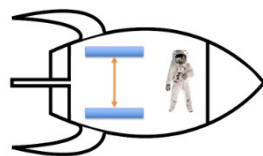
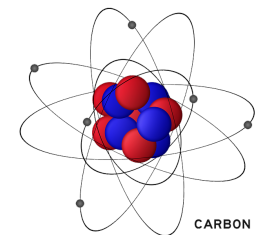
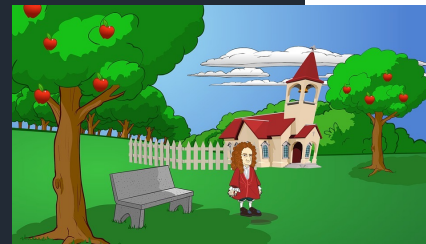
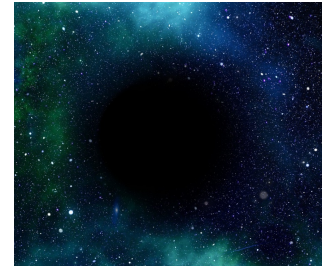
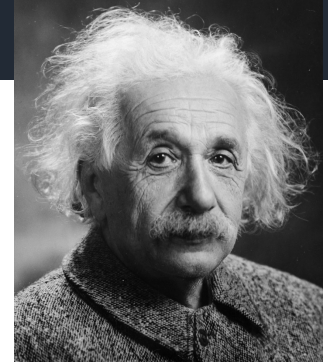
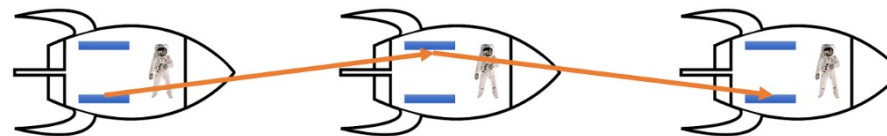


Frames of Reference and Relativity

- Newtonian Physics
- Problems with Classical Physics
- Modern Physics & Einstein's Special Theory of Relativity
- Michelson and Morley
- Postulates of Special Relativity
- Time Dilation
- Length Contraction



Vs.



Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

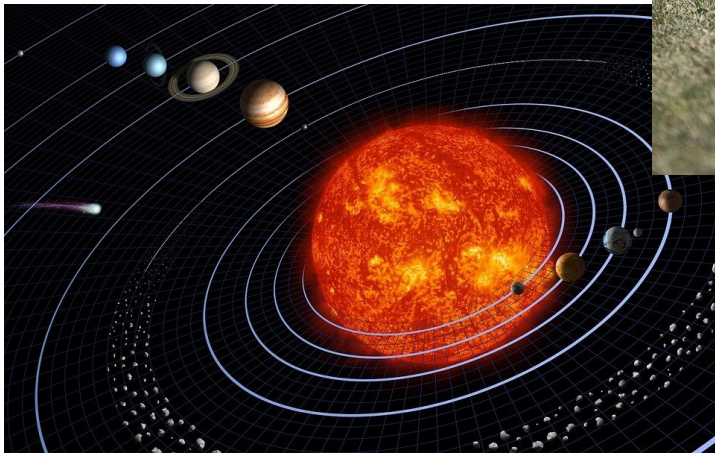
- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

**The paid full version of your resource includes
both Google Slides and PowerPoint and is
Google Classroom Ready**



Newtonian Physics

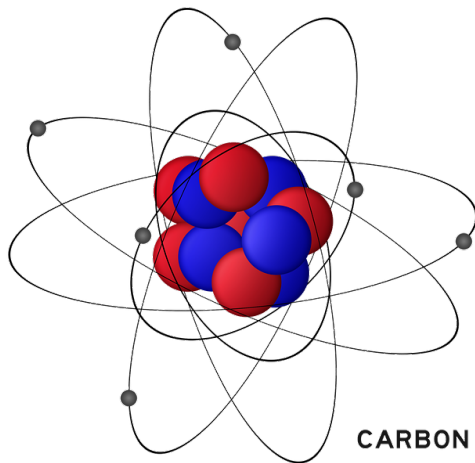
Newtonian (Classical) Physics is very good for predicting the motion of everyday objects including fruit, people and planets.



Problems with Classical Physics

Classical Physics does not work when

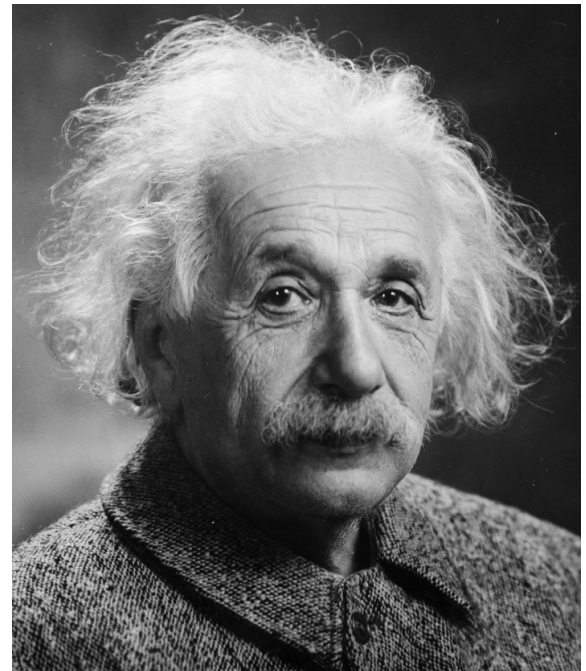
- objects are very small (protons, electrons)
- _____
- _____



