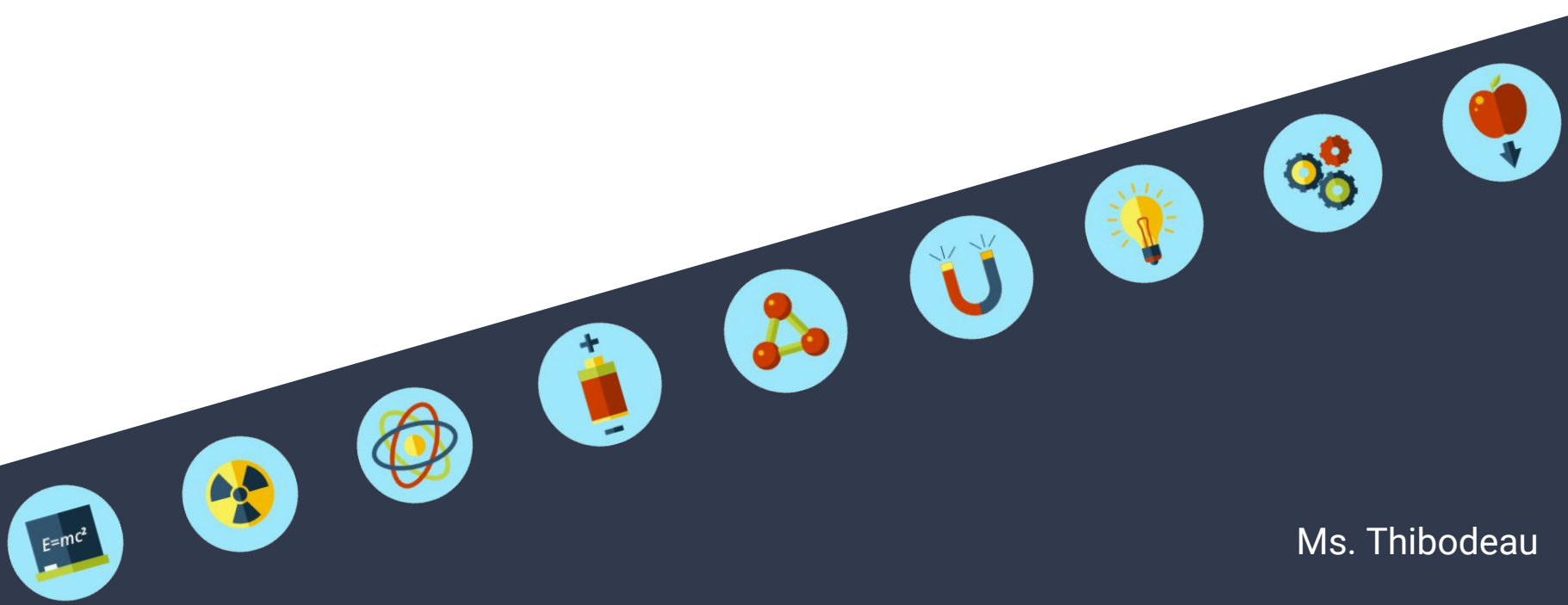
# The History of Motion




Ms. Thibodeau

# Aristotle

Aristotle aka “the Philosopher” was a Greek philosopher more than 2500 years ago.

He wrote on many subjects including physics, poetry, music, theater, logic, metaphysics, rhetoric, ethics and politics.

Aristotle’s work in physics is popular around the world and prevailed for many years until being replaced by modern physics.


# Aristotle and Science

Aristotle believed in qualitative data, collecting data through observation. He did not test his observations or try to repeat any ideas experimentally.

His influence on the world of science declined when mathematicians and scientists began to emphasize quantitative observations and mathematical calculations.

# Aristotle and Motion

Aristotle wondered how an object would behave if it were free of any constraints or forces acting on it.

Aristotle explained the physics behind motion as as “what goes up, must come down”

I.e. He believed that all objects had a “natural” motion toward the centre of the universe (earth).

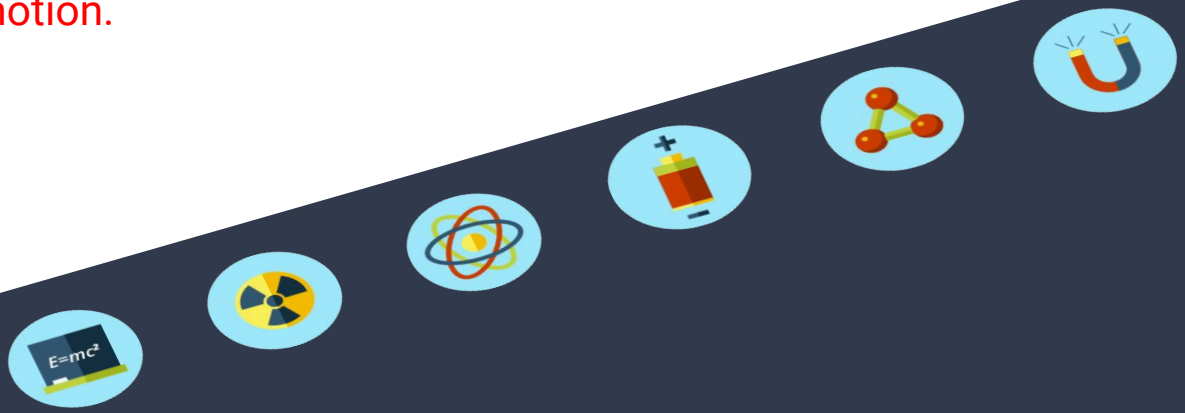

# Aristotle and Motion

Aristotle believed that the speed at which an object moved towards the earth was based on its mass.

He also believed that any sideways motion would require a force to be acting on it.

Ex. Pushing a book across a table.

Aristotle believed that you must apply a force to move an object and continue to apply this force to keep the object in motion.




# About Galileo...

Galileo Galilei was born in Italy and lived from 1564 - 1642.

Galileo was an astronomer, physicist, mathematician, philosopher and inventor.

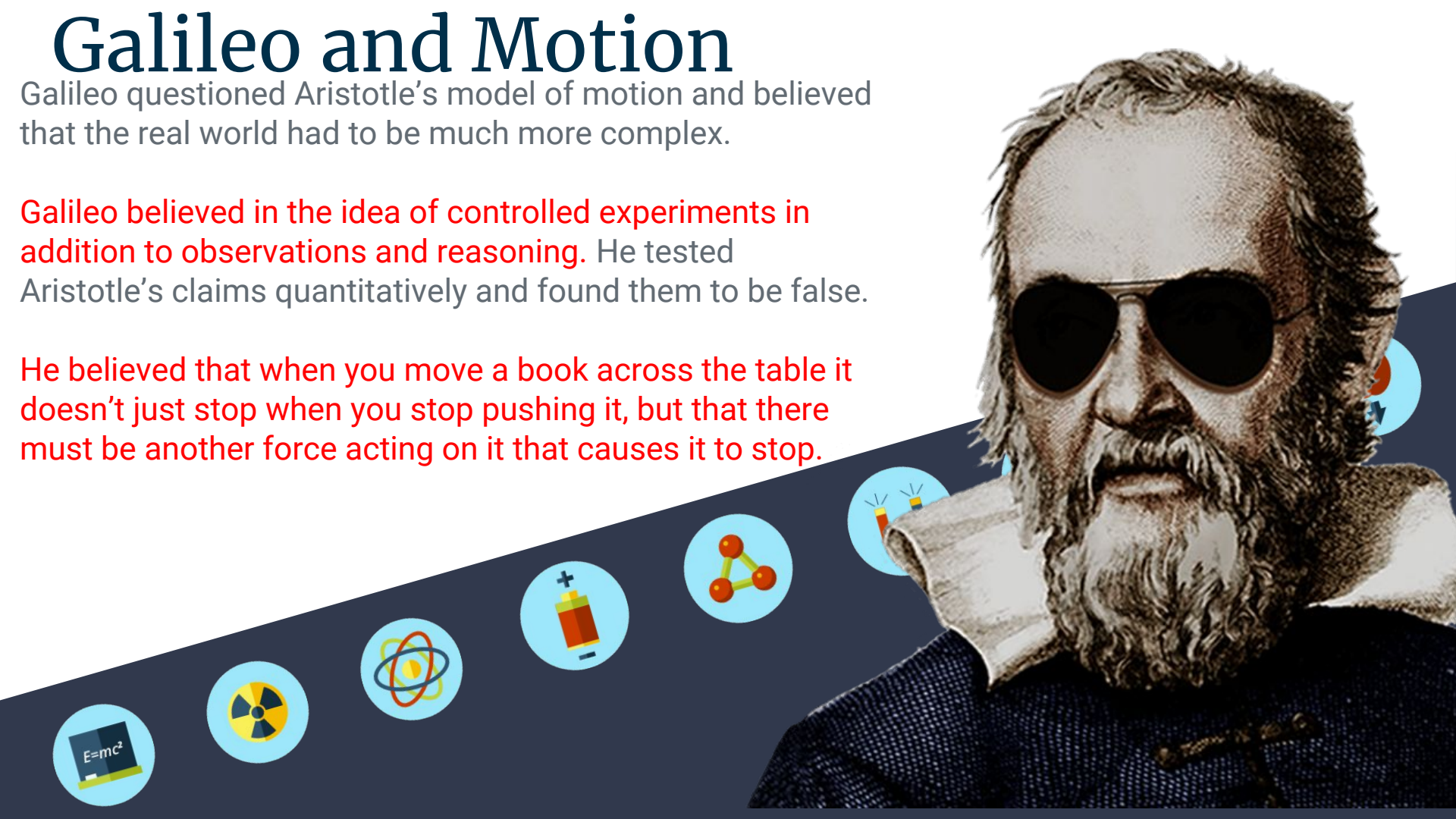
His most famous inventions are the telescope, the compass, and the thermometer.

