PAC *(18-14)*

ORIENTING KRPs of NAVODAYA AND THAT OF ANDHRA PRADESH TO ENCOURAGE CHILDREN TO CARRY OUT RESEARCH BASED PROJECTS IN SCIENCE AT SECONDARY LEVEL

(2006-07)

Project Modules

(with report)

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[National Council of Educational Research and Training]

2006

Dr M N Bapat
Department of Physics

5th December 2006

Dear Friends,

I have immense pleasure in providing the preliminary write-up relating to encouraging children to carry out Research Based Projects at Secondary Level. A list of suggested projects and an approach in the form of 10 modules is given as guidelines.

The coordinator expects that you as Key Resource Persons would make impressive posters, create conducive environment and inspire children to interact with you that eventually would lead to encouraging them to undertake research based projects preferentially in groups and make their science learning more meaningful.

I would make it clear that the given list is not the only list and modules are not the only approaches. Many other approaches should be visualized and tried. Many other investigations need to be explored and tried for different projects.

Suggestions regarding improvement of this write up are most welcome. Suggestions will find place in the final write-up if found worth.

Wish you good luck!

(M N Bapat)

Coordinator

Foreword

Regional Institute of education Mysore in consultation with the officials of Government of Andhra Pradesh and authorities of Navodaya Vidyalaya Samiti decided that in the tune with NCF 2005 they would take such steps that might motivate and involve Secondary School students to undertake research based projects.

Accordingly PAC proposal for 2006-07 was sent to NCERT. Which was agreed to and the programme '*ORIENTING KRPs of NAVODAYA AND THAT OF ANDHRA PRADESH TO ENCOURAGE CHILDREN TO CARRY OUT RESEARCH BASED PROJECTS IN SCIENCE AT SECONDARY LEVEL*' was undertaken jointly by physics section, chemistry section, Botany section, Zoology section of Department of Education in Science and Mathematics and a few faculty drawn from Education Department of RIE Mysore.

It is a pleasure for me to acknowledge the overwhelming support received from every section and persons concerned. It was conducted in three phases. The reports of the activities are sequentially appended.

It is requested that the concerned may please go through it and make suggestions to make this and such reports more useful. All such comments would be gratefully acknowledged and taken deserved heed in planning in future activities.

I take this opportunity to express my heartfelt thanks to all those who were instrumental in giving right direction and guidance to me from time to time till the conclusion of this venture.

Mysore
Feb19,2007

M N Bapat
Coordinator

Contents

Academic report

Regional Institute of Education Mysore undertook this PAC programme of orienting KRP's of Navodaya and that of Andhra Pradesh to encourage children to carryout research based projects in Science at Secondary level under NCERT's laid down principles and policies of providing expertise in the field of education in view of states requirement for the academic year 2006-07.

Some Faculty members from DESM and Department of Education were identified for undertaking this. I have no hesitation in acknowledging their unwavering support to best of their capabilities.

The in-house meeting in this connection was conducted on 1st September 2006. It suggested names of the experts to be invited for the first activity and chalked out tentative plan for the programme.

First activity was conducted during 25.09.2006 to 27.09.2006 where seven resource persons were present in addition to seven internal resource persons. It discussed the theme paper. After 3-day exhaustive deliberation the mode and strategies were discussed and a list of feasible research based projects for secondary school level was finalized. Some more literature was procured/written along with a poster material to motivate pupils at school level.

The written material and modules – the approach to research based projects, were sent to all resource persons who had participated in first activity and all those who had given their willingness to participate in the II activity. This material was also given to all science internal faculty for their comments.

II activity, the orientation of KRP's was undertaken during 5th to 8th December 2006. The list of 23 participants, (12 from state schools and

11 from Navodaya schools) and 13 resource persons (6 external and 7 internal) is given in the report of II activity. What really happened is given in the rescheduled timetable. 6 electronic posters were made and distributed to selected schools. After discussion on the poster material, poster contents were finalized. Some additional modules and activities were prepared as a follow-up on receiving the feedback. This also includes information on tissue culture downloaded from Internet.

III activity was taken during 12th Feb. to 16th Feb. 2007. Three faculty members from RIE visited a Navodaya and 4 states' schools from Andhra Pradesh. The faculty interacted with students of the schools and science teacher. They also provided the information sought for. A questionnaire for students, teachers and principals was got filled. This was analysed and commented for future action.

A few copies of this final report will be sent to NCERT HQ, New Delhi, Education Department of Andhra Pradesh and authorities of Navodaya Samiti, in addition to usual distribution to local units.

The coordinator sincerely seeks constructive feedback in all areas of the write-up so that maximum cross section of the science teaching community would be able to help in encouraging the children with whom they interact to become nation's future proud scientists.

Coordinator	*M N Bapat,*
Members of the team	*P R Lalitha*
	M S Shrimathi
	G V Gopal
	S P Kulkarni
	V D Bhat
	C Janghaiah
	P Tamil Selvan

ORIENTING KRPs OF NAVODAYA AND THAT OF ANDHRA PRADESH FOR ENCOURAGING CHILDREN TO UNDERTAKE RESEARCH BASED PROJECTS

II Activity (5 – 8 December 2006)

Days/Time	9 – 10	10- 11.15	11.30 – 1.00	2.00 – 3.15	3.30 – 4.30	4.30 – 5.30
Tuesday 5.12.2006	Registration	Programme aspects and General Interaction	Why research? **VDB + CJ**	Presentation **Yoganand**	Research in Biology **GVG+SPK**	KRP + Experts' inter-action
Wednesday 6.12.2006	Feedback (2 KRPs) **Phys Sci**	Presentation **MNB+ PRL**	Presentation **Dr. Srinivas Murthy**	Discussion on Poster	Presentation **Dr N B Ramchandra**	-do-
Thursday 7.12.2006	Feedback 2 KRPs) **Bio Sci**	Presentation **Prof. Subramaniam**	Presentation **Lavali Devi + M S S**	Discussion **Prof. Sivamoorthy**	Presentation **P Tamilselvan**	CAD Demo **Sivashankar**
Friday 8.12.2006	Visit to Science Park	Presentation **P R Rao**	Presentation **N Ahilya**	How KRPs propose to further the activity	Valedictory	

Note:
All the **external resource persons** are requested to involve in-group discussion/ interaction with KRPs as per their convenience.
Experts and RIEM faculty would suggest how science at secondary level could be seen through an integrated approach.
Invited RIEM faculty may please help subject coordinators in presentation/ discussion.
All experts are requested to give at least **2-page** write up.
Save for exigencies, timetable will be adhered to.

Coordinator

Encourage pupils to carry out Research Based Projects in Science at Secondary level

THEME PAPER
(Contribution from M N Bapat, N R Nagaraja Rao and M S Shrimathi)

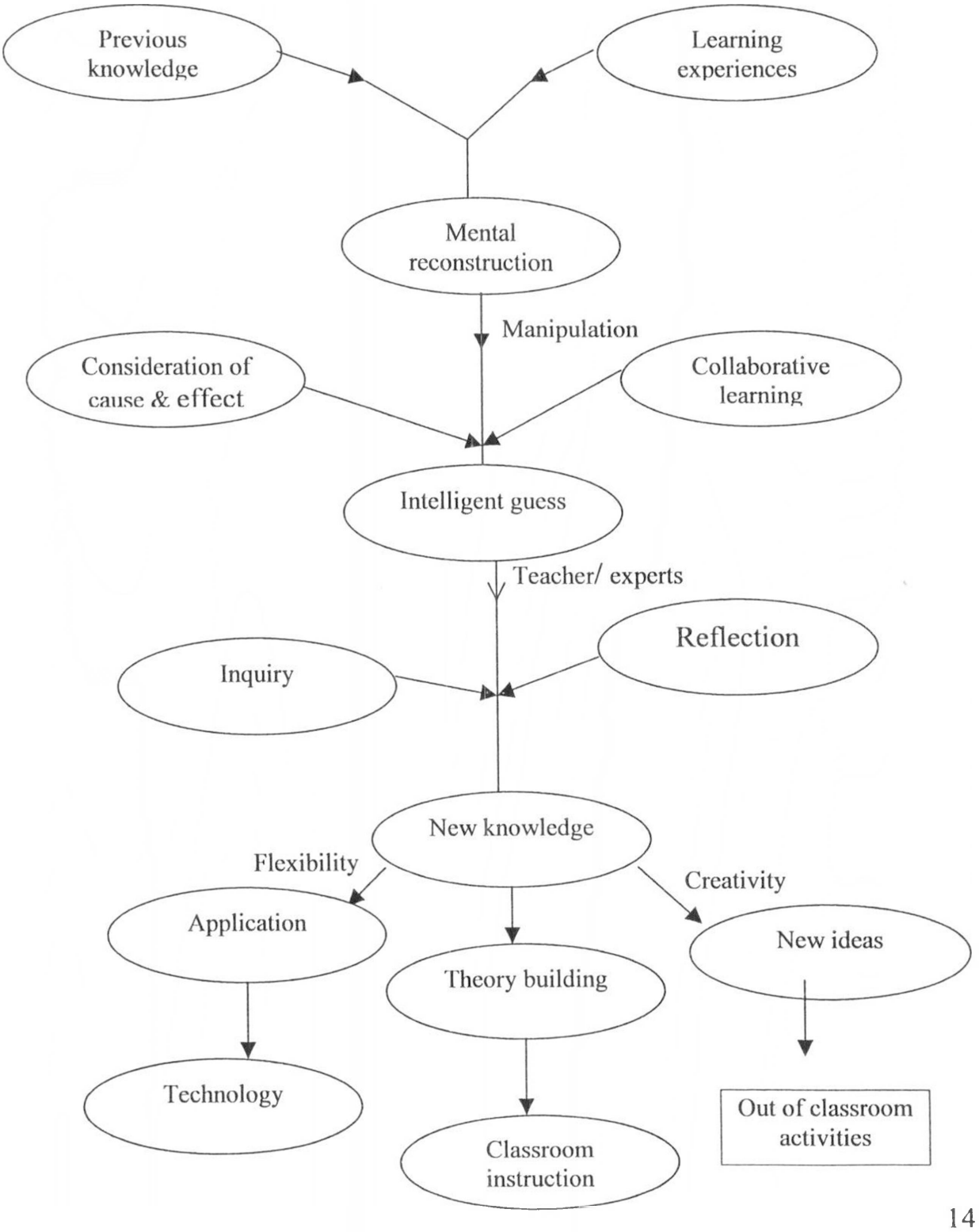
Meaningful learning can be envisaged in hundreds of ways. The essential feature of these is to help pupil understand by

1. culling out links with the learner's real life experiences.
2. insuring that the learner remains motivated even after a few failures.
3. directing / designing learning experiences that encourages self-learning.
4. providing open ended situations to facilitate critical/lateral thinking
5. exposing and allowing pupils to use and seek different sources of knowledge.
6. allowing pupils to enjoy the thrill of hands on experiences.
7. infusing scientific temper
8. providing opportunities to apply their experiences and integrate them in new form.
9. projecting significance of systematized approach to problem solving.
10. furnishing platform to interact with experts, etc.

One such method where learning enhancement has been noticed is promoting an environment wherein children volunteer to take up research based projects in some amenable science area – do research reporting – bring in suggestions and problems – feel satisfied to have contributed something worth by handling the research based project.

Background

NCF 2005 envisages prospective learners to construct their own knowledge by connecting new ideas to existing ideas on the basis of activities/ materials presented to them. The flow chart can be



Essentially, thus the objective is to develop capabilities, practices and skills of understanding through schooling. If such a component is missing in their environment, opportunities need to be created for project activities with interwoven interdisciplinary approach. Such knowledge generation activities would greatly enhance the quality of educational experience (if given its intrinsic variability). It may not be out of place to quote Confucius "Learning without thinking is fruitless. Thinking without learning is dangerous."

Tentative stages of a research project

1. Selection

The learner due to the felt need of solving some daily life problems selects the project. Due to his intelligent guess or thinking the learner identifies the area of science in which works is to be carried out to arrive at a solution for the problem. He translates the problem in terms of scientific vocabulary and terms. This enables one to discriminate between what is known and what is unknown. "Clarity in the statement of the problem is half accomplishment of the solution".

2. Planning

Once the problem is identified the learner decides whether he can carry out the project on his own or needs to form his own group of classmates who would join hands to carry out the project. At this stage, it is better to take guidance from the teacher and decide the size of the group. It should neither be too small nor too large. A like-minded group of 3 to 4 is usually ideal. Once this is settled, the group sits and plans the mode of carrying out the project under the guidance of teacher.

3. Designing and Conducting

The required data/apparatus is to be decided and procured. The project problem is to be broken down into time bound subtasks to be completed in a definite time. Either one member or all the members take up work on each sub-task. This depends on the nature of the project. This being the heart of the whole project, lot of patience, concentration, flexibility and devotion to the task taken has to be contributed by each member. This is an important milestone towards the success of the project.

4. Recording and Reporting

The observations are to be made with equipment of reliable precision, repeated to establish their validity and recorded in a systematic manner. The number and nature of observations vary from project to project. It is important to keep external parameters affecting a given measurement same throughout the experiment. Each member of the group should be equally sincere and do his best to arrive at the result.

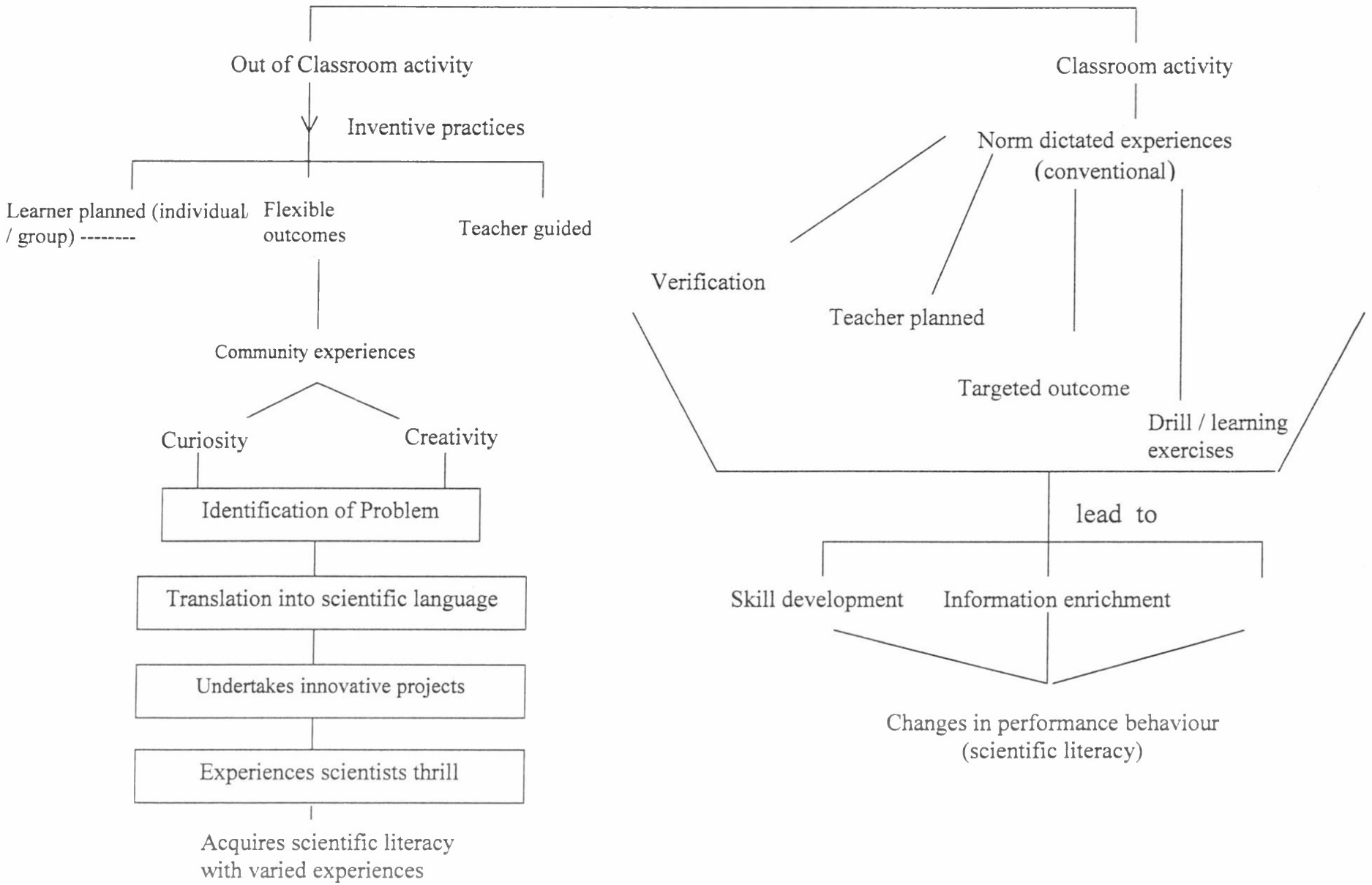
The final reporting of observations is done both in tabular and pictorial form (if possible). The conclusions are arrived at based on the interpretation of readings, graphs, etc. in the case of indecision the facts need to be displayed logically. All findings should be organized into a small number of meaningful groupings of the ideas and interpretation should be left to the reader.