**This Slide Has Been
Removed**

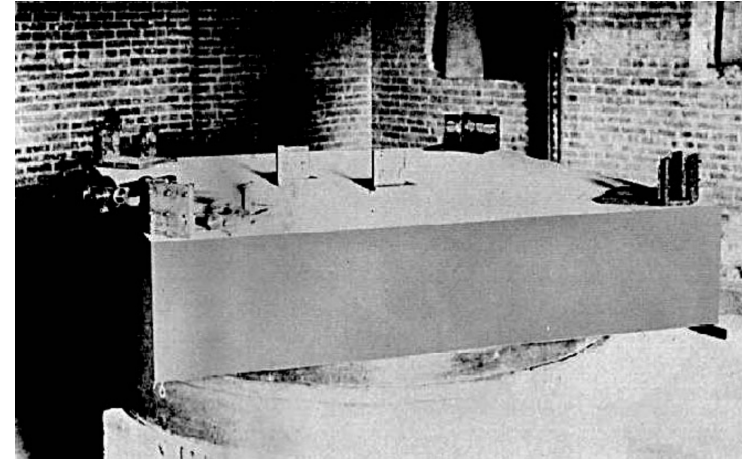
Einstein's Conflict

Is the speed of light relative? If the speed of light is equal to “ c ”, and you are in a car travelling at 100 km/h and shine a flashlight in the forward direction, does that mean that the light from the flashlight is moving at $c + 100$ km/h?



Michelson and Morley

- Prior to their experiment in 1887, it was thought that light must travel through some kind of medium – called ether
 - We now know that light does not require a medium to travel through
- Michelson and Morley designed a way to determine the speed of light travelling in different directions within this medium under the assumption that the speed would fluctuate slightly
 - Like swimming with and against the current



Michelson and Morley's experimental setup.



Morley



Michelson

Michelson and Morley

- The importance of the experiment lies in its failure to show what was expected



-

**This Slide Has Been
Removed**

Postulates of Special Relativity (1905)

The findings of the Michelson-Morley experiment led to Einstein's Special Relativity which had two main assumptions

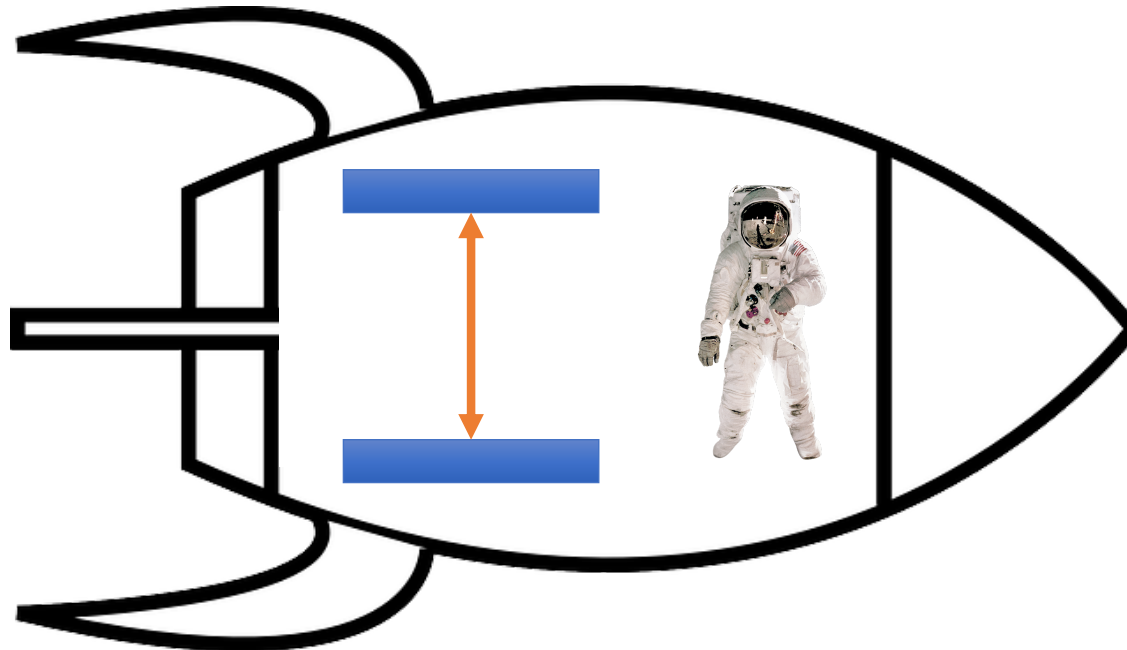
1. _____

- i.e., electricity, magnetism, optics, etc. are ALWAYS true in one particular reference frame.

