# "Orientation of Secondary Science Teachers to develop the skill to use constructivist pedagogy in classroom situations''

**PAC 16.29**


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# INTRODUCTION

Science is a dynamic, expanding body of knowledge, covering ever new domain of experiences. So the teaching of science should be so planned that it enable students to examine and analyse everyday experiences. More so at secondary stage where students should be learning science as a composite discipline and for doing this, first teachers should be trained. The same is also recommended in NCF 2005.

It is also pointed out in NCF 2005 that teacher education programs today train teacher to adjust to a system in which education is seen as the transmission of information. (p.107) Teacher education must become more sensitive to the emerging demands from the school system, it mentions. More so far the teaching of science. So it recommends the in-service programs like refresher courses, seminars, workshops etc. for the teachers which can play significant role in the professional growth of teachers and function as an agent in school related practices. (p.111).

But before this some training material should be prepared in advance on which the above programme can be organized and the material thus prepared can be distributed to science teachers. This training package should employ a constructivist approach to learning and teaching using five phases, known as the **5Es** (Engage, Explore, Explain, Elaborate and Evaluate). The ***Engage***phase aims at promoting interest and motivation. During this phase the emphasis is on activities to arouse curiosity, puzzle students and raise questions for further investigation. The***Explore***phase provides students with practical experiences. During this phase students continue to raise questions, listen to the views of others and begin to investigate different phenomena. Students are encouraged to express and share views while value judgments about views are suspended. In the ***Explain*** phase students explain their findings to others and their ideas are

subjected to greater scrutiny. During this phase, the teacher introduces relevantscientific explanations. By theend of the explain phase students

should have developed greater understanding of phenomena under investigation. The emphasis in***Elaborate*** phase is on students applying their new understandings developed during previous phases, to a range of familiar and unfamiliar situations.

During this phase, students can see how fruitful their new ideas are. This phase is important as it allows students to see how well their ideas work in a range of contexts. The ***Evaluate*** phase is the final phase. Here students' understanding is assessed formally and students are encouraged to reflect on and question the ideas which they have developed. Each lesson taught involves aspects of each phase, and each phase should be evident in the planning and implementation of the unit as a whole.

Keeping this in mind this PAC program is organized.

# Acknowledgement

The Training Package is not just an effort made possible by the help of the experts but several persons of my institute too were very helpful in its preparation.

I'm indebted to Prof. H.K. Senapaty, Director NCERT. Prof. NityanandaPradhan, Principal, Prof. I.B. Chughtai, Dean of Instruction, Prof. L.K. Tiwary, Head, DEE, RIE, Bhopal for their guidance and support. Their support and inspiration have been instrumental in preparation of this Training Package.

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# Content

## CONSTRUCTIVISM – A TEACHING APPROACH

Piaget was the first major constructist. He emphasized on involvement of children through activities to achieve cognitive development. On the basis of extensive researches he identified four stages of cognitive development:

1. Sensory motor stage : 0-2 years
2. Pre – operational stage : 2-7 years
3. Concrete operational stage : 7-11 years
4. Formal operational stage : 11 years onwards

Apart from the identification and sequence of the stages of cognitive development, Piaget underlined that activities conducted by children are major means of learning and meaningful learning does not take place through oral communication. Therefore, inclusion of activities that provide opportunity to operate upon concrete objects enhances quality of learning. Secondly, Social interaction among children also helps to understand others point of view. Though approximate age of attaining different stages of cognitive development have been mentioned earlier. These are tentative and cognitive development could be accelerated by including various cognitive activities.

Vygorski was another person who contributed to the understanding of cognitive development. He emphasized on socio-cultural perspective in learning. The traditional classroom teaching is based upon 'blank-slate' model and positivist view of learning. The blank-slate model assumes that,

- Students come to the class with-blank mind-slate and anything can be miscribed on it;
- the knowledge is with the teacher, is propagated by him/her and is received, interpreted and assimilated by the student in the same form without any distortions, and
- a good lecture. Therefore, coupled with-some demonstrations, etc. is a sure method to improve efficacy of teaching.

The positivist view of learning assumes that it is possible to study an object or phenomenon objectively and arrive at the 'universal truth' unaffected by previous ideas or beliefs. Through logic, mathematical applications and objective experience one could discover the reality. As a contracts to this, constructivist view of learning assumes that knowledge is constructed through experience, is continually refined in view of new observations and does not exist independent of human experience. The brain is an active agent which continually draws interpretation on the basis of information received by it. The brain is assumed to be selective in receiving information while it ignores other information which it considers

as useless for its purpose. The mental constructs are mental models which are continually tested against the new experiences and modified, if need be. In this way the prior experiences, beliefs and emotions affect the individual's perception and interpretation of events. The important features of constructivist model of learning could thus be stated as,

- Knowledge acquisition is a constructive or generative process and each student's knowledge is personal or idiosyncrative.
- Misconceptions may originate as a result of students interaction / experience with the real world and / or because of his/her misinterpretation of ideas presented to him/her.
- The process of concept formation is a continuous process of successive approximations and refinement.
- Due to their different conceptual ecologies, different learners can interpret and the same new experience / idea differently in their conceptual structures / frameworks.
- Development of alternative frameworks or misconceptions is from the same mechanism that leads to the development of conception. In addition, some modes and sequences of presenting information during teaching may result into development of misconception.
- Students hold intuitive ideas that are both stable and identifiable and have enough commonality to make it worth use in planning instructional strategies.

In the context of constructivist approach, student's errors are recognized as a part of developmental phenomenon and not due to misunderstanding of the concept. The constructivist philosophy regards high epistemological status to individual's personal conceptions. This considers 'error' as a natural developmental stage, rather than the cognitive deficiency, inadequate learning, carelessness or the part of student and poor teaching.

**Nature of student's ideas**

From the large number of studies, some common features of student's ideas have been observed. These are:

- Ideas are stable and do not change easily despite teachers tutoring them to the contrary and instructions in the school. Sometimes they seem to change, but students retrograde to the earlier ideas when they encounter new / difficult situation.
- The ideas are context specific and may not be applied in another scientifically similar situation. They lack generality and have limited application.

- Many ideas are developed prior to teaching. When children come to the classroom, and are provided with different scientific ideas, children either (i) modify the previous view-points (ii) possess two ideas, one for the classroom and the other for personal feelings and interpretation in a compartmentalized manner, or (iii) discard the original idea and adopt the scientific explanation.
- Ideas are personal. Some experience may have different implications for different students due to their varied conceptual ecology. Thus what they internalize and member is different. This does not mean that many children do not have common ideas. For example, some commonly held misconceptions are:
    - If a body is not moving, there is no force acting on it.
    - Half lens would make half image
    - Sun in living.
- Children's ideas do not have precise language. They may have similarity with-scientific theories rejected in the past.

**Teaching in view of children's ideas**

In view of existing variety of concepts, which may not be in accordance with scientific ideas it is necessary to adopt special strategies to bring out necessary conceptual change. For conceptual change the necessary conditions are:

1. Learner must encounter such a situation which he is not able to understand using existing knowledge. Thereby producing dissatisfaction in the learner.
2. Learner must come across some knowledge which is intelligible to him and seems plausible.
3. The new knowledge helps learner to understand some new situations which were beyond his reach earlier.

Driver and Oldham has suggested constructivist teaching sequence consisting of five phases: 1. Orientation, 2. Elicitation of children's ideas, 3. restructuring of children's ideas through (i) clarification and exchange, (ii) exposure to conflict situation, (iii) constructions of new ideas and (iv) evaluation of new ideas, 4. Application of new idea and 5. Review of change in ideas and comparison with previously held ideas.

To reconstruct children's ideas various strategies could be used. These include demonstration, discussion, debate and experiment etc. In this context it is important to remember that,

- Conduction of activity in itself is not enough. It is the way it is done and meaning is made out of it is important.

- Analyzing student's response, it is important to see the reasoning given in aiming at the response.
- Scientific theories are not the unique result of scientific observations. Theories are constructs of human intellect.
- Learner's construct meaning themselves and do not nearly repeat what is told to them.
- Learners do not learn is unconnected bits but are able to see relationship with other ideas.
- Teacher understands that meaningful learning cannot take place without considering preconceptions.

**Characteristics of constructivist classroom environment**

- Atmosphere is democratic and student's ideas are paid adequate attention.
- Students feel free to ask questions and raise doubts.
- Students take autonomy and they are encouraged to take initiative.
- For learning raw data, primary sources and interactive material are used.
- Cognitive activities such as reflective thinking, prediction, creating hypothesis are extensively used.
- Misconceptions are not considered as mistake but a point of view which needs to be examined and evaluated by the learner himself.
- Support cooperative learning.
- Activities are learner centered rather than teacher centered.

Assessment is part of learning process where concepts are evaluated by students.

# THE FUNDAMENTAL UNIT OF LIFE

**Subject:Science(Biology)**

**Key Words**

Cell, Plant Cell, Animal cell, Cork, Microscope.

**Learning Aspects**

- Cell - History and discovery.
- Cell is the fundamental unit of life.
- Single Cell organisms.
- Multicellular organisms.

**Process Skills**

Experimentation, observation, interpretation, presentation of data and analysis.Logical thinking, problem solving and reflective thinking.

**Learning Resources:**

Permanent slides of *Amoeba, ParamoeciumChlamydomonas,* human cheek cell, Onion bulb, leaves of *Rhoeo discolor* plant, glycerine, safranine, slides, watch glasses, needles, brush blotting paper and compound microscopes. A poster showing picture of cork cells as seen by Robert Hooke 1665."

## 1. Engage

The teacher may start the class by telling a small story from the scientific history about how in the year 1665, Robert Hooke, cut a thin section of cork and observed its structure under a self designed primitive microscope. The teacher may show the poster depicting the historical diagram as seen by Robert-Hooke.

The teacher may ask the students draw and note down their observations in their notebook.

Following questions may be asked:

(1) Describe the structure that you see in the diagram.

(2) What is the structure of a unit in the diagram.

Teacher may explain that these box like structures were named "cell" by Robert Hooke. "Cell" is a Latin word which means 'a little room'. The teacher asks - What do you think the animal and plants are made of?

The teacher tells the student that they were going to explore to find answer to above question.

**2 Explore**

The teacher divides the class into 4 groups A, B, C and D.

Group-A will study onion peeling of bulb.

Group-B will study *Rhoeo discolor* leaf peeling

Group-C will study human cheek cell from permanent slide.

Group-D will study single cell of *Amoeba, Paramoecium* and *Chlamydomonas*.

At the outset the teacher explains and demonstrates to the class - How to take out peel from onion bulb and *Rhoeo discolor*leaf and - How to make their temporary mounts to study under microscope.

The teacher facilitates the students with various activities like slide making, & observation under microscope.

The students of all groups are instructed to-

- Draw diagrammes, note observations as observed through microscope.
- Students are asked to study features of what is visible under the microscope.
- Students of all groups are asked to observe slides prepared by each other.

**Explain**

Students are asked to make a presentation group wise:

- Each group presents its findings through diagrams.
- They discuss the salient features of the structures observed by them.
- They express analysis of observation by explaining their results.
- Teacher intervenes and suggests explanation wherever necessary.

The students are able to draw following conclusions after making observation and discussion:

1. All the structures look alike and a unit structure is rectangular (onion peel) or hexagonal (*Rhoeo*).
2. Together they form a big structure like onion bulb.
3. Onion bulbs of different sizes have similar rectangular structure visible in their peels under microscope.
4. There is a dark spherical structure in the centre of rectangles.
5. Permanent slide of human cheek cell also exhibit similar structures.
6. Permanent slides of *Amoeba, Paramoecium* and *Chlamydomonas*show single strctures of specific shape and size.

**Elaborate**

The Teacher further elaborates the findings of the students into scientific concepts.

- These small structures that are seen in the peel of onion bulb, leaves of *Rhoeo* or human cheek scrape are basic building blocks or units.
- These structures are called cells.
- They may have different shapes and sizes e.g. rectangular in onion bulb and hexagonal in *Rhoeo* leaf.
- The dark spherical point observed in the centre of these cells is called 'Nucleus'.
- Single cells may also constitute a whole organism as seen in the permanent slides of *Amoeba, Paramoecium,* and *Chlamydomonas*.
- Such organisms that are single celled are called "Unicellular".
- When many cells group together to form an organism, such organisms are called "*Multicellular*" e.g. Onion bulb, *Rhoeo discolor*, Human beings.

**Evaluation**

It was also carried on through $E_1$ - $E_4$.

- Students *may be exchanged in the groups* and asked to repeat the experiments using different epidermal peelings from other leaves.
- They may be asked to answer following questions:
  Do all cells look alike in terms of size and shape?

What are the similarities found in all cells studied?

Do you think cells from different parts of a plant (Leaf, stem) have similar structure?

Draw diagrams of different types of cells studied by you.

# STRUCTURAL ORGANISATION OF CELL

**Subject:Science(Biology)**

**Key Words**

Plasma Membrane, Cell-wall, Nucleus, Diffusion, Osmosis, Cytoplasm.

**Learning Aspects**

What are cells made of? Plasma membrane, Cell-wall, Nucleus, Cytoplasm, Osmosis, Diffusion.

**Process Skills**

Experimentation, observation, interpretation and Analysis of Results, Presentation of data, communication, Logical and reflective thinking.

**Learning Resources**

Raisins or apricots, eggs, dilute HCl concentrated salt/sugar solution, some presoaked swollen raisins, potato tuber, sharp knife, paper pin, petre dishes, glass slides *Rhoeo discolor* leaf, Ice cream spoon, needle, brush, slide, cover slip, methylene blue, compound microscope.

**Engage**

The teacher asks the students to recall the slides made from onion bulb peeling and *Rhoeo* leaf peeling from the previous class. She/he asks the students to draw the cells seen by them and asks to describe their features. They may answer - There is boundary surrounding a central space having a spherical dot like structure in the centre.

Teacher: This outer boundary is called Plasma membrane or biological membrane, the space has cytoplasm and the dot like structure is called the nucleus.

Almost all cells studied under the microscope have three parts - outer plasma membrane, cytoplasm and nucleus. All the activities inside the cell are possible due to these features.

**Explore**

Demonstration by the Teacher - Take an egg and put it in a dilute hydrochloric acid. The outer shell which is made of $CaCO_3$ dissolves and a thin membranous layer is observed. This layer is called Plasma membrane. All the students will be shown the plasma membrane in which all content of an egg are contained.

Now the Teacher divides the students in four groups 'A', 'B', 'C' and 'D' and assigns them four different activities.

**Activity - I Group-A**

- Take two eggs.
- Remove shells by placing in dilute HCl.
- Place one de-shelled egg in a beaker containing water.
- Place another de-shelled egg in a beaker containing concentrated salt solution.

**Activity - II Group-B**

- Put 20 Raisins/ Apricots in water in a beaker.
- Put 20 swollen presoaked Raisins in a beaker containing concentrated sugar solution.

**Activity - III Group-C**

Take three potatoes (tubers) and peel out its outer skin. Cut its one end to make the flat bottom. Now make hollow cavity sufficiently deep on the opposite side to make a small cup.

(a) Take a potato tuber cup, pour some conc. sugar solution upto half the cavity and mark level by inserting a pin in the wall of the tuber. Put the potato tuber in a beaker containing small amount of water.

(b) In the second potato tuber cup cavity water is filled, level marked with a pin and placed in a beaker containing conc. sugar solution.

(c) In the cavity of third potato tuber cup, sugar solution is filled and level marked with the help of a pin. The tuber is placed in a beaker

containing same concentrated sugar solution as was filled inside the cavity.

All the students of these three groups were asked to take observations 20 minutes after the experiments were setup.

**Activity - IV Group-D**

- Take a glass slide with a drop of water on it.
- Using a clean ice-cream spoon gently scrape the inside surface of the cheek.
- Observe whether any material gets stuck to the spoon.
- With the help of a needle transfer the material on the slide and spread it evenly.
- Put a drop of methylene blue solution on it and place a cover slip.
- Observe the slide under microscope and note the details.
- Observe a darkly coloured, spherical structure near the centre of the cell.
- Draw your observations and label them.
- Compare the structure of these cells with those observed in the onion peel and epidermal peel of Rhoeo leaf.

**Explain**

The students present the observations with the help of diagrammes. Describe and label various structures. They also try to present their observations regarding processes observed by them. They provided evidences to support their views. The teacher behaved as a facilitator and encouraged the learners to explain concepts and conditions in their own words. The teacher asked for justification and clarification from students and then formally provided definitions, explanations and new labels. Following learning points come out of the presentation and discussion:

Based on activities I, II & III.

1. The experiments show that water can pass through the plasma - membrane in both directions.

2. In case the concentration of the medium and cell is the same, equal amount of water moves in both directions, cell shape remains the same. The solution is called isotonic i.e having same concentration so, no osmosis occurs.
3. In case the concentration of the medium is lower than cell, therefore more water moves in as compared to moving out, hence swelling up of cell and increase in size occurs e.g. in case of egg size, volume in potato cavity and swelling of raisins soaked in water.

   The solution inside the cell is called hypertonic. The process is called Endosmosis.
4. In case of the concentration of medium outside cell is more as compared to inside of the cell. More water moves out of the cell than coming in leading to shrinkage. Hence size of the cell decreases or shrinks e.g. shrinking of swollen raisins, egg and decrease in level of solution in the potato tuber cup. The concentration of the medium is called hypertonic and the process is called Exosmosis.
5. It is also noted that the plasma membrane is flexible.

Based on the activity No. IV following findings are reported:

1. Cells from a plant (onion peel) and arimal (human cheek) have similar structures basically.
2. There is an outer boundary - plasma membrane.
3. Dark spherical body in the centre known as Nucleus.
4. The space occupied between plasma - membrane and nucleus is occupied by cytoplasm.

**Elaborate**

The teacher explains the topic further in detail based on existing data and understanding of the students and enriching it with definitions, concepts and labels.

1. The fundamental organizational unit of life is the cell.
2. Plasma Membrane cells are enclosed by plasma membrane composed of lipids and proteins. It separates the contents of the cell from its external environment.

