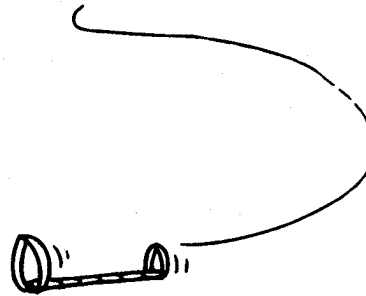# THESE THINGS FLY!

Overview: These flying oddities aren't your typical paper airplane. They may be strange to look at, but they're simple to make and fun to fly.

Materials:
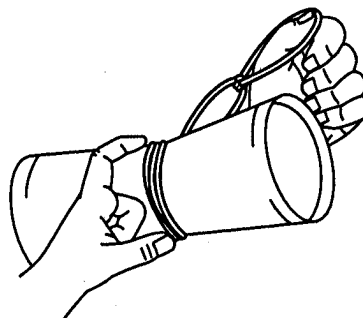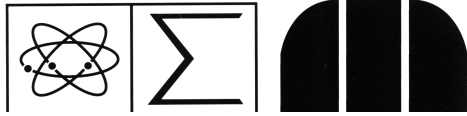- Paper
- Paper or foam cups
- Tape
- Straw
- Elastic bands

Doing it:

1. **Straw Flyer:** Cut a paper strip 2 cm x 24 cm and another 1.5 cm x 18 cm. Make the strips into loops by overlapping the ends a couple of centimeters and taping the ends together on the inside and the outside. The overlapping ends should form a sleeve into which you can slip a straw. You may want to keep the straw in place with a bit of tape. What happens when you throw the Straw Flyer like a spear? Is there a difference if the big loop is in front or if the small loop is in front? How does the Straw Flyer's flight compare to that of a plain straw? Try putting the loops in different positions along the straw. Try making the Straw Flyers with two big loops, and then with two small loops. Combine a really big loop with a really small loop. Use more than two loops. Put loops on the top and the bottom of the straw.
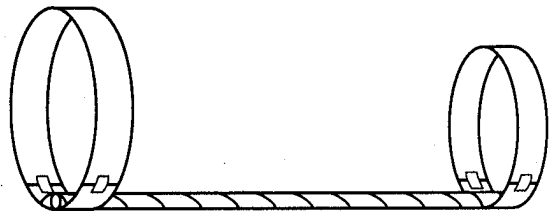
2. **Aero-Cups:** tape together the bottoms of two paper or foam cups. Loop together the ends of five or six elastic bands to form a long chain. Wrap the elastic-band chain around the center of the two-cup structure. While making sure that the elastic band chain comes from the underside of the two-cup structure, put your thumb through the end elastic in the chain and stretch out the chain while holding the cups. Release the Aero-Cups and watch them spin through the air. Can you design a similar flying structure using four cups?

THE PLANE TRUTH

Overview: By making and flying paper airplanes, you can discover some of the basic principles of aerodynamics. Here's one of the simplest paper airplane designs, the Dart.

Materials:
- Paper (preferably stiff paper)
- Tape
- Optional—scissors

Doing it:

1. Fold a sheet of paper lengthwise, exactly down the middle. Unfold it and smooth the paper flat.

2. Fold one of the corners over as far as the center fold. Then fold the other corner over in the same way.

3. Fold the corners over again so that they meet at the centerfold.

4. Fold the two sides together along the center fold. Then, to make wings, fold the top portion of each side down toward the center fold.

