Acceleration Due to Gravity

- As you move farther from Earth (as r becomes larger), the acceleration due to gravity is reduced.

- EX: 400 km above the Earth's surface, the acceleration due to gravity is 8.7 m/s^2.

- How then, can this astronaut, who is in orbit 400 km above the Earth, feel "weightless"?

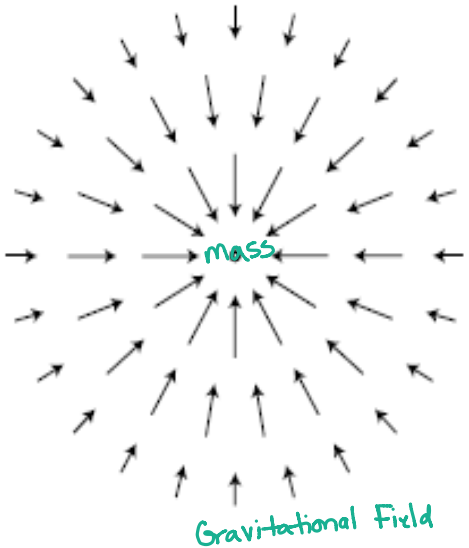
Weightlessness

- Remember – you only feel your weight when something is exerting a contact force on you
- EX: the floor / a chair
- If your chair or the floor were to be removed OR if they were to accelerate towards Earth at the same rate as you, you would feel weightless (your apparent weight would be 0).

- Since a space shuttle and everything in it are in free fall (falling towards Earth)
  – the astronaut can experience Weightlessness
- Astronauts In Orbit ← Watch this - great explanation!

Gravitational Field

- Gravity is a long range force
  - No contact needed
- Any object with a mass is surrounded by a gravitational field, that always points towards the center of the mass.



Gravitational Field

- Gravitational field is an area in which gravitational force can be experienced.
- Any mass within the gravitational field experiences a force caused by the interaction of its mass with the gravitational field at that location.
- http://physics.bu.edu/~duffy/semester1/c17_field.html

Gravitational Field

- Gravitational field strength (g) is equal to the force experienced per unit mass in a gravitational field.

$$g = \frac{F}{m}$$

F ← Force due to gravity of object in field

m ← mass of object in field

- Units: N/kg which also equals m/s^2
- Note: This expression is the same as that of an acceleration of a mass due to a force.
- EX: Earth's gravitational field strength is 9.8 N/kg, which is equal to the acceleration due to gravity on Earth. ($9.8\ m/s^2$)

Gravitational Field

- To calculate gravitational field given only the mass of the center body (M) and the distance another mass is away (r):

$$g = \frac{GM}{r^2}$$

- Note: The gravitational field depends on the Mass of the object exerting it, not the mass of the object experiencing it.
- Gravitational field is a Vector.