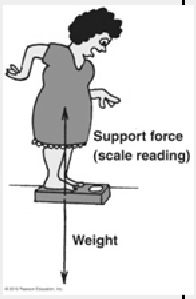
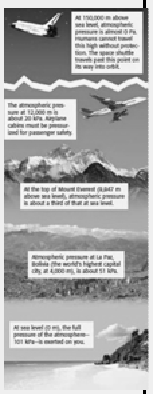
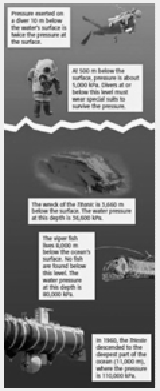
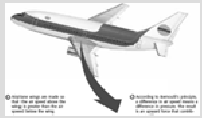
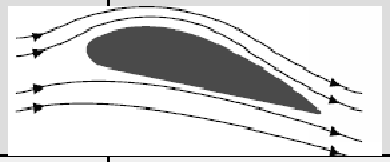
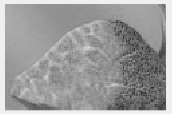
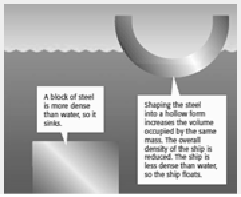
Chapter 7: Forces in Fluids

7th Physical Science

Announcement

- Take notes on the back of the paper.
- Make a poster on the front of the paper.
- Poster is classwork: color is extra

Chapter 7 Poster

My Pressure on the floor Calculate 	Atmospheric Pressure Picture of outfit  Add if you climb a tree→ Labeled →	Water Pressure Picture of outfit  Label→	Fluid Flow In life Example #1 Explain → 
Bernoulli's Principle: State it. Draw an example.  	Explain	Fluid Flow In life Example #2 Explain Hint: pipette, straw, breathing…	Fluid Flow In life Example #3 Explain
Archimedes' principle What is it?	When something floats With Numbers → 	When something sinks With Numbers → 	Density and floating: Explain boat, submarine, or fish Explain → 

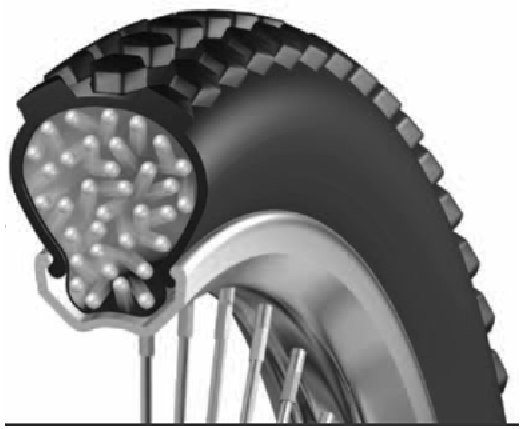
7.1 Fluids and Pressure

- Fluid = anything that changes shape by container
  - Air
  - Water
  - Made of tiny particles, always moving

- Pressure = how hard a thing presses against surface.

$$pressure = \frac{force}{area}$$

  - SI Unit of pressure: Pascal = N/m^2



7.1 Fluids and Pressure

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MATH FOCUS

Pressure, Force, and Area What is the pressure exerted by a book that has an area of 0.2 m^2 and a weight of 10 N?

Step 1: Write the equation for pressure.

$$pressure = \frac{force}{area}$$

Step 2: Replace *force* and *area* with the values given, and solve. (Hint: Weight is a measure of gravitational force.)

$$pressure = \frac{10\ N}{0.2\ m^2} = 50\ N/m^2 = 50\ Pa$$

The equation for pressure can be rearranged to find force or area, as shown below.

$force = pressure \times area$ *(Rearrange by multiplying by area.)*

$$area = \frac{force}{pressure}$$ *(Rearrange by multiplying by area and then dividing by pressure.)*

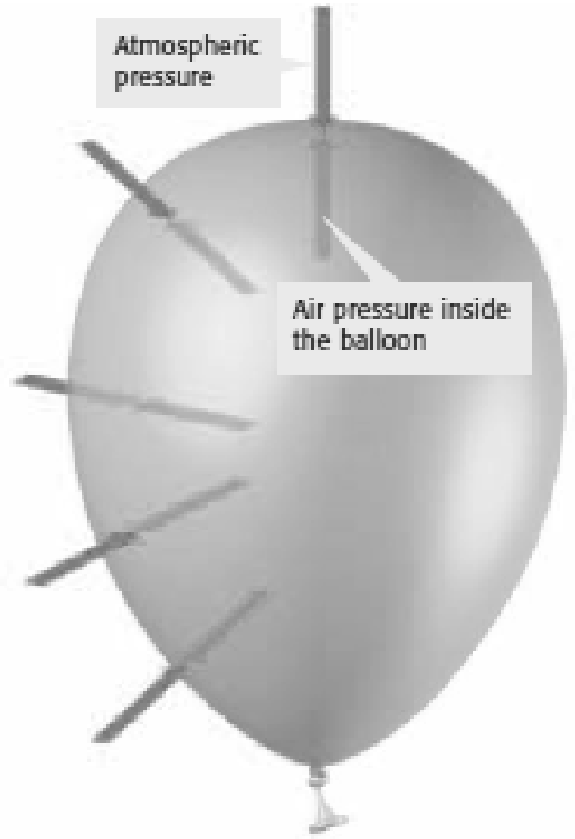
Now It's Your Turn

1. Find the pressure exerted by a 3,000 N crate that has an area of 2 m^2.
2. Find the weight of a rock that has an area of 10 m^2 and that exerts a pressure of 250 Pa.

