

PAPER FLYERS

Credit to the EAA Museum Education Program

Concepts Illustrated:

- (1) To teach basic information about aviation, using hands-on activities.
- (2) To teach the FOUR forces of flight, Bernoulli's principle, and parts of an airplane.
- (3) To teach how a helicopter gets lift.
- (4) To teach how a parachute works.

Time Requirements: 60 Minutes

Grade Level of Audience: This activity is primarily suited for kids in grades 5-9.

I. Materials and Equipment Utilized

Thick straws
Tape
String
Wing on a string activity page
Scissors
Optional: Paper airplane plans
Hole punchers
Softball thing!
Optional: Airflow generators (box fans)
Scissors
Plastic play helicopter rotors
Helicopter activity sheet
Paper clips
Kleenex
Thread
Paper Clips

II. Details of Student Implementation

The approach utilized by the EAA AirVenture Museum Education staff is to (1) teach the specific aviation content, (2) demonstrate the hands-on activity, and (3) then allow time for the students to construct them. The following pages have each topic broken down into a lesson plan. You can teach them as individual activities. In

this case, make sure to include any other flight information that you need to.

1. Airplanes

- Teach the four forces of airplane flight, (weight, drag, thrust, lift).
- In doing paper pilots, you have probably already taught the rocket forces. In this case the only other force you have to teach them about is lift.
- Discuss the parts of an airplane (propeller, engine, fuselage, landing gear, wing, tail, horizontal stabilizer, vertical stabilizer, rudder, elevator, and ailerons). Utilize some type of visual aid. Ideally, show these on an actual plane.
- Discuss the form and function of the airfoil shape.
- On a chalkboard or whiteboard, draw the airfoil shape and talk about the air going over and under the wing. This is a good place to discuss Bernoulli's principle. (Be sure to show some Bernoulli demonstrations!!!!)
- Connect Bernoulli's principle to an airplane wing. The air over the top has to speed up to get over the curve. Therefore, its pressure would drop. High pressure underneath wants to go towards the low pressure on top so the wing would lift up. More lift would also be created by increasing the angle of attack, (the angle the wing meets the air).
- Demonstrate how to make a wing on a string.

WING ON A STRING

(Modified from the Rochester Museum and Science Center, Rochester, New York for the EAA)

MATERIALS:

Paper
Transparent tape
Sharp pencil
Drinking straw
Thread or very thin string
Tape
Hairdryer
Template of air foil to be cut out