2. Light travels at a constant speed, regardless of the motion of the source or observer.

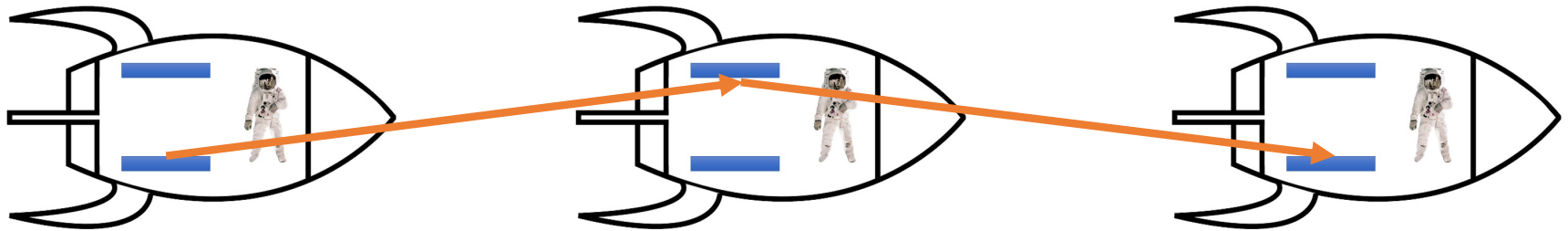
Time Dilation

Imagine an astronaut in a spaceship as shown below. A beam of light travels from a source, across the spaceship to a mirror, and then reflected back to a light sensor.



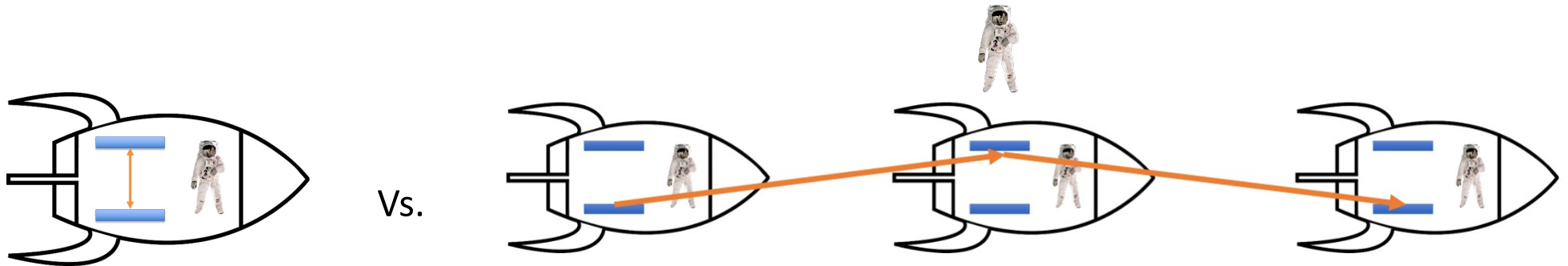
**This Slide Has Been
Removed**

Time Dilation – Moving Observer



Outside observer

Time Dilation



- Notice that for someone viewing the light from outside the spaceship, the light needs to take a longer path (orange line) therefore, its distance travelled (d) is increased.

- _____

$$c = \frac{\Delta d}{\Delta t}$$

Time Dilation Equation

$$\Delta t_m = \frac{\Delta t_s}{\sqrt{1 - \frac{v^2}{c^2}}}$$

t_s is the time interval for the observer stationary relative to the sequence of events (i.e., standing inside the spaceship).

t_m is the time interval for an observer moving with a speed v relative to the sequence of events (outside the spaceship, observing).

**This Slide Has Been
Removed**

Check Your Understanding

If a pilot spends their entire adult life flying commercial aircrafts, will they be younger, older or the same age vs. spending their adult life driving a taxi? Why?



Check Your Understanding

A Tsini spacecraft has a speed of $0.600c$ with respect to Earth. The Tsini determine 32.0 h to be the time interval between two events on Earth. What value would they determine for this time interval if their ship had a speed of $0.940c$ with respect to Earth?

$$\Delta t_m = \frac{\Delta t_s}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Length Contraction

-

- This is true no matter which object you are on, as the other always appears to be moving towards you

Length Contraction Equation

$$L_m = L_s \sqrt{1 - \frac{v^2}{c^2}}$$

- L_s is the proper length
- L_m is apparent length due to rapid motion

**This Slide Has Been
Removed**

Check Your Understanding

A star is measured to be 40.0 light years from Earth, in the inertial frame in which both star and Earth are at rest.

- a) What would you determine this distance to be if you travelled to the star in a spaceship moving at 1.00×10^8 m/s relative to Earth?
- b) How long would you determine the journey to take in years?

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$v = \frac{\Delta d}{\Delta t}$$

$$L_m = L_s \sqrt{1 - \frac{v^2}{c^2}}$$

Albert Einstein's Special Theory of Relativity Summary

- The faster you travel, the slower time progresses (time dilation)
- The faster you travel the shorter length becomes (length contraction)
- Nothing is faster than light
- Everything is relative