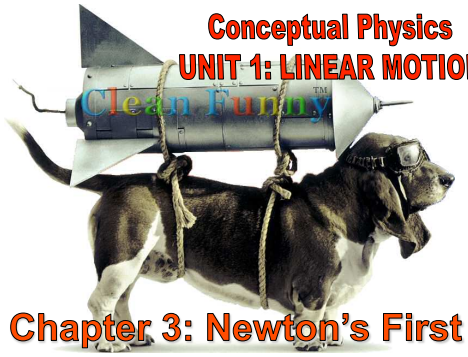


Conceptual Physics
UNIT 1: LINEAR MOTION
Chapter 3: Newton's First Law of Motion-Inertia

I. Aristotle on Motion (3.1)

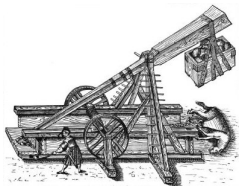
A. **Aristotle** (4th century BC– first to suggest force causes motion.

1. Divided motion into two types

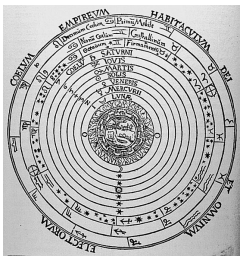
a. ***Natural Motion***– said to be either straight up or Objects would seek natural resting place fall to ground, smoke

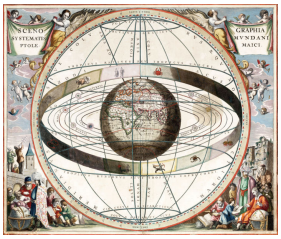
b. ***Violent Motion*** -was "imposed" motion. Result of forces that pushed or pulled. (this motion had an external force)

2. Objects in natural resting places could not move by themselves. (had to be pushed or pulled)



B. Before 16th century thought Earth must be in its natural resting place (a force large enough to move it was unthinkable)

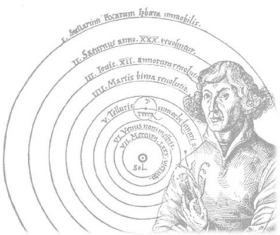




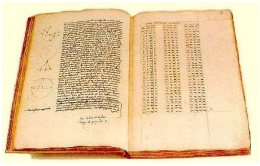
II. Copernicus and the Moving Earth (3.2)

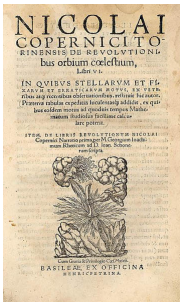
A. Nicolaus Copernicus (1473-1543)- said Earth and other planets move around sun.

1. Worked on his idea in secret to escape persecution



2. Wrote book ***De Revolutionaibus*** about his work (reached him on the day of his death)





III. ***Galileo*** on Motion (3.3)

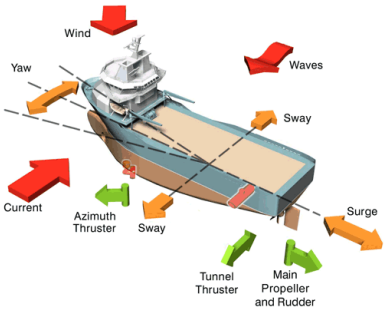
A. Foremost scientist of the late-Renaissance Italy

1. supported **Copernicus**– heliocentric theory around sun)

2. Resulted in house arrest for his think

B. Said force was not necessary to keep an object moving

1. ***Force***– is any push or pull

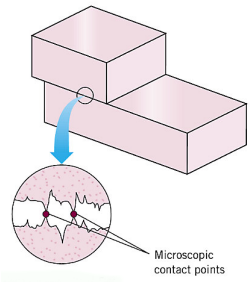


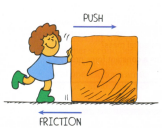
Contact vs. Long Range Force

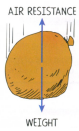
Contact Force**-** acts on an object by touching it.