5. Use a small piece of tape to fasten the wings together. If you wish, you can sip off about 1cm of the plane's nose. Tape together the keel. (Paper under the wings) at both ends.
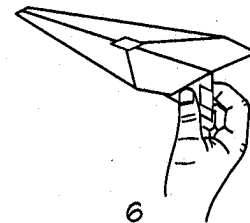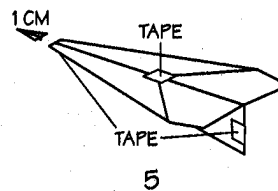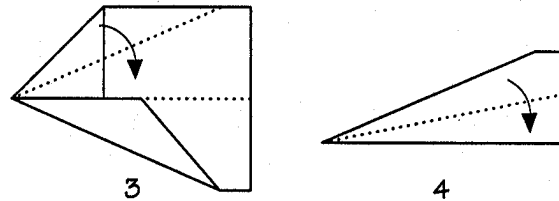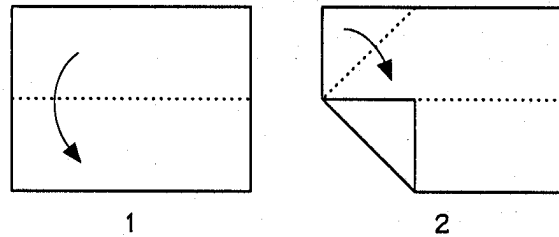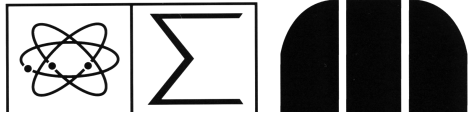
6. Launch the Dart by holding it at the back of the keel and throwing. How long does the Dart stay in the air? How far can you throw it?
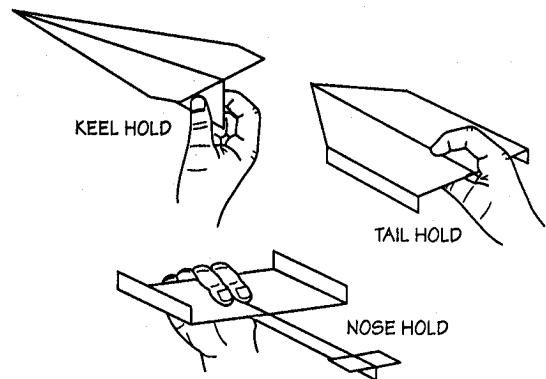
PLANE DESIGN AND FLYING TIPS

These design and flying tips apply to almost any kind of paper airplane. Start with simple planes, and then try more complicated planes.

Materials:
- Paper airplanes
- Tape
- Scissors
- Paper clips-
- Different weights of paper (e.g. tracing paper, construction paper, writing paper)

Doing it:
1. Space: Paper planes fly best in a large empty area where there's a little or no wind.

2. Construction: If a paper plane doesn't fly straight, it may be because it isn't made straight. Every little bend, cut, and dent in the paper changes how a plane flies. All folds should be sharp. Look down along the nose of a paper plane to see if both wings are the same size and bent to the same angle. Check that all the folds and cuts on one side are the same size and bent to the same angle. Check that all the folds and cuts on one side are the same size and shape as those on the other side. If your plane is lopsided, it will never fly straight. If everything looks okay, and the plane still doesn't fly right, experiment with the factors listed below.

3. Launching Speed: There's no such thing as the "best" launching speed for paper planes. Different planes need different launching speeds. In general, try to launch a plane so that it glides in a straight path without diving, climbing, or turning. If a plane is launched too quickly, it tends to climb, then stall, and finally dive down. If a plane is launched too slowly, it dives to pick up more speed. Either way, distance and flying time are lost.

4. Throws: There are many ways to throw paper planes. Different planes work better with certain throws. For the keel hold, hold the back of the plane at the bottom, and then launch the plane with a sharp throw. In the tail hold put your index finger on top of the plane with your thumb and other fingers underneath. Move your hand forward at the speed you think the plane will fly and just let the plane go. Don't jerk or push the plane forward; just let it glide from your hand.


KEEL HOLD

TAIL HOLD
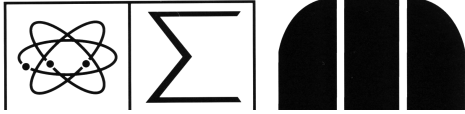
NOSE HOLD

The nose hold is best for loops and circles. If you want a plane to veer to the left or right, launch it at an angle.

5. Circles: A Dart usually won't do circles, but the Barnaby (described later) and other planes with long wingspan are good at circles. Hold a plane by its nose at you waist. Keep the bottom of the plane toward you body; the wings should be straight up and down. Pull your hand straight across from one side to the other and then let the plane go. The plane should circle and return to you. If a plane won't do circles, be sure it isn't lopsided and try throwing it harder.