5. Validating and inferring

The whole project can be repeated at different times keeping external parameters same. The results obtained are to be checked for consistency among themselves, with common sense and daily life experiences. Otherwise suitable changes may be effected at appropriate stages of the project. The teacher/ experts' help should be sought in the form of hints. Ultimately, the project should be carried on to completion successfully to arrive at the solution.

STUDENT LEARNING (reflection upon pupils learning)

INVENTIVEPRACTICES



Evaluation

On successful completion of the research project evaluation can be done by appropriate agency giving due weightage for

i) selecting a realistic achievable project

ii) the meticulous planning, sincerity in carrying out the project with simple experimental set up,

iii) the duration over which the learner/s achieved the task

iv) the reliability in validating, the systematic way of reporting and

v) the way in which the results were interpreted to arrive at the solution.

The criterion for evaluation however need not be the same for all type of projects; it is characteristic of the project itself.

References

S S Raghavan, Staff and Educational Development International (2005), 87 – 91.

NCF 2000, NCERT New Delhi

NCF 2005, NCERT, New Delhi.

Lalit Kishore, IAPT Bulletin 2006, p360 recalls importance of cognitive development practices, which have become an important area of linking of science instructions with students' cognitive development. He mentions Goods insistence that the teacher must have an understanding of the general cognitive characteristics and range of abilities of the children. He also makes a mention of Points et. al. who advocated that the children learn best by trying out their ideas in the practical solution of the real problem.

J C Pearce 'to be creative one must lose fear of being wrong'

A P J Abdul Kalam as quoted by Reader's Digest Feb 2007 'Thinking should become our capital asset'.

R G Taylor says that even simple by products of up coming technology cannot replace nature's intricate system. Those also cannot replace bare necessities of living a life.

Feynman lectures indicate that the difficulties of Science to a large extent are all the artificialities which are invented by man , not by nature.

REPORT OF FIRST ACTIVITY

Orienting KRPs of Navodaya and that of Andhra Pradesh to encourage children to carry out Research Based Projects in Science at Secondary Level

As per decision taken in preliminary meeting of the internal faculty of RIEM on 1.9.2006, the first activity for the above stated PAC program for 2006-07 was undertaken from 25.9.2006 to 27.9.2006.

Out of the nine invited external resource persons, following 7 could make it and actively participated in deliberations and planning of second activity to be held in December 2006.

1. Prof S Sivaraman, Chennai
2. Prof S V Subramaniam, Bangalore
3. Prof Sivamurthy, Manasagangotri
4. Prof P R Rao, Mysore
5. Dr K B Yoganand, Bangalore
6. Dr B S Lavalidevi,Mysore
7. Dr K C Srinivasamurthy, Bangalore

Following RIEM faculty cooperated in identifying areas of research, assisting external resource persons, finding and analyzing feasibility of different approaches suggested and finalizing the first activity discussion document.

1. Dr M N Bapat
2. Prof P R Lalitha
3. Sri N R Nagaraja Rao
4. Dr M S Srimathi
5. Sri P Tamil Selvan
6. Dr G V Gopal
7. Prof V D Bhat

The coordinator of the programme Dr.Bapat welcomed the eminent persons, exhorted to scrutinize the theme paper prepared for 3-day programme. He suggested that NCF 2005 need to be taken with due seriousness by the teacher-educators and all those who have concern for science education at large. He redefined the term research in the context of secondary school students. Prof. Bhat indicated that unless teacher motivates his/her student to inquire and search for answers themselves, our intention to involve pupils to undertake research-based projects might not lead to targeted objectives. Prof. Sivaraman made it clear that one needs to remember that teacher is the permanent facilitator in envisaged activity while the students are like flowing stream. Teacher should strive to see that batches after batches of students involve, participate and enjoy in doing something that would provide thrill and experience of discovering for themselves, which is new addition to their knowledge. Prof. Subramaniam

welcomed vision of such activity and stressed the need on national basis for encouraging students to undertake research-based projects.

Each of the participants/resource persons expressed their view on whats? and How's of the research based projects.

From afternoon session on 25.9.2006 to till last session of 27.9.2006 each group separately and collectively discussed the approach/ modus operandi / format and different areas wherein research based activity could be undertaken.

Following are the excerpts of the first activity.

1. Though different topics were being suggested the KRPs of the II activity need to be told that the research based projects have to be of science and not compartmentalized as physics, chemistry or biology.
2. The exemplary module to be prepared for II activity where KRPs would participate must bear integrated approach.
3. Instead of drafting 50 projects list each from physics, chemistry and biology it can be a composite list of over 100 suggestive projects.
4. 10 modules may be prepared as exemplary ones. As far as possible, different modes of conducting them can be suggested.
5. RPs at II activity may explore and discuss ***research-based projects*** other than enlisted.
6. Asking several questions about matter and local environment of the pupil, one must arrive at research topic.
7. Evaluation of the project must be done in order to show that teacher is serious and has concern for pupils' activity. His/her actions should

suggest that he/she is willing to do whatever is needed to encourage the pupils and see that this activity becomes an ongoing activity. If possible, such pupils can be given proper recognition.

8. HMs through KRPs may be requested to keep an hour per week free in school timetable in which pupil-teacher can have useful discussion on science themes.
9. Research based project should be time bound and in some cases a group may attempt only part of a problem per session.
10. As far as possible whole class may be divided into several groups (each group may comprise students of different ability). All the groups are given problems from the same broad area. When data gathered by such project areas are pooled, an inference worth noticing may be expected.

Each group of the preparatory workshop has provided a set of module for exemplar projects and a list of research based projects, a suggestive source for KRPs. In general, the principle is asking questions like what? When? Where? Why? How?, etc. on any manifestation of nature, scientific devices, procedures, science processes lead to formulation of a new project topic.

The internal faculty was asked to consolidate the list of suggestive research based projects and write about 10 modules providing varied insight and methodology for conducting those by pupils of the schools. This essentially is expected to pave the way for designing suitable approach at their end.

In this presentation, the list of suggestive experiments is followed by exemplar approach for research-based projects that can be undertaken at secondary level in science. It may be noted that the exemplar approaches suggested are not sacrosanct. Investigators as per facility and feasibility can adapt an appropriate methodology for their investigation. Further, the list cannot be finite. The teacher and students are encouraged to take up projects that they themselves conceive, design and accomplish.

Following is suggestive mode of approach that a group of investigators may follow in order to carry out a *research-based project*. It may be noted here that the activities need not incorporate all the components of a full flagged research. Instead it could touch upon few aspects wherein prowess of pupils is effectively made use of. The tentative structure can base on themes like:

1. Projects that would generate information (not known beforehand to the pupil).
2. Conduct of an experiment and tabulate data.
3. Make a survey with specific objective and gather data.
4. Use data available with various agencies (even from library, data book, encyclopaedia) and device different activities like

Animation	disk game	crossword	quiz	braino	antakshari
herbarium					

5. Observe a particular manifestation of nature and express it in proper sequence.

6. Interact with expert in an area of interest and consolidate the experiences.
7. Identify hardspot from the content area. Look the content development for that from 10 or more different books and analyse.
8. Browse the Internet for a given topic and record how many different methods have been attempted to attack the problem.
9. Do modeling for feasible structures. (Scientists use model as simplified way of looking at a complex system to give physical insight into its physical properties).
10. Try to notice ***cause and effect*** relationships in nature about your surroundings.
11. Notice a result on a physical quantity and ask questions. Why? How? When? Where? What? Etc.
12. Follow a worksheet.
13. Find relationships between different variants in a given phenomenon.
14. Dramatise an event.
15. Take a task of analyzing a question.

Each of the exemplars can follow any of the different approaches available. It is upto teacher/ guide to mould a given problem in view of various factors that otherwise hinder progress of any venture and its follow up. All projects, however, cannot be done in all modes equally effectively; hence the persons involved must give a serious thought before adapting a particular strategy to minimize chances of frustration.

FOLLOW-UP ACTIVITIES

The list of research-based project was prepared which reads as follows. Note it is only suggestive one. One needs to prepare as per one's preferences , possibilities of their handling, local specific requirements and availability of materials around the school.

1. Observe the moon.

   Observe the moon at the same time of the day, each day for a month and record as under: Time of observation.....

Day	Size and shape of moon	Elevation from Earth
1.		
2.		
3.		
...		
...		
...		

   Hence provoke questions like what if I observe moon at different times of the day? What is relation with time of observation and brightness ? What is cycle of moon's appearance? Etc.

2. Electrification of bodies

   Collect several bodies around you. Electrify them by rubbing, taking different combination. Quantify and identify charge on them using hanging pithball/ thermocol ball / polythene or cellophane strip.

   General questions like – what would be the ideal shape of bodies for undertaking such experimentation? How does electrification depend on rubbing time? When only does electrification occur (conditions)? Enlist other substances that can replace glass/ ebonite rod, etc.?

3. Drop small spherical balls (use different material balls) and estimate terminal velocities in different liquids. Ask questions on properties of liquid and ball material. Investigate effect of temperature.
4. Make a survey of deaths in your town and its cause over a period of time. Tabulate findings. Provide inference and suggestions.
5. Study of transmission of heat - into a vessel and out from the vessel. What are different parameters that can be identified in these studies? How are practical problems tackled?

6. How does a loading affect the frequency of vibrating body? Investigate size, mass and location of loading on the vibrating body. Search for their practical application.
7. Substitution is best method of measurement. How can it be used in different situations?
8. Explore our town/village lake.
9. Do Water Budgeting in your locality.
10. How much water do we consume?
11. How much water do we receive through rain (water gauge)?
12. Survey water resources in your locality.
13. List out disease-causing insects and classify.
14. Create a weather chart.
15. I care my tree! How?
    Study tree morphology, its growth, its health, and its need? Does it respond to affection? When will it die? Who tortures it?
16. Study plant diversity in our town.
17. Classify flowering and non-flowering plant in our town.
18. Study roots of different plants.

19. Study .....of affection of plants to different creatures.
20. Make acugraphs.
21. Study seed sprouting time. Identify most favourable and most unfavourable conditions.
22. List out plants used in house hold medicinal treatment – what portion of it is most suitable?
23. Find uses of plants found in our locality.
24. How can I be helpful in waste management of my town?
25. How would I save energy most?
26. Study life cycle of an insect.
27. Let me observe soil of my town! (Physical character, pH, biological character, water holding capacity, porosity, erosion, air in soil, fertility.
28. Study of pollination mechanism).
29. How should I dispose off rotten or remains of fruits and seeds?
30. Study of biodiversity (in your town or through encyclopaedia).
31. Study of colour of flowers.
32. Classify fruits.
33. Study leaf shapes.
34. Investigate into process of fermentation.
35. Study of saps from plants.
36. Birds of my town.
37. How do we collect honey?
38. How to make coconut tree friendlier?
39. Immature killing of banana tree. Role of superstitions/ God adoration.
40. Determination of age of the tree.
41. Let me see flowers and leaves through magnifier!

42. Measure wind speed at different altitudes – investigate effect of surrounding structures and vegetation.
43. Estimation of breaking stress of different natural fibers.
44. Observations on natural fibers.
45. Absorption of heat by variety of clothes.
46. Effect of impurity on melting of ice.
47. Survey food habits of people living in different localities.
48. Time of boiling milk as a function of water quantity in it.
49. Study the structure of my school building.
50. Study the minimum time interval between two flashes in camera after successive discharges. Hence investigate intermittently the condition of the battery used in it.

51. Motion of different shaped objects (of the same material) through liquids.
52. Observations on a slinky.
53. Study of frictional force.
54. Study of liquid pressure at a point due to liquid filled in containers of different shapes.
55. Making of a lactometer / liquid density meter using plastic balls.
56. Investigation of quantity of liquid flow on constricting rubber tube.
57. Effect of bending the delivery tube on the quantity of flow of water.
58. Verify $\angle i = \angle r$ using sun rays and slits.
59. Lens can become opaque! Investigate conditions.
60. Survey people with vision defect – classification and categorization.
61. Genetic findings on ear defect.
62. How to measure energy stored in a cell?

63. Hygrometric studies.
64. Search for Bernoulli's theorem in nature's manifestations.
65. Simple investigations on surface tension.
66. To find optimum quantity and efficiency of lubricant to be used between axle and wheel or other moving parts over stationary ones.
67. Do non-metallic threads produce sound by vibrations?
68. Investigate LDR and photo diode response to different colours.
69. Measure large distances by parallax method.
70. Find current voltage relationship for a wire maintained at different temperatures.
71. Understanding data provided on an electrical gadget.
72. Making scales and different devices of length measurement of arbitrary magnitude.
73. Comparison between rolling and sliding friction.
74. Estimate molecular size.

75. Making a hydraulic press, simulation.
76. Estimation of force needed to rotate a body using sticks (levers) of different lengths.
77. Observing thermal expansion of liquids converting it into usable forces.
78. Survey cleaning capacity of different soaps and detergents.
79. Observe rate of cooling of a liquid of given quantity on covering it with a lid of different colours and nature.
80. Playing with springs – parallel and series combination.

81. Make cylinders of different materials roll on an inclined plane. Estimate frictional opposing force to rolling by measuring distance travelled. Try this with surfaces of different curvatures.
82. Device a method to determine content of copper in brass. How will you verify your result? Hint: Find relative density of brass.
83. Observe leaves of same plant in different locations of the city to study presence of suspended particles in air.
84. Estimate amount of dissolved air in different samples of water.
85. Collect rainwater at different times in rainy season. Compare their acidity.
86. Find out components in potable water.
87. Determine purity of chilly /turmeric/ tea /honey/ other food items.
88. Determine carbon content of different oils.
89. Classify various food materials into solutions, suspensions and colloids.
90. Study Tyndall effect in colloids used as food.
91. Study colloidal properties in different food samples e.g. milk, jam, jelly, gum, etc.
92. Chemical etymology.
93. Survey soil of different location to find how society is doing damage to it.
94. Talk to grandparents for household / nature cure known to them and compile the information from common responses.
95. Find fat content in different food items.
96. Make herbarium of medicinal plants from your locality.
97. Device methods to remove contaminants from food items.
98. Prepare natural pH indicators.