Long-range Force**-** is exerted without contact (e.g. magnetic forces, gravity

2. ***Friction***– name given to the force that acts between materials that touch as they move past each other







Typical Coefficients of Friction		
Surface	μ_s	μ_k
Rubber on concrete	**0.80**	**0.65**
Rubber on wet concrete	**0.60**	**0.40**
Wood on wood	**0.50**	**0.20**
Steel on steel (dry)	**0.78**	**0.58**
Steel on steel (with oil)	**0.15**	**0.06**
Teflon on steel	**0.04**	**0.04**

3. Galileo argued that only when friction is present– as it usually is– a force needed to keep an object moving.

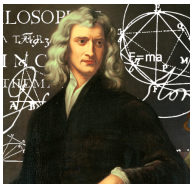
4. He stated– every material object resists change to its state of motion– called **inertia**

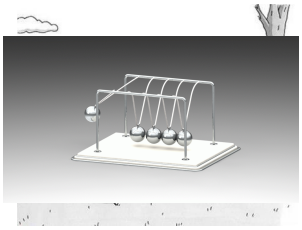
5. Led the way for Isaac Newton

IV. Newton's Law of Inertia (3.4)

A. **Isaac Newton** (1642-1727)- born same year that Galileo died

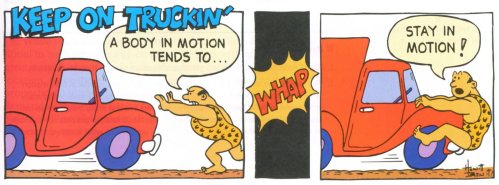
B. Developed famous laws of motion (replaced Aristotelian ideas that dominated for previous 2000 years)





1. **Newton's First Law of Motion**– usually referred to as the **law of inertia**

Every object continues in a state of rest, or of motion in a straight line at constant speed, unless it is compelled to change that state by forces exerted upon it.



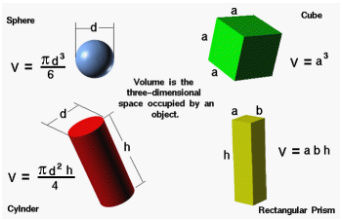
a. Restatement of Galileo's ideas

b. Simply put– **things tend to keep doing what they're already doing**

V. Mass-A Measure of Inertia (3.5)

A. Mass is Not Volume– entirely different concepts

1. ***Volume***- a measure of space (units like cubic meters, liters, etc.)
2. **Mass** -measured in ***kilograms***



B. Mass is Not Weight

1. Often confused with weight
2. ***Mass***– measurement of amount of material in an object and depends on number of and kind of atoms that compose it

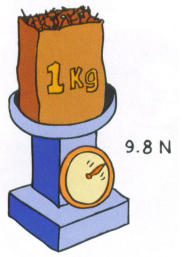
MEASUREMENT OF MASS

Mass		Weight
A measure of the amount of matter in an object	**Definition**	A measure of the gravitational force on an object.
Always constant, no matter the location.	**Does it change with location?**	Depending on where the object is in relation to the earth
kilogram (kg) gram (g)	**Unit used**	Newton (N)
Electronic balance 	**Measured with**	Spring scale 

3. ***Weight***– a measure of the gravitational force acting on the object

a. One Kilogram Weighs 9.8 Newtons

1). ***Newton*** (N)-SI unit of weight



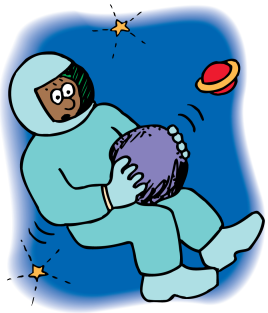

My WEIGHT on Earth is around 560N


My WEIGHT on the moon is around 90N


My MASS is always 56kg!!

Mass—A Measure of Inertia

Which would be harder to shake? A stone in its weightless state in space or in its weighted state on Earth?



2). Weight = Mass x acceleration of gravity

$$Weight = mg$$

$$F_g = mg$$