Introduction to Science

Fundamentals for Class 9th

Also see ISRO Education Portal for video films on science

What is Science ? and What is Matter?

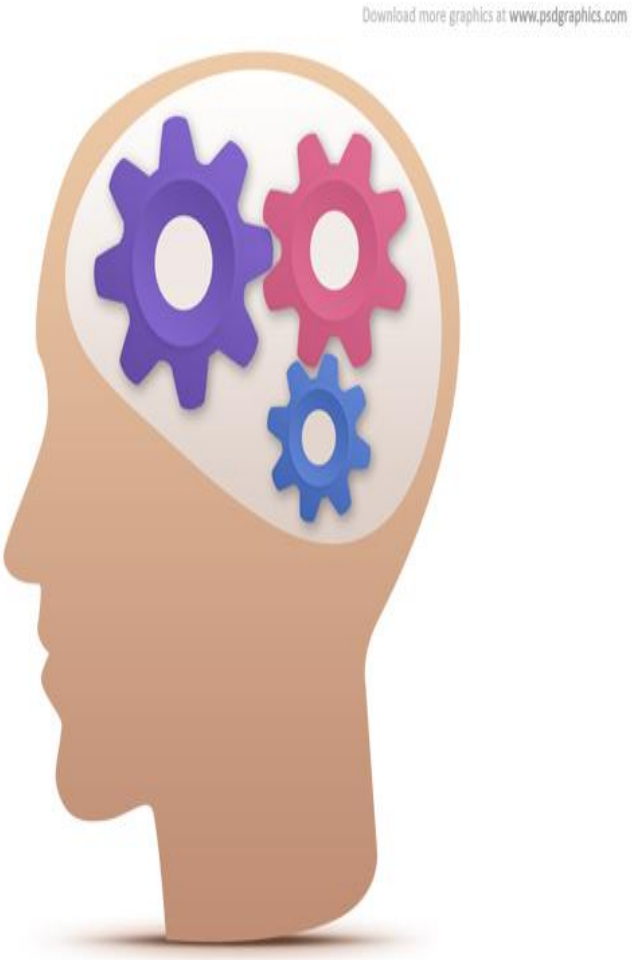
- Science is the study of Energy and 'non-living' matter only.
- Science has a larger component of Mathematics than Social Sciences.
- Matter is any substance that occupies space and has mass.

1. Matter is all 'non-living' or 'Inorganic' and living substance found in Nature.

2. All non-living 'Matter' in existence today was created at the time the Universe was created.

What is Science?

- Science aims is to understand the Reality about matter in the universe, on basis of facts that can be verified.
- Its study is based on logic and methods of Reasoning.



“God does not play dice with the Universe”. Albert Einstein

- Mathematics is called the ‘perfect language’ because its rules always produce exactly the same result.
- It is the language that underlies all ‘Truth’ in Nature, and all ‘Reality’ that exists in the Universe.
- It is the language of the Universe, and the entire Creation, including our Solar System, the Galaxies and beyond, are believed to move by its rules.

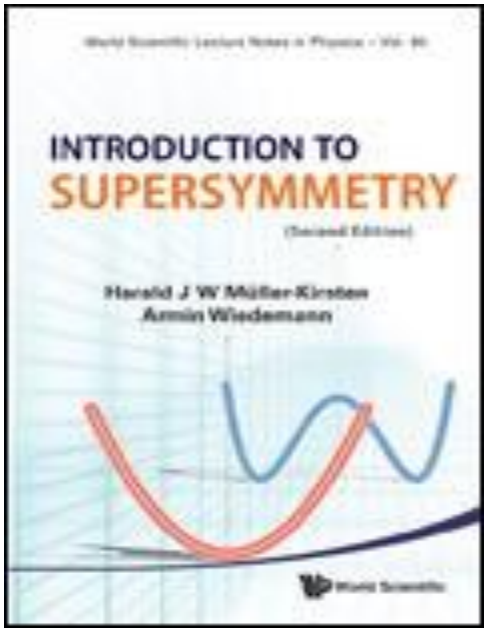
How?

- Science is based on Mathematics and methods of Reasoning, and has established 'scientific principles'
- Science is the study of Energy , non-living matter and 're-actions' of non-living matter

The methods of Reasoning

1. Inductive Reasoning
2. Deductive Reasoning
3. The Scientific Experiments that are done to establish 'Scientific Principles' also involve these two methods of reasoning.