# Galileo and Motion

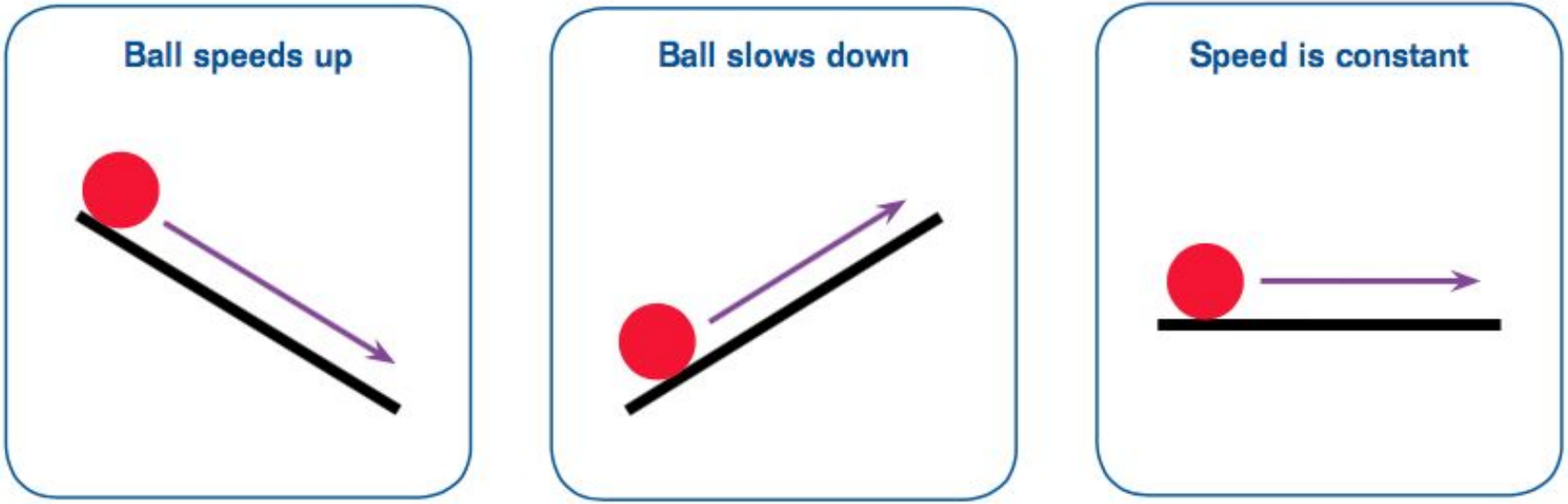
Galileo questioned Aristotle's model of motion and believed that the real world had to be much more complex.

Galileo believed in the idea of controlled experiments in addition to observations and reasoning. He tested Aristotle's claims quantitatively and found them to be false.

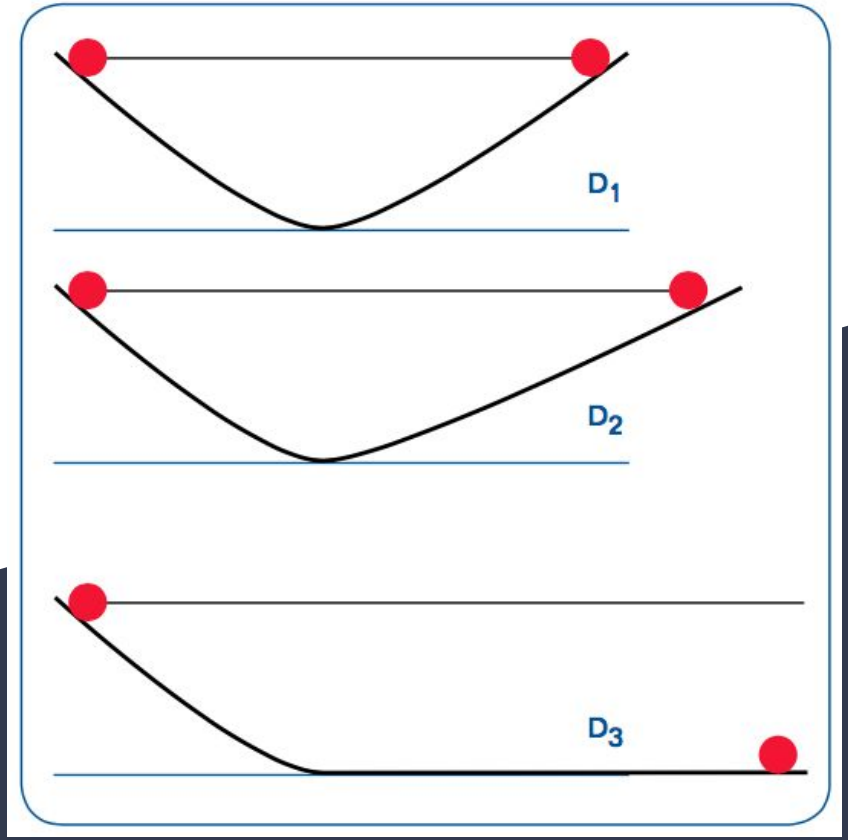
He believed that when you move a book across the table it doesn't just stop when you stop pushing it, but that there must be another force acting on it that causes it to stop.



