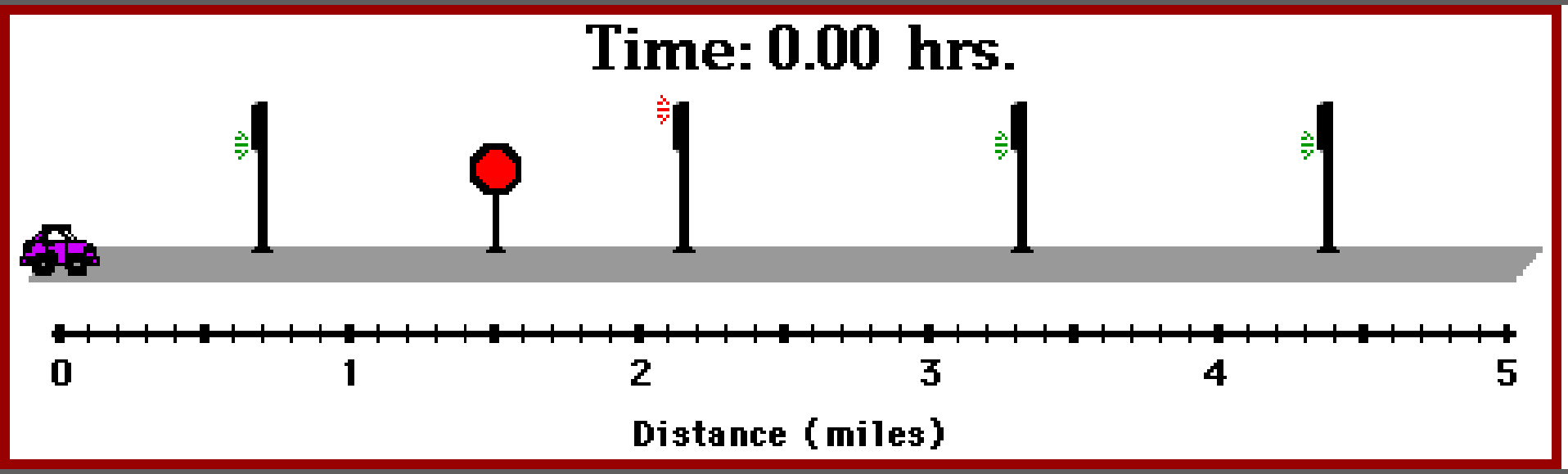
Acceleration and Momentum



Newton's second law -

- a net force on an object causes acceleration
- Force Equation
  - Force = mass X acceleration
    - F=ma
    - Newton = kg x m/s^2

Falling objects and Gravity

- Gravity is a force that causes things to accelerate toward the earth
- All things accelerate toward the earth at 9.8 m/s^2
- If F=ma, then a one kg object exerts a 9.8 Newton downward

Air resistance

- Air causes things to accelerate at a slower rate toward the earth
- Air is a fluid that resist motion
  - The faster something moves through air the greater the air friction
- Force upward due to air friction increases as velocity increases
- *Terminal velocity* is when a falling object quits acceleration do to the force of air friction upward equaling the force of gravity downward

Projectiles

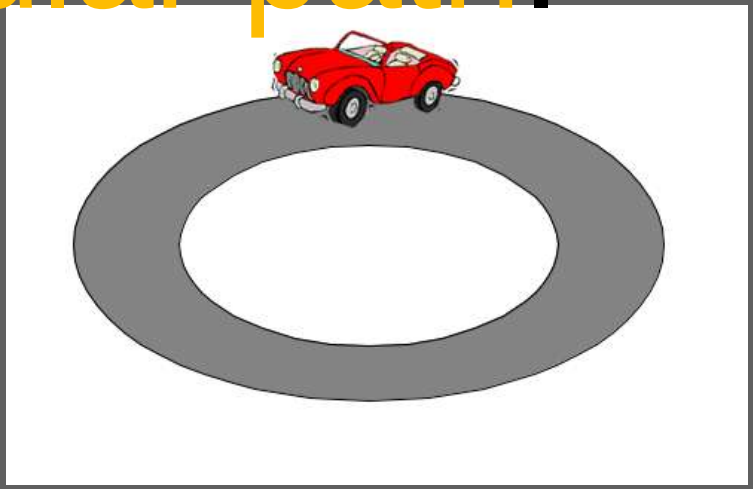
- Projectile - anything thrown, shot or propelled through the air
- All projectiles have to components to their motion
- All projectiles have motion horizontal to the earth's surface
- All projectiles are acceleration toward the earth at $9.8ms^2$
- These two components cause all projectiles to travel on a curved path (internet site)
- Canon firing

Circular Motion

- Centripetal acceleration – Any force that causes the acceleration in a curved path
- Centripetal force is the force acting toward the center of a curved path
- There must be centripetal force before and object can accelerate toward the center or around a curve

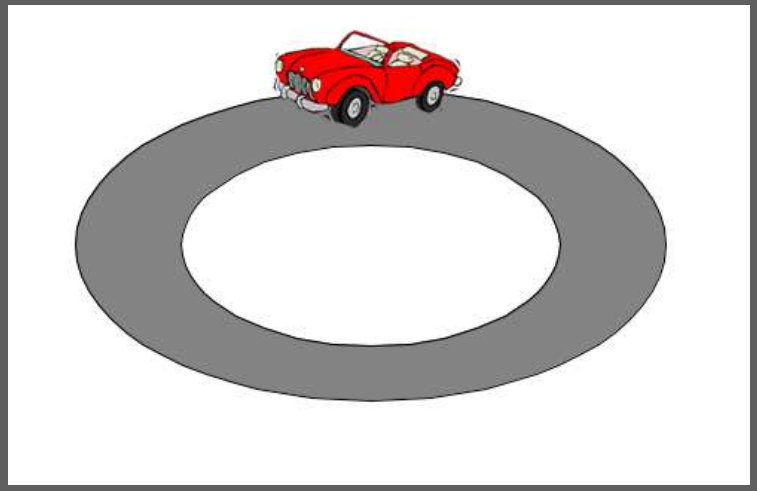
Centripetal Acceleration

Acceleration toward the center of a circular path.

