

# Thursday, April 11, 2019

#### Pick up: none

#### Today you will:

 Learn about Telescopes, Kepler's Laws and Newton's Laws ISN pg 153

#### HOMEWORK: Study!

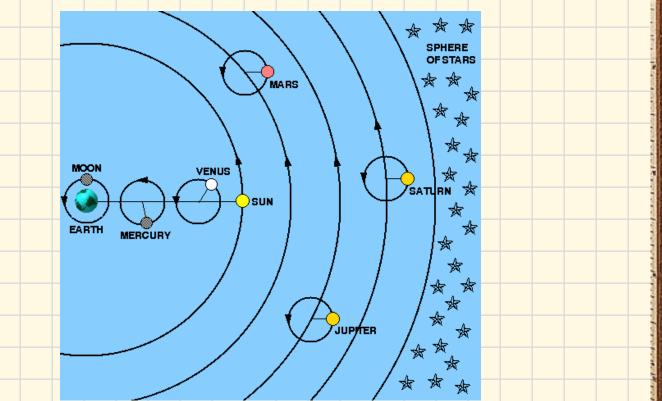


# Review – What is Scientific Law?

- What is a Scientific Law?
- A. An observation
- B. A description of an observed phenomenon
  - C. An explanation of an observed
    - phenomenon
- D. A hypothesis

# Models of the Solar System

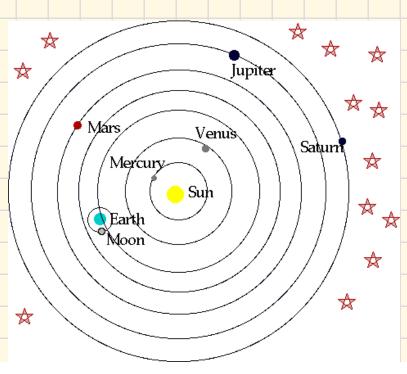
- Ptolemy's Model:
  - Geocentric model
    - **Earth** is the **center** of the solar system



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# Models of the Solar System

- Copernicus's Model:
  - Heliocentric model
    - The <u>Sun</u> is the <u>center</u> of the solar system





# Kepler's Laws of PlanetaryMotion

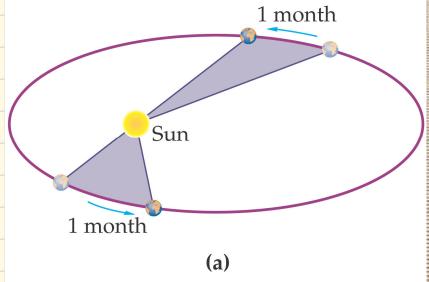
- Kepler studied **Tycho Brahe's** notes and observations
  - Lead to development of <u>three</u> laws
- Very <u>accurate</u>
  - Still used today

# #1: Law of Ellipses

- What is an ellipse?
- Each planet <u>orbits</u> the sun along a path called an <u>ellipse</u>
  - AKA <u>oval</u>
- Some are more <u>circular</u> looking than others
- **Eccentricity**:
  - A number value that describes how <u>far off</u> (eccentric) a planet's orbit is
    - Perfect circle: Eccentricity = 0.00

# #2: Law of Equal Areas

- Describes the <u>speed</u> of objects at different <u>points</u> in their orbits
- Object is <u>nearer</u> to the sun = moves <u>faster</u>
- Object is <u>further</u> away from the sun = moves <u>slower</u>
  - Still covers the <u>same</u> exact
    - area in **<u>both</u>** places