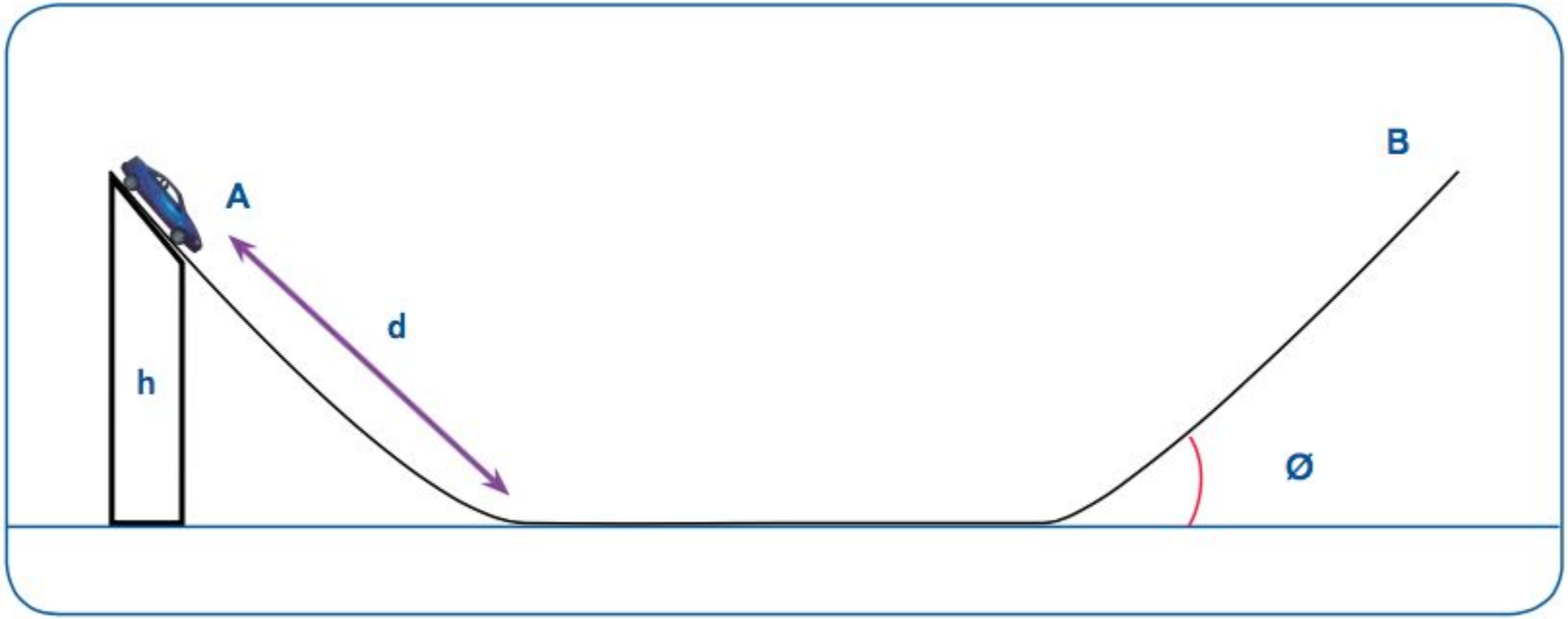
# Galileo's Thoughts on Motion



# Galileo’s Thoughts on Motion



# Thought Experiment Real Life

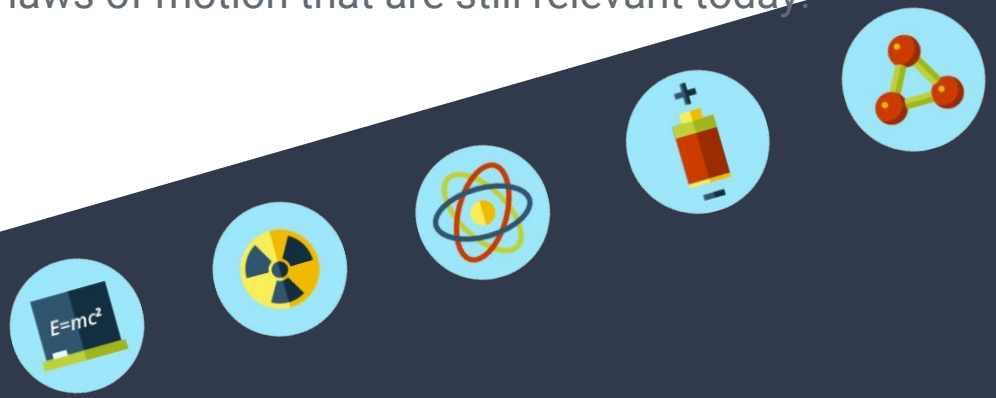


# About Newton...

Sir Isaac Newton lived from 1642-1727

Newton was an English philosopher and is one of science's many influential theorists.

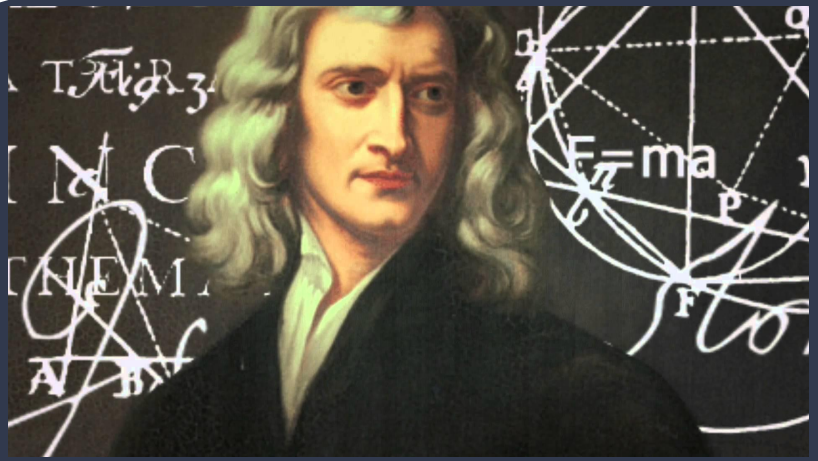
In 1686 Newton published the "Principia Mathematica Philosophiae Naturalis" also known as the "Principia." This included his 3 laws of motion that are still relevant today!

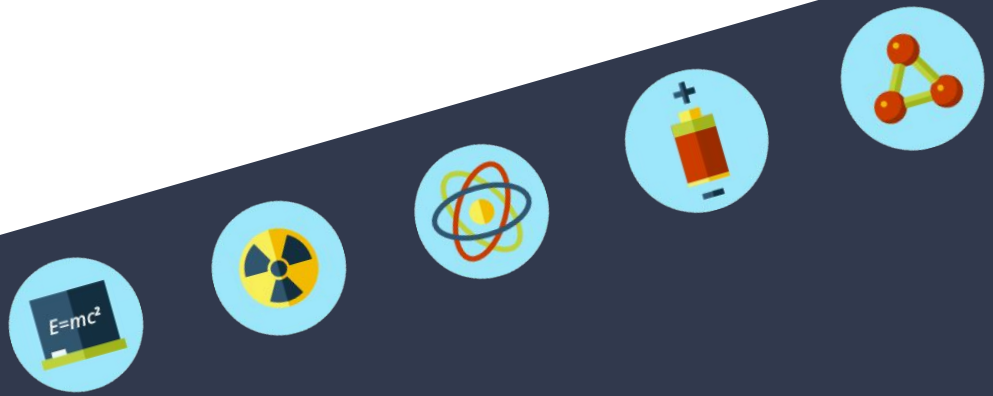



# Newton and Motion

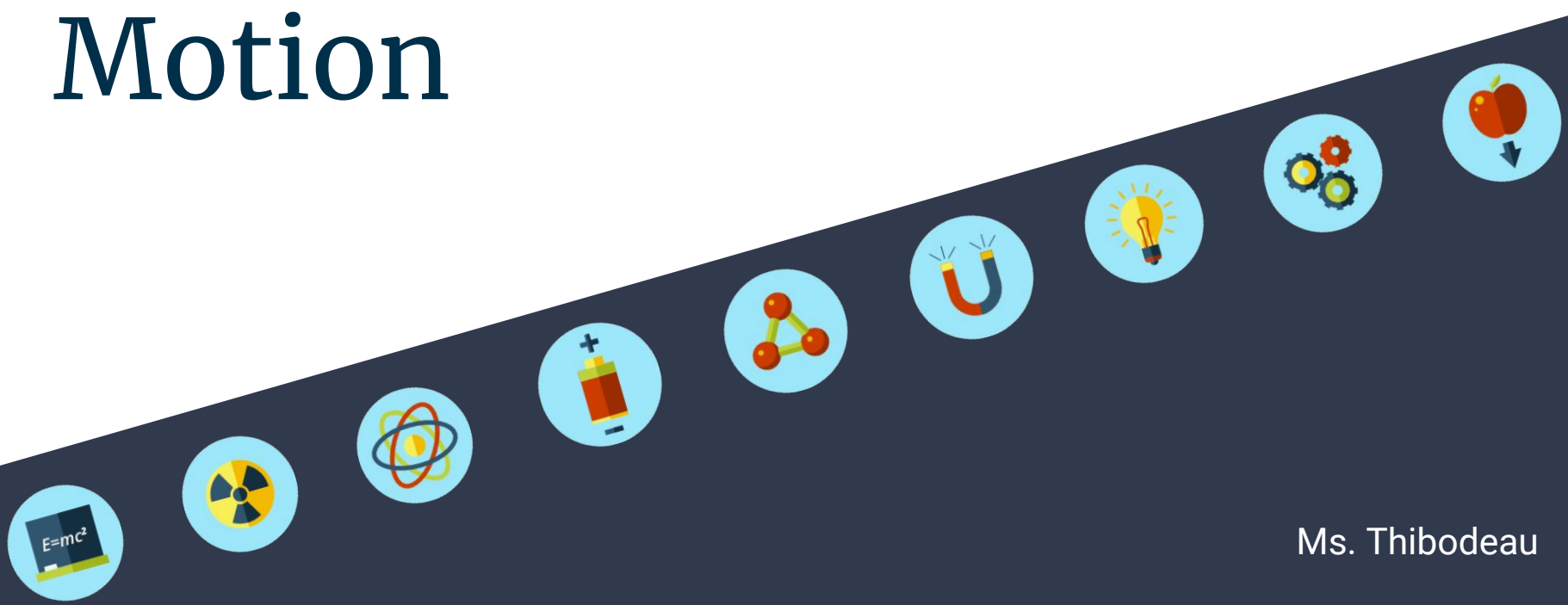
Galileo had a great idea about natural motion, but it was Rene Descartes who built on Galileo's idea that the natural tendency of a moving object was really in a straight line.