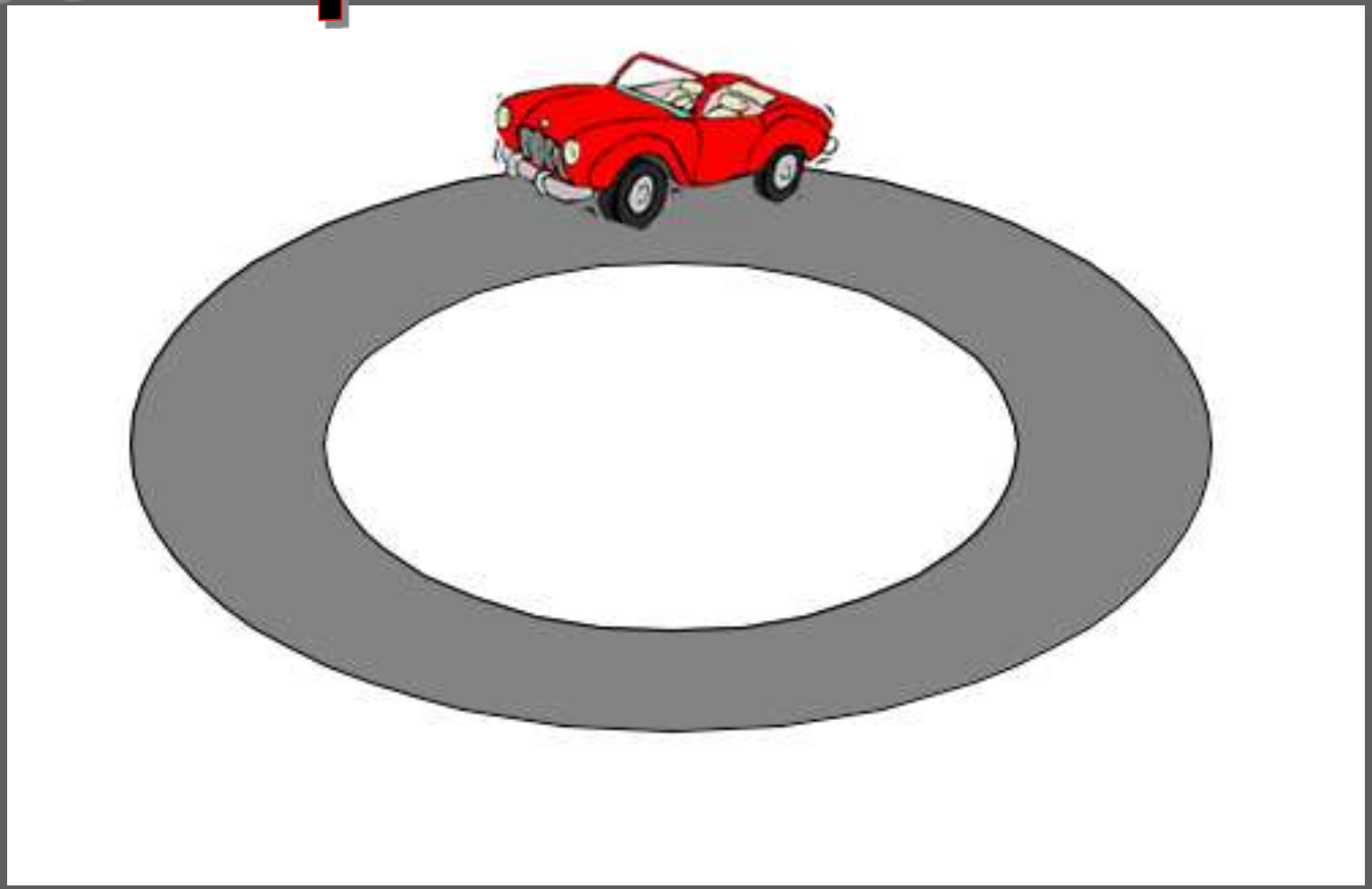


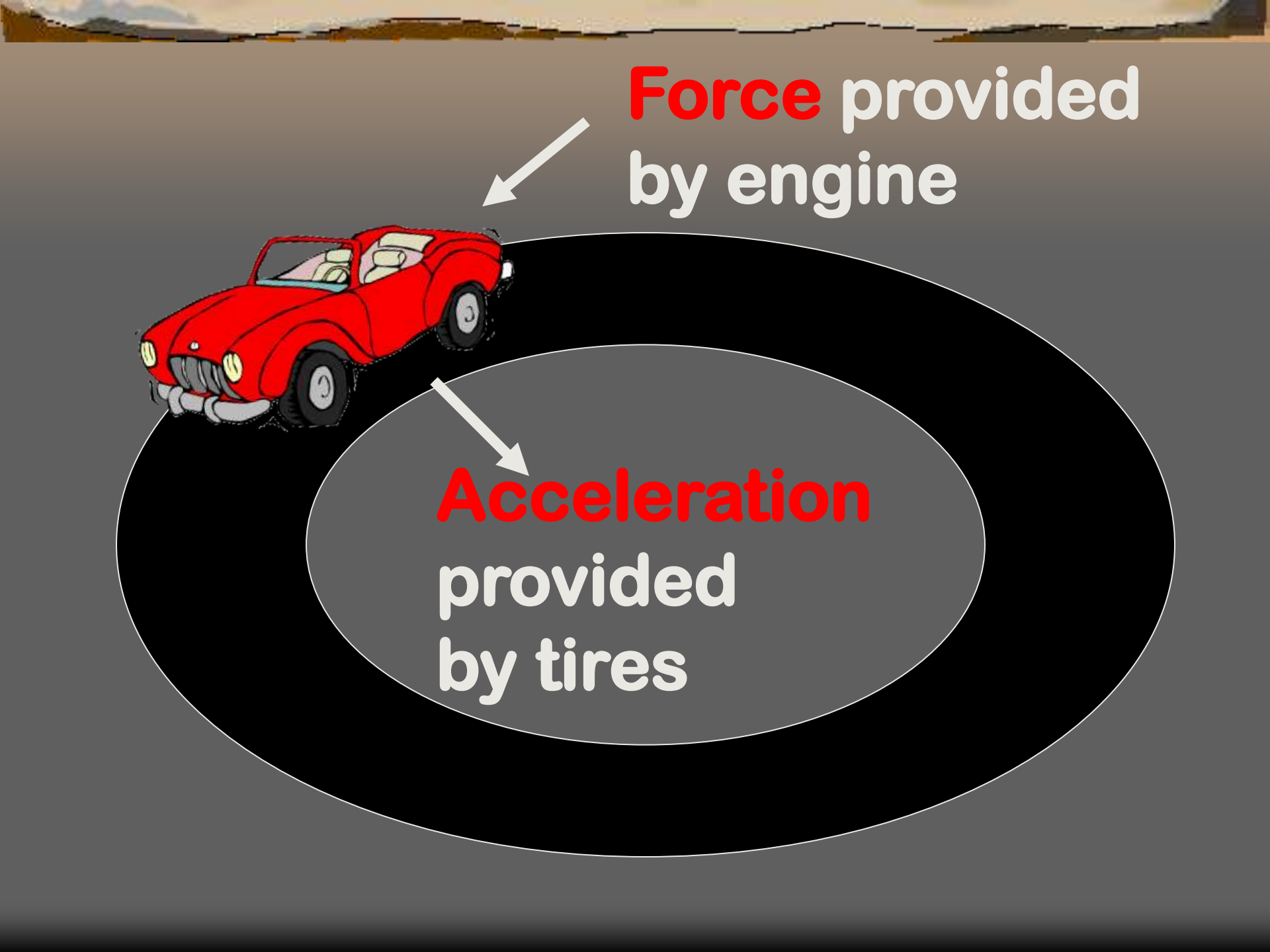
Centripetal Acceleration

For an object to travel in a curved path, some force must be accelerating it toward the center of the circle.