6. Loops: When you're trying to make a plane loop, curl up the back edge of the tail or wings. For a downward loop, start by holding the plane's nose. Aim the nose down and quickly launch the plane with a hard throw. Be careful to launch the plane straight, without twisting your wrist or curving you arm. The plane should make a look and then fly level. For an upward loop, hold the plane by its nose again. Aim the nose up. Pull the plane straight up, and let go when the plane is in front of your face. With practice, the plane should loop away from you and come back so that you can catch it.
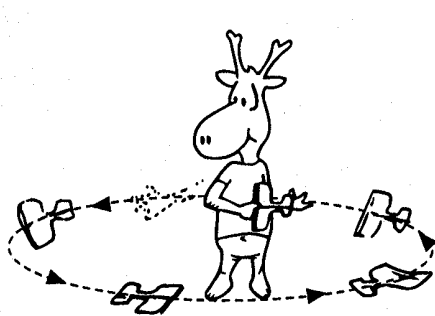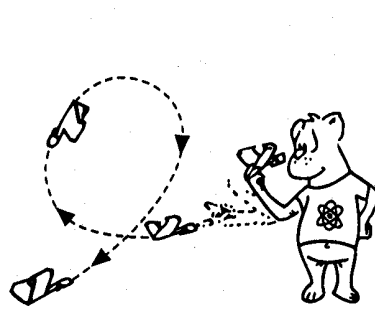
CIRCLES   DOWNWARD LOOP   UPWARD LOOP
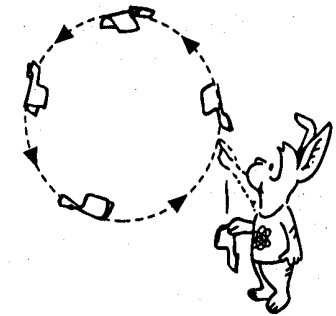
7. Weight: Try making several planes using the same design, but different kinds of paper (e.g. tracing paper, construction paper, writing paper). Do the planes fly differently? In what ways? Not only is overall weight important, but so is the way the weight is distributed. Shifting weight can be used to overcome problems like interference from air currents outdoors. Add a paper clip to a plane's nose. How does it fly? What happens is you put a paper clip on the tail instead of the nose? What happens if you add two or more paper clips? How can you tell too much weight has been added?

8. Ailerons: Make flaps, or ailerons, for a plane by cutting two 1 cm slits in the back of each wing. Bend the flaps. What happens when both flap are tilted up? What happens when both flaps are tilted down? What happens if only one of the flaps is bent
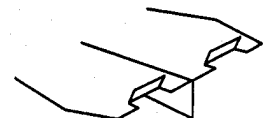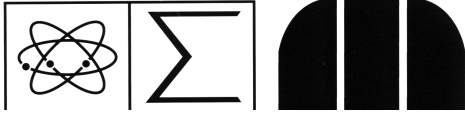
out? Try tilting one flap up and the other flap down. Try different flap widths.

PLANE DESIGN AND FLYING TIPS (cont'd)

9. <u>Vertical Stabilizers</u>: These are used to make a plane fly straight and smooth. Bend the tips of the wings upward. What happens if you have only one stabilizer on a plane instead of two? Try bending the stabilizers down instead of up. Try making small stabilizers, and then try larger stabilizers.
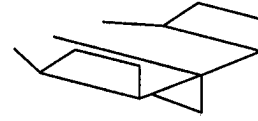
10. <u>Rudders</u>: Flaps in vertical stabilizers can be used as rudders that change the direction of a plane's flight. Turn both rudders slightly l the same way, to see one change in flight. Then turn them the other way. Try bending in just one rudder. Try bending both rudders outward.
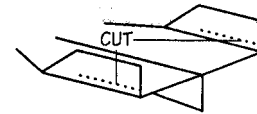
11. <u>Cambering</u>: Curve a paper plane's wings downward slightly by running them between you thumbnail and fingers. This will create a slight arch in the wings and the plane may fly better.