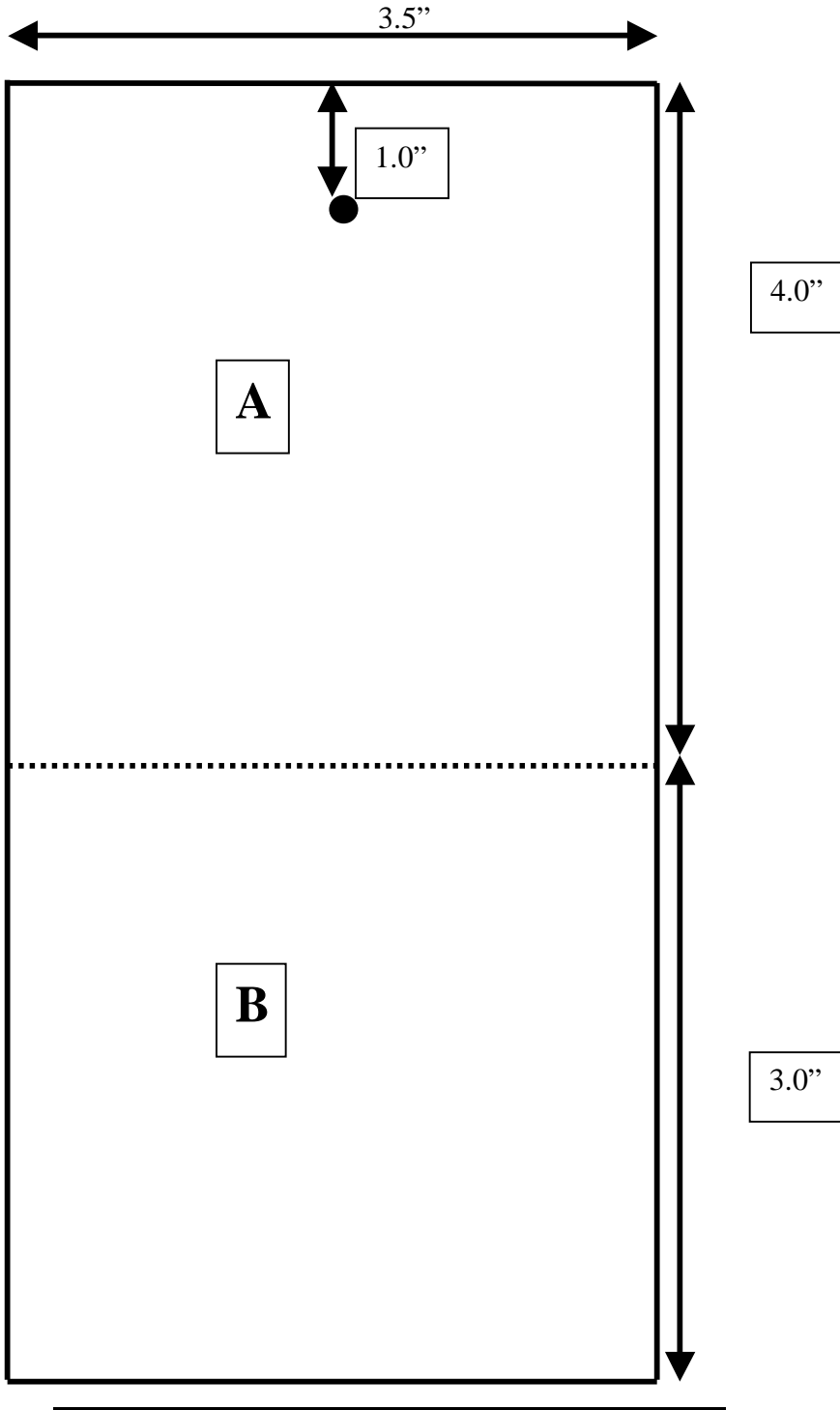
BACKGROUND:

Lift is created by the curved shape of the wing, which causes the air to move faster over the top of the wing than the bottom. According to the Bernoulli principle, this results in the air pressure above the plane's wing being less than the air pressure below. Thus, there is a net upward force on the wing due to the motion of air over both surfaces of the wing. Provided the lift on both wings of an airplane is greater than the weight of the plane, the plane will accelerate upward. If the lift due to the wings is equal to the weight of the plane, the plane neither accelerates upward, nor accelerates downward.

INSTRUCTIONAL DETAILS:

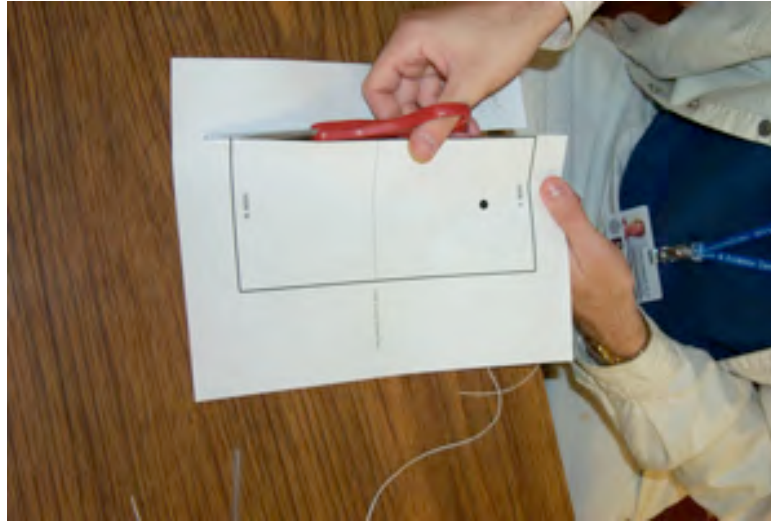
1. Time Allotment: 45-60 minutes
2. Have students work individually.
3. Each student should make his or her own airfoil
4. Technical Terms: air foil, Bernoulli Effect, pressure