3. The cell membrane is an active part of the cell. It regulates the movement of materials between the interior of the cell and the outer environment by a specialized form of diffusion called Osmosis.
4. When a cell is placed in a medium having hypotonic solution, endosmosis occurs and water moves in the cell which swells. When placed in a hypertonic solution, water moves out of the cell due to exosmosis and the cell shrinks. If the cell is placed in the isotonic solution then equal amount of water moves in and out of cell across plasma membrane causing no gain or loss of water.
5. It allows or permits entry and exit of some materials in and out of the cell.
6. It also prevents the movement of some materials across it, it is therefore, called selectively permeable membrane.
7. Plasma membrane is made of mostly lipids and proteins.
8. Plasma membrane also permits the movement of gases across it.

**Cell Wall**

In plant cells, the cell wall is composed of mainly cellulose and is located just outside the plasma membrane. The cell wall is rigid and its presence enables the cells of plants, to exist in a hypotonic media without bursting.

**Cytoplasm**

The teacher asks the students to recall the observation made from temporary mount of the onion peel and those of activity IV of human cheek cell.

1. A Large region in each cell enclosed by the cell membrane can be seen.
2. The region takes up very little stain and is called cytoplasm.
3. The cytoplasm is a fluid content inside a plasma membrane.
4. It contains many specialized cell organelles.
5. Each organelle performs a specific function and has a specific structure.

6. Cells need a lot of chemical activities to support their complicated structure and function. To keep these activities separate from each other, the cells use membrane bound structures or "Organelles" within themselves.
7. Some important examples of cell organelles are Endoplasmic reticulum Golgi apparatus, Lysosomes, Mitochondria, Plastids and Vacuoles.
8. The teacher may use ICT, multimedia animation and three-D models to explain the structure and functions of their organelles.

**Nucleus:** The teacher may explain the following with the help of a display chart:

1. The nucleus has a double layered covering called nuclear membrane.
2. The nuclear membrane has pores that allow the transfer of material from inside the nucleus to outside.
3. The nucleus contains chromosomes which are visible as rod shaped structures only when the cell is about to divide.
4. When the cell is not dividing chromosomes form chromatin material, which is a visible entangled mass of thread like structures.
5. Chromosome are composed of DNA and protein.
6. A functional segment of DNA is called Gene.
7. DNA molecules contain information regarding construction and organizing cells.
8. Nucleus plays a central role in cell reproductionthe process by which a single cell divides and forms two new cells.

**Evaluation**

1. What would happen if the plasma membrane breaks or ruptures?
2. What is Osmosis? Explain its process and significance.
3. Mount a peel of *Rhoeo* leaf in water:
   (a) On a slide and examine cells under Microscope.
   (b) Put a drop of strong solution of sucrose or salt on the mounted peel on the slide.

(c) Wait for a minute and observe under Microscope.

(d) Put few drops of water on the above peeling.

(e) Wait for a minute and observe under Microscope.

(f) Place*Rhoeo* leaves in boiling water for a few minutes.

(g) Then mount on a slide and put a strong solution of sugar or salt on the mounted peelon the slide.

(h) Wait for a minute and observe it again.

On the basis of observations explain the phenomenon of-

1) Exosmosis

2) Endosmosis

3) Plasmolysis

4) Only living cells exhibit plasmolysis.

5) What will happen when the cell wall of a plant cell is removed and the cell is placed in water.

4. Describe the structure of a cell.

5. Describe the structure and functions of nucleus.

## Life Processes

## NUTRITION IN PLANTS

### Learning Concepts

**Nutrition:** Types of Nutrition – Autotrophic nutrition. Raw materials and conditions required for photosynthesis, photosynthetic equation, steps involved in the process of photosynthesis.

**Process Skills**: Experimentation, observation interpretation, argumentation.

**Learning resources**: Variegated leaves, slide of T.S. of leaf, alcohol, beaker iodine, test tube, bell jar iodine solution.

### Opportunities for open ended discovery

The students are aware of the fact that green plants prepare their food through the process of photosynthesis. They can be asked about the dependence of all animals (including human beings) on the process of photosynthesis for oxygen and food, thus highlighting the importance of this process to our life.

**Engage:** The students can be asked that apart from light what are the other substances required for the process of photosynthesis.

The experiments mentioned in the text book can be demonstrated in the class and the students can be given the following questions. The answers to these questions can be discussed.

(i) Why plants look green and how is this related to photosynthesis?
(ii) For these experiments why it is required to keep the plants in dark for some days.
(iii) What is role of light during photosynthesis?
(iv) How does carbon dioxide enter the leaves?
(v) Do plants that do not appear green carry out photosynthesis?
(vi) Why plants are required around us.
(vii) How plants help to purify the air?

### Explore

The students are divided into groups so that the experiments are performed and its findings are discussed amongst the students. Each group may be given specific task based on the above questions and other related matters for which the groups may be given time to explore. They may consult the books, their parents or other persons for arriving at the conclusion.

**Explain**

The groups will analyse their explorations and make presentations about the task given to each group. They may present the following salient points.

1. Plants look green because of the presence of chlorophyll which is located in the chloroplasts in the cell.
2. Chlorophyll is essential for photosynthesis as it absorbs light to carry out photosynthesis.
3. $CO_2$ is also required for photosynthesis

Here the teacher will elaborate this point of requirement of raw materials and introduce the equation of photosynthesis.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

glucose

While the students are making presentations, the teacher can facilitate the students in arriving at a conclusion. The teacher can ask such questions which will further stimulate their thinking e.g.

If chlorophyll is essential for photosynthesis then how do the plants which appear to be reddish in colour (*Amaranthus*: LalChaulai) would photosynthesize.

**Elaborate:**

After the presentations and discussion with the students, the teacher here would further elaborate the concept of photosynthesis in order to strengthen the understanding of the concept by mentioning the following steps about the process of photosynthesis.

(i) Absorption of light by the pigment chlorophyll
(ii) Conversion of light energy to chemical energy
(iii) Splitting of water into hydrogen and oxygen.
(iv) Reduction of carbon dioxide to carbohydrates.

The hydrogen produced in step iii is used to reduce carbon dioxide to carbohydrates which is the actual product of food in the plants.
The teacher at this point can emphasize the fact that all living organisms directly or indirectly depend upon plants (except chemosynthetic bacteria). The plants need sunlight for production of food meaning thereby that sun is the ultimate source of energy.

Similarly the oxygen evolved at step (iii) is essential for all organisms for respiration of all organisms.

**Evaluation**

Although evaluation will be done by the teacher right from E-1 to E-4, some evaluation; questions can be put like:

(i) Which cell organelle is involved in photosynthesis?
(ii) What is the source of energy for photosynthesis?
(iii) What are the raw materials required for photosynthesis?
(iv) How the process of photosynthesis is considered to reduce air pollution?
(v) How do the aquatic plants photosynthesize?

Questions of other forms like MCQs can also be framed. In addition to this evaluation the students may be asked to reply the following

a. What are the new terms I learnt
b. What were my misconceptions which were corrected?
c. What have I learnt about photosynthesis?

# RESPIRATION IN PLANTS

**Subject:Science(Biology)**

**Key Words**

Gaseous exchange, diffusion, photosynthesis

**Learning Concepts**

Difference between respiration in plants and in animals, exchange of gases during respiration, respiratory equation, relationship of photosynthesis and respiration in plants, Kreb's Cycle.

**Process Skills**

Experimentation, observation interpretation, drawing inference, reflective thinking.

**Learning Resources:**

Germination of seeds, floral buds, glassware, lime water.

**Previous Knowledge**

Students know about the process of photosynthesis and also respiration in animals.

**Engage**

The students will be involved in a discussion that all living organisms respire, so do plants, also respire? Different responses may come and some students might relate the process of breathing during respiration which actually does not occur in plants. So how does exchange of gases occur in plants.

During this phase the students would become receptive and also teacher would know about the misconception of the students about the phenomenon of respiration in plants.

**Explore**

Theteacher would put two beakers one full of germinating seeds, and the other full of dry seeds in front of the class. And she will call some students to touch the seeds to find if they feel some difference in temperatures between the two (teachers, she can also tell them that when your mother prepare the sprouts in kitchen try to touch the sprouts, you will feel these to be warmer than dry seeds). The teacher can design an experiment to prove that $CO_2$ is evolved during respiration. The teacher would divide the students into groups and give each group a specific task.

(i) Why germinating seeds have higher temperature than dry seeds?

(ii) How does exchange of gases occur during respiration in plants?

(iii) How process of gas exchange during respiration is affected by photosynthesis?

(iv) Why plants don't emit $CO_2$ during day time?

The students will discuss these questions in groups to come out with one or more possible answers.

**Explain (Presentation and Discussion)**

All the students would listen carefully to the points put forward by group leaders. The teacher would facilitate in arriving at the correct answer. Any of the students or teacher can also ask questions during the presentations.

**Following points may emerge after presentation and discussion:**

(i) The materials used for the experiment mentioned above should be non green (buds or sprouts). Why?

(ii) Increased temperature is related to release in energy.

(iii) Stomatal openings provide passage for gaseous exchange (What can be other paths?)

(iv) As photosynthesis and respiration processes are opposite to each other, gaseous exchange will be markedly affected by the rate of these processes.

**Elaborate**

Based on above points the teacher will give the following equation:-

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Energy$

glucose

The teacher will also elaborate on the following facts & concepts.

(i) Release of energy by breakdown of substrates like carbohydrates.

(ii) Other substrates like proteins and fats, may also be mentioned.

(iii) Opening and closing of stomata may be demonstrated by preparation of leaf peels and using sugar solution.

(iv) Relationship of the processes of photosynthesis and respiration and their relative rates may be explained by taking examples.

**Mis-conception**

Plants don't respire during day time must be addressed by giving logical explanation of the simultaneous occurrence of the two processes: photosynthesis and respiration and why $CO_2$ is not evolved from the plants during day time.

A comparison of respiration in animals and that in plants will further strengthen the concept. Following points may be highlighted:

(i) In animals while there is an organized breathing system, in plants the exchange of gases occurs through stomatal opening and other surfaces.

(ii) In plants there is little transport of gases from one part to another unlike in animals.

(iii) Plant respiration occurs at much slower rate than animal respiration.

The teacher can also explain the concept of aerobic and anaerobic respiration by giving examples of fermentation in yeast and during vigorous muscular activity.

**Evaluate**

The students will be evaluated through $E_1$ to $E_4$. However following questions can be framed in order to assess the understanding of concepts.

Q.1 At the time of sunset and sunrise there is no net-evolution of $CO_2$ and $O_2$. Why?

Q.2 Draw the structure of stomata and explain how these open and close.

Q.3 What are respiratory substrates? Name the substrate commonly used in respiration. What are the other substrates used.

Q.4 During respiration which of following steps occur:-

a) Release of energy

b) Absorption of water

c) Synthesis of carbohydrates

d) Release of energy

e) Exchange of gases

f) Breakdown of food materials

Q.5 Why respiration is considered as biological oxidation?

Q.6 How do water plants respire?

# REPRODUCTION IN PLANTS

**Subject:Science (Biology)**

**Key Words**

Reproduction, Asexual reproduction, Sexual reproduction, Vegetative reproduction or propagation in plants Reproductive organs of plants.

**Learning Concept**

Reproduction is a process by which organisms are able to produce new organisms of its own kind to produce more plants so that their species may continue to live on earth. There are different modes of reproduction i.e. Asexual and sexual.

In plants asexual and sexual reproduction occurs. In addition to this two, also takes place. The process of reproduction ensures continuity of life on earth.

**Prior Knowledge**

1. Cat reproduces by producing similar young ones (Kittens)
2. Hens reproduce by lying eggswhich hatch into chicken.
3. Most of the plants reproduce by producing seeds and some by vegetative parts like stem& leaves.
4. Productive parts of plants

**Learning Objective**

To understand asexual, vegetative and sexual reproduction in plants.

**Process Skill**

Demonstration, observation, communication.

**Learning Resources**

Conical flask, sugar, water, yeast powder slide, magnifying glass, glycerin, cover slip, charts, *Bryophyllum* leaves, potatoes, bread slice.

**Asexual Reproduction in Plants**

Asexual reproduction takes place in lower organism that produce youngones exactly similar to parents.

Types of Asexual reproduction: Budding, Fission, Fragmentation, Spore formation. Different types of method will be explained with the help of activities.

Teacher: The class has been divided in groups (five groups). Demonstrate the activity in groups and after the activities, each group can make presentations.

**Activity-1** Binary fission in *Amoeba*

- Observe a permanent slide of Amoeba under a microscope.
- Observe another permanent slide of Amoeba showing binary fission.
- Now, compare the observations of both the slides.

**Activity-2** Budding in yeast

- Dissolve about 10gm of sugar in 100 mL of water.
- Take 20mL of this solution in a test tube and add a pinch of yeast granules to it.
- Put a cotton plug on the mouth of the test tube and keep it in a warm place.
- After 1 or 2 hours, put a small drop of yeast culture from the test tube on a slide and cover it with a cover slip.
- Observe the slide under a microscope and see the following structure.
  (i) Bulb like projection appear on the yeast cells. These out growths are called buds.
  (ii) Sometimes these buds are formed one after the another resulting in a chain of cells.

**Activity-3** Spore formation in Bread mould (*Rhizopus*).

- Wet a slice of bread and keep it in a cool moist and dark place.
- Observe the surface of the slice with a magnifying glass.
- Record your observation for a week.

**Activity-4** Fragmentation in *Spirogyra*.

- Collect water from a lake or a pond that appears dark green and contains filamentous structures.
- Put one or two filaments on a slide.
- Put a drop of glycerin and cover it with a cover slip.
- Observe the slide under microscope to identify the individual spirogyra.

**Vegetative Propagation**

What are the vegetative parts of plants?

**Ans**:- Vegetative parts of plants are root, stem and leaves.

In vegetative reproduction plant parts like root, stem and leaves develop into new plants under appropriate conditions.

Examples- Sugarcane, rose, grapes, orange, jasmine etc.

**Activity-5** Vegetative Propagation by Potato stem:

- Take a potato and observe its surface on which notches are be seen?
- Cut the potato into small pieces such that some pieces contain a notch or bud and some do not.
- Spread some wet cotton on a tray and wet it place the potato pieces on this cotton. Note where the pieces with the buds are placed.
- Observe changes taking place in these potato pieces over the next few days. Make sure that the cotton is kept moistened.
- Which are the potato pieces that give rise to fresh green shoots and roots?

Potato with notches or buds show the growth of new plants whereas the other pieces of potato do not show growth.

**Activity-6** Vegetative Propagation by Stem cutting;

- Select a money plant.
- Cut some pieces such that they contain at least one leaf.

- Cut out some other portions between two leaves.
- Dip one end of all the pieces in water and observe over the next few days.

Answer the following questions:-

Q.1 Which ones grow and give rise to fresh leaves?

Ans: The piece which has at least one leaf develops fresh leaves and branch because money plant leaf has bud between leaf and stem which grows into new plant.

Other portions between two leaves (internode) piece that does not bear buds to develop into new fresh leaves.

Q.2 What would you conclude from your observation?

**Activity-7** Vegetative Propagation by leaves.

The leaf budding in plants can be explained with the help of an activity. Pluck some leaves of *Bryophyllum* plant and keep these leaves in a petridish containing water with a blotting paper placed in it. This set up may be left for about one week. After one week buds arise from the notches along the leaf margin of *Bryophyllum* leaves. This is vegetative propagation.

**Sexual Reproduction in Plants:**

Q. Name the reproductive part of a flowering plant?

Ans: Flower

Different parts of a flower shown with the help of chart and ICT.

The class is divided into four groups. Each group may be given a different flower such as Gulmohar, China rose, Mustard, *Petunia*. Each groups may be told to identify different parts in the given flower, sepal, petal, stamens, pistil. Each group may take out various parts from the given flower and paste them in their notebook. Teacher will ask questions:

Q.4 Name the Male and Female reproductive parts of a flower?

Ans: Stamen - Male reproductive part.

Pistil - Female reproductive part.

Q.4 What are the functions of different parts of flower?

**Pollination**

Concept of pollination self and cross pollination and their differences may be discussed with the help of diagram/ chart/ICT.

Teacher explains that after pollination, fertilization occurs in the plant discussed with the help of diagram/ chart. Changes after fertilization are explained by showing figures. (i) The ovary develops into the fruit (ii) The ovules develop into seeds. The seed contains the embryo or the potential plant. During the formation of fruit rest of the flower withers away.

**Activity:** Germination of seeds.

- Soak a few seed of Bengal gram (Chana) and keep them overnight.
- Drain the excess water and cover the seeds with a wet cloth and leave them for a day. Make sure that the seeds do not become dry .
- Cut open the seeds carefully and observe the different parts.

**Observation:** The seed consists of two cotyledons when it starts growing it shows the growth of shoot (stem) called plumule and future root called radicle. Radicle comes out first from the seed during germination and it may be seen in germinated seeds.

**Figures:**Pollination, Budding in feast, *Bryophyllum*leaf for vegetative reproduction, Reproductive parts of flower, fertilization, seed, embryo, etc.

**Evaluation/ Assessment**

1. MCQ multiple choice questions, can be prepared.
2. What are the various methods of vegetative reproduction?
3. Student will be asked to prepare a report of the activities performed for the asexual reproduction in the class and give a presentation.
4. Write the differences between asexual and sexual reproduction.
5. Draw a labelled diagram of a flower showing its various parts including reproductive parts.

6. Project may be given to note down the changes in flower after pollination.
7. What is a seed? What are the parts of a seed? Explain with the help of a labelled diagram.

## CONTROL AND CO-ORDINATION: REFLEX ACTION

**Subject:Science(Biology)**

### Learning Aspects/Concepts

1. Sensory and motor neuron, Reflex arc
2. Role of spinal cord and reflex and
3. Reasons of non-involvement brain in reflex arc and its need.

### Learning Objectives

1. To understand concept of a reflex arc,
2. To explore the path of message from receptors to effectors.
3. To appreciate responding to stimuli with out involvement of brain.
4. To develop skill of drawing figures related to reflex arc.