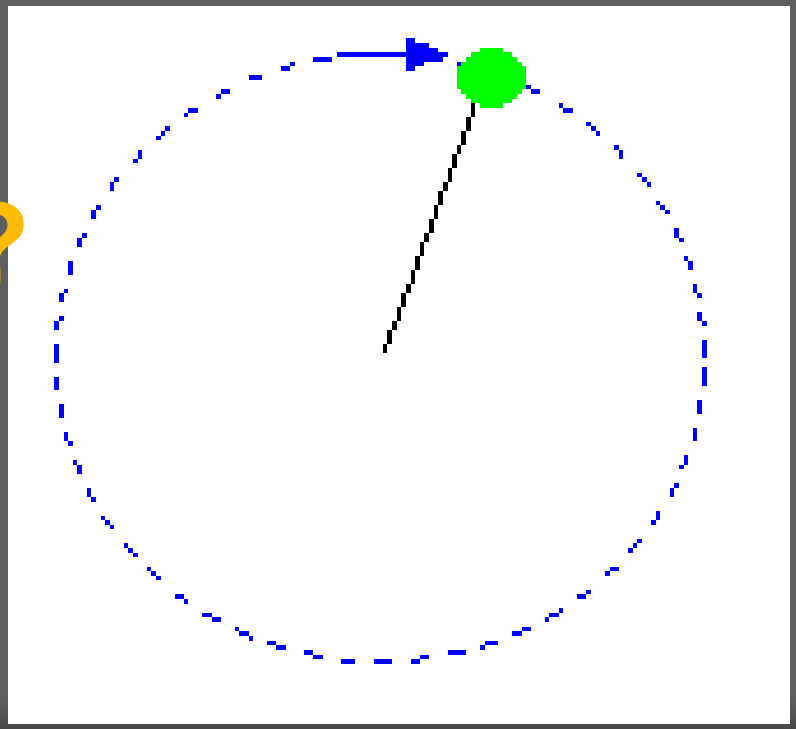
Centripetal Acceleration




Force provided
by engine
Acceleration
provided
by tires

Centripetal Acceleration

What happens if the accelerating force is removed?

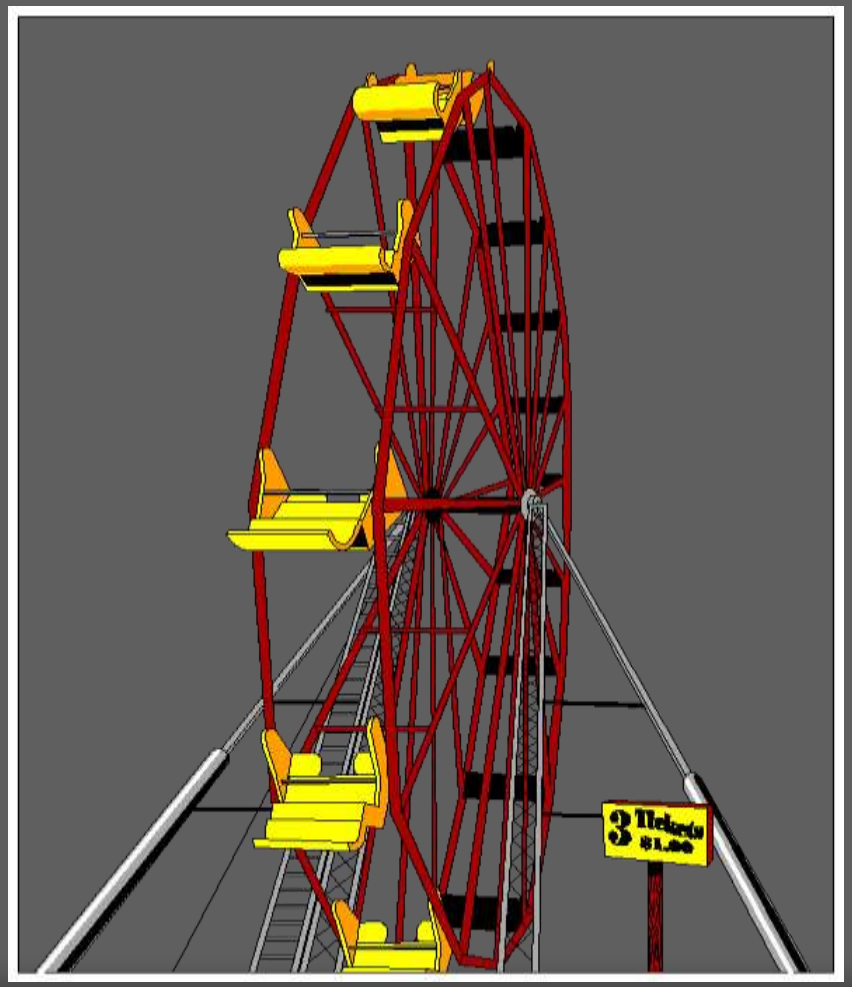


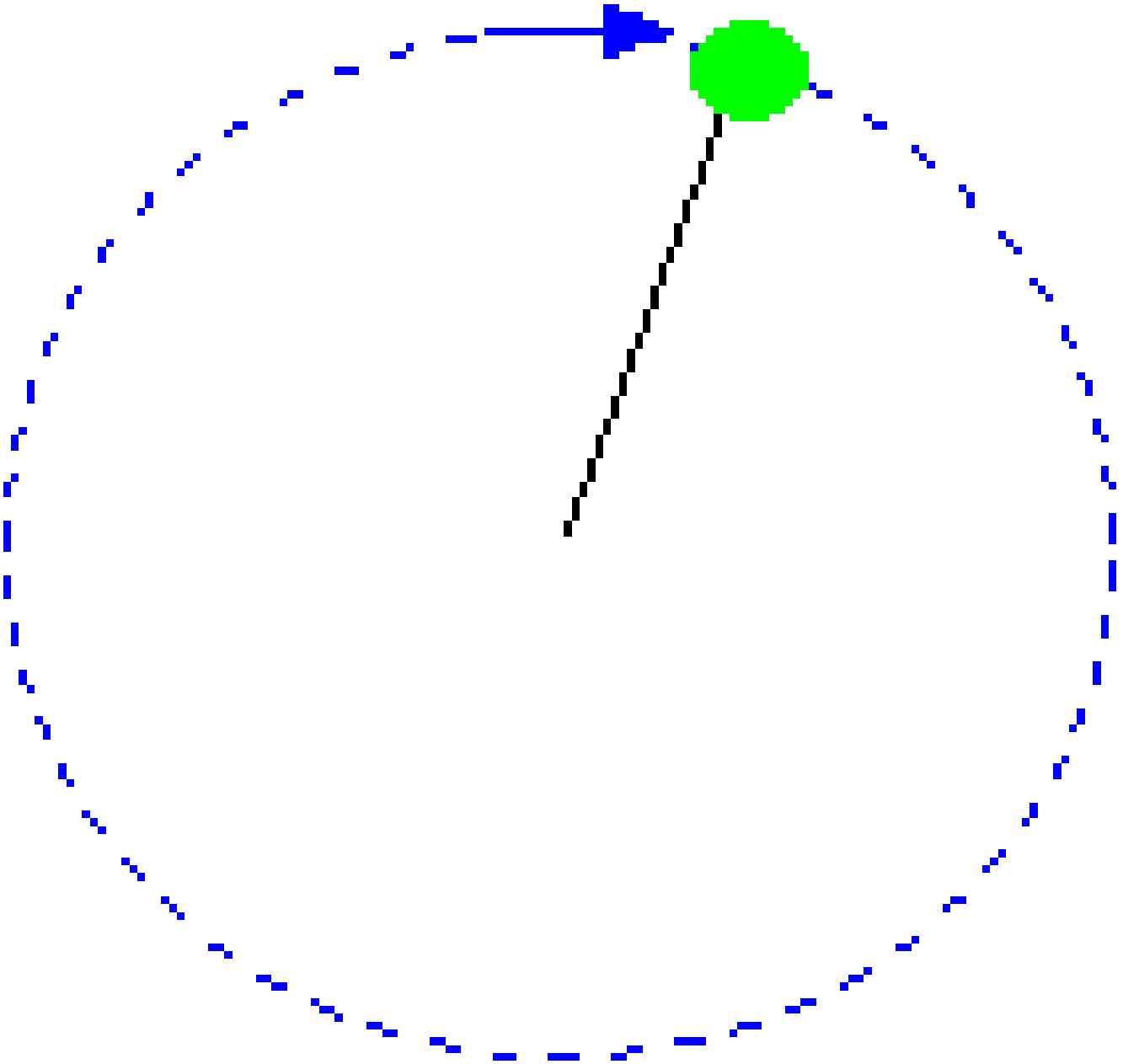
Centrifugal Force

An apparent force that appears only in rotating frames of reference.