7.1 Fluids and Pressure

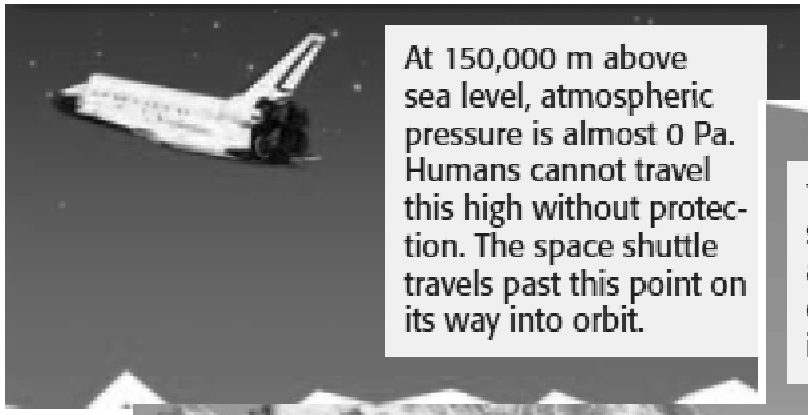
- Atmospheric pressure – pressure caused by weight of the atmosphere
  - 101,300 N ~ 101 kPa at sea level

- Why don't you implode?
  - The fluids in your body exert pressure.



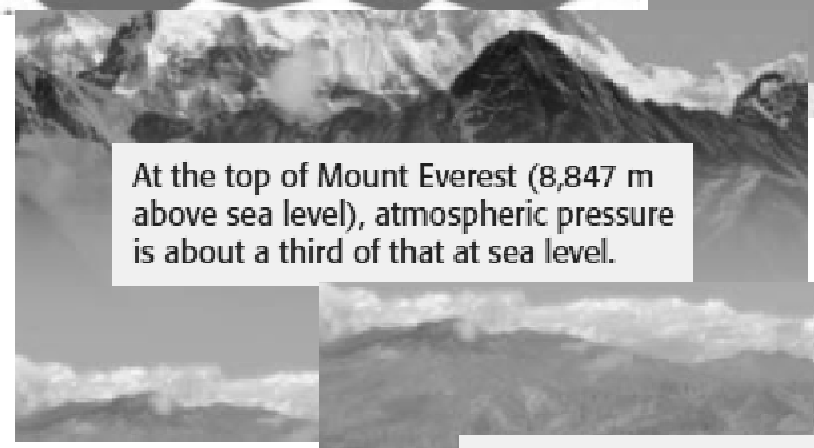
7.1 Atmospheric Pressure

Explode or implode?

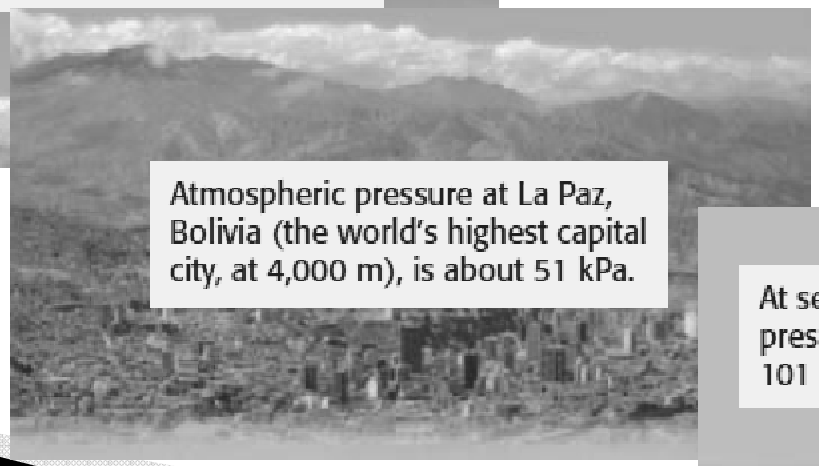


At 150,000 m above sea level, atmospheric pressure is almost 0 Pa. Humans cannot travel this high without protection. The space shuttle travels past this point on its way into orbit.

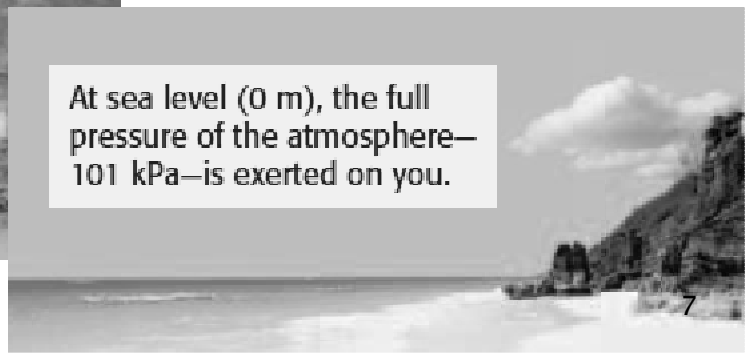
The atmospheric pressure at 12,000 m is about 20 kPa. Airplane cabins must be pressurized for passenger safety.



At the top of Mount Everest (8,847 m above sea level), atmospheric pressure is about a third of that at sea level.



Atmospheric pressure at La Paz, Bolivia (the world's highest capital city, at 4,000 m), is about 51 kPa.



