



35<sup>th</sup> Annual  
*Kepler*  
&  
*MAHHHHZ!*

© 2009, 2010, 2011

Daryl L. Taylor, Fizzix/Astro Guy  
Greenwich HS, CT / Rowan University, NJ  
[DTFizzix.com](http://DTFizzix.com)

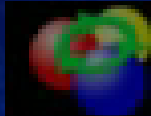
# WHS

## Pre-assessment :

---

- 1. Betty Boop
- 2. Bullwinkle J. Moose
- 3. Dudley DoRight
- 4. Booboo Bear
- 5. QuickDraw McGraw
- 6. Frodo Baggins!
- 7. George of the Jungle

# Silly Diversion...



UNREGI  
STERED

# Intro Stuff

(That means “boring stuff.”)

- Ancient Astronomy
  - The 1<sup>st</sup> REAL Physical Science
    - Besides “falling over”
    - Some early views
  - Ptolemy
  - Copernicus
  - Galileo
  - **Kepler!**
  - **Newton!**



# Intro Stuff

(That means “boring stuff.”)

- So, where does Tycho Brahe fit in?
  - Aristocratic Moron (Autistic)
    - Died from a burst bladder!
  - Stayed up EVERY night of his life
    - Mapping the sky
    - Keeping data
  - Volumes & VOLUMES of data

# Intro Stuff

(That means “boring stuff.”)

- Kepler?
  - Genius - mathematics
  - Astronomy - hobby
  - Made a living being an astrologer!
  - Was puzzled by some things
    - But, had no data

# Intro Stuff

(That means “boring stuff.”)

- Stole Tyco’s stuff
  - Hired a coupla street thugs
- Studied data for 19 years.
- Published his 3 “LAWNS”
  - NO EXPLANATIONS!
  - Was NOT a real scientist!

# Intro Stuff

(That means “boring stuff.”)

- 3 LAWS?
  - Ellipses
  - Equal Areas
  - $K = T^2 / R^3$
- Math or Science?



# Our Leaders?

---

**“Statistics show that teen pregnancy drops off significantly after age 25.”**

**Colorado State Senator,  
Mary Ann Tebedo**

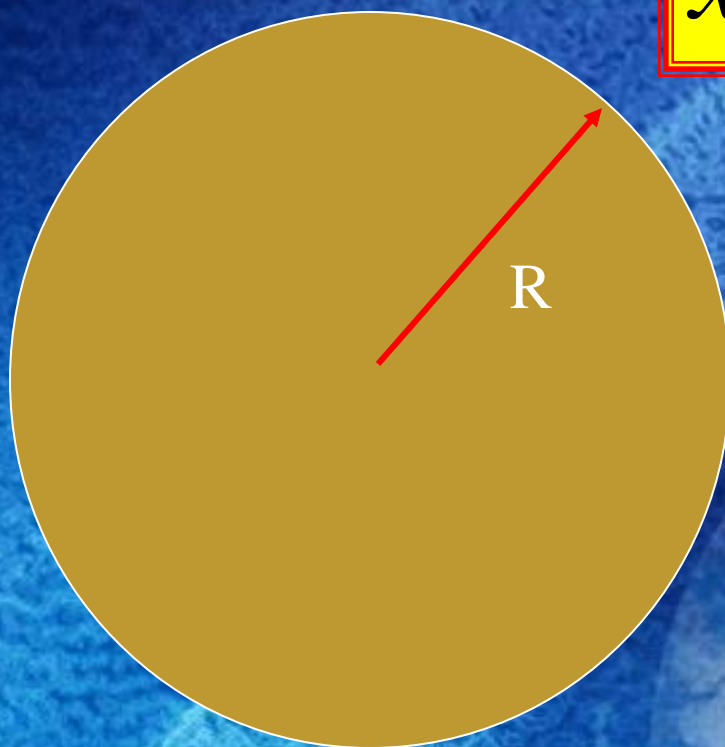
# Real Stuff

- 1<sup>st</sup> Law
  - Planets travel in ELLIPTICAL orbits, not circular.
  - Definitions
    - Circle – ‘ $r$ ’
    - Ellipse – ‘ $a+b$ ’
  - Why?



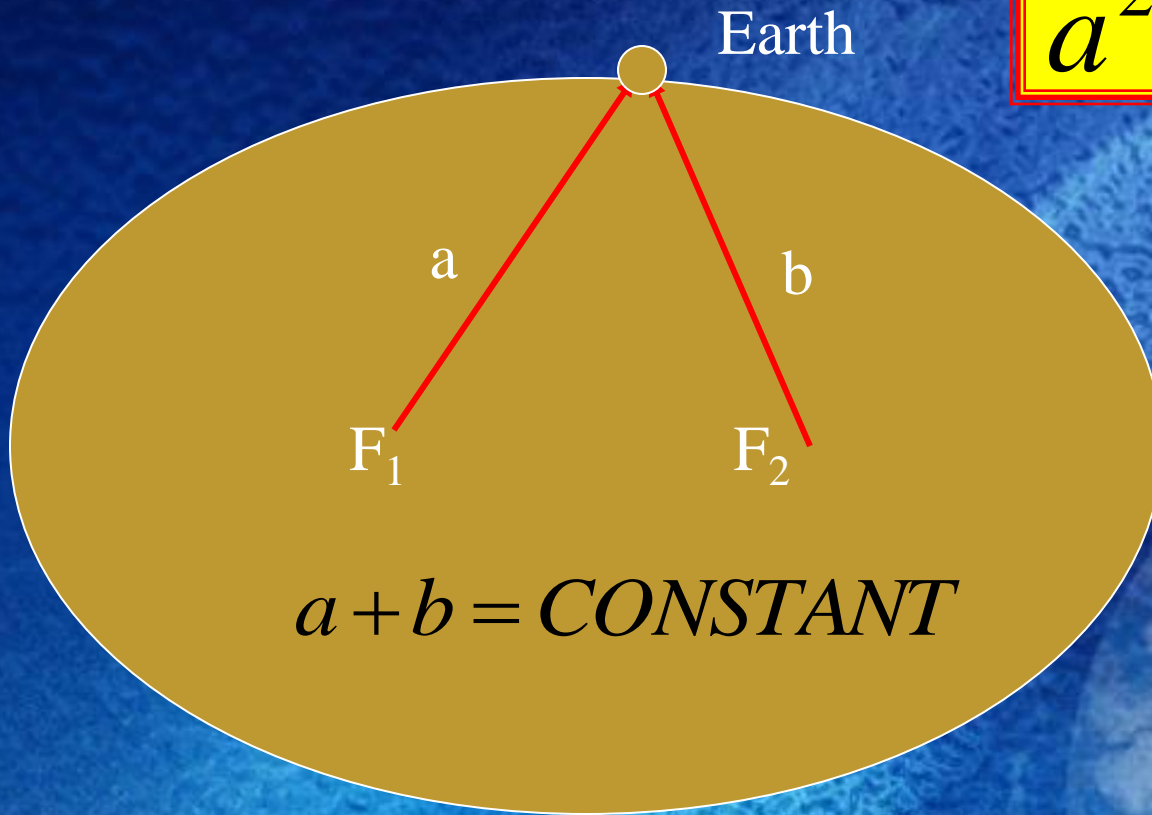
Circle, duh...