12. <u>Extension</u>: Come up with your own paper airplane design. Then write instructions, including diagrams, for making the plane. Can someone else follow your instructions and make the plane?
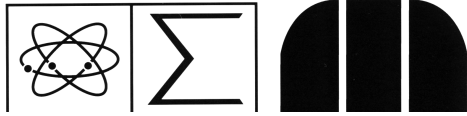
STUNT FLYER

Overview:

Once you're familiar with making and flying paper airplanes, the Stunt Flyer is an interesting, simple plane to try.
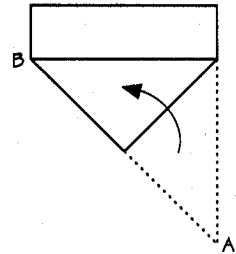
Materials:

- Paper (preferably stiff paper)
- Tape

Doing it:

1. Fold up one corner of a sheet of paper to the opposite side.
2. Fold over point A so that it meets point B.
3. Fold up the bottom tip to the centre.
4. Fold the paper in half.
5. Fold down each wing so that the crease is approximately 2 cm from the bottom of the plane (i.e. keel is 2 cm).
6. Fold up each wing tip by 1 cm.
7. Use a small piece of tape to fasten the wings together. Also, tape together the keel at both ends. You're ready to launch.
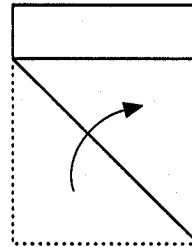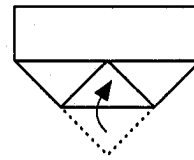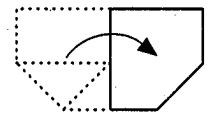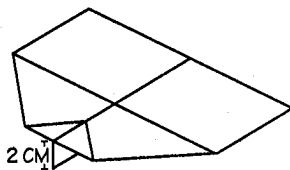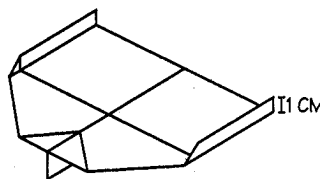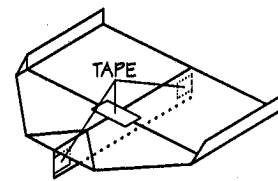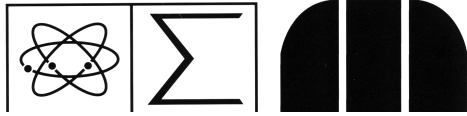
BLUNT NOSE

Overview:

What happens when a plane has a blunt, rather than a pointed, nose? Make this plane and see what it can do.

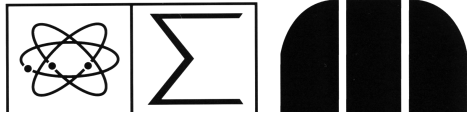**Materials:**

- Paper

Doing it:

1. Fold up one cover of a sheet of paper to the opposite side. Unfold the paper.
2. Fold up the other cover of the paper. Unfold it.