### Process Skills

Logical reasoning, inference, reflective thinking.

### Learning Resources

Chart of graphical/ actual diagram of reflex arc.

### Opportunity for open ended discovery

Examine different responses of human being to different stimuli and identify reflex ions.

| Step of constructing knowledge | Stimulus | | Response (How do you respond/ Act.?) |
|---|---|---|---|
| Engage (individually) | 1. | When unknowingly you touch any hot object | ..... |
| Set-I | 2. | Suddenly bright light falls on your eyes. | ..... |
| | 3. | Suddenly a mosquito bites you | ..... |
| | 4. | You get a pinch of sharp object while sitting or a chair. | ..... |
| | | Stimulus | Response (How do you respond/ |

| | | | |
|---|---|---|---|
| | | | Act?) |
| Set - II | 1. | When suddenly you feel <u>hungry</u> at midnight? | …… |
| | 2. | When due to <u>A/C</u> suddenly you feel cold? | …… |
| | 3. | When you see a <u>beautiful and cute baby</u>? | …… |
| | 4. | When you found lot of <u>dust on a chair</u> on which you have to sit? | …… |

Are you finding any differences between Set I and Set II situations with regard to your response.

**Explore**

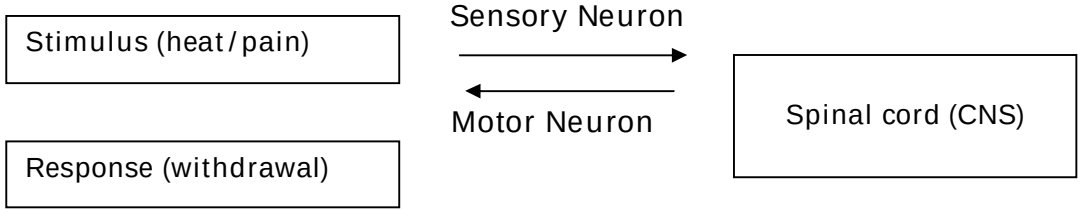
Think in groups and explore the difference between the two sets in terms of amount of time in responding to stimuli (separately for both sets of situations).

Similarly find out the thinking involved (in terms of use of brain) while responding to stimuli separately for both sets of situations.

Concentrate on situation 1 in Set 1 and find out which organ receives stimulus (heat)? What can you call to that organ? Similarly through which organ we respond/ show the effect? What can you call to that organ which shows effects?

What happens in between i.e. one receives the stimulus and then shows the effect or responds.

Figure 1: Graphical representation of Reflex arc




Refer to figure 1 and show through efforts in muscles the path of message of stimulus and its response (i.e. path of message from receptor to effecter)

What is the role of spinal cord? Are you noticing that absence of role of brain in the above i.e. for similar situations given in Set I.

What do you call to this situation where there is sudden responds to stimulus without involvement of brain. List down some of the situations/ actions where Reflex arc is involved?

**Learning aspects**:**Control and Coordination:Activities onReflexes**

**Introduction:**

To prepare the students for the following activities based on reflexes. First they have to be alert, for that purpose short 5 minutes meditation can be performed where the students will sit their eyes closed and there must be absolutely no noise in the room except for the breathing of the students and the demonstrator. For the judgment of the control and coordination of individuals the chapter must be introduced to the students via the help of certain examples like: if we suddenly make any sound in a quiet room where you are taking rest what happens to you? What are the physiological changes you notice in you after the experience etc. students may be asked that whether they know the reason behind these changes? And the chapter thus may be introduced to them.

**Key words:** reflexes, nerves, control, pupil, responses, patella, synapse, acceleration, gravity

**Group formation:**Before starting the activities small 2-3 member groups may be formed amongst the students.

**Activities:**

**1) Pupil to Pupil**

**Materials:**

Just a room you can make dim

**Methods:**

Dim the lights in a room. After a few minutes, look at the eyes of another person and note the size of the pupil (the black center spot in the middle of the eye). Turn the room lights back on. Check the size of the pupils again. The pupils should now be smaller.

**Discussion:**

This is the pupillary response: it "automatically" keeps out excessive light that may damage the eye.

**Conclusion:**

This particular response makes your eyes protected from the harsh effects of stong light.

**2) Jump to It!**

**Materials:**

A large book or other heavy object to make a noise

**Methods:**

Here's a quick demonstration of reflexes. Talk to a group of people about how the brain and the rest of the nervous system control movement. Then, suddenly slam a book on a table to create a loud noise. Ask the class and count the number of students who:

1. Twitched
2. Moved their heads
3. Blinked their eyes
4. Put their hands up
5. Screamed

**Discussion:**

What type of movements were more and what do you conclude ? Why they made certain movements?

**Conclusions:**

Reflexes are used to protect the body automatically. They get us away from objects that might hurt us, before they hurt us. For example, if you put your

hand on a hot stove, you immediately remove your hand BEFORE the message, "Hey, my hand is on a hot, burning stove," gets to your brain.

**3) Knee Jerk Reflex (Patellar Reflex):**

**Material:**

Own hands

**Methods:**

The knee jerk reflex is one that you may have had tested at a checkup at the doctor's office. In this test, the doctor hits your knee at a spot just below your knee cap and your leg kicks out. Try it! Have a partner sit with his or her legs crossed so that his leg can swing freely. Hit his leg just below the knee with the side of your hand. DO NOT USE A HAMMER!!!! The leg will kick out immediately (if you hit the right place).

**Discussion:**

Why does the leg kick out?

**Conclusion:**

The knee jerk reflex (seen in the figure to the right) is called a monosynaptic reflex because there is only one synapse in the circuit needed to complete the reflex. It only takes about 50 milliseconds between the tap and the start of the leg kick. That is fast! The tap below the knee causes the thigh muscle to stretch. Information is then sent to the spinal cord. After one synapse in the ventral horn of the spinal cord, the information is sent back out to the thigh muscle that then contracts.

**4) Think Fast!**

**Materials:**

Cotton balls (or rolled-up paper towels)

A transparent barrier (a wire screen, plastic or glass window)

**Methods:**

Have a student stand behind a see-through barrier like a window or a wire screen. Throw a cotton ball at the person.

**Discussion:**

Did he blink? Probably. This is the blink reflex and serves to protect our eyes from damage.

**Conclusion:**

Our built-in reflexes really do protect us. Another demonstration of these built-in capabilities is the blink reflex.

**5)HowFast are You?**

Unlike the other activities on this reflex page, this project does not test a simple reflex. Rather, this activity is designed to measure your response time to something that you see.

**Materials:**

A ruler (or a yardstick or candy bar)

**Method:**

1. Get a ruler (or a yardstick or candy bar). Hold the ruler near the end (highest number) and let it hang down.
2. Have another person put his or her hand at the bottom of the ruler and have them ready to grab the ruler (however, they should not be touching the ruler).
3. Tell the other person that you will drop the ruler sometime within the next 5 seconds and that they are supposed to catch the ruler as fast as they can after it is dropped.
4. Record the level (inches or centimeters) at which they catch the ruler (you can convert the distance into reaction time with the chart below).
5. Test the same person 3 to 5 times (vary the time of dropping the ruler within the 5 second "drop-zone" so the other person cannot guess when you will drop the ruler).

**Supplementary data:**

Here is a table to convert the distance on the ruler to reaction time.

For example, if you caught the ruler at the 8 inch mark, then your reaction time is equal to 0.20 seconds (200 ms). Remember that there are 1,000 milliseconds (ms) in 1 second.

| Distance | Time |
|---|---|
| 2 in (~5 cm) | 0.10 sec (100 ms) |
| 4 in (~10 cm) | 0.14 sec (140 ms) |
| 6 in (~15 cm) | 0.17 sec (170 ms) |
| 8 in (~20 cm) | 0.20 sec (200 ms) |
| 10 in (~25.5 cm) | 0.23 sec (230 ms) |
| 12 in (~30.5 cm) | 0.25 sec (250 ms) |
| 17 in (~43 cm) | 0.30 sec (300 ms) |
| 24 in (~61 cm) | 0.35 sec (350 ms) |
| 31 in (~79 cm) | 0.40 sec (400 ms) |
| 39 in (~99 cm) | 0.45 sec (450 ms) |
| 48 in (~123 cm) | 0.50 sec (500 ms) |
| 69 in (~175 cm) | 0.60 sec (600 ms) |

If you want to be more precise with your calculations, use the following formulas:

**Formula 1** $y=0.5\ gt^2$

**Formula 2** $t=(2y/g)^{1/2}$

Where, **t** = time (in seconds); **y** = distance (in cm); **g** = 980 $cm/sec^2$ (acceleration due to gravity). [Note: you can also use inches in your distance measurement, but you must change g to equal 385.8 $in/sec^2$.]

**Formula 1** provides you with the distance an object will fall in a given amount of time.

By rearranging Formula 1 into Formula 2, you can get the amount of time it takes an object to fall a certain distance...that's what you want to find out.

All you have to do is plug in the distance (in either centimeters or inches) that the ruler fell into Formula 2 - this will give you the reaction time.

**Discussion:**

How readily did the other student grab the falling object? How much time did he take?

**Conclusion:**

This reaction time experiment required visual information (the movement of the ruler) to travel to your brain. Then your brain sent a motor command ("grab that falling ruler") to the muscles of your arm and hand. If all went well, you caught the ruler.

**Exercises:**

**Questions and Comparisons (for students)**

- Try the experiment in dim light. Does your reaction time increase, decrease or stay the same? Can you explain your results?
- Test the whole class. Who is fastest?
- Compare boys vs. girls. On average, are the boys or girls faster?
- Compare different ages. Who is fastest? The older students or younger students?

- Compare the scores after practice. Does reaction time improve with practice?
- Compare kids' scores vs. parents' scores. Who is faster?
- Test the whole school!!

# The pupil reflex

You are going to work in pairs and investigate the pupil reflex of the eye with your partner.

**Materials required:**

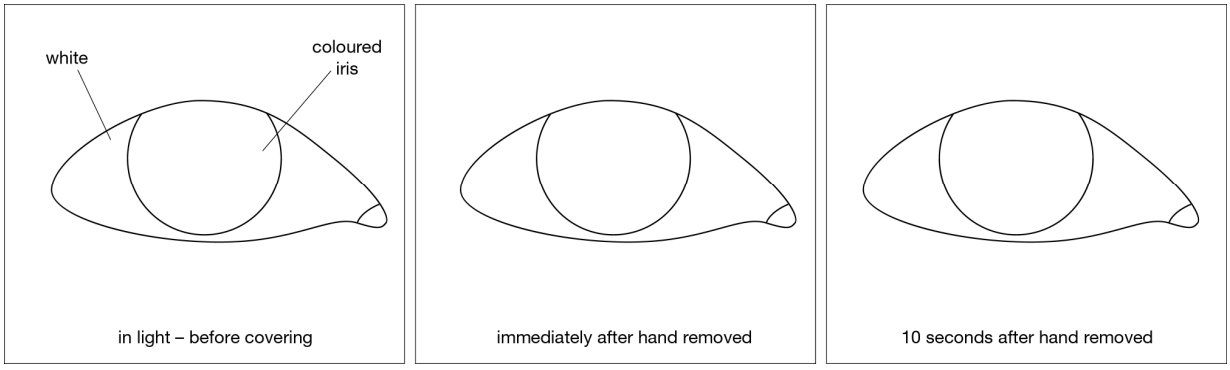
Equipment (per pair):stop clock

**Method:**

1. Look carefully at the pupil (dark area) of one of your partner's eyes and draw its shape on the first eye below.
2. Your partner now covers up that eye with their hand for about 30 seconds.
3. Your partner then removes the hand from their eye. Look immediately at the pupil and draw its shape on the second eye below.
4. Then look at your partner's pupil about 10 seconds after the hand was removed and draw its shape on the bottom eye.

**Results:**

**(a)** **(b)** **(c)**




**Conclusion:**

Complete the sentences below.

In diagram **(a)** the pupil is small to limit the amount of light entering the eye. This prevents the retina
from being damaged by bright light.

In diagram **(b)** the pupil is.....

_____

This is because.....

_____

In diagram **(c)** the pupil is.....

_____

This is because.....

This is an example of a cranial reflex. Nerve impulses travel from the eye to the brain and back.

Even though the nerve cells (neurones) go to the brain, there is no thinking involved.

---

QUESTIONS

**1)** How do you know there is no thinking involved in this action?

_____

_____

**2)** A reflex action is automatic. What does automatic mean?

_____

_____

**3)** Reflex actions are to protect you. How does this pupil reflex protect you?

_____

_____

_____

**4)** Blinking is another example of a reflex action. How does this reflex protect you?

_____

_____

_____

_____

_____

# MEASURING REACTION TIME

You are going to investigate reaction time with the whole class!

**Materials required:**

Equipment (whole class):stop clock

**Method:**

**1)** Everyone in the class stands in a large circle and holds hands with their neighbours.

**2)** One student, the timer, holds a stop clock in their left hand.

**3)** When everyone is ready, the stop clock is started with the left hand and immediately the timer squeezes their neighbour's hand with their right hand.

**4)** As soon as a student's left hand is squeezed they pass on the message with the right hand. This passes the message around the circle.

**5)** While the message is going around the circle, the stop clock is transferred to the timer's right hand.

**6)** When the squeeze arrives back at the timer's left hand, the stop clock is stopped and the time in seconds is recorded.

**7)** Repeat the experiment to allow for mistakes!

**8)** Record the times of each attempt in the results table below.

**9)** Calculate the average reaction time for a student by dividing the total time by the number of students in the circle.

**10)** Repeat the experiment but this time send the squeeze in the opposite direction and record the results in the table below and calculate the average reaction time for a student.

**Results:**

| **Attempt – direction 1** | **Total reaction time in seconds** | **Number of students** | **Average student reaction time in seconds** |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| **Attempt – direction 2** | **Total reaction time in seconds** | **Number of students** | **Average student reaction time in seconds** |

| | | | |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |

**Conclusion:**

If there was a difference in results between the two directions, suggest an explanation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

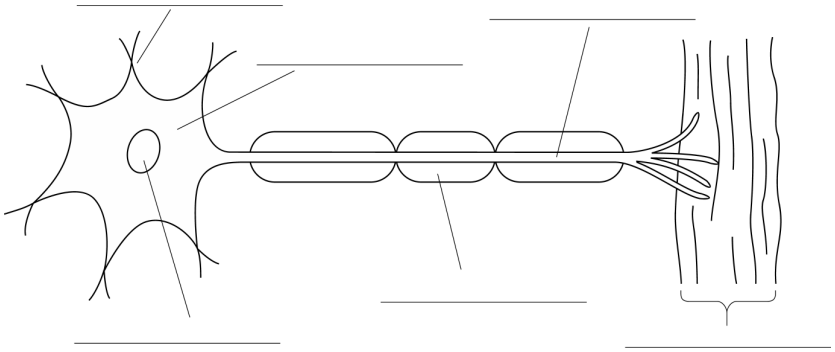
_____

## Reflexaction

Read page 115 of the science text book and then answer the questions below.

Nerve cells are called neurones. They carry electrical impulses.

**1)** Label the diagram of a motor neurone below. It carries impulses to a muscle or gland.



(Read page 115-118 of the science text book and then complete the stages of a spinal reflex below.)

**2)** Heat stimulus from cooker.....

**3)** Pain receptor in.....senses high temperature

**4)** .....neurone carries impulse to spinal cord

**5)** Impulse passed on to.....neurone in spinal cord

**6)** .....neurone carries impulse to muscle

**7)** ..... contracts

**8)** Hand moves away from heat.....

**(Answer to the questionsfor Pupil reflex and Reflex arc are on the last page of the module.)**

# How sensitive is your skin?

This experiment is designed so that you and your partner can find out how sensitive your skin is. Single- and double-touch stimuli are used.

**Materials required:**

Equipment (per pair):

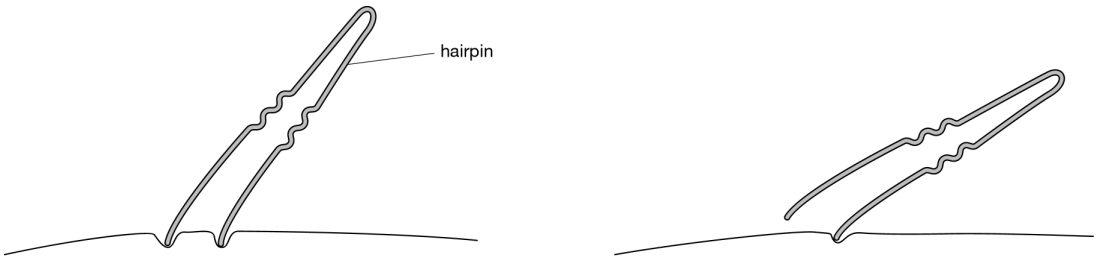
- metal hairpin
- ruler

**Method:**

**1)** Stretch a hairpin until its points are 1cm apart.

**2)** Your partner looks away.

**3)** Press the hairpin on to the back of your partner's hand so that either one or two points touch the skin.




double stimulus

single stimulus

**4)** The stimulus should use only a little force and last only for about 1 second.

**5)** If both points touch the skin they must touch at the same time.

**6)** Your partner tells you whether he or she can feel one point or two points.

**7)** Repeat the experiment five times, changing the number of points used.

**8)** Record whether your partner was correct in the results table below.

**9)** Repeat the experiment on your partner's fingertips and forearm.

**10)** Change places with your partner and repeat the experiment.

**Results:**

| Back | Correct / incorr | Finger | Correct / incorre | Forear | Correct / incorr |
|---|---|---|---|---|---|

| of hand | ect | tip | ct | m | ect |
|---|---|---|---|---|---|
| test 1 | | test 1 | | test 1 | |
| test 2 | | test 2 | | test 2 | |
| test 3 | | test 3 | | test 3 | |
| test 4 | | test 4 | | test 4 | |
| test 5 | | test 5 | | test 5 | |

**Questions:**

When an incorrect response is given to two points, this means that the same nerve ending is being stimulated.

**1)** Which area of skin showed the most:

Correct responses? .....

Incorrect responses?.....

**2)** Which area of skin was the most:

Sensitive to touch? .....

