Project Work

A project work is a planned and definitely formulated piece of study involving a task or problem taken up by the learner, either individually or in a group, to supplement and apply classroom and laboratory transactions. It follows the approach of *Learning by Doing* and *Learning by Living*. It is often experienced that there is no time in a *tight* school timetable for *all* the content of science curriculum to be applied. Prescribed textbooks and laboratory manuals primarily envisage the knowledge and concepts that are considered appropriate for learners at a certain stage. These provide wide body of knowledge and understanding. While project work aims to call on pupils' capability to apply such knowledge and understanding, to select that might be useful in a particular instance, and to use it in the design of a decision-making process. Thus a project work is an attempt to promote creativity and the spirit of enquiry in learners.

Project work is a more or less open-ended activity and depends on the nature of the task. For selecting a task, the situations which can raise suitable questions amongst the students are identified. Such situations may be arrived at through libraries, laboratories, magazines, discussions, field trips, print and electronic media, internet etc. Students may choose a project depending on their abilities, enthusiasm, and interest. However the complexity of the project, availability of the material resources, and time available to furnish the project shall always influence the selection of task. The working on a chosen project must first include the tentative objectives that might be attained. The execution of the task must be properly planned. It is advised that the project team keeps a complete record of work including the choice of project, planning, discussions held, distribution of work assigned to different team members, references and books consulted, observations, difficulties faced, guidance sought etc. The report of project may include the title, theory/hypothesis, objectives, materials required, procedure, observations, results and discussions, references etc.

Types of Project

The nature of a project work may be categorised on the basis of tasks involved: (i) Practical tasks – in which the emphasis is given on actual construction of material such as model making. (ii) Appreciation – in this type direct or vicarious experiences, such as reading or listening stories etc. are involved. (iii) Problem-solving – in which the purpose is to solve a problem involving the intellectual processes. (iv) Master of a skill, knowledge – in which the emphasis is aimed to attain a certain degree of skill such as laboratory demonstrations directly from either the textbooks or laboratory manuals.

The project work aims to apply pupils' knowledge and understanding daily life problems, promotes habit of critical thinking and helps the students to adopt the scientific method of working. Learners can perform at their own convenience. They also learn to plan and execute their ideas within a given timeframe. While appreciating learning science by doing and living, project work widens the mental ability of students. The students get an opportunity to learn several skills such as observation, reasoning, interpretation and inference, reporting etc. A project conducted in a group also promotes social interaction and cooperation among all the members.

Various approaches may be adopted while taking up a project work. Such approaches may be based upon modes like building an apparatus, project that involves experimentation, survey based projects, project based on observing nature, project through learner sheet, project based on use of available data, project based on field work, project based on exploration, project that generates information etc. Some projects based on these modes are suggested in the next section.

Some Suggestive Projects

1. Observe the moon. Observe the moon at the same time everyday for a month and note its shape, brightness and its elevation from the earth.
2. Preparing a triboelectric series. The triboelectric effect refers to a charge of electricity generated by friction (as by rubbing glass with silk). Collect several materials around you. Charge them by rubbing by taking different combinations.
3. Study of transmission of heat. Investigate parameters that can affect the transmission of heat.
4. Explore the habitation, plantation etc. in a pond/lake in your vicinity.
5. Survey water resources in your locality. How much water do we consume everyday? How much water is wasted due to leakage of taps in our homes?