Examples of Books indicating Mathematical content of Higher Physics



Problems and Solutions in Theoretical and Mathematical Physics

All Inorganic matter comprises of 92 Elements found in Nature

- In these 92 Elements, only 8 Element comprise of 98% of all non-living (inorganic) matter.
- These 8 Elements are

Oxygen (49%)	Silicon (26%)
Aluminum (8%)	Iron (5%)
Calcium (3%)	Sodium (3%)
Potassium (2%)	Magnesium (2%)

Status on Elements as in 2016

International Union of Pure and Applied Physics announced recognition of discoveries of elements 115, 117 and 118.

Element 113 sits between copernicium and flerovium on the periodic table.

A team of scientists in Russia and the US were vying for naming rights for 113 after announcing its discovery in 2004.

Isotopes of element 113 have a very short half-life, lasting for less than a thousandth of a second, making its discovery very difficult.

After twice succeeding to create it, the group tried for seven years before further success, in August 2012.

Inorganic Matter

1. Science is the study of Inorganic Matter

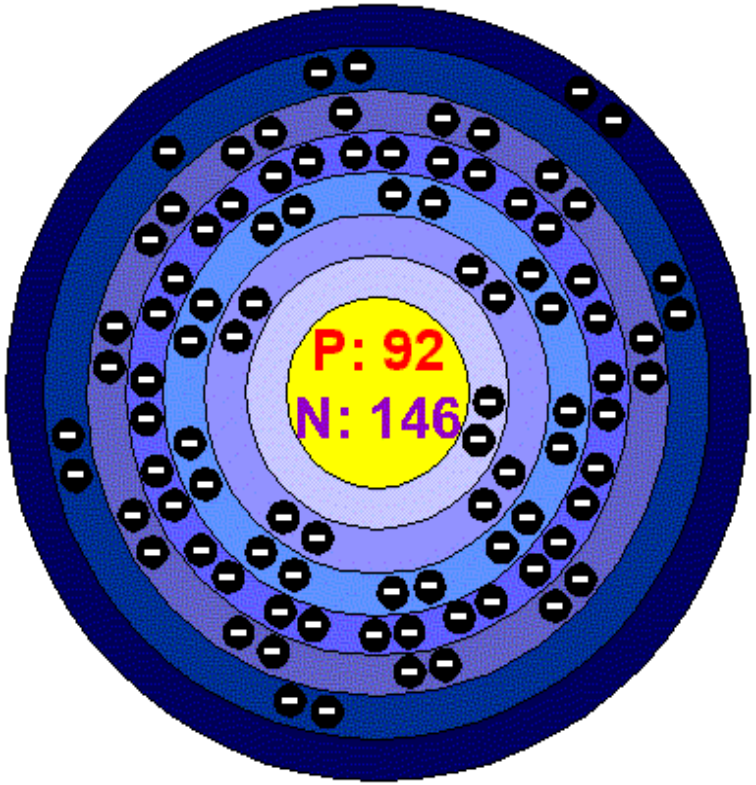
- Inorganic Matter cannot be created by Man but Man has found ways to change its form from gas, to fluid, to solid under certain conditions.
- Technology has facilitated combining of two or more Elements to create a new compound or alloy.

Reducing Uncertainty through Scientific Principles

1. Science subjects, deal with non-living matter. As such they have greater certainty in predicting their characteristics and reactions.

1.2 Due to the certainty, involved in non-life elements and matter, Scientific Principles can be formulated.

The Scientific Principles when applied in the given conditions, produce the exact same results.



Atomic structure of Uranium that has a Melting point at 1132 degree centigrade And boiling point at 3828 degree Centigrade

Scientific Principles?

- Science can establish permanently certain facts that are called 'Scientific Principles'.
- These facts may be tested in the given conditions, at any time, by anyone, in any place, to produce the exactly same result.
- This is because Science studies only 'Inorganic Matter' that re-acts repeatedly, as predicted.
- As such, Science has a quality of 'precision' like a clock-work that shows precise time every time.

Some examples: -

1. At Sea level, the boiling point of water is 100 degrees centigrade and its freezing point is 0 degree centigrade.
2. There is an equal and opposite reaction to every action.
3. All things fall towards the Earth, due to its Gravity.
4. $E = MC^2$

   = Energy produced is equal to mass of matter multiplied by twice the velocity or speed of matter.

