GASES

Describing the Properties of Gases

PRESSURE

Describing the Properties of Gases

- Scientists study matter by making *observations* that are summarized into *laws*.

- We try to explain the observed behavior by hypothesizing what the atoms and molecules of the substance are doing.

- This explanation based on the microscopic world is called a *model* or *theory*.

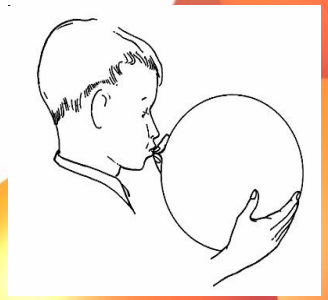
Describing the Properties of Gases

- When we make a change in a property of a gas, other properties change in a predictable way.
- We will discuss relationships among the characteristics of gases such as pressure, volume, temperature, and amount of gas.

- These relationships were discovered by making observations as simple as seeing that a balloon expands when you blow into it, or that a sealed balloon will
  shrink if you put it into the freezer.

PRESSURE

- **What are the properties of a gas?**
  - **It uniformly fills any container.**
  - **It is easily compressed.**
  - **It mixes completely with any other gas.**
- **One of the most obvious properties of a gas is that it exerts pressure on its surroundings.**
- **For example, when you blow up a balloon, the air pushes against the elastic sides of the balloon and keeps it firm.**



PRESSURE

- **The gases most familiar to us form the earth's atmosphere.**
- **The pressure exerted by the gaseous mixture that we call air is dramatically demonstrated in the Collapsing Can experiment.**
- **It is the atmospheric pressure that crumples the can.**
  - **After cooling, the H_2O molecules formerly present as a gas are now collected in a much smaller volume of liquid, and there are very few molecules of gas left to exert pressure outward and counteract the air pressure.**
  - **So, the pressure exerted by the molecules in the atmosphere shes the can.**

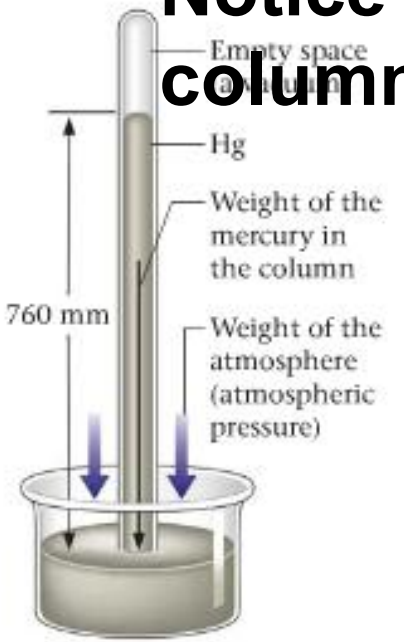
CLICK HERE to view the Collapsing Can demonstration.

See online text video page 443 if this link doesn't work

PRESSURE

MEASURING PRESSURE

- **Barometer** → device that measures atmospheric pressure.
  - Invented in 1643 by an Italian scientist named Evangelista Torricelli.
- Torricelli's barometer is constructed by filling a glass tube with liquid mercury and inverting it in a dish of mercury.
- **Notice that at sea level the height of this column of mercury averages 760 mm.**

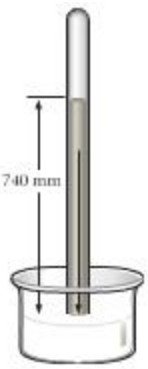


- The pressure exerted by the atmospheric gases on the surface of the mercury in the dish keeps the mercury in the tube.

PRESSURE

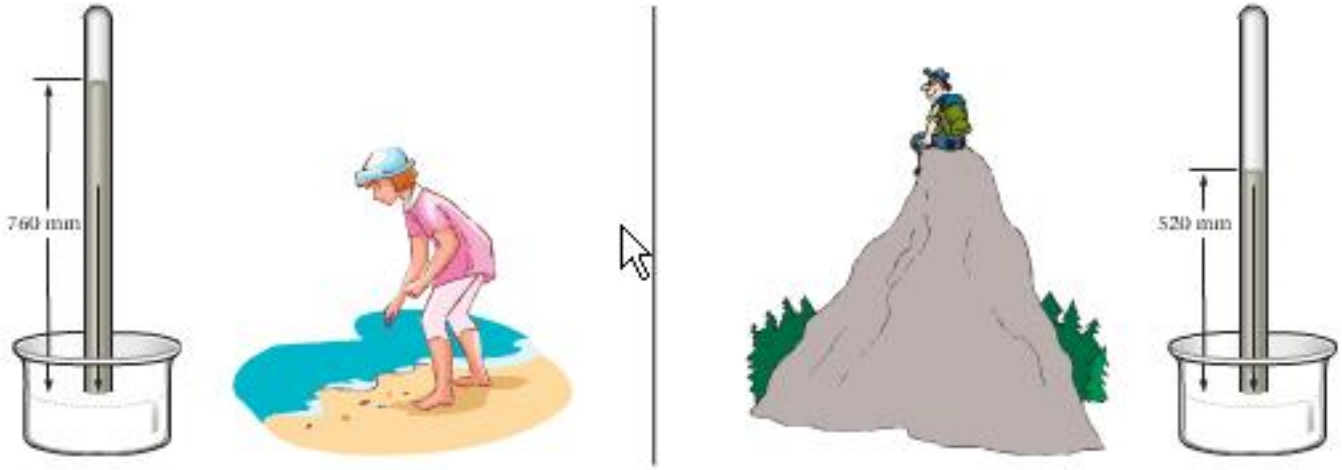
ATMOSPHERIC PRESSURE

- Atmospheric pressure results from the mass of air being pulled toward the center of the earth by gravity -- in other words it results from the weight of the air.
- Changing weather conditions cause the atmospheric pressure to vary so that the barometric pressure at sea level is not always 760 mm.
  - A "low" pressure system is often found during stormy weather.
  - A "high" pressure often indicates fair weather.



PRESSURE

- **Atmospheric pressure varies with altitude.**
  - **In Breckenridge, Colorado (elevation 9600 feet), the atmospheric pressure is about 520 mm because there is less air pushing down on the earth's surface than at sea level.**



PRESSURE

UNITS OF PRESSURE

- Instruments used for measuring pressure often contain mercury.
- The most commonly used units for pressure are based on the height of the mercury column (in millimeters) that the gas pressure can support.
- The unit mm Hg (millimeters of mercury) is often called the torr in honor of Torricelli.
- *Torr* and *mm Hg* are both used by chemists.
  - A related unit for pressure is the standard atmosphere (abbreviated atm).
- 1 standard atmosphere = 1.000 atm = 760.0 mmHg = 760.0 torr

PRESSURE

- The SI unit for pressure is the pascal (abbreviated Pa).
- 1 standard atmosphere = 101,325 Pa

Thus 1 atm is about 100,000 or 10^5 pascals.

  - Because the pascal is so small we will use it sparingly.
  - A unit of pressure that is employed in the engineering sciences and that we use for measuring tire pressure is pounds per square inch, abbreviated psi.

- 1.000 atm = 14.69 psi

Sometimes we need to convert from one unit of pressure to another.

- We do this by using conversion factors.

- **The End**