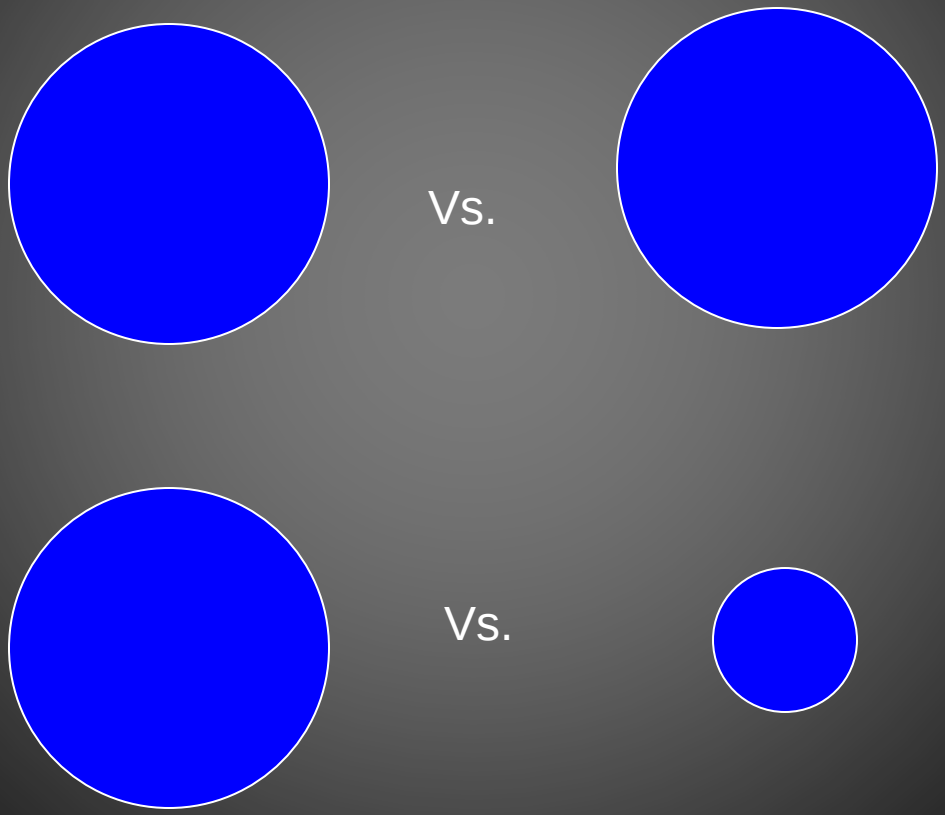
Effects of Forces

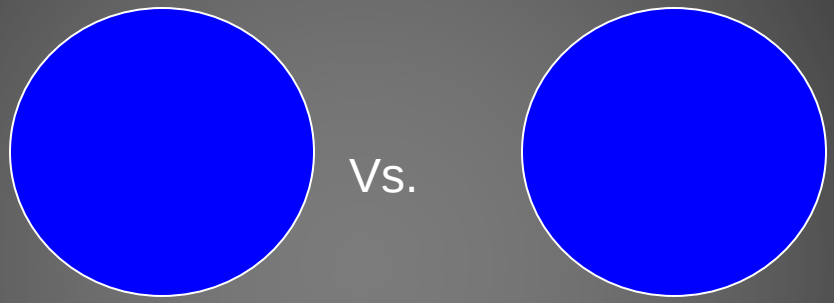
Gravity

- Remember:
  - Gravity is a force of attraction – it PULLS
  - Gravity is affected by the mass of objects and their distance from each other
  - On EARTH the acceleration due to gravity is 9.8 m/s^2
  - Law of Universal gravitation – Gravitational attraction depends on mass and distance

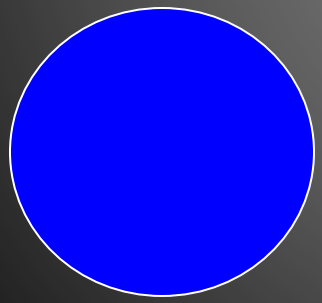
Which ones have more gravitational pull?



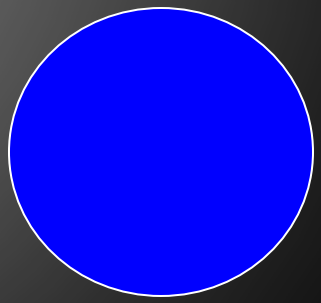
Which ones have more gravitational pull?