Insensitive to touch?.....

Suggest an explanation for your results.

(If you have time you can repeat the experiment, this time varying the distance apart of the two points of the hair pin. You may be surprised how far apart the points need to be for you to feel both points.)

Answers

## The pupil reflex

**1** Happens immediately

**2** Without thinking

**3** Prevents too much light entering the eye and damaging the retina

**4** Prevents dust, grit and other objects getting into your eye

## Reflex action

**1** Labels from top left clockwise: branching dendrites, cell body, axon, muscle fibres (effector), sheath, nucleus

**2** Beat stimulus from cooker

**3** Pain receptor in skin senses high temperature

**4** Sensory neurone carries impulse to spinal cord

**5** Impulse passed on to relay neurone in spinal cord

**6** Motor neurone carries impulse to muscle

**7** Muscle (effector) contracts

**8** Hand moves away from heat

# PERIODIC TABLE

**Subject-Science**

Learning aspects-elements, symbols of elements, atomic numbers of elements, arrangement of elements in periodic table.

***Learning objectives:***

1. To make students understand the uses of periodic table
2. How elements are arranged in of periodic table
3. Information's you gather from of periodic table
4. Why atomic number is used for arrangement of elements in of periodic table

***Process Skill***

- Observation
- Practically performing
- Reasoning
- Argumentation
- Problem solving
- Logical thinking
- Reflecting

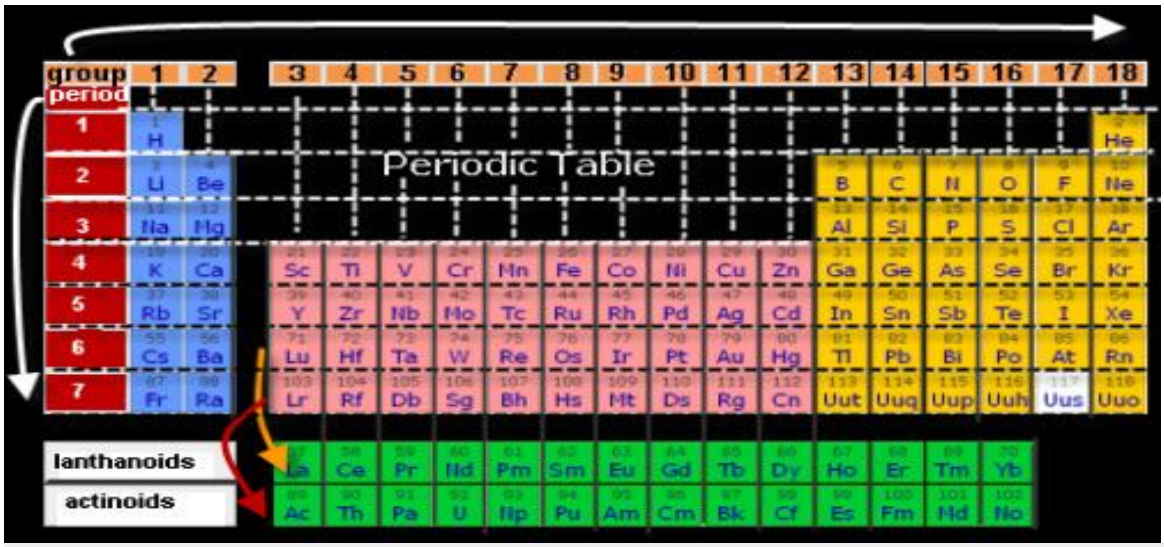
***Learning progress:***

- Cards,blocks,charts
- Table making
- Play way
- Songs

***Creating learning situation***

**Motivation**

**Engage**- Introduce students to the periodic table. Tell students that this is the periodic table. Explain that each box contains information about a different atom.




# The Periodic Table

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H | | | | | | | | | | | | | | | | | 2 He |
| 3 Li | 4 Be | | | | | | | | | | | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne |
| 11 Na | 12 Mg | | | | | | | | | | | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| 19 K | 20 Ca | 21 Sc | 22 Ti | 23 V | 24 Cr | 25 Mn | 26 Fe | 27 Co | 28 Ni | 29 Cu | 30 Zn | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr |
| 37 Rb | 38 Sr | 39 Y | 40 Zr | 41 Nb | 42 Mo | 43 Tc | 44 Ru | 45 Rh | 46 Pd | 47 Ag | 48 Cd | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe |
| 55 Cs | 56 Ba | 57-71 | 72 Hf | 73 Ta | 74 W | 75 Re | 76 Os | 77 Ir | 78 Pt | 79 Au | 80 Hg | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | 86 Rn |
| 87 Fr | 88 Ra | 89-103 | 104 Rf | 105 Db | 106 Sg | 107 Bh | 108 Hs | 109 Mt | 110 Ds | 111 Rg | 112 Cn | 113 Uut | 114 Fl | 115 Uup | 116 Lv | 117 Uus | 118 Uuo |
| | | 57 La | 58 Ce | 59 Pr | 60 Nd | 61 Pm | 62 Sm | 63 Eu | 64 Gd | 65 Tb | 66 Dy | 67 Ho | 68 Er | 69 Tm | 70 Yb | 71 Lu | |
| | | 89 Ac | 90 Th | 91 Pa | 92 U | 93 Np | 94 Pu | 95 Am | 96 Cm | 97 Bk | 98 Cf | 99 Es | 100 Fm | 101 Md | 102 No | 103 Lr | |

The periodic table shows all the atoms that everything in the known universe is made from. It's kind of like the alphabet in which only 26 letters, in different combinations, make up many thousands of words. The 100 or so atoms of the periodic table, in different combinations, make up millions of different substances.

**Note**: It is often confusing for students to see the terms "atom" and "element" used interchangeably as if they are the same thing. Explain to students that an atom is the smallest particle or "building block" of a substance. An element is a substance made up of all the same type of atom. For instance, a piece of pure carbon is made up of only carbon atoms. This piece of pure carbon is a sample of the element carbon. The people who developed the periodic table could have called it the Periodic Table of the Atoms but they did not have a firm understanding of atoms at that time.

Since they were working with actual samples of elements such as copper, mercury, sulfur, etc., they called it the periodic table of the elements.

***Explain the meaning of the atomic numbers and symbols in the boxes in the periodic table.***

Tell students that the class will focus on the 26 elements over one period. On the first period, they will look at the number of protons, electrons, and neutrons in the atoms of each element will look at the arrangement of electrons in the atoms.

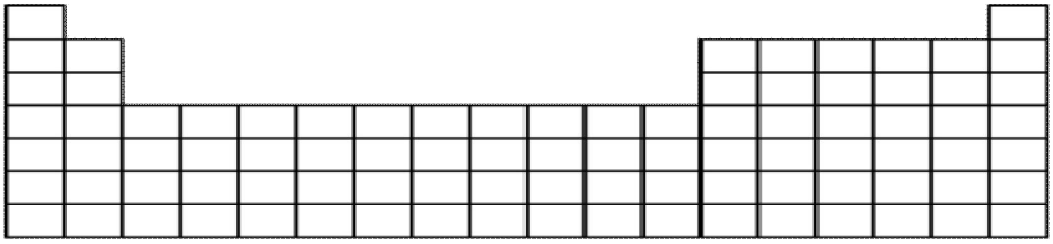
***Explain atomic mass:***

The atomic mass of an element is based on the mass of the protons, neutrons, and electrons of the atoms of that element. The mass of the proton and neutron are about the same, but the mass of the electron is much smaller (about 1/2000 the mass of the proton or neutron). The majority of the atomic mass is contributed by the protons and neutrons.For any element in the periodic table, the number of electrons in an atom of that element always equals the number of protons in the nucleus. But this is not true for neutrons. Atoms of the same element can have different numbers of neutrons than protons. Atoms of the same element with different numbers of neutrons are called isotopes of that element. The atomic mass in the periodic table is an average of the atomic mass of the isotopes of an element

***Activity***

Students are provided with various coloured cards .numerals 12345678910.....is printed on it .now students are advised to arrange the cards as per instructions and criteria colour-numbering in increasing order

Facilitator will provide empty chart of periodic table to the groups, each group should be made of 5 students,group will receive a set of cards with information that describes a particular atom. Student's job is to figure out which atom the card describes and to place it in the area in periodic table for that atom.



Students will use the Periodic Table, Elements 1–26 chart to help you determine what atom your card describes. The diagram and information below will help to match your cards to the correct atoms. Explore-students are provided with elements name and symbols, valency numbers which demarcate number of electrons, electronic configuration.

***Guideline for filling the table**:*

1. There are 7 columns[groups] and rows [periods]
2. Cards of 26 elements are provided to students
3. Start from left side of the table, arrange cards as per increasing order in periodic table in rows
4. You will find that similar elements [see properties] comes under elements having similar valency
5. You will also find metals, non-metals metalloids in separate areas.
6. Motivators should assist students, analyse the complete work in intervals.

# NATURAL RESOURSES

**SUBJECT-SCIENCE**

Topic- natural resources

***Learning aspects:***

- Plants resources
- Soil resources
- Water resources
- Renewable resources
- Non renewable resources

***Learning objectives:***

1. To make students understand natural recourses.

2. What are the types of natural recourses

***Process skills:***

- Observation
- Practically doing
- Demonstration
- Reasoning
- Argumentation
- Problem solving
- Logical thinking
- Reflecting

***Learning recourses***

- Chart
- Animation
- Power point
- Play way
- Song
- Pre knowledge

Photographs and video clips of natural resources should be shown to the students in group of 05.give them 05 minute to discuss the topic among them.


AIR
WATER
LAND


15. Natural Resources
Some animals and birds give us milk, wool and flesh.
Cows
Sheep
Cock


**LESSON**

**Facilitator will start *(15 minutes)***

- To begin the lesson, ask your students to tell you the first thing they think of when they hear each of these words: plant, water, soil.
- Ask your class is anyone knows what a natural resource is. Encourage your students to make educated guesses.
- Ask the students to write down what they observed from the photos and video clips

- Write the words plants, soil, and water on the board. Explain that these are the three main types of natural resources.
- Start a class discussion about the importance of plants. Great questions include: *Why are plants important? Could we live without plants? How do plants help us stay alive? How do plants help animals?*
- Explain that plants provide us with food, oxygen to help us breathe, and protection through homes and fire. Plants make and protect soil, feed animals, shelter animals, and are used to make clothes and many medicines.
- Ask your students about the importance of soil. Great discussion questions include: *What is soil? Why is it important? What would our lives be like without soil? Could we live without it? Why or why not?*
- Share that soil contains important nutrients that plants and humans need to stay alive. Soil also helps plants retain the moisture they need to grow and thrive.
- Finally, ask your students about the importance of water. Suggested questions include: *Could we live without water? What about plants and animals? How long could someone survive without water?*
- Explain that water is the most essential natural resource that the Earth gives us, and those plants, animals, and people would die without it.

**Evaluation:**

**Facilitator** –groups of students are provided with materials consists of many things like plants,minerals,soils,image of animals,water,artificial things like plastic etc.

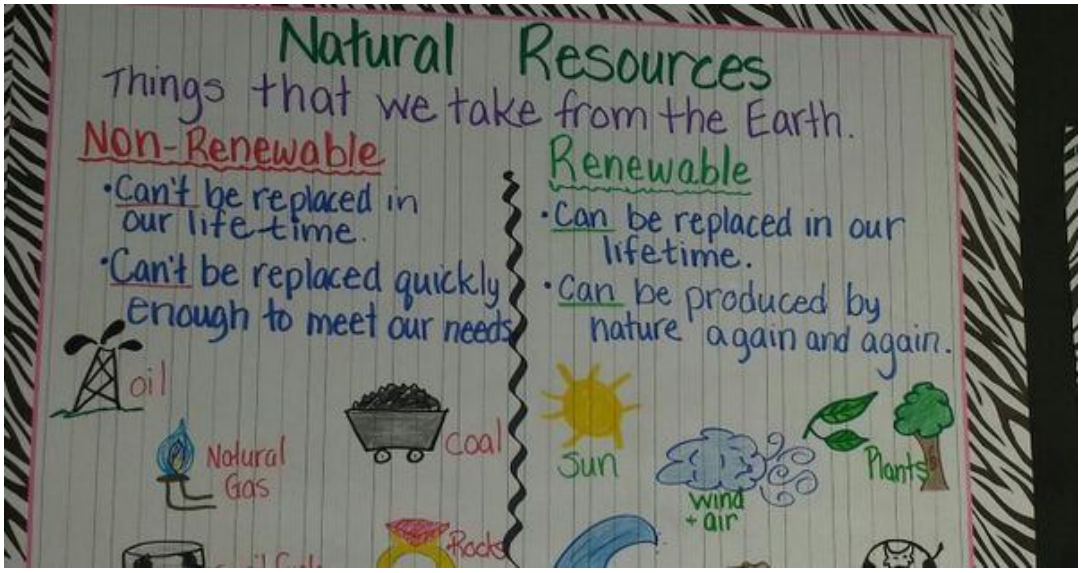
***Instructions to student group-***

1. They are asked to pick natural resources from the given things and separate non-natural resources.

2. Separate renewable and non-renewable resources

3. Define

- Natural resources
- Renewable resources
- Non- renewable resources




Facilitator-will inspect the work done by the student group.Then he explains renewable and non renewable resources with example. He also specifies the work done by the group and asks them to come to the dais to explain their findings.Meanwhile other group members are allowed to put questions after the topic

***Second period***—after understanding natural resources they are asked to identify the way they could manage and conserve natural resources with examples

1. Water
2. Animals
3. Plants
4. Minerals
5. Soil

# MORE ABOUT SALTS

**SUBJECT: SCIENCE**

**Keywords:** Salts, Soluble Salts, Ionization and Hydrolysis

***Prior Knowledge Assumed***

Students know about elements compounds and mixtures. Students have also acquired knowledge about acids, alkalis, ionization and assessing strength of acids and alkalis in terms of a scale, known as pH scale.

***Preparation*:** Teacher makes the following statement.

Students you are well familiar with the terms elements compounds and mixtures. You have already learnt about acids, bases (specific bases i.e. alkalis) and neutralization of acid by base or viva-versa. Today, I am placing before you a very comprehensive list of compounds. You work in five different groups and through discussion, you ascertain what **this, a particular class of compounds is.** I leave it to you totally on the strategy adopted by you. Further you may also bring out through discussion, **the least number of families** into which this comprehensive list of the compounds is categorized.

***Initiation***

The teacher introduces the list of following compounds to the students. Potassium sulphate, ferrous sulphate, sodium sulphate, copper sulphate, zinc sulphate, sodium chloride, potassium chloride, ammonium chloride, sodium hydrogen carbonate, sodium carbonate, sodium nitrate, potassium nitrate and potassium hydrogen carbonate.

***Performance***

Students divide them solves into approximately a group of eight students, before starting the discussion, teacher supervises the discussion of each group occasionally and if need be facilitates, the discussion. Students write formulate of each compound and also through discussion evolve the need to write the pair of suitable; acid and base (alkali) through

which each of the above listed compounds is resulted. After that students categorize the list of the compounds into suitable groups.

***Presentation and Discussion***

Teacher after a suitable time span invites outcome of the discussion by giving chance to each group to present their opinion giving chance to maximum students within a group to present their view point.

Students through discussion bring out the fact that from the list of compounds used, on the basis of cation would render these into seven groups naming. While on the basis of anion categories them into five groups namely; sulphates, chlorides, nitrates, hydrogen carbonate (sometimes referred to as bicarbonates also) and carbonates and, the categorization on the basis of anions is thus a more suitable strategy. Students also come to the conclusion that all the compounds fall under a common category of compounds named as SALT. Students view point of the salt at this stage perhaps is that when acid – base (alkali also) react then the reaction produce other than water is called salt.

***Comparison with scientific theory***

Since students have the knowledge of ionization, the teacher gives the chance to the students to get close to the scientifically accepted definition of the salt and for this the teacher introduces some reactions for the considerations of students such as:

$$\underset{\text{(Dilute)}}{Zn\ (granular) + H_2SO_4} \rightarrow \underset{\text{(salt)}}{ZnSO_4 + H_2(gas)}$$

$$Fe(s) + 2\ HCl \rightarrow FeCl_2 + H_2(gas)$$

(Dilute) (salt)

$$FeS(s) + H_2SO_4 \rightarrow FeSO_4 + H_2S(gas)$$

(Dilute) (salt)

$$\underset{\text{(salt)}}{NaOH(aq) + CO_2(g)} \rightarrow NaHCO_3$$

$NH_{3(g)}$ $HCl_{(g)}$ → $NH_4Cl_{(s)}$
(salt)

At this stage he advises the students to rework in their groups, discuss and come out with the revised definition of salts. The definition arrived through discussion among the students is:

Salt is a type of compound, which on ionization produces a cation other than $H^+$and anion other than $OH^{(-)}$. Teacher at this stage informs the student that this indeed is the conceptual understanding amongst chemists about salts.

Teacher thereafter, asks the students to reconsider the following salts, namely sodium chloride, potassium chloride, potassium iodide, ammonium chloride, sodium acetate, sodium carbonate, copper sulphate, ferric chloride and instructs them to prepare aqueous solution of each of this salt by dissolving approximately 1g of each sample in 10 mL of water (distilled quality only) and test the behavior of aqueous solution of each salt with both type of litmus paper red as well as blue and also with pH paper. Teacher assigns that this work again be carried out in the same groups. He further instructs that each group may record their findings and through discussion reason out the observation recorded in each case of salt sample and suggest categories of the salts into which these components can be divided.

Based upon their observations, the students place these salts into following three categories namely A, B and C.

| **Category A** | **Category B** | **Category C** |
|---|---|---|
| NaCl | $NH_4Cl$ | $CH_3COONa$ |
| KCl | $CuSO_4$ | |
| KI | $FeCl_3$ | $Na_2CO_3$ |
| (Aqueous solution neutral) | (Aqueous solution acidic) | (Aqueous) |

Students based upon their previous knowledge about strong and weak acids and bases (alkalis also) put forth the following explanation. Salts which are

produced from strong acids and strong bases, their aqueous solutions would be neutral, salts produced from strong acids and weak bases will exhibit acidic character in their aqueous solutions and on the other hand such salts which are the result of the interaction between strong bases and weak acids would impart alkaline/basic character to their aqueous solution.