$$x^2 + y^2 = r$$



# Ellipse,

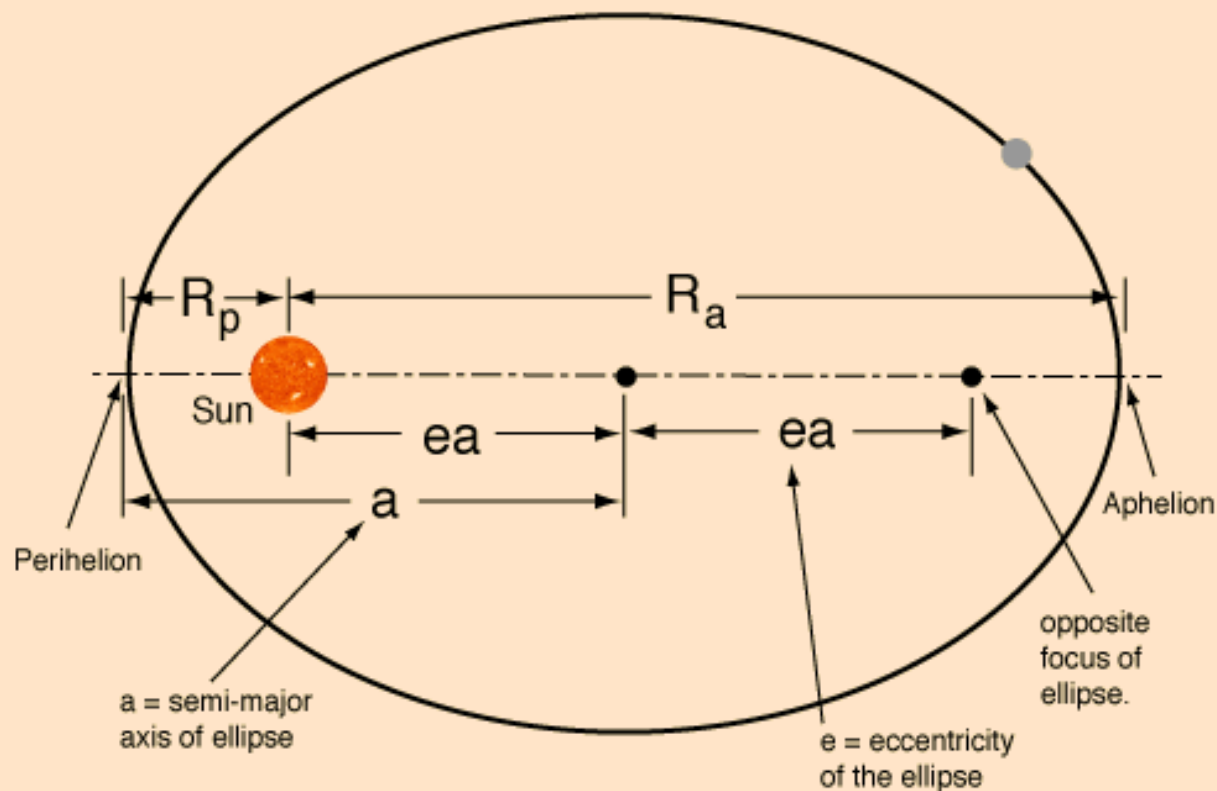
$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = C$$



$$a + b = \text{CONSTANT}$$

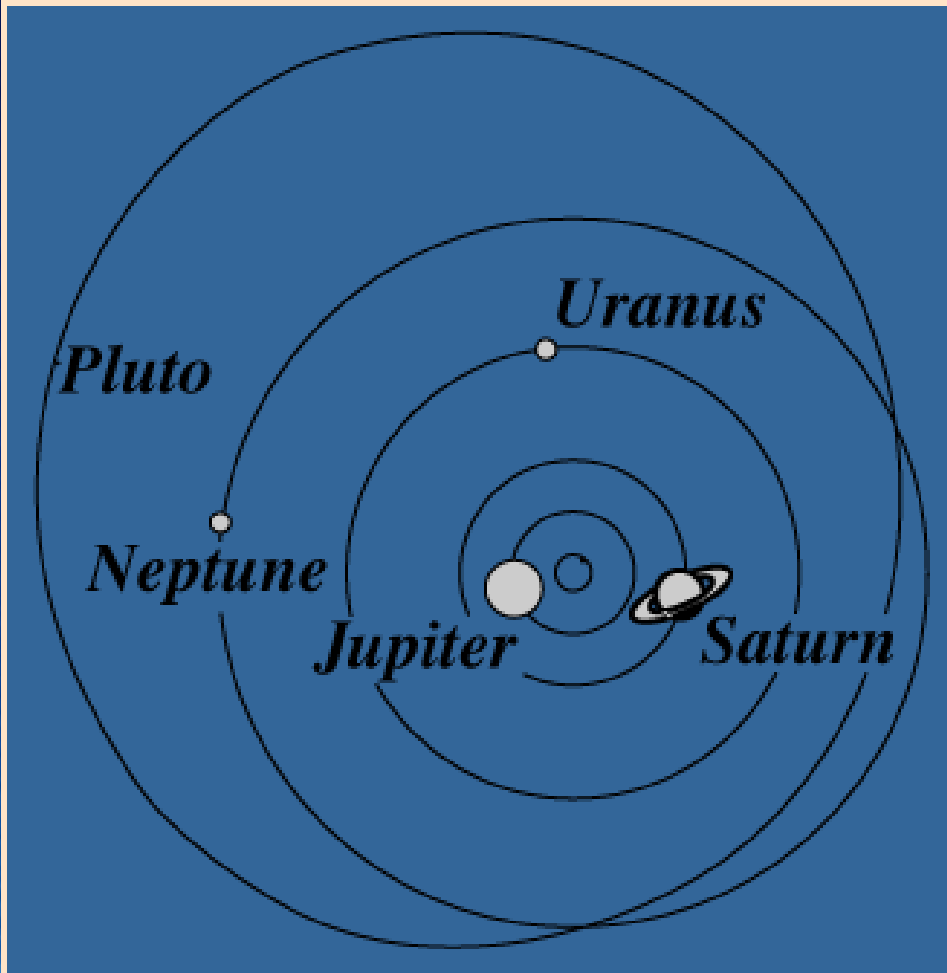
# The Law of Orbits

All planets move in elliptical orbits, with the sun at one focus.