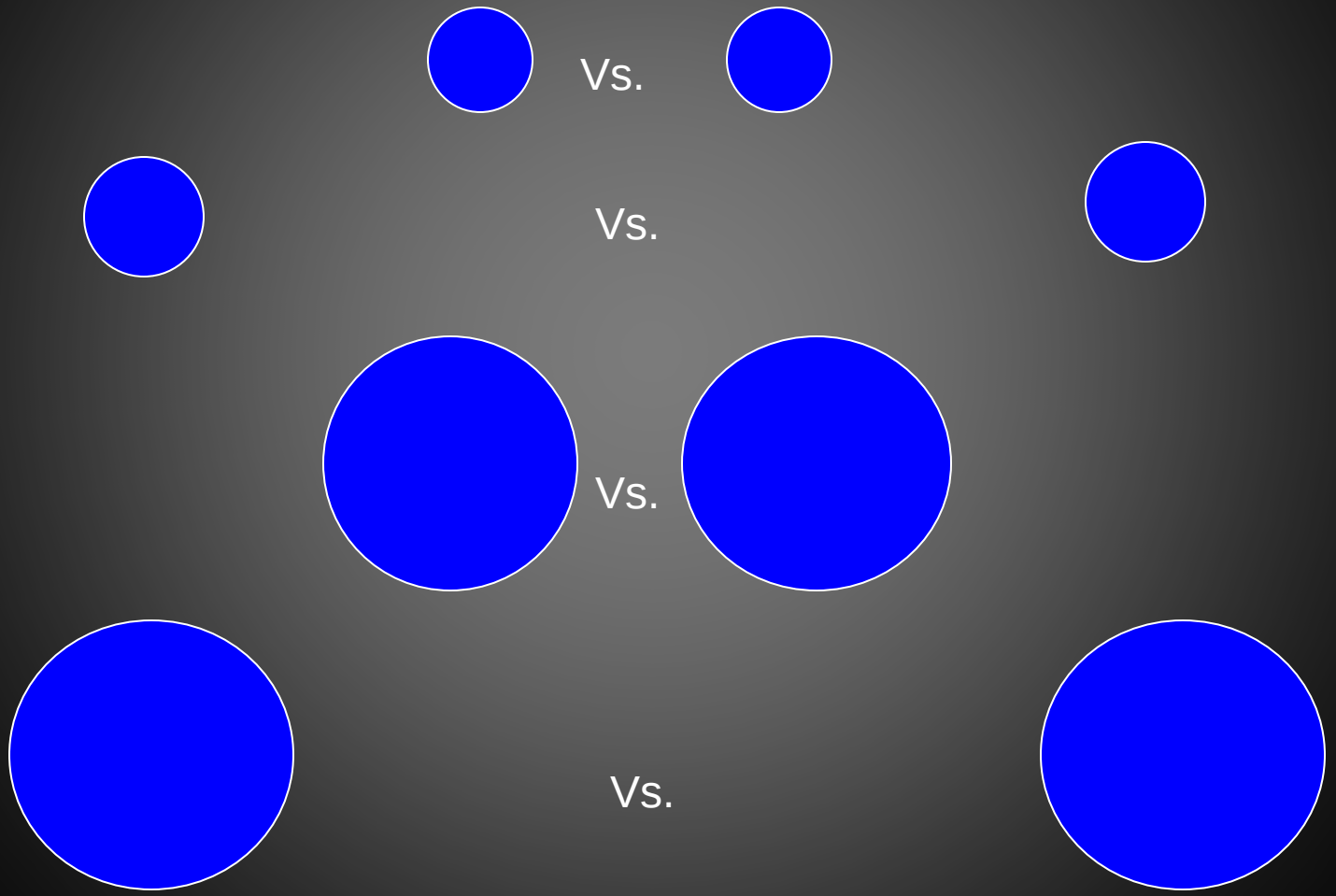
Vs.



Vs.



Now which ones?

