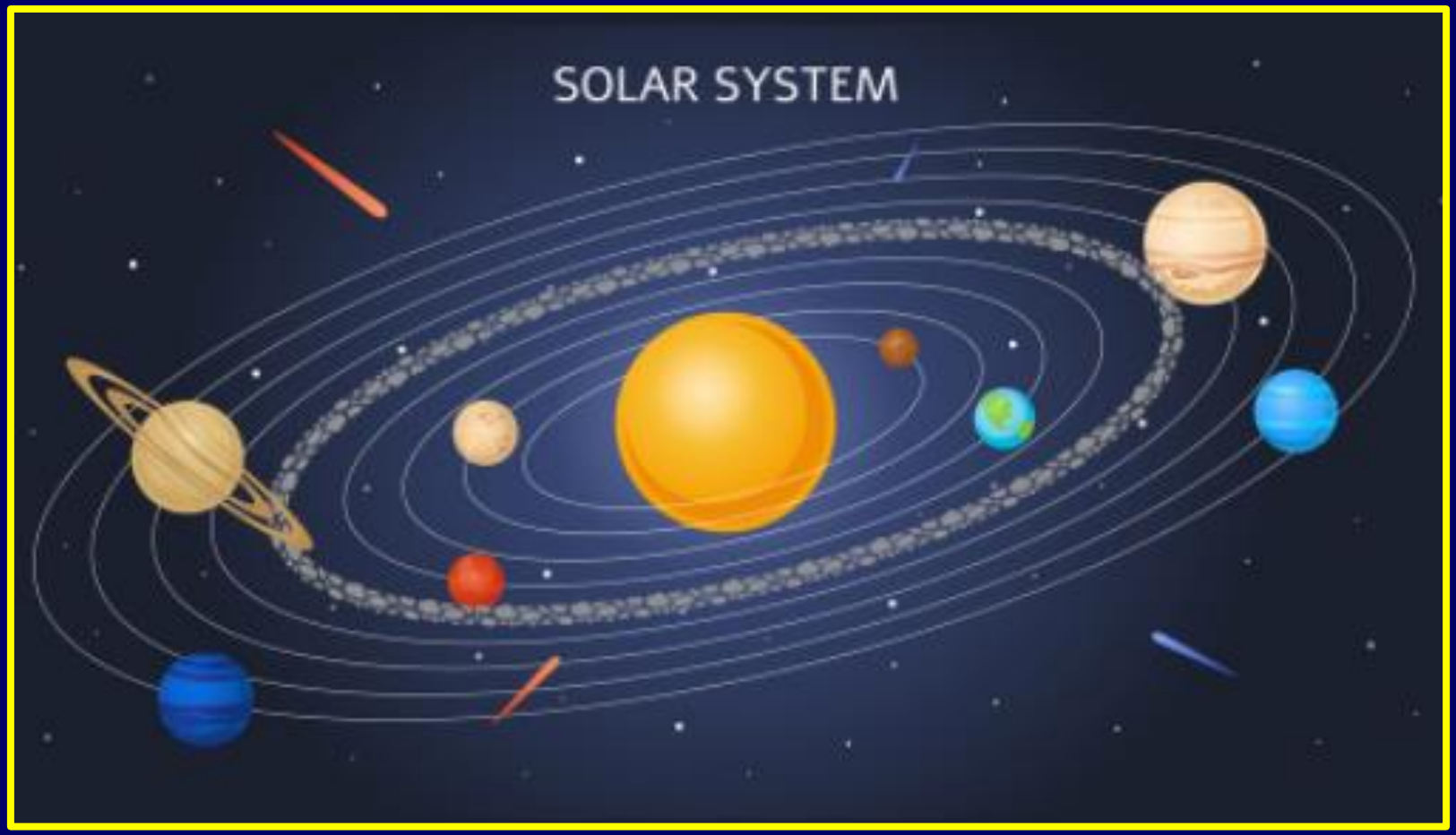
Orbital Motion



Essential Standard 1.1

Explain Earth's role as a body in space.

Objective 1.1.1:
Explain Earth's motion through space, including precession, nutation, the barycenter, and its path about the galaxy.

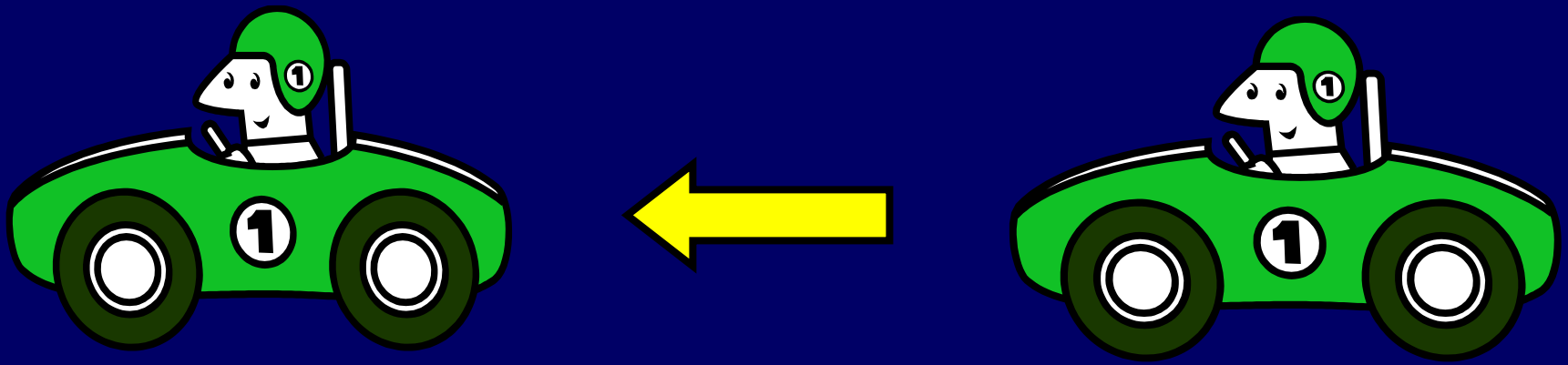
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can explain the Law of Inertia.
- I can explain The Law of Gravity and what causes gravity.
- I can explain how inertia forces and gravitational forces act together to produce orbital motion.

