Pressure

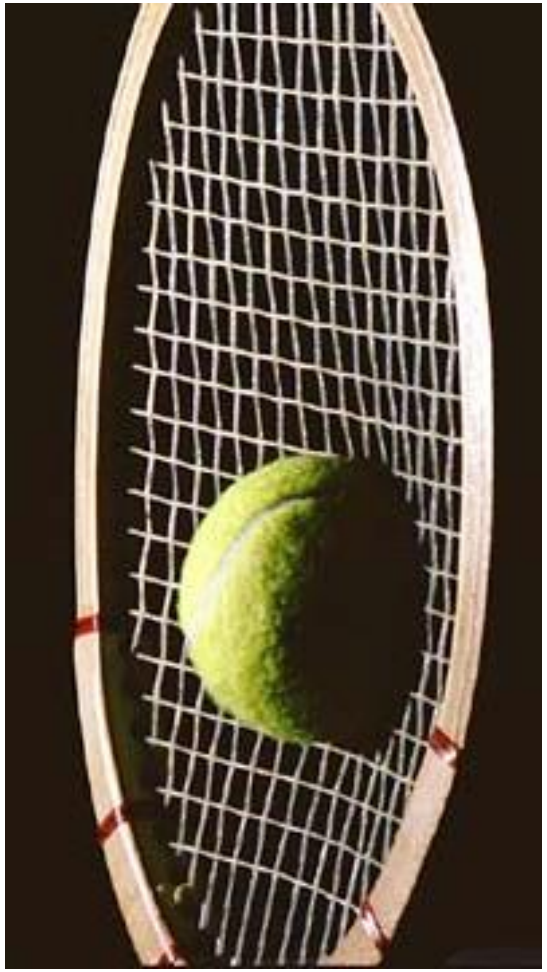
Lesson 27

Pressure

- How would you use the word “pressure” to describe a fast-moving championship game of tennis?
- Would you say the players are under a lot of pressure to do well?
- Would you say the ball is under pressure as well?

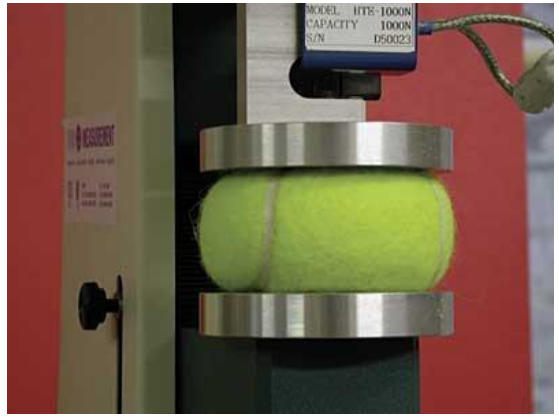
Pressure

- **Pressure** is the amount of force acting over a given area on an object
- As the pressure is applied to the ball, its shape changes
- What do you think has happened to the particles of air inside the ball?
  - The increase in pressure forces the particles closer together in a smaller volume
  - The space between the particles is compressed
- **Compression** = a decrease in volume produced by force



Gases Are Compressible

- A gas can be easily compressed because there is a large amount of space between its particles
  - Less than 1% of the volume of a gas is made up of particles
  - The rest of the volume is the space between the particles
- A container full of a gas, like a tennis ball filled with air, can briefly absorb a great deal of force because of the space between its particles



Pressure and Kinetic Activity in Gases

- Pressure can be a good indicator of the kinetic energy of a gas
  - When energy is added to a gas the kinetic energy of the particles is increased, and the particles move faster
  - This means that a warmer gas will expand in its container faster than a cooler gas will
  - Also, gas that is trapped in a container and heated will increase in pressure as the fast-moving particles bounce against the sides of its container
    - Increased pressure could cause an explosion