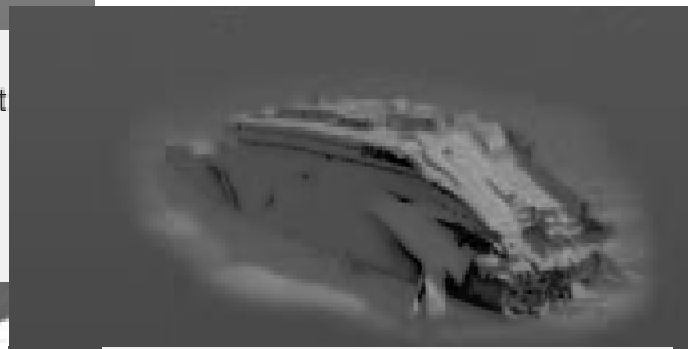
At sea level (0 m), the full pressure of the atmosphere—101 kPa—is exerted on you.

7.1 Water Pressure

Explode or implode?

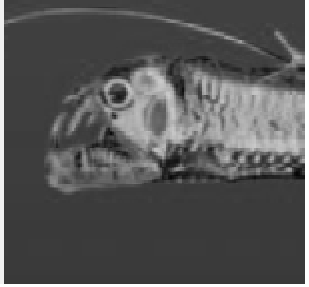
Pressure exerted on a diver 10 m below the water's surface is twice the pressure at the surface.

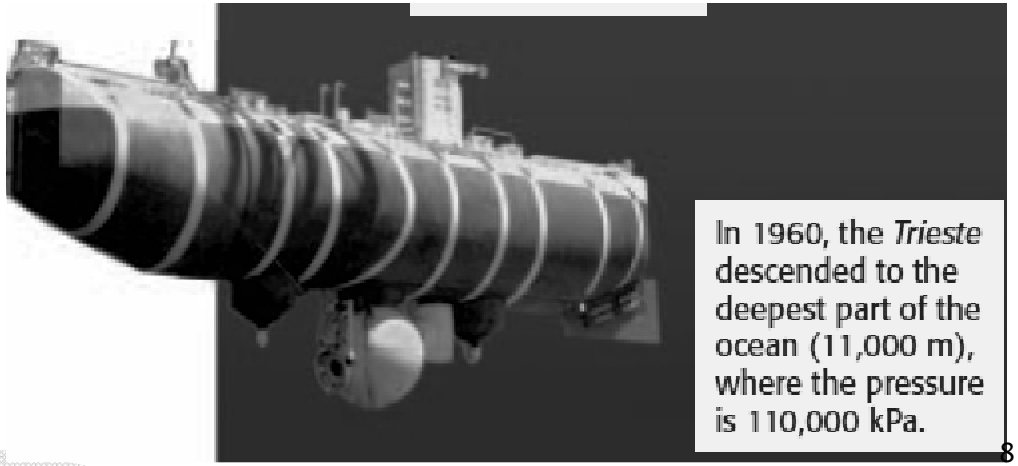
At 500 m below the surface, pressure is about 5,000 kPa. Divers at or below this level must wear special suits to survive the pressure.



The wreck of the *Titanic* is 3,660 m below the surface. The water pressure at this depth is 36,600 kPa.

The viper fish lives 8,000 m below the ocean's surface. No fish are found below this level. The water pressure at this depth is 80,000 kPa.

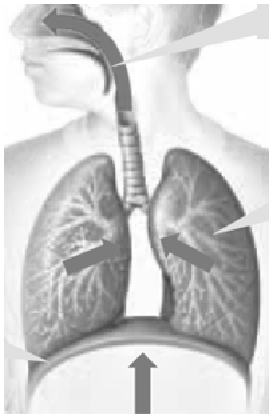




In 1960, the *Trieste* descended to the deepest part of the ocean (11,000 m), where the pressure is 110,000 kPa.

7.1 Fluids and Pressure

- Pressure Difference: Fluids flow from high/low to high/low pressure
- Everyday examples:
  - How does a dropper work?
  - How does a straw work?
  - How do your lungs inhale air?
  - Why are tornadoes like vacuum cleaners?

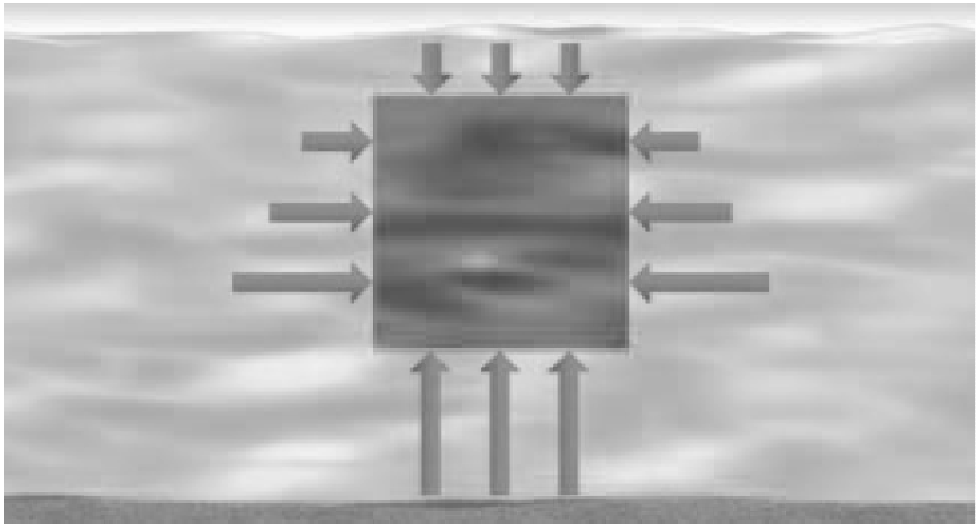


7.1 Fluids and Pressure

- Question: Why does pressure increase with depth?

