



# Flaps, Rudders, and Elevators Oh My!

Learn to Fly a Plane  
Presented by: OSU STEM Outreach  
Slides by Jenna Hardin



# What Flies?

Boeing 787 Dreamliner



Karman MAX



Superman



Hot Air Balloon



Delta IV Heavy



V-22 Osprey



Flying Squirrel



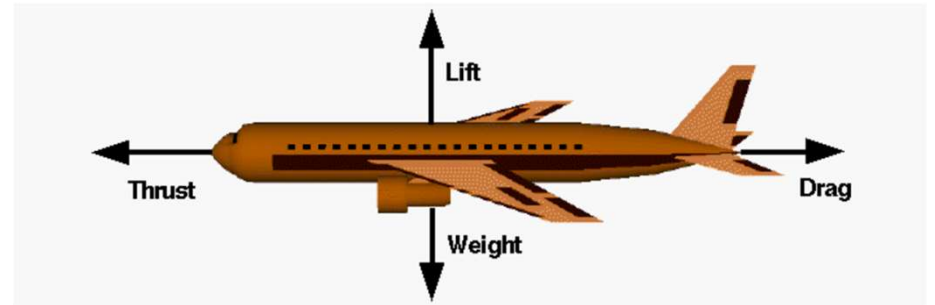
# How Does a Plane Fly?

- Why don't we fly?



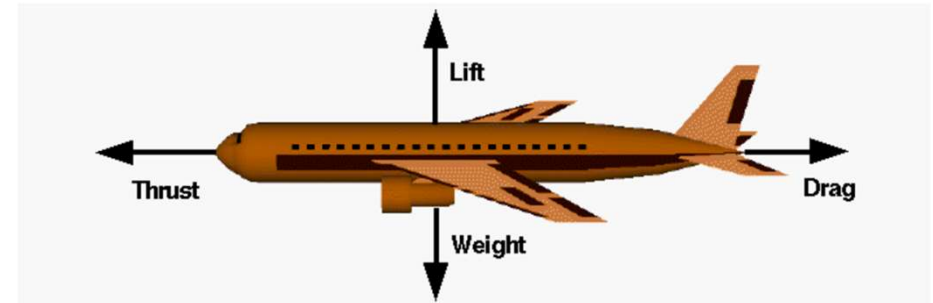
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# How Does a Plane Fly?

- Why don't we fly?
  - Gravity! The plane needs to fight against that force, and many others
- How Does it Move Forward?
  - Engines push the plane forward. This is called **thrust**.