99. Make chemical models using plaster of Paris.
100. Undertake a project to know method of sugar/ jaggery preparation.
101. List down exothermic and endothermic reactions taking place around you.
102. Examine friction, growth of a plant, and digestion in respect exothermic and endothermic reactions processes.
103. Identify catalyst in your daily life.
104. List out hygroscopic substances around you and estimate their relative affinity for water.
105. Make a survey of different soaps and their effectiveness in cleansing action.
106. Make a survey of events where you notice interconversion of different forms of energy. Hence list the names of transducers.
107. Determine efficiency of different fuels.
108. Determine calorific value of foods.
109. Observe different processes around you like filtration, pasteurization of milk, fermentation, etc.
110. Collect plant saps and find their properties like, colour, density, % of water content, medicinal value.
111. Study acids and bases used in your kitchen. Try to find out their composition and reactivity.
112. What are biomolecules? Trace their composition and function.
113. Determine foaming capacity of soaps. Is it related to cleansing power? Investigate.
114. Study efficiency of paints, oils, Zn / Sn coat, grease for their preventive action for corrosion.
115. Analyse fruit and vegetable juices.

116. Effect of impurities on boiling points of liquids.
117. Show effect of heat on contained air.
118. To find the trace amount of metal ions in water samples using Daniel cell. Propose any other method known.
119. To compare electrode potentials of different metals using electrochemical cell.
120. How to identify composition of an alloy?
121. Make a *crossword* for elements / science terms/ scientist names.
122. Make electrical braino (brain game using electrical connection to find right answers given among many).
123. Make a fill in the blank electrical circuit (blank is pair of terminals between which an electrical component like resistor / capacitor / inductor can be connected) to enumerate condition for lighting a lamp.
124. Determine stoichiometry of chemical reaction.
125. Separate out transition elements from periodic table and list down coloured compound available from them.
126. Observe volatility of different liquids.
127. Nature oriented research projects like – investigations on banana stem – threads and making paper from it.
128. Idea of valency through models.
129. Find hardness of water.
130. Angular diameter of full moon by a coin.
131. Concretise ideas through moulds.

132. Listing out difficulties in making working models.
133. Listing out paradoxes with comments.
134. Listing out superstitions with comments.

135. Listing out phrases from literature that involve development of science.
136. Listing out various scientific devices and their use.
137. Objectivity in science.
138. Making a health indicator.
139. Growing and nurturing a medicinal plant garden.
140. Studying life cycle of an insect.
141. Studying 'Pollination' mechanism.
142. Studying dispersal of fruits and seeds – the nature's way.
143. Germination of seeds.
144. Study of bio-diversity.
145. Physiology experiment.
146. Soil erosion.
147. Life cycle of a farmer.
148. Working of a nearby industry.
149. Science magazines in vogue and type of content in them.
150. Railways and its dimensions.
151. Autobiography of an automobile (car/scooter/airplane).
152. Case study of a device (scientist / invention)
153. Crystallisation of Benzoic acid or salicyclic acid from solutions using different solvents such as water/ ethanol/ ether/ acetone.
154. Effect of changing variants on crystalisation e.g. cooling rate/ high temperature treatment/ ice-cold condition.
155. Colloids preparation / study coagulation, filterability, Brownian moment in colloids.
156. Concept of solubility – solubility in different solvents.
157. Conditions of combustion.

158. The history of science is replete with examples of serendipity. Make a search.
159. Standards and measurements essential to chemistry.
160. Everyday uses of acids and bases.
161. Identify the different oxidation – reduction reactions in your daily life.
162. Renewable and non-renewable sources of energy.
163. Types of plastics that can be recycled.
164. Types and functions of food additives.
165. General composition, properties and methods of production of glass, ceramics and cement.
166. Benefits and harmfulness of sunlight.
167. Kinds of industry-related air pollution.
168. Sources of indoor air pollution.
169. Sources of indoor water pollution.
170. Sustainable agriculture
171. Dependence of modern agriculture on insecticides and herbicides.
172. Factors affecting the productivity of soil.
173. Organic farming
174. The interdependency of the various branches of science.
175. + many more as under suggested activities and other projects

Note:
Problems have been stated in a variety of ways. These are essentially

1. Leisure activities on curriculum/daily life;
2. Activities with pleasure and purpose;
3. New and delightful to pupils.

***

A teacher must be creative to get pupil think and create

Why activities?

(The Objectives)

A curriculum is aimed at to equip pupils with envisaged information in which mostly they are relatively passive.

The questions that may bother us with such a course of study are

1. Does the course succeed in tapping students' energies properly?
2. Would students find course interesting and become involved in the study?
3. Does the course provide chance for student satisfaction and enable them to take initiatives for themselves?
4. Is the course only meant for academic achievements?
5. Will it answer questions like – "What does it mean?" "What would happen if…" etc?
6. Would students be able to generalize from what they have learnt ?
7. Do we send our pupils out delighted with understanding of science?

Whereas a wide range of activities incorporated in a course is likely to lead to achievement* of

1. pupil with scope to 'transfer of training' in some skill to other situations.

(*These have influence of age, abilities, and family/ parental encouragement for hobby projects, study trips on the part of student. But it depends also on teachers' abilities, teachers' attitude, his understanding and communicability, his enthusiasm to take spirit of inquiry out of the class etc. And in no way least important is it acts as a two-way bridge between school and community)

2. supply of rich ideas – providing frame of reference for invention and communication ability to think of alternatives and improvements/ creative skills
3. scope of divergence of thought / critical thinking
4. sense of responsibility / doing science
5. planning / flexibility of approach / organization
   ability to accept feelings and use of others' ideas
6. imagination and manipulative skill
7. desire to apply knowledge / scientific spirit

as everyday activities in which students are active mentally and sensitive emotionally, practicing skills and experiencing the results on doing. Further there is more chance of a two-way communication; it may also generate incidental learning. We may remember Ruth Beard's comment 'Where the purpose is to teach skills, students must be given opportunity to exercise them'.

Depending on the extent to which pupil associates feelings of enjoyment, interest, and inspiration with his studies, far reaching transfer of skills occur. The more he enjoys his science, the more he likes discussing its philosophy, the more he is likely to retain and generalize the teaching.

Tree of understanding as proposed by Bradfield and Moredock highlights this importance:

Creating / discovering / restructuring/ inquiry / new insight

↑

Explaining / justifying / estimating/ inferring

↑

Relating / discriminating / illustrating

↑

Recognising / recalling / classifying

↑

Duplicating / imitating

Scientific tempers in pupils enable them to grow vertically as learning happens.

What are scientific methods?

These are the ways in which a scientist gathers knowledge and builds an increasing sense of its validity.

Research

According to dictionary, it is a careful systematic investigation towards increasing the ***sum of knowledge***. From this one can ask a question to oneself and try to find its solution scientifically on the basis of empirical evidence. Other definitions are

- It is an attempt to collect unbiased information about a phenomenon

- It is active involvement in solving of the problem thwe answer to which the researcher does not know
- It is that activity which involves the processes of science

Developmental Project

It is a purposeful activity designed for achieving some tangible objective.

Action Research

It is investigator's own designed flexible, in situ process that tries to attempt a problem in order to guide, correct and evaluate remedial action. This is a continuous process, which includes trying out a line of approach – modify- change if warranted and record the results.

Researchable Problems

Any problem that arises out of some doubt, unconvincing answers, difficulty, non-feasibility of idea / thought / action, validity of solutions, testing hypothesis under different conditions, verifying results under different environment, simplifying processes at hand, implementing new techniques, etc. form a research problem.

Let us examine the statement 'nature is in a conspiracy to thwart man by introducing some new phenomenon to undo every phenomenon that he thought it would permit to find ...'. Out of such frustration also Poincare' could suggest that *a complete conspiracy is itself a law of nature.*

Teachers' job

The highest level of understanding is enabling pupils to give original and productive thinking. When pupils' understanding attains this level, he can make discoveries*. He acquires capabilities of restructuring/ reorganising his knowledge, having new insights, in formulating new problems. The supreme art of teacher is to awaken joy in creative expression and knowledge in pupils. To optimise it, one of the approach that teacher can envisage is involving pupils in research based projects.

A big list of feasible projects can be given. Many agencies provide ready-made projects to be spoon-fed. All these cannot substitute originality. Creativity, interest and involvement lacks in them. Teacher as a guide / facilitator / pathfinder can however contribute positively in identifying an appropriate and satisfying project based on local specific issues. "Display posters" may help identify these. Such projects may be well received by community and see cooperation and deserved interaction.

Teacher may ensure that science teaching entails concrete experience, clear concepts and least verbalism. On analysing, response to display questions (some representative questions are given below), teacher can assign a topic for research based project. The questions may, however, be chosen, modified or cast to suit best in given school situation.

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* *More inclusive definition of creativity allows for inventions that are unique to the individual, though not new to mankind. This view is more useful for teachers trying to develop creative abilities.*

Tentative Poster Material

(Kindly display such kind of poster that may encourage children to take-up a project)

Topic Identification: Local Specific

1. What about 'nature' interests you most?
2. Were you ever interested to know more about any of the *natures'* wonders? Describe.
3. At any time did you wonder why 'nature' behaved peculiarly?
4. What aspect of 'nature' you think had strong impact on you?
5. Have you at any time felt that you need to know how 'nature' works?
6. Have you ever felt that answer provided to a query about the happening around you was unsatisfactory? Describe.
7. Has any event made you curious? What was that?
8. Was there any observation against your expectation? Describe.

Topic Identification: Subject Specific

9. Have you ever come across any explanation/ description in book or by teacher improper/inadequate? Describe.
10. What question has bothered you for quite some time? (Students are advised to make a diary to note down unusual happenings they witness).

Topic Identification: Technology Specific

11. Has any device made you curious? What is that?
12. Were you ever curious to know 'How it works?'
13. Have you ever felt to suggest alteration / moderation / modification to a device?

Capacity to Work

14. What kind of exploration you would like to undertake?
15. In what area of skill, you believe you can do better than others?
16. In what area, you can render help to others and in which area you would like to seek help from others?

Interaction

17. How do you think you can contribute to the growth of science?
18. Do you possess any idea that needs serious consideration? What is that?
19. Do you think an expert on some argument should hear you?
20. How do you propose to communicate with others? (Interview / questionnaire/ Mediator)

Students please remember: When you undertake a project – welcome suggestions and criticisms. Do not derive big conclusions (why?), work in-group, and keep interacting with team members and the Guide.

It is advisable to base project problem on

1. material available in plenty around the school
2. felt need
3. themes for which solution is feasible within competence and experimentation easy.
4. not of verification kind as far as possible
5. specific, clear and possible to carry out under natural conditions.
6. concepts useful for schools (not a decorative one)
7. whys in content area.

Delimitation of Problem

Once the investigator group identifies a problem, he /she must specify it further to make it more pinpoint, mentioning variables to be kept constant, the independent one's and dependent ones, etc. It mentions description of 'sample', tools to be used, procedure and its scope.

Making a research statement

Upon selection of a problem, the problem is transformed into a proposition or hypothesis, which is assumed to formulate solution to the problem. It should be restated in simple terms so that it can be tested in tangible way.

Designing the experiment

The hypothesis, delimitation and prevailing conditions, enables an investigator to chalk down the procedure and design the experiment for

collection of data under carefully controlled conditions. The ultimate objective is to test the hypothesis in order to arrive at a solution to a problem. Hypothesis also tells what kind of data is anticipated. Hence defines how experiment should be designed for its effective use.

Plan of Action

To conduct/design an experiment to solve the problem, investigator needs to pronounce steps, identify tools, suggest modifications in existing tools (if needed).

Think of deterrents to innovations

Lack of money-time-freedom to experiment is a few constraints among many others. Planners should foresee these and take proper notice. In unforeseen situations, remedy must find a place in the plan of action.

Setting Experiments

Classify research-based projects under:

Open-ended experiment – without guidelines,
Open-ended experiments with guidelines

and follow the strategy accordingly.

Learn to see Science as a whole

Science should appear to our pupils as fabric of knowledge interwoven intelligently with pieces that they learn and react during their course of study to build a comprehensive net. The factual contents must be the connecting tags. Hence ultimate objective is to effectively develop explanations to describe natural phenomena to the best of one's ability.

Experience in analyzing the result of an experiment must be provided so as to develop

1. the ability to see relationships
2. to organize the data so that meaningful pattern emerges
3. to draw inferences
4. to visualize the ways to improve the experiment.

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Resources

1. Visweshwaraiah Museum, Bangalore.
2. Tarang, Scientific Instruments, Dharwad.
3. Museums / zoos/ botanical gardens
4. Science centres / science parks/ Science City
5. Internet
6. Libraries / activity books/ project books
7. Forest / hills / riverside / ponds
8. Nature / devices
9. Curricular content

Module 1

Mode - Building an Apparatus

Topic: Water Gauge

Process Involved: Making a device, skill of correct disposition, measurement and calculation.

Objectives: Pupils will be able to conceive a design of set up, choose appropriate materials, make set up and use it.

Minimum Learning Outcomes: An effort to make device and test its worth.

Background:

Rains are not uniform and same over different parts of the country. Its quantum enables one to plan for harvesting, use and plan timely. Further, it is the ultimate and important source of sustenance (survival) all living beings.

Activities:

Group A: Searching of appropriate material, construction of water gauge, fixing and testing for leakage and usability.

Group B: Installation at various locations, monitoring its safety.

Group C: Periodic measurements

All group together analyse data to draw inferences.

Evaluation Questions

1. If rains in the locality were scarce, what would be the shape of water gauge?
2. Funnel is an ideal collector of rainwater. What are its advantages?

3. How would you calibrate the store bottle?
4. Why should you avoid leaking?
5. On what basis frequency of recording must be decided?
6. If you place 10 water gauges in your locality, each giving different measurement, how would you interpret? What kind of analysis would you suggest then?
7. What kind of instruction you would give to people residing nearby the rain gauge?

Further Suggested Activities

Make collector funnel of different shapes and estimate their areas with respect to a standard one through which water collected in store bottle. Do they agree? Construct collector of irregular shape and estimate its area from the quantity of water collected.

Place collector-funnel at different angles and prove that effective area as cos θ times the real one.

Other Projects

Design rainwater harvester for different localities.

Construct auxiliary wells near main well.

Study the chemical composition of rainwater. Is it different at different seasons?

Module 2

Mode - Project that involves Experimentation

Topic - Rusting of Iron

Processes Involved: Conduct of experiments involving iron nails (or iron filings), weight measurement, collection of rust powder.

Objectives: Pupils will be able to recall factors causing rusting, pupils will notice that surface of iron when rusted becomes brownish gray, rust is a loose powder on the surface of iron.

Minimum Learning Outcome: Skills relating to i) use of chemicals, ii) learning about planning and execution, iii) how to prevent corrosion ?

Background: Iron is one of the most common and widely used metal of civilization. But moist air causes its rusting which weakens its strength.

Activities

Group I: Observe rusting of iron nails due to moisture produced with distilled water.

Group II: Rusting with moist alkaline water.

Group III: Rusting with moist acidic water.

Group IV: Rusting with moist water mixed with vaseline.

Collective deliberations:

What procedure would you adopt for affecting (causing) rusting?