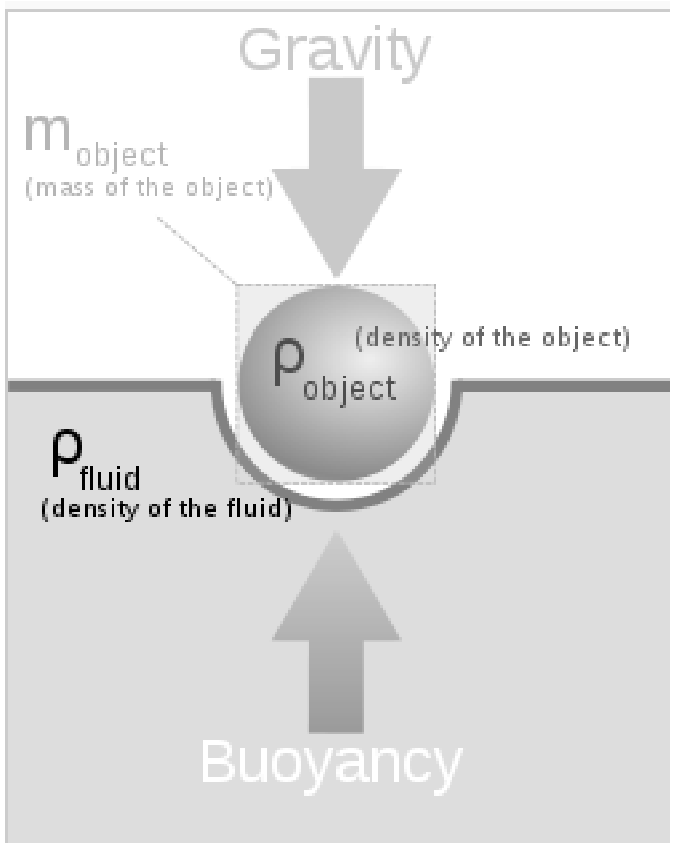
7.2 Buoyant Force

- There is more pressure below than above



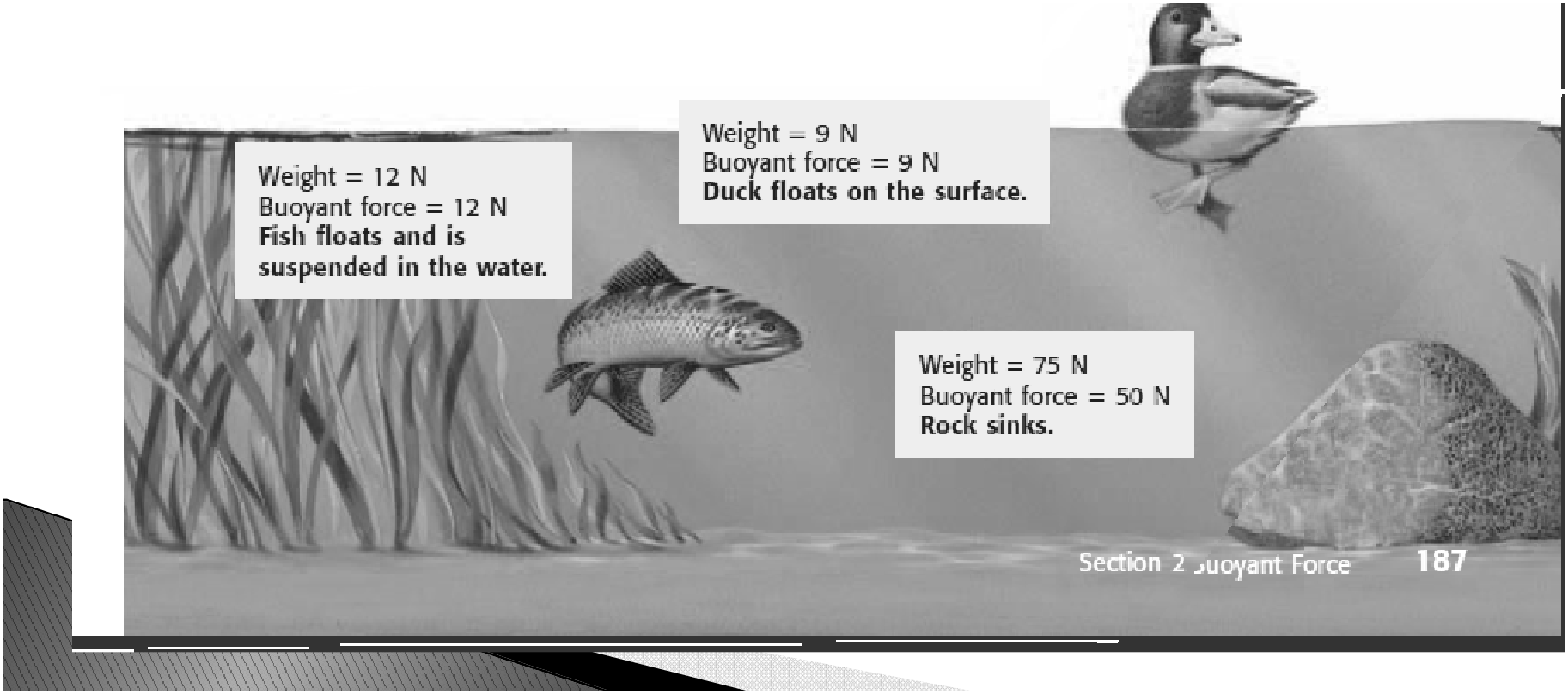
7.2 Buoyant Force

- Buoyant force = upward force that fluids exert on all matter.



