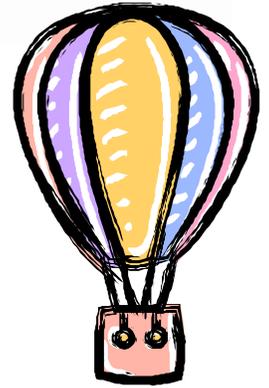




Paper Hot Air Balloon

How do hot air balloons work?

The science behind hot air balloon flight is the same science that makes you float in a pool. It's DENSITY! If you are less dense than water, you float, if you are more dense, you sink. Density is calculated by taking the mass of an object and dividing it by the volume of the object. Air has mass and volume. We usually talk about the volume of air in cubic feet or meters.



So, if there is air inside a hot air balloon and air outside of the balloon, how can they have different densities? It all has to do with temperature. Temperature is a measure of the average kinetic energy (energy of motion) of the atoms in a substance. The warmer a substance gets, the faster its atoms move, higher temperature! When we heat the atoms inside of the hot air balloon they move much faster than the atoms on the outside. This means there can be fewer atoms inside the balloon and still have the same air pressure as the surrounding air. This means the balloon is less dense and it floats. For more information about balloons, check out the link below. To build your own hot air balloon click on the directions below.

<http://www.howstuffworks.com/hot-air-balloon.htm>

Hot Air Balloon

Supplies:

- 6 sheets 20" x 30" art tissue paper
- 30" length of butcher paper to make pattern
- glue stick
- scissors
- 6 straight pins
- Acellophane tape

Estimated time for assembly: less than 4 hours

Supervision: Older students can make the balloon on their own, but an adult should always be present at the launch.

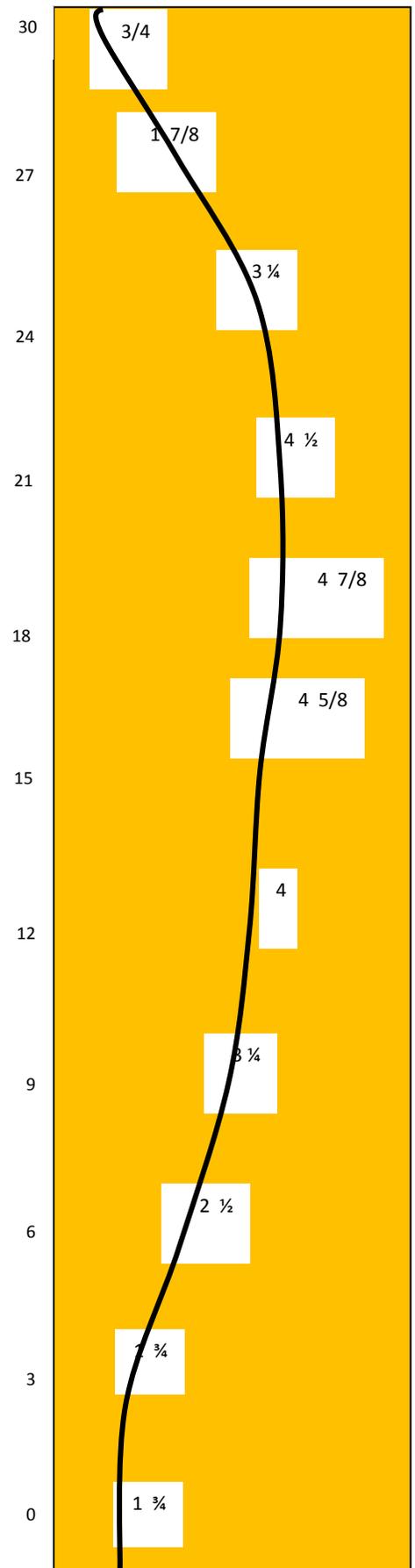
Create the pattern:

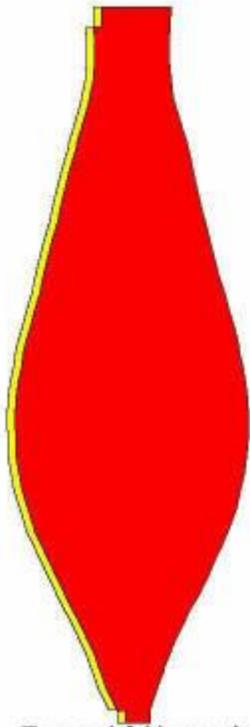
1. Fold a 30 inch piece of butcher paper lengthwise.
2. Mark the fold at every three inches.
3. With the fold to your left, start at the very bottom (0 inches) make a mark $1\frac{3}{4}$ " from the fold. At 3" from the bottom, make a mark $1\frac{3}{4}$ " from the fold. At 6" from the bottom, make a mark $2\frac{1}{2}$ " from the fold. Continue in this manner till all marks are made.
4. Use a smooth curved line to connect the marks.
5. With the pattern still folded, cut along the curved line.
6. Unfold pattern and set aside.