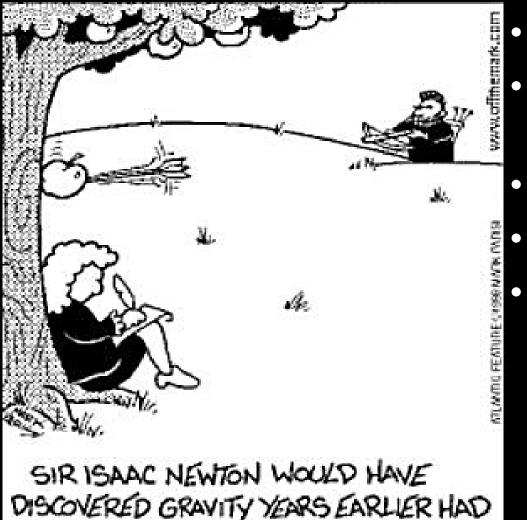


# #3: Law of Periods

- Orbital period:
  - The <u>time</u> it takes for a planet or other body to
    <u>complete</u> one orbit
- $\mathbf{K} \times \mathbf{a}^3 = \mathbf{p}^2$ 
  - -K = 1 (constant)
    - a = average distance of a planet from the sun
  - -p = planet's orbital period
- Describes how a planet's <u>distance</u> to the sun is related to orbital <u>period</u>

# Newton's Laws

# Newton's Contributions



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- Calculus
- Light is composed of rainbow colors
- **Reflecting Telescope**
- Laws of Motion
- Theory of Gravitation

## Newton's Laws of Motion

- Newton wanted to <u>explain</u> why planets moved the way <u>Kepler</u> had observed
- Lead to development of <u>three</u> laws
  - Describes the <u>motion</u> of objects on <u>Earth</u> and the motion of objects in <u>space</u>

### Newton's 1<sup>st</sup> Law of Motion

- 1<sup>st</sup> Law:
  - An object in motion stays in motion until an outside force acts on it
  - Resistance to change in motion
    - AKA Inertia
  - Objects travel in straight lines in space
    - Planets' orbits <u>curve</u> due to <u>gravity</u> (outside force)

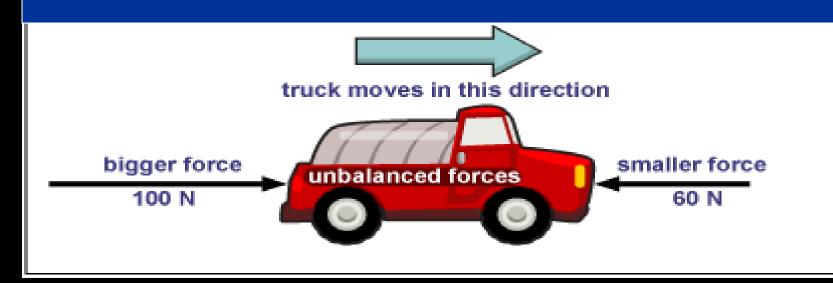
# **Balanced Force**



# Equal forces in opposite directions produce no motion

# **Unbalanced Forces**

# Unequal opposing forces produce an unbalanced force causing motion



# 1<sup>st</sup> Law



 Unless acted upon by an unbalanced force, this golf ball would sit on the tee forever.

What is this unbalanced force that acts on an object in motion?



- There are four main types of friction:
  - Sliding friction: ice skating
  - Rolling friction: bowling
  - Fluid friction (air or liquid): air or water resistance
  - Static friction: initial friction when moving an object

# 1<sup>st</sup> Law

• Once airborne, unless acted on by an unbalanced force (gravity and air - fluid friction) it would never stop!



# Newton's 2<sup>nd</sup> Law of Motion

- 2<sup>nd</sup> Law:
  - The relationship between <u>mass</u> (m), acceleration (a), and <u>force</u> (F)
  - Simply put:
    - $\cdot \mathbf{F} = \mathbf{m} \times \mathbf{a}$

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# Newton's Second Law



One rock weighs 5 Newtons. The other rock weighs 0.5 Newtons. How much more force will be required to accelerate the first rock at the same rate as the second rock?

Ten times as much

# Newton's 3<sup>rd</sup> Law of Motion

- 3<sup>rd</sup> Law:
  - For every <u>action</u>, there is an <u>equal</u> and <u>opposite</u> reaction
  - For example:
    - Stepping off a <u>boat</u> onto a dock or the <u>shore</u> of a lake
      - We go toward the shore/dock
      - The boat goes away from you



# Think about it . .

What happens if you are standing on a skateboard or a slippery floor and push against a wall? You slide in the opposite direction (away from the wall), because you pushed on the wall but the wall pushed back on you with equal and opposite force.





Why does it hurt so much when you stub your toe? When your toe exerts a force on a rock, the rock exerts an equal force back on your toe. The harder you hit your toe against it, the more force the rock exerts back on your toe (and the more your toe hurts).