Aerated water causes rapid rusting. Justify. Oil treatment of iron samples reduces the rate of rusting. What could be the nature of oils?

Evaluation Questions:

1. What kind of reaction leads to rusting?
2. Do hot / cold conditions suit rusting?
3. Does weight of iron body increase on rusting?

4. What is difference between rusting and corrosion?
5. What is the action of oil on iron?
6. What are the different materials used as anti rusting?

Further suggested activities

Observe effect of light and of temperature on rusting.

Estimate iron content in commercially available iron capsules.

Find the rate of corrosion of iron filings.

Loh-Bhasma is used as medicine in Ayurveda. Investigate its properties.

Other Projects

Rusting with impure water, still water, dump water, lake water, salted water, flowing water.

Rusting of copper

Rusting of aluminium

Corrosion in some metals used in daily life.

Cover of Moss/Algae / Fungi on moist objects and objects lying in still water.

Infection in leaves

Dust on metal surfaces

Composition of dust

Module 3

Mode - Survey based Project

Topic; Water Management

Processes Involved: Making questionnaire, seeking information, interactions, displays for awareness posters, popularising slogans.

Objectives: Pupils will be able to learn skills related to survey, gather data through interaction, how to make effective displays for generating awareness.

Minimum Learning Outcome: Generate data; need to save water, why water gets polluted easily?

Background:

1. Most of the potable water goes into washing and drainage.
2. Many localities have scarcity of water whereas in many places, it is wasted unscrupulously.

Activities

Group A: Water budgeting – Home based study survey

No. of persons in a family : .... Water requirement in litres: ....

Drinking	Cooking	Cleaning	Washing	Drainage

How much of this water is used in recycle mode / watering plants?

Group B: Quality of water – different sources survey.

What are the water sources in your localities?

Aspect	Lake/ Tank river	Tap/Well / Hand pump	Canal/Dam/ Gutter
Water level study			
Contamination			
Purification methods used			

Group C: Wastage of water – Urban survey

- How many taps leak?
- How many taps are missing from the pipes?
- How much area is filthy around tap / hand pump / well? Is it a place of heath hazard?

Group D: Educating Society (Urban/ Rural)

1. Survey – How many people know the importance of water conservation (analyse the response to the questionnaire)?

   How many argue against your project?

   What mode of convincing populace you must adopt?

   What kind of posters you would like to display to generate awareness?

2. Survey – Mode of procuring water.

   Are people health-conscious?

   What kind of filtering do rural people use?

   How would you convince that water from source could also be contaminated one?

   What steps need to be taken to provide potable water to all ?

Group E: Irrigation

Survey – What fraction of your locality plants are watered ?

What are the effects of excess water on a crop ?

Evaluation Questions:

1. What is the purpose of doing Survey?
2. How do you make awareness posters and slogans effective?
3. What is the prevalent method of water treatment?
4. What is chemical composition of water in your locality?
5. How would you say that water is universal solvent?
6. What was pH value of water under study?

Further Suggested Activity:

Find soap action with your water samples.

Why should outflow of water be avoided?

What are different processes of filtration? Find ratio of potable water to total consumption of water in an average family.

Other Projects

Are we wasting water? Trace our water resources with water table.

Local water bodies. Investigating properties of water.

Reasons for flood. Irrigation versus animal needs of water.

Modes of water harvesting. How to protect our natural water sources from indiscriminate depletion? Water recharge – what is being done?

Why is desert dry? Why there are different kinds of clouds?

How to make different kinds of waves? Study of Habitat of spiders / ants and type of food they take.

Module 4

Mode - Project based on Observing Nature

Topic -My tree

Processes involved: Measurement, identification, classification, rear and care.

Objectives: To develop observation skill among the pupils.

Minimum Learning Outcome: Listing out various properties of trees, notice factors affecting its growth and health, learn how to rear and care.

Background: Trees form one of the key factors of our survival. With fast depletion of forest, animal kingdom is affected adversely. If slogan for arresting population is 'we two ours is one' to save environment the slogan can be 'I care my tree'.

Activities:

1. What kind of soil is best for my tree?
   (Make a survey / interact to find what kind of location, soil and condition suits most to your tree).
2. How shall I ensure best health of my tree? (Survey literature; take guidance for fertilizer, pesticides, frequency and quantity of pouring water).
3. How is my tree growing? [Measure height and breadth at appropriate intervals of time. Is this interval proportional to increase in diameter/ 2.5?].

4. Type of canopy (find different species in its class).
5. Type of its leaves – simple / complex (trace its shape, length to breadth, ratio, colour).
6. Kind of flowers and fruits (give details).
7. What insects roam around? (Kind, their preferred location, nature – friendly or harmful to tree).
8. Birds that move around (name and their time of visit).
9. Flora and Fauna observed (give details).
10. Uses of different parts of the tree.

Evaluation Questions

1. How would you preserve imprints of tree as it undergoes different stages of growth?
2. How would you measure diameter of stem with height from ground? (Plot a graph between diameter and height at which it is measured).
3. When tree grows tall, how would you measure its height?
4. How will you protect your tree from insects, heavy rains, hot summer and tree fellers?
5. When will you claim that your tree is healthy?

Further Suggested Activities

Compare two trees of same species under different environment.

Seek information on biodiversity.

Spread tree protection awareness

Other Projects

Study of Herbs / Shrubs

Analyse condition for rapid growth for common/rare trees.

Wild growth of plants and weeds.

Smell of animals

Stinging activity of insects.

What is sponge? How it is formed?

Colour of skin why? And how?

Module 5

Mode - Project Based on Watching

Topic - Let us Watch Birds

Processes involved: Watching, recording - size, colour, special feature (if any), size/ shape of beak and sketches, classifying under genus including their common name.

Objective: To develop watching skills among pupils and collect information regarding the bird species found in their locality.

Minimum Learning Outcome: Kind of birds found, migratory birds, their mode of nutrition and mode of taking rest with duration, their cooperation and pattern of fight, nesting habit, breeding, parental care.

Background: Hundreds of bird species fly in our skies but all are not seen at all places and in all seasons. Many birds migrate in search of their food. The life cycle, habitation is also quite different.

Activities: Watching by different groups

Group A: In open space away from population

Group B: In populated space

Group C: River / Lake / Tank side/ Archaeological / Heritage places

Group D: Forest side

Group E: Filthy / stingy / deserted / remote places

1. Take group wise pupils to excursion. Impart them the skill of watching and record observations in tables like:

Locality	Time, date and time-duration	Name of bird/ number	Size*/ colour / voice/ distinct marks	Beak	Feeding on	Nesting

* Compared to 1. Sparrow, 2. Pigeon, 3. Kite

2. Undertake excursion as many times as possible during different conditions (take photos). Observe the pattern of flight.
3. Consolidate each group's observation.
4. Make comparative study for all groups.
5. Collection of pictures from different print media.
6. Collect feathers/ egg / egg shells without disturbing birds.

Evaluation Questions

1. Which species feeds on fruits?
2. Which species are carnivorous?
3. What is average distance travelled by a bird between two hops?
4. How many birds are domesticated?
5. Do all birds fly same height? What patterns do they make during flight?

6. Where and when do birds sleep?
7. What are composition, colour and smell of their excreta?
8. Describe the structure of a typical nest.

Further Suggested Readings

Find more species for a particular genus of a bird.

See encyclopedia: where else your birds are found most?

Browse for more information.

Refer to Salim Ali's book on birds.

Similar Activities / Other Projects

Insect watch (and collection?)

Butterfly watch

Earthworm observation.

Watching insects around you (not harmful).

Watching waves.

Watching wind flow.

Module 6

Mode - Project through student sheet

Topic - Reflection of light from dyes:

Processes involved: Collection of dyes, painting dyes on glass/ metal/ wood, observation of colour.

Objective: To enable pupils to identify secondary, complementary and supplementary colours.

Minimum Learning Outcome: Pupils will be able to reason out mixing of colours yields a new colour.

Background:

1. If any material absorbs light strongly at a certain frequency (colour), it also strongly reflects that frequency (colour).
2. Reflected light gives perception of the colour.
3. Red, blue and green are primary colours.
4. Yellow, violet (turquoise) and magenta are secondary colours.

   Pure crystals of dyes have metallic shine, e.g. dried purple ink has golden metallic reflection, dried red ink gives greenish metallic reflection. Low intensity of light however, gives sensation of only black and white.

Activities

Group A : Uses primary colours

Group B : Uses secondary colours

(Pupils can use colour filters/gelatin papers)

1. Coat a glass plate with a colour and allow it to dry.

2. Allow a direct beam of white light (from an incandescent lamp) on the plate.
3. Observe transmitted beam and reflected beam.
4. Mix two colours and coat glass plate. Follow steps 2 and 3 thereafter.
5. Mix three colours and coat the glass plate. Follow steps 2 and 3 thereafter.
6. Use metallic plate instead of glass plate and follow steps 2 to 5.
7. Use wooden plate and follow steps 2 to 5.

Record observation as under:

Sl. No.	Material of the Plate	Colour coated	Colour of reflected light	Colour of transmitted light (if any)	Comments

Evaluation Questions:

1. Does the intensity depend on angle of incidence?
2. What different ways do you propose for mixing colours?
3. Do the results of Group A and Group B investigators agree?
4. Give reasons for naming some colours complementary.
5. Why should coating be allowed to dry before taking observations?
6. How would you design set up to see coloured light effect on plants/ insects?
7. Are you allowing light to fall on the coated side of the plate? What happens if it is sent from the other side?

Further Suggested Activities

Suggest alternative activities for steps 1 to 7.

Light intensity can play a crucial role. Sort out.

The thickness of colour coat is a parameter to notice. Investigate.

Use LDR or photo diode as light detector.

Module 7

Mode - Project based on use of available data

Topic - Making a cross word

Processes involved: Construction at mental level and Evaluation.

Objective: To enable pupils to select proper questions and answers relating to a topic and sequence them to make a *cross word* for learners.

Minimum Learning Outcome: Manipulative skills.

Methodology:

i) Sort out a minimum of twice the number of questions and answers on the related topic from available resources, which you propose to use. Answers should preferably be of one word.

ii) Make square box depending on / class / expected competency from 4×4 to 12×12.

iii) Fill one letter of answer in one square. Take (say) horizontal rows for writing answer and accommodate as many answers as possible.

iv) Choose appropriate answers from other questions that would fit with existing letters in vertical columns.

v) Darken squares, which remain blank. Write selected questions sequentially.

vi) Give quiz feature to the crossword.

vii) Provide answers on the next page.

Follow up

If pupils find difficulty in construction and/or answering training may be given in a group.

Topic of Research Based Project – Solar System

Step 1 :

Sl. No.	Questions	Answers
1.	Who proposed laws governing planetary motion?	Kepler
2.	From what process sun obtains its energy ?	Fusion
3.	Which planet does not have a moon ?	Venus / Mercury
4.	Which planet is red ?	Mars
5.	What is the major element on sun ?	Helium
6	It completes its orbit about sun in 687 days.	Mars
7.	Recent Indian satellite	Edusat
8.	Green planet that takes 166 years for orbiting the sun	Neptune
9.	Earth's colour as seen from satellite	Blue
10.	Colour of sky appears from satellite	Black
11.	Origin of universe is ascribed to.....	Big bang
12.	Number of planets in solar system	Nine
13.	It is the space cloud full of dust and gases.	Nebula
14.	Nearest celestial body to earth.	Moon
15.	The shape of waxing moon appears of the shape of English alphabet	D
16.	The year that has 366 days is called	Leap year
17.	The cause of absence of atmosphere on moon is low.....	Gravity
18.	During summer earth is .....to the sun.	Closer
19.	The navigator who took up voyage round the earth	Yuri Gagarin
20.	Life does not occur in many celestial bodies because of lack of water whose source is.....	River
21.	The planet recently de recognized	Pluto

Steps 2, 3 & 4

K	E	P	L	E	R		B
			E	N	I		L
M			A	E	V		U
O		V	P	B	E		E
O		E	Y	U	R	I	
N	I	N	E	L	S		
		U	A	A			
D		S	R	M	A	R	S

Step 5 :

1 K	E	P	6 L	7 E	R		8 B
			E	9 N	I		L
10 M			A	E	V		U
O		V	P	B	E		E
O		E	2 Y	U	R	I	
3 N	I	N	E	L	S		
		U	A	A			
4 D		S	R	5 M	A	R	S

Clues

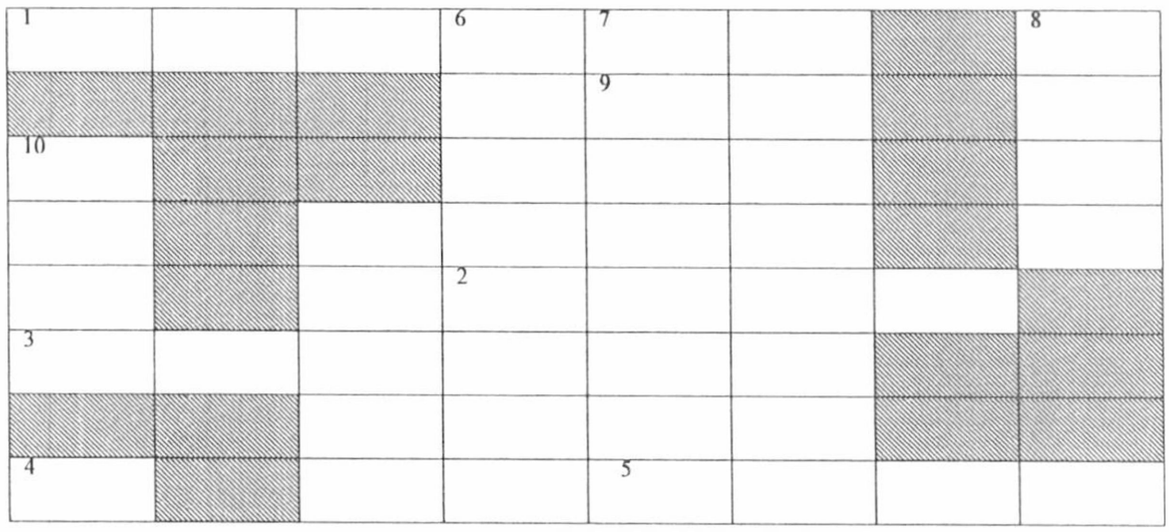
Across:

1. He proposed laws of planetary motion (6)
2. First navigator who took up voyage round the earth. (4)
3. Number of planets in solar system (4)
4. Waxing moon appears of this shape (1)
5. It completes its orbit in 687 days (4)

Down:

6. This year has 366 days. (4,4)
7. Source of water (6)
8. Earth's colour as seen by satellite (4)
9. Cloud in space full of dust and gases (6)
10. Nearest celestial body for us (4)
11. The planet does not have moon (5)

Step 6 :



Step 7 : Provide answers at appropriate places.

Other Projects

Disc games

Brain games

Block puzzles

Module 8

Mode - Project based on field work

Topic - Dissolved air in water

Processes involved: Collection of water samples from different sources, analysis of samples.

Objectives: Pupils will recall that water from different sources contain different quantity of dissolved air.

Minimum Learning Outcome: Air can be dissolved into water or removed from it as per use envisaged.

Background: Survival of fish is due to dissolved air in water, corrosion of iron in water is due to it. Many soft drinks contain dissolved CO_2.

Activities:

Different groups should collect water samples (say 1 litre each) from different sources / places in the localities, recording its every possible detail.