3. Fold up the bottom edge of the paper so that the crease goes through the spot where the first two creases cross. Unfold the paper.
4. Fold the paper along the crease like an accordion.
5. Fold down both corners of the pleat toward the centre tip.
6. Fold up the two bottom points of the first layer of paper.
7. Fold up the bottom tip of the second layer of paper so that it covers the other points.
8. Now comes the tricky part. Look for the two pockets. Underneath these pockets are two, triangular flaps. Tuck these flaps into the pockets to hold them securely in place.
9. Turn the paper over. Fold both wing tips toward the center.
10. Fold out the edge of each wing.
11. Crease the center, front of the plane to give it a gentle, upward curve. You're ready to launch.
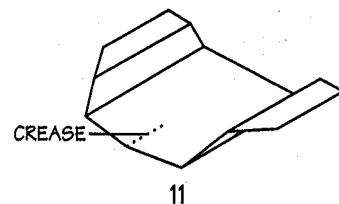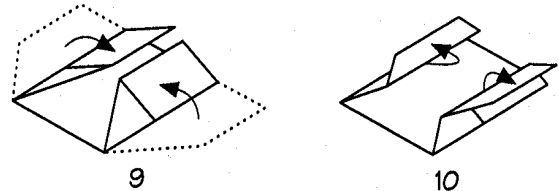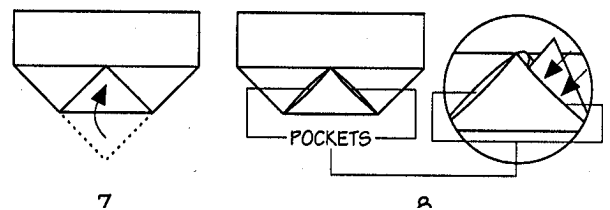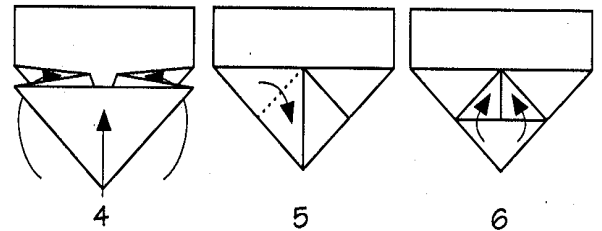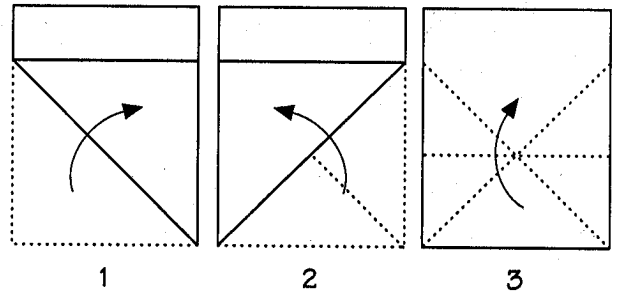
THE BARNABY

Overview: The Barnaby was designed by Ralph S. Barnaby, who was a captain in the United States Navy. Make this plane and follow in his footsteps.
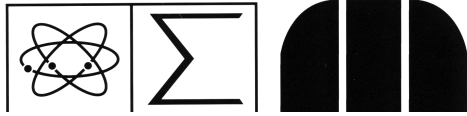
Materials:
- Paper (preferably stiff paper)
- Ruler
- Pencil
- Scissors

Doing it:

1. Fold a sheet of paper exactly down the middle. Unfold it. Fold the paper exactly down the middle in the other direction. Unfold it. The creases are your guidelines.