7.2 Buoyant Force

- Archimedes' Principle:
  The buoyant force = weight of displaced fluid
- The weight of the object does not matter!



7.2 Buoyant Force

- Math
  - You need a force of 15 N
    to lift an object that is underwater.
    The object displaces 2 L of water
    1 L weighs 10N.
    What is the weight of the object?

7.2 Buoyant Force

- Floating, sinking, and density.
  - When the object is more/less dense than the fluid, the object will sink/float.

- Density =

$$\frac{\text{mass}}{\text{volume}}$$

7.2 Buoyant Force

- Pg. 188

MATH FOCUS

Finding Density Find the density of a rock that has a mass of 10 g and a volume of 2 cm^3.

Step 1: Write the equation for density. Density is calculated by using this equation:

$$density = \frac{mass}{volume}$$

Step 2: Replace *mass* and *volume* with the values in the problem, and solve.

$$density = \frac{10\ g}{2\ cm^3} = 5\ g/cm^3$$

Now It's Your Turn

1. What is the density of a 20 cm^3 object that has a mass of 25 g?
2. A 546 g fish displaces 420 mL of water. What is the density of the fish? (Note: 1 mL = 1 cm^3)
3. A beaker holds 50 mL of a slimy green liquid. The mass of the liquid is 163 g. What is the density of the liquid?

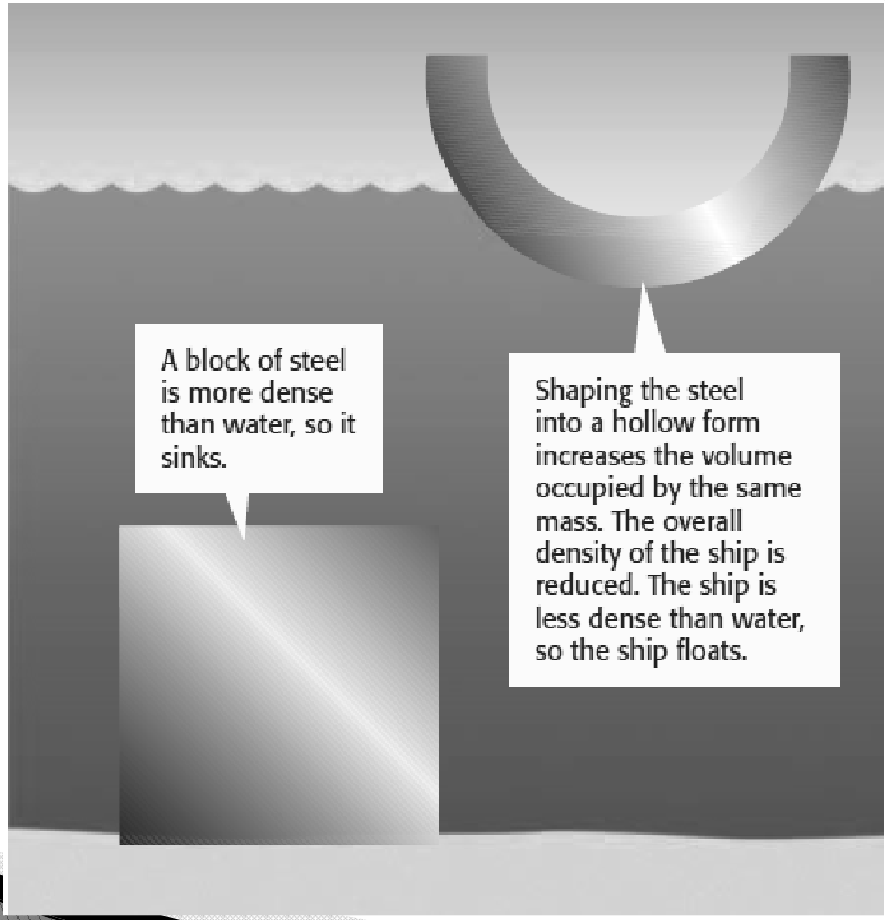
7.2 Buoyant Force

- Bonus
- 1. The density of the liquid mercury is 13.5 g/mL. What is the mass of a 12.4 mL sample of mercury?

- 2. The density of aluminum is 2.7 g/cm^3. What is the volume of a 9.45 g sample of aluminum?

7.2 Buoyant Force

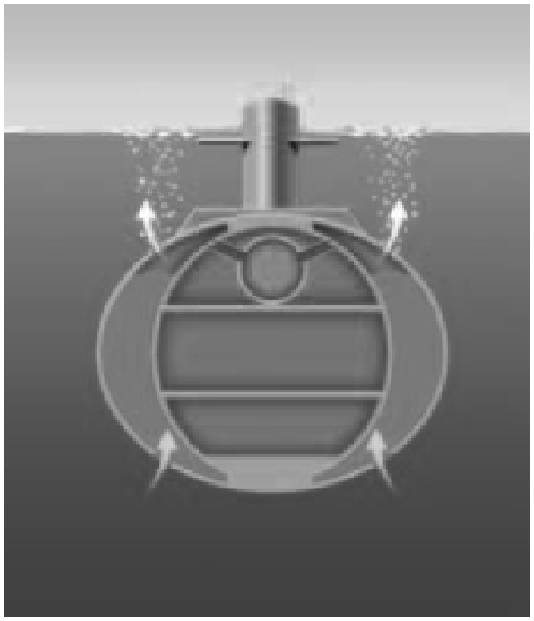
- Changing overall density.
  - Make the density less by filling up more space with air.



