

## Time Dilation

How will humans be able to travel to planets many light years away?

Einstein's theory of relativity states that time moves slower for objects in motion. He actually figured out a formula that calculates the time difference for velocity.

**Problem:** A space ship is traveling .98 of the speed of light through space. The captain on the ship is 32 years old when the ship leaves, and is 36 years old when he returns. The captain's wife was 28 years old when he leaves. How many years old will his wife on earth be when he returns?

### Time Dilation Equation

v = velocity of moving object

c = speed of light

$t_0$  = time for the moving object

t = time for the object at rest

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

# Pedulums and Waves

The equation for the frequency of a pendulum:

$g$ =acceleration due to gravity, 9.8 m/sec<sup>2</sup>

$l$  = the length of the pendulum

$$f = \frac{1}{2\pi} \sqrt{\frac{g}{l}}$$

Challenge: Construct a pendulum wave machine.

Information: A set of pedulums in a line when set in motion with the same amplitude simultaneously will exhibit a remarkable unfolding pattern of waves. This phenomena ONLY will occur if the frequency of vibration (full swings per second,  $f$  in the formula above) differs between each pedulum in a linear progression, that is, that the frequency increase from one pedulum to the other is exactly the same. To accomplish this, the lengths of each pedulum will NOT be a linear progression, but an inverse square.

Specifics: Suppose you want to make a wave machine using 12 different pedulums, and the first pedulum is one meter long, and the last pedulum is 15 meters long. Calculate how long each pedulum would have to be so that you could construct the machine.