Teacher appreciates the view point advanced by the students and to the entire class poses at this stage a very pertinent question.

***What common name you would like to give to the interaction of salts of category B and C when these salts experience following reactions.***

$NH_4Cl + H_2O \rightarrow NH_4OH + HCl$

$CuSO_4 + 2\ H_2O \rightarrow Cu(OH)_2 + H_2SO_4$

$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$

$CH_3COONa + H_2O \rightarrow NaOH + CH_3COOH$

$Na_2CO_3 + 2H_2O \rightarrow 2NaOH + H_2CO_3$

The teacher in order to facilitate thinking among the students further let his students know that all salts in aqueous solution are capable of furnishing ions and here in all cases water experiences cleavage of its bond into $H^+$ and $OH^-$ ions. Teachers provoking directed discussion giving examples of the terms pyrolysis, electrolysis and Photolysis helps the student to name this phenomenon as SALT HYDROLYSIS and informs the students that whereas in category B and C we name it salt hydrolysis the, same we do not use for category A. At this stage the teacher further intervenes to inform the students that their learning about salt hydrolysis is yet not adequate. The teacher then introduces the following reactions for consideration of his students and marks this category as category D.

$NH_4F + H_2O \rightarrow \underset{\text{(weak base)}}{NH_4OH} + \underset{\text{(weak acid)}}{HF}$

$NH_4CN + H_2O \rightarrow \underset{\text{(weak base)}}{NH_4OH} + \underset{\text{(weak acid)}}{HCN}$ and

$HCOONH_4 + H_2O \rightarrow NH_4OH + HCOOH$
(weak base) (weak acid)

He further informs that in hydrolysis of salts placed under the category D, whereas the hydrolysis of $NH_4F$ and $HCOONH_4$ results into acidic solution, the hydrolysis of $NH_4CN$ results into alkaline solution. He then advises the students to reassemble in their respective groups and reason out the behaviors exhibited by the salts placed under category D, Another task that the teacher assigns to the students is that they should discuss in their groups as to what do they mean by the term salt hydrolysis.

After the group work students reassemble as a combined class and put forth the following view points.

(i) As in category D, the base formed is the same i.e. $NH_4OH$, therefore, the acidic/alkaline nature of the aqueous solution of salt in each case rests with the fact whether the acid formed in stronger compared to $NH_4OH$ or weaker. Students opine that the reasonable explanation could be that whereas HF and HCOOH acids are stronger acids compared to $NH_4OH$. Thus suggesting that these acids have the better capacity to furnish $H^+$ ions compared to the capacity of $NH_4OH$ to furnish $OH^-$ and that is why their aqueous solutions are acidic. They also put forth the wow point that, reverse could be the case with $NH_4CN$ wherein the base has a better capacity to furnish $OH^-$ compared to the acid HCN, and this thus results into alkaline solution. Students further opine that in this special category of salts, to label the solution as acidic or alkaline, we have to be more meticulous, wherein we have to take into consideration the comparative ionization tendency of both the components of the reaction mixture which was not the case with category B and C.

At this stage the teacher shows agreement with the explanation advanced by the students and goes on to **record that this indeed is the accepted behavior agreed amongst the chemists for the aqueous solution of these salts**. The teacher then asks each group to

present their understanding of the phenomenon of hydrolysis. The teacher gives chance to each group to present their definition of the phenomenon of salt hydrolysis and through discussion it is ascertained that:-

A salt is said to hydrolyse if its aqueous solution is either acidic or alkaline, i.e. its pH is not 7.

The teacher informs the students that in his opinion, students have adequately learnt the term salt hydrolysis through their experiences.

**Reflection:**

(1) Comment upon the following observations/practices :

(a) If someone in the family is suffering acidity, then why do we as a remedy suggest a very dilute solution of $NaHCO_3$ to the taken?

(b) Persons who suffer from the problem of kidney stone (salt $CaC_2O_4$) are advised to consume lesser quantity of milk and lesser intake of tomatoes in their diet.

(2) Consider the following reaction

$$HCO_3^- + H^+ \rightarrow H_2O + CO_2$$

Aqueous solutions of which of the following salts can cause this change with a solution of $NaHCO_3$:

(a) $FeCl_3$ (b) KCN (c) $CH_3COONa$ (d) $Na_2CO_3$

(3) Though $CH_3COOH$ and $NH_4OH$ are both marked as weak acid and weak base, yet the salt $CH_3COONH_4$ is not regarded to undergo hydrolysis. Why?

(4) Though $FeSO_4$ and $FeCl_3$ both the salts experience hydrolysis, of the ions i.e. $Fe^{2+}$ and $Fe^{3+}$ which would be more respondent for hydrolysis and why? (The reason may be sorted out through group discussion).

(5) The teacher may ask the students to consider following salts:-

NaI, $Na_2CO_3$, $KNO_3$, $ZnCO_3$, $CaCO_3$, $Ca_3(PO_4)_2$, NaCl, $ZnSO_4$, $CaSO_4$, $2H_2O$, $2CaSO_4$, $H_2O$, $(NH_4)_3PO_4$, $CaOCl_2$ and $NH_4Cl$

He should direct the students to reflect through poster the utility of these salts in our daily life. The entire class for this may be divided into 8-10 groups. Teacher, thereafter, should evaluate the poster prepared by each group and explain his evaluation criteria to the students.

(6) Divide the following salts into minimum possible groups:

$FeSO_4$ $(NH_4)_2$ $SO_4$ $6H_2O$, KCl , $MgCl_2$ $6H_2O$, $MgCO_3$ $CaCO_3$

$K_2SO_4$, $Al_2(SO)_4$, $24H_2O$, $CuCO_3$, $Cu(OH)_2$ and $ZnCO_3$, Zn $(OH)_2$

(7) What different compounds you can prepare from the salt NaCl?

(8) How is the concentration of chloride ion estimated in an aqueous solution of potassium chloride?

**Transaction of Molecular Mass and Mole Concept through Constructivist Approach**

**MOLE CONCEPT**

**Subject:Science**

**Keywords:** ISO topic contributes relative atomic mass,macroscopic quarterly and microscopic practices.

***Learning Aspects:***

Concept of molecular mass, Mole – a number representing fixed number of identical species and this number related to mass for convenience.

***Process Skills:***

Interpretation, logical thinking, argumentation, skillfully correlating phenomenon, drawing inference and drawing conclusion.

***Previous Knowledge Assumed:***

Students are aware about, symbols, formulae, chemical reactions, balancing of chemical reactions, atomic mass and concepts of isotopes and molecular mass.

***Learning Strategy:***

The learning strategy would involve:-

(i) Individual problem solving.

(ii) Group work

(iii) Presentation, discussion and drawing conclusion.

(iv) Appreciating the role of suitable analysis to strengthening conceptualization.

***Learning Resources/Situations:***

(i) Group activities in the name of experimentations:- Aqueous solutions of sodium chloride, silver nitrate, test tubes, iron dust, sulphur powder and magnet.

(ii) Figuratic view depicting correlation between mole – molecular mass and stipulated numbers of particles present in one mole of the material chosen.

**Engage:**

**Teacher:** Students, I am introducing a table before you, which enlists, elements and their atomic masses.

**Table:** Showing Atomic Masses of Few Elements

| Element | Atomic Mass (E) |
|---|---|
| Hydrogen | 1 |
| Carbon | 12 |
| Nitrogen | 14 |
| Oxygen | 16 |
| Sodium | 23 |
| Magnesium | 24 |
| Sulphur | 32 |
| Chlorine | 35.5 |
| Calcium | 40 |

I need you all, to carefully examine this table and ponder over two questions

(1) Who is that element with whose reference, this mass has been assigned to different elements in this table?

(2) Why is the atomic mass of chlorine in fraction? Students respond to these questions and come out with answers.

(i) Whereas in first case the reference is $^{1}/_{12^{th}}$ part of that isotope of carbon whose mass is exactly 12,

(ii) Normal chlorine that we come across (say in NaCl) has contribution from its two isotopes namely $35_{Cl}$ and $37_{Cl}$ and further chlorine has 35% proportion from $35_{Cl}$ and 25% from 37Cl and this is average mass which is indicated in the above table.

Students responses are appreciated by the teacher and thereafter, the teacher instructs the students to complete the following assignment by inserting missing information.

| Compound | Formula | Atomicity of the molecular representation of compound | Computed molecular mass |
|---|---|---|---|
| Water | $H_2O$ | --- | --- |
| Carbon monoxide | CO | --- | --- |
| Carbon dioxide | $CO_2$ | --- | --- |
| Sodium Chloride | NaCl | --- | --- |
| Ammonia | $NH_3$ | --- | --- |
| Sulphur dioxide | $SO_2$ | --- | --- |

As students complete this assignment, the teacher explains to the students that the purpose of this task was solely to compute molecular mass of substances through their representation with the help of average atomic mass of the atoms of the element. At this stage, the teacher creates an anxiety by putting forth the question that upto the moment, we have experienced that molecular mass is mass of the substance, here one pertinent question arises is this molecular mass, number also. The teacher further goes on to add:

**Explore:**

Students to resolve the above raised querry, I am exposing you to certain questions and activities. You would divide yourself into four groups, discuss these questions in groups and perform the activities in group. After you have completed group work, we would assemble as a entire class and each group will present their answers / findings.

***Questions to be processed:***

(1) There are $10^4$ glass balls in a box, which are identical in all respects, then in what convenient way these can be quickly weighed?

(2) You go to a bank and demand 50 Rs.coins for Rs. 500/- note. Remember this number is going to be $10^3$, then in what way the bank personnel can conveniently handle this number.

(3) If a pack of sweets contains 20 pieces, then suggest a way to take (assess) mass of 1 million of such sweet pieces which are identical in all aspects.

(4) What is the significance of selecting gross as a unit over dozen as a unit?

***Activities to be performed:***

(1) Take 1g sodium chloride aqueous solution solutions in a test tube, preferably present in 20mL water. To this add 1g silver nitrate solid sample shake the test-tube-well. Filter the white precipitate formed and to the filtrate again add some solid silver nitrate. What do you observe? If some fresh precipitate is formed, then what according to you is the reason for additional precipitate formed though sodium chloride and silver nitrate were taken in equal mass?

(2) Take a test tube, to it add 1g iron dust and then add 1g sulphur powder. Heat the contents of the test tube for about 30 minutes. Now take a paper and break the test tube by giving a Jerk and collect it contents on the papers. Observe the contents on the paper carefully. You may see some yellow sulphur particles. Now move the magnet in the contents collected over paper. Do some iron dust particles get struck up to the magnet? Perhaps your answer will be No. Here again the same questions comes to mind, why does it happen so that inspite of the fact that we take equal mass of sulphur and iron particles, then why does some sulphur remains un-reacted.

***Explain: Discussion on the Assignment Work Performed***

As students discuss, the issues, they may come out with the following suggestion/explanation.

(i) For questions 1 to 3 listed above, the only possible answer seems to be a relation between mass and number, wherein knowing the one, the other can be ascertained.

(ii) Though we take equal masses of two reacting species, in boththe activities, i.e., NaCl and $AgNO_3$ under activity1, and 'Fe' and 'S' in activity (2), the number of species could not be equal and this could be the precise reason for encountering unreacted NaCl particles in activity (1) and 'S' particles under activity (2).

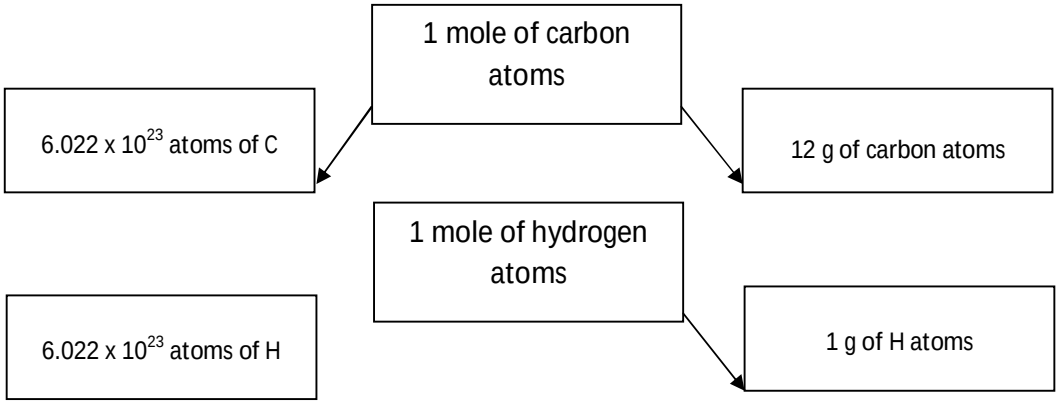
***Expand:***

Appreciating these responses, the teacher supplements that actually when chemical reactions occur, the equivalence of interacting species lies in their number relationship and not in mass. For example in the combustion of methane gas taking place according to the reaction:

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$$

1 g of each reacting materials differ in their number 1 g $CH_4$ would have more $CH_4$ molecules then 1g $O_2$. Another highlighting aspect here is that though 1 $CH_4$ molecule requires 2 molecules of $O_2$ for its combustion, yet 1 g $CH_4$ still is left out with some residual unreacted molecules even if we pick upequal mass of $CH_4$ and $O_2$. Students, therefore, it is more convenient in chemistry to refer to the quantity of a substance in terms of the number of its molecules or atoms, rather than their mass.

Thus a new unit Mole is introduced, One mole of any species (atoms, molecules, ions or) is that quantity in number having a mass equal to its atomic or molecular mass in grams. For further clarity the teacher may now introduce the following figurate set up and also inform that this number is $6.022 \times 10^{23}$. This number is referred to as Avogadro number or as Avogadro constant.



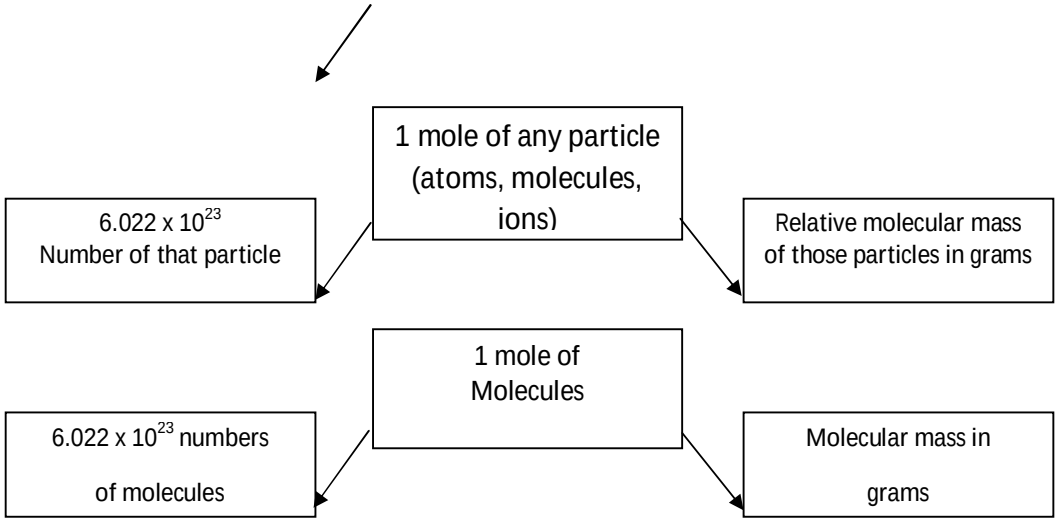



Figure showing relationship between mole, Avogadro number and mass

To further strengths students learning, the teacher may ask the students to work out individually on the following problem:

Consider the following:

(i) 90 g $H_2O$ liquid

(ii) One mole $SO_2$

(iii) 44g $CO_2$

(iv) $6.022 \times 10^{23}$molecules of $C_4H_{10}$ (which is mainly the burning component of LPG).

Which out of these has the largest number of atoms and Why?

In teaching this unit, the teacher should focus on the aspect that "to meaningfully understand concept of amount of substance and the mole, one has to be aware that mole is MAOROSCOPIC quantity related directly to the MICROSCOPIC world of substance (atoms, ions and molecules)".

***Evaluation:***

(1) Potash alum used to purify muddy water is $K_2SO_4Al_2(SO_4)_3$ $24H_2O$. Using atomic mass data, compute the mass in grams of 1 mol of potash alum.

(2) A Jar contains 180mL water ($H_2O$). If density of water is lg $mL^{-1}$, then how many $H_2O$ molecules are contained 180 mL of water?

(3) Consider the reaction:

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O\ (l)$$

How much water is formed if we have 4g each of hydrogen and oxygen sample. How many molecules of $H_2$ would be left out unreacted?

(4) Ascertain the number of $P_4$ molecules present is 62g of solid phosphorus.

(5) Consider the reactions:-

(i) $CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$

(ii) $2NH_3(g) + CO_2(g) \longrightarrow NH_2CONH_2(s) + H_2O(g)$

What mass of $CaCO_3$ is needed to produce 6 kg urea?

In addition to this the teacher may also evaluate the performance of students about their participation in the group work.

# METALS AND NON METALS

**Subject: Science**

**Topic:** Reactivity of Metals and Reactivity Series.

**Key Words:**

Displacement Reaction, Metal Salt Solution, Oxidation, Reduction.

***Learning Concepts:***

Reactivity of metals is governed by their oxidizing and reducing tendencies. The metal having higher oxidizing tendency displaces other metal from their respective salts.

***Learning Objectives*:** The students will learn to:-

(i) Differential between reactive and less reactive metals.

(ii) Correlate reactivity with chemical reaction shown by the metals.

(iii) Correlate reactivity with oxidation and reduction.

(iv) Arrange the metals in decreasing or increasing order of their reactivity.

***Process Skills***

Classification, observation, inference interpretation, reasoning, communication, logical thinking and critical thinking.

***Learning Resources***

Sodium, Potassium, Aluminium, Iron, Zinc, Magnesium, dilute HCl, Copper sulphate, Zinc sulphate, Iron sulphate, test tubes, thermometers, Daniel Cell.