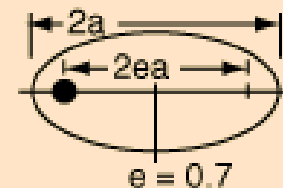


$$R_a = a(1+e) \quad R_p = a(1-e)$$

# Orbit Eccentricity



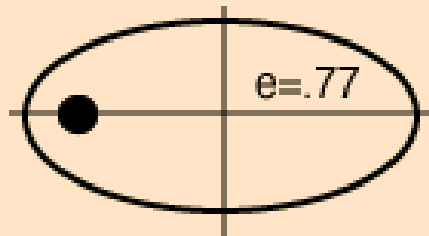
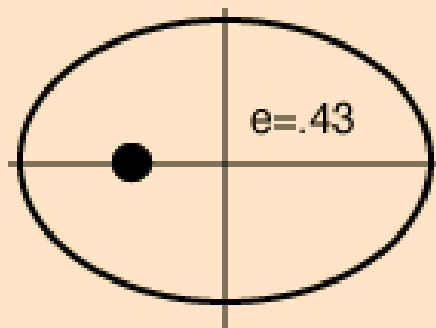
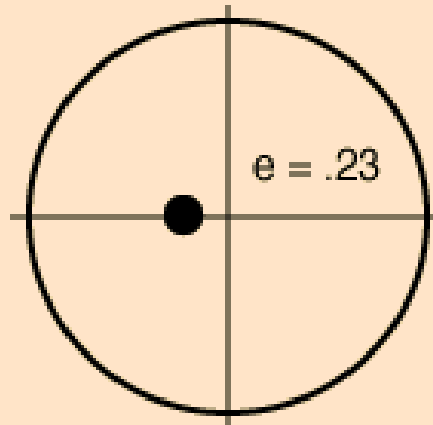
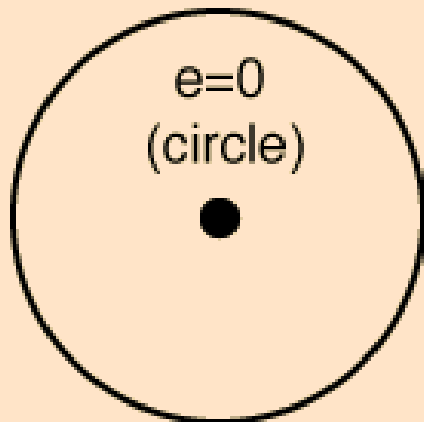
The eccentricity of an ellipse can be defined as the ratio of the distance



between the foci to the major axis of the ellipse. The eccentricity is zero for a circle. Of the planetary orbits, only Pluto has a large eccentricity.

[Eccentricity examples](#)

# Examples of Ellipse Eccentricity



Planetary orbit  
eccentricities

Mercury .206

Venus .0068

Earth .0167

Mars .0934

Jupiter .0485

Saturn .0556

Uranus .0472

Neptune .0086

Pluto .25

[Outer planets](#)



And now, the all-time  
biggest bonehead move...



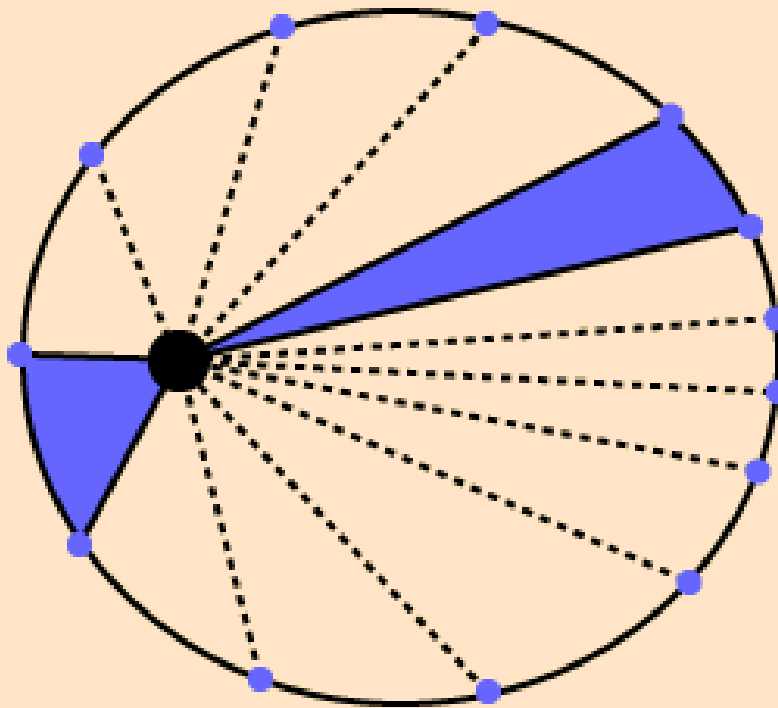
# Real Stuff

- 2<sup>nd</sup> Law
  - Planet makes  $\Delta$ 's with  $=A$ 's.
  - Say WHAT?
  - Why?

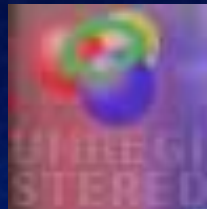


# The Law of Areas

**A line that connects a planet to the sun sweeps out equal areas in equal times.**



This is one of [Kepler's laws](#). This empirical law discovered by Kepler arises from [conservation of angular momentum](#). When the planet is closer to the sun, it moves faster, sweeping through a longer path in a given time.