Group I : Use beakers of same size and pour water collected and count number of air bubble sticking to walls of beaker.

Group II : Put the collected water in vessels with lid. Measure initial volume and initial weight. Next warm the vessel gently. Ensure that no steam escapes out. Record new measures of volume and mass.

Group III : Immerse perforated material in water. Observe drops formed on it. Measure related quantities.

Group IV : Note how long fish is comfortable in fully closed water bottle.

Evaluation Question

1. Are water samples same in all respects obtained from different localities?
2. If number of bubbles formed on walls were same, what parameter would decide the quantity of air present?
3. When water is warmed, some bubbles are seen to come out. What is their source?

Further Suggested Activities:

Investigate which soft drink has more CO_2 dissolved in it?

What are the different gases present in water in dissolved state?

See if milk has dissolved air.

Do Foaming with soap water / edible oils and investigate different parameters..

Study thermocol.

Study of sponge

Study of mushrooms

Other Projects

Is dissolved air useful in potable water? What is the source of air in water?

Is dissolution of air in water a regenerative process in river / lake / sea?

List down advantages / disadvantages of dissolved air. Foam formation in oil increases its volume. Sponge – natural and artificial. Nest / web formation. Study of mesh formation in coconut leaves/and fruits (Hint dry it). Plantain leaf, papal tree leaf. Formation of nodes in different kinds of trees.

Module 9

Mode - Project based on Exploration

Topic - Soil Characteristics

Processes involved: Exploration, sample collection skill, analysis and classification, testings.

Objectives: Pupils will develop skills relating to exploration, analysis and classification.

Minimum Learning Outcomes: Soils of different localities have different colour, texture, biomaterials and composition.

Background: Vegetation depends to a large extent on climate and soil composition. All kinds of soil is equally useful under different perspectives. Only humanity needs to explore, protect and take advantage of (not exploit) the soil characteristics.

Activities

Different groups would collect soil from various places including at different depths and altitudes to have a good variety. In the process, they will record information like vegetation around, insect movement, arid or humus nature, weather condition, temperature zone, etc.

The groups will test/observe for colour, smell, graininess, scudding rate, pH, bio material present and their percentage density, porosity, quantity of occluded air, composition, etc. They would also observe effect of heat, acid action, alkali action, etc. They will explore its main crop, minerals present and how the soil be saved from run away.

Evaluation Questions

1. What is the difference between survey and exploration?
2. What are the basics of classification?
3. If you burn the soil, what kind of material you lose from it?
4. Farmers say let soil burn in hot sun, it will become more fertile. What are the reasons?
5. Running water takes away useful ingredients from soil. How would you reduce it?

Further Suggested Studies

Compare riverside / lakeside soil with seashore soil.

Compare soil of forest and fields.

Make a paste with water and allow it to harden. Find its strength.

Other Projects

In forest, rocks give way to roots of forest trees. What is the result?

Hill forest and level forest soil is of different in composition. Find out the difference.

Burning soil paste makes bricks. What processes are involved in its making?

Make charts

1. Soil vs vegetation
2. Altitude vs vegetation
3. Climate vs vegetation

Module 10

Mode - Project that generates information

Topic - Germination of Seeds

Processes involved: Seed sorting, evolving right conditions for germination, observation.

Objectives: Through the observation, pupils will be able to record pertinent data, on varying factors affecting germination. Pupils will be able to generate data on a given theme.

Minimum Learning Outcome: Identification of healthy seeds, observe process of germination, all seeds do not need similar conditions for germination. The incubation time is also different.

Background: Healthy seeds give healthy sprouts mostly when they are exposed to moist air and light. But some seeds need lot of action time, which can be reduced by proper treatment to the seeds.

Activities:

Different groups will take a different kind of seed. Observe them for colour, size, mass, shine, etc.

These groups will try out different processes on seed and information generated is tabulated appropriately.

The conditions to be varied are

1. Light – colour, intensity and duration.
2. Immersion in water – full, intermittent, partial.
3. Condition of water – acidic, alkaline, aerated, distilled water, mineral water.
4. Treatment - warming/ cooling / applying pressure.
5. Soil immersion – kind of soil, depth, etc.

Further, norm based information is tabulated.

Evaluation Questions

1. What are the essentials of sprouting?
2. Moist air spoils edible grains. Why?
3. Vacuum preserved seeds do not germinate. Why?
4. Acidic rain (first rain showers) is accompanied with wild growth of some species including grass. What is the characteristic of grass seeds?

Further Suggested Activities

Take excursion to different forms and interact with experts, interact with farmers growing different fruits.

Other projects

Study fruit juice for gathering information.

Seeds produce oils.

What seeds are more capable of it?

Investigate into sizes of different seeds? (Size differing from grass to coconut).

Sprouts exert tremendous pressure. Estimate.

Some plants / flowers orient towards light. Classify.

Find seed % that germinate on an average. Classify seeds accordingly

Research Reporting

Rationale - After collecting the data and analysing it, the investigator has to make his findings known to others.

It helps in

- pursuing additional studies related to research topic,
- helps other workers working in similar field to compare their findings, verify claims, follow a path that has already been pursued and conclude comprehensively for making generalizations,
- seek feedback for the findings from experts as well as from the peer group

Format

Title Page

Top of the page: Research topic and the name of the investigator

Bottom page: Name and address of the Institute and year of the publication.

Middle of the backside: Names and designations of the committee members/ guides.

Preface and Acknowledgement

It can be a foreword written by some eminent person in the field followed by investigators' overall observation. The last para should be devoted to acknowledgement for assistance received in different forms.

Index

It should provide the content sequenced in the report.

Introduction

a) Need of the study: State the nature of the problem for which the project was undertaken with a mention of how investigator(s) got interested in the proposed work.

b) Historical background: It should review research problem and some related studies already undertaken prior to this work.

c) Purpose of the study : Here specific aims and objectives should be spelt out. It may include the hypothesis to be tested during the investigations.

d) Delimitations of the Study : It should contain the scope of the project. Since the project cannot be exhaustive during the short period of time, the delimitation or parameters need to be specified which were chosen for the study.

Procedure

1. It should mention the sample selected for the study with all details as size of the group, number of repetitions, time, space, modifications done, etc.

2. It discusses mode adopted in the experimentation and procedure followed. If the study is of development type, then it should indicate step-by-step method, techniques and programme followed. It may also include interactions had with peer group, experts. It should talk about periodical evaluation and modification in the study affected from time to time.

3. It includes the tool used in the study. The source of the tool may invariably be mentioned. It is always good to indicate the validity of the tool used in reference to proposed study. Modifications in the tool

if done that should be specifically mentioned. This part may also mention role played by different personnel.

4. This part may include the source and field of the data collected. It is always advantageous to mention the method of collecting the data. The success of research study depends on collecting the right type of data. It may include the relevance authenticity and utility of the data.

Presentation and Analysis of the Data

The collected data must be systematically, logically and comprehensively arranged. It should be possible for a reader to make out what investigator intends to convey. Data in a tabular column or in graphs can be presented. The table or the graph must be self-explanatory. Care may be taken to remove the data which is not consistent. But it should be done only after lot of care and reasoning. The data that is not necessary to support the hypothesis may also be kept separate. Unwieldy data can be transferred to the appendix. It is enough to present such data in the some chart through frequency distribution mode, etc. Data may be interpreted on many different levels of student ability.

The analysis of the data need to be done using textual methods or by discussion. Correlation if any may be indicated. The formulae used may be written in the appendix.

Findings and Conclusions

The conclusions drawn are pure personal interpretations of the investigator. There need not be any right answer. Each one has to find a right answer for himself. It is influenced by the views and environment in which

the investigator works. To make it objective, the findings should be organised into a small number of meaningful grouping of the ideas. This would enable investigator to draw conclusions effectively. If investigator is not confident then she/he should explore various possibilities and allow reader to draw conclusions. Sometimes observation on experimental group and the controlled group is useful in drawing the conclusions.

While reporting the conclusions the conditions under which investigations were done must be indicated. Remember that investigator has open mind and is willing to accept if the data goes against the hypothesis.

Follow-up

A post study may be done to see the usefulness of the project handled. A plan of it may be chalked out here.

Appendixes

It contains all the details for which reference has been given in the text. It may include procedures, copies of different research tools, formulae, etc.

Bibliography

One should see that a selected bibliography related to study is given at the end of the report. It can be used in any format prevalent.

Summary

Ensure that

It is logical sequence of thoughts and action of investigation.

The textual material is in past tense and third form.

Page set up and general set up is expressive/ attractive (catchy) and eye-friendly. It should be in presentable form.

This presentation is based on Research in Classroom, A hand book for Teachers by D S Rawat, NCERT, New Delhi, 1969

Report of II activity

As a prelude to II activity, report of first activity along with a write up detailing the envisaged approach to research based project (page 13 to page 53 of the project manual) was sent to all resource persons who had contributed their vision in the first activity and who had assured their active presence in the II activity.

Some changes in the list of the external resource persons were affected because of the following reasons.

Dr. Hosmani from Mysore did not respond to our letters hence Professor Goswami from Bhopal was invited to participate and help us in giving valuable inputs to KRPs in the second activity. At the last minute because of reservation problems, he could not make himself available. Dr N B Ramchandra was approached as another alternative for which he obliged.

Dr. T R Ramchandra of IISc Bangalore had received our earlier invitation letter only after the ***I activity*** schedule was over. Hence he was approached again. Since he was not available for the duration slated for II activity he suggested the name of Dr. N Ahalya from the same institute. We could get her deserved presence.

Same write up was provided to all RIEM faculty involved plus the following for their comments so that the module improved in quality could be supplied to KRPs during orientation programme. These people were also requested to find time and interact with the participants of the II activity at least when subject of their specialization was discussed:

Physics: Sri N R Nagaraja Rao
Chemistry: Dr G R Prakash
Botany: Dr V V Anand
Zoology: Dr A Sukumar

A copy of the material was also given to the Principal inviting him formally.

6 sets of Electronically formatted Posters were prepared on the suggestion of Prof V D Bhat which according to him if displayed at a prominent place in the school was likely to draw attention of the students and motivate them to undertake research based projects. The version supplied to them appears on page 33. KRPs were however encouraged to make a poster appropriate to the local situation and needs of the school. An improved format is given in this report.

As per acknowledgement list given elsewhere, those posters were distributed to schools through their teacher representatives.

A request was made through DEE to invite 14 KRPs from Navodaya Schools of Southern Region, 14 KRPs from State Schools from Andhra Pradesh and 2 KRPs from DM School Mysore as per norms laid down.

11 KRPs from Navodaya Schools, 12 KRPs from State Schools from Andhra Pradesh and None from DM School Mysore participated in the orientation programme.

A time schedule together with booklet the ***Project Module*** was kept ready spiral bound for distribution to KRPs, External Resource Persons and Resource persons pooled from RIEM. The 63-page booklet, among other things contained exhortation by the coordinator, report of the first activity, and a long list of feasible projects that could be handled easily by pupils of average school of India. This material, which will be finalized after ***III activity*** in February 2007, was intended to serve as a pre final report cum instructional material useful to generate interest among those who are

involved in the envisaged programme. This was however, a revised / improved and corrected version to that which was made available well in advance to the experts before they could land the programme venue. It was made clear to all present and with whom communication went on that at any point of time coordinator will not hesitate in incorporating suggestions, incorporations, deletions and modifications if brought to the notice and if found worthy of inclusion.

Following External Resource Persons could make themselves available to a fair extent during the conduct of the programme

Professor S V Subramaniam
Prof P R Rao
Ms Lavali Devi
Dr Shrinivasmurthy
Dr N B Ramchandra and
Dr N Ahalya

Following internal faculty helped the coordinator in smooth conduct of the programme

Prof P R Lalitha
Dr M S Srimathi
Mr P Tamil Sevlan
Dr G V Gopal
Dr S P Kulkarni
Dr V D Bhat and
Dr C Jangaiah

The participants wanted to include modules on tissue culture, on genes & on DNA. This addition will be incorporated in final version of the orientation package.

Dr N B Ramchandra gave three more suggestive modules as detailed in the annexed 5 pages.

The work schedule that was ultimately followed is as under.

ORIENTING KRPs OF NAVODAYA AND THAT OF ANDHRA PRADESH FOR ENCOURAGING CHILDREN TO UNDERTAKE RESEARCH BASED PROJECTS

II Activity (5 – 8 December 2006)

Days/Time	9 – 10	10- 11.15	11.30 – 1.00	2.00 – 3.15	3.30 – 4.30	4.30 – 5.30
Tuesday 5.12.2006	Registration	Programme aspects and General Interaction	Why research? **VDB + CJ**	Research in Biology **GVG+SPK**	Presentation **Dr. Srinivas Murthy**	KRP + Experts' inter-action
Wednesday 6.12.2006	Feedback (2 KRPs) **Phys Sci**	Presentation **MNB+ PRL**	Discussion on presentations **SVS+PRR+MNB**	Discussion on Poster participants + **SVS+PRR+MNB**	Presentation **Dr N B Ramchandra**	KRP + Experts' inter-action
Thursday 7.12.2006	Feedback 2 KRPs) **Bio Sci**	Presentation **Prof. Subramaniam**	Presentation **M S S + Lavali Devi**	Discussion **PRR**	Presentation **Tamilselvan**	CAD Demo **Sivashankar**
Friday 8.12.2006	Visit to Science Park	Presentation **PRR**	Presentation **N Ahilya**	Presentation **Tamilselvan**	How KRPs propose to **further** the activity and Valedictory	

Note:

All the **external resource persons** were requested to involve in-group discussion/ interaction with KRPs as per their convenience.
Experts and RIEM faculty would suggest how science at secondary level could be seen through an integrated approach.
Invited RIEM faculty may please help subject coordinators in presentation/ discussion (no body peeped in).
All experts are requested to give at least **2-page** write up (no body bothered).
Save for exigencies, timetable was adhered to.

Coordinator

Names of all those who participated in the activity during 5-8, December 2006

1. Mr. T. Charles Studd
   School Assistant, Mahaboob College, High School,
   R. P. Road, Secunderabad, Andhra Pradesh 500 003.
   Cell No. 98490 67936.

2. B. Bethanasamy
   PGT Chemistry, **J.N.V,**
   Varichikudy-Rayanpalayam, Karaikal.
   Pondicherry 609 609.

3. Mr. Noel Joseph
   School Assistant, St. Joseph High School,
   Ramagundam, Karimnagar, Andhra Pradesh 505 208.
   Cell No. 94403 83513.

4. G. Reddappa Kumar
   PGT Physics, **J.N.V**,
   Veleru, Bapulapadu, (M D), Krishna District, Andhra Pradesh 521 110.
   Cell No. 99487 92953.

5. Y. Gopinatha Reddy
   School Assistant Biology, Z.P.High School,
   Rajupalam Village and Mandal,Kadapa District, Andhra Pradesh 516 359.
   Cell No. 94406 70166.

6. V. Vijaya Bhaskar Reddy
   School Assistant, Govt. High school,
   M.G. Road, Mahaboobnagar, Andhra Pradesh 509 001.
   Cell No. 99893 57465

7. M Murali Mohanachary
   School Assistant (Bio Science), Z.P. High School,
   Bijinapally, Mahaboobnagar District, Andhra Pradesh 509 203.
   Cell No. 98859 51425.

8. M. Male Khan
   School Assistant, Physical Science,Z.P.High School,
   Gargeyapuram, Kurnool Mandal and District, Andhra Pradesh.
   Cell No. 93478 98752.