It was then Newton who compiled these ideas about forces and motion in his famous book "Principia" giving him the credit of the three laws of motion.



# Newton's First Law of Motion

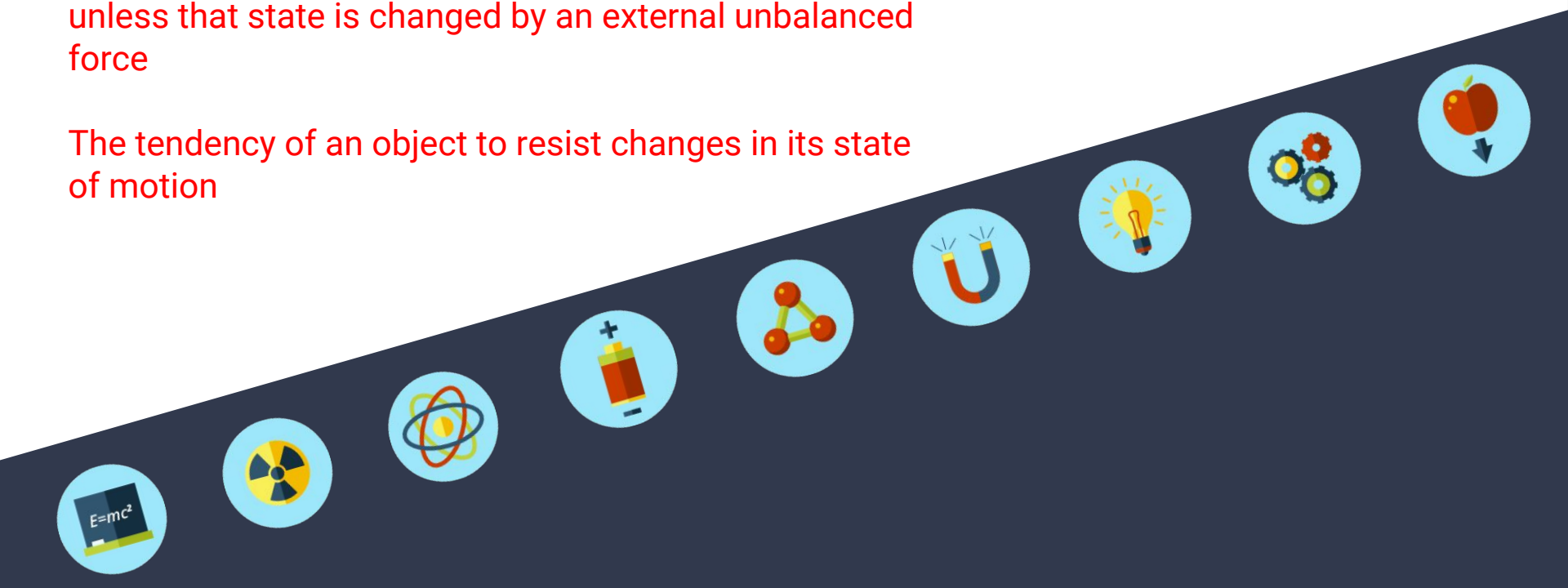



Ms. Thibodeau

# What is Inertia?

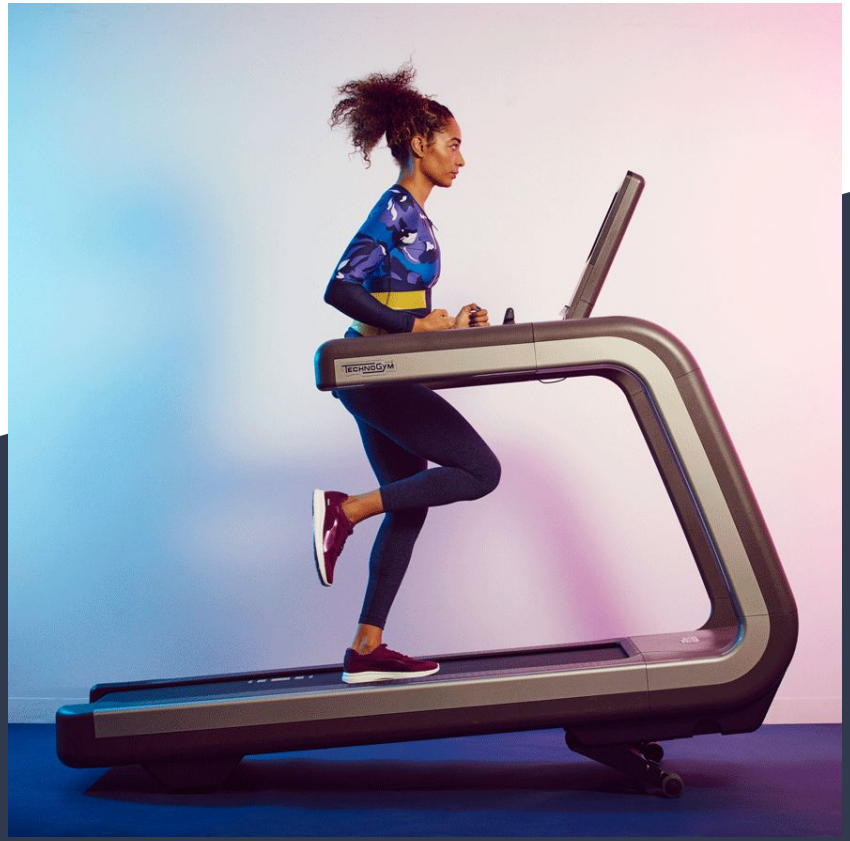
Inertia is a property of matter by which it continues in its existing state of **rest** or **uniform straight line motion**, unless that state is changed by an external unbalanced force

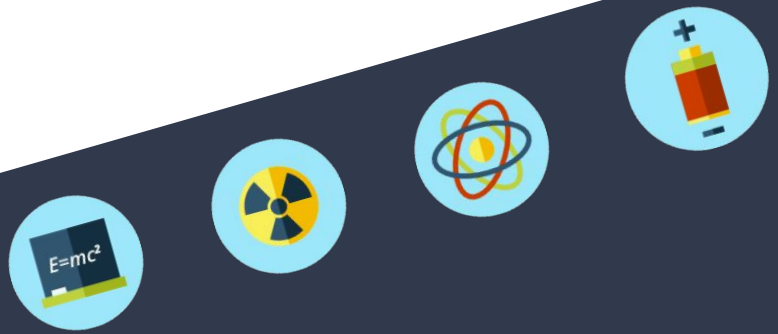
The tendency of an object to resist changes in its state of motion



# What is Uniform Straight Line Motion?

**Uniform straight line motion** is the motion of an object that has constant velocity (both in magnitude and direction) or zero acceleration.