A ROMAN GOD  
OR THE PLANET  
NEAREST THE  
SUN

CLUE

21

# Real Stuff

- 3<sup>rd</sup> Law

- $K = T^2 / R^3$

- Definitions

- R

- T

- AU?

- Taylor's Constant!

- Why?

$$k_K = 2.98 \times 10^{-19} \frac{s^2}{m^3}$$

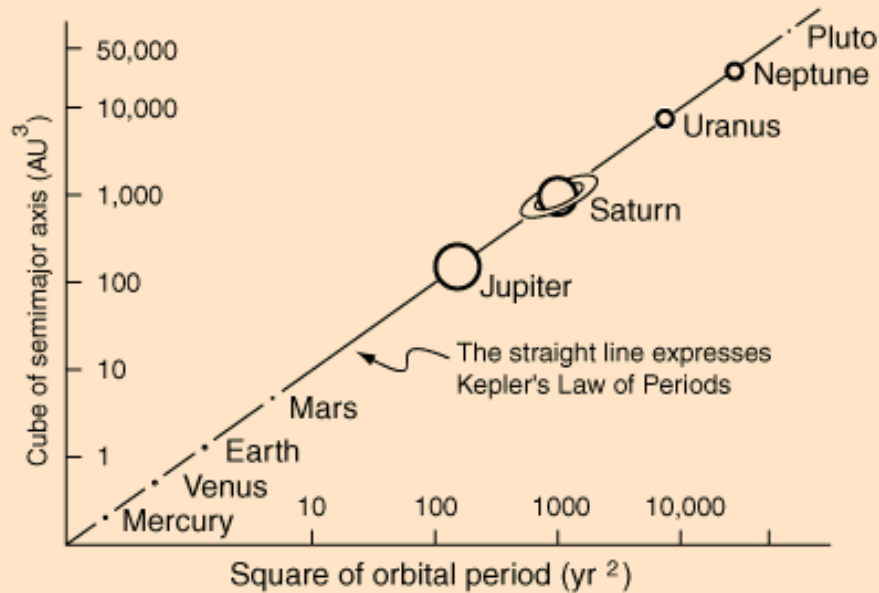
$$k_T = 1 \frac{yr^2}{AU^3}$$

# The Law of Periods

The square of the period of any planet is proportional to the cube of the semimajor axis of its orbit.

$$T^2 = \frac{4\pi^2}{GM} a^3$$

This is one of [Kepler's laws](#). This law arises from the [law of gravitation](#). Newton first formulated the law of gravitation from Kepler's 3rd law.



$$T^2 = \frac{4\pi^2}{GM} a^3$$

can be expressed as simply

$$T^2 = a^3$$

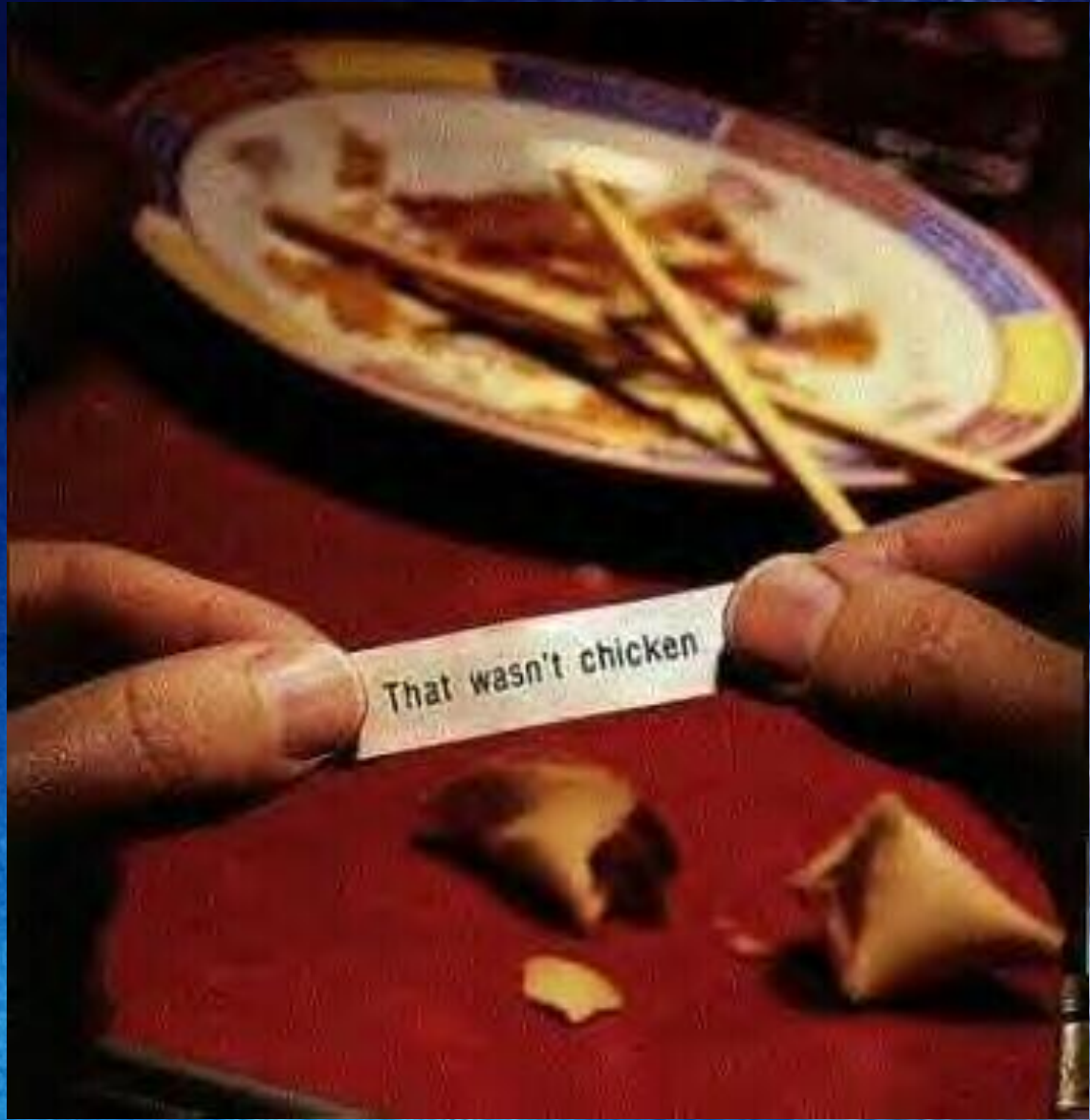
If expressed in the following units:

$T$  Earth years

$a$  Astronomical units AU  
( $a = 1$  AU for Earth)

$M$  Solar masses  $M_{\odot}$

Then  $\frac{4\pi^2}{G} = 1$





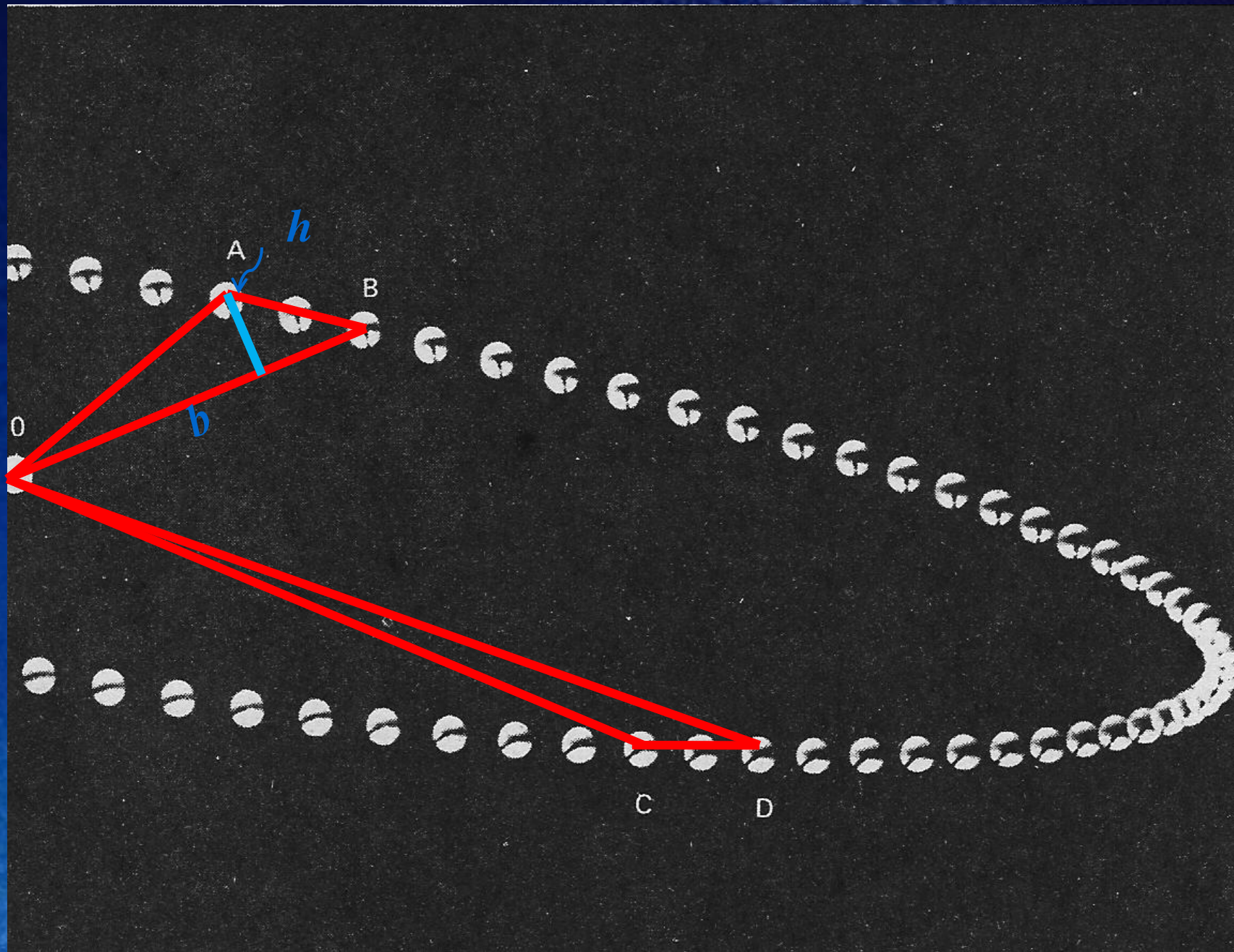
UNREGI  
STERED



6:47 53°  
4

Hosted@  
theYNC.com





# Real Stuff

- Newton's Synthesis

$$F_g = G \frac{m_1 m_2}{r^2}$$

