Why Do Boats Float?
Archimede’s Principle

• Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object. (Archimedes of Syracuse, 212 BC)
Remember...

- Weight is the force of gravity pulling objects down toward the earth (Newtons)
- Mass (grams) is roughly equivalent to weight on Earth’s surface, BUT
- Mass is constant throughout the universe.
Density

• How “heavy” something is, compared to how “big” it is
• Volume is how “big” something is (l x h x w)
• Density = mass/volume
So how do we know if something will float?

- If the density of the object is LESS than the density of water it displaces, it will float.
- Water’s density is 1 g/cm³
- If an object’s density is less than 1, it will float!
But ships are made of steel, and steel sinks!

- A ship has hollow areas in its hull.
- If the ship’s AVERAGE density is less than water’s density, it will float.
- The more full the hull is, the lower the boat sits in the water (draft).
Ballast

• Ships are often more stable if they ride lower in the water.
• Ships that do not have cargo in their hulls may fill “ballast” tanks with water so they ride lower (more draft).
Taking on iron ore without sinking!

- Iron ore pellets (taconite) are loaded carefully and evenly until the ship is at its desired draft (depth) in the water.
Bouyant force keeps it afloat!

- The weight of air in hollow spaces in the hull, added to the iron ore’s weight, average less than 1 g/cm³ (less than water).