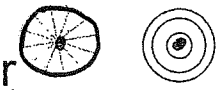
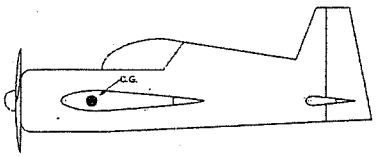
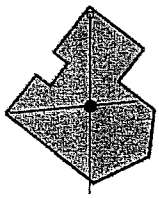
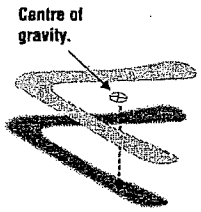
Center of Gravity and Mass

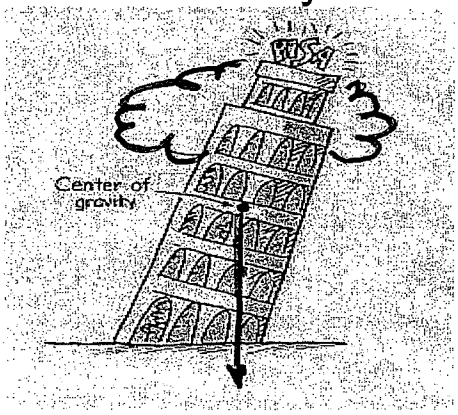
Center of Gravity (CG): point at which all of an object's weight can be considered to be concentrated

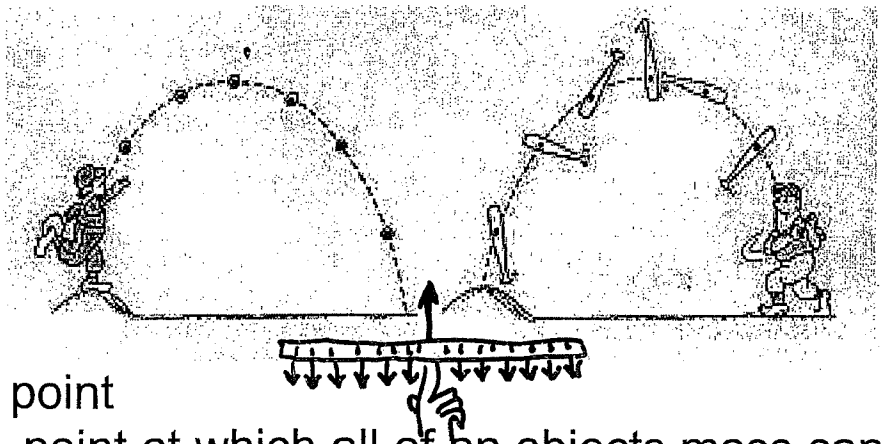
- Uniform/symmetrical obj.: CG at the Geometrical center 
- Varying Density/irregular shaped objects: CG doesn't need to be at geom. center, actually CG will be closer to heavy end



- On a suspended object, CG lies on the vertical line below suspension
  - For irregular shaped objects, suspend it in multiple places and the intersection of the lines is the CG
- Objects rotate around CG
- In projectile motion, CG follows a smooth parabola
- CG can be where no material exists 
  - Ex. Solar system: Sun = geo. center, but CG is located just outside of the Sun, which is why the Sun wobbles as it spins
  - Ex. Basketball
- CG has a tendency to take the lowest position possible
- An object topples when CG extends beyond the support base, which is why Leaning Tower of Pisa doesn't fall





- CG is the balancing point

Center of Mass (CM)- point at which all of an objects mass can be considered to be concentrated, Near Earth CM = CG

Center of Mass

* The center of mass is the location where all of the mass of the system could be considered to be located.

* For a solid body it is often possible to replace the entire mass of the body with a point mass equal to that of the body's mass. This point mass is located at the center of mass.

* For homogenous solid bodies that have a symmetrical shape, the center of mass is at the center of body's symmetry, its geometrical center.

* The center of mass is the point about which a solid will freely rotate if it is not constrained.

* For a solid body the center of mass is also the balance point. The body could be suspended from its center of mass and it would not rotate, i.e. not be out of balance.

* The center of mass of a solid body does not have to lie within the body. The center of mass of a hula-hoop is at its center where there is no hoop, just hula.

* The center of mass for a system of independently moving particles still has meaning and is useful in analyzing the interactions between the particles in the system.

When a collection of objects act together as a single entity, then the motion of that entity can be described by the position of the centre of mass of the system of objects. For example, when describing the motion of a car travelling down the highway, it is not neccessary to worry about the location of each wheel, or the engine, or the passengers, etc. Instead a single point is sufficient, the point located at the centre of mass of all the components which make up the car.