# Real Stuff

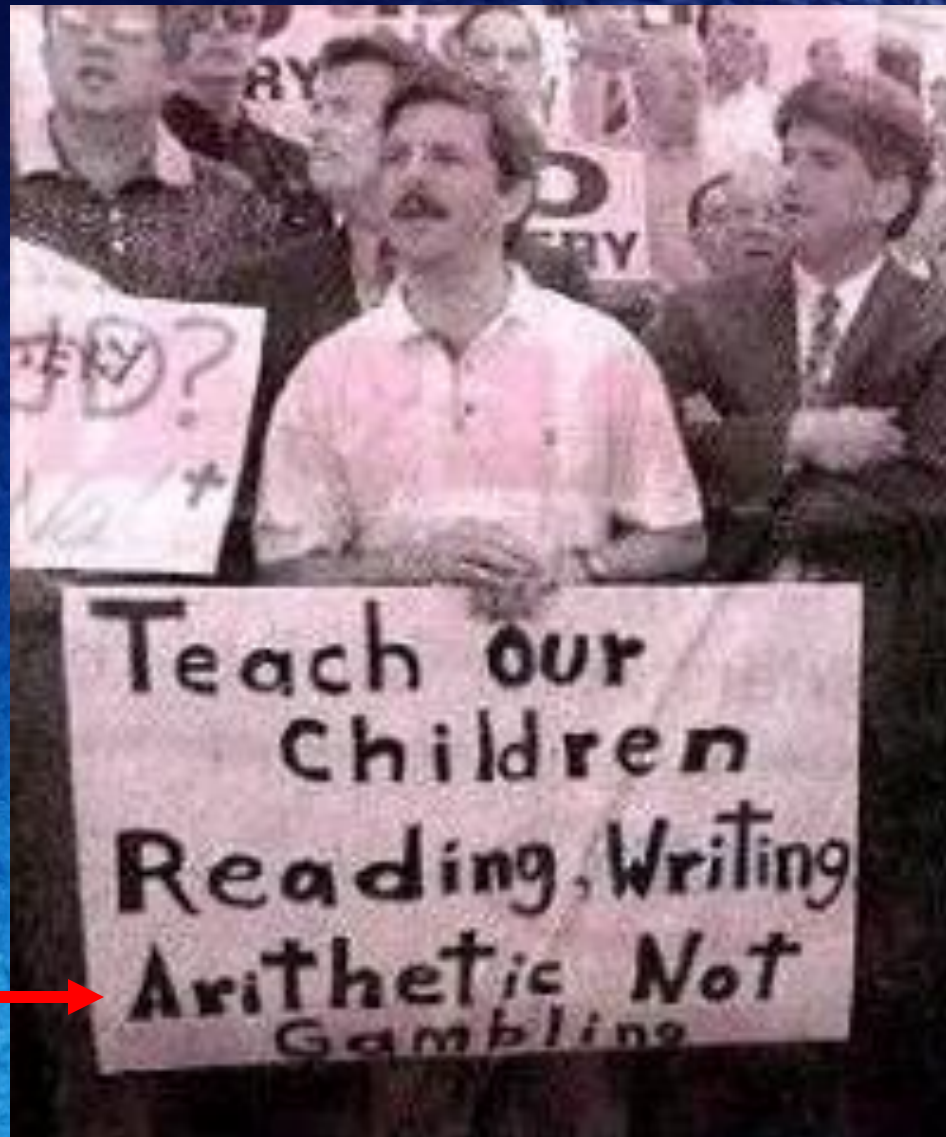
- Newton's Synthesis

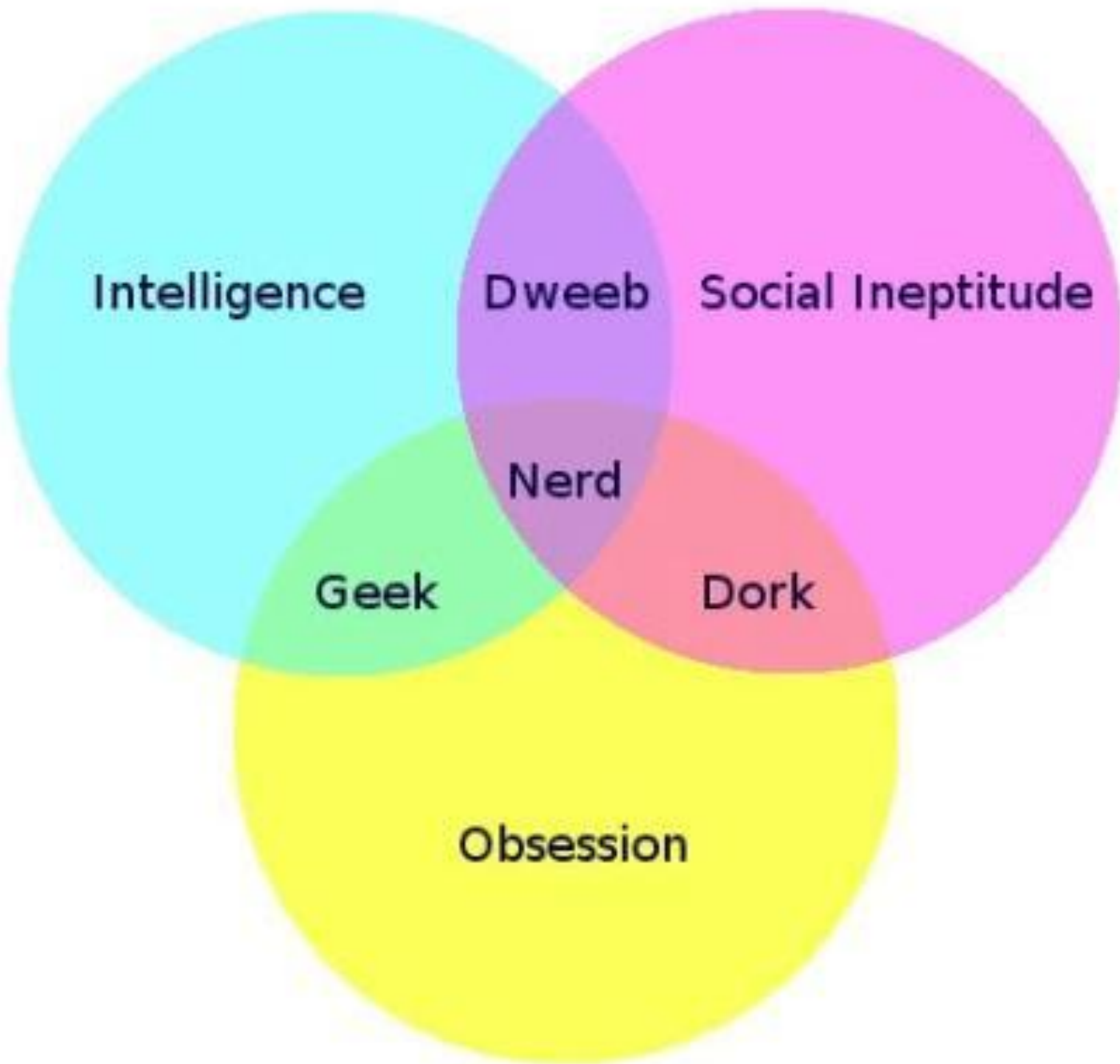
$$F_c = m \frac{v^2}{r}$$

# Real Stuff

- Newton's Synthesis

$$\frac{T^2}{R^3} = \frac{4\pi^2}{GM}$$





# Prepared Leaders?

---

“I think we agree,  
the past are over.”