9. Mrs. Cibil K.G.
PGT Biology, **J.N.V**, Kannur,
Kerala.

10. V. Durga Prasad
PGT Physics, C-4, **J.N.V,**
Vennelawalara, Sarubujjili Mandal, Srikakulam District,
Andhra Pradesh 532 458.
Phone No. 08942 246910.

11. R. Venkateshwara Rao,
School Assistant (N S), A.V.N (V) M.H. School,
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12. S. Kumari Bindu
PGT Biology, **J.N.V**. Chennithala,
Alleppey, Kerala.

13. Eslamma John K
PGT Chemistry, **J.N.V**. Pathanamthitta,
Kerala.

14. Bindhu S.
PGT Physics, **J.N.V**, Pallakad,
Kerala.

15. K. Lakshmana Rao S A (N S)
GVK Z P High School, Sampathnagaram,
East Godavari District, Andhra Pradesh 533 124.
Cell No. 98492 69671

16. S. Venkata Rama Raju
School Assistant Bio Science, Z.P. High School, Begumpet
Rajapet Mandalam, Nalagonda District, Andhra Pradesh.
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17. M. G. Aravindakshan
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Cell No. 94470 15168.

18. K.N. Shaji
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Cell No. 94470 11643.

19. V. Gangadhar Reddy
School Assistant, Physical Science, Z.P. High School, Pamulparthy, Medak, Andhra Pradesh. 502 279.

20. K. Sailaja
PGT (Biology), **J.N.V**. Ananthpur District, Andhra Pradesh.

21. Suhasini Devi
School Assistant, S.K.M.C. High School, Guntur District, Andhra Pradesh.

22. Rekha Naika
PGT Physics, **J.N.V**. Mavinakere, Holenarsipur Taluk, Hassan District.

23. T.N. Jagannath
Z.P. High School, K.J. Peta, Prakasham District. Andhra Pradesh.

Following External resource persons helped in conduct of the programme

24. Dr. N Ahilya
Centre for Ecological Science, Indian Institute of Science, Bangalore 560 112.

25. P. R. Rao
Reader in Physics (Retd),
No. 24, 9th Main, 5th Cross, Vinayakanagar, Mysore 12.

26. Dr. K.C. Srinivasa Murthy
Assistant Professor, S.V.C.E, Bangalore.

27. B.S. Lavali Devi
Lecturer in Chemistry, Maharanis Science College,
J.L.B. Road, Mysore.
Cell No. 94490 07350.

28. S.V. Subramaniam
Professor, Indian Institute of Science,
Banglaore.

28. Dr N B Ramchandra
DOS in Zoology, Mysore University
Mysore

Following RIE Mysore Faculty that did the coordination and resource person's job

29. Dr. P.R. Lalitha
Professor in Physics,
R.I.E. Mysore.

30. Dr. G.V. Gopal
Reader in Botany, DESM, R.I.E,
Mysore.

31. Dr. S.P. Kulkarni
Lecturer in Zoology,
DESM, R.I.E,
Mysore.

32. P. Tamilselvan
DESM, R.I.E,
Mysore.

33. Dr M S Shrimathi
DESM, RIE
Mysore

34. Prof. V D Bhat
    DE, RIE
    Mysore

35. Dr. C Jangaiah
    DE, RIE
    Mysore

36. Dr. M.N. Bapat,
    Coordinator,
    DESM, R.I.E, Mysore.

Day 1

Session ensued with inauguration by Professor Raghavan I/C Principal of RIE. Professor B S Upadhaya Head DEE introduced the background for conducting such PAC programmes. He indicated that whenever states expressed desire to conduct programme of some kind or the other as per their needs the RIE strives to undertake the project to its fullest capability. He welcomed the participants on behalf RIE. Dr Bapat, the coordinator of the programme maintained that the scenario in education is changing fast. To cope up with the trend we must make our students more creative. NCF 2000 and NCF 2005 though they are essentially the sum and essence of earlier policies on education, yet are more comprehensive and action oriented. NCF 2005 specially stresses for construction of knowledge by the learner upon exposing them with a varied kinds of experiences. The programme envisaged for those 4 days was an effort in the right direction.

Prof Raghavan hinted that projected based learning gives a direct and hands on experience to the learner and recent theories and observations have sufficiently evidenced it. He invited various suggestions to find the ways and designing of learning experiences that will enhance the involvement of the students in the learning activity.

First session began with introduction by Dr Bapat to the orientation programme and different aspects, which would be touched upon during the orientation programme. He talked about Whys and How's for the research-based projects. The school situation where ample of (all?) energetic, enthusiast students exuberating with desire to do something is very appropriate for

carrying out activity based projects. He cited definition of research from dictionary and experts in the field but cautioned that we need not expect students to follow all steps mentioned in it rigorously. He suggested that group or even a class as a unit could concentrate on a project and pool the observation results. He impressed upon the need to explore the nature / environment which is local specific to the school. He quoted Feynmann who had said that the rules are framed after careful observation of the nature. To satisfy that the rules so framed ***do work*** he has suggested following three ways

1] Arrange the given aspect of the nature and try to predict what will happen if rules worked. Next, verify whether it happens.

2] Derive sub rules – these also should work excellently. If by chance any sub rule does not work discover new rule.

3] Make rough approximations based on the rules and see if you can arrive at some sensible circumstances.

He also discussed how quality of teaching and learning could be assessed. For this he quoted a formula-

If teaching is related to memorization, mostly it is information storage and its retrieval. Most of our learning situations belong to this category. However, certainly these cannot be categorized as a satisfactory mode.

If teaching learning process requires substitution of numerical values in the formula or comparing with analogous situation, it can be of a satisfactory quality.

If teaching involves deduction or induction process, it is of a better quality.

But if the learning involves application (transfer of knowledge) of or an innovative creation from what has been learnt it nothing can match that at least from the today's perspective.

He further discussed following article in detail with appropriate examples.

An Exclusive survey What's wrong with our Teaching?

(By R Chengappa and S Maheshwari, in India Today, November 27, 2006.)

General Observations

- Learning seems to be taking place in *watertight* compartments with little relation to real life.
- Students trip up on those questions that need interpretation and analysis.
- Class size or school facilities (like computer, library etc.) make no substantial difference to school's performance indicating that what matters most is *the children are being taught to learn.*
- Quote from Dr K Subramanian of HBCSE Mumbai 'even our top schools have very unsatisfactory learning. Children are not using their minds and there is something that is putting their thinking and analytical abilities

off.' We are loosing the right direction. Goal of education is to uncover knowledge not to cover syllabus.

- Future will witness umpteen numbers of new careers requiring specialized skills. It is important that the base-***the school education***-be flexible and innovative to help students meet those challenges.
- Quote from Albert Einstein ' I never teach my pupils. I only attempt to provide the conditions in which they can learn.'

Sample Questions that based above observations

1. What is the weight of regular teaspoon?

2. A square of side 1 cm is cut from a sheet what would be the change in perimeter.

3. What will happen if a solid having the same density as the liquid is placed in it?

Should we worry from the following conclusions?

* Learning improved as students progressed from IV to VIII many caught III and IV concepts only when they reached class VI.

* Student fares better if the question is direct, showing an inability to handle unfamiliar questions.

- Students know but fail to apply the knowledge

A H Premji suggests that teachers need to move from teaching for exams to teaching for understanding. Classroom has to be more experimental and collaboratories so that child learns deeply and meaningfully.

Edward de Bono, in "Parallel Thinking" says Traditional thinking is concerned with search, discovery, hard-edged judgment and classification whereas lateral (parallel) thinking is concerned with design and creation. It uses soft edges and accepts probabilities, flagpoles and spectrum.

Nuffield Physics Teacher's Guide III, Nuffield Foundation, Longmans, Green and Co. Ltd. London 1966 gives this description

Place the pupil in scientist's world and facilitate him so that he /she emulates scientist.

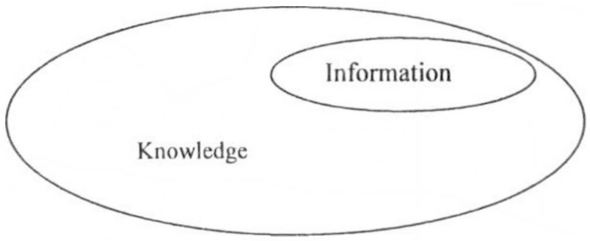
*Scientist devises his own experiment, meeting difficulties as well as successes, trying things out with a watchful eye and a critical mind. He feels the thrill of being **detective**- not only finding clues but doing their own reasoning from them and assessing their reliability.

*It is most often doing experiment that a scientist finds importance of theory. He should see science building by models with imaginative thinking taking place. He should learn to question

*We do not believe that the under standing comes from formal learning of definitions or working out examples by substituting numerical values in the formulae. Important is to discuss several rival answers to a question and give a critical thinking to it.

Next session of the day was aimed at introducing the concept of research in science and need of encouraging the research-based activities among young children. Dr Bhat and Dr Jangaiah initiated the interaction by inquiring how to test knowledge. They elaborated and gave lucid description / differentiation of tacit and verified knowledge. Dr Bhat quoted 'Polanyi who said that knowledge is generated but not the information. He recalled 8 ancient ways of testing knowledge. He gave a few examples of how knowledge was transferred. Shabda Pramanam related to what knowledgeable person had said and believed as it is. More reliable version was where the experiences are documented. Though witnessing an event first hand not though always possible, gets more authenticated knowledge.
Dr Jangaiah told that scientific knowledge dealt with
Phenomenolism
Functionlism
Scepticism and
Realism
He dwelt upon the questions like what is knowledge, what is scientific knowledge? Information being only a sub set of knowledge as shown in the Venn's diagram
He also made comparison among information, knowledge and organized knowledge.

While discussing scientific processes, the speakers maintained that science evolves in an attempt to answer a question or to a response of an urge.
The discussion touched upon topics like
What is other than concepts in science?
How to contrive evidences in order to explain the result
What is the role of similar situation?



Ultimately they landed in to the knowledge generating processes. In a convincing way, they could establish that it is the *research mode* that if employed skillfully at feasible learning levels, nothing could match it.

Dr G V Gopal and S P Kulkarni initiated afternoon session. They talked about different aspects of research-based project. They provided a list of subjects that can be handled at school level and the need of integrating different branches of science. As a vivid example, they first showed hundreds of birds seen around through a CD show. Finally, they discussed different aspects in bird watching in interactive mode. Through a transparency of parts of the bird, they hinted what to observe in such projects.

Shrinivasmoorthy presented project based on fuels. He talked about quality of a fuel as well as different parameters that need to be taken care of while designing the methodology. A lively discussion was witnessed on the projects based on chili. The pungency of the chili can be a parameter which can be studied when different organic solvent including vegetable oils.

Mr Y Gopinath Reddy from participants' side told how he is involved with minimum resources and how such activities are being organized through science club and other district forums. He exhorted the fellow teachers to act and experience how funds flow in automatically.

Day 2

Charles Stud was the KRPs representative to give in put in physical sciences. He briefed state of affairs in the present day school. Hence, his emphasis was to include the research activities in the school curricula.

Mr M G Aravindakshan assured that such activity would be undertaken with zeal. Bindu,S. wanted to know more about class projects and grading for the projects.

In the first session of the day, Dr Bapat and Prof Lalitha demonstrated a wide range of experiment in physics. The participants were asked to play with those and then suggest
The objectives inherent in the activity
Parameters that might play a decisive role
The tentative hypothesis for the activity
Mode of observations and that
How those activities can be converted into research based projects.

The experiments discussed were

1. How oscillations of one pendulum are transferred to second one coupled through a flexible support when both of them are in resonance.
2. How the time period of leaky pendulum changes continuously as the center of gravity of the pendulum changes continuously due to leakage of the material in the bob.
3. Investigate the minimum kinetic/potential energy needed in order that the ball takes full path in a circular track in vertical position. Hence, find relation between height of release of the ball and radius of the circular track.
4. How the area of plane surfaces can be measured by rolling a cone or a cylinder on it. What are the sources of error in getting results different from the real ones?
5. How the regular geometric shapes appear different when they are redrawn on uneven surfaces.
6. Why the aim while firing a bullet or arrow has to be manipulated in order to take in to account of the projectile motion of those projectiles?
   What does the distribution of shots tell?
   How to account for the deviation of hits from the bulls' eye?
7. To measure angle of elevation of the sun during different times of the day.

Next session was devoted to handling of the experiment, replies to the *queries and experiences* of the resource persons. Every time the stress was on why to involve the children in research.

Afternoon session was devoted to discussion on the poster, which can be displayed at a prominent place in the school in order to encourage children to take up research projects. The tentative poster material with 20 salient points printed on 4x6 posters were distributed through representative teacher to 6 schools under following criterion

1. D M School, Mysore since it belongs to RIE. But no teacher from that school participated it was sent through the messenger and handed over to Head Mistress
2. One to each of the Two lady teachers
3. One to each of the Two to JNVs teachers as their number was one less than the state schools
4. One to each of the Three to state schools teachers
5. One to Physics one to Chemistry, one to physical science and two posters to biological science streams.

Acknowledgement of the distribution so arrived at is pasted on the following page. Since each participant and resource persons had the tentative poster material printed on page 33 of the project manual booklet it was easy to get useful suggestions for making it more effective. It was however, made clear that the material can be modified according to the needs and facilities available at the schools.

The suggestive poster contents arrived at through consensus is pasted on the following pages. The participants were ready to make their own posters when they go back to their schools.

Dr Ramchandra discussed three modules pertaining to chromosomes, drosila and survey that took the following session. Participants appreciated a lot his introductions and other suggestive projects.

Day 3

Cibil, K took stock of the activities that were witnessed on 6th. She expressed desire to visit genetics lab and zoology lab. This was arranged on 8th along with the visit to Science Park. Bindu, S. wanted to include activities relating to DNA and tissue culture. Coordinator promised to do his best in this respect.

Noel through his feedback suggested how to maximize the use of apparatus lying unattended in the schools. He furnished more information on bird watching. He narrated usefulness of that project. He further indicated that the nesting habits could be another research project.

Professor Subramaniam argued why we must insist on children carrying out research projects. His contention was that through it we could inculcate scientific temper in them. He also replied to a simple question why do we want students to conduct the routine experiments. His presentation included-
Suggestion to install query boxes for students so that their queries could be attended. Encourage student to ask question. Arrange for answering them at regular interval of time by inviting some experts. Providing incentives to those who ask questions through query box.
He talked to a great length about triangulation method for estimating the distances. He gave information about different agencies like IAPT and INPhO and other Olympiads who conduct training camps and encourage students in practical aspects of the subjects. His suggestive research based projects were

To find mass and volume of grains
Make a medium of continuously varying density
About evaluation of the project, he told that the project should be acceptable. Research based projects should become culture. He suggested that grading the projects must not discourage the students.

Acknowledgement

Received an electronic poster to inspire children to undertake research based project for my school as detailed below.