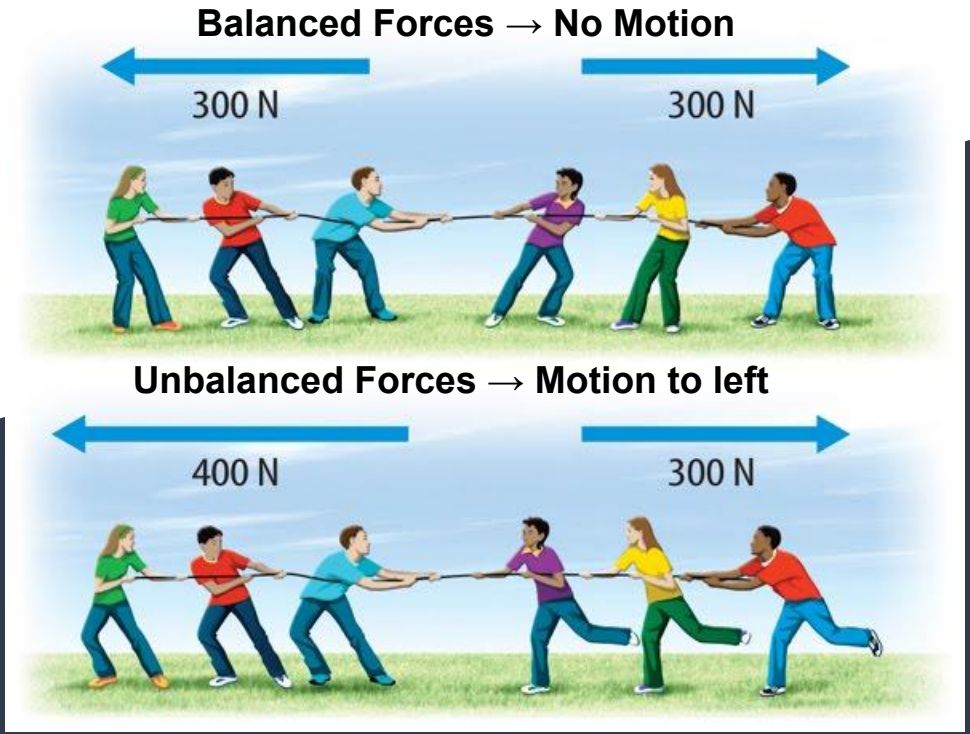


# Balanced vs. Unbalanced Forces

When **balanced forces** act on an object at rest, the object will not move.

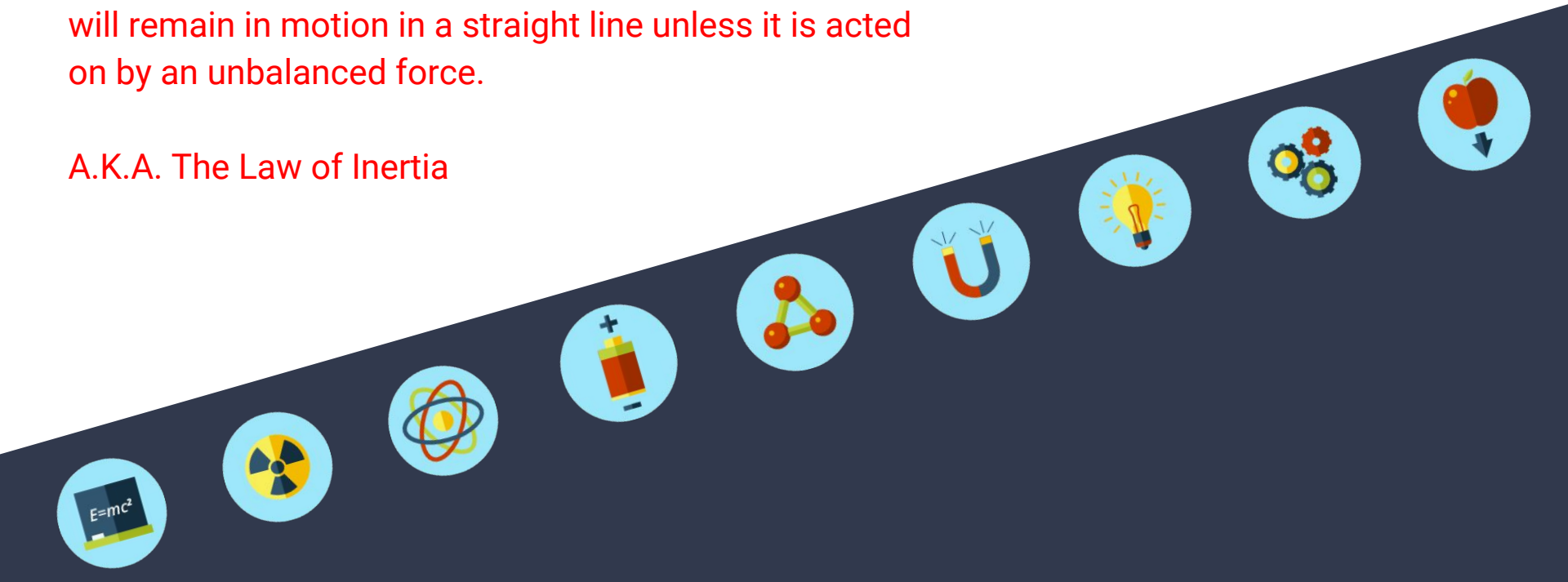
Forces that cause a change in the motion of an object are **unbalanced forces**.



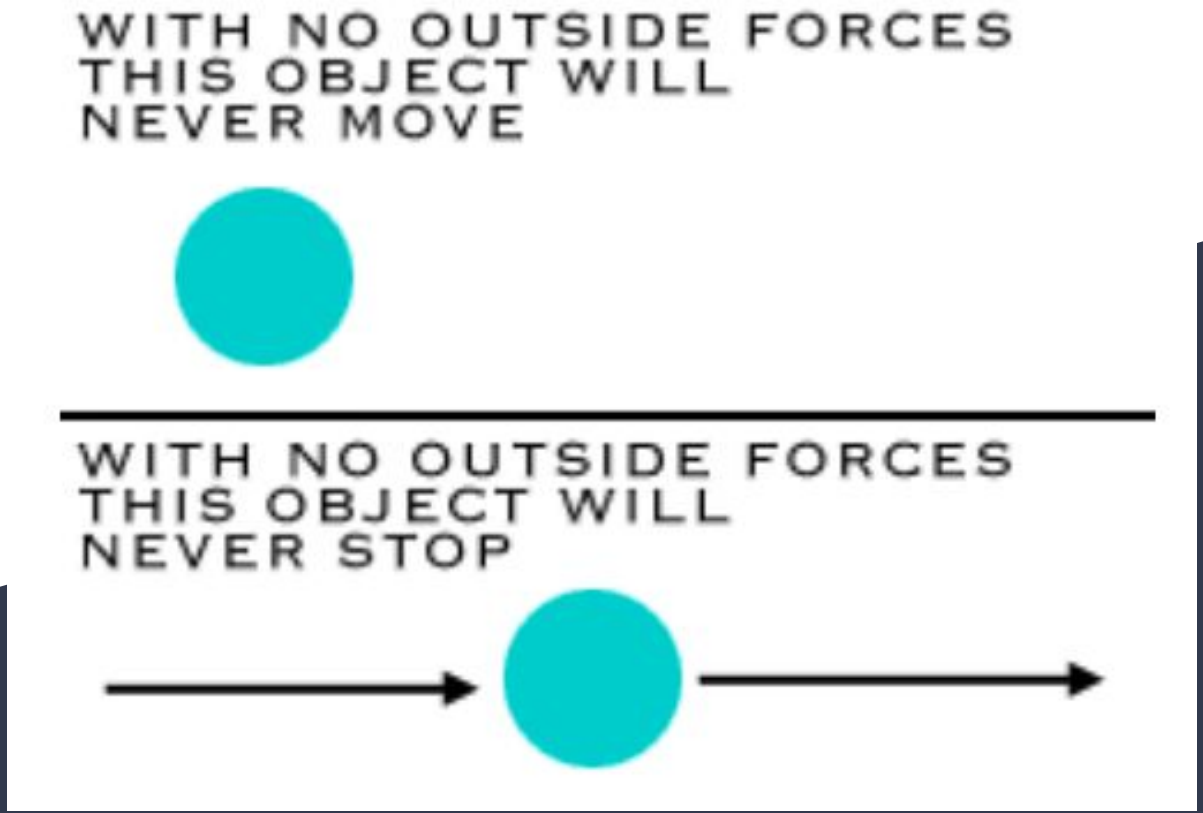

# Newton’s First Law

Objects at rest will remain at rest and objects in motion will remain in motion in a straight line unless it is acted on by an unbalanced force.