Centrifugal Force

This “false” force appears to push away from the center of the circular path.





Forces cause changes in motion

Weightlessness

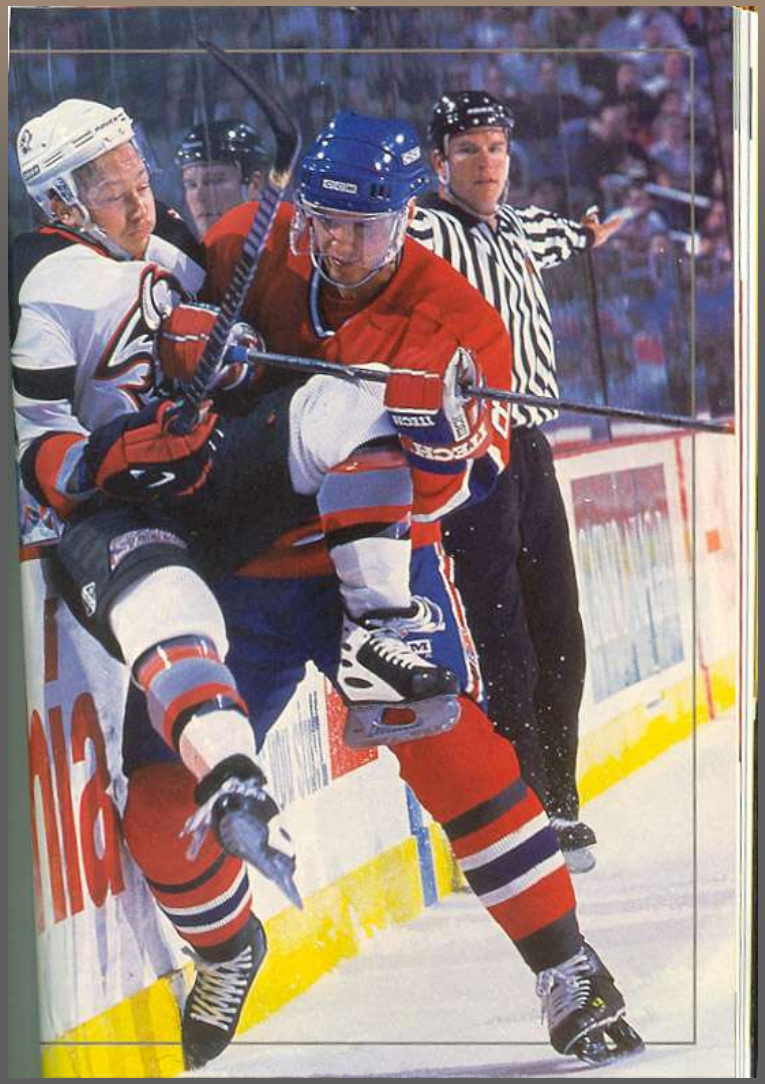
- in orbit is really freefall on a curved path around the earth

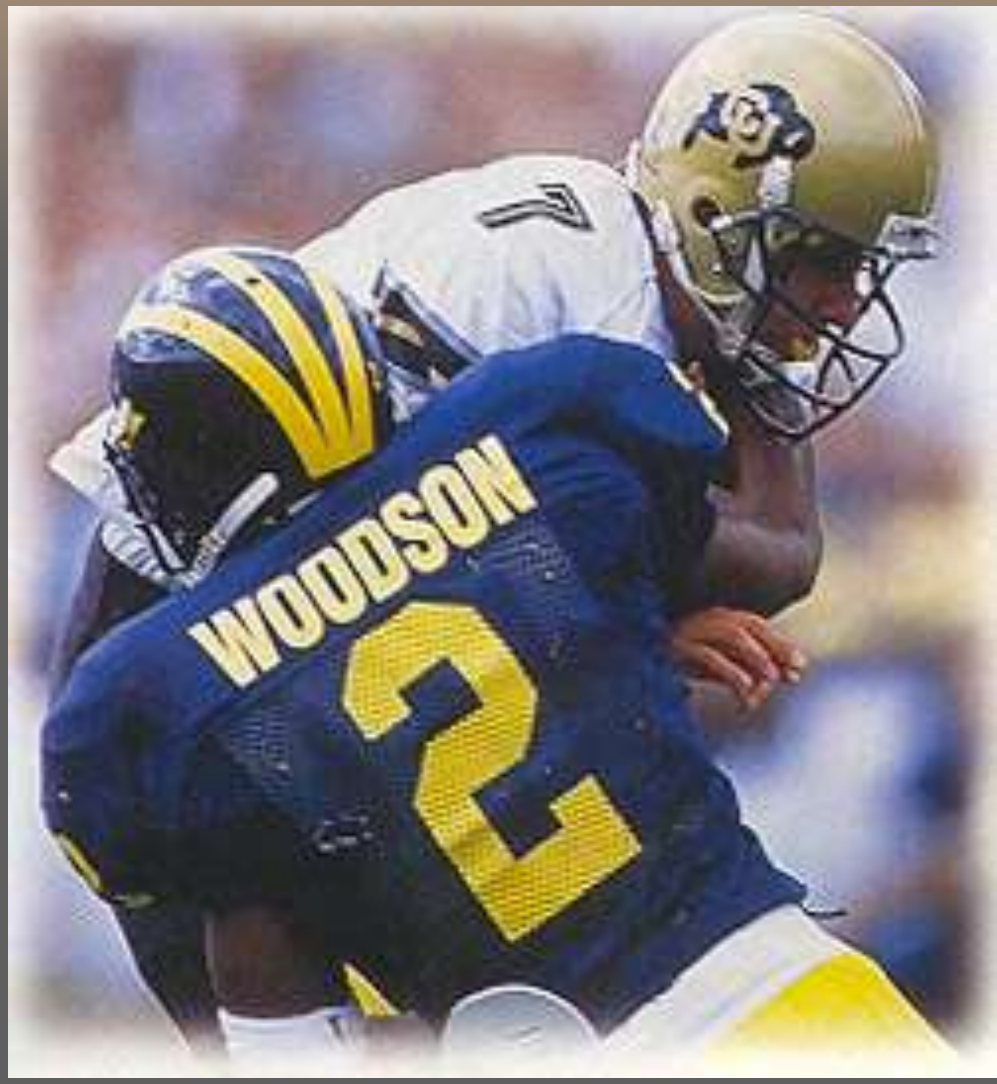
Artificial satellites

- Objects put up in orbit by man
- Objects have to reach a certain velocity before it will stay in orbit
- Speed depends on how high above earth's surface the satellite orbits.
- Speed of orbit is about 29,000 km/hr
- Geostationary satellites seem to move the same speed as the earth's rotation
- Satellites fall because the horizontal velocity decreases