Wing on a String Template

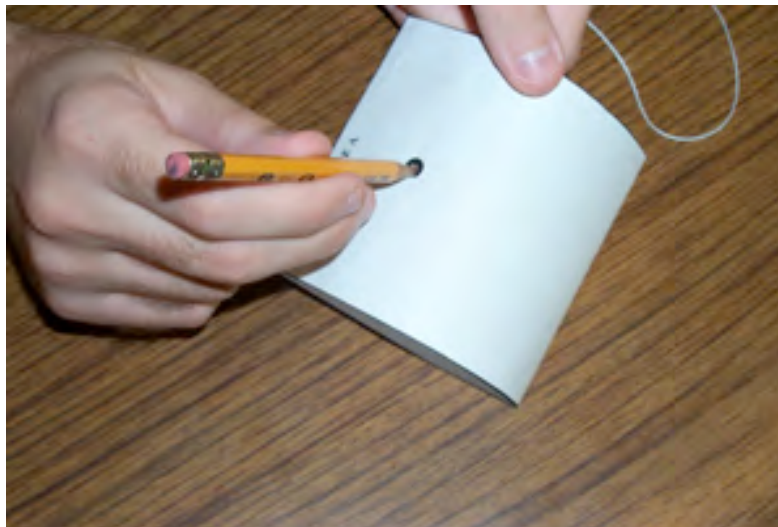


I. Construction Details

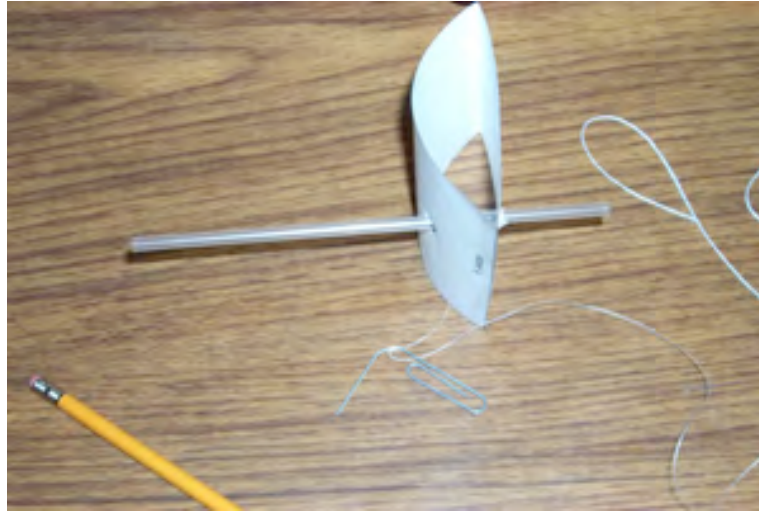
1. Cut out the wing's shape along the dark solid line.



2. Fold along the dotted line. One half is $\frac{1}{2}$ " shorter than the other.
3. Tape Side 1 to Side 2, such that, the bottom side is flat and the top is curved like an arch.
4. Use a pencil to make a hole where the black dot is, and poke straight through to the other side of the wing, so that the pencil can slide in one end and out the other.



5. Push a straw through the hole and attach it to the top and bottom of the wing with two small pieces of tape.



6. Cut the straw so as little of the straw is above or below the wing as possible.



7. Feed some thread through the straw and tie the end that is on the flat side of the wing (Side 2) to a paper clip.



8. Tie the end of the string with the paper clip to the arm of a chair or another secure spot.
9. Hold the other end of the string in the air so that the string is up tight and pointing up and down.



10. Experiment with the hair dryer and/or a box fan pointed at the wing on a string and observe what happens.
11. Try holding both the top and bottom of the string and
 - a. Run down the hall
 - b. Spin very quickly in place

Allow time for students to make and try their wings.

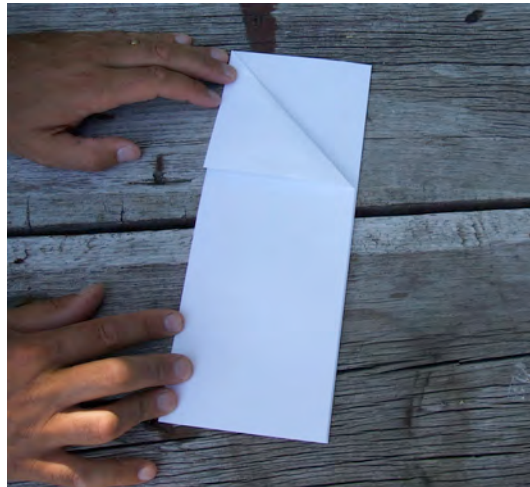
Airplanes: (These are great airplanes with complete instructions and templates)
www.funpaperairplanes.com/Plane%20Downloads.html