Motion

Motion refers to a change in position of an object.



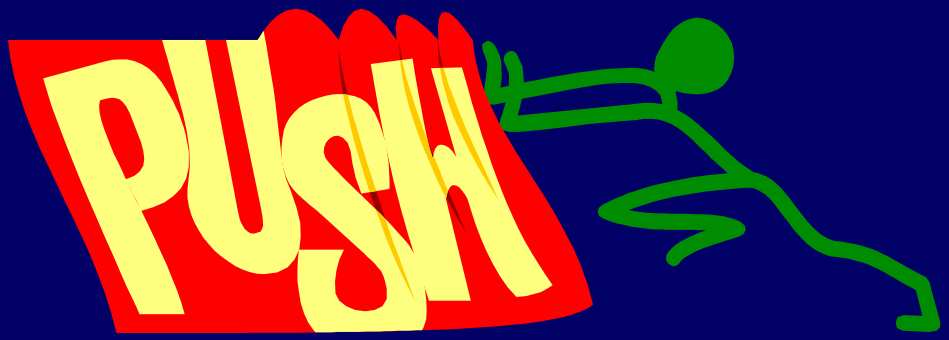
Ending Position

Starting Position

In order for motion to occur, a force must be applied.

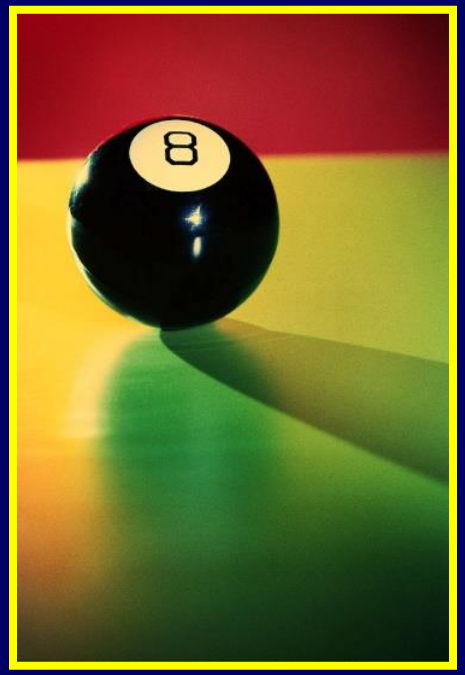
Force

A Force is a Push or Pull that One Object Exerts on Another.



Motion and Force

When a force is applied to an object, the direction of the motion will be in the same direction as the applied force.



Changing Motion

If an object is already in motion, the object will remain in motion, traveling in the same direction, unless another force is applied to change the direction of that motion.

Inertia

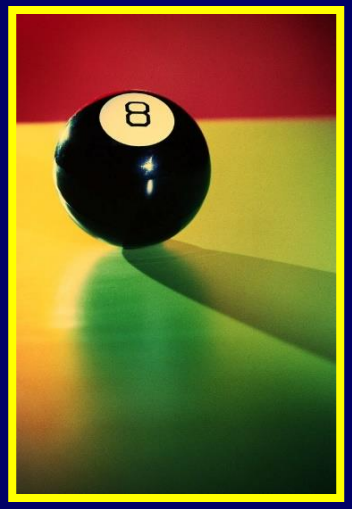
Inertia refers to an object's resistance to any change in motion.

These bowling pins could and would remain sitting in the exact same position forever.

But if enough force is applied to overcome their inertia force, then they will move.

Inertia

Part of an object's inertia is based on its mass.