(Materials that can be made available: Sodium iron, Al, Zn, dilute HCl $CuSO_4$, test tubes, thermometers)

Connection to the students life: Storage of sodium in Kerosine oil, rusting of iron, cells and battery.

***Learning Situation/ Experience***

i) Use of $NH_4NO_3$ is banned. Letter from MHRD to all organistions using this chemical.

***Opportunity for open ended discovery:***

Students have learnt the general characteristics of metal and non-metals in Class-VIII and IX. In Class-X they have read some common reactions of metals and non-metals. Here students will find opportunity to

compare the reactivity of some common metals and arrange them in increasing and decreasing order of their reactivity. They will also find opportunity to correlate oxidation and reduction of metals with their reactivity.

**Creating Learning Situations:**

**Engage:**

In the first part teacher captures the attention of students on the context.

**Teacher:** How many of you have read about the chemical $NH_4NO_3$ in newspaper? (Students think for a while & then respond)

**Students X:** Sir, I have read that in the Hyderabad bomb blast $NH_4NO_3$ was used in making explosives.

**Teacher:** Good, can you think why $NH_4NO_3$ only is useful in making harmful explosives whereas other nitrates like Zinc nitrates, copper nitrate etc. are not?

**Student:** Sir, $NH_4NO_3$ is more reactive than other nitrates you have mentioned.

**Teacher:** Good, Now we shall perform a simple activity. I need two students for my help.

(Two students A and B come forward to assist teacher)

**Activity:** Two test tubes are taken which are half filled with water. In one test tube a small piece of sodium kept in kerosene was added slowly (with help of tongs) and in other test tube a small piece of aluminium was added.

**Teacher:** Thanks the volunteers ,what is your observation?

**Student C:** Sir, Sodium is violent in reaction with water whereas aluminium is not reacting with water.

**Teacher:** Very good, now I will give some metals and your task will be to arrange them in decreasing order of their reactivity. You can work in groups. I am with you all the times for your help. Teacher provides four metals sodium, iron, zinc and copper.

**Explore:**

Students of the class are divided into three groups. They start discussing about the problem. Each group designed their experiment and performed. Teacher suggested adding piece of sodium in water after wrapping in paper.

**Explain** - Now teacher invites each group to present their experimental findings.

**Group-I:** We have seen the reaction of meals with water. Except sodium no metal shows reaction with water.

Teacher - What do you conclude?

**Group-I** - Sodium is more reactive than iron, zinc and copper. But, we are not able to compare the reactivity of iron, zinc and copper.

Teacher - Ok, You may also try with hot water or steam. Let us see what group II has done?

**Group-II** - Sir, we have seen the reactivity of these metals with dil. HCl some gas evolves after adding iron and zinc to dil. HCl but no such change has been observed with copper.

**Teacher:** What is your conclusion?

**Group-II:** Since sodium reacts violently with water. It is most reactive than zinc and zinc, iron are more reactive than copper.

**Teacher:** Very good, but how will you compare he reactivity of iron and zinc?

**Group-II** - We did not think about it.

**Teacher:** We may note the temperature of each test tube after adding these metals into dil. HCl. Let us see group III. What techniques they have employed?

**Group-III** : Sir, we have studied the displacement tendency of metals from metal salts. Zinc is able to displace iron from iron-sulphate which is evidenced by decolorization of iron sulfate by adding zinc into it. Similarly iron displaces copper from copper sulphate.

**Teacher:** Very nice. Now you are getting the outcome of group work. Now can you arrange these metals in terms of their reactivity?

**Student** - He comes forward to black board and writes the correct order.

**Elaborate:**

**Teacher:** We have compared here the reactivity of few metals only. Can you extend this idea with other metals and prepare a reactivity series?

**Students:** Yes sir, But we need the respective metal salts.

**Teacher:** What you actually think is the reason of displacement of one metal by another from the metal salts?

No Answer!!

**Teacher:** Do you know about oxidation and reduction?

**Student Q** - Yes Sir, Oxidation is the combination of oxygen and reduction is the combination of hydrogen.

**Teacher:** OK, But, oxidation and reduction is also explained appropriately in terms of loss or gain of electron. Loss of electron is oxidation and gain of electron is reduction. In your case zinc is having higher tendency to lose electron compared to copper. Hence, when zinc is added to copper sulphate, zinc is oxidized to zinc ion. On the other hand copper ion in copper sulpahte gain electron and in reduced to copper. Now you can extend this idea to other reactions. You can also extend this idea to explain the working of Daniel cell and Dry cell.

**Evaluate:**

During the whole process teacher continuously evaluate the performance of students. Rubrics that can be developed are as follows:

i) Ability to perform experiments.
ii) Ability to infer.
iii) Ability to interpret.
iv) Ability to make conclusion.
v) Ability to present.
vi) Group behavior.
vii) Ability to analyse.
viii) Management Skill.

In addition to the assessment of group work as indicated above, some other probing questions can also be part of evaluation for example.

(2) Copper does not react with dilute $H_2SO_4$ but it does react with concentrated $H_2SO_4$. Dilute $HNO_3$ and concentrated $HNO_3$. Why?

(3) An solution of copper sulphate can be safely stored in a pot made up of:-

(a) Mg (b) Ag (c) Zn (d) Fe

## CARBON AND ITS COMPOUNDS

**Subject:**Science

**Learning concept:**Addition Reactions

***Previous Knowledge Assessment:***

Students are knowledgeable about telravalency of carbon and catenation tendency of carbon. Students are also aware about the structural of differences between saturated and unsaturated compounds.

***Preparation:***

The teacher addresses the class at stating at students I have two samples of hydrocarbons marked as A and B with are. I am adding bromine water to both the samples; you simply record your observation as to what happens to both the samples on addition of bromine water. Further I am dividing the class into 6 groups and in the group you have to process the following set of questions. I may also inform you that sample A here is cyclohexane whereas the sample B is cyclohexene.

***Initiation:***

Students start discussing the questions of the teacher, which are as follows:

(i) Out of samples A and B which sample decolorizes the bromine water?
(ii) Do samples A and B have some structural difference?
(iii) Do samples A and B attain some type similarity when one bromine out of these has reacted and the other has not?
(iv) Is there any other regent with whom the colour change like bromine water can also be possible?
(v) If reactions of the type:

(a) $CH_4(g) + CH_4(g) \xrightarrow{\textbf{Sunlight}} CH_3Cl(g) + HCl(g)$

(b) $CH_4(g) + HONO_2(l) \xrightarrow[\textbf{(Nitric Acid)}]{\textbf{Heat}} CH_3N_2O(g) + H_2O(g)$

Can be designated as substitution reactions then what name you can propose to the said reaction of bromine water with sample B?

(vi) What different compounds can be represented by the formulae$C_4H_8$? In how many classes these compounds can be divided?
(vii) If you are given a mixture of ethane and ethene then how can this mixture be separated?
(viii) How can the compounds $H_2C = CH_2, HC \equiv CHand\ CH_3 \equiv C\ CH_3$ be distinguished from each other?

***Thick Performance:***

Students start discussing the topic assigned by the teacher. To get answers to the questions assigned to them they discuss among themselves, at time seek few guidance from the teacher and consult learning materials other than their text book.

***Thick Presentation:***

As desired by the teacher (about which students are already hinted by the teacher) they present their group work to the entire class and the likely outcome of their group work is as follows:

(i) Cyclohexane is a component in which the tetravalenly of carbon is satisfied through are single bonds whereas in cychohexene it is not so as it has a double bond.

(ii) Compounds which include double or triple bonds named as unsaturated constructed compounds show a class of the reactions which are labelled as Addition Reactions.

(iii) Unsaturated compounds through addition reactions have the tendency to get converted into saturated compounds.

(iv) Another reagent apart from bromine water with which unsaturated-enic compounds can be confirmed is alkaline $KMnO_4$, where reaction of the following type is possible:

$$2KMnO_4 + 2KOH \longrightarrow 2K_2MnO_4 + H_2O + O$$
$$K_2M_nO_4 + H_2O \longrightarrow MnO_2 + 2KOH + O$$
$$CH_2 + H_2O + O \longrightarrow CH_2OH$$
$$\| \qquad\qquad\qquad\qquad\quad |$$
$$CH_2CH_2OH$$

The reaction preciously becomes the cause of decolanization of the colour of potassium permanganate.

(v) Unsaturated compounds convert themselves to saturated compounds through a class of the reactions known as Addition Reaction.

(vi) $C_4H_8$ is manifestation of the following compounds:

$$H_2C-CH_2 \qquad CH_3CH = CHCH_3, \qquad CH_3 - C = CH_2$$
$$| \quad | \qquad\qquad\qquad\qquad\qquad\qquad |$$
$$H_2C-CH_2 \qquad CH_3CH_2\,CH = CH_2CH_3$$

(Cyclobutane)

The two classes is which these can be divided in quite obvious i.e., Saturated and Unsaturated

(vii) A mixture of ethane and ethane can the separated by passing the gases through excess of bromine water, wherein ethane would the absorbed and the left out issuing gas would be ethane. From the reactions product of ethane with bromine which is ($C_2H_4Br_2$) recovered as:

$$\begin{array}{l} CH_2Br \\ | \\ CH_2Br\,CH_2 \end{array} \quad Or\ (C_2H_4Br_2) + Zn \longrightarrow \begin{array}{l} CH_2 \\ \| \end{array} + Z_nBr_2$$

(It may be kept in mind that separations mean to recover with the components separately).

(viii) To get answer to query numbered (viii), adequate support of the teacher may be needed. Through teacher's support the students may arrive at the following conclusions:

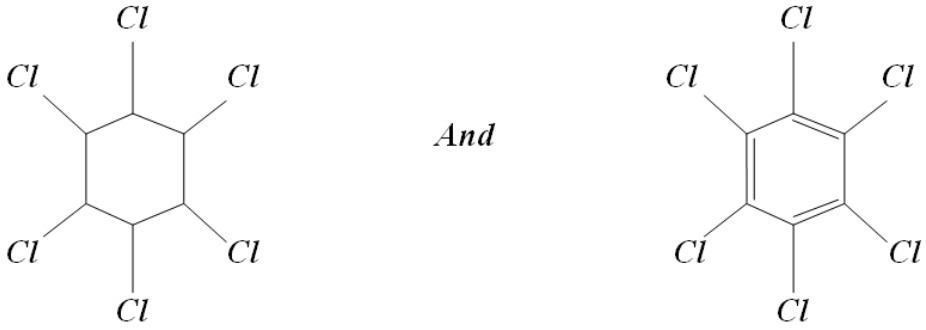
(i) Whereas all the compounds namely $H_2C = CH_2$, $HC = CH$, and $CH_3C \equiv CCH_3$ can decolorize bromine waters, (ii) only triply bonded carbon with free hydrogen would react with ammoniacal $Ag\,NO_3$ to give a preapitate of $Agc \equiv C\,Ag$. Involving following reactions -

$$HC \equiv CH + 2\underbrace{AgNO_3 + 2NH_4OH}_{\text{Ammonical Silver nitrate}} \longrightarrow Agc \equiv Ag + 2NH_4NO_3 + 2H_2O$$

***Polymers Reflection:***

(1) Trace out the role of addition reactions in polymer industry, list four addition polymers of daily life use.

(2) What names are given to the following compounds:




Which out of these is achieved though addition reaction?

(3) How is unsaturated oil converted to saturated fat? What important chemical phenomenon is associated with their conversion technique?

(4) Alkenes are represented by the formula $C_nH_{2n}$, then why is the species:$CH_2$ putting *n* value equals to unity not stable?

(5) How can the following acids he distinguished?

$CH_2 = CH\,COOH$ and $CH_3CH_2\,COOH$?

(A) (B)

Do compounds (A) and (B) show same similar reaction also?

# ARCHIMEDES' PRINCIPLE

**Subject: Science**

**Keywords:**

Displacement (of fluid), up thrust, gravitational force.

**Learning concepts**:

A body immersed in a fluid experiences upward thrust or upthrust equal to weight of displaced liquid. If the up thrust is less than the weight of body, the body sinks, if it is equal it just floats, and if it is more the body floats on the fluid.

**Learning objectives**: Students would

1. Show forces acting on a body when immersed in a fluid;
2. Explain conditions under which a body floats or sinks;
3. Give logical explanation of occurrence of up thrust.
4. Predict which solid body would float or sink on a given liquid.
5. Calculate density of a solid using Archimedis' principle.

**Exploring questions**

1. If a balloon is floating in air at a fixed place and is stationary, what are the forces acting on it.
2. A wooden block is floating on water, give reasons, why it does not sink.
3. If a stone a wooden piece, a plastic piece, an iron nail are immersed in water, which of these would sink/float? Give reason for your answer.
4. A piece of wood weighing 2 kg and a iron nail weight 01.kg are taken. Which of these would sink/float on water. Give reason.

To explore the alternative frameworks or misconceptions, prevalent among students, following questions could be asked individually or with the help of questionnaire or collectively in the class:

1. A balloon is floating in air, and is stationary at a place. Name the forces acting on the balloon. Show the forces in the diagram and their direction also.

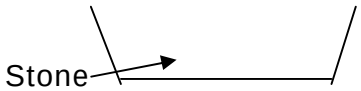
Air Fig....

Floating

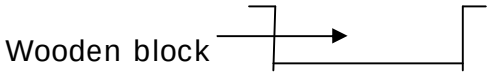
balloon

2. A stone is thrown in a pool of water. It sinks and settles down at the bottom. Show all the forces with their direction acting on the stone.

Similarly to the case of balloon, in this case also weight and up thrust are acting on stone. Eight is equal to up thrust. It is required that students are able to state and show the direction of gravitational force and up thrust/buoyancy due to air. If they are notable to do so, children would be led to this through probing, logic and discussion.




3. A wooden block is floating on the surface of water. Show all the forces with direction acting on wooden block.




**Again**, in this case forces are same as earlier but up thrust is equal to weight of wooden block because block is floating.

Looking at the three demonstrations students would be required to,

(i) Show all the forces acting on balloon/stone/wooden block

(ii) Explain, why stone sinks and wooden block floats

On the basis of responses misconceptions among students would be identified.

**Some Possible misconceptions among students are**

1. Heavier things sink and lighter float.
2. When a body floats, no force is acting on it.
3. When a body is immersed in a liquid, only gravitational force i.e. weight is acting on the body.

**Restructuring of the ideas**

In order to remove misconceptions and develop scientific concepts following group activities demonstrations could be conducted and observations discussed to draw conclusion.

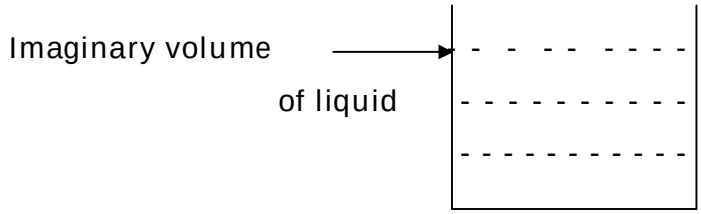
1. Immerse heavier piece of wood and lighter piece of iron or some other metal in water. Observe which sinks/floats.

Similarly take two pieces of wood and iron of equal weight and repeat the activity. Repeat with heavier iron piece and lighter wooden piece.

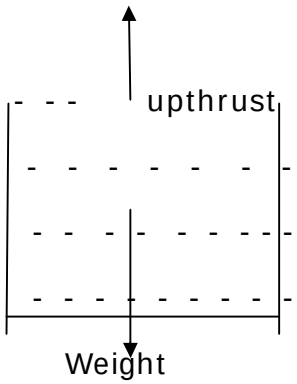
Conclusion could be drawn on the basis of various observations that a body is sinks if weight is more than up thrust: if floats partially immersed if weight is less than up thrust. It just floats if two are equal.

2. Recall the experience that an immersed body when brought out of water, appears heavier in air than in water. Similarly, when we immerse our hand/ foot in a pool of water, we experience lighter inside water. Discuss similarity of two experiences and possible cause.
3. A floating balloon, when left free, goes up. Similarly, a piece of wood when left free at the bottom of pool of water comes up. Why this happens? Is gravitational force acting on it? What is its direction? What could be the cause of observation? Discuss such questions or students could discuss among themselves and arrive at logical conclusion.
4. Teacher demostrates with the help of spring balance that weight of a stone, as shown by a spring balance, reduces when the stone is immersed in water. Teacher discusses the observation on the

following lines consider a vessel filled with a liquid. Let us consider on imaginary volume of liquid of this (see fig.)




Since this volume is stationary, no net force is acting on it in any direction. Consider forces acting on it in vertical direction. On this, gravitational force i.e. weight is acting vertically downward. Since the considered volume is stationary net force acting on it in vertical direction is zero. One can conclude from this that there must be a force acting on it in vertically upward direction and equal to downward weight. This is known as upthrust i.e.




Up thrust (upward) = Weight (down ward)

This force i.e. upthrust is due to liquid outside the imaginary volume.

Now imagine, this imaginary volume of liquid is replaced by a solid body of exactly same shape and volume. In that case also, upthrust would be acting on the solid and its magnitude would be equal to the weight of liquid displaced.

Now, there are three possibilities

1. Up thrust < Weight of liquid Vertical body immersed
   Net Vertical force is down ward and body sinks.
2. Up thrust = Weight of body immersed

Vertical net force is zero, body just floats. It remains where left.

3. Up thrust > Weight of body immersed

Vertical net force is upward, and body moves upward and floats. In this case body attains stable position with part of body immersed such that weight of body is equal to weight of liquid displaced. Important point to note here is that volume of liquid displaced is less than the total volume of body floating. However, since part of body is displaced upthrust is equal to weight of body floating.

Thus, on the basis of relative magnitude of upthrust and weight of body, the body sinks, just floats or floats with part of body immersed.

On this basis of discussion one arrives at Archimedes' principle.

When a body is partly or fully immersed in a fluid, it experiences upward thrust equal to weight of fluid displaced.

**Application of Archimedes Principle**

It could be used to find relative density of a material.

