

# Paper Airplane Design

## Introduction

Flight is found all around, from insects to aircraft, what keeps them from going down? Build paper airplanes to find out what flight's all about!

## Think About This

What makes some paper airplanes fly better than others?

## Materials



Paper sheets, such as:

- White paper
- Notebook paper
- Construction paper
- Newspaper (cut to 8.5" x 11")

Ruler or Measuring Tape

Scissors

Tape

## Do Ahead of Time:

Find a large, open area for test flights, such as:

- Long hallway
- Open basement
- Empty Garage
- Outside (find a dry place without wind)

Mark a launch point with tape from where the planes will be thrown

(Optional) Mark distances from the start point every five feet to help make measuring easier.

## Directions

All things that fly are affected by the same four forces. Create and modify a paper airplane to investigate these forces and to see how far you can go.

## BASIC FLIGHT:

- 1 Start by folding a basic Dart paper airplane, found in the resources section at the end of this activity. Make each fold as sharp as possible by creasing it with a finger.
- 2 Test this plane by throwing it from the launch point with as little force or thrust as possible (gently toss the plane).
- 3 Measure each flight for distance from the launch point to where the plane first hits the ground. Record your measurements below.
- 4 Repeat steps 2 and 3 at least 3 times with "low thrust". Make sure the plane is in good condition between each test.
- 5 Repeat steps 2 - 4 with a medium thrust, then a high thrust.
- 6 Continue to the observations section below

## Measurement 1

Low Thrust Tests	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

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Medium Thrust Tests	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

High Thrust Tests	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

### Observations

What did you observe about how your plane flew? Did it travel the same distance each time? Did it fly straight? What happened when you threw it harder or softer?

Which amount of thrust resulted in your plane travelling the farthest?

How might adding flaps to the tail change how the airplane flies? Make a prediction below and write it out.

### Hypothesis

IF flaps are added to the tail of the airplane,

THEN \_\_\_\_\_

BECAUSE \_\_\_\_\_

### TAIL FLAPS:

- 1 Change how the plane flies by adding flaps to the tail end of the plane.
- 2 Use a scissors to cut 1-inch slits on the back of the plane along the fold where the wings meet the body of the paper airplane.
  - a. See the image in the resources section for a visual.
- 3 Fold each flap up. Make sure that both flaps are folded the same amount.
- 4 Test this modified plane from the launch point.
- 5 Measure each flight for distance from the launch point to where the plane first hits the ground. Record your measurements. Do three tests for each of the three amounts of thrust.

### Measurement 2

Low Thrust Tests, Flaps	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

Medium Thrust Tests, Flaps	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

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High Thrust Tests, Flaps	Flight Launch (Number):	1	2	3
	Distance Travelled (Feet):			

### Observations

What did you notice about the plane design that travelled the farthest?

### What's Happening?

Changing the shape or design of your paper plane changes its **aerodynamics**, how easily an object can move through the air. There are four aerodynamic forces that determine how things fly - lift, weight, thrust, and drag.

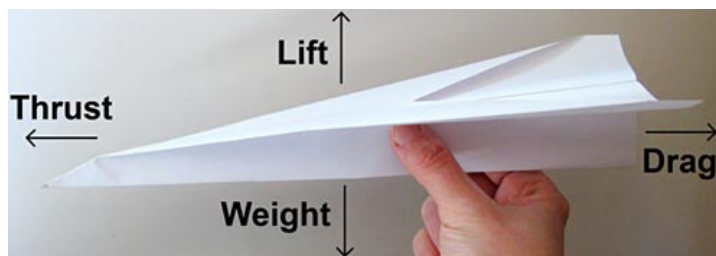
**Lift** allows things to fly upward, and usually comes from air moving over and under wings.

**Weight** is how much Earth's gravity pulls down on something.

**Thrust** is a push forward. It can come from an engine, wind, or moving wings. Thrust can change the amount of lift.

**Drag** is the push of air against something moving. The larger the thrust, the larger the drag.

For something to fly, the thrust must be stronger than the drag and the lift must be greater than the weight.



Your plane experienced different amounts of drag depending on how gently it was thrown, or how much thrust it had. The more thrust something has, the more drag it produces. You may have seen this in your experiment if you found your plane not traveling further even by throwing it harder. This means the speed of your plane will affect how far it flies.

Drag is also affected by shape. Your original plane had a small area for the air to push on, meaning the drag was small. Your modified plane had a larger area for the air to push on, so its drag is larger. Your modified plane may not have flown as far as your original plane. The shape of your plane will affect how far it flies.

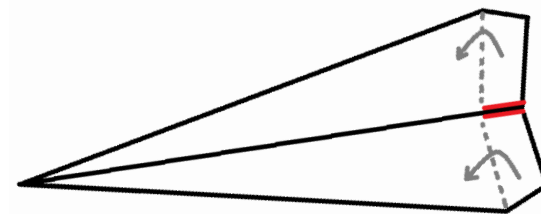
### Take it further:

Repeat this experiment, but try changing other aspects of the plane's design, such as:

- Add weight to the plane by adding paperclips to it
- Change the shape of the plane's wings
- Use larger, smaller, or heavier pieces of paper to change the size and weight of the plane

### Resources

Flap Modification - Tail Flaps: Step



# Paper Airplane Design Continued

