans

### Evaluation:

The following rubric will be used to evaluate your graph.

CATEGORY				
<b>Accuracy of Plot</b>	All points are plotted correctly and are easy to see. A ruler is used to neatly connect the points or make the bars, if not using a computerized graphing program.	All points are plotted correctly and are easy to see.	All points are plotted correctly.	Points are not plotted correctly OR extra points were included.
<b>Labeling of Y axis</b>	The Y axis has a clear, neat label that describes the units and the dependent variable.	The Y axis has a clear label that describes the units and the dependent variable.	The Y axis has a label.	The Y axis is not labeled.
<b>Labeling of X axis</b>	The X axis has a clear, neat label that describes the units used for the independent variable (e.g, days, months, participants' names).	The X axis has a clear label that describes the units used for the independent variable.	The X axis has a label.	The X axis is not labeled.
<b>Title</b>	Title is creative and clearly relates to the problem being graphed (includes dependent and independent variables). It is printed at the top of the graph.	Title clearly relates to the problem being graphed (includes dependent and independent variables) and is printed at the top of the graph.	A title is present at the top of the graph.	There is no title.
<b>Units</b>	All units are described (in a key or with labels) and are appropriately sized for the data set.	Most units are described (in a key or with labels) and are appropriately sized for the data set.	All units are described (in a key or with labels) but are not appropriately sized for the data set.	Units are neither described NOR appropriately sized for the data set.
<b>Neatness and Attractiveness</b>	Exceptionally well designed, neat and attractive. Colors that go well together are used to make the graph more readable. A ruler and graph paper (or graphing computer program) are used.	Neat and relatively attractive. A ruler and graph paper (or graphing computer program) are used to make the graph more readable.	Lines are neatly drawn but the graph appears quite plain.	Appears messy and "thrown together" in a hurry. Lines are visibly crooked.

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