6. How much water do we receive through rains (making of a water gauge)?
7. Create a weather chart.
8. I care my tree! How? Study of its morphology, growth, health, what does it need? Does it respond to affection? When will it die?
9. To study plant diversity in our town.
10. Classify flowering and non-flowering plants in our town.
11. To study roots of different plants.
12. To study seed sprouting time. Identify most favourable and most unfavorable conditions.
13. Listing of plants used for house-hold medicinal treatment. Which parts of them are most suitable for treating the ailment?
14. Energy management.
15. Water management.
16. Waste management in our locality/town/city.
17. Study of life cycle of an insect.
18. To study of soil. Its physical characteristics, pH, biological character, water holding capacity, porosity, erosion, air in soil, fertility, etc.
19. To study biodiversity (in your town or through encyclopedia).
20. To study colour of flowers.
21. To study leaf shapes.
22. To study the process of fermentation.
23. To study saps obtained from plants.
24. Birds of my town.
25. How do we collect honey?
26. Determination of age of a tree.
27. Measure wind speed at different heights – investigate effect of surrounding structures and vegetation.
28. Observations of natural fibers.
29. Absorption of heat by variety of clothes made of different fibers.
30. Effect of impurity on melting of ice.
31. Time taken in boiling of milk as a function of water quantity in it.
32. To study the minimum time interval between two flashes in camera after successive discharges. Hence investigate condition of the battery used in it.
33. Motion of different shaped objects (of the same material) through liquids.
34. Observations on a slinky.

35. To study sliding friction on horizontal and inclined planes.
36. To study liquid pressure at a point due to liquid filled in containers of different shapes.
37. Making of a lactometer/liquid density meter using plastic balls.
38. Survey of people with vision defect – classification and categorization.
39. How to measure energy stored in a cell?
40. Hygrometric studies.
41. Find current – voltage relationship for a conducting wire at different temperatures.
42. Making scales and different devices of length measurement of arbitrary magnitude.
43. Estimation of force needed to rotate a body using sticks (levers) of different lengths.
44. Survey of cleaning capacity of different soaps and detergents.
45. Observing rate of cooling of a liquid of given quantity on covering it with a lid of different colours and nature.
46. Roll cylinders of different materials on an inclined plane. Estimate friction force by measuring distance traveled by them in a given time interval. Try this with surfaces of different curvatures.
47. Estimate amount of dissolved air in different samples of water.
48. Collect rain water at different times in rainy season. Compare their acidity.
49. Determine purity of chilly/turmeric/tea/honey/other food items.
50. Determine carbon content in different oils.
51. Classify various food materials into solutions, suspensions, and colloids.
52. To study colloidal properties in different food samples e.g. milk, jam, jelly, gum, etc.
53. Find fat content in different food items.
54. Make herbarium of medicinal plants from your locality.
55. Prepare natural pH indicators.
56. List down exothermic and endothermic reactions taking place around you.
57. List out hygroscopic substances around you and estimate their relative affinity for water.
58. Make a survey of events where you notice inter-conversion of different forms of energy. Hence list the names of transducers.
59. Determine efficiency of different fuels.
60. Making a chart to show calorific value of food materials.

61. Collect plant saps and find their properties like, colour, density, percentage of water content, medicinal value etc.
62. To study acids and bases used in your kitchen.
63. What are bio-molecules? Trace their composition and function.
64. Determine pH and foaming capacities of different brands of soap available. Are these related to their cleaning powers?
65. Effect of impurities on boiling points of liquids.
66. How to identify composition of an alloy?
67. Make a crossword for elements / science terms/ scientist names.
68. Determine stoichiometry of chemical reaction.
69. Separate out transition elements from periodic table and list down colour compounds available from them.
70. Observe volatility of different liquids.
71. Nature oriented research projects like – investigations on banana stem – threads and making paper from it.
72. Idea of valency through models and charts.
73. Angular diameter of full moon by a coin.
74. Listing out difficulties in making working models.
75. Listing out superstitions with comments.
76. Listing out phrases from literature that involve development of science.
77. Growing and nurturing a medicinal plant garden.
78. Science magazines in vogue and type of content in them.
79. Crystallisation of Benzoic acid or salicyclic acid from solutions using different solvents such as water/ethanol/ether/acetone.
80. Preparation of colloids and to study coagulation, filterability, Brownian movement in colloids.
81. Identify the different oxidation – reduction reactions in your daily life.
82. Identification of plastics that can be recycled.
83. Types and functions of food additives.
84. Benefits and harmfulness of sunlight.
85. Kinds of industry-related air pollution.
86. Sources of indoor air pollution.
87. Sources of indoor water pollution.
88. Sustainable agriculture.
89. Dependence of modern agriculture on insecticides and herbicides.
90. Organic farming.
91. Comparison of stomata of monocots and dicots.