Example of a Scientific Principle

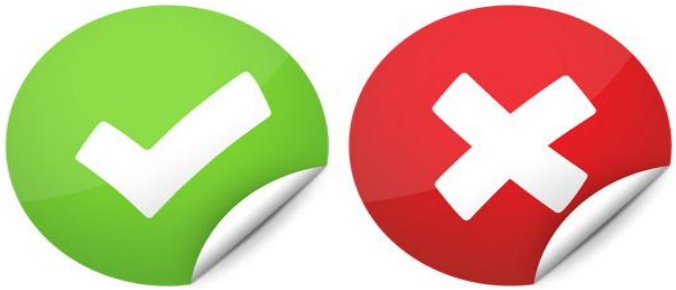
- Principle I. The Wave Equation
(Space is a Wave-Medium and Propagates Wave-Motions)
- This Principle describes how quantum waves are formed and travel in the space medium.
- The wave amplitudes are scalar numbers. If the medium is uniform, typical nearly everywhere, only *spherical waves* occur.
- If observed in relative motion, Doppler modulation and elliptical waves appear.
- If the medium is locally dense, as in the central region of a proton, waves *circulate* like sound waves in a drum or a crystalline sphere.

INORGANIC TOPICS IN CLASS 9TH TEXTBOOK

Chapter No.	Title of the Chapter	Specialized subject area of the chapter	Later on to be studied in advance study of	Other remarks/ Higher studies subject matter
1	Matter and Law of conservation of matter	Chemistry	Inorganic Chemistry	Inorganic Chemistry, Chemical engineering
2	Gas Laws	Energy	Physics	Physics and Environmental Science
3	Elements, Compounds and Mixtures	Chemistry , and Geography	Chemistry and Geography	Geography and Mining Engineering
4	Language of Chemistry	Inorganic Chemistry	Chemical Engineering and Mineralogy	Mineralogy and Chemical Engineering
5	Physical and Chemical Changes	Mechanics, Engineering Biology, Geography,	Physics	Mechanical Engineering, Biology, Geography
6	Water	Urbanization, Energy, Geography	Physics	Hydro power , transportation mechanics.
7	Atomic structure	Physics and Chemistry	Electricity and Nuclear Power	Electronics, Energy, Nuclear power, nuclear medicine.

Ch 5. Physical and Chemical Changes

- Change is the difference between one form of matter, from another form of matter.
- Energy is always used in bringing Change.
- Physical change occurs when the outer form of a thing is different from its earlier form, but the two forms are reversible are can be restored. Example, water changed to steam or ice can be restored to its water form.



Chemical Change

- Chemical change occurs when in addition to physical change, the structure of the matter also gets changed, in a manner that cannot be reversed.
- Example, burning of any matter is a chemical change as the original substance cannot be restored .

Physical change Water changes into vapour, forms clouds, rains as water in fluid form or as snow in solid form. This change is reversible.

After a chemical change, the substance cannot be restored to its original form.

- Leaves contain a matter called ‘Chlorophyll’. This gives the leaves their green colour.
- Photosynthesis occurs only in the presence of sunlight and water.
- The leaves absorb air. During photosynthesis, carbon from oxygen is separated.
- Oxygen is released back into the atmosphere, and carbon is retained in the leaf, to be converted to starch.

Plant Energy, in Science is concerned with Living matter

Plant Energy

- In the presence of Sunlight, the leaf mix the carbon with water and change it into starch, called ‘carbohydrate’ (carbon + hydrate or water)
- This starch is also called ‘fruit sugar’ or glucose and as it gets stored in fruits of the plant.

(Carbon from air+ water + sunlight)

Proteins

- ‘Proteins’ are more complex than fruit sugar. They are produces by a variety of plants called ‘legumen’.
- These plants attract a special variety of bacteria from the soil. This bacteria resides in the roots of these plants.
- The special bacteria separate nitrogen gas from the soil, which is then absorbed by the plant.
- During photosynthesis, in addition to carbon and water, nitrogen is also used to create proteins.
- (carbon+ water + nitrogen)

Food for humans- from fields to plate

Grains, vegetables and fruits are grown in fields, with sunlight and water.

These are sold in local markets, after harvestimg.

Cooked and prepared to be Consumed at home.

Fruits do not need to be cooked. They are eaten directly or prepared as juice

Use of Energy by humans

- Humans need energy for all activities. This includes external energy such as Light and Fire, and internal energy for strength that is obtained from food they consume.
- Humans depend on plants and animals to provide them with energy sources, such as vegetables, grains, cereals, milk.
- These sources are cooked on fire, to enable humans to digest them. Some plant products such as Fruits, are eaten directly without cooking.
- This process is expresses poetically in a line from a traditional *bhajan* : *"Dekho kese aam se mil kar meethi ho gai dhoop".*

THANK YOU