Newton's third law of motion -

- to every force there is an equal and opposite force
- Action reaction Forces
  - Rocket Propulsion is the result of action reaction

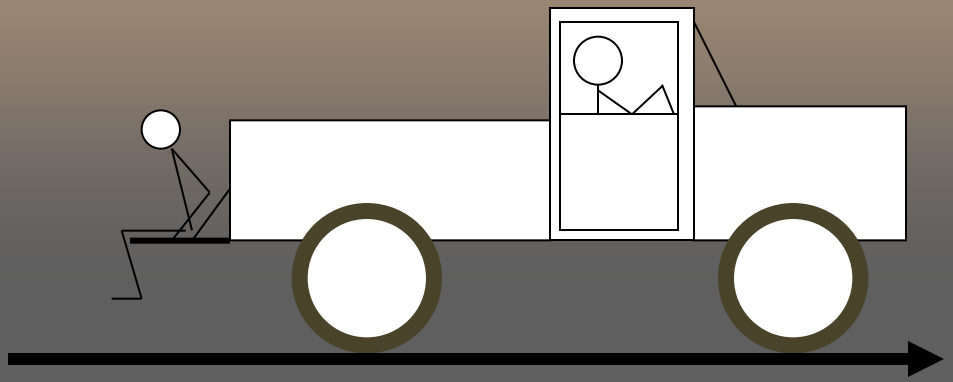




Take a look at these pictures, they are an example of Newton's third law. As you can see it is just some guy hitting another guy but what you might not see is Newton's third law. Each guy hitting the other one is feeling the same amount of force they apply. So the hockey player has to turn his feet sideways to stop himself from bouncing back. And the guy hitting the glass will bounce back because the glass to is applying the same amount of force exerted on it.

Mr. Sandoz's early experience

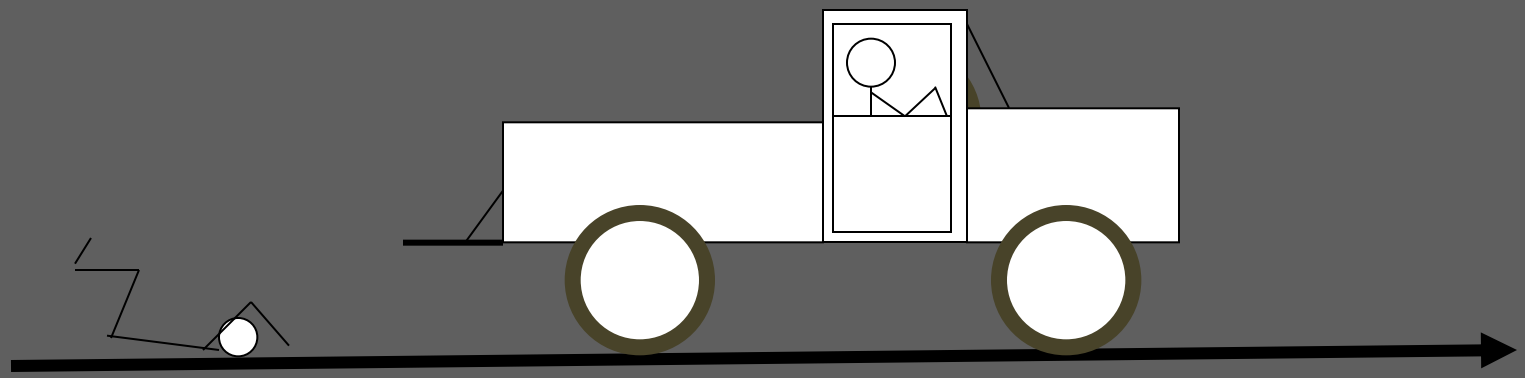
- Getting wood w/my dad
- Turned out to be one of my first realizations about what we are going to talk about today.



Before jumping out of the pickup moving less than 5 mph.

- I had jumped out of the pickup many times when it wasn't moving
- How do you think jumping out while the truck was moving was different than jumping out while it was stationary.?