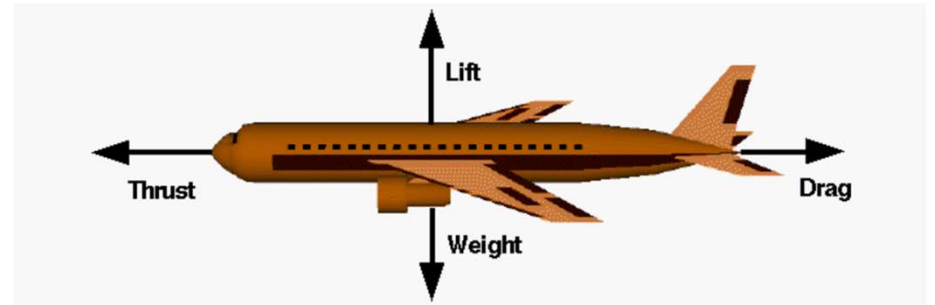
787-9 Rolls-Royce Trent 1000



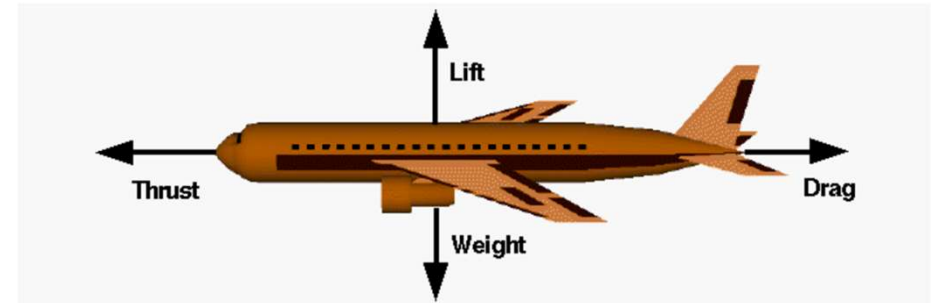
777-300ER General Electric GE-90-115B

# How Does a Plane Fly?

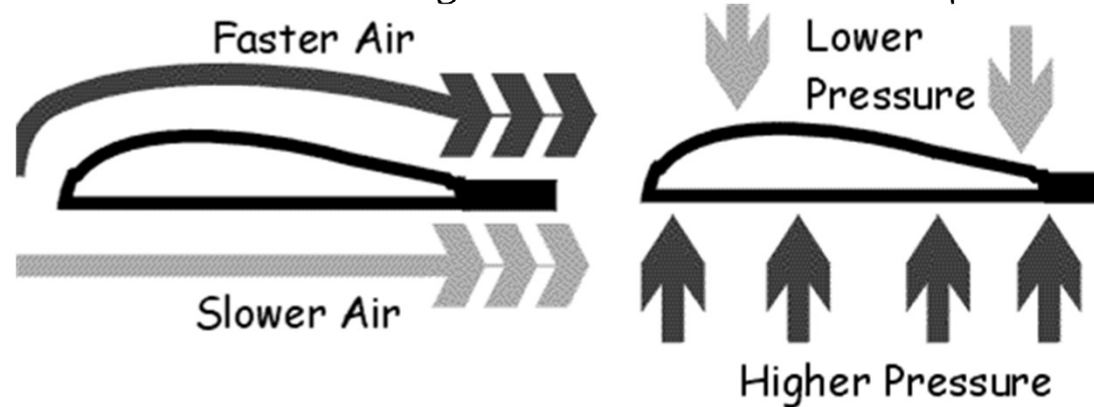
- Why don't we fly?
  - Gravity! The plane needs to fight against that force, and many others
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- How Does it Stay Up?



# How Does a Plane Fly?



- Why don't we fly?
  - Gravity! The plane needs to fight against that force, and many others
- How Does it Move Forward?
  - Engines push the plane forward. This is called **thrust**.
- How Does it Stay Up?
  - Pressure differences on the wings based off Bernoulli's Principle. This is called **lift**.



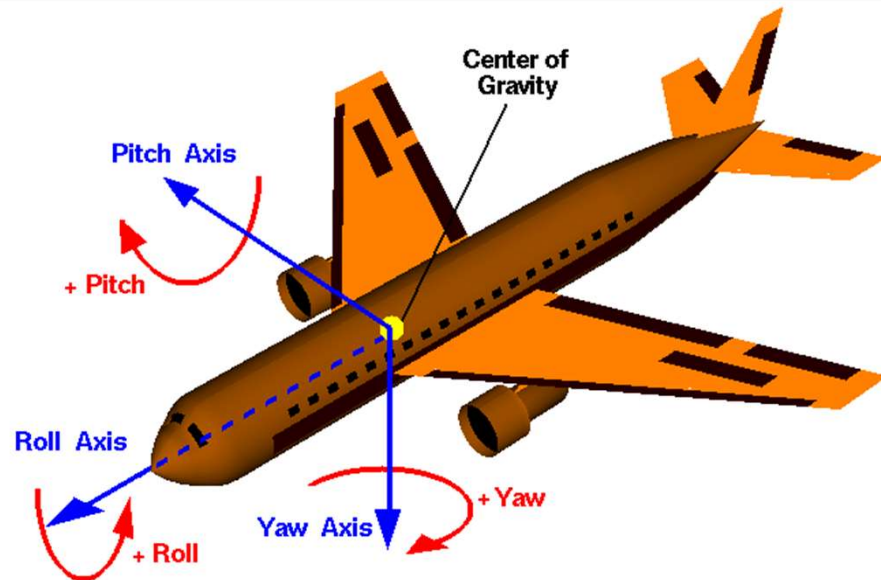
# Where Can an Airplane Move?

- Flaps on the plane control these types of movement



## Aircraft Rotations Body Axes

Glenn  
Research  
Center





# Changing Flight Paths

- We've talked about how the flaps can control a flight path. We can apply those flap positions to our paper plane