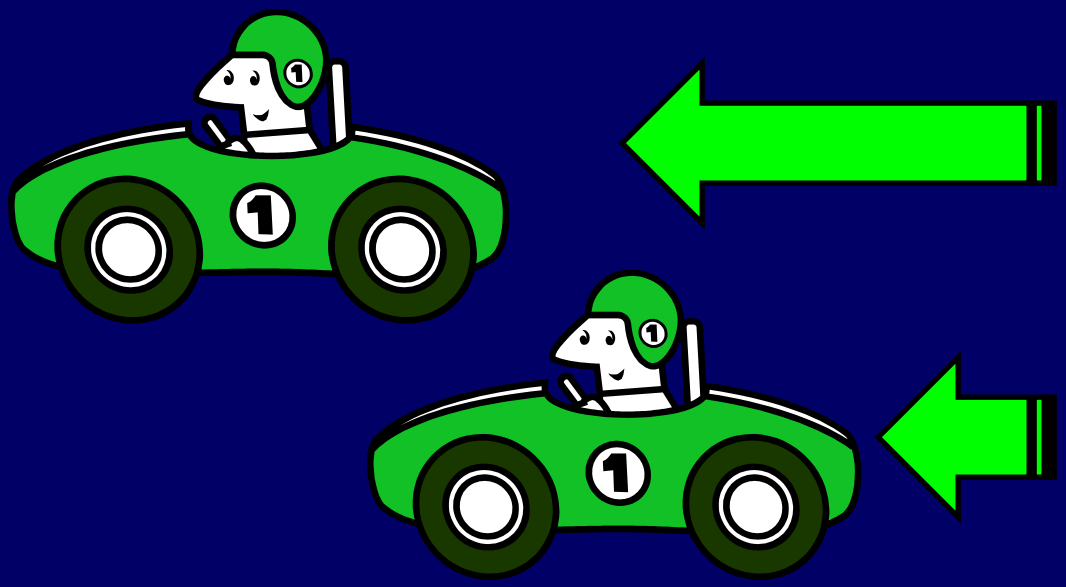


Since bowling ball has more mass than the eight ball, it would take more force to make the bowling ball move than it would the eight ball.

So, the bowling ball has more inertia.

Inertia

For objects in motion, part of its inertia is based on its speed.

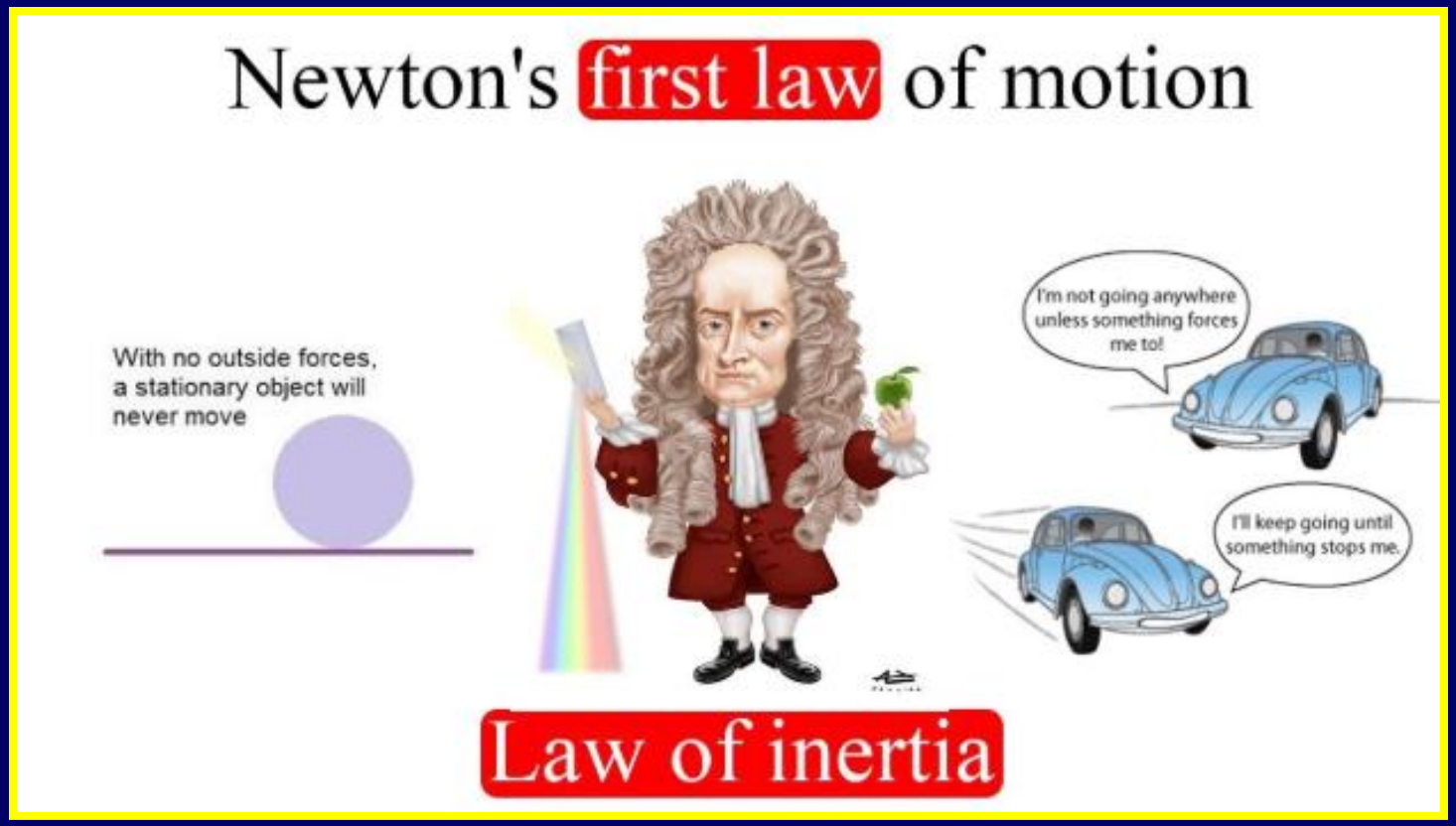


If mass was the same, an object traveling faster would be harder to stop than a sower traveling object.

A faster moving object has more inertia than a slower moving object and so requires more force to make it change its motion.