2. Make a 1.5 cm fold along the long edge.

3. Fold the folded edge over and over until you meet the middle guideline.

4. The last fold has to be very tight; so press your ruler down hard on the paper and run it along the edge.

5. Fold the paper in half (folded edge on the outside). Draw and cut out the shape shown.

6. Open the plane. Fold up 1 cm of each wing tip. Fold down 1 cm on each side of the tail.

7. Bend up a small portion of the folded-over edge, near the center. This will stiffen the wings and hold them in place.

8. Bend up the back edges of the wings a bit. You're ready to launch.
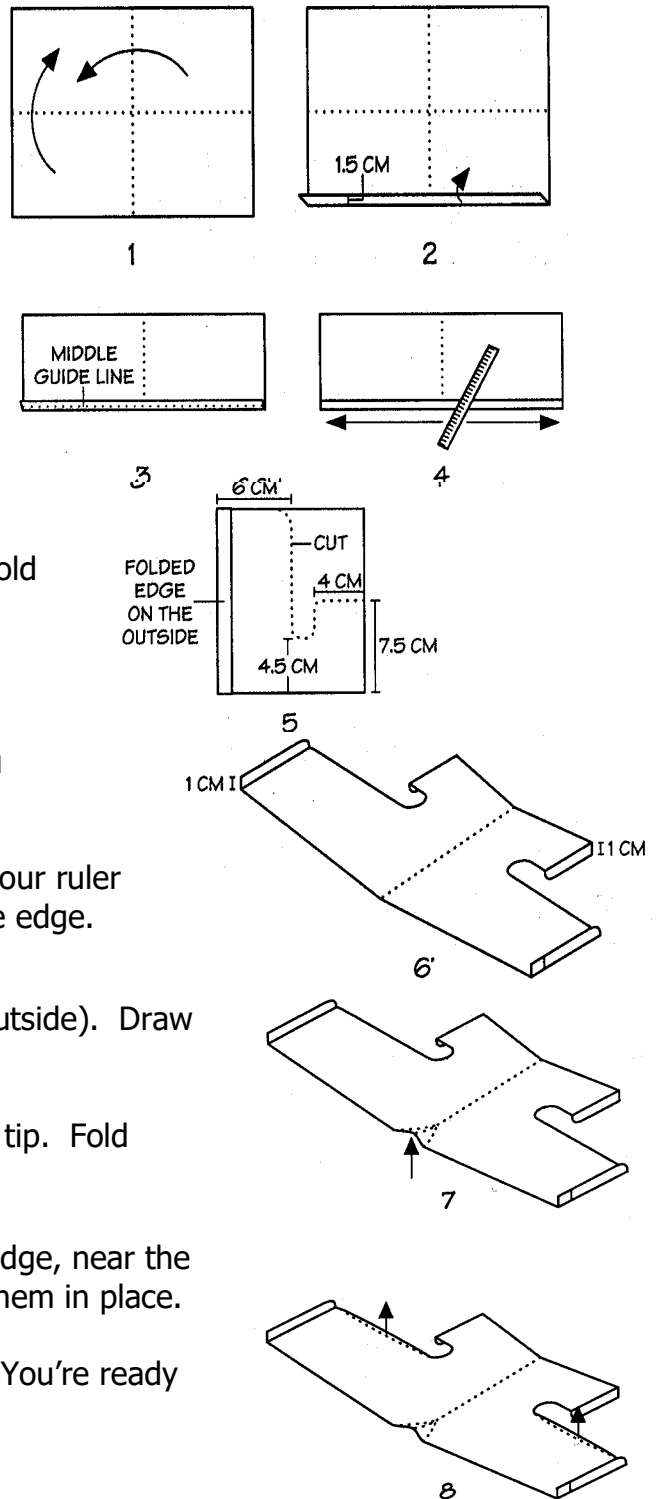
AIR SCORPION

Overview: If you like planes that fly fast, this design is for you. After a little folding and cutting, it looks very much like a get plane.

Materials:
- Stiff paper
- Tape
- Ruler
- Pencil
- Scissors

Doing it:
1. Fold a sheet of paper lengthwise, exactly down the middle.

2. Mark lines along the top edge of both sides of the folded paper. Mark one line 5 cm from the end and the other line 9 cm from the end.
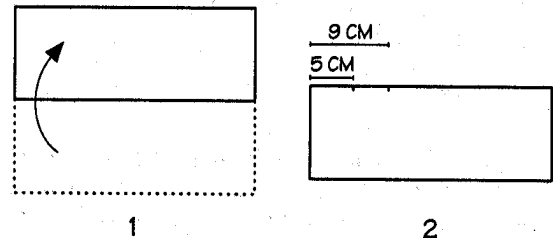
3. Fold down the far cover to the 9 cm mark. Fold the corner on the other side of the paper in the same way.

4. Fold the overhanging tips up
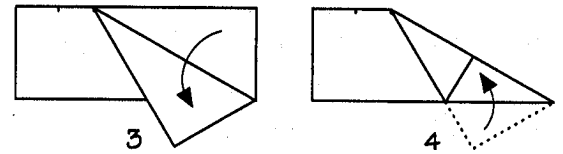
5. Open the two halves of the paper. It should look like the illustration.