NOTE: If you want to save time gluing, you can alter the pattern and cut only straight lines instead of a curve. Leave a vertical section at the top and bottom about 4 inches each before drawing straight lines to the edge of the pattern. The widest part of the panel should be at about 40 inches from the base. This method will shorten the time required to assemble the balloon by about an hour.

Create panels:

1. Neatly stack all six sheets directly on top of each other. Line up one end and the sides. Don't worry about the other end. It will be uneven, but that's okay
2. Lay the unfolded pattern on top of the stack with the bottom (wider end) of the pattern at the even end. Now paper clip the bottom, one on each side half way up, and two at the top to "pin" the pattern to all six sheets. This is done in the way a seamstress might pin down a pattern. Be careful to keep the bottom and sides lined up.
3. Now cut all six sheets at the same time around the pattern. Cut right next to the pattern but not into it.
4. Unpin the pattern and save it for another balloon. Leave the panels piled together.





Tear and fold over the top and bottom first.

Glue panels together:

1. Take panel one off the top of the pile and lay it by itself.
2. Take panel two and lay it on top of panel one. Line up the bottoms, but slide panel two so 1/2" of panel one is showing all the way along one side.
3. Put glue along the edge of panel two where the 1/2" of panel one is showing. Tearing every three or four inches, fold the 1/2" of panel one onto the glue of panel two. Glue the bottom and top first, then the rest of the side. This will help to keep things lined up while you glue the rest. This is called a French seam
4. Take panel three off of the pile and place it on top of panel two. Line up the bottoms and slide panel three so 1/2" of the unglued side of panel two is showing. This is like step 2. Now glue panel two to panel three the same way you glued panel one to two.
5. Repeat this process until all six panels are glued together. Be patient and take a break when you need one. This part takes the longest time.

Do not try to open the balloon until the directions tell you.

6. Now turn the whole thing over. Gently lift what is now the top panel and you should see two seams (four panels) and then the bottom panel. Fold the middle panels in so that the bottom panel can be glued to the top panel making a French seam as you did in step 4.
7. Now put your hands inside through the bottom and gently work the balloon open. Cut a circle out of the left over tissue paper and cover one side of the circle with glue. With your fist on the inside of the balloon, place the circle over the top of the balloon (sticky side toward your fist) to seal off the top of the balloon. You will want to tie a piece of string to the top of your balloon (or tape it on) to hold it when launching.

Bottom ring:

1. Hang the balloon to make the bottom easy to work with.
2. Cut a piece of poster board into a strip that is long enough to make a loop inside the bottom of the balloon. Putting it inside the bottom and expanding it till it fits works best.
3. Put the balloon inside the ring one-inch from the bottom. Fold the bottom of the balloon up over the ring making a one-inch seam. Use three very small pieces of tape to hold the seam closed and use glue to completely close the seam.
4. Check the balloon for unglued seams and holes. Holes can be patched with a scrap of tissue paper and the glue stick. Open seams simply need to be glued shut.

YOUR BALLOON IS NOW READY TO FLY

Launching equipment:

- barbecue grill
- broom handle with a nail in the end
- Heavy duty or oven gloves
- 6" x 24" stovepipe
- 6" to 8" flange
- 8" x 24" stovepipe
- 8" to 10" flange

Launching the balloon:

Launching needs to be performed by an adult for safety!

Hot grills are always dangerous! Use caution!

1. Pick a calm day and a clear area for launching.
2. Connect the four pieces of stovepipe in the order listed above to form a chimney.
3. Light a small to medium pile of charcoal in the grill. Put the grill in place, and put the chimney on top of the grill. Cover the open area of the grill (between the chimney and the edge) with aluminum foil. We want all of the hot air to be directed up through the chimney.
4. Make sure no flame or sparks are coming out of the chimney. If the fire seems too hot, slightly close the air intakes on the bottom of the grill. If the balloon scorches, the fire is too hot
5. Use the nail in the broom handle to lift the balloon by the string loop and lower the balloon over the chimney.
6. Wearing the gloves, hold the ring until the balloon inflates and you feel the balloon pulling up. Let go and watch your balloon sail into the sky. As the air inside cools it will gently float back to earth.