Law of Inertia

The relationship between motion and forces is known as Newton's First Law of Motion or the Law of Inertia.

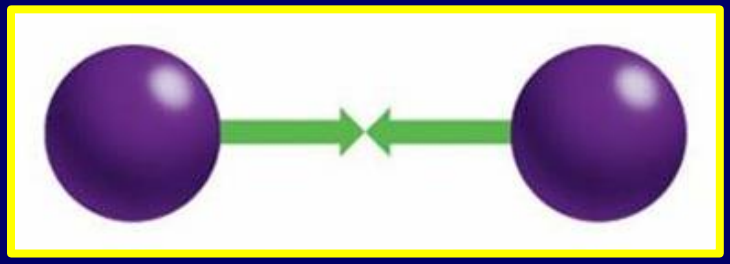


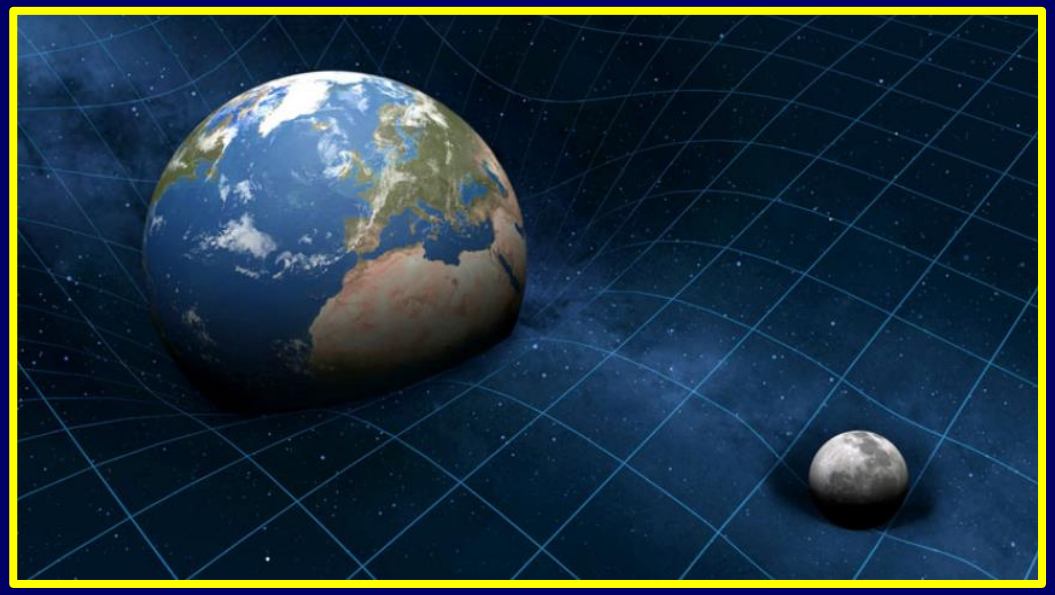
Law of Inertia

The Law of Inertia states that an object at rest will remain at rest and an object in motion will remain in motion, unless acted upon by a force.

Gravity

Gravity is an attraction force or a pulling force that exists between any two objects.



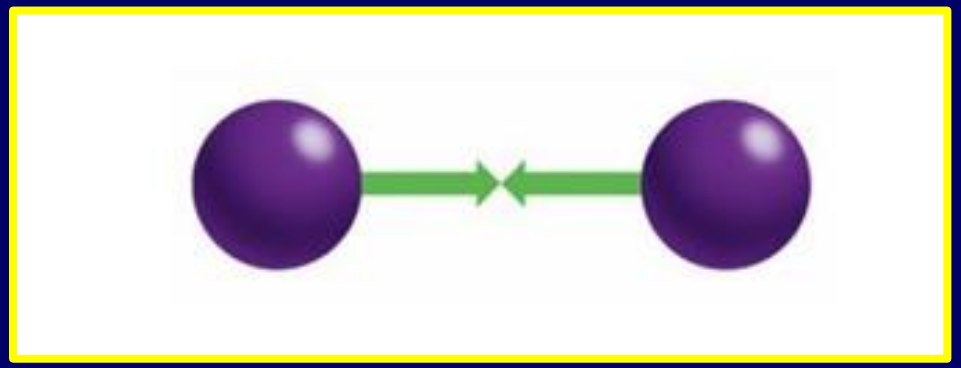


Gravity is due to the bending of space, with larger objects bending space more than smaller objects.

Gravitational Force

Gravitational force refers to the amount of force that exists between any two objects and is based on the mass of the objects and the distance between them.

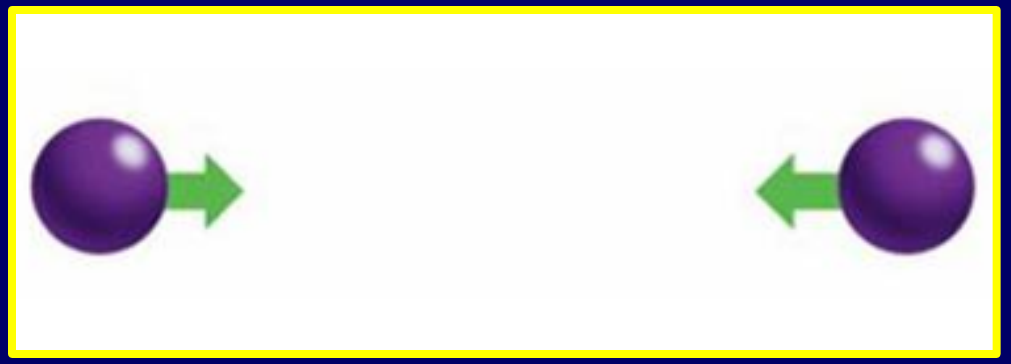
Gravitational force is small when both masses are small.