After jumping out of the pickup moving at about 5 mph

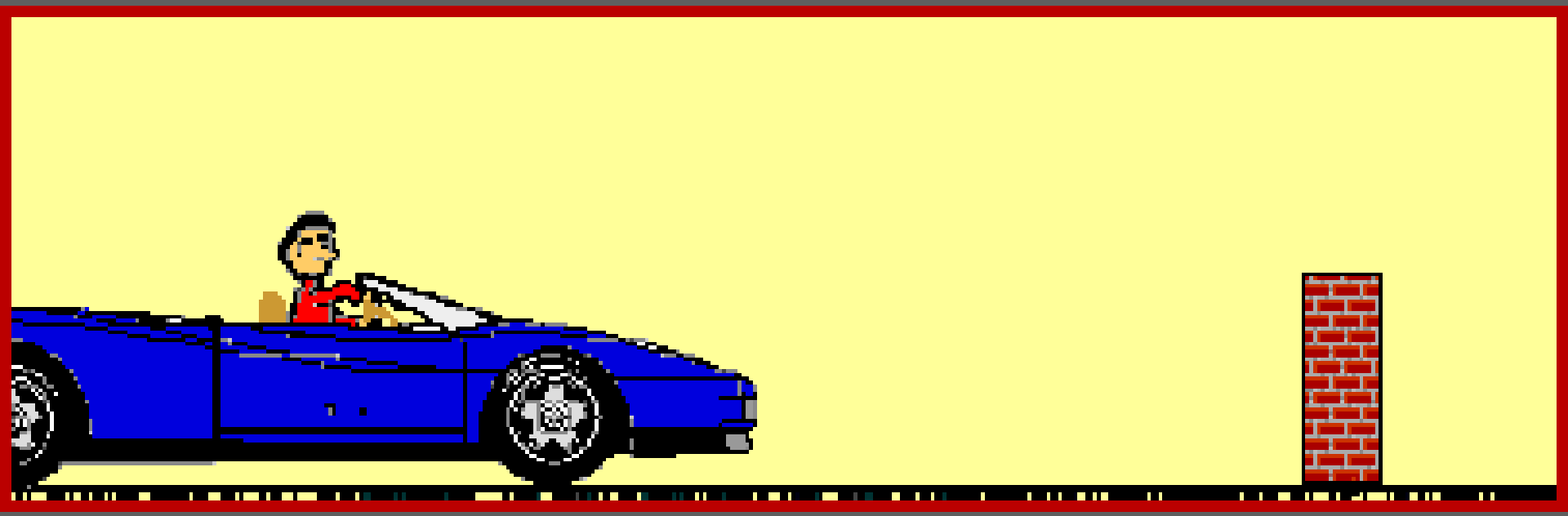


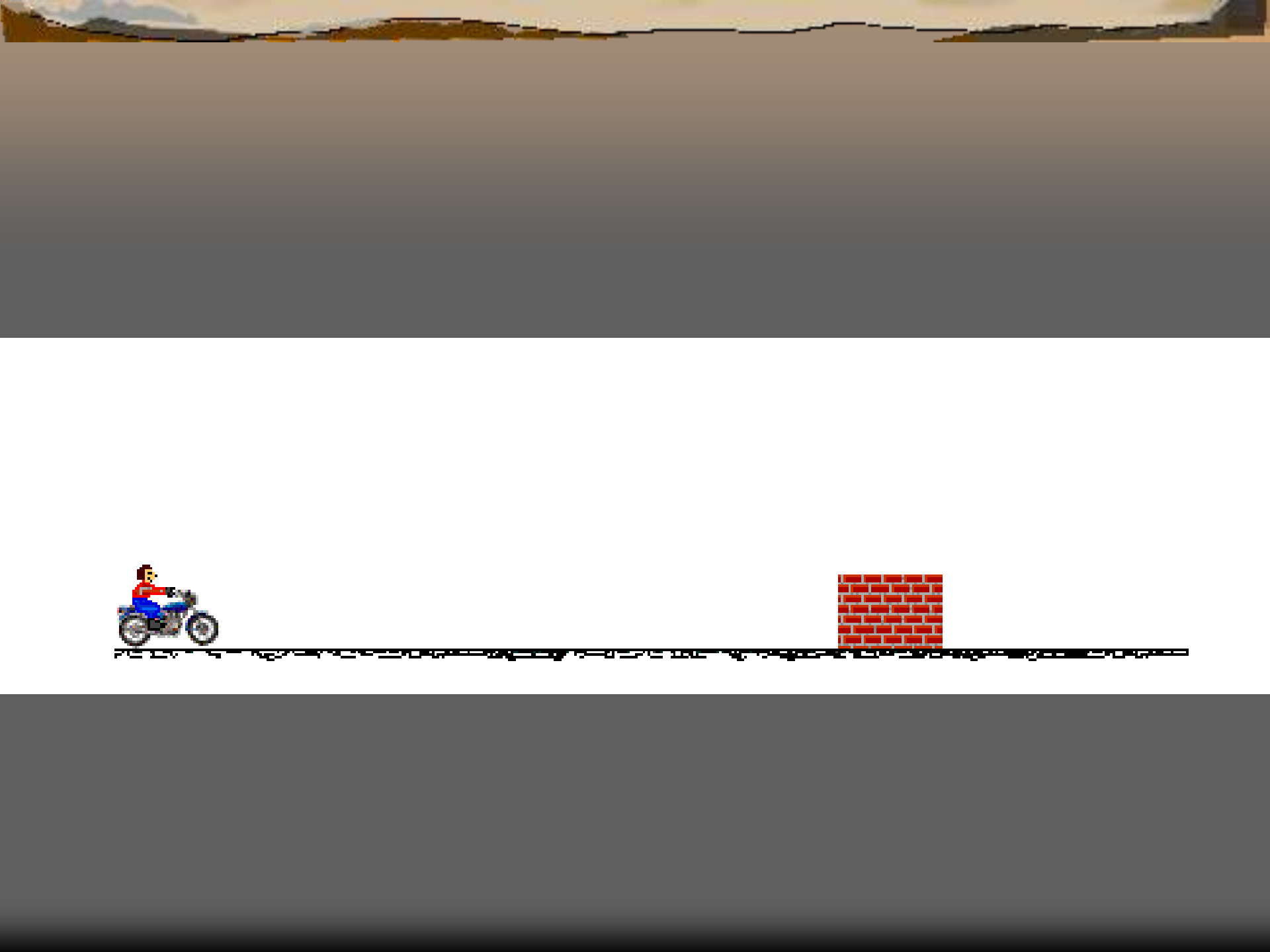
What do you think caused me to fall down on my back and hit my head?

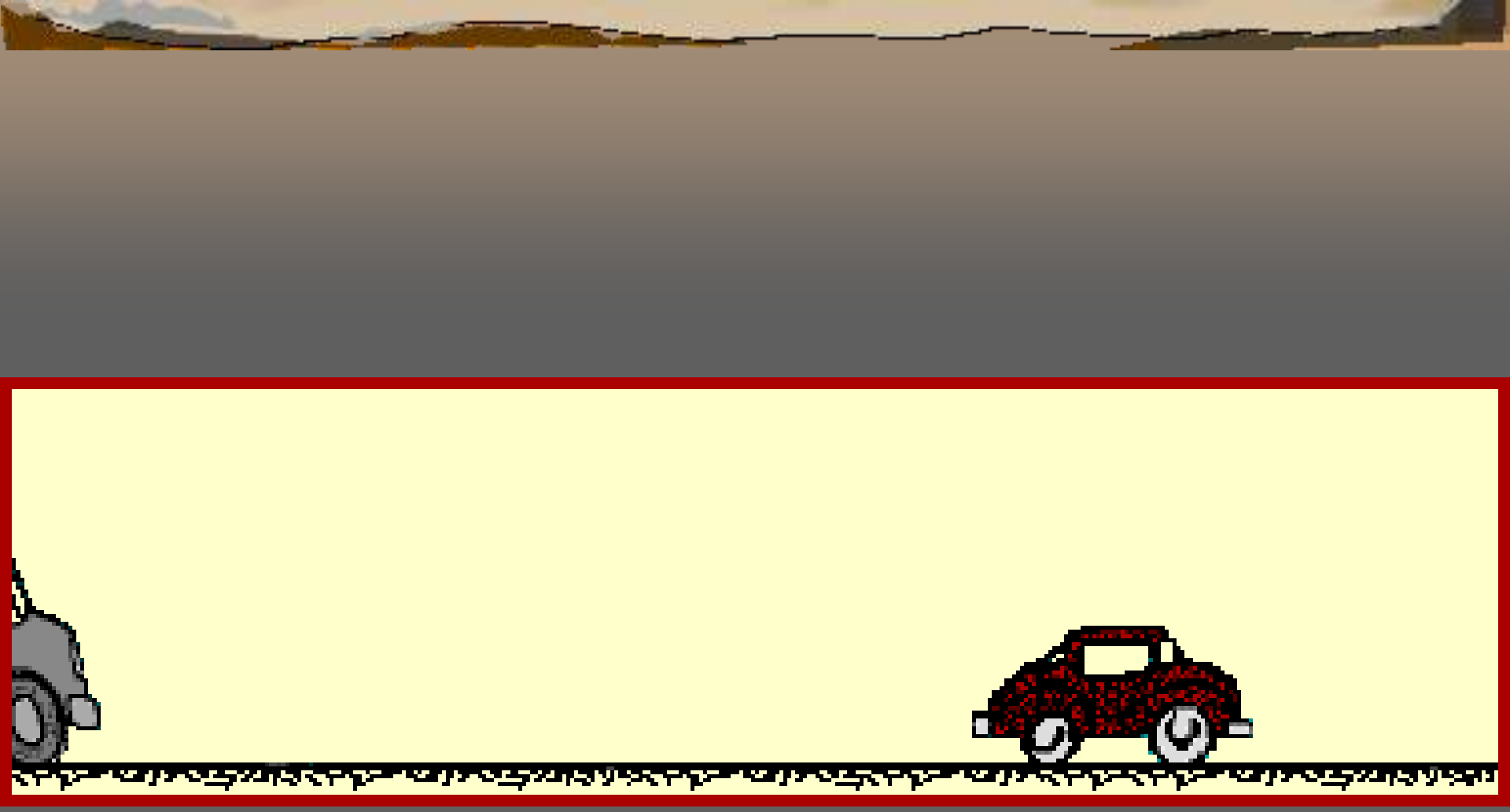
Momentum -

- mass on the move
- Momentum = mass x velocity
- P = m x v
- Law of Conservation of Momementum
  Total momentum does not change

Please Newton Stop Your Law!





