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Science Experiences That Come To You

Tissue Paper Hot Air Balloon

Ingredients & Supplies:

- Hot air balloon panel template
- Scissors
- Tissue paper (at least 22 square inch)
- Glue stick
- 2" x 4" strips of construction paper
- 3 oz. paper cup
- Pipe cleaners
- Hole punch
- Markers
- Hair dryer

Instructions:

Let's make a small model of a hot air balloon from tissue paper. You will need 2 sheets of tissue paper. You will also need a glue stick, a 3 oz. paper cup, scissors, 1 pipe cleaner, 1 strip of 2" x 4" construction paper, and 1 marker. Print the balloon template on cardstock paper.

First, you need to make your panels from the tissue paper. Lay 1 sheet of tissue paper on the table. Stack the 2nd piece on top. They should be open, flat, and evenly lined. Now carefully fold the tissue paper in half to make a rectangle. Now fold the pieces in half to make a square. Notice that 2 sides of the square are single sheets, and 2 sides of the square are folded. Cut along the dotted line on the template. Place the template on top of the tissue paper along the folded edge. **The straight edge of the template must be along the folded edge of the tissue paper.** Using a marker, trace the outline of the template onto the tissue paper. Only trace the curved edge of the template. Carefully, cut along the curved marker line. **Do not cut the straight edge - only the curve.** Make sure the sheets of tissue paper are lined up so you cut each piece equally. Open up each sheet of tissue paper. You should have teardrop shaped panels of tissue paper. You will only need 5 panels to make your hot air balloon. Choose the best looking 5 panels, and set the others to the side.

Using the glue stick, carefully apply glue along one edge of one panel. Layer another panel on top. Press down firmly to seal the edge. (The 2 pieces are now glued together along 1 side.)

Fold the top sheet over. Apply glue to the inside edge. Layer a 3rd panel on top. Press down firmly to seal the edge. Now you have 3 pieces glued. Fold over the



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3rd panel. Apply glue to the inside edge. Layer a 4th panel on top. Press down firmly to seal the edge. Fold over the 4th panel. Apply glue to the inside edge. Finally, layer the 5th panel on top. Press down firmly to seal the edge. Fold over the 5th panel and apply glue. Now it is time to complete your balloon. Layer the 1st panel on top of the 5th panel. Press the edges to seal.

Carefully, place your hand inside the balloon and open up the panels. You want to be sure the tissue paper is glued together only along the edges of the panels. If you see any openings, use the glue stick to repair the holes.

Place your balloon upside-down on the table with the hole facing up. Apply glue to your strip of construction paper. Place the strip of paper inside the opening of the balloon. It will give stability to the bottom of your hot air balloon.

Now, you've constructed a colorful balloon! Let's make sure it is intact. Place the hole up to your mouth. Blow into the tissue paper balloon like you are blowing up a rubber balloon. Wow! It inflated! This is a great time to check again for any holes. (If the balloon did not inflate, you probably have a hole. Use the glue stick to fix it.)

We know that our breath is air that inflates the balloon. But, how do we make it rise up? Hot air! Now, using your hair dryer, hold your balloon above the hair dryer and turn the dryer on low. What happens? Now turn the dryer to High. What happens? Which setting worked better? What else did you observe?

What else does the hot air balloon need? A basket! You will need 1 pipe cleaner, 3 oz. paper cup, and scissors. First, fold your pipe cleaner in half. Cut on the fold so you have 2 equal pieces. Now fold each of the pieces in half, and cut on the fold. You now have 4 equal sized pieces of pipe cleaner. These are the ropes to hold the basket to your balloon.

Your 3 oz. cup is your basket. To hold passengers, a basket needs a bottom. However, for our hot air balloons to work, the basket needs a hole on the bottom. Therefore, gently squeeze your cup. Cut off the bottom half of your cup. This should leave 1 inch of the cup's top. This will be your basket.

Using the hole puncher, make 4 holes on the top of the cup. The holes should be at 4 opposite points. (Like a "+".) Now make 4 holes on the construction paper at the bottom of your balloon. Again, the holes should be at 4 opposite points.

Now, we can connect our basket to the balloon using the pipe cleaner ropes. Insert the end of one pipe cleaner into a hole on the cup. Fold the tip of the pipe



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cleaner and gently twist. The longer end of the pipe cleaner should be sticking straight up. Do this with the other 3 pipe cleaners in the remaining 3 holes on the cup. Now you have 4 pipe cleaners sticking straight up from the cup. These are the ropes to attach your balloon.