Paper Plane Model #1 (Courtesy Science in Flight...Classic Design)

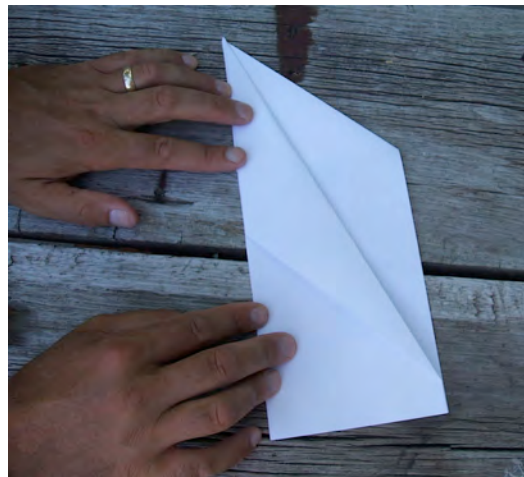
- Take an 8- 1/2" x 11" sheet of paper, fold it in half lengthwise. Make sure the folds are sharp, crisp, and precise.



- Fold the short edge of one side down to the first fold (producing a 45° angle). Repeat for the other side.



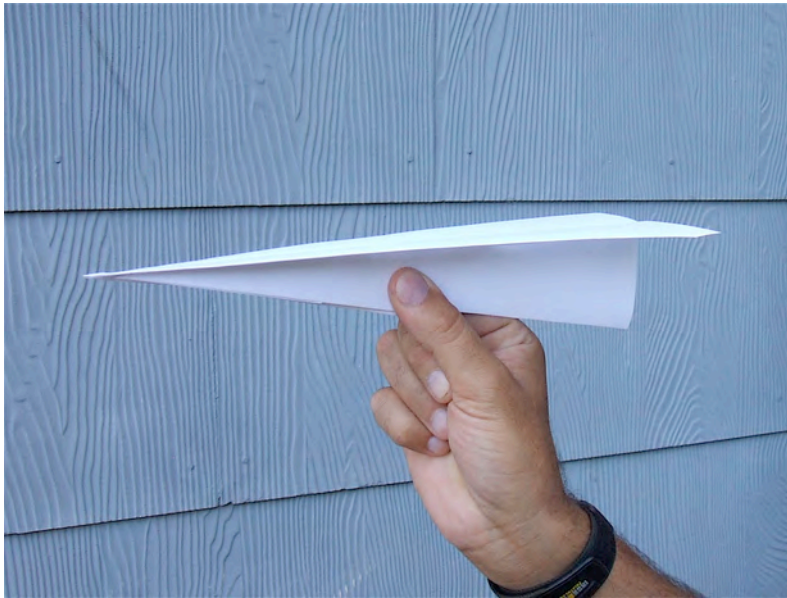
- Fold down the new fold you have created to the original fold down the center. Repeat for the other side.



- Fold down the new fold you have created to the original fold down the center. Repeat for the other side.



- Hold center and open wings out. Now throw!