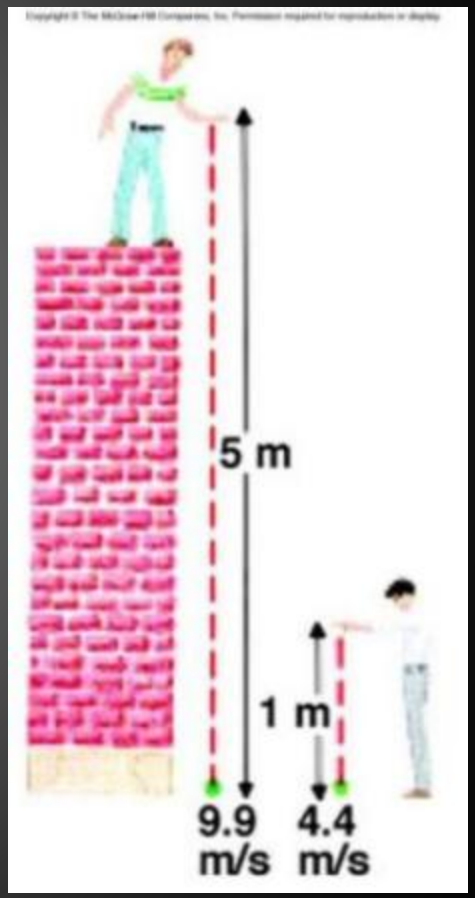


Free Fall

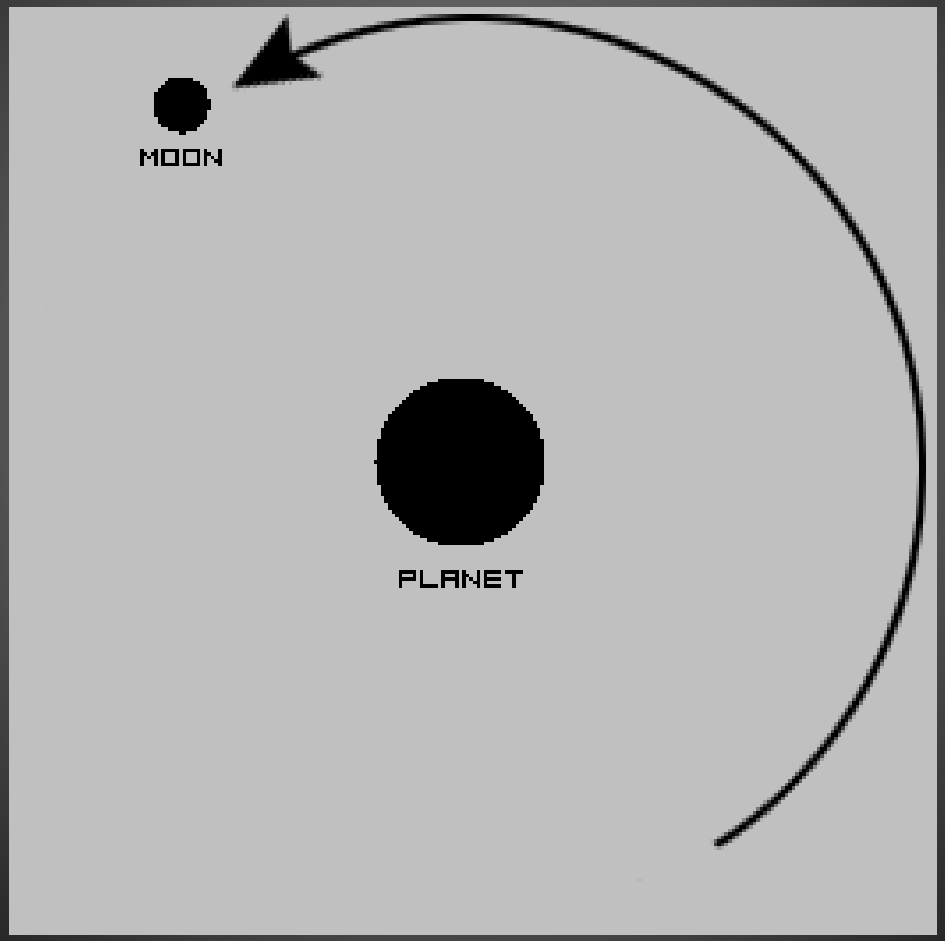
Free fall- when gravity is the **only force** acting on an object (free fall acceleration is directed toward center of earth)

The **acceleration of gravity** (*g*) for objects in free fall at the earth's surface is 9.8 m/s^2.

Galileo *found that all things fall at the same rate in the absence of air resistance, regardless of their mass*



Orbiting objects are in free fall.



So if all objects experience gravity, then can something ever be weightless?

No. When an object is “weightless” it is really falling and hasn’t hit an object yet.