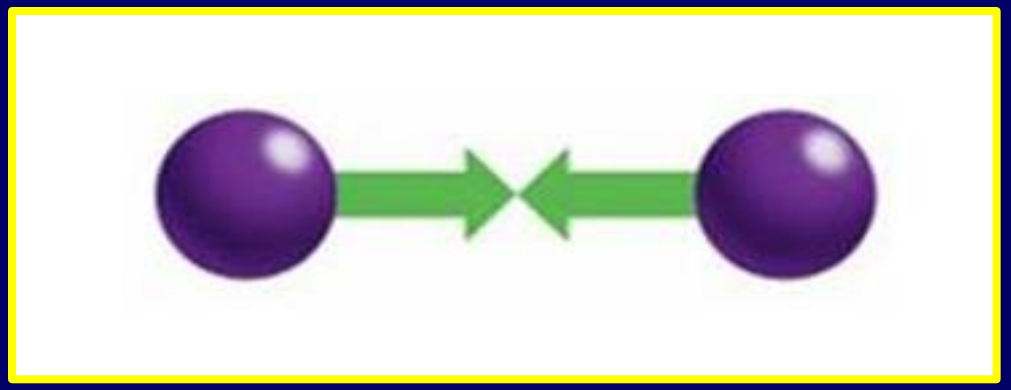
Gravitational force is large when both masses are large.

Gravitational Force

The amount of gravitation force between two objects also depends upon the distance between the two objects.



Gravitational force is small when the distance is large.



Gravitational force is large when the distance is small.

Law of Gravity

The Law of Gravity shows this relationship in an equation, where the gravitational force is equal to the sum of both masses divided by the distance between the masses.

$$Fg = \frac{M_1 M_2}{r^2}$$

Fg – Gravitational Force

M_1 – Mass of 1st Object

M_2 – Mass of 2nd Object

r^2 – Distance

Law of Gravity

Since both mass and gravitational force are in the numerators of the equation, they are proportional.

$$F_g = \frac{M_1 M_2}{r^2}$$

As mass increases, so does the gravitational force.

Law of Gravity

Since gravitational force is in the numerator and distance is in the denominator, they are inversely proportional to each other.

$$F_g = \frac{M_1 M_2}{r^2}$$

As distance increases, the gravitational force decreases.

Law of Gravity

Also, since distance is squared, it means the effect of distance is exponentially greater on gravitational force than the effect of mass.

$$F_g = \frac{M_1 M_2}{r^2}$$

Law of Gravity

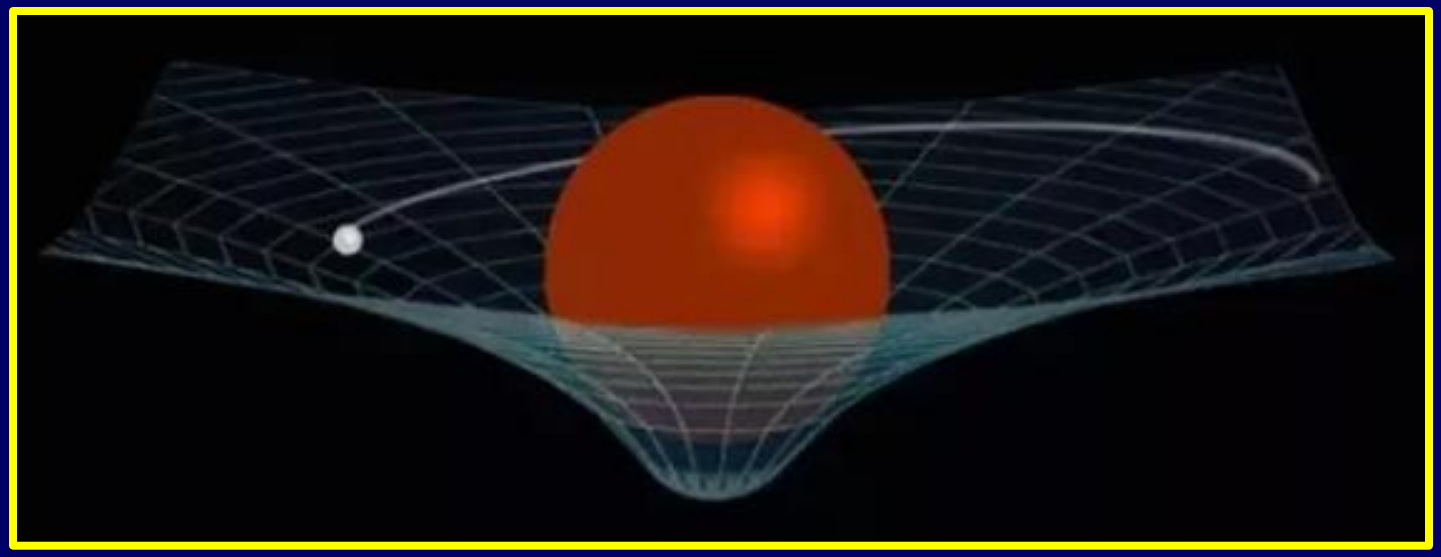
The relationships exhibited in the Law of Gravity explains why the Moon has more gravitational pull on Earth's oceans than the Sun.

$$F_g = \frac{M_1 M_2}{r^2}$$

Even though the Moon is much smaller than the Sun, the Moon is much closer, so the gravitational force between the Earth and Moon is greater.