Insert 1 pipe cleaner into one punched hole on the construction paper. Gently fold the end of the pipe cleaner and twist. Do this with each of the remaining pipe cleaners in the construction paper holes. The basket should hang evenly beneath the balloon. There should be about a 1-inch space between the balloon and the basket.

Now, let's use the hot air again! How is it different? Why? Does the weight of the basket affect the balloon's flight? Great job!

The Science Behind It:

Aeronautics is the science of flight. Scientists and engineers study how to design airplanes, rockets, helicopters and any type of flying machine. There are many different aspects of aeronautics.

Aerodynamics is the study of how air moves around and interacts with an object. The word *Aeros* means, "relating to air" and *dynamis* means, "force". Aerodynamics concerns any object in the air, such as a baseball, a kite, or an airplane. Scientists and engineers study the shape of flying machines because it is extremely important for aerodynamics. They study how air flows around the object and its effect. Should the shape be long, thin, flat, or round? Should the object have wings, fins or a tail? Should the machine be really big or small? All of these questions directly affect aerodynamics and how well the machine flies.

Flying machines are amazing contraptions designed by scientists and engineers. Hot air balloons work due to a basic science principle: warmer air rises in cooler air. Air molecules are dispersed all around us. In cool air, the molecules are close together. As air is heated, the molecules move apart. The dense cool air is heavier than the scattered, lighter warm air. Basically, hot air is lighter than cool air. By filling a balloon with hot air, it rises. The more hot air that fills the balloon, the higher it will fly. Heated air can lift a small amount of weight; therefore, a hot air balloon has to be really big to carry people! To lift 1,000 pounds, a hot air balloon must hold 65,000 cubic feet of air.

A hot air balloon pilot, also known as a balloonist, must keep heating the air during the entire flight. The pilot heats the air using propane, a type of bottled fuel. Propane tanks are carried in the basket beneath the balloon. The balloon is built with steel coils. The propane helps to heat up these coils, which heats the



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air inside the balloon. The pilot can control the flight of the balloon with the amount of heat released from the propane tanks. The pilot uses a lever, or knob, to release the propane gas. More fuel means hotter air causing the balloon to *ascend* (rise.) To move downward, the pilot opens the parachute valve. This allows some hot air to escape, or *vent*. This decreases the air temperature inside the balloon, causing it to *descend* (move down.)

The pilot can control the ascent and descent (up and down movement) of the balloon with the amount of heat. The horizontal movement of the hot air balloon is affected by wind. Therefore, it is very difficult to fly a hot air balloon along an exact course. The pilot can manage the horizontal movement by staying alert and aware of the wind conditions. In general, the wind speed increases in higher altitudes. Therefore, the pilot can move up and down to catch various wind currents. While in flight, a hot air balloon can reach up to 3,000 feet above the ground!

Before a flight, the pilot must stay informed about the weather. Rain and strong winds greatly affects a successful flight. Hot air balloons depend on ideal, sunny weather for a fun and safe ride through the air. Before taking off, a pilot often sends up a *piball* (pilot balloon) to test the wind currents. A *piball* is a helium filled balloon that is released into the wind at the launch site. The pilot's flight plan depends upon on how the wind affects the piball.

There are three main parts of a hot air balloon – the balloon, the basket, and the burner. The balloon is called the *envelope*. This holds the hot air. The envelope is made of nylon and polyester fabrics. Nylon and polyester are heat resistance; therefore they do not burn when heated. (These fabrics are also used to make parachutes.) The balloon is constructed with individual pieces of fabric called panels. The panels are sewn together. The average size of hot air balloons is 50-90 feet!

The burners are under the opening of the balloon. The pilot controls the flame and amount of heat that shoots up into the balloon.

Passengers are carried inside a wicker basket underneath the balloon. (The basket is also called a *gondola*.) Wicker twigs are from a willow tree. It is very useful for hot air balloon baskets because wicker is sturdy, flexible, and lightweight. Because the wicker basket is flexible, it can absorb some of the impact when the balloon lands. This makes it much easier on the passengers. The basket is attached to the envelope (balloon) with sturdy cables. This helps keep the balloon steady and level while in flight.