President George W. Bush



1

MAR/15/09 7:54PM E1 SLP  
MAR/15/09 0:14:01



2

MAR/15/09 8:19PM E1 SLP  
MAR/15/09 0:01:32



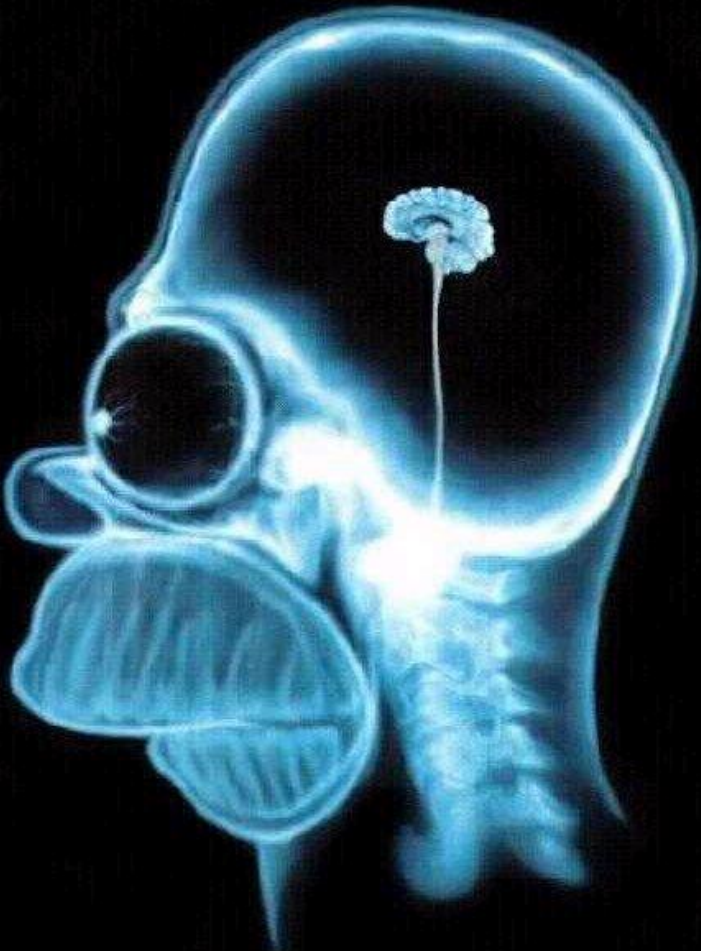
3

MAR/15/09 8:22PM E1 SLP  
MAR/15/09 0:02:49



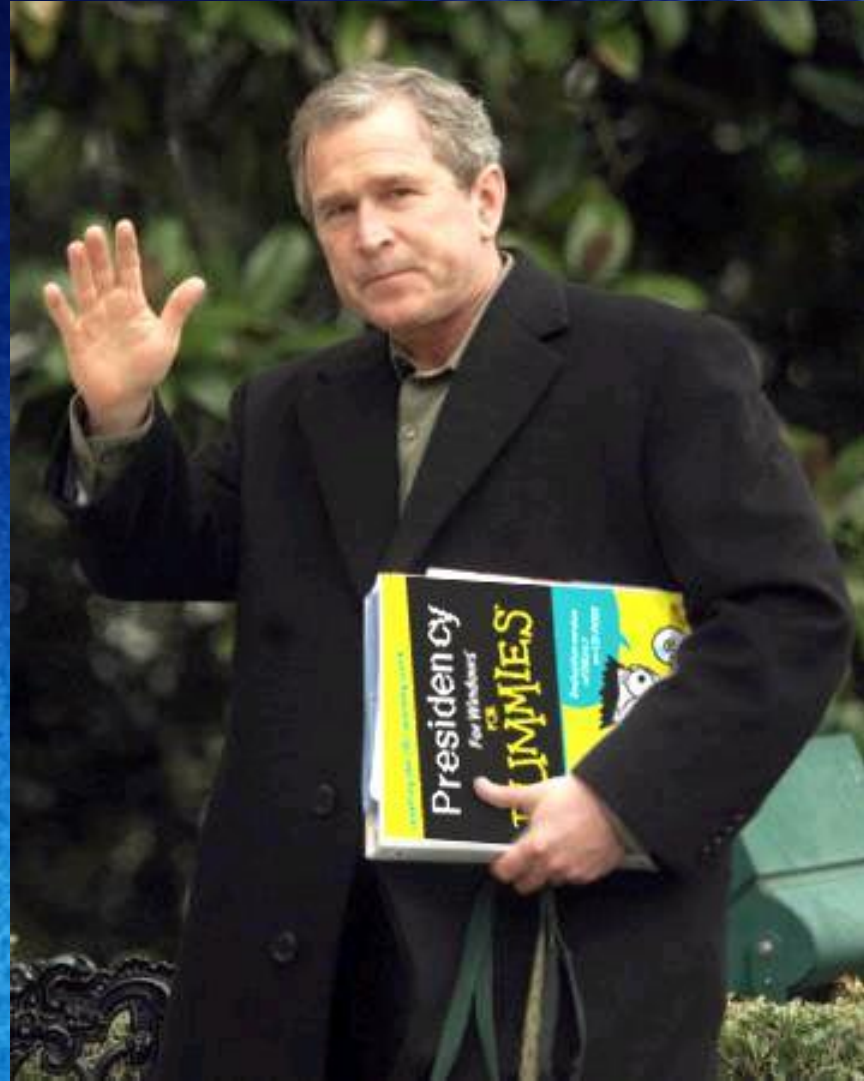


KODAK SAFETY FILM 954029 L



H. J. SIMPSON



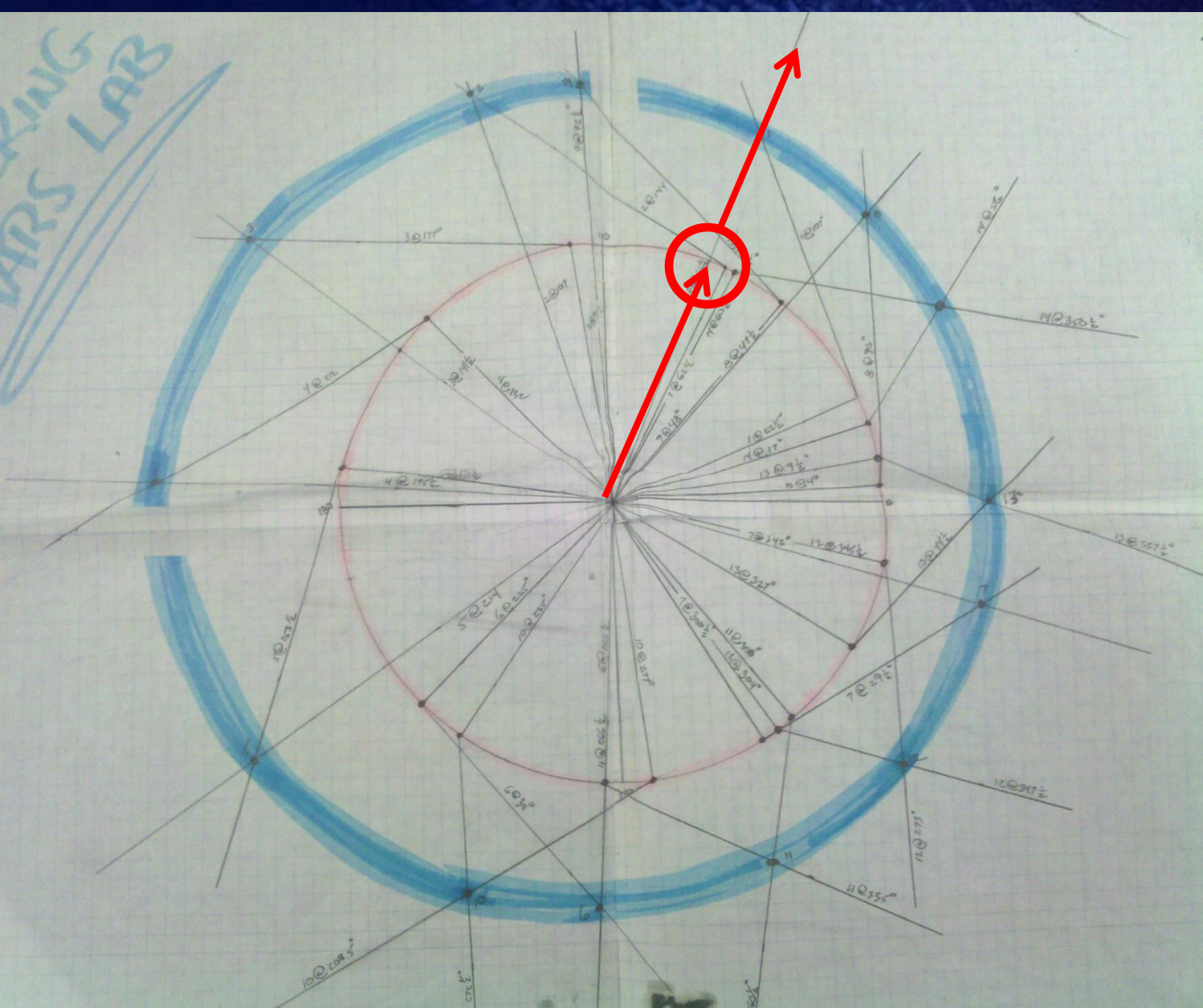