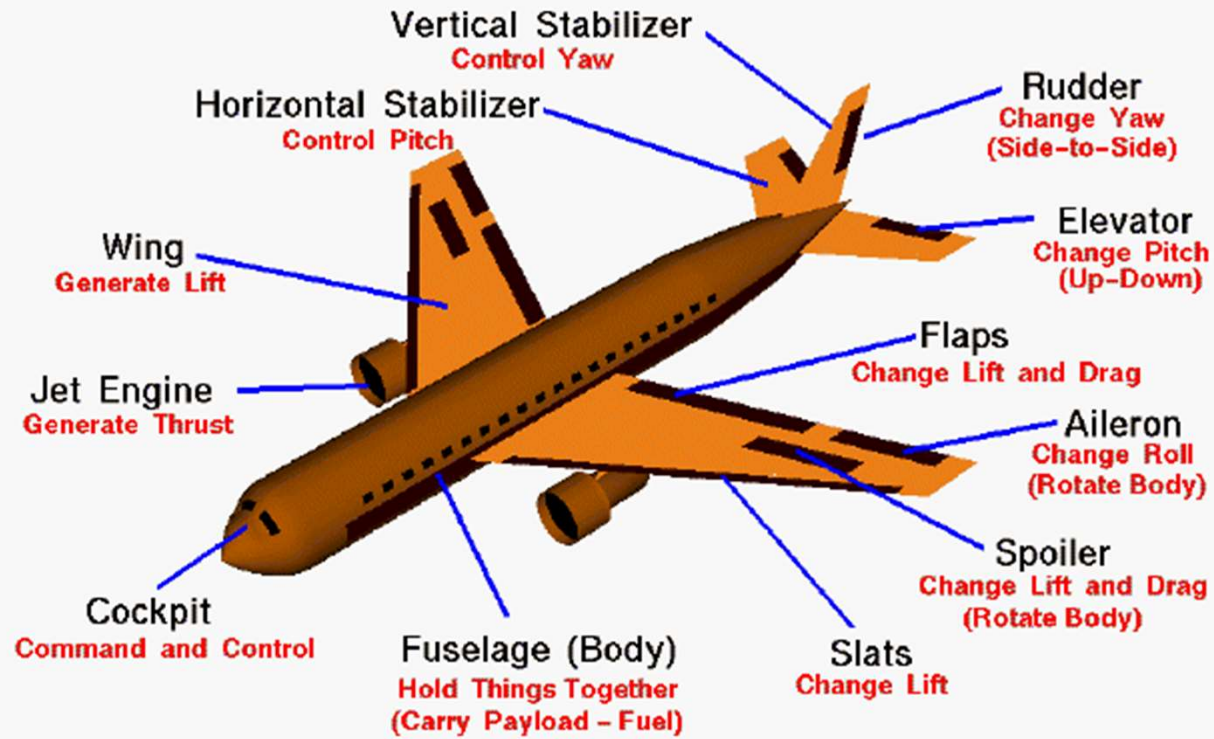
<b>Land (Increase Drag)</b>	R Flap up, L Flap up
<b>Take-Off (Decrease Drag)</b>	R Flap down, L Flap down
<b>Right Roll (Increase Roll)</b>	R Aileron up, L Aileron down
<b>Right Turn (Increase Yaw)</b>	Rudder left
<b>Tilt nose up (Increase Pitch)</b>	R Elevator Up, L Elevator Up

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## Airplane Parts Definitions

Glenn  
Research  
Center



# After You've Built Your Plane

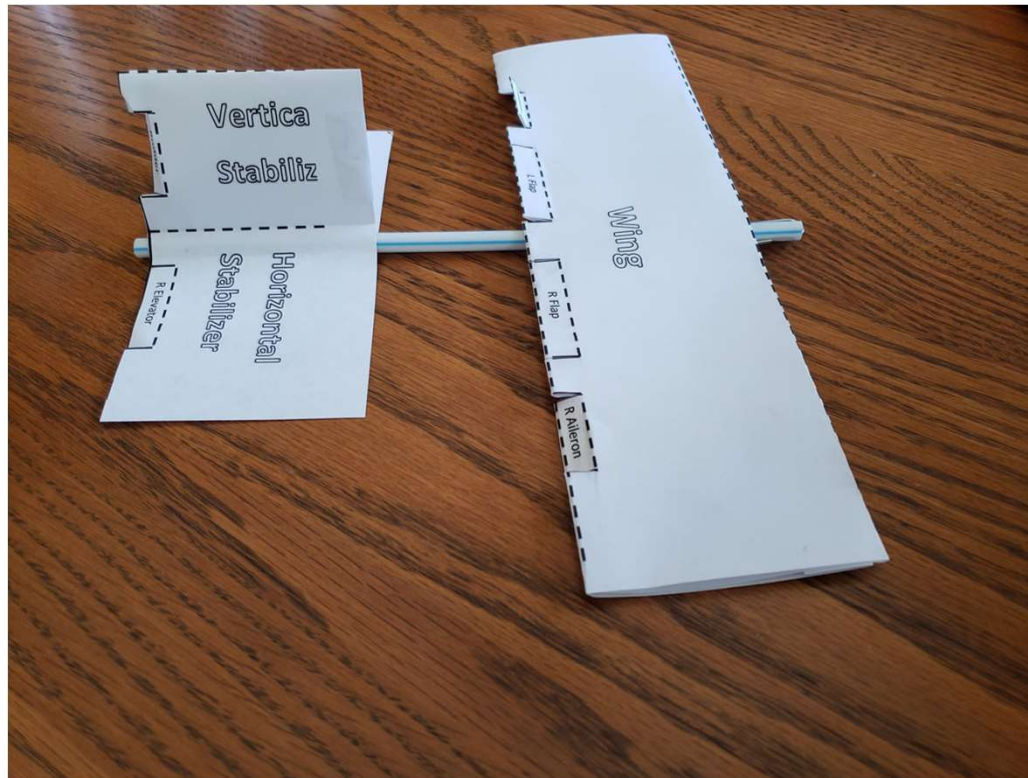
- Planes take off from a runway at airports
- Pilots must get clearance from an air traffic controller before take-off
- Where is our runway?
- Script for take-off:

**Pilot:** This is Captain [your name here] requesting clearance for take-off

**Air Traffic Controller:** You are cleared for Take-Off, Captain [name]



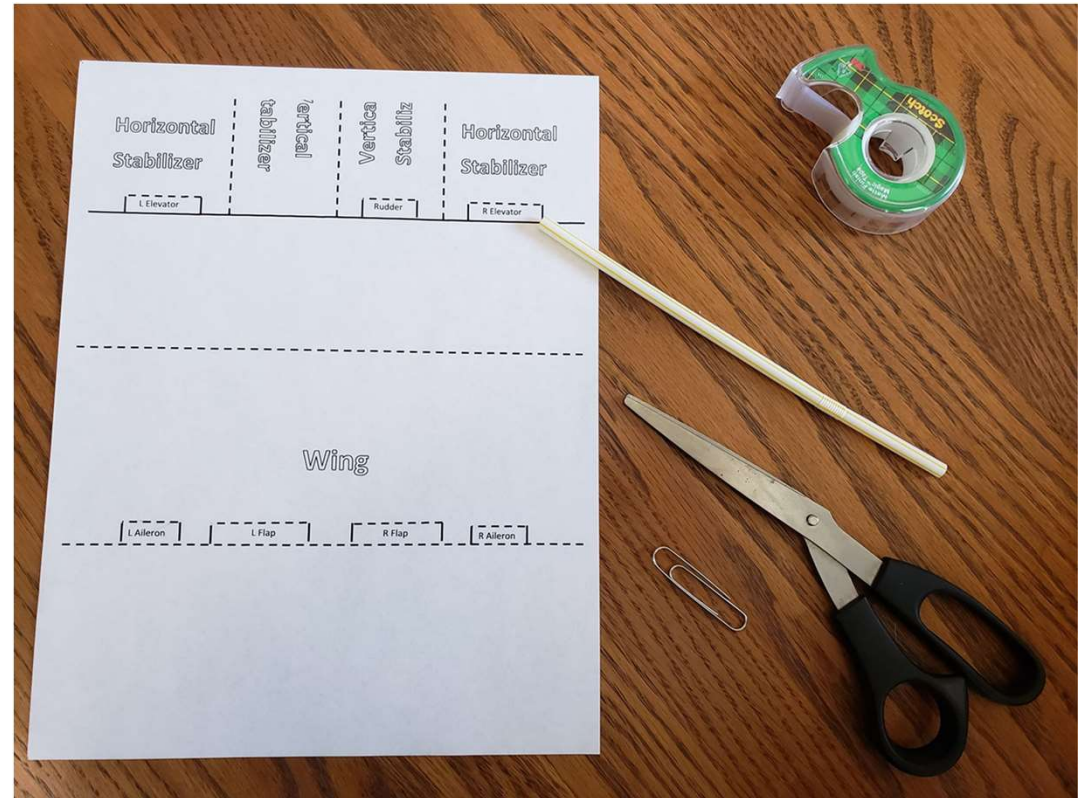
# Let's Build a Plane!



# Let's Build a Plane!

Materials You'll Need:

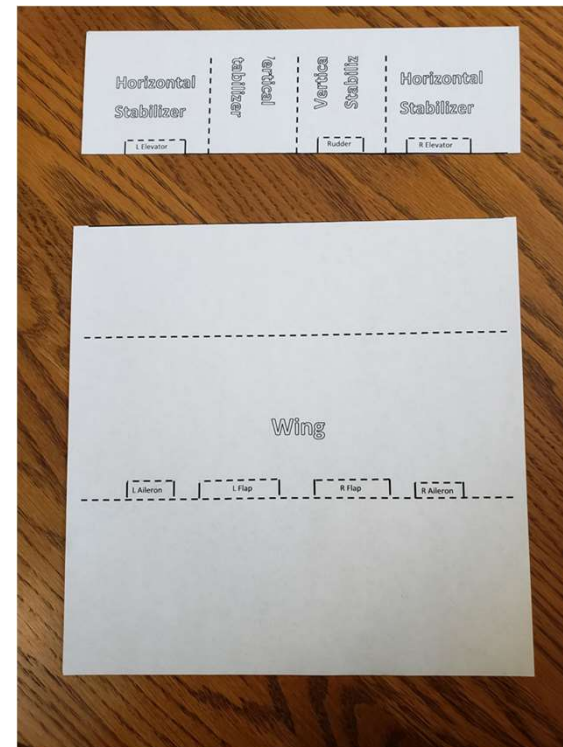
- Straw
- Paper
- Scissors
- Tape
- Paperclip





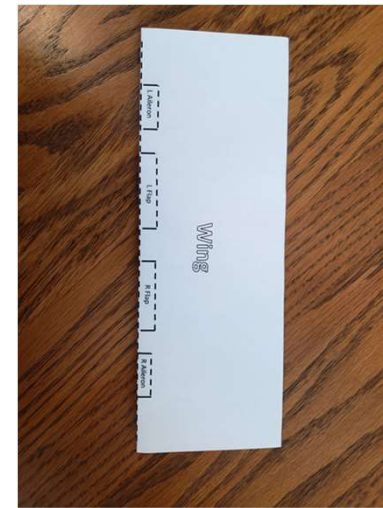
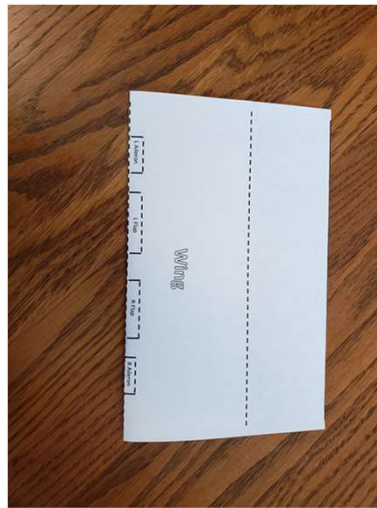
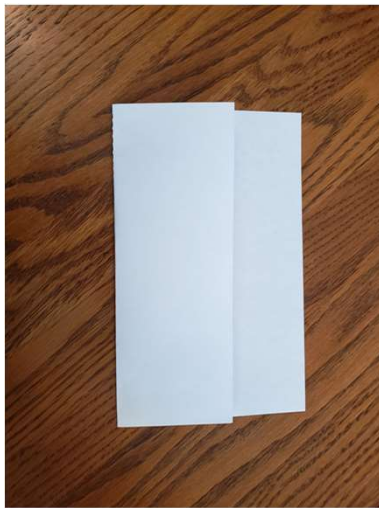
# Cutting the Paper