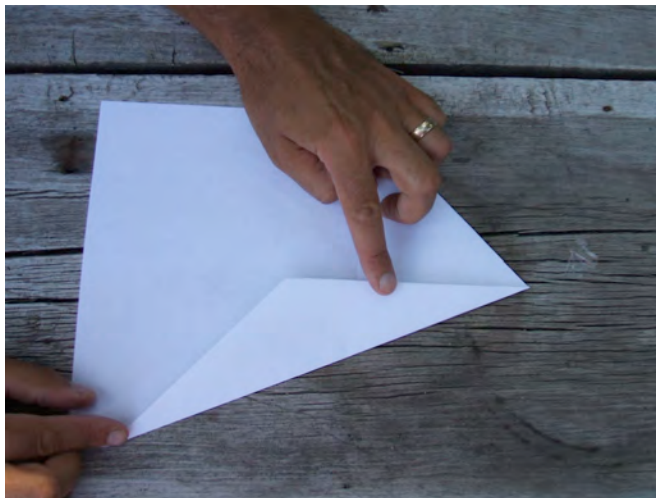


Paper Plane Model #2

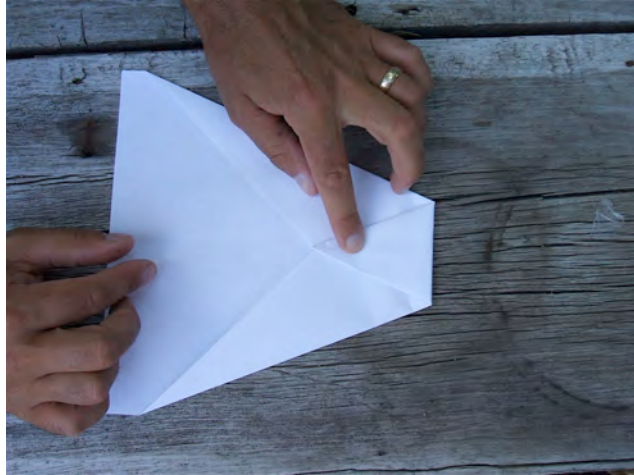
- Fold the top left and top right corners, such that, they meet at the mid-line of the 8-1/2" x 11" sheet of paper.



- Fold the left and right folds over again, such that, they again meet at the mid-line.



- Fold the tip down, such that, the tip ends up at the vertex of the other two sides.



- Flip the paper over and fold the left side to the right side, such that, the outside edges of the wings line up.



- Fold the wings down, such that, the outer edge of the wing lines up with the base of the center section. Cut two slits, one inch apart, along the back edge of each wing for elevator adjustments. You can add wing dihedral by tilting the wings slightly upward. Now, you are ready to fly.

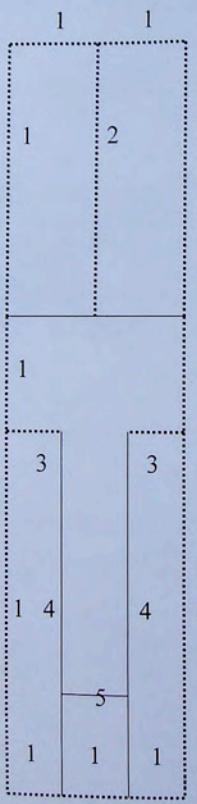


Helicopters

- 1) After teaching about airplanes, this project is very simple.
- 2) A helicopter flies basically the same way an airplane flies. It has to do with that airfoil shape again.
- 3) The propeller of an airplane also has the airfoil shape. Now it is just turned sideways to produce lift going forward.
- 4) Show students the plastic helicopter toys but turning them and making them fly.
- 5) Tell students a helicopter rotor works the same way an airplane propeller does. That airfoil shape produces lift.
- 6) Demonstrate how to make the paper helicopters.

➤ Duplicate or construct the template shown below.

Specifications For The Helicopter



(I) Cut around the entire perimeter along dashed lines "1"

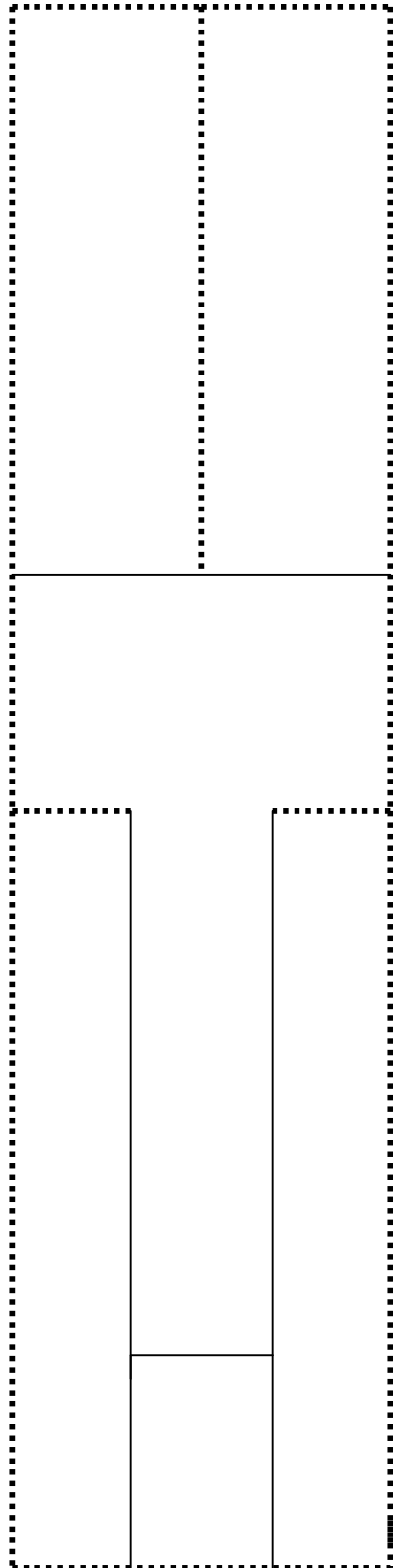
(II) Cut along dashed lines "2" and "3"