6. Close the two halves again. Fold the nose back and between the halves.
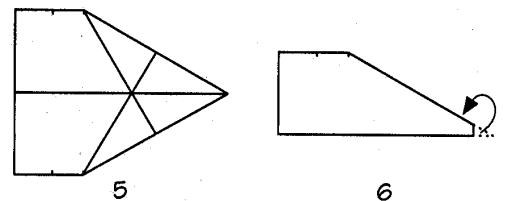
7. Draw three lines: the first one vertically from the 9 cm mark to the bottom of the fold; another across the bottom of the fold, 1.5 cm up from the fold; and one diagonally from the 5 cm mark.
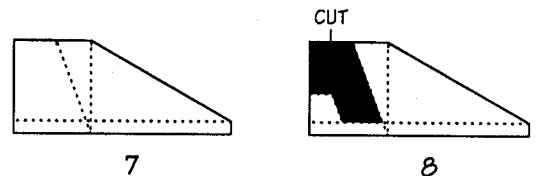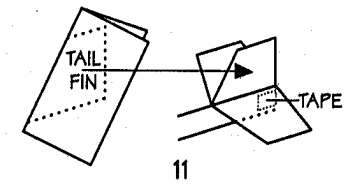
8. Draw in a tail at the back of the plane. Cut out the shaded area shown.

9. Bend the tail and wings along the line which is 1.5 cm from the fold (i.e. line drawn in step 7).
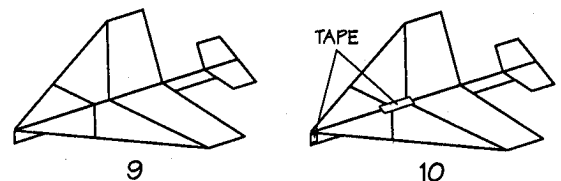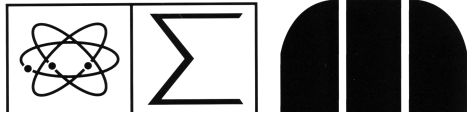
10. Keep the wings in place with tape. Tape the nose.
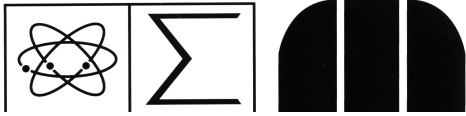
11. Draw the tail fin pattern on a folded piece of paper. Cut it out. Tape it to the inside of the back end of the plane. You're ready to launch.
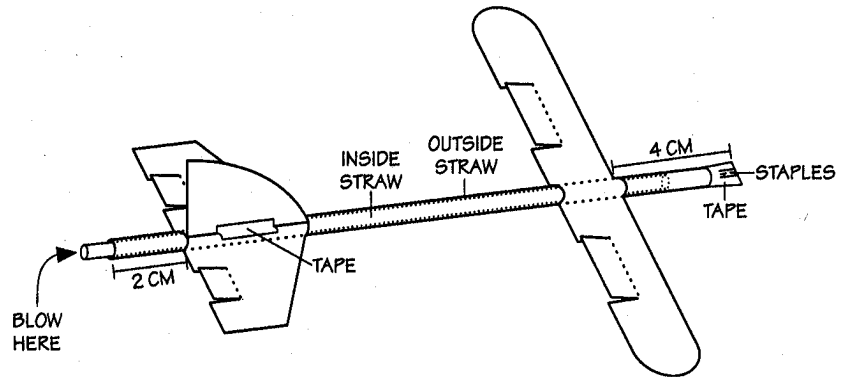
SUPER ZOOMER

Overview: This paper airplane involves more construction work that other paper planes, but it's a great flyer and an interesting design.

Materials:
- Thin drinking straw
- Fat drinking straw (wide enough so that thin straw fits inside)
- Stapler
- Tape
- Stiff paper
- Ruler
- Pencil
- Scissors

Doing it:

1. Staple one end of a fat straw several times. Seal the end with tape to make it airtight

2. Fold a sheet of paper in half. Draw the plane parts on the folded paper, as shown.

3. Leaving the paper folded, cut out the wing and tail.

4. Make the rudder out of only one thickness of paper.

5. Make the wing and tail flaps by cutting the four solid lines (in illustration). Bend each flap up slightly

6. Open the wings and tape them to the fat straw, 4 cm from its closed end.

7. Open the tail and tape it to the fat straw, 2cm from the open end.

8. Tape the rudder to the top of the tail.

9. To fly the plane, put the thing straw inside the fat straw. Bend your head back a little. Holding onto the thing straw, blow into it. The plane should shoot into the air.

10. Experiment with the Super Zoomer, using the design and flying tops discussed earlier.