1. Cut along the **solid** lines to separate the front wing from the back wing



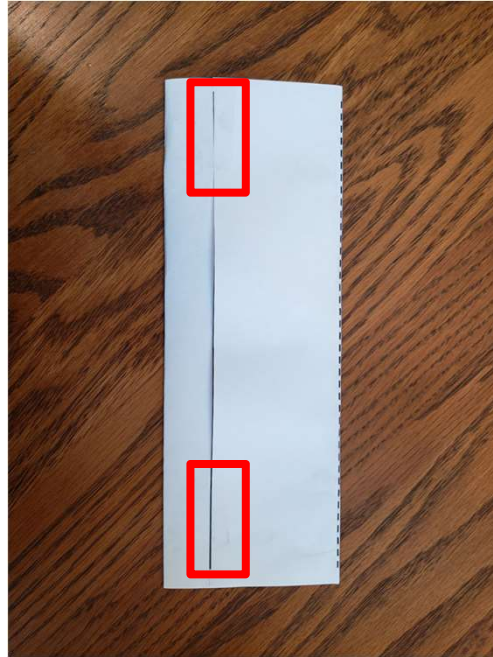
# Folding the Front Wing

2. Fold the front part wing on the **dashed** lines. Tuck the top and bottom white parts behind the wording



# Taping the Front Wing

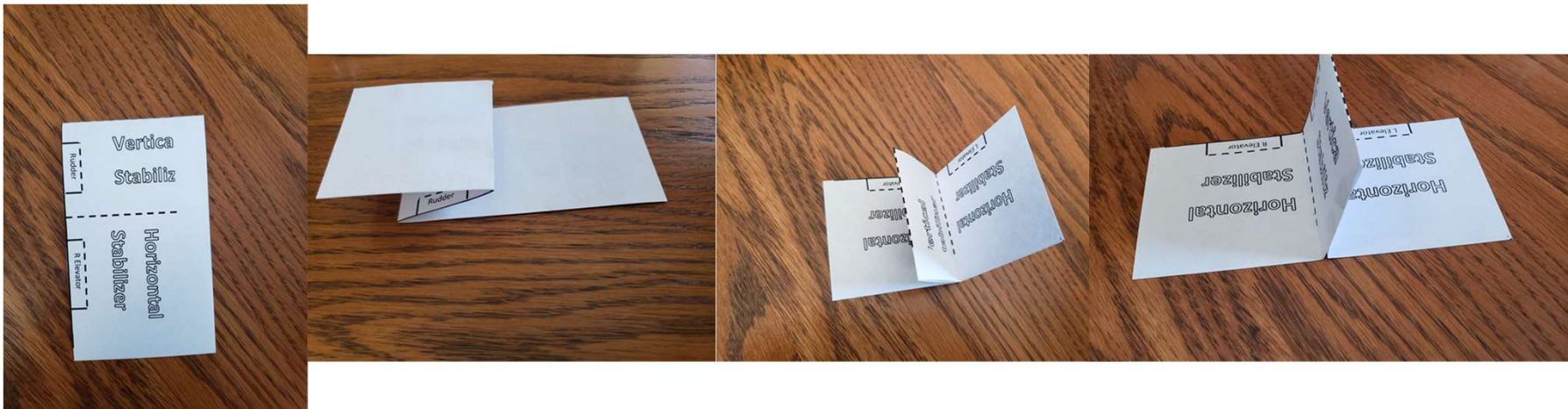
3. Place two pieces of tape towards both ends of the back side of the front wing





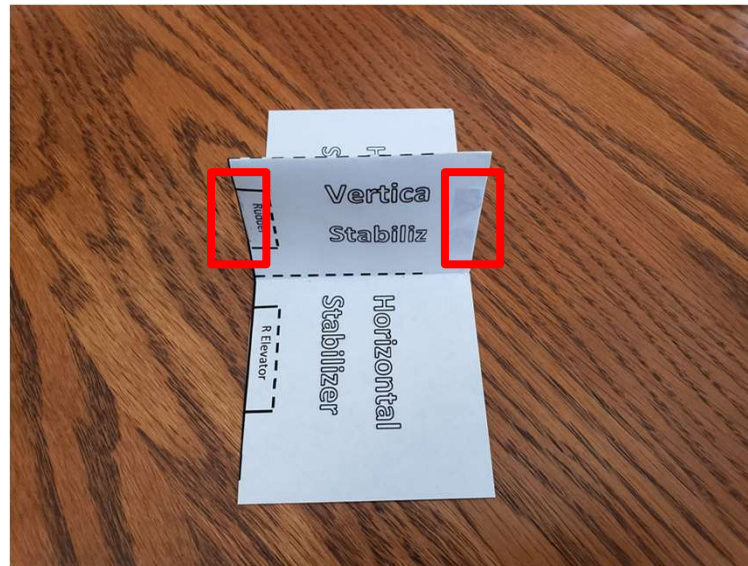
# Folding the Back Wing

4. Fold on the **dashed** lines of the back wing. First fold in half, Fold the Horizontal Stabilizer up, then repeat on the other side.