Effect of Gravity

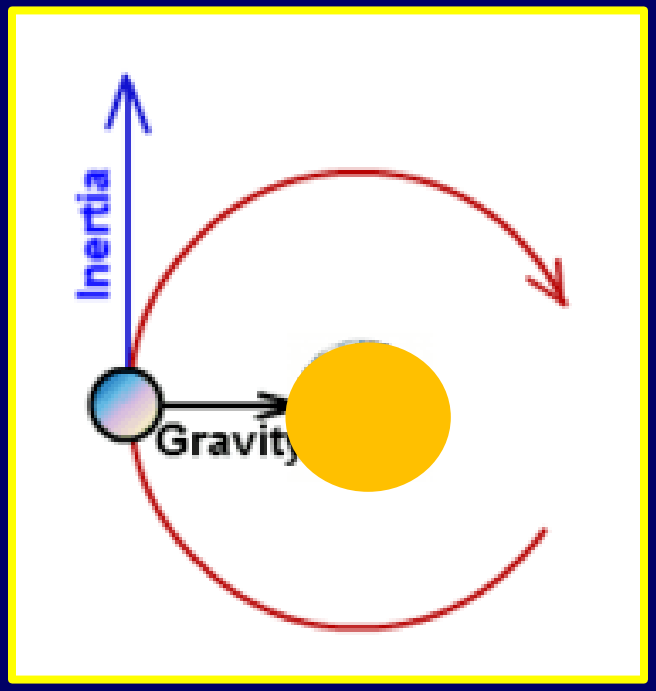
When an object traveling in space encounters another object, gravity causes the traveling object to be pulled towards the other object.



Closer distances and more massive objects will generate greater pulling forces.

Inertia and Gravity

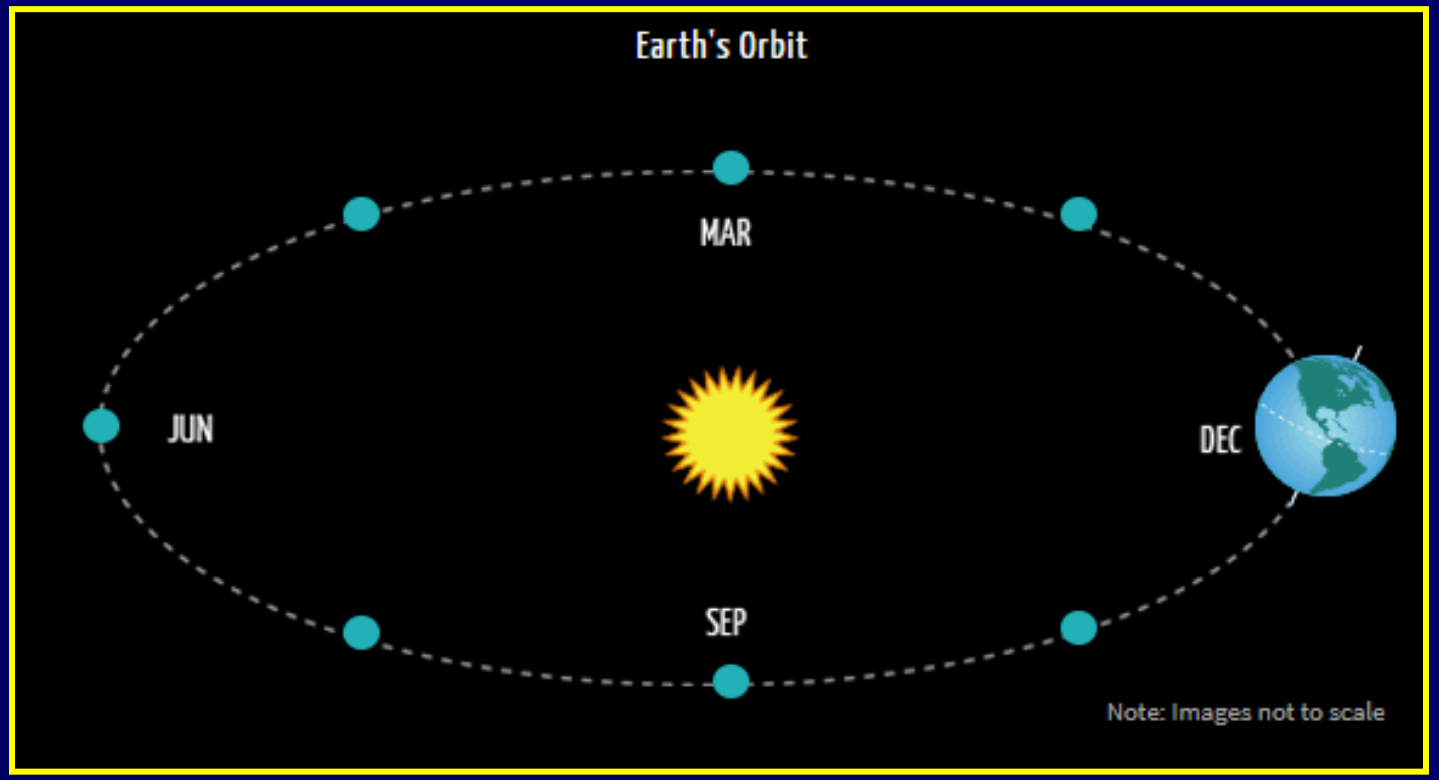
Due to inertia, planets would move in a straight line, but gravity pulls the planets towards the Sun, the balance of both inertia and gravity causes the planets to follow a circular path around the Sun.