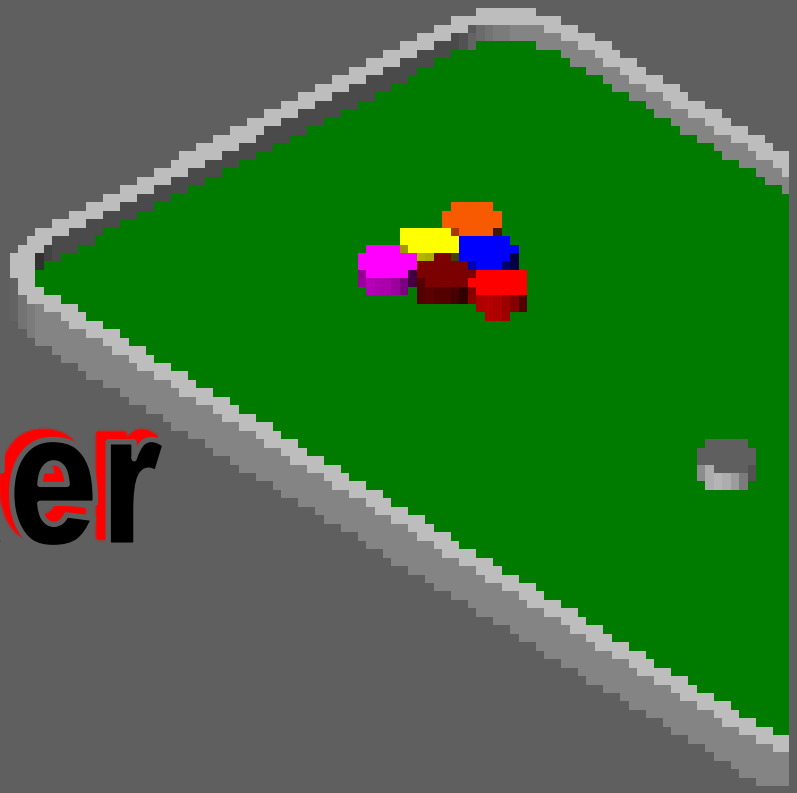


Inertia

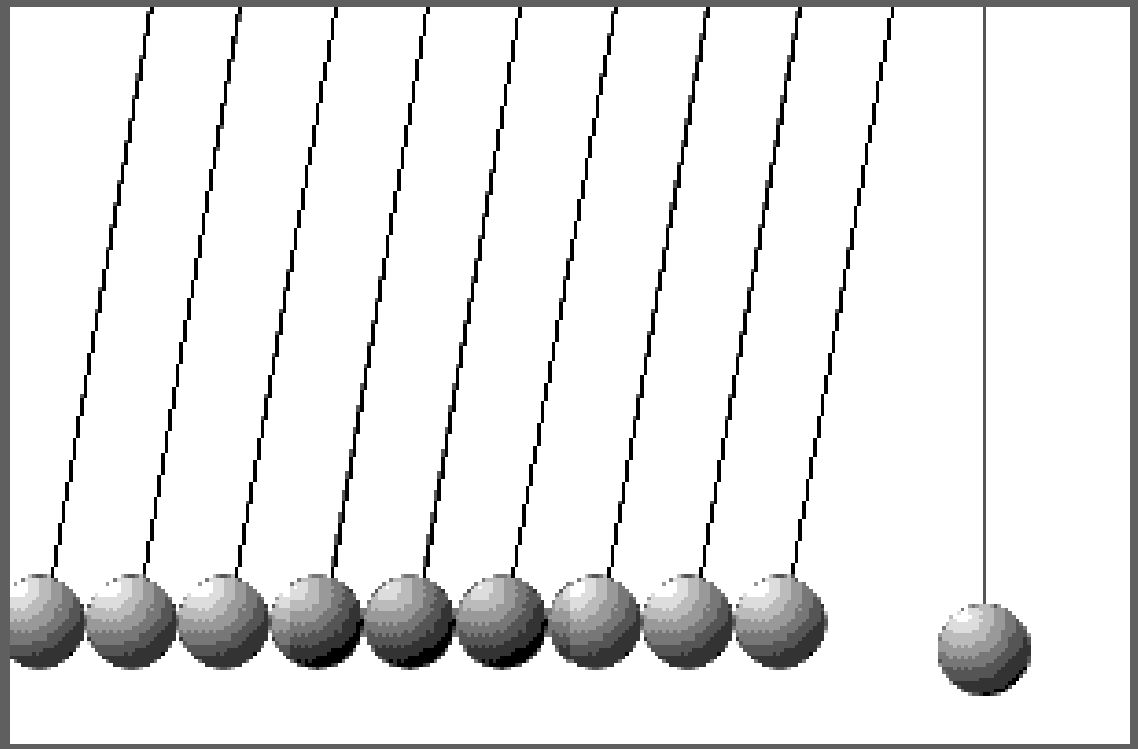
Inertia

Momentum

is the same before and after a collision



Momentum

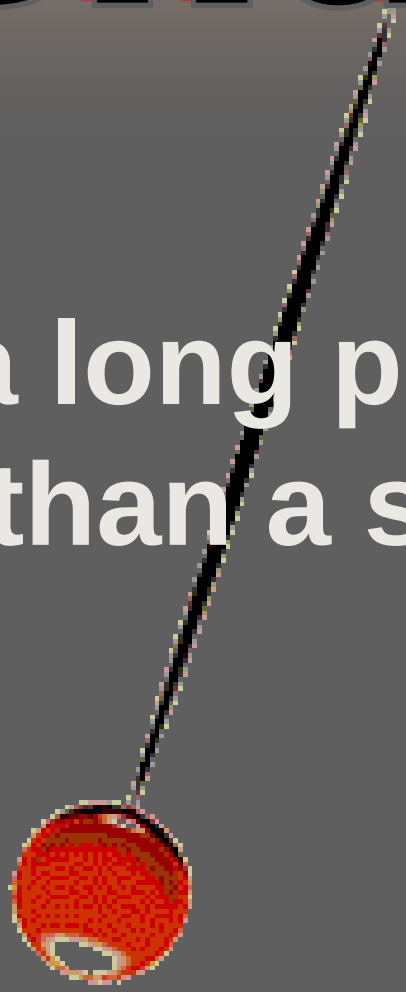


mass X velocity

Momentum

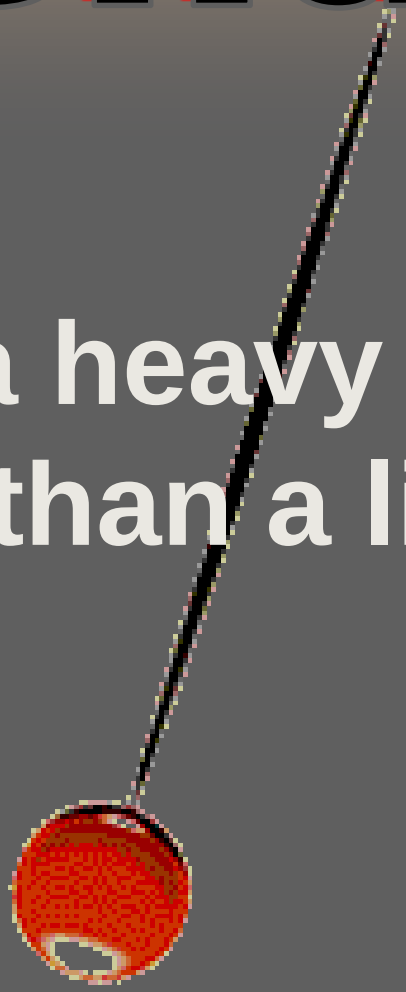
mass X velocity

Pendulum



Does a long pendulum swing faster than a short one?