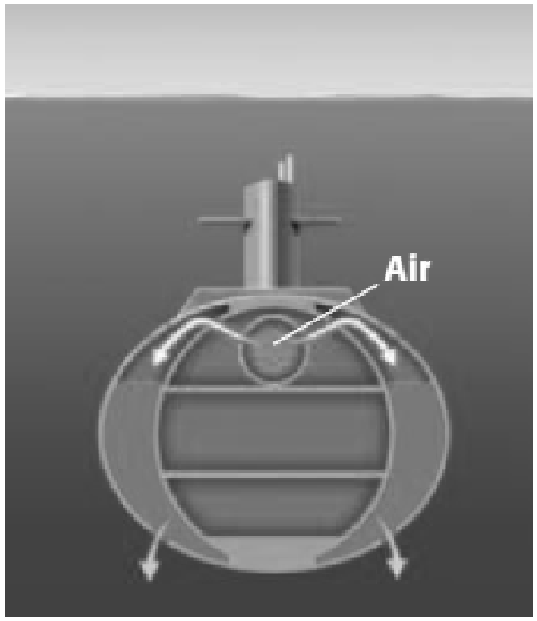
7.2 Buoyant Force

- Changing density by changing mass.

When a submarine is floating on the ocean's surface, its ballast tanks are filled mostly with air.



Vent holes on the ballast tanks are opened to allow the submarine to dive. Air escapes as the tanks fill with water.



Vent holes are closed, and compressed air is pumped into the ballast tanks to force the water out, so the submarine rises.

7.2 Buoyant Force

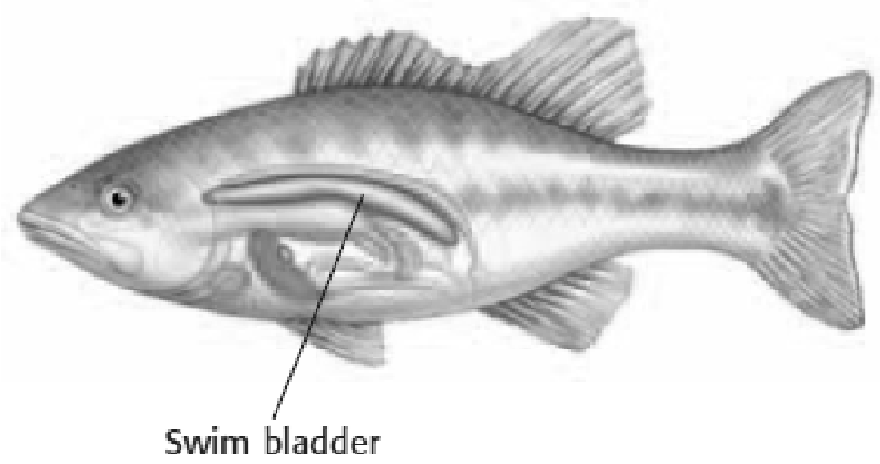


Figure 6 *Most bony fishes have an organ called a* swim bladder *that allows them to adjust their overall density.*

7.2 Buoyant Force

- Review:
  1. How can you determine the buoyant force acting on an object?

  2. Who discovered how to determine buoyant force?

7.3 Fluids and Motion

- http://www.youtube.com/watch?v=WDGNcmEOjs4
- http://www.youtube.com/watch?v=yvz_pS3pZ8s&feature=related
- http://www.youtube.com/watch?v=fgHvC55AKig&feature=related

7.3 Fluids and Motion

- What happened?