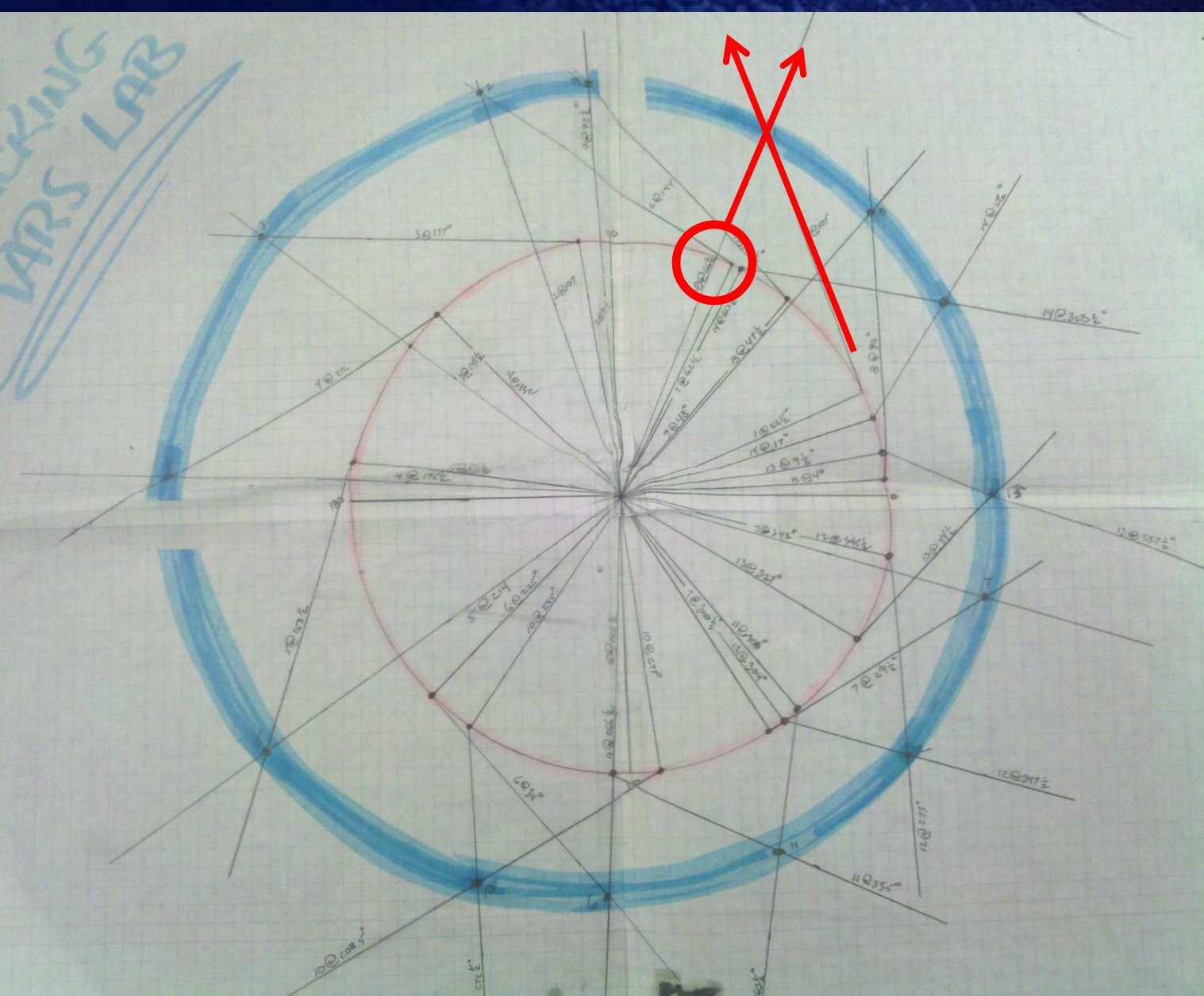


**MAHHHZ**  
**ORBIT ANIMATION**  
**THINGEE**

# TRACKING MARS LAB



# TRACKING MARS LAB





**MAHHHZ  
ORBIT VIDEO  
THINGEE**



# PETA Disclaimer :

---

*No small furry creatures were harmed in the production of this presentation.*

**Dude, he said 'PETA!'**  
**HA EH EH EH....**