**Case 1: Body floats**

If a body floats with its nth part immersed i.e. if volume is V, V/n part is immersed while floating. It means that weight V/n volume of water is equal to V volume of substance of body. Therefore,

$$\text{Relative density} = \frac{\text{Density of substance}}{\text{Density of water}} = \frac{m/V}{m/(V/n)} = \frac{1}{n}$$

**Case 2: Body sinks**

When a body sinks, its apparent weight in immersed condition is less than its real weight. This is due to upthrust acting on the body. Let W be the weight of body in air and loss of weight is w, relative density can be found in the following way.

If V is the volume of the body,

$$\text{Relative density} = \frac{\text{Density of substance}}{\text{Density of water}}$$

$$= \frac{W/V}{w/V} = \frac{W}{w}$$

- Strictly speaking weight = mass x g, and g will cancel out, taking the ratio.

**Evaluation**

Evaluation of newly emerged ideas could be on the basis of 1. Reconsideration of three questions raised earlier and 2. Discussing some more similar questions such as,

1. A body floats such that its one third volumesare out of water and two-third part is immersed. What is the relative density (ratio of density of substance of body and water) of the substance of body?
2. A boat of 100 kg floats on water. How much of its volume would be immersed in water, while floating.
3. How can we estimate the purity of gold piece without damaging it?
4. A sealed packet of 500 $cm^3$ has mass of 350g. Would it float or sink in water. If it floats, how much part of it would be immersed in water while floating.
5. A balloon filled with helium when left free, is seen going up to some height. After attaining a certain height it stops going up but stays at a fixed height. Explain why this may happens.
6. In a region in outer space where bodies are weightless would Archimedes principle be explain or applicable?
7. A body sinks in water. When taken on moon its weight reduces. Is it possible that on moon it floats on water?

# ELECTRIC CURRENT THROUGH CONDUCTORS

**Subject: Science**

**Key words**: Conductors, resistors, potential difference, open circuit, closed circuit, current power consumed.

**Learning concepts:** Current is flow of charge in a closed circuit; No current is lost (destroyed) or created; (produced) while passing through a conductor; the energy consumed per second or power dissipated when current passes through a conductor is VI, where V is potential difference across two ends of conductor and I is current passing through it.

**Learning objectives**: Students would,

1. Show evidence by logic or otherwise that no current is consumed or destroyed in an electric circuit,
2. Explain that current flows in a circuit or part of circuit when circuit is complete,
3. Understand that current through two conductors connected in parallel is inversely proportional to their individual resistance.
4. Explain that power dissipated when current is passed through a conductor is VI.

**Exploring questions**

To ascertain the understanding of students regarding electric current, questions such as following could be asked. These questions can be given to students in the form of questionnaire, by showing actual circuit in the classroom. They should also be asked to explain the reasoning used in order to arrive at their response.

Q.1. In the circuit shown three identical bulbs $B_1$, $B_2$& $B_2$ are connected Answer the following:

(i) Would the three bulb's glow:

(a) with same intensity (b) with $B_1$ as brightest

(c) with $B_3$ as brightest

(ii) Would the current passing through three bulbs be

(a) equal

(b) unequal, with maximum current through bulb $B_1$

(c ) unequal, with maximum current through bulb $B_3$

Q.2. Figure shows two resistors $R_1$and $R_2$ connected in a circuit. Which of the following statement(s) as true:

(a) There is current passing through point A but not through B.

(b) There is current passing through point B But not through A.

(c) There is no current in the circuit.

(d) There is current passing through both points A and B.

Q.3. In the circuit shown, three resistances of 5 units, 10 units, 15 units are connected as shown. Which of the following statement is true.

(a) Current through $R_1$, $R_2$ andRs is equal

(b) Current through $R_1$ is maximum and minimum through $R_3$.

(c) Current through $R_2$ is minimum.

(d) Current through $R_1$ is maximum and minimum through $R_2$.

Q.4. Two bulbs of different resistance are connected to identical cells, as shown. Which statement is true about consumption of power by the bulbs?

(a) Both bulbs $B_1$ and $B_2$ will consume equal power.

(b) Bulb $B_1$ will consume more power.

(c) Bulb $B_2$ will consume more power.

5. In figure, a bulbs is connected to a cell in different ways. Which statement is true about glowing of bulbs?

   (a) All bulbs will glow

   (b) Bulbs in (ii) and (iv) will glow

   (c) Only bulb (ii) will glow

   (d) Bulbs (i) and (iii) will glow.

6. Which statement is true about magnitude of current at different points in the circuit shown?

   (a) It is maximum at A

   (b) It is minimum at A

   (c) It is minimum at C

   (d) It is equal at A and C.

Questions of this type could be used to explore students understanding of current. This could be done in variety of ways such as (i) administering a questionnaire, (ii) asking students to predict and later verifying the prediction, (iii) by asking students to perform an activity and explain the results and so on. During this teacher may observe students response and identify misconceptions among students.

Through discussion and in view of the fact that charge is neither created nor destroyed it could be shown that equal current would pass through there bulbs$B_{1,}B_2$ and $B_3$(Q.1).Therefore,three bulbs beingidenticalwould glow with equal brightness. Similarly no current will flow in the circuit shown in Q.2. Same logic applies in Q.3 and Q.6 and equal current would pass through three resistors.

Q.4 is little tricky in the sense that student may think that higher resistance would consume more power. The fact is that power consumed is equal

to product of potential difference across the resistor and current passing through. Hence,

$$\text{Power consumed} = V.I = V.V/R = V^2/R$$

Therefore, smaller resistance would consume more power. For this reason bulb of higher voltage has lower resistance.

Finally in Q.5, examination of completeness of the circuit show that in onlybulb (ii) would glow-

**Possible misconceptions among students**

It is likely that some students have some of the following misconceptions:

1. In the context of Q.5, bulbs in (i)/(iii)/(iv) would glow. It implies one wire connected to bulb is sufficient to glow the bulb. Alternatively, both terminals connected to same electrode of cell would glow the bulb.
2. Higher the resistance, more heat/light would be produced by the resistor. However, if equal current is passing through two resistors, one with higher resistance would produce more heat because heat produced is $I^2$ Rt. Current being equal; heat produced is proportional to R. Note that in Q.4. current is not equal in two cases.
3. Different amount of current flows in conductors of various resistances connected in series (References. Q.3)
4. Current gets consumed as it passes through various conductors (Q.6)
5. Higher resistance consumes more power (Q.4).
6. In an open circuit, non-zero current is there in parts connected to battery (Q. 2 & 1).

Through discussion and in view of the fact that charge is neither created nor destroyed it could be shown that same amount of current would pass through three bulbs $B_1$,$B_2$and $B_3$(Q.1).Therefore,three bulbs being identical,would blow with equal brightness.Similarly,no current will flow in the circuit shown in (Q.2).Same logic applies in Q.3 andQ.6 and equal current would pass through three resisters.Q.4 is little tricky in the sense

that student may think that higher resistance would consume more power.The fact is that power consumed is equal to product ofpotential difference across the resister and current passing through. Hence power consumed =V.I = V. V/R = $V^2/R$.

Therefore, smaller resistance would consume more power. For this reason bulb of higher woltage has lower resistance.

Finally examination of completeness of the circuit show that bulb (ii) would glow.

**Restructuring and constructing ideas**

Many strategies could be adopted to remove misconceptions and to develop ideas further. Some of these are:

(a) **Group discussion**: Students are divided into groups of 5-6 students of heterogeneous ability. They argue land discuss among themselves and present the opinion of the group about the correct response. When one group presents other students can give their opinion and/or discuss.

(b) **Using analogy**: Flow of electricity could be compared with flow of water in a closed loop with the help of a pump (see.Fig.). Students in small groups can discuss the similarity between current and water flowing. Questions such as, what corresponds to battery, conductor of high resistance, low resistance in the water circuit shown. Further, students could discuss the result if water circuit parallel to electric circuit is made corresponding to some questions mentioned earlier.

One could also discuss how water circuit is different from electric circuit.

(c) Students working in small groups could make different circuits and observe flow of current in different parts. They could also measure current in different parts of circuit and confirm if the prediction made is true or not, Reasoning for it could be discussed.

When current passes through a conductor, work is done per second and it is equal to product of potential difference between the two ends of conductor and current passing through it. Teacher may ask students to recall that current is charge flowing per second. Since potential difference V is the amount of work done is moving l coulomb charge from lower potential to higher potential, the teacher could arrive on this basis that,

Power dissipated = V (Q/t) = VI

Where Q is charge flowing in time t. Further, teacher would explain that for V= 1V, I= 1A, W = 1 Watt.

**Questions such as following would help to improve understanding:**

Q.1. Two bulbs, operating at 220V, have power 60W and 100W respectively (How much current would pass through, them when glowing?

Q.2. When two bulbs, one of 25ohm and another of 60ohm resistance, are connected as shown, which of the following statement(s) are true.

(a) Current passing through two bulbs in unequal.

(b) 60 ohm bulbs would glow brighter.

(c) Both bulbs would glow with equal intensity?

**Evaluation**

Since electricity is observed as a result of effect it produces (e.g. heat, glow of bulb), one method to evaluate the understanding could be by providing concrete situation using circuit, cell, resistor etc. and asking question based on it. Few such situations are given here.

Q.1. A circuit is shown. Which of the following relation (s) are true between I, $I_1$ and $I_2$ ? ($R_1 > R_2$)

(a) $I_1 = I_2$

(b) $I = I_1 + I_2$

( c) $I_1, > I_2$

(d) $I_1 < I_2$

Q.2. A resistance $R_1$ is connected to a cell, in first position. In second position, another resistance $R_2$ is connected in the circuit without altering other things. Which of the following statement is correct about I and $I^1$

(a) $I > I^1$

(b) $I < I^1$

(c ) $I = I^1$

Many more such situations could be given and students asked to predict the result and compare it with actual result.

# SOURCES OF ENERGY

**Subject:Science**

**Learning Concepts:**

Renewable and non-renewable sources of energy, fossil fuel – petroleum, coal and natural gas, thermal power plant, nuclear energy, alternative sources of energy, hydroelectric power station, solar energy, biofuel – solid bio-fuel, liquid bio-fuel, biogas (gobar gas), wind energy, solar energy, solar cooker, solar stilt, solar water heater.

**Learning objectives:**

Students would understand that,

a. there are some sources of energy of which there is limited stock available on the earth and hence exhaustible**,**
b. petroleum, coal and natural gas are fossil fuels,
c. energy is obtained from fuel by burning (oxidation) them It is used to generated electricity, and light
d. use of fossil fuel creates problems for wild life, human beings and ecosystem,
e. nuclear energy is obtained as a result of nuclear decay,
f. use of nuclear energy also involves some risks for the present and future.
g. biofuels are alternative sources of energy and they are cleaner sources of energy? but with limited availability.
h. solar energy is clean source of energy but difficult to use and of limited availability,
i. hydrogen is the future source of energy producing no pollution when used.

**Exploring questions**

There could be many relevant questions that could be asked at different stages of concept development as learning progresses on the topic. The purpose of these questions is 1 to ascertain knowledge and understanding of the students regarding the topic in question and 2. to explore misconceptions and learning gap among students. Sample of some such questions are given here.

Q.1. What are various sources of energy?

Q.2. What are fossil fuels? From where are they obtained? What is the source of their creation?

Q.3. Is the stock of fossil fuel limited? How long is it expected to last?

Q.4. How does the use of petroleum effect, ecosystem, wild life and human being?

Q.5. What are the different ways by which electricity is produced? Is environment affected in these processes?

Q.6. Do you agree that nuclear energy is clean energy and its production and use involves no risk. What are the evidences to support your answer?

Q.7. Is biofuel used in India? In what ways? What are cleaner methods?

Q.8. List, various ways in which solar energy is commonly used.

Q.9. Solar energy being free, why it is not more used?

Q.10. How the use of fossil fuel could be more eco friendly?

**Possible misconceptions:**

1. The fossil fuels are available in plenty and there is no danger of exhausting them.
2. Use of fossil fuel does not affect adversely environment in any way.
3. Constructing a dam does not effect in any way wild life, human being or ecosystem.
4. Environmental pollution is in limits and has not much effect on human health.
5. It is very difficult to use solar energy.
6. Construction of dam is an easy way to obtain energy and it involves no problem.

**Developing and restructuring ideas -**

## I. Renewable and non-renewable source of energy

Students would form teams of 5 to 6 members and making use of library, other books, internet etc and each term would seek answer one of following questions In the end each team would submit report to the whole class and discussion would be held covering points such as,

1. What are the different sources of energy? How do you compare them in terms of utility, difficulties in using them and pollution produced.
2. Which sources of energy are available in limited quantity? What is the role of consumption of various sources and how long the stock of source of energy is expected to last?
3. Are there some renewable sources i.e. lasting for very long time without getting exhausted. What are they, if any?
4. What are the difficulties involved in using coal/petroleum/natural gas? How does it affect environment?
5. What are the risks in using nuclear energy?
6. Is the dams clean source of energy? Do they affect environment and human population?

On the basis of discussion matter would be summarized for each source on the following lines.

1. Coal, petroleum and natural gas are fossil fuels. These and (nuclear) radioactivity are non-renewable sources of energy.
2. Solar energy used directly and through dam, forests, plants etc. Provide renewable sources of energy.
3. Coal is obtained through strip mining and underground mining. Strip mining destroys forest, flora and fauna. It also leads to soil erosion and destruction of agricultural land. It also pollutes water bodies. Underground mining involves risk of fire, lowering water table, health problem to miners and many other problems.
4. When coal is burnt, it produces large amount of carbon dioxide, fly ash, $SO_2$ and carbon mono-oxide. These are pollutant to environment.
5. There are three steps in use of petroleum. First is exploration of underground source extraction of petroleum and its refinement for use and actual use. All these stages adversely affect ecosystem. It creates noise, air and water pollution at each stage. Survey and extraction of petroleum results into large quantity of liquid and solid waste. Petroleum is spilled over in sea. As many as 450,000 birds die each year due to this. Use of petroleum pollutes environment by producing $VO_x$, $SO_2$, $CO_2$, an other pollutants.

6. Nuclear reactors are expansive to make, take time to build up and shut down. Extreme precautions are to be taken to operate them because they involve radioactivity. Sometimes accident takes place which are lethal. Nuclear reactors produce nuclear waste which is highly radioactive. It is getting accumulated and there is no safe method to dispose it off.
7. Construction of dam requires huge land. For this purpose many times human population is dislocated, forests are destroyed, farm land is acquired and much wildlife is destroyed. Operating dam is free of problems and stored water is used for irrigation. However, they are also source of methane. Availability of water in a dam also depends of rain in catchment area.
8. Solar energy is used directly for drying, heating, cooking and generating electricity. However, it is available only for part of the day. Moreover, like fossil fuel, it is also not available equally in all parts of the world; more at equator and nearby regions and less near poles. Its continuous use requires storage system.
9. Fossil fuels are available in specific regions. For example, US, Russia, China, Australia, India are top 5 countries with coal reserves. Similarly, Saudi Arabia, Venezuela, Canada, Iran, Iraq, Kuwait, UAE and Russia are top 8 countries with petroleum reserves. The reserves being limited, it is estimated that at present rate of consumption petroleum may not last for more than 50 – 100 years. Coal may last for about 200 years or so.

## II. Consequences of using energy from different sources

Again students would be divided into few teams and each team would be assigned to study consequences of obtaining a source (e.g. coal from mine) and using it as source of energy. Study would include the following aspects.

**Name of source of energy**

1. How is it obtained?
2. Consequences/Effects of obtaining the source(e.g. coal) and using it on the environment, wild life etc.
3. How it effect human being?
4. Ways in which it is used and purpose.
5. Methods to improve efficiency to obtain energy and reduce environmental degradation.

However, there could be some different they are aspects to be included that are specific to the area of study. For example, in case of solar energy, following aspects could be covered:

a. Which parts of earth get more solar energy and which get less? Reasons thereof.
b. Ways and purposes for which solar energy is commonly used.
c. New methods and purposes for which solar energy could be used.
d. Use of Green House, solar water heater solar stilt etc.
e. Limitations of using solar energy
f. Indirect ways of using solar energy, e.g. growing plants.

**3.Comparison of different exhaustible sources of energy**

Similar questions could be generated in case of other sources of energy.

It would be useful to compare various sources of energy and their availability. The information could be tabulated as following:

| Source | Availability | Advantages | Disadvantages | Where Used | % of use in world |
|---|---|---|---|---|---|
| Petroleum<br>Natural gas<br>Coal<br>Nuclear fuel | | | | | |

It may be mentioned that percentage of use varies from country to country and time to time depending upon the conditions. For example, the data given by WEDC (2000) is as following:

| | Coal | Oil | Renewable | Nuclear | Natural gas | Hydro electricity |
|---|---|---|---|---|---|---|
| India | 55.2 | 31.5 | 3 | 1 | 79 | 3 |
| World | 23 | 35 | 2+10* | 7 | 21 | 2** |

*Traditional biomass ** Large hydroelectricity

**4.Study of use of solar energy**

Ultimately, it is solar energy that provides renewable source of energy. Solar radiations are used in two ways: 1. Using solar radiation directly for various purposes such as heating, drying etc. 2. Using solar radiation indirectly such as using biofuel, hydroelectric power station etc. Student could study in detail one of these on the following lines.

**Object of Study:**Gobar gas plant/ Bio gas etc.
**Input and its source:**
**Output:**
**Cost:**
**Working:**
**Availability:** Locally, brought from far off, constructed by the user etc.
**Advantages:**
**Disadvantages/Limitations**
**Remarks**

**5.Energy source, human health and environmental concerns**

It is known that many diseases are caused due to pollution. The source of this pollution is method of obtaining source of energy (e.g. coal) and/ or the way it is used to obtain energy. For example, mining and use of coal both produce pollution. To appreciate it fully students in groups could take study such as:

a. Patients in hospitals suffering with diseases caused by environmental pollution.
b. Effects of thermal power plants/ factory etc. on nearby flora, fauna and soil.
c. Effects of mining on wild life, soil and economy of nearby human settlements.