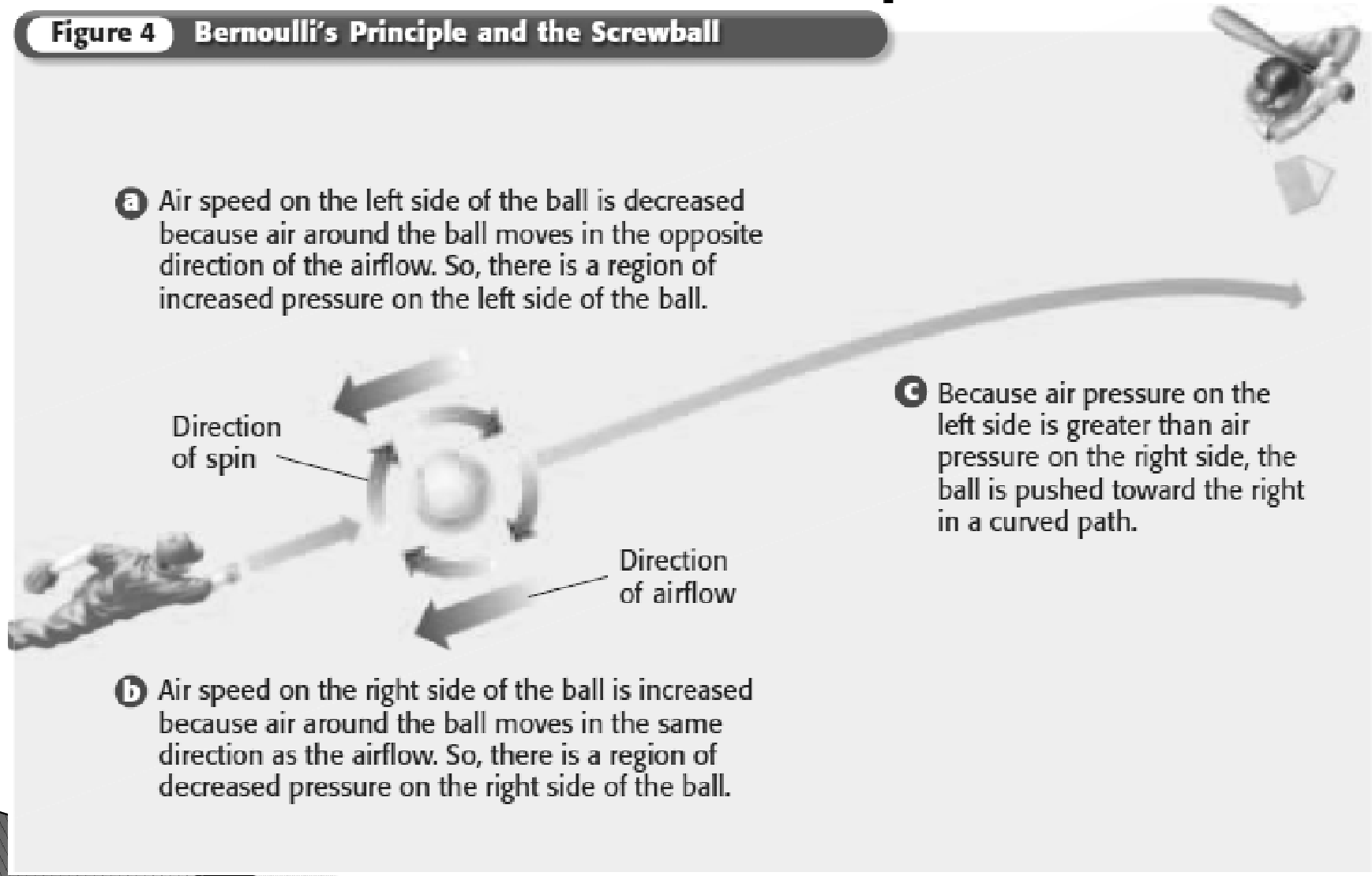
- Bernoulli's Principle: The faster the fluid moves, the less pressure there is.
  - Think of a running crowd.

