Sir Isaac Newton

Isaac Newton 1642-1727

- Considered one of the greatest intellects that ever lived
- Newton had a difficult childhood and was considered an odd boy.
- He was sent to Cambridge in 1660 to earn a degree in law.

- During this time, a mostly Plato/Aristotle view of universe predominated.
- Newton sought truth in science and math.
- “Plato is my friend, Aristotle is my friend, but my best friend is truth.”

Newton returns home

- Graduated from Cambridge in 1665 with no distinction.
- The plague closed university that same year.
- Newton returned to his family's farm for 18 months.

1666 – Newton's miracle year

- Newton developed a theory of light (white light is composed of all colors).
- He developed calculus.
- Created his laws of motion.
- And finally, created his universal theory of gravitation.

Development of Calculus

- He named it the “Method of Fluxions.”
- Used it for finding areas, tangents, the lengths of curves and the maxima and minima of functions.

- Newton needed this to develop his laws of motion and law of gravitation.
- The credit for calculus is now shared with Leibniz.

Newton’s three laws of motion
First Law

- An object does what it’s already doing unless affected by an unbalanced force.
- This is Galileo's concept of inertia.
- Also called the “law of inertia”.
- Friction is a force.

- This was more advanced than the Plutonian view of movement.

Second Law of Motion

- F = ma
- F = net (unbalanced) force in Newtons
- m = mass in kilograms
- a = acceleration in m/sec^2

- He probably used Galileo's experimental conclusions to develop this equation.
- This equation can be developed from lab experiments.

Newton's Third Law of Motion

- For every action, there is an equal and opposite reaction.
- For every force, there is an equal and opposite force.

Newton's Universal Gravitation Theory

- His "ah-ha!" experience started with a falling apple- does the moon also fall?
- The same laws that apply to the Earth also apply to the heavens.

$$F_g \propto m_1 m_2 / s^2$$

- **F = force in Newtons**
- **$\propto$ read as "is proportional to"**
- **m_1 = mass of first object in Kg**
- **m_2 = mass of second object in Kg**
- **s^2 = distance between object's center of gravity in meters**

Final form of gravitation equation

- $F_g = Gm_1m_2/s^2$
- G = the gravitational constant (determined 100 years after Newton)
- $G = (6.67 \times 10^{-11}\ N(m_2/Kg_2)$.

- Newton developed a mathematical “proof” based on his first 3 laws of motion.
- This law also supported by Kepler’s calculations and orbit data.

New paradigm for society

- The universe is subject to “cause and effect” (responding to forces).
- Less magic, and more reason.
- All of nature can be explained by math and reason.
- The universe is like a giant wind-up clock, set in motion at creation.

Newton's Social Life

- Became a member of Royal Society of Science in 1672.
- Reluctant to publish, because he was sensitive to criticism.
- Was also very vindictive to enemies.

Strengths of Newton's Theory

- Explains almost all observations.
- Can accurately calculate outcomes (used to calculate everything from space shuttles to the design of skyscrapers).
- For the most part, is derived by applying logic to everyday experience (applied common sense).

Weaknesses of Newton's Theory

- The theory did not explain the cause of gravity – Why does mass attract mass?
- Eventually, the absolute speed of light would create problems.