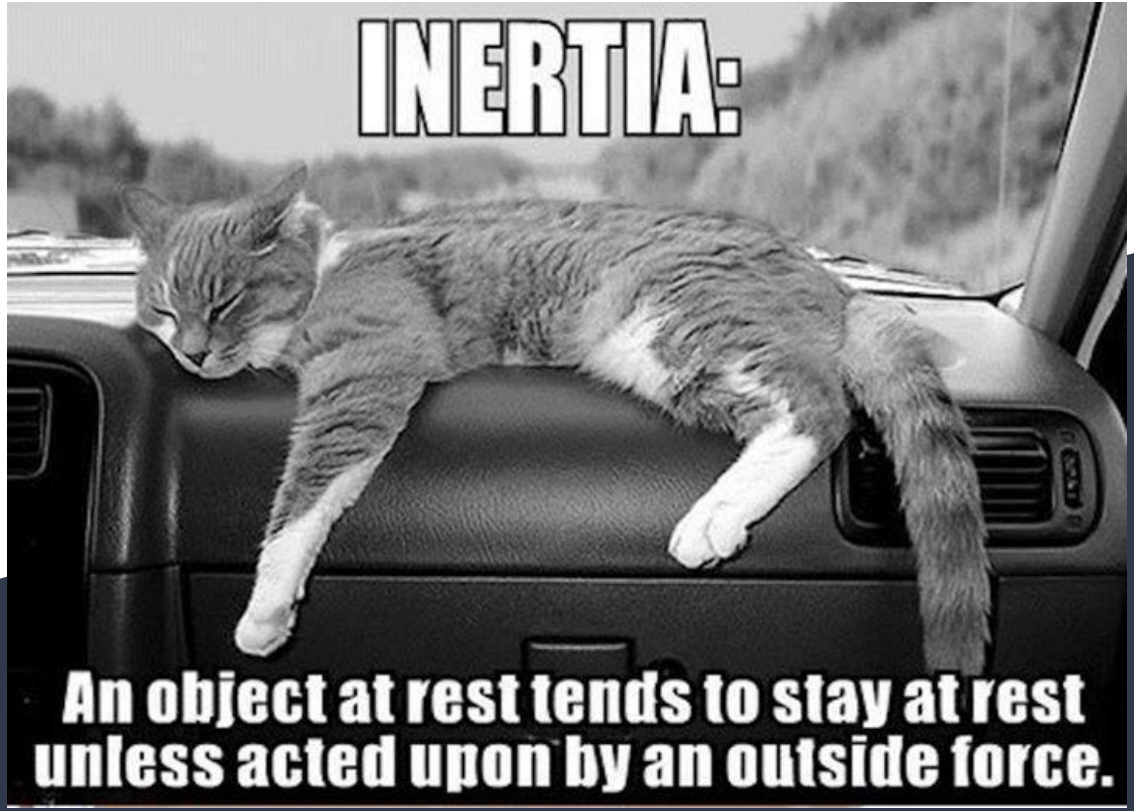
A.K.A. The Law of Inertia



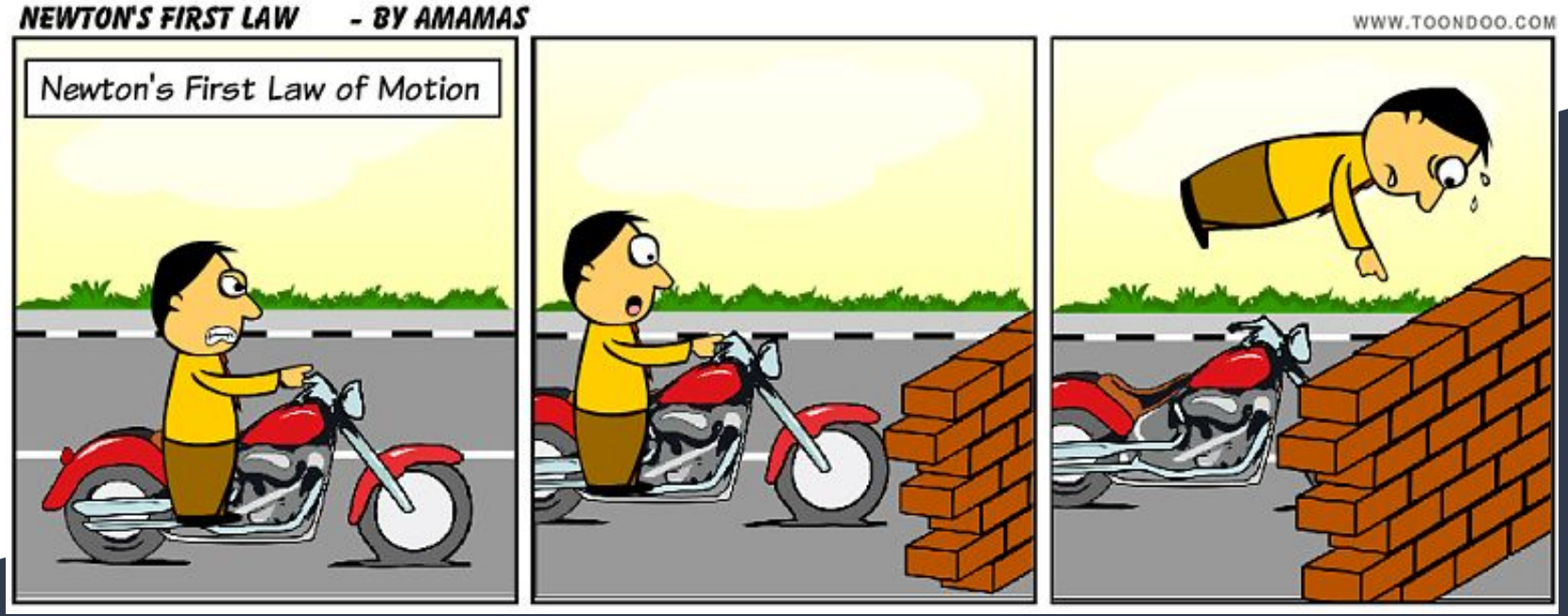
# The Law of Inertia Says...



# Inertia: At Rest



# Inertia: Uniform Straight Line Motion



# Newton’s 1st Law Example


4GIFs
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# Newton’s 1st Law Demo

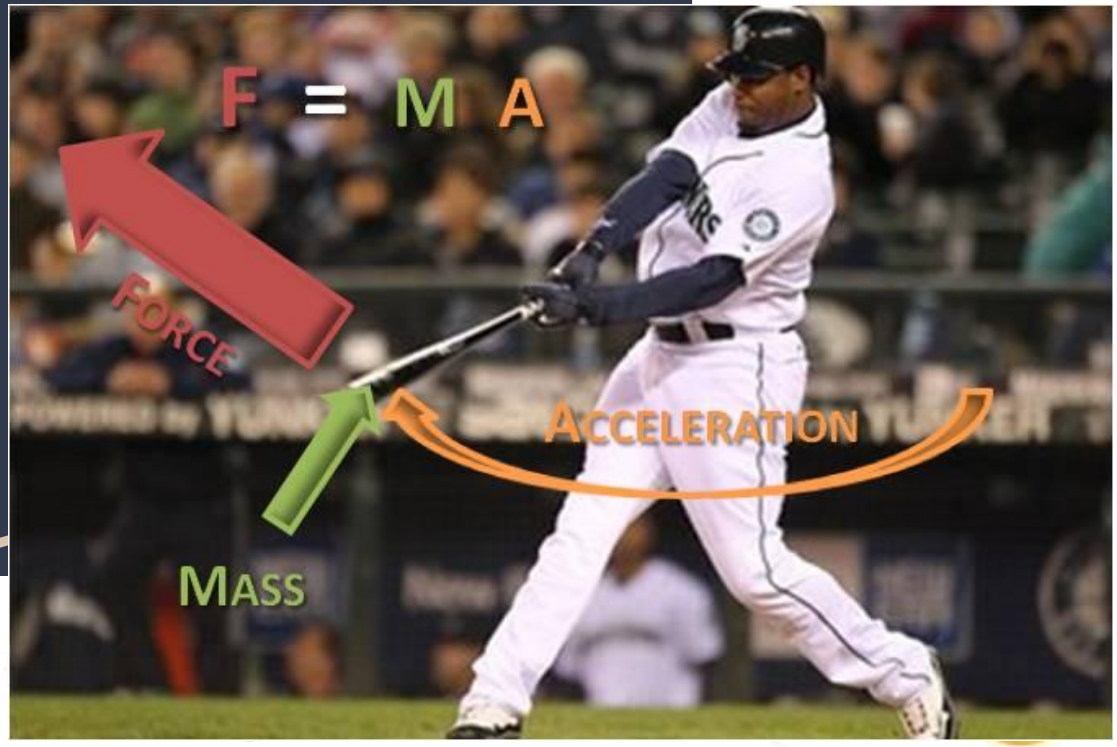
# Inertia Example

https://www.youtube.com/watch?v=KcPjVz4pTEg

# Newton's Second Law

When an unbalanced force acts on an object, the object will accelerate in the direction of the force according to the relationship:

**F** = m**a**



# Newton's Second Law Units

**F** → Force measured in Newtons (N)
m → mass measured in kilograms (kg)
**a** → acceleration measured in metres per second squared (m/s^2)

N = kg•m/s^2

# What is Force?

A force is any kind of interaction on an object.

