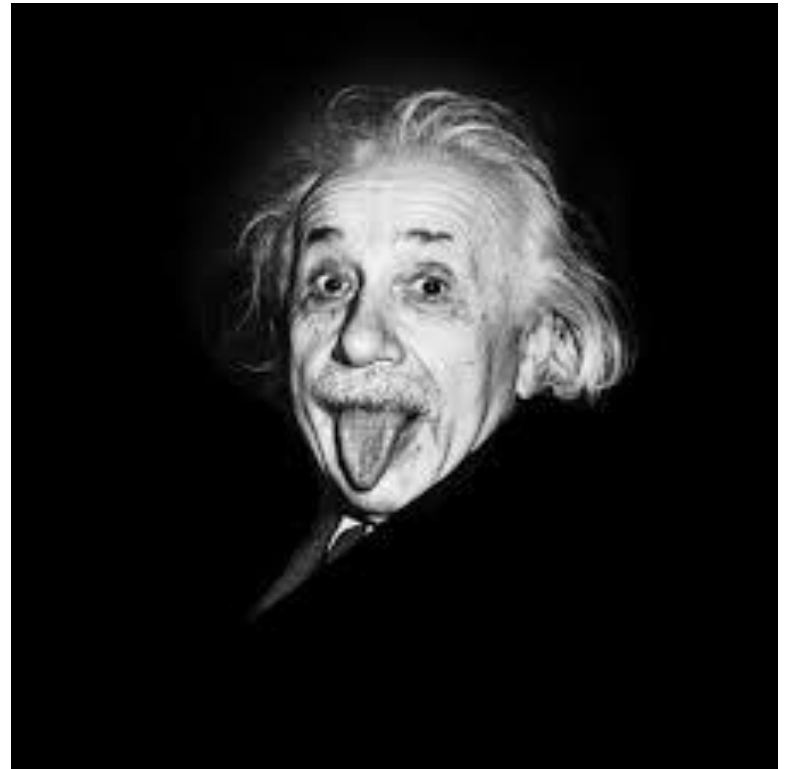
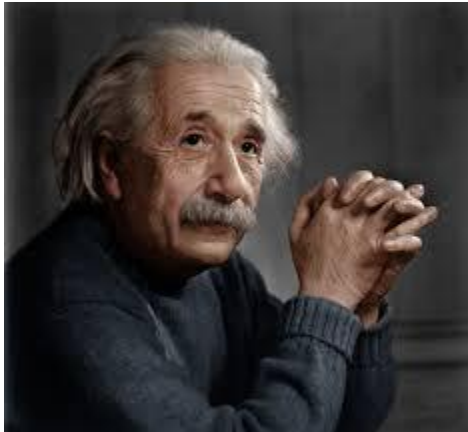


# Einstein and Relativity

## Introduction

- ▶ Albert Einstein (1879-1955)
  - Started connecting \_\_\_\_\_ and \_\_\_\_\_
  - Revised Newton's understanding about the laws of motion
    - Called the *theory of* \_\_\_\_\_



# Einstein and Relativity

## Special Relativity

- ▶ Einstein started by looking at how \_\_\_\_\_ saw \_\_\_\_\_ happening
- ▶ **The Special Theory of Relativity** – the \_\_\_\_\_ of Einstein's theories that specifies \_\_\_\_\_ motion
- ▶ **First Postulate** - Observers can never \_\_\_\_\_ their \_\_\_\_\_ motion except relative to \_\_\_\_\_ objects



# Einstein and Relativity

## Special Relativity

### ▶ *The Principle of* \_\_\_\_\_

◦ Ex: Sitting in the \_\_\_\_\_

- When looking out the window at the trees, everything looks like its flying past you when in reality you are the one \_\_\_\_\_ and those objects are \_\_\_\_\_ .
- You can't tell which is actually moving without \_\_\_\_\_ a third object



# Einstein and Relativity

## Special Relativity

- ▶ The \_\_\_\_\_ of relativity cannot be done by an \_\_\_\_\_ in the \_\_\_\_\_ in question (i.e. the car) because it requires a \_\_\_\_\_ object
- ▶ This means that all motion is \_\_\_\_\_
  - Must be \_\_\_\_\_ in the situation
- ▶ Fancy version of the first \_\_\_\_\_ :
  - *The laws of physics are the same for all \_\_\_\_\_ , no matter what their \_\_\_\_\_ , as long as they are not \_\_\_\_\_ .*
    - *Accelerated* is important!