Name of the Teacher and School	Signature
1. Headmistress Demonstration Multipurpose School Mysore.	7.12.06
2. Y. Gopinatha Reddy School Assistant (**Biology**), Z.P. High School, Rajupalam Village and Mandal, Kadapa District, Andhra Pradesh 516 359. Cell No. 94406 70166.	Y. Gopinatha Reddy
3. Mr. Noel Joseph School Assistant (**Biology**), St. Joseph High School, Ramagundam, Karimnagar District, Andhra Pradesh 505 208. Cell No. 94403 83513.	
4. Suhasini Devi School Assistant (**Physical Science**), S.K.M.C. High School, Guntur District, Andhra Pradesh.	
5. Bindhu S. PGT **Physics**, J.N.V, Pallakad, Kerala.	Bindhu S
6. B. Bethanasamy PGT **Chemistry**, J.N.V, Varichikudy-Rayanpalayam, Karaikal. 609 609.	B. Bethanasamy

Finalized Poster Material

(For Identifying Research Based Projects)

Teachers are requested to kindly display such posters that may encourage children to take-up a project (Preferably in local language)

Topic Identification: Nature Specific

1. What in 'nature' interests you most?
2. Are you interested to know more about in nature and natural phenomenon?
3. List some observations of 'nature' or natural phenomenon. Which have excited you most? Would you like to simulate those?
4. What aspect of nature you think had a strong impact on you?
5. Have you at any time felt that you need to know how 'nature' works?

Topic Identification: Local Specific

6. What is very special in your locality?
7. Do you want to explore your local specific *nature*?
8. Do you have any query about the happening around you? Describe.
9. Has any event happened earlier or you witnessed made you curious? Mention.
10. Was there any observation of *nature* against your expectation? Describe

Topic Identification: Subject Specific

11. Have you ever come across any explanation/ description in book or by teacher improper / inadequate? Narrate.
12. What question has bothered you for quite some time? (Students are advised to make a diary to note down unusual happenings they witness).

Topic Identification: Technology Specific

13. Has any device made you curious? What is that?
14. Were you ever curious to know 'How it works?'
15. Have you ever felt to suggest alteration / moderation /modification to a device?

Capacity to Work

16. What kind of exploration you would like to undertake?
17. In what area of skill, you believe you can do better than others?
18. In what area, you can render help to others and in which area you would like to seek help from others

Interaction

19. How do you think you can contribute to the growth of science?
20. Do you possess any idea that needs serious consideration? What is that?
21. Do you think an expert on some argument should hear you?
22. How do you propose to communicate with others (Interview / Questionnaire / Mediator)?

Students Please Remember: You may need Hints from the teacher to answer those questions. Do not hesitate in getting those hints. When you undertake a project –keep in touch with your guide/teacher welcome suggestions and criticisms. Do not try to derive big conclusions (why?), work in-group, and keep interacting with team members and give importance to their views.

Next session had presentation by Shrimathi madam and Lavali Devi. They introduced what projects can be undertaken in chemistry. Dr Shrimathi's presentation included an acronym related to different aspects of thinking

P - Process of planning and systematic thinking
R - Rational thinking
O – Objective based thinking
J – Jubilant thinking
E – Efficient and
C – Critical thinking with
T – Team spirit.

They discussed how the projects can be conducted and what areas in chemistry can be easily explored at the school level. They demonstrated following experiments that can become research based.
Diffusion of a solid in a liquid: example $CuSO_4$ in water, alcohol etc., Effect of temperature and quantities of the component materials in diffusion.
Rate of chemical reaction: innovative idea presented. It was to look a cross mark through the reactant solution and note the time it takes to become invisible. The experiment shown was

$$Na_2S_2O_3 + HCl$$

Other modifications would be to see the effect of catalyst. And study of reactions such as

$$KClO_3 + MnO_2 + \Delta$$

She suggested that observing its transparency; pH, odor, sediments and life in it could do the analysis of water samples. The reaction

$$Na_2S_2O_3 + KI + NaOH$$

with 50% $MnSO_4$ can also be used to analyze water samples.

P R Rao distributed a printout of one page article from Horword Physics in the afternoon session titled 'a lost child keeping worm' He asked each one to read that carefully and interact. He upon obtaining different views suggested how experiences when sequenced properly produce organized knowledge of science. He also talked about axis of learning.
In the later part of his discussion, he talked about scientific temper and scientific attitude.

In the evening session, Selvan demonstrated experiments pertaining to oxidation states of transition elements. He elaborated the concept of catalytic effects on chemical reactions. He used chromium in the form of sodium dichromate to demonstrate how variable oxidation state of it leads to changes in colour of the solution.

Mr Shivshankar of NIIT showed various demo kits available as teaching aid with the NIIT lab. He undertook some demonstration to validate his point.

Day 4

KRPs visited Science Park under the guiedence of Dr Bapat and Prof Lalitha. Paricipants belonging to biology stream also visited zoology lab with Dr Kulkarni

P R Rao took next session. He discussed research-based projects commensurate with the level of the pupils. He suggested that for class 8th and lower ones finding relationship between two variables is quite satisfactory. Those parameters may be selected from the syllabus or from the contents of a lower class. For the ninth standard and beyond the pupils can explore something not connected directly to the contents of the course of study but otherwise easy to study.

He further added that the evaluation of the projects should be objective based and finding of errors. The evaluators may see if the conduct of the project helps in the development of skill and the cognitive domain of the pupils in general. He also said the projects must be able to encourage them in learning of science.

Dr Ahalya had interesting interaction through multimedia presentation of work done by her group at IISc Bangalore. She talked about projects based on water quality, environment and ecosystem. She showed modules related to those themes. She gave her email id for seeking further information ahalya@ces.iisc.ernet.in. She informed that the Ministry of Environment and Forest Government of India gives financial assistance for different projects and supplies kits for assessing water quality and related areas for schools.

In the afternoon session, Selvan demonstrated two more experiments. One concerned with the oxidation of H_2O_2 action of catalyst on it and another making of Benzoic acid crystals. He indicated how those experiments could be converted into research-based projects.

The last session of the orientation programme was devoted to find out to what extent the programme was useful to the KRPs. The participants in general expressed desire that except for imposed constraints they are eager to involve their pupils to undertake projects in various themes.

Noel in the feed back said that one problem would be attempted with several pupils attacking its different aspects. Venkateswara Rao suggested that in such programme some children of secondary level might have been involved. It may be noted that unknowingly we had one student of the said standard seriously taking part in all deliberations. John madam said after a long time she found useful interaction while R Naika wanted that such programmes be organized very frequently and the concerned teacher may be invited invariably.

The programme came to an end with a vote of thanks.

Input from Dr N B Ramchandra, Department of Zoology, Manasgangothri, University of Mysore, Mysore

Module 1

Mode: Review of Literature
Topic History of Sciences
Processes involved: Standard relevant textbooks and Internet
Objectives: Review the past events critically, update with current knowledge and bring out the acceptability and limitations
Minimum Learning Outcome: Should be aware of past history of science, present status or theories of evolution and also have interest

Background: Major events with DNA• cracking of genetic code

•Flow of information DNA-RNA-Proteins •Mutation•Recombination
•Repair• Transposons •Cloning vehicle •Splicing – introns, axons & Ribozymes •cDNA •Recombinant DNA •Gene cloning **•Gene isolation**
•DNA sequencing• Sequence homology & phylogeny• PCR
•Artificial chromosomes, Genome analysis• transgenic systems
•Gene therapy Micro arrays •RNA interference •Nano technology

Activities

Different groups should take up different events or theories and collect as much as possible information. Compile and present critically
The assignment of the projects can be done depending on the interest of the group.
1) Evolution of DNA sequencing technology Determination of order and arrangement of base pair on the DNA fragment is DNA sequencing •The first successful attempt at sequencing a small portion of a gene completed in 1971, required three years of work to determine 12 bps from the termini of lambda phage DNA
2) Know about human genes
Covers a spectrum of sizes < 21 bp to > 2400kb, Micro RNA – ~ 21 bp
tRNA, snRNA genes – smallest 65-75 bp
The smallest protein coding genome- 406 bp – histone H4
The longest human gene - dystrophin gene- 2400 kb with 79 introns
3) Status of theories of organic evolution
What is evolution?
Evolution is a change in the genetic composition of populations.
By extension it affects almost all other fields of knowledge and must be considered one of the most influential concepts.
Evolution is nothing but descent with modification the history of evolution can be studied

Further suggested investigations
Investigate which method or theory is most useful or accepted
Plan for application of the method or theory for higher studies

Other projects
Genes and genomes of other model organisms

Module II

Mode:	Projects based on experimentation
Topic:	TESTING THE GENETIC LAWS
Processes Involved:	Culturing, handling and identification of *Drosophila* normal and mutant flies
Objective:	To know the inheritance pattern of traits
Minimum Learning Outcome:	Understanding of the principle and applications of genetic laws

Activities
Mendel's law of dominance, Mendel's law of segregation, Sex –linked inheritance, Random genetic drift
MODEL SYSTEM: *Drosophila melanogaster*
(White-eye, Barr eye, vestigial wing, ebony body, etc)
Mendel's law of dominance & Segregation

Module III

Magnocellular theory of dyslexia

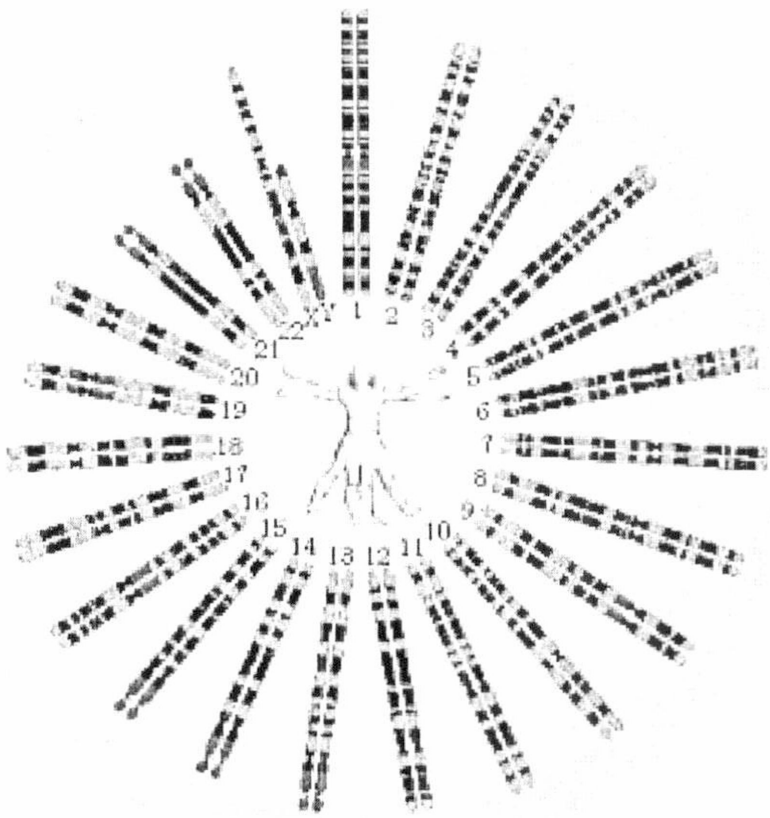
•The magnocellular is the pathway along with the parvocellular pathway connects the retina to the occipital and parietal lobes of the brain and information brought in by the eye is processed here.
•Impaired function of magno cellular pathway will lead to destabilization of binocular fixation, which leads to visual confusion and letters appear to move around. It has been found that binocular control of dyslexics is poor.
•Their eyes are unsteady when they are attempting to view small letters: hence their vision is unstable and they tend to make visual reading errors.
•Postmortem studies of dyslexic individuals have shown that magno cells (large neurons) of the lateral geniculate nucleus were disordered and 20% smaller than that of controls.
•Magnocellular dysfunction is not restricted to the visual pathways but also in other sensory modalities, auditory, tactile, motor and phonological abilities.

Details of different chromosome are displayed below.

Chromosome	# Genes	# of Bases
Chromosome 1	2968	279 million bases
Chromosome 2	2288	251 million bases
Chromosome 3	2032	221 million bases
Chromosome 4	1297	197 million bases
Chromosome 5	1643	198 million bases
Chromosome 6	1963	176 million bases
Chromosome 7	1443	163 million bases
Chromosome 8	1127	148 million bases
Chromosome 9	1299	140 million bases
Chromosome 10	1440	143 million bases
Chromosome 11	2093	148 million bases
Chromosome 12	1652	142 million bases

Chromosome 13	748	118 million bases
Chromosome 14	1098	107 million bases
Chromosome 15	1122	100 million base
Chromosome 16	1098	104 million bases
Chromosome 17	1576	88 million bases
Chromosome 18	766	86 million bases
Chromosome 19	1454	72 million bases
Chromosome 20	927	66 million bases
Chromosome 21	303	45 million bases
Chromosome 22	288	48 million bases
Chromosome X	1184	163 million bases
Chromosome Y	231	51 million bases

Human Chromosome Launch pad



Tamilselvan gave following additional input

Activity 1

The most important characteristic property of transition metals is that they show a variable oxidation state. The variable oxidation state of chromium can be demonstrated by the preparation of $Cr_2(CH_3CO_2)_4.2H_2O$ complex obtained from sodium dichromate.

1g Sodium dichromate ($Na_2Cr_2O_7$) is mixed with 1g Zinc metal +1g Zinc powder and 5 ml of distilled water in a round bottom flask or flat bottom flask. [The flask is fitted with a cork with two holes. A separating funnel passes through one hole and an arm of a long U tube is inserted into another hole. The other end of the U tube goes in to a test tube (100 ml) containing 4.5g sodium acetate dissolved in 10 ml distilled water].

When 35 ml of HCl solution (20%) is added the Cr^{7+} ions are reduced to Cr^{3+} which with the progress of reaction are further reduced Cr^{2+}. This can be easily noticed by the change in colour from orange red to dark green and finally to blue. The blue coloured solution rises up through U-tube and reaches the test tube where it forms brick red chromium acetate $Cr_2(CH_3CO_2)_4.2H_2O$

Activity 2

One of the important applications of transition metals is that their complexes are widely used as catalysts. Because of their variable oxidation states transition metals made good efficient catalysts.

As is well known the catalyst is a substance, which accelerates the rate of chemical reaction without itself, undergoing apparent permanent change. This concept was demonstrated by "Rail Traffic" experiment.

2g potassium sodium tartarate is mixed with 50 ml of distilled water in a beaker (250 ml) and is heated to 70^0 C.

Then 20 ml of hydrogen peroxide (15%) is added. No change should be noticed. Now this mixture is heated to 70^0 C and the beaker is removed from the heat source. On adding cobalt chloride ($CoCl_2$) solution (250 mg of $CoCl_2.4H_2O$ in 5 ml water) to the mixture the changes taking place are recorded.

Within a few seconds of addition of cobalt chloride (as catalysts) brisk effervescence (evolution of CO_2) can be noticed. And the colour of the reaction changed from pink to green. After a minute or so the green colour changes to pink indicating the completion of the oxidation of potassium sodium tartarate.

During the reaction the catalyst $CoCl_2$ undergoes some change but after the reaction is over it regains its original form. This is indicated by the colour change from pink to green during the reaction and green to pink after the completion of the reaction.

Activity 3

Here we can show how even a simple substance like KI can also be used as catalyst. For it we take the decomposition of H_2O_2 can be taken.

Three bottles with long neck are taken. In each bottle a mixture of H_2O_2 (15%, 150 ml) + 20 ml soap solution and a little of food colours are added. Simultaneously we can add 3g KI to each bottle. Coloured foam oozes out of each bottle forming colourful foam bed on the tray.

Investigation

Crystallization of Benzoic Acid

Laboratory grade benzoic acid can be purified by its crystallization in water. The investigation is aimed at exposing the participants to find a better method of setting fine crystals and see the rate of crystallization as a parameter. When they performed crystallization they found that water and ethanol mixture 1:1 ratio was the best solvent system for crystallization. To arrive at this conclusion they used a series of different solvent systems viz. 100% water, 100% ethanol, 25% ethanol in water and 50% ethanol in water.