We call this circular path an orbit.

One Year

The Earth orbits the Sun, every 365.25 days, or each year.



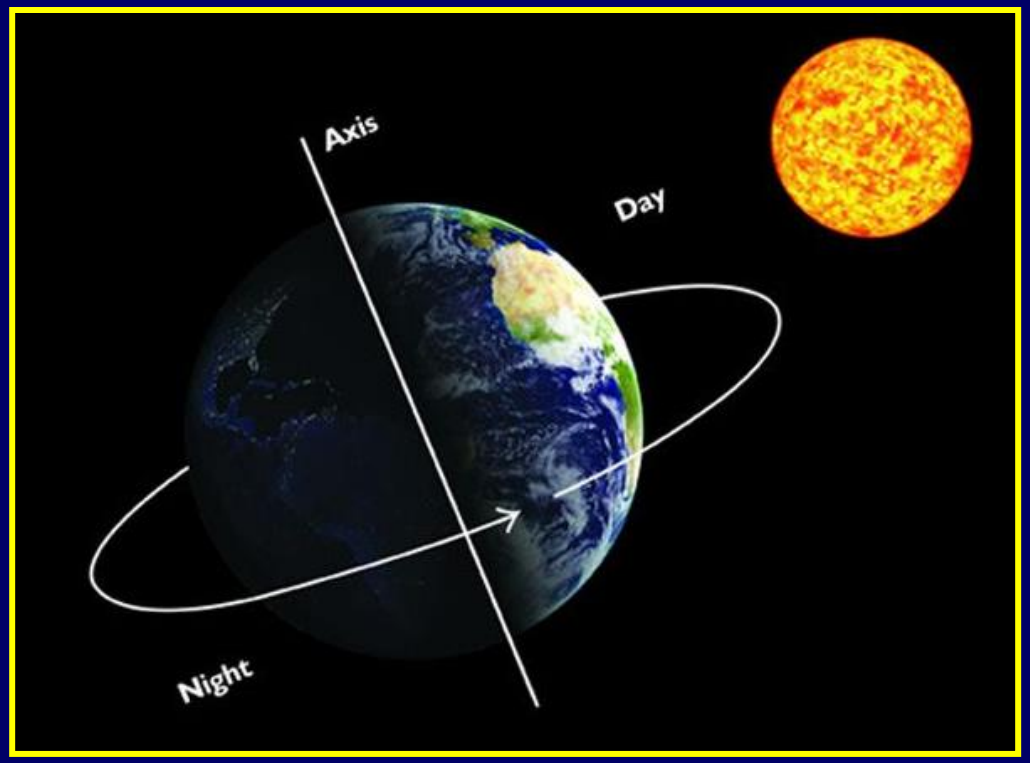
Leap Year

To account for the 0.25, one day is added to the calendar every four years.

We call that day a leap day and the year it occurs a leap year.