# Einstein and Relativity

## Special Relativity

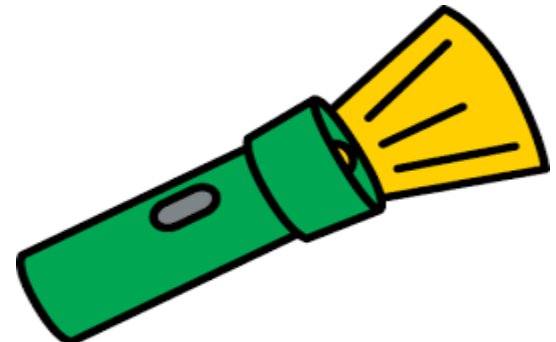
- ▶ \_\_\_\_\_ motion can be \_\_\_\_\_ by the passengers of a vehicle or ship because of the extra \_\_\_\_\_ it poses
- ▶ The first postulate only refers to \_\_\_\_\_ *motion*
  - **Uniform Motion** – \_\_\_\_\_ motion that has no extra force in regards to a \_\_\_\_\_ and \_\_\_\_\_



# Einstein and Relativity

## Special Relativity

- ▶ **Second Postulate** – The \_\_\_\_\_ of light is \_\_\_\_\_ and will be the same for all \_\_\_\_\_ independent of their \_\_\_\_\_ relative to the light source
  - The speed of light is \_\_\_\_\_ for everyone so if you could measure the speed of \_\_\_\_\_ from two different vehicles, then you could figure out who was moving faster
- ▶ This all works as long as \_\_\_\_\_ were small and \_\_\_\_\_ were low – not always going to be the case



# Einstein and Relativity

## Special Relativity

- ▶ Einstein reformatted \_\_\_\_\_ work and set it up to predict that a \_\_\_\_\_ object's mass is \_\_\_\_\_ on its velocity
  - For objects with low \_\_\_\_\_ it doesn't really matter, but when they start reaching the speed of light it makes a big difference!
  - Really high \_\_\_\_\_ = higher \_\_\_\_\_
    - Experiments can be done with electrons - nanophysics



# Einstein and Relativity

## Special Relativity

- ▶ This whole idea is what became the basis for the famous equation:

- $E = \frac{m_0 c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$
- $m_0$  – rest mass of a particle at rest
- $c$  – speed of light, a constant

- ▶ Example: moving 1 kg of material at the speed of light:
  - $1 \text{ kg} \times (3 \times 10^8 \text{ m/s})^2 = 9 \times 10^{16} \text{ joules (J)}$
  - This is the same amount of energy released from a 20 megaton nuclear bomb... that's a lot.





# Einstein and Relativity

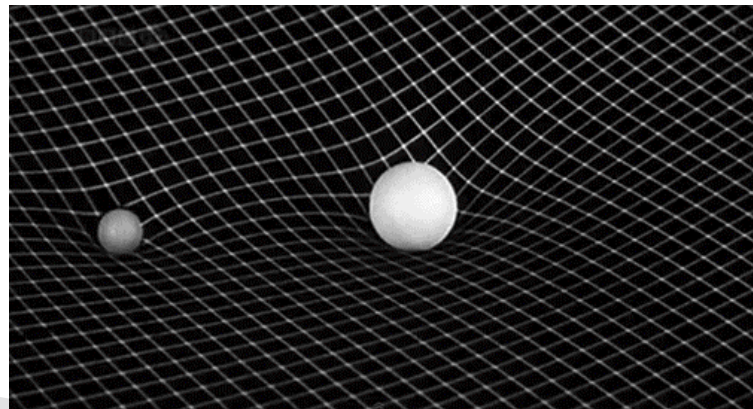
## The General Theory of Relativity

- ▶ **General Theory of Relativity** – a more \_\_\_\_\_ version of the \_\_\_\_\_ theory of relativity that deals with \_\_\_\_\_ as well as \_\_\_\_\_ motion
  - This contains the new \_\_\_\_\_ of gravity
- ▶ Einstein thought about the relationship between how gravity \_\_\_\_\_ and how the force of \_\_\_\_\_ feels
  - He called it the *Equivalence Principle*

# Einstein and Relativity

## The General Theory of Relativity

- ▶ **Equivalence Principle** – Observers cannot \_\_\_\_\_ locally between \_\_\_\_\_ forces due to acceleration and uniform \_\_\_\_\_ forces due to the presence of a massive body
- ▶ The mass that resists \_\_\_\_\_ is same as the mass that exerts \_\_\_\_\_ forces
  - Gravity, inertia, and acceleration are all associated with the way space is connected with time (aka: space time)



# Einstein and Relativity

## The General Theory of Relativity

- ▶ \_\_\_\_\_ is sometimes referred to as the curvature of space
- ▶ **Gravity According to General Relativity** – \_\_\_\_\_ tells space time how to \_\_\_\_\_, and the curvature of space-time (\_\_\_\_\_) tells mass how to \_\_\_\_\_
  - This is what links time to gravity... through accelerated mass

