

Carmel Creek Young Scientists Club

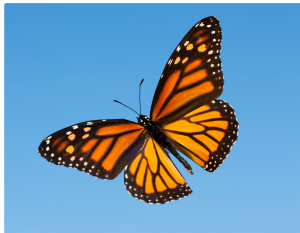
Forces and Flight



April 16, 2021

How to Fly

How do airplanes (birds, butterflies, kites, ...) fly? Why don't they fall to the ground?



Air Resistance

forces?

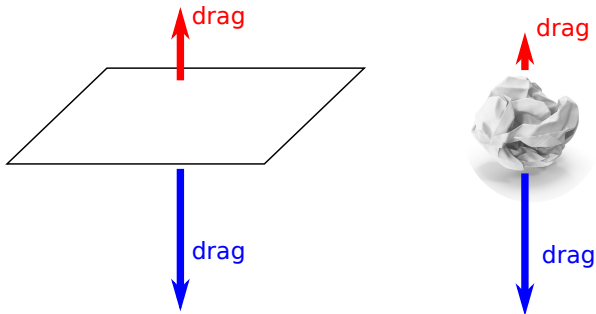


What force is the same on both of these?
What force bigger on one than the other?

Air Resistance

Drag Force

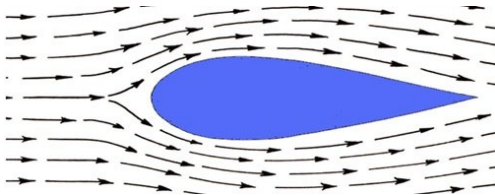
Any object moving through air feels a force (push) opposite to its direction of motion.



What shape could you make to fall fastest?

Stream-lined Shapes

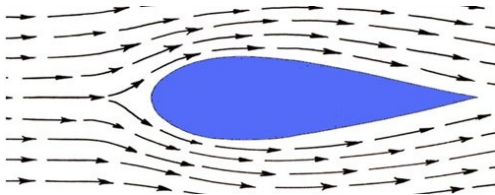
A **streamlined** shape is narrow in front and back, and wide in the middle. These shapes tend to minimize the drag force from air or water



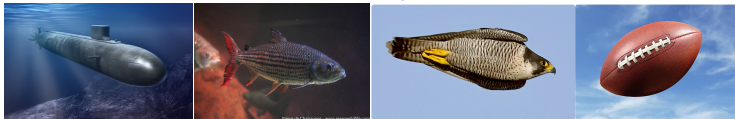
What natural or man-made objects can you think of that use this shape?

Stream-lined Shapes

A **streamlined** shape is narrow in front and back, and wide in the middle. These shapes tend to minimize the drag force from air or water

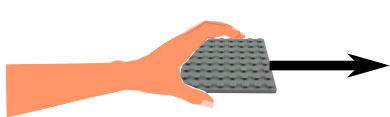


What natural or man-made objects can you think of that use this shape?

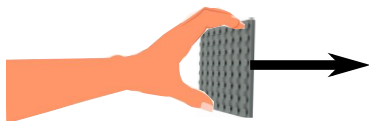


Drag and Orientation

- Objects moving through water also feel drag.
- Drag depends on how the object is turned relative to its direction of motion



narrow side forward



flat side forward

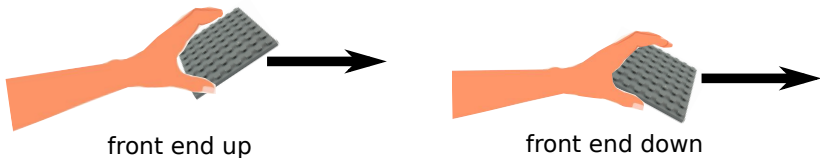
Poll question!

Which plate feels more drag?

- a) Moving narrow end forward
- b) Moving flat side forward
- c) Both feel the same drag

Lift Force

- If an object is turned just right, the push from moving fluid can be redirected upward.
- **Lift:** An upward force by moving air or water



Poll question!

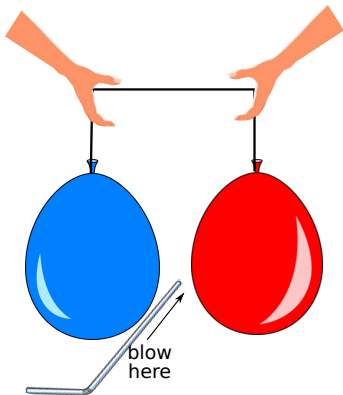
How to make plate feel an upward force while moving forward?

- (a) Tilt front end down
- (b) Tilt front end up
- (c) There is always an upward force
- (d) The force is always backward, never upward

Moving Air and Pressure

Let's experience another effect from moving air...

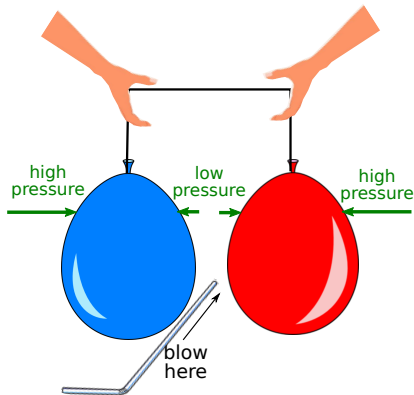
What happens to the balloons when you blow between them?



Moving Air and Pressure

Let's experience another effect from moving air...

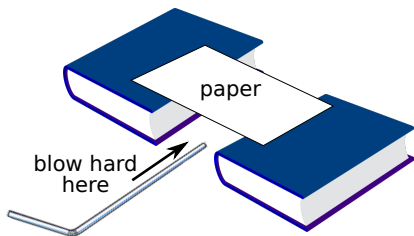
What happens to the balloons when you blow between them?