92. Preparation and study of Protozoan culture.
93. To study inflorescence of *Asteraceae* (*Chrysanthemum*/*Calendula*/*Tagets*).
94. Verification of Mendelian ratio using beads.
95. 'Life of the past' – A literature survey based project. Information on five extinct plants and extinct animals may be obtained from various sources. Try to discover the nearest living species of these extinct organisms.
96. Genetic variations within a family: study siblings of a family on the basis of their appearance. Infer the existence and origin of variations.
97. Construction of food-web and ecological pyramids by observing a garden.
98. To study the heartbeat rate of a sprinter (say after running 100 m) and to compare it with that of a person in normal condition.
99. To study the effect of different colour lights on germination of seeds those require light for germination.
100. To study the effect of different salt concentrations of water on growth of hydrophytes.
101. To study the effect of exercise on the metabolic rate (digestion of starch) in human beings.
102. To study the presence of microorganisms by culturing the sample of soil and to identify the factors affecting the productivity of soil.
103. To construct a metals activity series: observe and compare the reactions of different metals with dilute hydrochloric acid to form hydrogen gas bubbles. Use this series in determination of an unknown metal.
104. To study that fruits and vegetables consist of electrolytes.
105. To investigate and to formulate some idea about what affect a moving steel ball has on a stationary target ball?
106. Sound: Can you *see* sound? Can you put out a lighted candle with sound? Can you hear a bell in bottle? How fast does a sound travel? What causes sound? How would the nature of the medium affect sound?
107. Building a primitive electric motor/generator.
108. Homemade batteries.
109. To study the reflection of light ray from a semiconductor laser source by a plane mirror and a concave mirror in a smoke box.
110. To study the refraction of light ray from a semiconductor laser source by a convex/concave lens a smoke box.
111. To measure the critical angle of light ray in water (using a semiconductor laser source).

Exemplar Project Write-ups

Project 1

Bio-degradable and non-bio-degradable Wastes

Aim

To identify bio-degradable and non bio-degradable materials (wastes) in the environment.

Theory

It is important to recognise that the terms like bio-degradable and non-biodegradable materials referred herein pertain to 'wastes' produced by human activities. These 'wastes' if not disposed off efficiently will cause excessive accumulation and pollute water, land and soil. The wastes range from human and farm excreta, industrial sewage, pesticides and herbicides, empty cans, bottles and jars, metal and plastic cups, polythene bags and jars, paper, discarded machinery parts etc. Wastes also accumulate in the form of refuse from kitchen and vegetable markets, gardens, agricultural and farm lands etc. The list is very long but for the sake of convenience and from ecosystem point of view wastes are categorised into bio-degradable and non bio-degradable. In an ecosystem apart from producers and consumers there is another group of heterotrophic organism collectively referred to as decomposers that consist chiefly of bacteria and fungi which degrade and digest dead plant and animal material? All such materials which are degraded and decomposed by decomposers are called bio-degradable wastes. Such wastes are easily manageable by a natural process or in an engineered system (for example waste treatment plants) and can be turned into useful resources (for example, bio-gas, plants etc). A large variety of waste materials produced by man and industry, however, don't degrade (polythene, plastic, glass etc) or are degraded only very slowly by decomposers (for example DDT). Such wastes are called as non bio-degradable materials. Their constant accumulation especially in highly populated urban areas is proving to be a great health hazard and a biggest obstacle for clean living. This study is aimed to distinguish between the two types of materials.

Materials Required

Sample of waste materials available in the garden, kitchen, market, cowshed etc. a spring balance, a pair of hand gloves, two plastic bags, (10" × 6"), and nylon thread.