Simply applying a force does not mean that an object will move (ex. Pushing on a wall)

Force relates to the mass of an object. Those the more massive an object, the more force required to change its velocity (hence its acceleration)

$$\vec{F} = m\vec{a}$$

# Downward Acceleration on Earth

Earth has a constant acceleration a.k.a. gravity.

That means that all objects on earth will fall towards the centre of the earth at a constant rate if they both start at the same initial velocity.

Earth's acceleration due to gravity is -9.81m/s^2

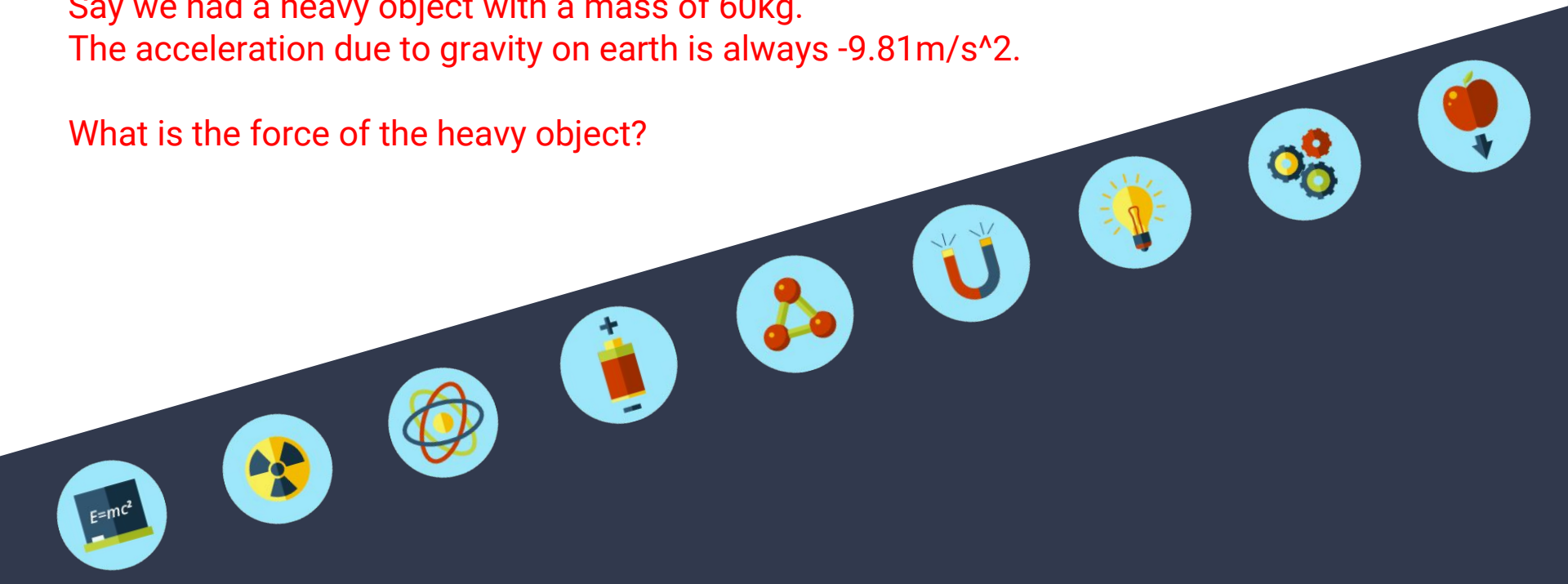
# Why does this work?

# Calculations using Newton's 2nd Law

**F** = m**a**

Say we had a heavy object with a mass of 60kg.
The acceleration due to gravity on earth is always -9.81m/s^2.

What is the force of the heavy object?

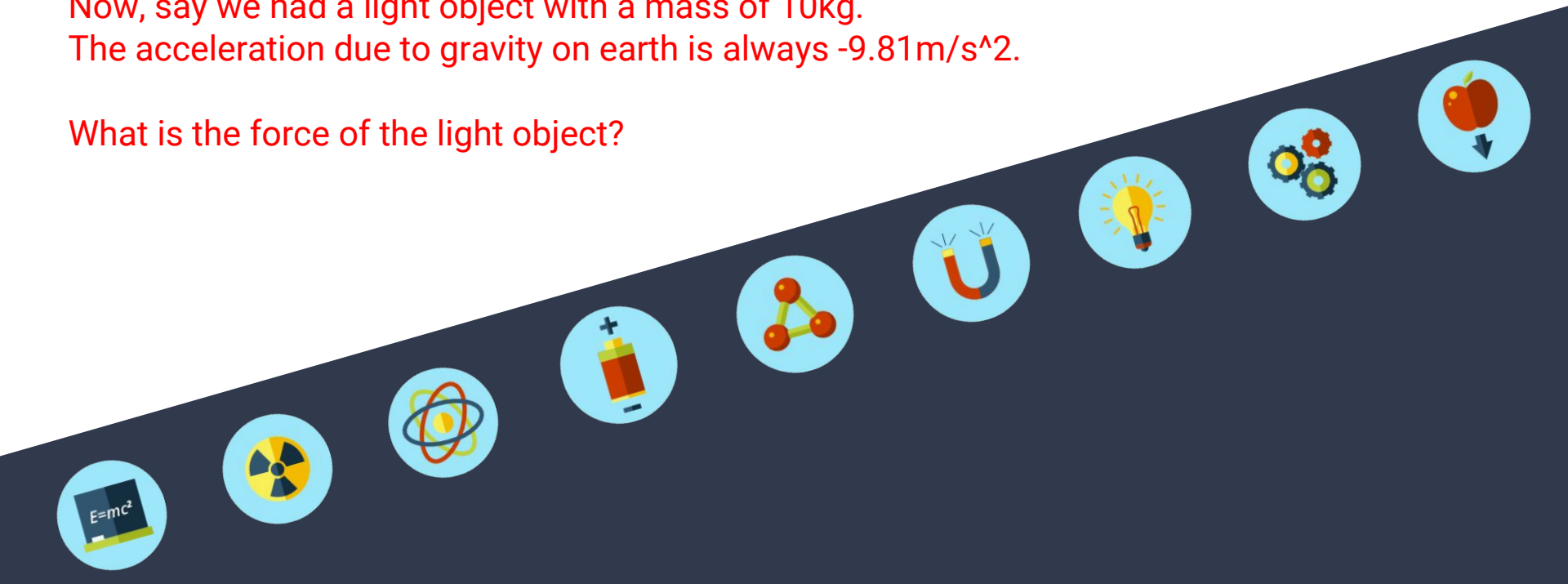


# Calculations using Newton's 2nd Law

**F** = m**a**

Now, say we had a light object with a mass of 10kg.
The acceleration due to gravity on earth is always -9.81m/s^2.

What is the force of the light object?