Pressure and Kinetic Activity in Gases

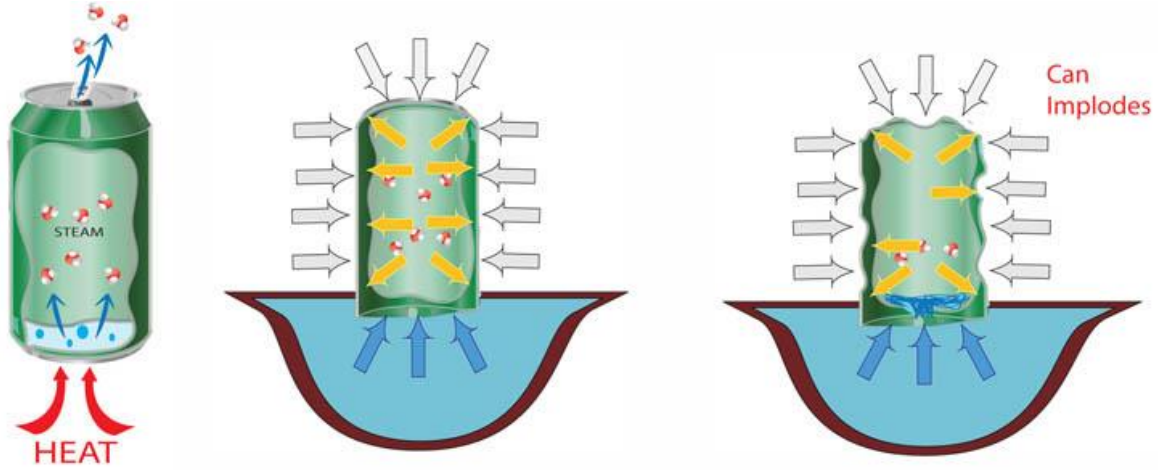
- Pressure can cause **explosions**
- Pressure can also cause **implosions**
  - A collapse inward

Implosion

Pressure and Kinetic Activity in Gases

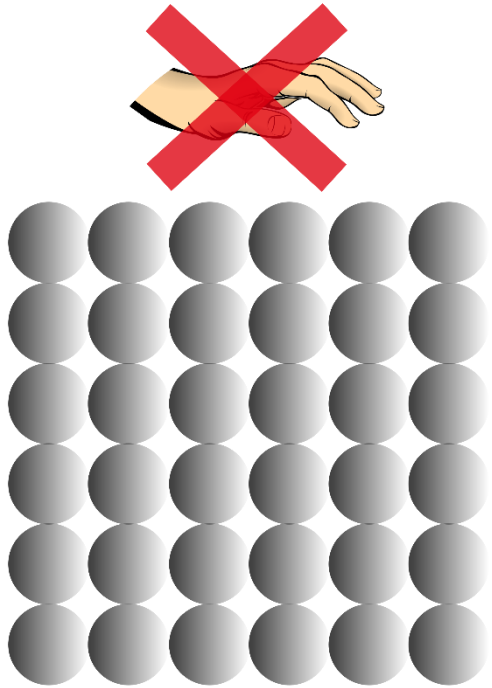
<u>Example:</u>

- A small amount of water is placed in a metal can
  - The can is then heated up
  - The can is then removed from heat and placed in cool water
  - As the can cooled, the particles of gas trapped inside also cooled, causing them to lose energy and contract
  - The contraction causes the pressure inside the can to become lower than air pressure outside the can
  - As a result, the air pressure on the outside pushed the walls of the can inward, crushing the can



Liquids and Solids Are Very Difficult to Compress

- The particles of liquids and solids are already so tightly packed together that squeezing them together is almost impossible
- We cannot change the volume of liquids and solids unless we actually remove some of it
- Solids and liquids are described as ***incompressible***
  - Not able to be compressed using normal means
- **Compression** is the action or state of being squished down or made smaller or more pressed together.
  - Decrease in volume produced by force



Compression and Deformation

- If you have squished a marshmallow or rolled up a foam mattress, have you compressed a solid?
  - This *appearance* of compression in a solid can be explained by the presence of air spaces within the solid

Compression and Deformation

- Solids can also appear to be compressed when they are deformed
- **Deformation** = a change of shape without being forced into a smaller volume
- E.g. a solid rubber ball may appear to momentarily compress when it hits the ground
  - If the ball contains no air, it does not compress
  - Instead, the ball's shape changes slightly as it hits the ground
  - As the ball deforms, it stores elastic energy which makes the ball bounce back upward

Compression and Deformation

- Compression and deformation can happen at the same time

<u>Example:</u>

- There are air spaces in the human skull, and the face is somewhat flexible
- Therefore, when the soccer ball applies a large force, the player's head both compresses and deforms
- The soccer ball also compresses and deforms because of hitting the player's head

Summary

- Pressure is the amount of force applied over a given area on an object
- When pressure is applied to matter, compression can result
- Compression is a decrease in volume produced by a force
- Gases can be easily compressed, but it is very difficult to compress liquids and solids