Consider a person whirling a ball on a string
What force is being exerted?

Obviously the person whirling the ball is exerting the force

This is called Centripetal force (center seeking)

$$F_C = \frac{mV^2}{r}$$

The larger the mass, the larger the force

The larger the velocity, the larger the force

The smaller the radius, the larger the force

For a planet rotating around the sun, the centripetal force pulling the planet in is the force of gravity. Thus, the gravitational force (given by Newton's law of universal gravitation) is equal to the centripetal force and for a planet of mass m:

$$F_c = \frac{mV^2}{r} = \frac{mMG}{r^2}$$

where r is the radius of the orbit and M is the mass of the sun

Can you get Kepler's 3rd law from the above?

The velocity of the planet keeps it from crashing into the sun. We can easily calculate just the velocity necessary to keep the planet in orbit.

$$\frac{mV^2}{r} = \frac{mMG}{r^2}$$

$$V^2 = \frac{\cancel{m}MG\cancel{r}}{\cancel{r^2}\cancel{m}}$$

$$V^2 = \frac{MG}{r}$$

$$V = \sqrt{\frac{MG}{r}}$$

With these equations, Newton was able to explain why Kepler's laws worked so well. His equations did not result from observation as did Kepler's. Instead they came from physical principles.

"Newton was the greatest genius who ever lived and the most fortunate for there cannot be more than once a world system to establish."

–J.J. Lagrange

The Giant Leap

The Hubble Space Telescope

A Window on the Solar System and the Universe

Hubble's Greatest hits

Comet Shoemaker-Levey Bombards Jupiter

Storm on Saturn's Equator

Martian Weather-Ice Caps and Clouds

The Galileo Mission to Jupitor

Pictures from galileo

Jupitor's Moon Io

Jupitor's Moon Io -2

Continental Drift

The following cards show continental drift.

The first card shows the arrangements of the continents as they are today.

The start button takes you backward in time to the super continent of Pangaea 200 million years ago.

750 million years ago

Snapshots

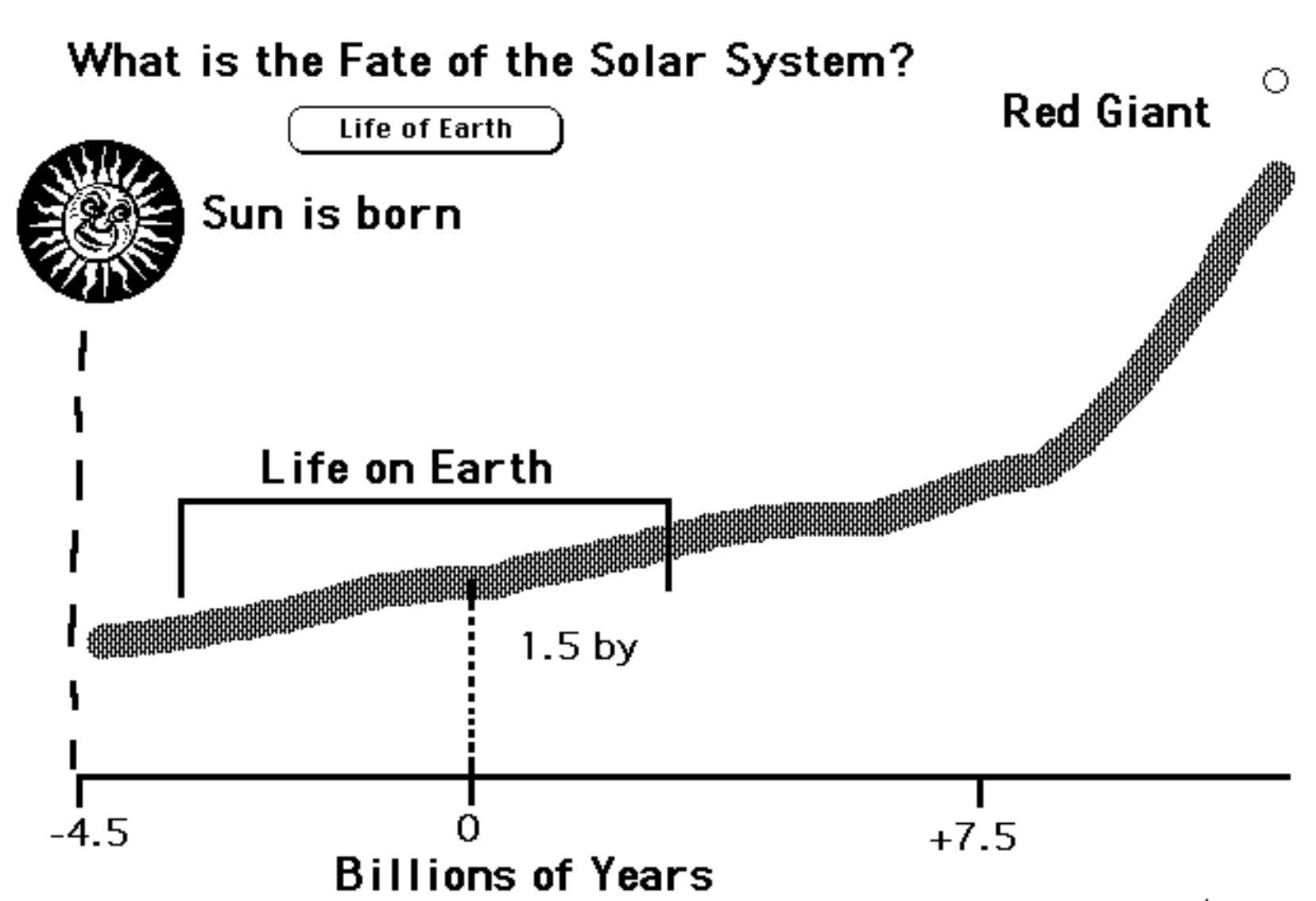
Plate Techtonics

Map of Earth's Plates

Earthquake Frequency

California Falts

San Andreas Falt


What is the Fate of the Solar System?
Life of Earth
Red Giant
Sun is born
Life on Earth
1.5 by
-4.5
0
+7.5
Billions of Years

Problem 9 Page 27 Calculate the velocity necessary to keep the moon in a stable orbit around the Earth at a distance of 383,000 Km

Use the formula $V^2 = MG/r$

M=Mass of Earth (5.97×10^{24} Kg)

r must be in meters $=(3.83 \times 10^5 Km)(10^3 m/Km)=3.83 \times 10^8 m$

$V^2 = 6.67 \times 10^{-11} Nm^2/Kg^2) (5.97 \times 10^{24}$ Kg)$/3.83 \times 10^8 m$

$V^2 = 1.04 \times 10^6$ Nm/Kg

Units are a bit tricky here 1N = 1Kg m/sec^2

$V^2 = 1.04 \times 10^6$ Kg m^2/Kgsec^2 = 1.04×10^6 m^2/sec^2

Now take the square root of 1.04×10^6 m^2/sec^2

$V = 1.02 \times 10^3$ m/sec