

Chapter 1

Physics, the Fundamental Science

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Definition of Physics

- ❖ The study of the basic nature of matter
 - Intrigued by curiosity about everyday phenomena
 - *Wind* – movement of air caused by uneven heat of the Earth
 - *Rainbow* – 7 colored arc formed when sunlight is scattered (refracted) by raindrops
 - *Lightning* – electrostatic discharge within the cloud or between the cloud and the ground
 - *Thunder* – the sound caused by the lightning when the air is heated and expanded rapidly
 - *Planets* – a heavenly body moving around the Sun (there are 8 planets)



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Definition of Physics - Continued

- ❖ The most fundamental science
 - Many other sciences build on ideas from physics
- ❖ The most quantitative science
 - Heavy use of mathematics
 - Numerical measurements
- ❖ Can be described more simply and cleanly than other sciences
- ❖ NOT just a collection of facts to memorize!

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General Realm of Science

Life Sciences

- Biology
- Health-related disciplines

Physical Sciences

- Physics
- Chemistry
- Geology
- Astronomy, etc.

- ❖ The life sciences deal with living organisms
- ❖ The physical sciences deal with behavior of matter in both living and nonliving systems

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Subfields of Physics

❖ Classical Physics

- Mechanics - forces and motion
- Thermodynamics - temperature, heat, energy
- Electricity and Magnetism - electric and magnetic forces, electric current
- Optics - light

❖ Modern Physics

- Atomic physics - structure and behavior of atoms
- Nuclear physics - nucleus of the atom (protons, neutrons)
- Particle physics - subatomic particles (quarks, etc.)
- Condensed matter physics – properties of matter in the solid and liquid states

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❖ Interdisciplinary Fields

- Biophysics
- Geophysics
- Astrophysics

❖ Physicists vs. Engineers

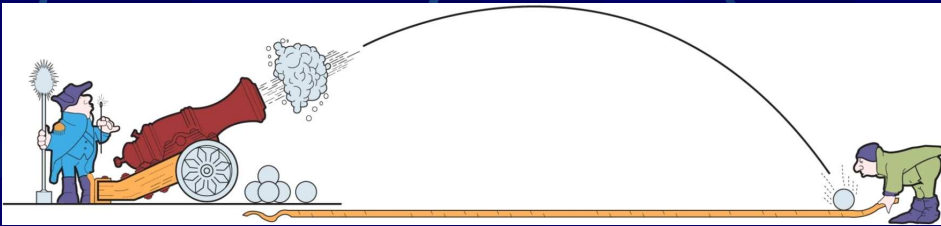
- Physicists: concerned with fundamental understanding of phenomena
- Engineers: concerned with practical applications of that understanding
 - Often overlapping roles

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Measurement and Mathematics

❖ *Careful measurements* are needed to test explanations or theories

- Different theories predict different results
- Measurement reveals which theory is correct
- For example, motion of a cannonball



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Exact Numbers and Measured Numbers

❖ *Exact Numbers* – those whose values are exactly known

- There are 12 people in a room
- There are 7 days in a week

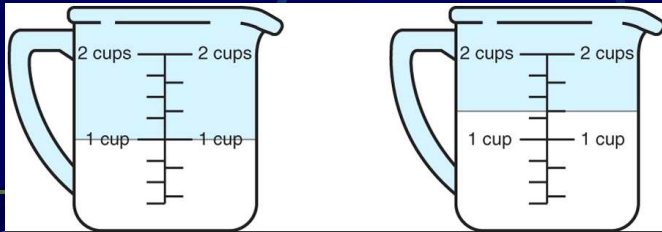
❖ *Measured Numbers* – those whose values are not exactly known because they must be measured

- In any measurement there is the possibility of an error
- E.g. the length of an air track glider or the spacing between diffraction fringes must be measured and the results will not be exact

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Measurement and Mathematics

- ❖ The *language of mathematics* is convenient
 - Fundamental relationships can be stated precisely
 - Equations can be manipulated to form different relationships ($d = vt$; $v = d/t$)
 - For example, altering a pancake recipe (one cup contains enough milk to make pancakes for 3 people and the other for 4 people – $4/3$ cups)



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Metric Units

- ❖ Most countries have adopted the metric system which has several advantages over the English system used in U.S.
- ❖ The main advantage is its use of standard prefixes to represent multiples of 10 – unit conversion is easier
 - 1 km = 1000 m
 - 1 cm = 1/100 (0.01) m
- ❖ VS.
 - 1 mile = 1760 yard
 - 1 yard = 3 feet

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