Procedure

1. Collect a handful of following samples from your nearby surrounding. Use a pair of gloves while handling the samples to prevent injury or infection. The samples could be vegetable matter, animal and fish remnants, bamboo pieces, card board pieces, straw, paper, leaves, pieces of glass, cow-dung, pieces of cloth, food leftovers, twigs, bark, thermoplastic wastes, fruit peelings, cigarette butts, pieces of plastic plates, rubber and plastic tubing, small pieces of ceramic pot, DDT powder etc.
2. Sort out small samples (5 g each) of waste from plant and animal sources. (for example vegetable matter, leaves, twigs, card board pieces, paper, cow-dung etc.).
3. Likewise sort out small samples (5 g each) of wastes materials from other than plant and animal source (for example, plastic caps, pieces of plastic tubes, polythene, glass nylon, metal can, ceramic pieces etc).
4. With the help of sharp knife cut all the samples into very small fragments and mix them thoroughly into separate heaps 'A' (of samples in step 2) and 'B' (of samples in step 3).
5. Mark the polythene bags 'A' and 'B' with water proof ink.
6. With the help of nail, pierce several small holes in each polythene bag. Fill the two samples 'A' and 'B' in their respective bags marked 'A' and 'B'. Tie their mouths firmly with nylon thread.
7. Using a spring balance, weigh each bag separately and note their initial masses.
8. Now bury the two sample bags in a shallow pit of appropriate size dug out in the corner of garden. Fill the pits with soil.
9. After three or four weeks, remove the bags from the pits, clean them thoroughly to remove any soil from the surface of the bags (Don't use water for cleaning.)
10. Keep the two bags in open sunlight to dry the bags.
11. Weigh the two bags again and find the difference between their initial and final masses.
12. Open the bags and transfer the contents separately on to two sheets of paper and observe the changes in the samples that

have occurred during the period of their burial in the pits. Record your observations in the following table.

	Initial mass	Final mass	Loss of mass
Sample A			
Sample B			

Observations

At the end of the study determine:

(i) which sample observes substantial loss?

(ii) Can various components in bags containing samples 'A' and 'B' be easily identified?

(iii) Has the colour or texture of the components of samples 'A' and 'B' changed?

Discussion

Sample 'A' contained waste materials of plant and animal origin. When buried they were subjected to decomposition by soil micro-organisms. The complex organic matter was decomposed into simpler compounds some of which leaked out through the pores into the soil. Some material was partially decomposed (like twigs, bark, petioles and veins) while the soft tissues of leaves and dead animals were completely decomposed. It is because of this reason a substantial loss of weight has occurred in sample 'A'. The weight of sample 'B' remains unchanged because no component in the sample could be decomposed by the micro-organisms. It therefore follows that all the different types of material in Bag 'A' were bio-degradable while in Bag 'B' the samples were non bio-degradable.

Project 2

Land Area and Leaf Area of a Plant

Aim

To establish relationship between 'land area' and total 'leaf area' of a plant.

Theory

Plants that we see around us are of different sizes and shapes. Some plants such as the garden ornamental herbs are very small and live for a few months only while others like coconut, mango, peepal, banyan etc. are large and also live for several years. Majority of the terrestrial plants, irrespective of their size, are erect and exhibit various types of branching. Each individual plant requires a minimum land area for its existence and this is dependent on the size of the plant and the dimension of its canopy. Within this land area it may allow a few smaller plants to grow but not any other plant of its dimension. This principle also applies to smaller plants like the herbs. Plants adapt to the land area that they have occupied to lead a normal life. However, these plants will have to maximize their leaf area in order to harness maximum sunlight for the process of photosynthesis. Through this project let us find out the leaf area of some plants and see its relationship with the land area of that plant.

Hypothesis

- The land area of a plant is smaller than its leaf area;
- Larger plants like trees require more land area that smaller plants like herbs;
- There is no relationship between the land area and leaf area of a plant.

Materials Required

A potted herbaceous plant with broad leaves such as *Petnia/Balsam/Hibiscus/Croton/Coleus/Flox/Salvia*) or any other locally available similar plant, thread, measuring scale, and a graph paper.