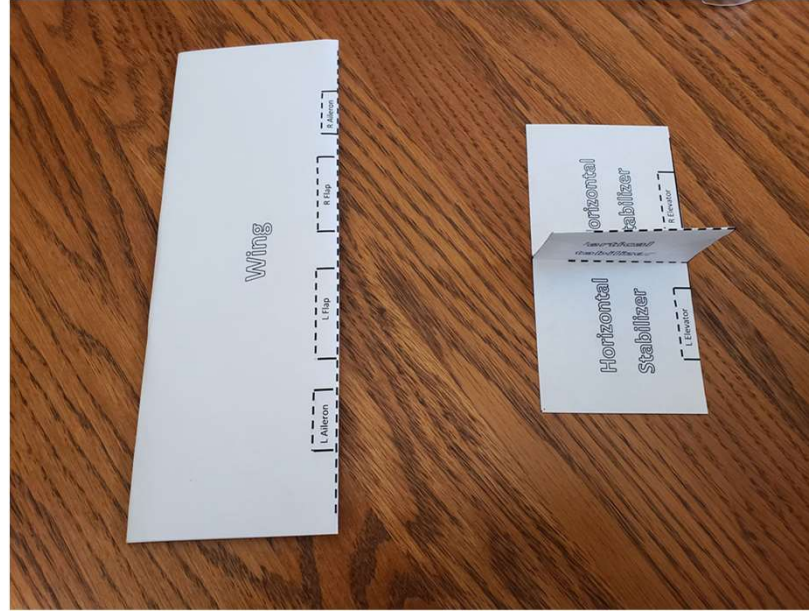


# Taping the Back Wing

5. Put two pieces of tape on the vertical stabilizer. Fold them around the back to keep its shape



# These are your wings!

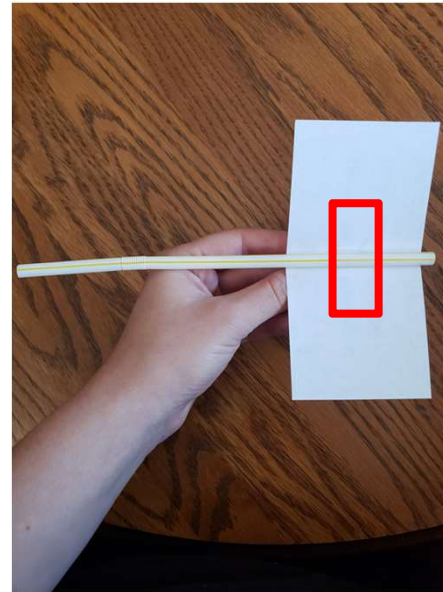


# Adding the Fuselage

6. The straw will act as our fuselage (the part where humans sit). Tape the back wing at the very end of the straw.

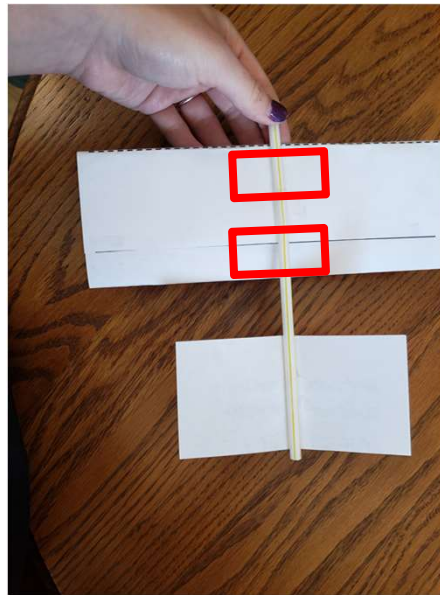


**Aircraft Fuselage**



# Adding the Fuselage

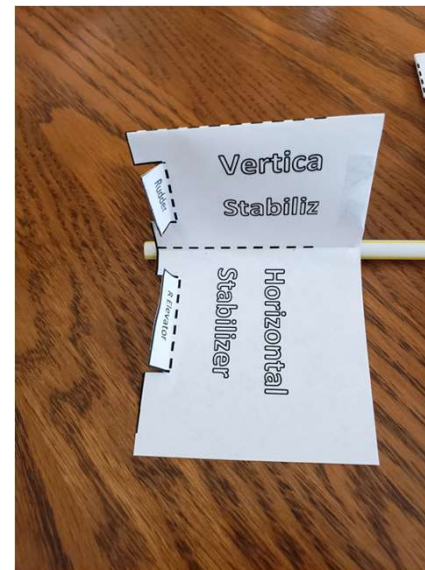
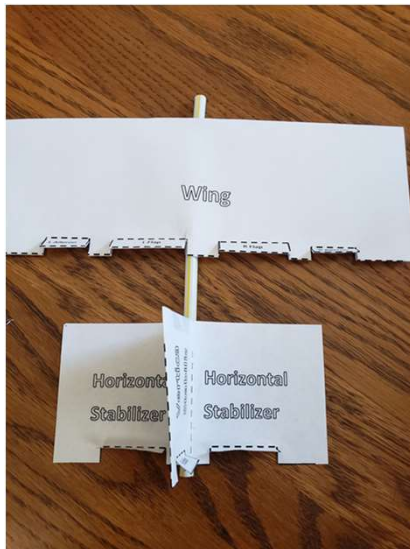
7. Tape the front wing to the staw (fuselage)  $\frac{2}{3}$  the way down the straw





# Cutting the Flaps

9. Cut the **solid** lines, and fold on the **dashed** lines for the flaps, ailerons, elevators, and the rudder

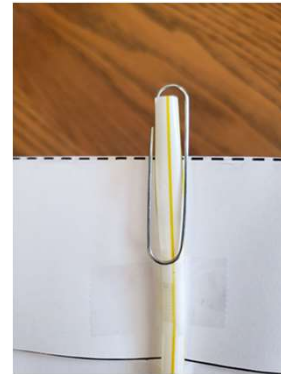


Flatten them back down after folding, or it will make you plane fly wonky!

