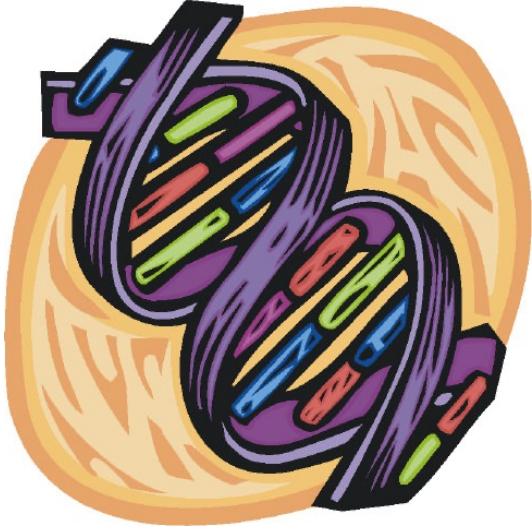
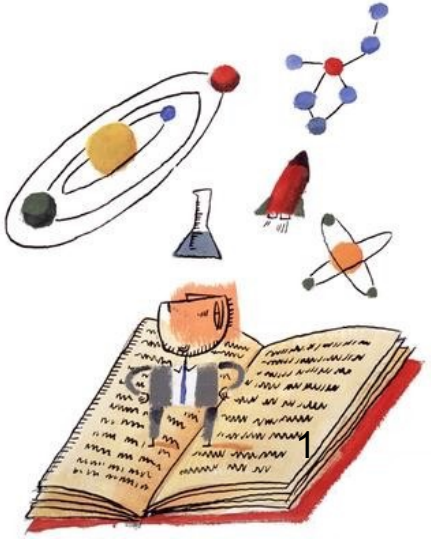


Nature of Science



Objectives

- Explanation of basic **scientific terms**

  Observation, Facts, Hypothesis, Laws, Principles, Models and Theories

Basic Scientific Terms

- Observation
  - Is the ability to describe clearly what you see in words and /or sketches and diagrams. For, example the motion of a falling stone.
- Physical Quantities
  - Quantities that are associated with what is observed and can be measured

Basic Scientific Terms (cont.)

- Fact
  - When several qualified observers agree with a repeatable careful observation or measurement and is accepted as true.

    For example, if you throw a ball up it will fall towards the ground.

  - They are *not* absolute (things that were "facts" long ago have been proven wrong now!) For example, the earth is the center of the universe.

Basic Scientific Terms (cont.)

- Hypothesis
  - An educated guess to the solution of a problem
  - Leading to a prediction which can be tested
  - Not a fact
  - Must have a test for proving it wrong
  - After tested by many scientists, a hypothesis may become a Law or Principle
  - They are changed or abandoned **if contradicted by experimental evidence**

Examples of Hypotheses

- Atoms are the smallest particles of matter that exist. **This is a scientific hypothesis because it is testable.**
- Outer space contains a kind of matter which existence can't be detected or tested. **This is not a scientific hypothesis because it cannot be tested.**
- The Pope of the Roman Catholic church is the holiest man on earth. **This is not a scientific hypothesis because it's an assertion that cannot be tested**

Basic Scientific Terms (cont.)

- Law or Principle
  - Is a generalise description of the relationship between the quantities associated with observations which can be measured
  - May be changed if the right evidence is found to prove to the contrary

Examples of Laws

- Newton's laws of motion.

  Describe how the motion of a body is related to the force that producing that motion. This laws can be used to predict and explain the motion of a body to which a known force is applied.

- Coulomb's law

  Describe the electrostatic force between stationary point charges. This law can be used to predict and explain the electrostatic interactions between charges.

Basic Scientific Terms (cont.)

- **Models**
  - Scientific model is a conceptual representation whose purpose is to explain and predict observed phenomena.
  - Are limited to explain specific aspects of the natural world
  - Can be refined as new information obtained

Examples of Models

- Rutherford 's model of the atom

  Could explain the existence of the atomic nucleus

- Bohr's model of the atom

  Could explain atomic structure and why atomic spectra contain only limited number of light frequencies.

The atomic puzzle

"This is the highest form of musicality in the sphere of thought."

Niels Bohr

Putting things together...

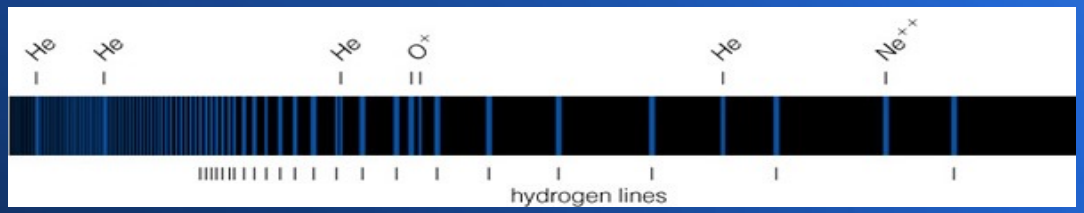
The atomic puzzle

“That this insecure and contradictory foundation was sufficient to enable a man of Bohr's unique instinct and sensitivity to discover the principal laws of the spectral lines and of the electron shell of the atoms, together with their significance for chemistry, appeared to me as a miracle – and appears to me a miracle even today.”

Albert Einstein (Autobiographical Notes)

Putting things together...

Emission Line Spectrum: e.g., the Sun hot upper atmosphere or the Orion Nebula



Orion Nebula

Basic Scientific Terms (cont.)

- Theory
  - A scientific theory is a well-established explanation for how or why a phenomenon happens that incorporates scientific facts, tested hypotheses, laws.
  - Can be refined as new information obtained
  - Explain observable aspect of the natural world using facts, laws or models.

Examples of Theories

- Kinetic molecular theory of matter

  Explain the changes in the physical states of matter.

- Quantum theory

  Explain the behaviour of light.

- Big Bang

  Explain how galaxies are presently moving away from one another.