Procedure

1. Select an adult, flowering, ornamental herb from among the plants listed above and mark it as an experimental plant (tie a small piece of thread for identification).
2. Pluck one adult leaf of the plant and trace its outline on a graph sheet. Count the number of squares that lie within the margins in the area of the leaf lamina and calculate the area of leaf.
3. Count the number of leaves in the plant. Count even the smallest visible leaf and note the number in your book.
4. Calculate the total 'leaf area' of the plant by the formula.
5. Total leaf area = Area of one adult leaf × number of leaves in the plant (cm^2).
6. Measure the width of the plant at the broadest points. This can be done by measuring the distance (in cm) between the tips of two oppositely inserted adult leaves by holding them perpendicular to the stem (y_1).
7. Calculate the width at right angles to the orientation of the pair of leaves with which you took the first readings (y_2).
8. Calculate the land area that is, $y_1 \times y_2$ (cm^2).
9. Measure the height of experimental plant and record it in the tabular column.
10. Repeat the experiment with two more experimental plants of the same specie.
11. Calculate the ratio of land area to leaf area of all the plants studied and work out a relationship between these two parameters.

Observations

Feature	Plant 1	Plant 2	Plant 3
Number of leaves			
Area of one adult leaf (cm^2)			
Total 'leaf area' (cm^2)			
Height of the plant (cm)			
Number of branches in the plant			
'Land area' of the plant $y_1 \times y_2$ (cm^2)			
Ratio of land area to leaf area			

Discussion

Based on the values obtained, students will be able to establish relationship between the land area and leaf area of a plant. The ratio can be extrapolated to estimate the land area and leaf area of a tree in the vicinity.

Project 3

Rusting of Iron

Aim

To study rusting of iron and to identify the conditions for rusting.

Theory

The surface of iron when comes in contact with the moist air gets rusted. The rust so formed is hydrated iron (III) oxide ($Fe_2O_3.xH_2O$). Thus rusting is a process of oxidation of iron that takes place in presence of both air and moisture. In this project work we shall study the factors causing rusting of iron.

Materials Required

Anhydrous calcium chloride (2 g), oil, distilled water, fifteen iron nails, three test tubes, a measuring cylinder (50 mL), a beaker, three corks, burner, tripod stand, dropper, and a piece of sand paper.

Procedure

1. Take three test tubes and label them as tubes A, B, and C.
2. Take about 10 mL of distilled water in a tube A and about 15 mL boiled distilled water in tube B. Also pour a little amount of oil in tube B to make a layer on the boiled distilled water. In tube C place about 2 g of anhydrous calcium chloride. Place all the three tubes in a test tube stand.
3. Take a few iron nails and clean them by rubbing with a sand paper.
4. In tube A, dip two or three rust free clean iron nails in distilled water. Cork the test tube tightly.

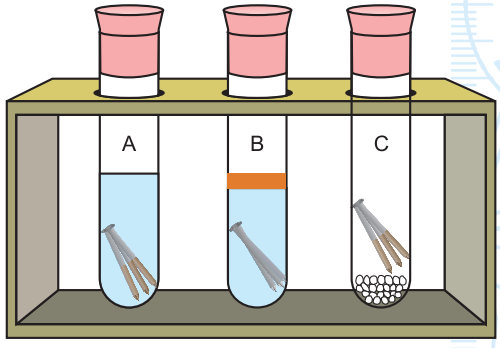

Fig. 3.1 : *(a) Iron nails dipped in water; (b) Iron nails dipped in boiled distilled water over which a layer of oil is present; and (c) Iron nails kept in dry*

5. In tube B, put a few rust free clean iron nails in boiled distilled water over which a layer of oil is present. Cork the test tube tightly.
6. In tube C, insert a few rust free iron nails in anhydrous calcium chloride. Tightly cork the tube to make it airtight.
7. Leave the set-up of three tubes for three or four days. Note and record your observations.

OBSERVATIONS

Sl. No.	Test Tube	Observation	Inference
1.	A		
2.	B		
3.	C		

RESULTS AND DISCUSSION

On the basis of observations infer that how distilled water produces rusting on iron nails; how oil treatment reduces rusting and how does it happen in the presence of anhydrous calcium chloride. Now suggest methods to avoid rusting of metals like iron. Also check and comment on the nature of rust.