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First Hot Air Flight:

The first hot air balloon that carried passengers took flight in 1783. Two brothers, Joseph-Michael and Jacques-Étienne Montgolfier, were wealthy paper manufacturers. (Paper was a new high-tech industry during this time.) The men had noticed that pieces of paper would rise when heated with air. To test their observations, the brothers built the first modern hot air balloon made of silk and lined with paper. The first launch did not have passengers. However, the balloon floated for ten minutes and traveled one mile! News of their success quickly spread. The brothers wanted to plan a demonstration for King Louis XVI of France. Therefore, the next hot air balloon was decorated with golden embellishments. Not knowing if the flight was safe for people, the men chose three heroic passengers – a sheep, a duck, and a rooster. With 300,000 people in attendance, along with King Louis XVI, the hot air balloon took flight for 8 minutes, traveling 2 miles. It was a success! The men quickly began planning for a manned flight. One month later, a physics teacher stepped up to be the first human to fly in a hot air balloon. The science teacher was in the air for 4 minutes, and he landed safely. The Montgolfier brothers were highly praised around the world. The hot air balloon became a symbol for innovation. The balloon image decorated a variety of household items. With their study and invention of the hot air balloon, the Montgolfier brothers pioneered the Science of Flight!

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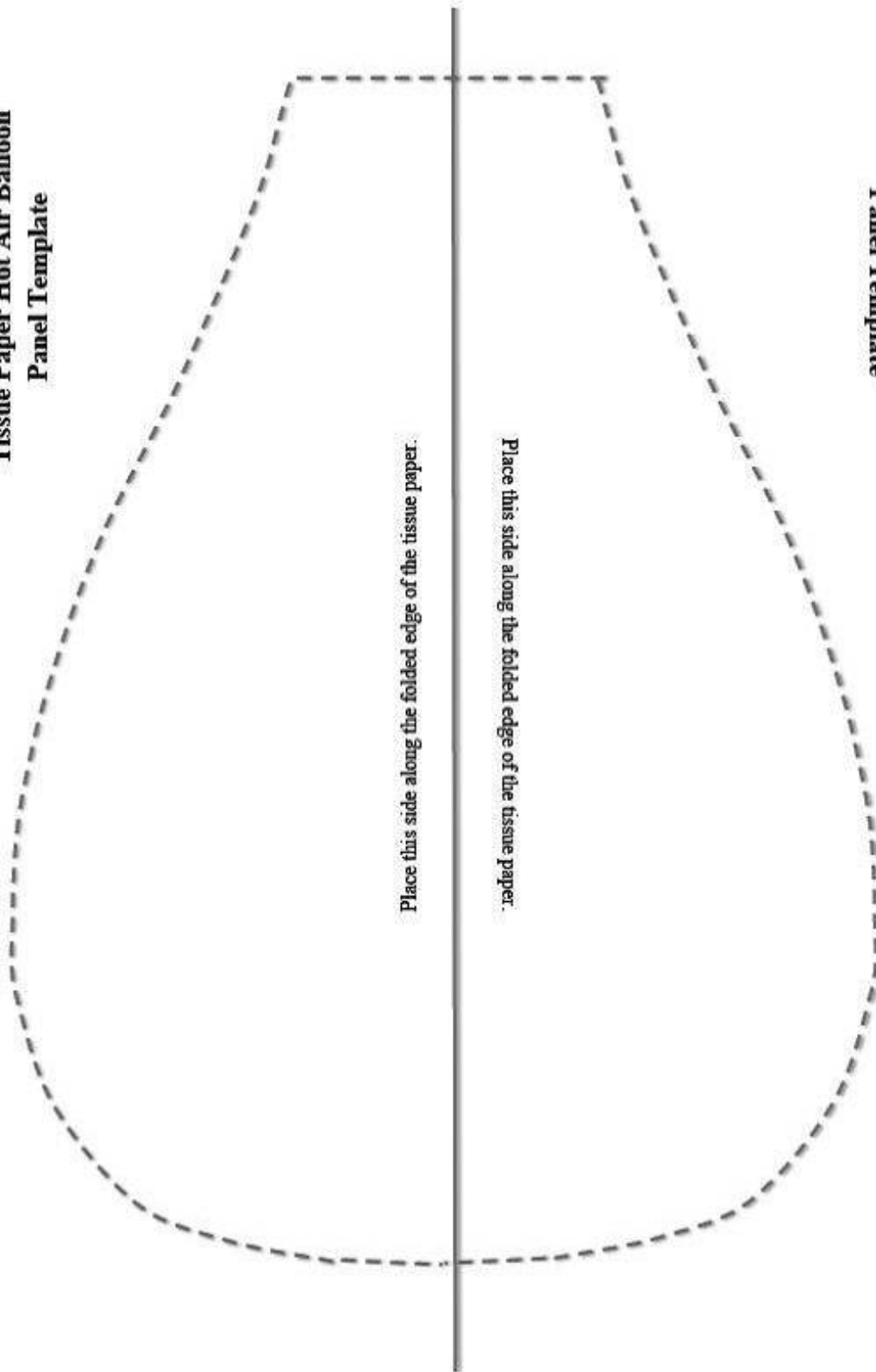


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