

Chapter 7 Forces in fluids

7.1

▶ fluids and pressure:

Fluid is any material that can flow and take the shape of its container.
2 types: ① liquids ② gases

particles in fluids move past each other and allow fluids to flow.

▶ Fluids exert pressure:

What happens when you pump up a bicycle tire?

▶ you pump in air particles that collide against each other and against the inside of the tire.

▶ the force of air creates pressure.

Pressure is the amount of force exerted on a given area.

▶ Calculating pressure: (math focus)

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

Pascal is the SI unit for pressure

One Pascal (1 Pa) is the force of one newton exerted over an area of one square meter (1 N/m^2)

Pressure and Bubbles:

Why does a soap bubble get rounder instead of longer as you blow into it?

→ the air inside the bubble is a fluid. Fluids exert equal pressure in all directions, so the bubble expands equally in all directions and creates a sphere.

Atmospheric Pressure:

Pressure caused by the weight of the atmosphere
Gravity holds the atmosphere in place
10N (about 2lbs) press on every square centimeter of your body.

▶ Variation of Atmospheric Pressure:
• at the top of the atmosphere, pressure is nonexistent.
• 80% of the atmosphere's gases are found within 10 km of Earth's surface.

Mount Everest

▶ Atmospheric Pressure and Depth → Figure 3

HIGHEST

• Space Shuttle at 150,000m above sea level

• Airplane at 12,000m

• Mount Everest's peak

• La Paz, Bolivia

• Beach at sea level

LOWEST

Pressure changes and your body:
 Why do your ears "pop" when you take off in an airplane?
 → pockets of air behind your eardrums experience a change in pressure as atmospheric pressure changes. The fluids in your body have to adjust to maintain equal pressure.

Water Pressure:

- increases as depth increases
- water pressure and atmospheric pressure affect total pressure on objects that are underwater.
- water pressure does NOT depend on the amount of fluid present
- water is about 1,000 times more dense than air.

Density is the amount of matter in a given volume, or mass per unit volume

Why does water exert more pressure than air?

• water exerts more pressure than air because water is more dense than air and therefore weighs more.

- the water pressure at 500m below the surface is about 5,000 kPa (kilo-pascal)
- 8,000 m would be 80,000 kPa

▶ Pressure Differences and Fluid Flow

▶ How does pressure change as you drink through a straw?

- as you sip, you remove some of the air in the straw, causing the pressure in the straw to drop.

- the greater pressure outside the straw pushes on the liquid and forces it up through the straw.

• fluids flow from areas of high ~~concentration~~ pressure to areas of low pressure

▶ What happens when pressure is lower inside the lungs than outside the lungs?

- air flows into your lungs
- the air carries the oxygen you need to live.

* Figure 5 *

▶ How do pressure differences explain destructive effects of a tornado's winds?

- air pressure inside a tornado is much lower than the air pressure outside the tornado. This difference creates a vacuum-cleaning type effect, where objects are pushed into the tornado.

Physical Science

7.2: NOTES

Buoyant force:

the upward force that fluids exert on all matter

▶ Buoyant force and fluid pressure:

in a fluid, buoyant force exists because the pressure is greater at the bottom of an object than the pressure at the top.

Archimedes' principle:

- the buoyant force on an object in a fluid is an upward force that is equal to the weight of the volume of fluid that the object displaces.

the weight of displaced fluid determines the buoyant force on an object.

▶ Weight versus Buoyant force:

if the weight of the water an object displaces is equal to the weight of the object, the object floats.

if the weight of the water an object displaces is less than the weight of the object, the object sinks.

if the weight of the water an object displaces is greater than the objects weight, the object is buoyed up.

• when rock sinks = Buoyant force is less than weight

• when a duck floats = Buoyant force is greater than weight

• when a fish is suspended = Buoyant force equals weight in the water

▶ Floating, Sinking, and Density:

How does the density of a rock affect its ability to float?

* a rock is denser and therefore heavier than water, so it sinks.

• why does an ice cube float in water?
* because it is less dense than water.

• why does a helium balloon float in air?
* because helium is less dense than air.

▶ Changing overall density:

• a steel ship can float because the hollow shape increases the ship's volume and decreases its overall density allowing the ship to float.

• what is the purpose of a submarine's ballast tanks?

* control density by filling with air so the

submarine can float or filling w/water so

the submarine can dive below the surface.

compressed air in a submarine is used to blow water out of ballast tanks so the submarine can rise.

Fish have an organ called a swim bladder that fills with gases, this increases the fish's volume decreasing the fish's overall density keeping the fish from sinking.

7.3 : Fluids and Motion :

~~Bernoulli's principle says that the~~

~~greater the velocity of the fluid~~

Bernoulli's principle says the faster

the fluid's speed is, the lower the pressure.

Bernoulli's principle can be seen when

you blow between two sheets of paper

that are held parallel to each other.

When air is blown, air speed b/t

the sheets increases and pressure

decreases. High pressure outside the

sheets forces them together.

Another example would be a table tennis ball