(III) Fold flaps toward each other along fold lines "4".

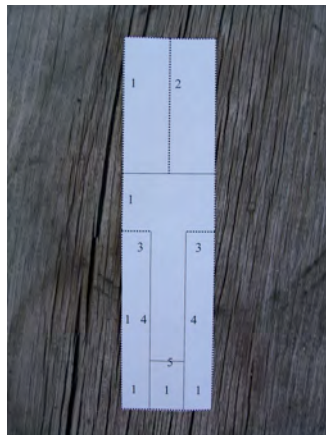
(IV) Fold up bottom tab along fold line "5"

(V) Fold rotors down along fold lines "6" in opposite directions.

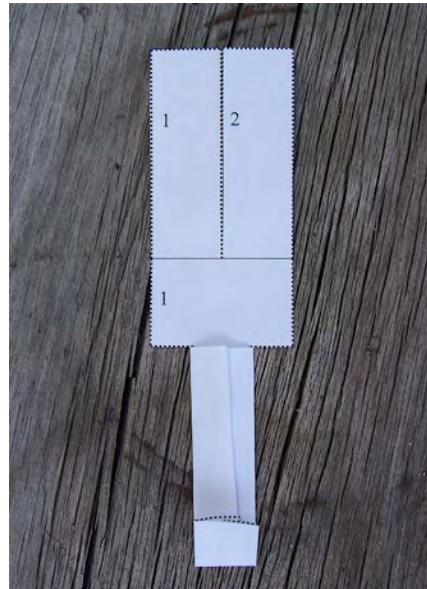
(VI) Add a paper clip or small paper clamp to add weight.



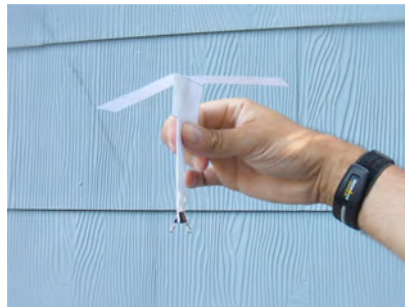
➤ Cut around the entire perimeter along dashed lines "1".



- Fold along dashed lines “2” and “3”. Fold flaps towards each other along fold lines “4”. Fold up bottom tab along fold line “5”.



- Fold Blade 1 back and Blade 2 forward.

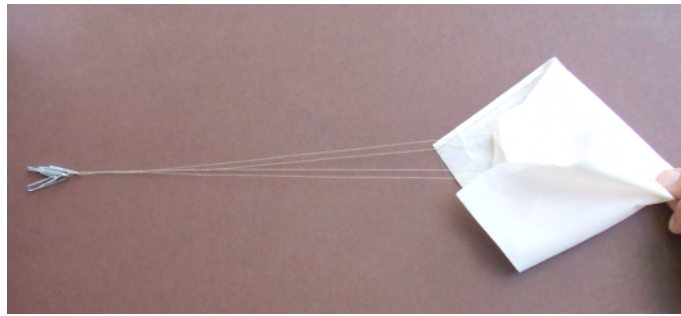


- Add paper clips to vary the helicopter behavior.

- 7) Place a paper clip or paper clamp at the bottom of the helicopter to make it work better.

Parachutes

- 1) Parachutes work because you are capturing air inside the chute to slow it down.
- 2) Demonstrate how to make the parachute.
- 3) Take one piece of Kleenex (it might be double layered. In this case, peel the layers apart). Using a piece of thread, tie to opposite corners of the Kleenex. Take another piece of thread and tie it to the other corners. Place a big paper clip at the middle, where the pieces of thread meet.



- 4) Compare the rate of fall for a dropped paperclip to the rate of fall for a paperclip attached to the parachute.