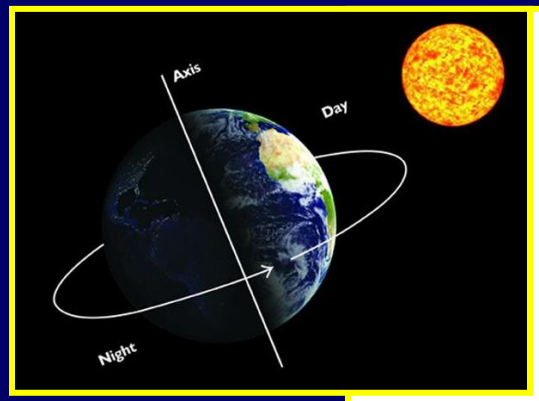
Earth's Rotation

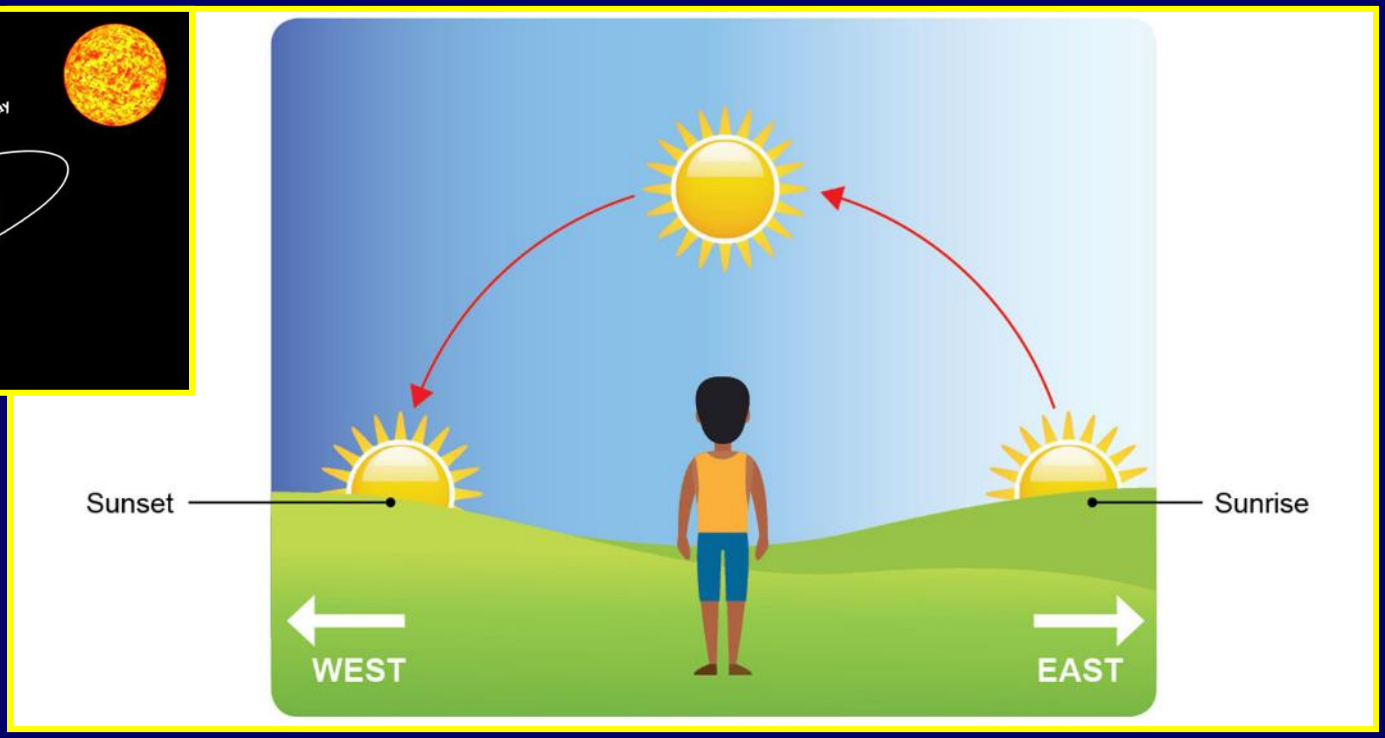
As the Earth orbits the Sun, the Earth also rotates around its own axis, every 24 hours or one day.



Counter-Clockwise Rotation

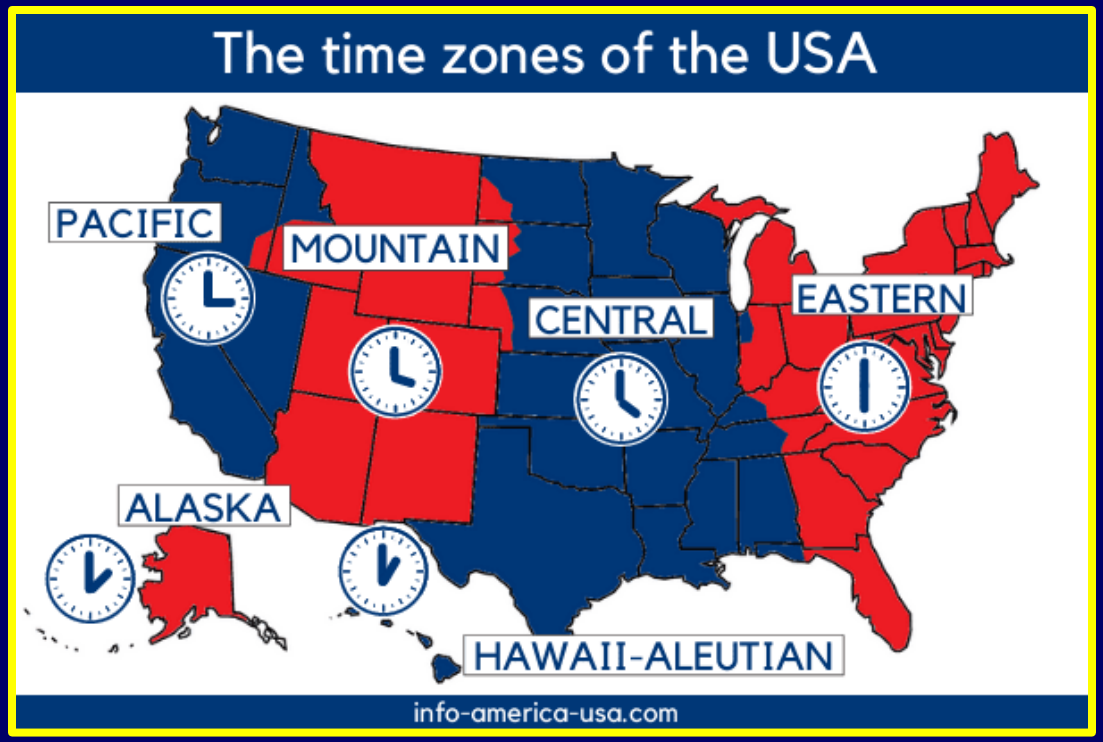
Earth rotates in a counter-clockwise direction, causing the Sun to rise in the East and set in the West.





Time Zones

Because the Sun rises at different times across the 50 states, 6 different time zones were established.



The End