**Enrichment by the teacher and evaluation**

At every state of presentation and discussion teacher would supplement the information and take corrective measures, if required. Moreover, in this kind of approach students work could best be evaluated during the 'process' rather than the end.

As an extension of study teacher could discuss hydrogen as fuel of future, while also mentioning hydrogen and its storage in liquid form in vacuum insulated cryogenic tanks, as is being used in space programme.

However some questions such as following could be used for evaluation:

1. Compare the use of solid biofuel and biogas in view of various aspects related to environment and human population.
2. Which source of energy you consider as most damaging to environment? Write your views supported by evidences.
3. On what basis the progress of students should be evaluated while teaching this unit. Give specific ideas.
4. How does mining of coal effects environment. Suggest methods to reduce adverse effects.

# NEWTON'S LAWS OF MOTION

**Subject:** Science

**Key Concepts** of force and Newton's three laws of motion

**Learning concepts:**

To understand the concept of force, interaction between two objects, explain the motion of an object as resulting from the forces acting on the object and hence the Newton's three laws of motion.

**Learning objectives:**

1. To understand that force is not only associated with a body in motion
2. To understand that objects at rest are subjected to balanced forces
3. To understand that unbalanced forces will lead to objects slowing down, speeding up or changing direction
4. To understand the concept of NET force, sum of all forces acting on an object and its connection with Newton's first and second laws of motion
5. To find out the direction of force acting on an object
6. To understand that Force acting on any object in any situation is always the result of its interaction with another objectforce as acting onone object from (or due to) another object. That is concept of pair forces and their connection with Newton's third law of motion.
7. To understand that there does not exist any definition of force independent of Newton's laws of motion
8. To draw free body diagram and calculate the forces associated with it.

**Excite**

Teacher will ask students to give examples of some situations/statements were the term force is used.

**For example**

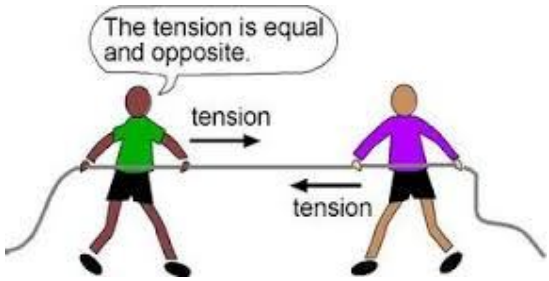
- police force,
- 'Dad forced me to do it',
- 'May the force be with you',
- 'Don't force it — it might break',

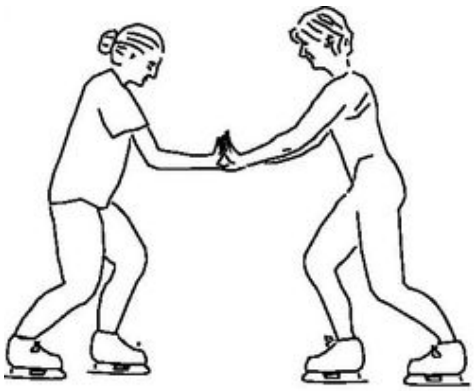
Ask student which of these uses matched most closely to the scientific meaning. The answer will be of course the last point

**Exploring questions:**

1. **What does the word Force makes you think about?**" Students will share within the group and then choose a few to share with the class.

- Having students arm wrestle to show balanced forces (when the same amount of force is applied by each person) and unbalanced forces (when one person wins). The students will learn the effects of unbalanced forces by sharing what they felt as they were winning or losing. Give a rope and ask two students to hold the opposite ends and start pulling in the opposite directions? Ask the students what will happen? Summarize when we have pulls in opposite direction there is no movement. Ask students what happens pulls are not equal? In which direction will the rope move? This will also be a good example to demonstrate the effect of balanced and unbalanced forces. unequal forces acting in opposite directions that results in movement in the direction of the larger force.

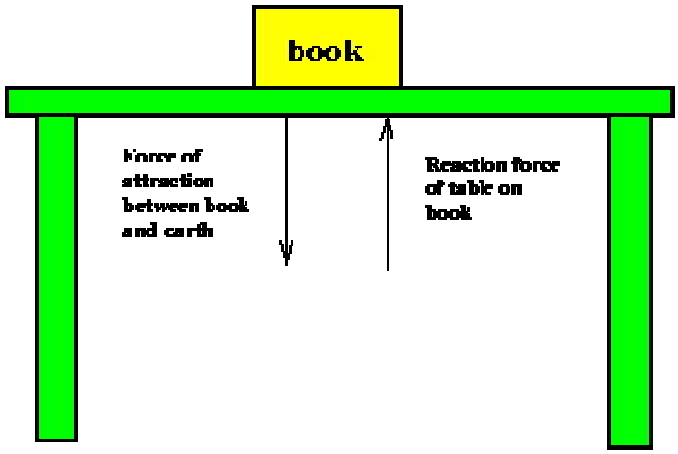


Ask students if they can think of other examples to demonstrate the effect of balanced and unbalanced forces.

2. Is force associated with moving objects only or with stationary objects also?

Place a book on the table. Ask the students to make a rough picture of this in their notebooks. Ask them whether any forces are involved or not?



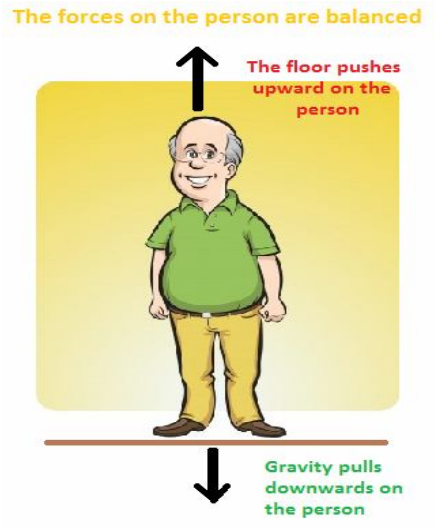

This activity will help students realize that forces are associated with stationary objects also only that the net forces are balanced so there is no motion.

3. What is net force?

To define net forces give one example of a stationary object and one of moving object. **Take any example of an object in motion or at rest and identify all the forces acting on the object and then state whether they all sum up to zero or not?**

Ask the students to label all the forces involved.

For stationary object the example of a person standing on a floor can be given. Ask the students what forces are acting on a person standing on the floor.




To calculate the net forces on a moving object consider a ball thrown vertically upwards. What kind of motion you expect? You find that the ball loses it speed as it climbs up until it stops climbing up and starts falling down. In this considered example, or you may actually throw a ball upwards in the classroom and ask your students following questions about the upward and downward journey of the ball.

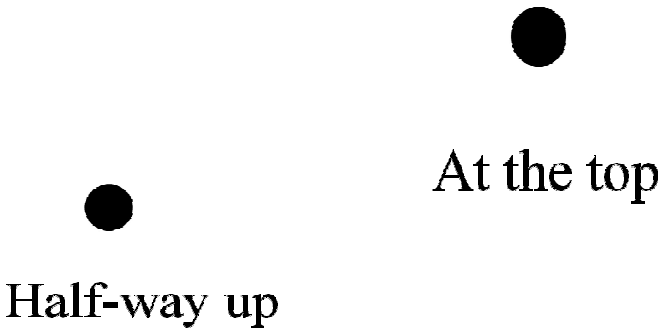
1. Identify the forces acting on the ball also identify by whom each of the force is applied (neglecting air resistance).

2. What is the direction of the net force on the ball as it climbs up and when it comes down?

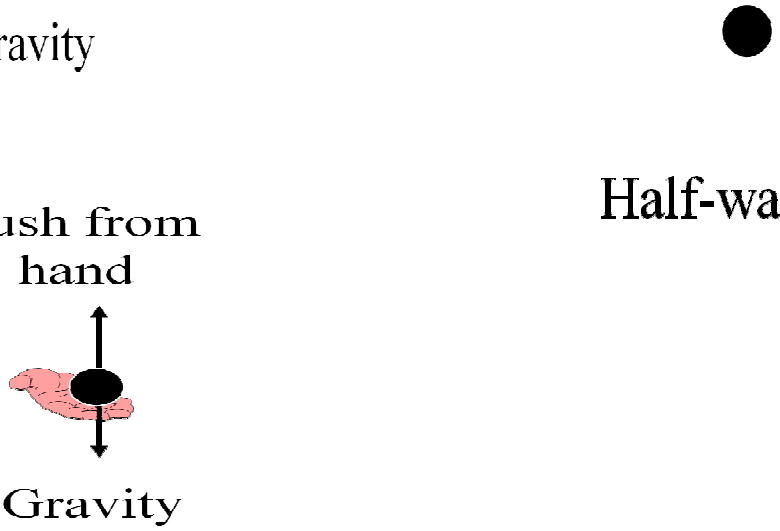
3. What is the direction of the net force acting on the body as it comes to momentary rest, before its starting of downward journey?

4. What about the magnitude of the force?

5. What is the cause of this force?



Gravity



Half-way down

Push from hand



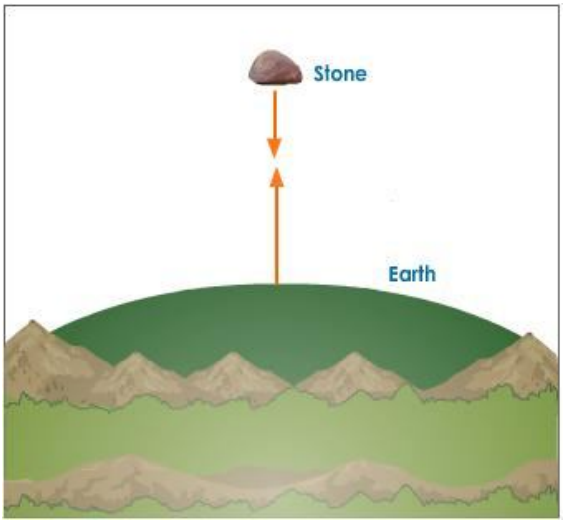
Gravity

4. How much force is acting on a body moving with constant velocity?

A car travels at a constant 60 mph, along a flat road. What are the forces acting on it?

Is the forward force greater than, equal to or less than the combined backward forces?

5. Is the wind (blow football, wind on leaves) a force-at-a-distance?
6. If you release a stone from a height what are the forces acting and how you calculate the net force?

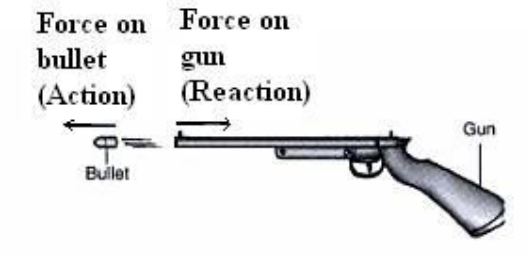


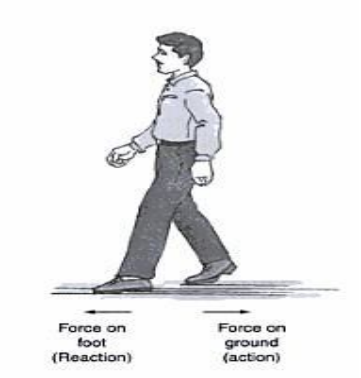

If you allow a stone to fall and if its acceleration is observed as ‘a’ then ‘ma’ gives us the net force acting on the stone. This net force is the

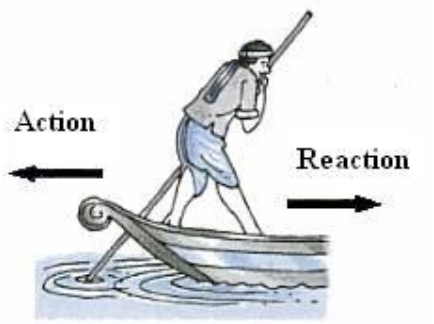
combination of the force due to earth and the opposing force due to surrounding air.

7. Give ten examples of force acting on one object from (or due to) another object.

Students will give several examples in which action and reaction forces are involved. Recoil of gun, Propulsion of a boat in forward direction. These forces act on different objects and so they do not cancel each other.




Possible misconceptions among students

Students are aware of the fact that force is push (makes something start or stop moving) or pull (makes something that's already moving go faster or slower). Also that force causes change in shape. Some of them might even be aware of the forces at a distance like the gravitational force, magnetic and electric forces. The alternative conceptions that can arise in a student's mind are listed below:

1. Force is associated with the body till it is in motion.
2. When a body is at rest the force acting on it is zero.

3. Force is always in the same direction as the velocity of the body.
4. If the velocity is changing then force is also changing.
5. The action-reaction forces act on the same body.
6. The product of mass and acceleration is force.
7. Only animate things like people and animals exert forces; passive ones like tables, floors do not exert forces.
8. Forces applied by, say a hand, still acts on an object after the object leaves the hand.

**Restructuring of ideas/Explanation**

Having understood the concept of balanced and unbalanced forces students can now write the newton's first law of motion in their own words. While discussing the examples mentioned above the teacher can explain to the students to consider a body on which no net force acts. If the body is at rest, it will remain at rest. If the body is moving with constant velocity, it will continue to do so. An important word here is NET. It means "total" or "sum of all" (forces). It is not that no force at all can act on the body. It is just that all the forces must add to zero (cancel each other out).

Therefore Newton's First Law of Motion can be written as:

Every object persists (stays) in its state of rest or uniform motion in a straight line unless it is compelled (made) to change that state by forces impressed (acting) on it .

According to Newton's first law of motion things come to rest not because they naturally do but because forces act on them to bring them to rest. A common force is friction – which is the push or pull things give to each other when they rub together. Eliminate friction and things would keep moving in a straight line.

- Compare surfaces with more and less friction

  Ice vs. carpet

- Newton's first law does hold true as long as you account for all the forces.

Discussing the Newton's second law of motion teacher can discuss the example of a stone thrown from a height. If you allow a stone to fall and if its acceleration is observed as 'a' then 'ma' gives us the net force acting on the

stone. This net force is the combination of the force due to earth and the opposing force due to surrounding air.

So, newtons second law of motion which is commonly shortened to "F=ma".

Correctly, it is :

$$\sum \vec{\mathbf{F}} = m\vec{\mathbf{a}}, \qquad \vec{\mathbf{a}} = \frac{\sum \vec{\mathbf{F}}}{m}$$

This is the reason that the stone and a piece of paper do not fall down with same acceleration. If you attach a small stone to a parachute made out of a polythene bag and allow it to fall, at first, the stone would tend to fall fast enough and increase its speed and we may conclude that there is some net force acting on the stone. But after some time you may notice that the stone is falling down almost with uniform speed with zero acceleration. From this observation you can conclude that net force acting on the stone is zero. The force due to earth remains same but the opposing force due to air because of the parachute increases with increasing speed. When these opposite forces cancel each other the velocity of the stone does not increase.

Discussing the examples mentioned above teacher can explain the Newton's third law of motion. Whenever two bodies interact with each other, the force exerted by the first body on the second is called action. The force exerted by the second body on the first body is called reaction. The action and reaction are equal and opposite.

Newton's Third Law of Motion states: 'To every action there is an equal and opposite reaction'.

It must be remembered that action and reaction always act on different objects. The Third Law of Motion indicates that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first object. These two forces are always equal in magnitude, but opposite in direction. These forces act on different objects and so they do not cancel each other. Thus, Newton's Third Law of Motion describes the relationship between the forces of interaction between two objects.

**Evaluation**

1. Assuming air resistance can be ignored, which gets to the ground first, a bowling ball or a tennis ball if they are dropped from the same height at the same time? Explain.
2. Does a book at rest on the table have no forces acting on it? Explain.
3. A car is traveling at a constant 60 mph in a straight line. What is the net force acting on the car?

4. Draw the diagram showing a body of mass *m* in projectile motion under gravity. Show the magnitude and direction of the force acting on the body when it is a) ascending, b) at the top most position, and c) descending. Give reasons.
5. We take say 5 identical paperweights and put them on a fairly smooth horizontal table so that they touch each other and lie on a straight line. Now if we hit this line of paperweights head on with another identical paperweight moving horizontally in the same line, it is found that one paperweight at the end of the line moves out and the moving paperweight comes to rest. Explain this observation on the basis of the principle of conservation of momentum and in terms of the force acting on each paperweight.

**"Orientation of Secondary Science Teacher to develop the skill to use Constructivist Pedagogy in classroom situations." (PAC 16.29)**

**DATE – 31.01.2017 to 03.02.2017**

| **Date/Day** | **1st Session 9:30 – 11:00 am** | **2nd Session 11:30 – 1:00 pm** | **1:00 – 2:00 pm** | **3rd Session 2:00 to 3:30 pm** | **4th Session 4:00 to 5:30 pm** |
|---|---|---|---|---|---|
| 30.01.2017 (Monday) | ***Inauguration*** | ***"Constructivist Approach"*** Prof. A.B. Saxena | ***Lunch*** | ***"Constructivism in Science"*** Prof. RatnamalaArya | ***"Nutrition in Plants"*** Prof. Reeta Sharma |
| 31.01.2017 (Tuesday) | ***"More about Salt"*** Prof. I.P. Agarwal | ***"Metals &Nonmetals"*** Prof. L.K. Tiwary | | ***"Respiration in Plants"*** Prof. Reeta Sharma | ***"Carbon & its Compounds"*** Dr. Chitra Singh |
| 01.02.2017 (Wednesday) | ***"Mole Concept"*** Prof. I.P. Agarwal | ***"Sources of Energy"*** Prof. A.B. Saxena | | ***"Periodic Table"*** Dr. R. Krishnan | ***"Control & Coordination"*** Dr. ArunimaBanik |
| 02.02.2017 (Thursday) | ***"Force"*** Dr. ShivalikaSarkar | ***"Food Resources"*** Prof. P. Kulshreshtra | | ***Groups Work*** Prof. I.P. Agarwal Dr. Chitra Singh | ***Group Work*** Dr. Chitra Singh Dr. ArunimaBanik |
| 03.02.2017 (Friday) | ***Presentation I*** | ***Presentation II*** | | ***Presentation III*** | ***Valedictory*** |

**(Dr. Chitra Singh)**
Programme Coordinator