It does not have something for the force of gravity to pull it against

Free Fall

The rate of falling increases by 9.8 m/s every second.

$$\text{Height} = \tfrac{1}{2} g t^2$$

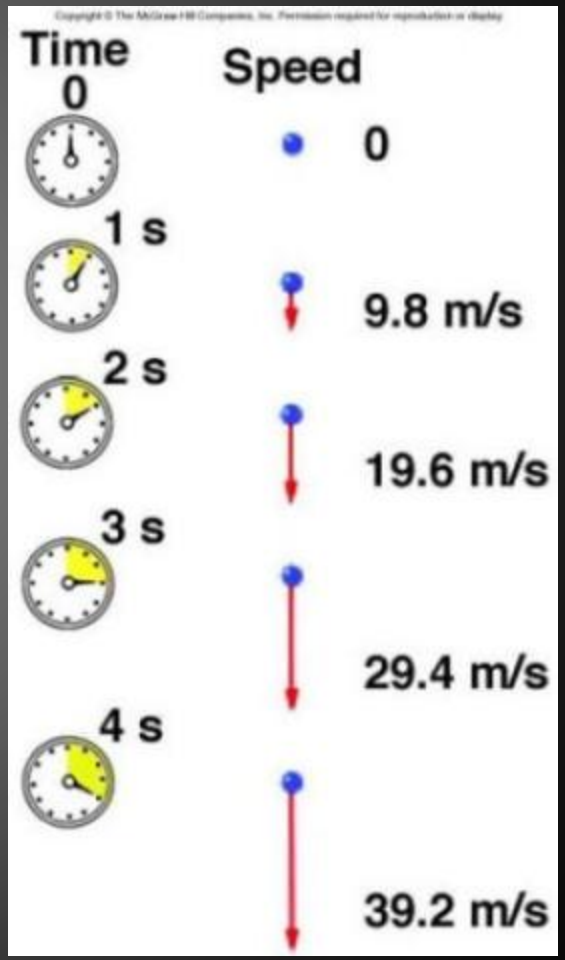
For example:

$\tfrac{1}{2}(9.8)1^2 = 4.9$ m

$\tfrac{1}{2}(9.8)2^2 = 19.6$ m

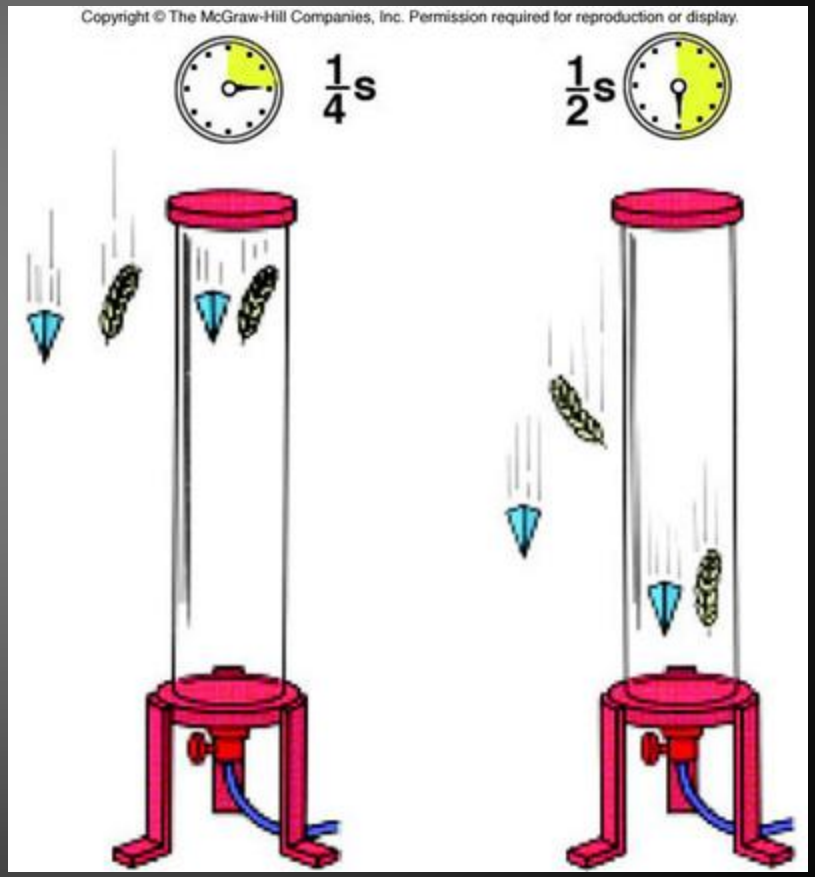
$\tfrac{1}{2}(9.8)3^2 = 44.1$ m

$\tfrac{1}{2}(9.8)4^2 = 78.4$ m

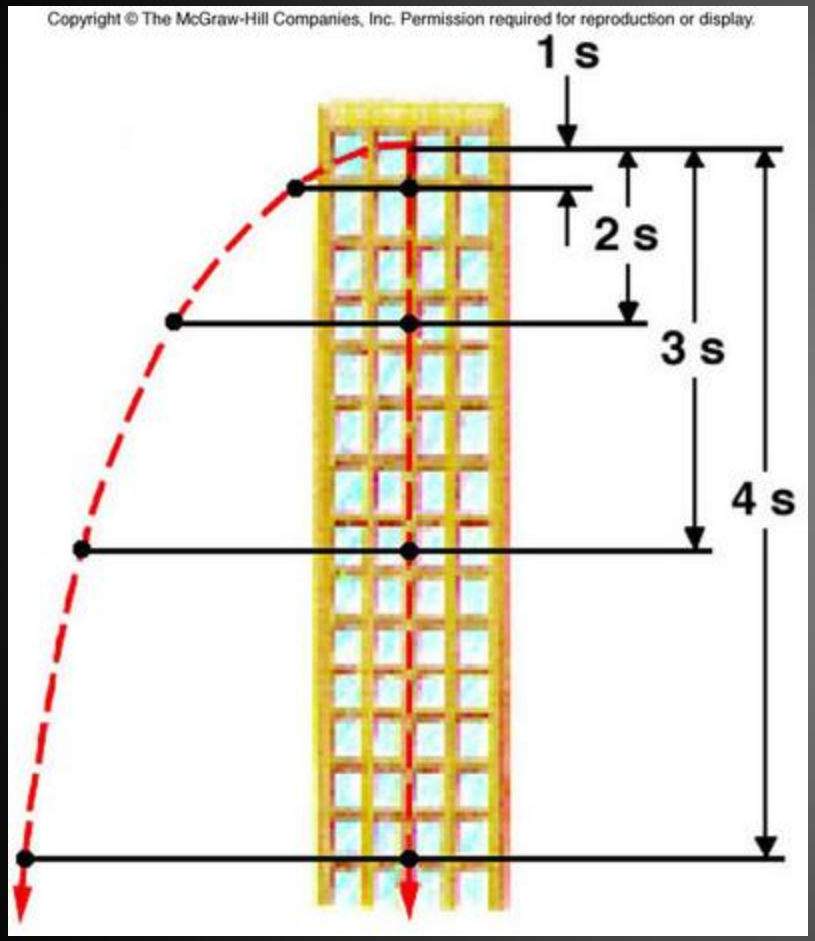


Air Resistance= Fluid Friction

- In air…
  - A stone falls faster than a feather
    - Air resistance affects stone less
- In a vacuum
  - A stone and a feather will fall at the same speed.