7.3 Bernoulli's Principle

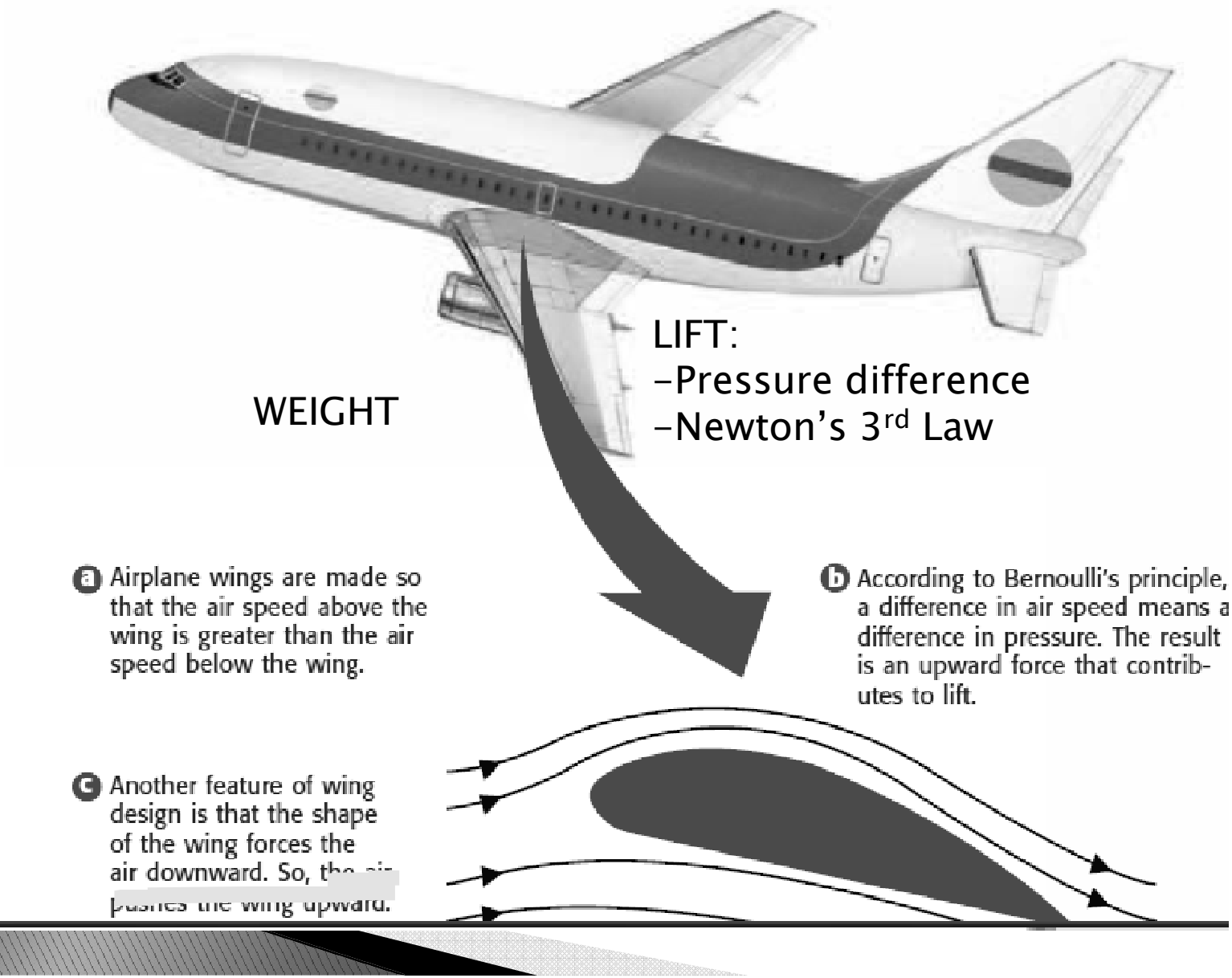
- Explain this

7.3 Bernoulli's Principle

Figure 4 **Bernoulli's Principle and the Screwball**



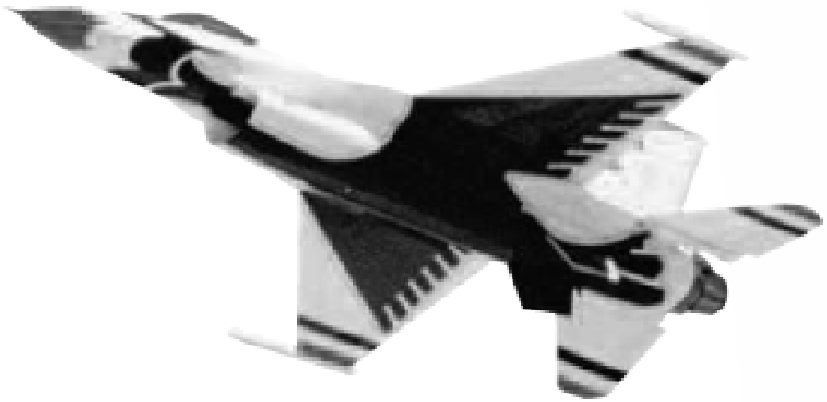
7.3 Bernoulli in Flight



7.3 Bernoulli's Principle

- Do you think a fast or slow plane needs bigger wings? Why?

Figure 3 **Increased Thrust Versus Increased Wing Size**



The engine of this jet creates a large amount of thrust, so the wings don't have to be very big.

This glider has no engine and therefore no thrust. So, its wings must be large in order to maximize the amount of lift achieved.

7.3 Bernoulli's Principle

- Do you think a fast or slow plane needs bigger wings? Why?

  The plane with more thrust (more force to go faster) has less pressure above wings, so it has more lift.

  The slower plane has less pressure above wings, so it needs bigger wings for more lift.

7.3 Bernoulli's Principle

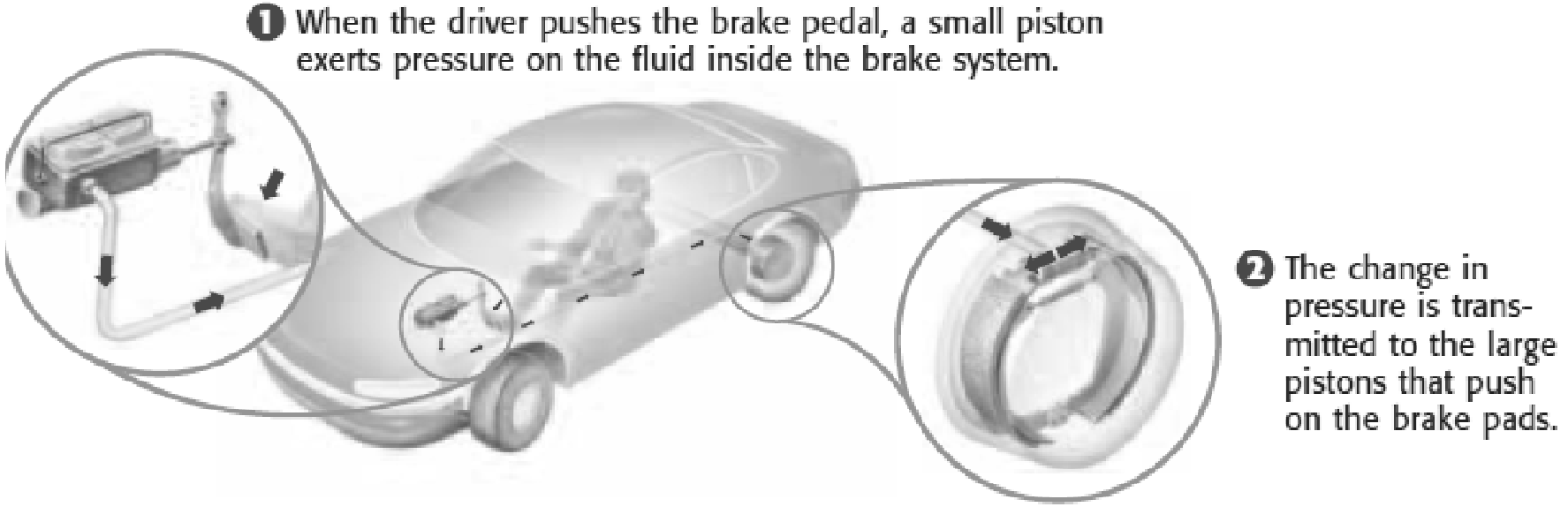
- Why does a small bird need to flap more to fly? Why does a large bird flap less?

7.3 Bernoulli's Principle

- What are the flaps on an airplane wing for?

7.3 Pascal's Principle

- For an enclosed fluid, change in pressure in 1 place = change in pressure everywhere.



7.3 Fluids and Motion

- Review

1. What forces act on an airplane?

2. When an airplane is flying, how does the air pressure above a wing compare with that below the wing?

3. How is thrust related to the speed of an airplane?