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# Adding the Flight Deck

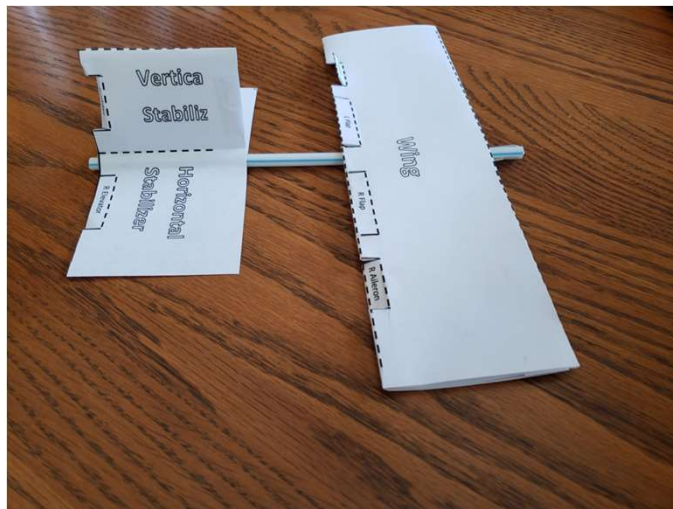
8. The flight deck is where the pilots sit and control the plane. The paperclip will act as our flight deck. Slide the paperclip (flight deck) into the straw (fuselage).



Our purpose for the paperclip is to weigh down the front of our paper plane. Try removing it on one of your take-offs!

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# You're Done!



Now it's time to fly your plane

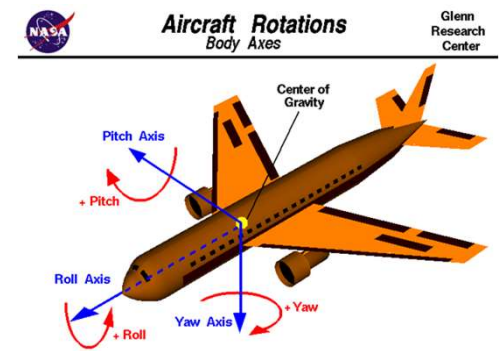




# Flying Your Plane

1. Set your flaps, ailerons, elevators, and rudders to how you want

Land (Increase Drag)	R Flap up, L Flap up
Take-Off (Decrease Drag)	R Flap down, L Flap down
Right Roll (Increase Roll)	R Aileron up, L Aileron down
Right Turn (Increase Yaw)	Rudder left
Tilt nose up (Increase Pitch)	R Elevator Up, L Elevator Up



1. Find the Air Traffic Controller

**Pilot:** This is Captain [your name here] requesting clearance for take-off

**Air Traffic Controller:** You are cleared for Take-Off, Captain [name]

3. Throw your plane! Didn't go where you wanted? Adjust flaps, remove paperclip, or throw from a different angle

# Other Modifications that Affect Flight

## 1. Weight Distribution

- Where is the heaviest part of the plane? Should passengers/luggage be moved?

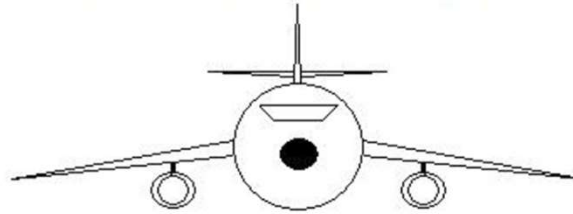
## 2. Dihedral Angles

- What is the angle between the front wings

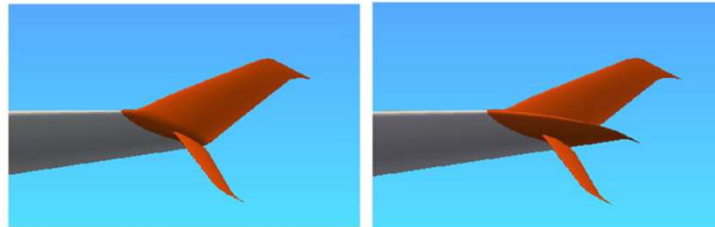
Front view of jet airliner with dihedral wings



Front view of jet airliner with anhedral wings



## 3. Winglets (use less fuel)



# Resources

<https://www.grc.nasa.gov/WWW/K-12/airplane/shape.html>

[http://www.kidsgen.com/school\\_projects/model\\_planes.htm](http://www.kidsgen.com/school_projects/model_planes.htm)