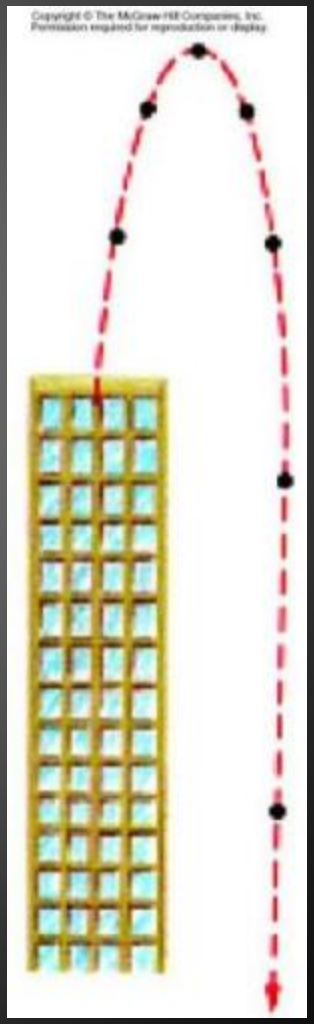
Free Fall



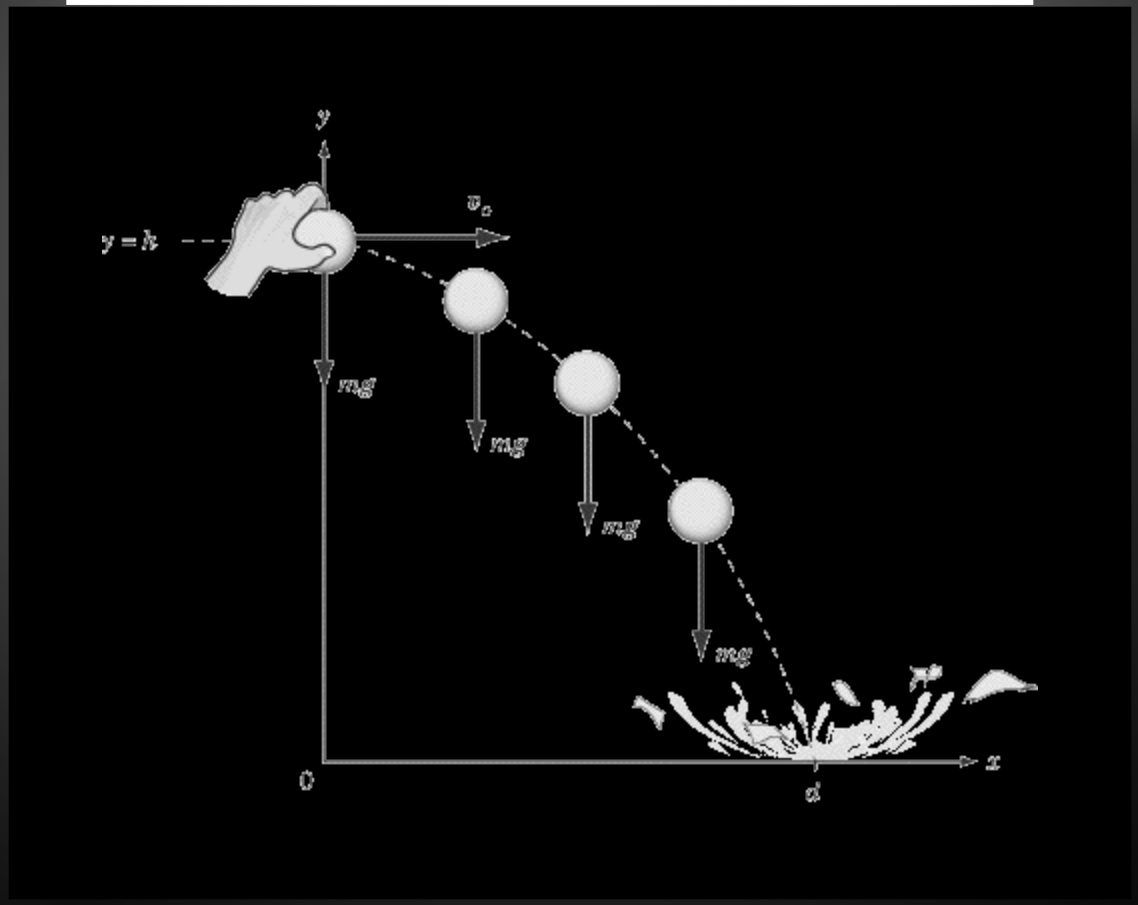
A ball thrown horizontally will fall at the same rate as a ball dropped directly because the acceleration due to gravity is the same for all objects in earth.

Free Fall

A ball thrown into the air will slow down, stop, and then begin to fall with the acceleration due to gravity. When it passes the thrower, it will be traveling at the same rate at which it was thrown.



Projectile motion-curved path an object takes when thrown near the surface of the Earth.