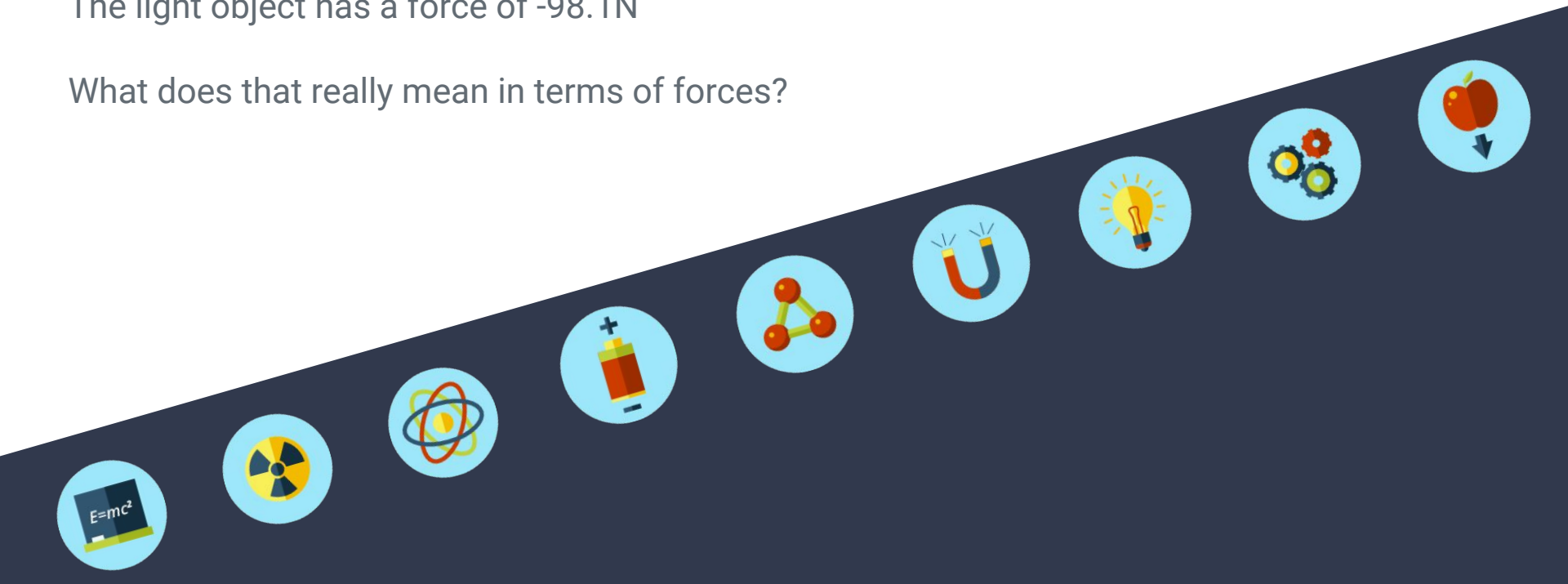


# Calculations using Newton's 2nd Law

The heavy object has a force of -5.886N

The light object has a force of -98.1N

What does that really mean in terms of forces?



# 3rd Law of Motion

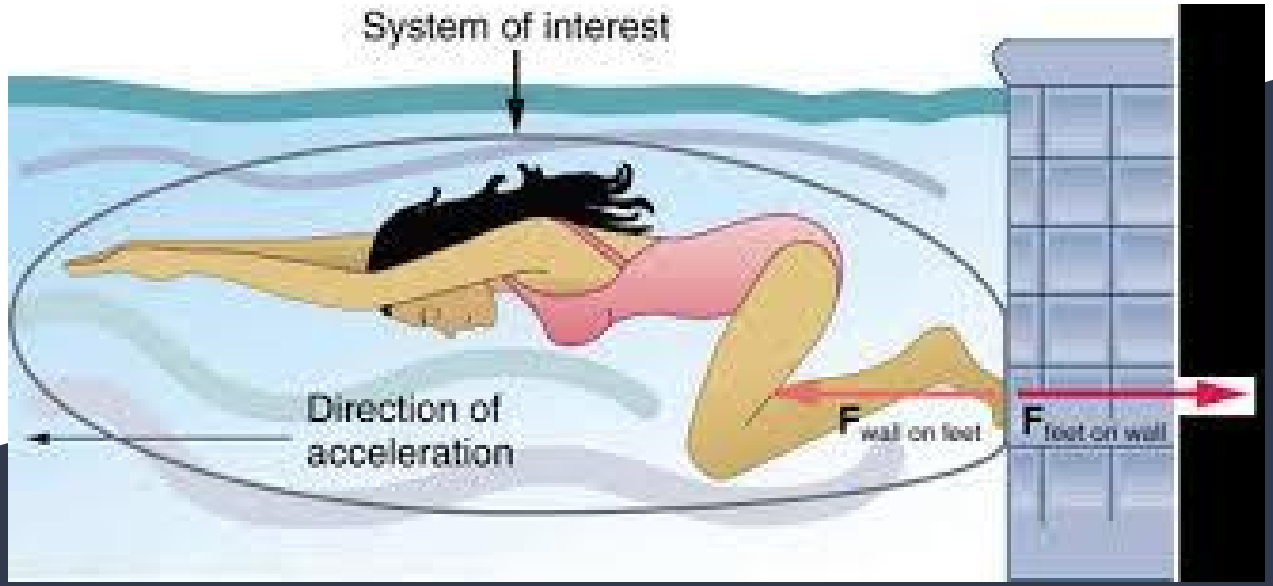
For every action there is an equal and opposite reaction

Equal in magnitude.

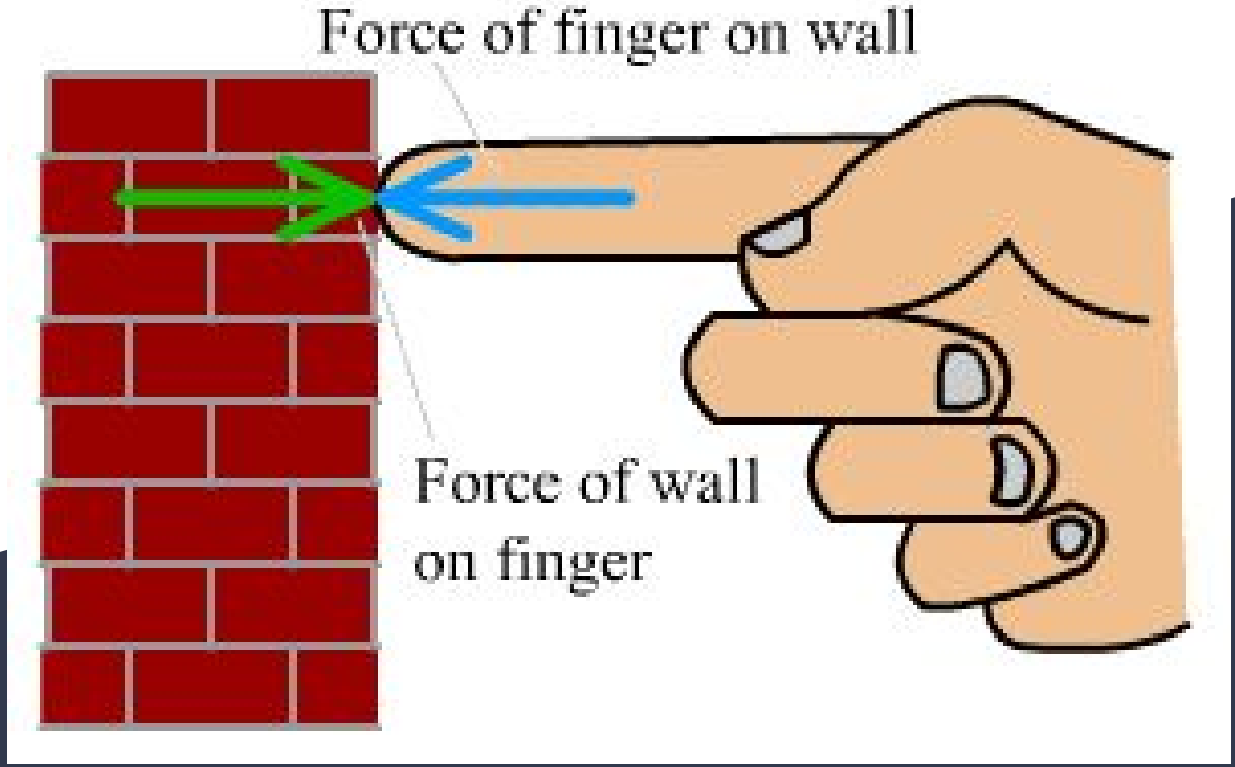
Opposite in direction.

# Newton's 3rd Law

Action force – the force that initiates the reactions
Reaction force – the force that responds to the initial action.



# You can’t always see both Forces



# Homework:

1. Complete the F = ma questions
2. Come up with/find an example of Newton's 1st law to share in class
3. Come up with/find an example of Newton's 2nd law to share in class
4. Come with up/find an example of Newton's 3rd law to share in class.