Bernoulli Principle

Fast moving fluid creates a zone of **low pressure**. Higher pressure on the outside makes objects move towards that zone.

More Bernouli



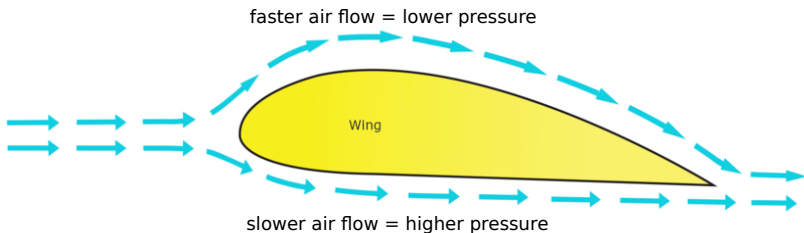
Poll question!

Make a prediction: what will happen when you blow underneath the paper?

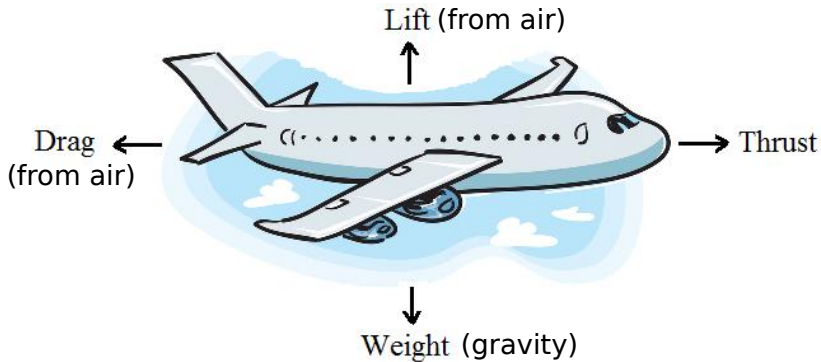
- (a) It will bend down towards the table
- (b) It will arch up higher
- (c) It will fly off the books
- (d) Nothing will happen.

Bernoulli and Airplanes

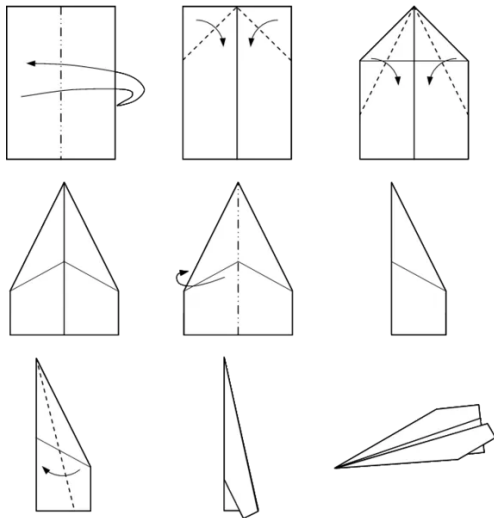
- Airplane wings are curved on top to make air flow over the top faster.
- Bernoulli's principle: less pressure on top, plane gets pushed up



Summary: Forces on Airplanes

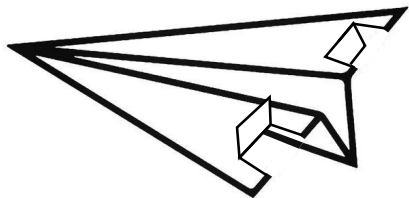
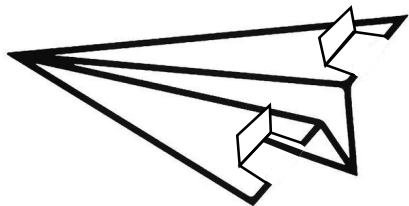


Make a Paper Airplane!



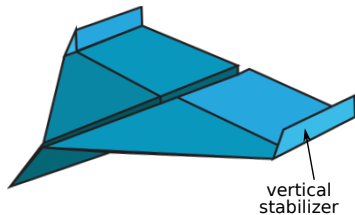
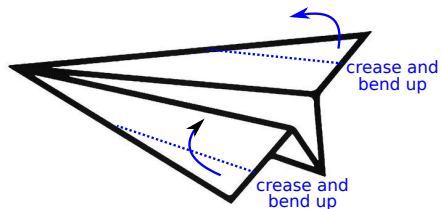
Try some Flaps

- What effect do you expect with both flaps bent up?
- What if you bend one up, one down?



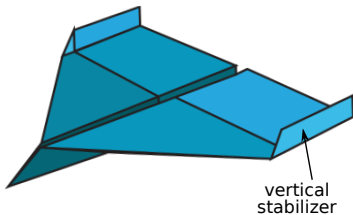
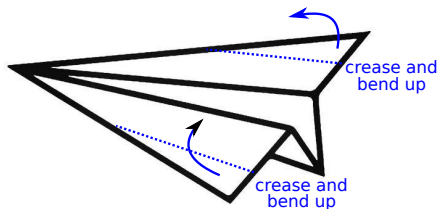
Vertical Stabilizers

- Try adding vertical stabilizers (crease parallel to the center line)

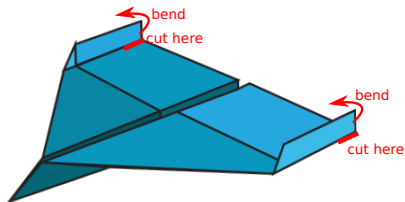


Vertical Stabilizers

- Try adding vertical stabilizers (crease parallel to the center line)



- Add vertical flaps



What effect do they have?

Airplane Control Surfaces

Which of these control surfaces did you try out on your paper airplane?