Pendulum



Does a heavy pendulum swing faster than a light one?

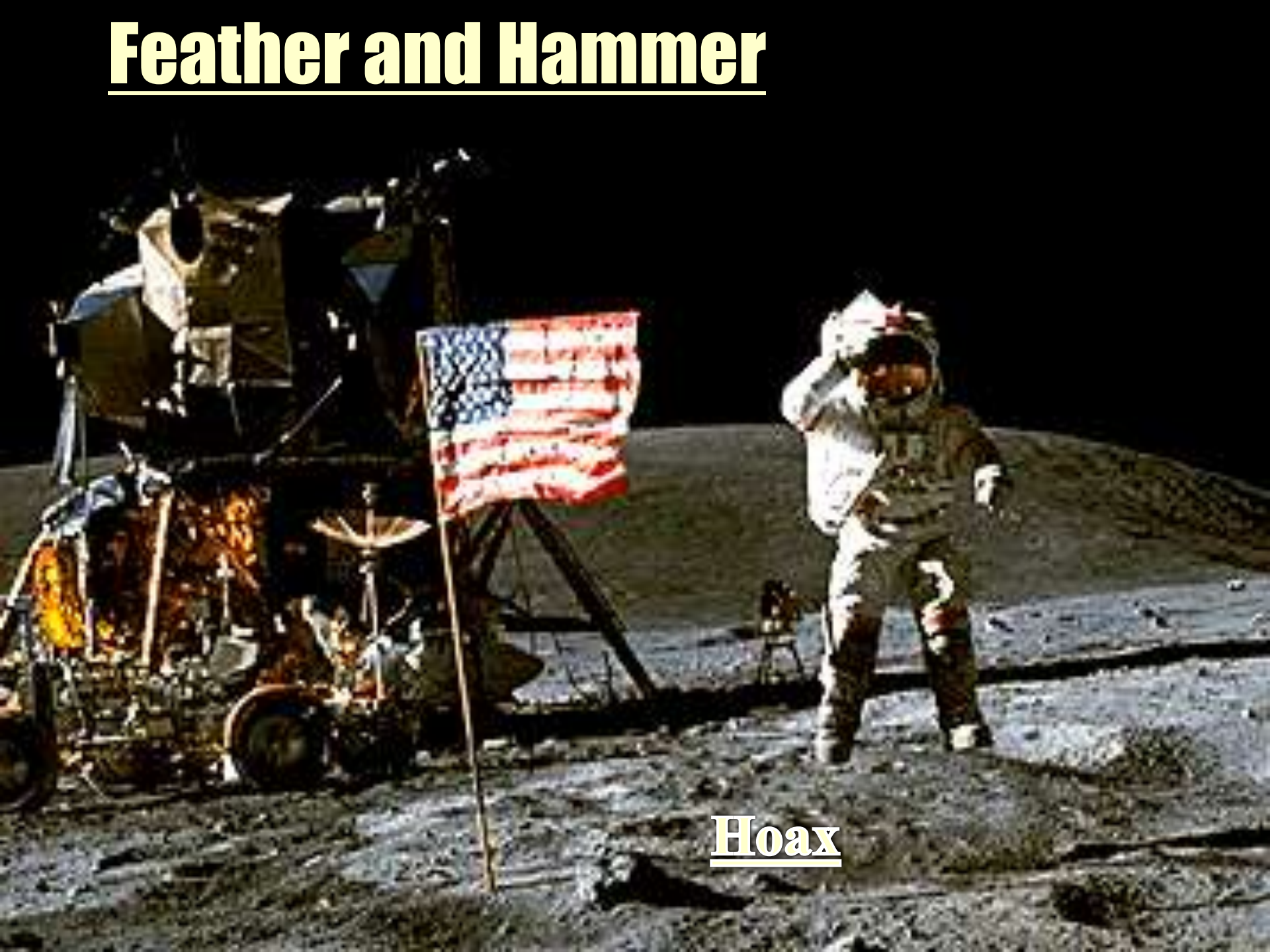
Conservation of Momentum

The total momentum of any group of objects remains the same unless acted on by outside forces.

If the boulder and the boy have the same momentum, will the boulder crush the boy?

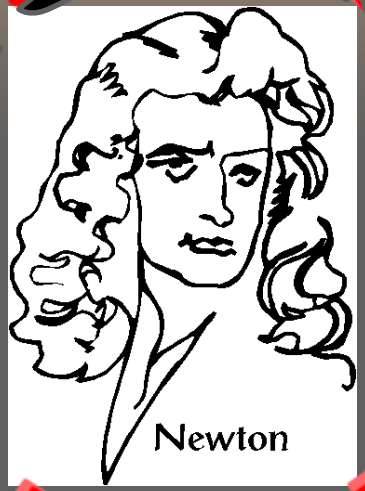
Hint: Which would have the larger speed?

Feather and Hammer



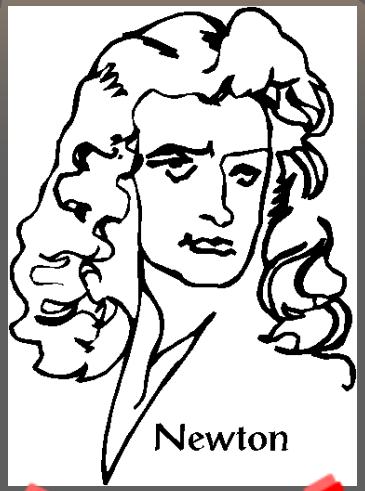
Newton's Laws

First Law of Motion



An object at rest will remain at rest, and a moving object will remain at a constant velocity unless acted on by unbalanced forces.

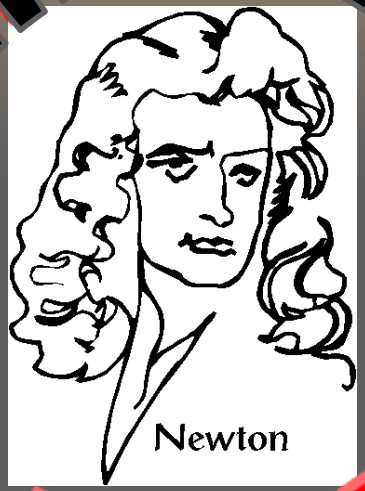
Second Law of Motion



$$F = Ma$$

Force = mass X acceleration

Third Law of Motion



For every action, there is an equal and opposite reaction.