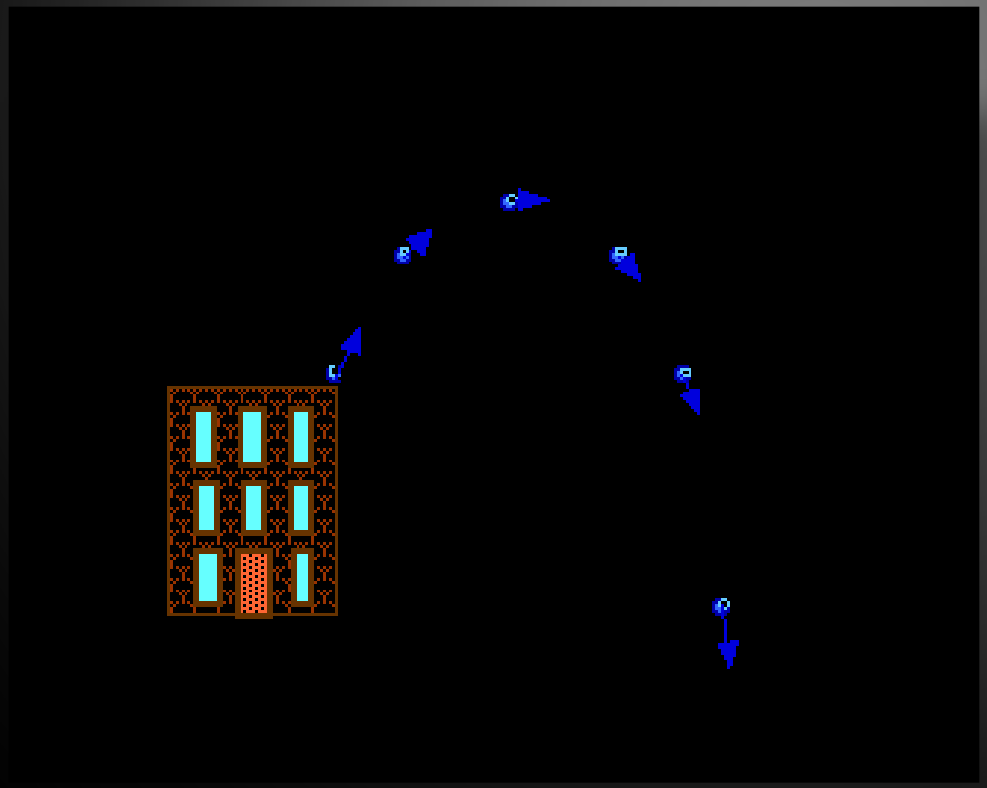
2 parts of projectile motion:

Horizontal Motion

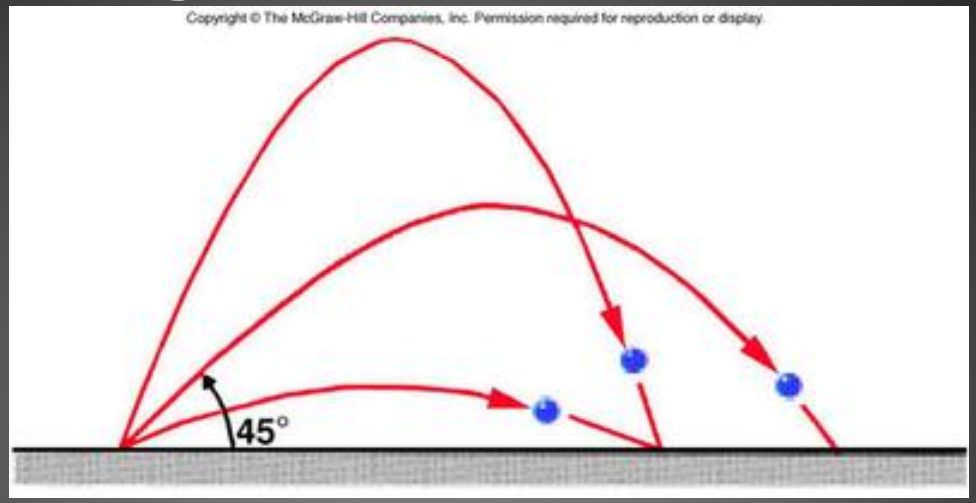
- Force of throw.
- Across

Vertical Motion

- Gravity pulling downward.
- Down



Projectile Motion



•An object thrown upward at an angle to the ground follows a curved path called a **parabola**.

• combines vertical and horizontal motion

•Orbiting objects- forward motion combines with free fall and object follows a curved path

Free Fall Review

- Dropping something from a resting position (gains speed as it falls so it accelerates)
- Gravity pulls objects down (air resistance can affect how fast) (no air resistance- in a vacuum)
- When gravity is the only thing that affects falling object → **FREE FALL**
- Acceleration due to gravity is 9.8 m/s^2

Newton's Laws

- Newton's Three Laws of Motion help us to think about and describe how forces effect objects and their motion.
- Think if one example of each of Newton's Laws effecting objects and their motion that you might encounter in a regular day.
- Write down Newton's Laws and your examples in your notes.