The article is based on and is sourced from
Www.research.umbc.edu/~jwolf/method5.htm - 51k

Tissue Culture

TYPES OF CELLS GROWN IN CULTURE

Tissue culture is a generic term that refers to both organ culture and cell culture. Cell cultures are derived either from primary tissue explants or cell suspensions. A primary cell culture typically has a finite life span in culture whereas continuous cell lines are abnormal and are often transformed cell lines.

WORK AREA / INSTRUMENTATION

Essentially the cell culture can be done by two methods

A. Laminar flow hoods. There are two types of laminar flow hoods, *vertical and horizontal*. The vertical hood, works as a biology safety cabinet and is best for working with hazardous organisms since the aerosols that are generated in the hood are filtered out before they are released into the surrounding environment. In Horizontal hoods the airflows directly at the operator hence they are not useful for working with hazardous organisms though they are the best protectors for cultures. Both types of hoods have continuous displacement of air that passes through a high efficiency particle filter. The particle filter removes particulates from the air. In a vertical hood, the filtered air blows down from the top of the cabinet hence it is preferred over horizontal hoods. NOTE: these are not fume hoods and should not be used for volatile or explosive chemicals. They should also never be used for bacterial or fungal work. The hoods are equipped with a short-wave UV light that can be turned on for a few minutes to sterilize the surfaces of the hood, but be aware that only exposed surfaces will be accessible to the UV light. Do not expose you body to the UV light as it can cause skin and eye damage. The hoods should be turned on about 10-20 minutes before being used. In normal school studies sunlight may be used for UV and hoods can be replaced by simple honey type box with proper ventilation can be used effectively. Wipe down all surfaces with ethanol before and after each use. Keep the hood as free of clutter as possible because this will interfere with the laminar flow air pattern.

B. CO_2 Incubators. In this system the cells are grown in an atmosphere of 5-10% CO_2 because the medium used is buffered with sodium bicarbonate/carbonic acid and the pH must be strictly maintained. Culture flasks should have loosened caps to allow for sufficient gas exchange. Cells should be left out of the incubator for as little time as possible and the incubator doors should not be opened for very long. The humidity must also be maintained for those cells growing in tissue culture dishes so a pan of water is kept filled at all times.

Observing the culture. Inverted phase contrast microscopes are used for visualizing the cells. Microscopes should be kept covered and the lights turned down when not in use. Before using the microscope or whenever an objective is changed, check that the phase rings are aligned.

Mode of Preservation. Cells are essentially stored in liquid nitrogen (schools are discouraged to do it).

What kinds of vessels to be used? Anchorage dependent cells require a nontoxic, biologically inert, and optically transparent surface that will allow cells to attach and allow movement for growth. The most convenient vessels are specially treated polystyrene plastic that are supplied sterile and are disposable. These include petri dishes, multi-well plates, micro titer plates, roller bottles, and screw cap flasks - T-25, T-75, T-150 (cm^2 of surface area). Suspension cells are shaken, stirred, or grown in vessels identical to those used for anchorage-dependent cells.

MAINTENANCE and REARING

Cultures should be examined daily, observing the morphology, the colour of the medium and the density of the cells. A tissue culture logbook should be maintained that is separate from regular laboratory notebook. The logbook may contain: the name of the cell line, the medium components and any alterations to the standard medium, the dates on which the cells were split and/or fed, a calculation of the doubling time of the culture (this should be done at least once during the semester), and any observations relative to the morphology, etc.

A. Growth pattern. Cells will initially go through a quiescent or lag phase that depends on the cell type, the seeding density, the media components, and previous handling. The cells will then go into exponential growth where they have the highest metabolic activity. The cells will then enter into stationary phase where the number of cells is constant; this is characteristic of a confluent population (where all growth surfaces are covered).

B. Harvesting. Cells are harvested when the cells have reached a population density, which suppresses growth. Ideally, cells are harvested when they are in a semi-confluent state and are still in log phase. Cells that are not passaged and are allowed to grow to a confluent state can sometime lag for a long period of time and some may never recover. It is also essential to keep the cells as happy as possible to maximize the efficiency of transformation. Most cells are passaged (or at least fed) three times a week.

1. Suspension culture. Suspension cultures are fed by dilution into fresh medium.

2. Adherent cultures. Removing the old medium and replacing it with fresh medium can simply feed adherent cultures that do not need to be divided.

When the cells become semi-confluent, a rubber spatula can be used to physically remove the cells from the growth surface. This method is quick and easy but care may be taken to see that there is least disruption to the cells, which would otherwise lead to cell death.

Growth requirement

A. temperature – 37°C for cells from homeother
B. pH - 7.2-7.5 and osmolality of medium must be maintained
C. humidity to a good level
D. gas phase - bicarbonate conc. and CO_2 in equilibrium
E. visible light – avoid as much as possible

Medium requirement

A. Presence of Bulk ions - Na, K, Ca, Mg, Cl, P, Bi carbonate or CO_2
B. presence of Trace elements - iron, zinc, selenium
C. Appropriate quantity of sugars - glucose is the most common
D. Some amino acids - 13 E. vitamins - B, etc.
F. Choline, inositol
G. Serum – as it contains a large number of growth promoting activities such as buffering
toxic nutrients by binding them, neutralizes trypsin and other proteases, has undefined
effects on the interaction between cells and substrate, and contains peptide hormones or
hormone-like growth factors that promote healthy growth.
H. Antibiotics – may be avoided though antibiotics are often used to control
the growth of bacterial and fungal contaminants.

Feeding –it can be done 2-3 times/week.

Measurement of growth and viability. The viability of cells can be observed visually using an inverted phase contrast microscope. Live cells are phase bright; suspension cells are typically rounded and somewhat symmetrical; adherent cells will form projections when they attach to the growth surface. Viability can also be assessed using the vital dye, try pan blue, which is excluded by live cells but accumulates in dead cells. Cell numbers are determined using a hemocytometer.

You can devise your own method also. The beginners can use a simple microscope.

SAFETY CONSIDERATIONS

- It is always good to assume that all the cultures are hazardous. They may harbor latent viruses or other organisms that are of unknown characteristics. The following safety precautions should be observed:

REFERENCES:

R. Ian Freshney, *Culture of Animal cells: A manual of basic techniques,* Wiley-Liss, 1987.

From Web page as maintained by Julie B. Wolf, UMBC;

TISSUE CULTURE PROCEDURES

Each student should maintain his own cells throughout the course of the experiment. This cell should be monitored daily for morphology and growth characteristics, fed every 2 to 3 days, and do subculture when necessary. A minimum of two 25 cm^2 flasks should be carried for each cell line; these cells should be expanded as necessary for the transfection experiments. Each time the cells are subcultured, a viable cell count should be done, the subculture dilutions should be noted, and, after several passages, a doubling time determined. As soon as you have enough cells, several vials should be frozen away and stored in liquid N_2. One vial from each freeze down should be thawed 1-2 weeks after freezing to check for viability. These frozen stocks will prove to be vital if any of your cultures become contaminated.

Procedures:

1. Media preparation. Each student will be responsible for maintaining his own stock of cell culture media; the particular type of media, the sera type and concentration, and other supplements will depend on the cell line. Do not share media with you partner (or anyone else) because if a culture or a bottle of media gets contaminated, you have no back up. Most of the media components will be purchased prepared and sterile. In general, all you need to do is sterile and combine several sterile solutions. To test for sterility after adding all components, pipet several mls from each media bottle into a small sterile petri dish or culture tube and incubate at 37°C for several days. Use only media that has been sterility tested. For this reason, you must anticipate your culture needs in advance so you can prepare the reagents necessary. But, please try not to waste media. Anticipate your needs but don't make more than you need. Note that the Tissue culture reagents are very expensive
2. All media preparation and other cell culture work must be performed in a laminar flow hood. Before beginning your work, turn on blower for several minutes, wipe down all surfaces with 70% ethanol, and ethanol wash your clean hands. Use only sterile pipets, disposable test tubes and autoclaved pipet tips for cell culture. All culture vessels, test tubes, pipet tip boxes, stocks of sterile eppendorfs, etc. should be opened only in the laminar flow hood. If something is opened elsewhere in the lab by accident, you can probably assume its contaminated. If something does become contaminated, immediately discard the contaminated materials into the biohazard container and notify the instructor.

2. Growth and morphology. Visually inspect cells frequently. Cell culture is sometimes more an art than a science. Get to know what makes your cells happy. Frequent feeding is important for maintaining the pH balance of the medium and for eliminating waste products. Cells do not typically like to be too confluent so they should be sub cultured when they are in a semi-confluent state. In general, mammalian cells should be handled gently. They should not be vortexed, vigorously pipetted or centrifuged at greater than 1500 g.

3. Cell feeding. Use pre warmed media and have cells out of the incubator for as little time as possible. Use 10-15 ml for T-25's, 25-35 ml for T-75's and 50-60 ml for T-150's. a. Suspension cultures. Feeding and sub culturing suspension cultures are done simultaneously. About every 2-3 days, dilute the cells into fresh media. The dilution you use will depend on the density of the cells and how quickly they divide, which only you can determine. Typically 1:4 to 1:20 dilutions are appropriate for most cell lines. b. Adherent cells. About every 2-3 days, pour off old media from culture flasks and replace with fresh media. Subculture cells as described below before confluency is reached.

Further information on bird watching provided by Dr S P Kulkarni

Processes involved

Watching birds, recording observations made with respect to size, colour, beak, call, flight etc

Objectives

to develop skill of observation,
to record the observations
to identify the birds
to collect information about the birds

Steps

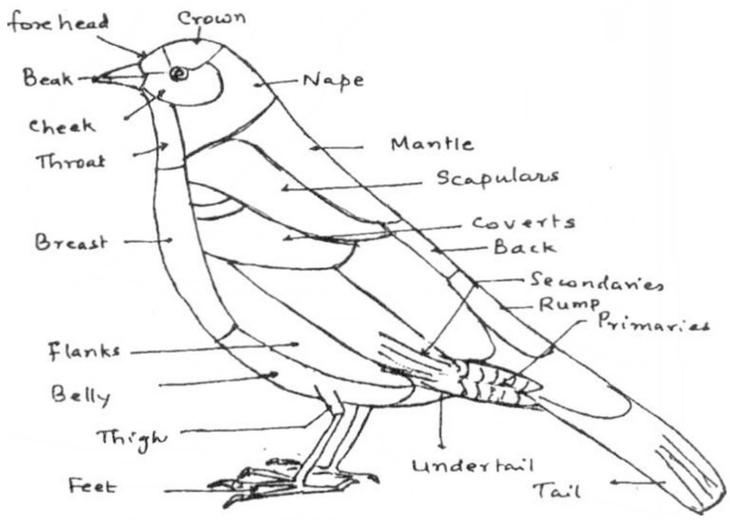
When pupils are taken out in the field they must be instructed to observe the birds and record their observations under following heads

1. Size: size is to be compared with most common birds like sparrow, myna, crow etc
2. Colour: colour of head
   Colour of beak
   Colour of wings
   Colour of belly
   Colour of tail
3. Beak: Size and shape e.g. small, stout, long , pointed, straight or curved
4. Head: a) special features like marks, extra feathers
   b) eyes: olour, marks around their eyes etc

5. Neck: a) size: long or short, straight or curved etc
   b) feathers on the neck and region
6. Back: colour of back

7. Belly: colour of belly
8. Wings: a) size of the wing (large/ small)
   b) colour of wings
   c) special marking on the wings
9. Tail: a) size and shape- long or short, large or small, blunt or pointed
   b) colour of tail feathers
10. Legs: a) size: long,short
    b) feet: clawed, small, webed
    c) colour of legs and feet

PARTS OF A BIRD



11. Food and feeding: observe where does the bird go frequently, what kind of thing it brings in its beak i.e. insect, fish, plant material. See whether it pokes its beak into flower and or in water.
    Does it kill large prey, tears muscles etc?
12. Nest and roosting: observe type of nest constructed by the bird, its location and material used etc.
13. Eggs: size and colour of its eggs
14. Young ones: how are the young ones of the bird?
15. Calls: Type of calls, timings, call sweet or harsh, shril or loud continuous or discontinuous
16. Habit: likes to live alone or in pair or in-group. How it moves singly or in pair or in-group?

Report of III activity

As per programme proposal III activity was related to take stock of present scenario in the schools. To find out how many schools /teachers/students are really serious in digesting the concept of undertaking and carrying out research based projects in science at secondary school level.

A letter was sent to 6 schools out of 23 that had sent their teachers for the orientation programme. The letter said that it is expected that the KRP's would propagate the concept of research-based projects far and wide and inspire the young's to undertake such activity. The letter also indicated that a few members of the RIEM faculty would visit their schools meet science teachers and interact with the students of classes VIII to X to further motivate and sort out problems if any in the very basic idea. Some additional input if desired would also be provided.

A team consisting of M N Bapat (Physics) the coordinator and Dr Gopal (Botany) and Sri Selvan (Chemistry) undertook visits to Secunderabad (two schools), Visakhapatnam (one school) and Srikakulam (Two schools). They carried a questionnaire appended with this report and interacted with all those who are involved in teaching science at secondary level and the taught.

The analysis and observation drawn on the questionnaire is appended with this report.

New schools visited were provided with a copy of the manual as also floppy containing the module.

It may be noted that student teachers from RIEM also go to a variety of schools for their internship training and through such venture would be publicized in the future.

Questionnaire

on

Encouraging the children at secondary stage in science to carry out research based projects.

For Principals

Name of the School

Managed by

Date

1. Would you spare one hour in school timetable to enable students and teachers to discuss research-based projects?

   If yes what day and time slot:

2. Would you invite a person of repute in any area of science to interact with your students and staff to talk about some simple research programme at least once in a month?

   If yes how do you propose to manage?

3. What are the financial constraints, if any?

   Specify / Mention

4. Can you provide a space in the school for activity corner?

   What type of space?

5. Would you allow space to display poster for motivating the students in research activities?

   How big poster you would like to display?

For Teachers

Name

Qualifications

School

Classes you engage

Date

Any additional information you would like to provide

1. Are the pupils frank enough with you to ask their doubts in science?

   (Y/N)

2. Do you any time discuss some activity by which some concepts of science become clearer?

   (Y/N)

3. How do your students respond when you involve student in out of class science activity?

   Clarify

4. What methodology you would adapt in order to keep the inquiring students interest alive?

   Specify

5. Do you go to students level to make them understand the subject?

   How do you ensure?

6. Have you ever expressed your wish that you also would like to know about a topic more through student activity?

   (Y/N)

7. Have you indicated the students that you also do not know every thing in science and hence you would like to learn with them?

   (Y/N)

8. How much extra time you can willingly devote for guiding students if they really involve themselves in research based projects?

   Please specify

9. Can you arrange guest lectures if permitted to do so?

   (Y/N)

10. Will you strive to make a science awareness club in your locality?

    How? What kind of efforts you feel would be appropriate?

11. Other constraint in your way

    Other suggestions

For pupils

Name

Class

Age

Parental background

Rural/urban?

Hobbies

Ambitions

Any other information?

1. What area in science interests you most?

2. Have you ever wondered on Why and How of nature?

3. Would you like to pursue higher studies in science?

   (Y/N)

4. What kind of question on science had bothered you and you wanted to know the answer?

   Give sample

5. Do you ask your doubts in science to your teacher?

   (Y/N)

6. Are you bold enough with your teacher in clarifying your doubts in science?

   (Y/N)

7. Do you feel great when you do something on your own? Has that motivated you to undertake more such tasks?

   Narrate situation

8. Do you like to do experiments?

   (Y/N)

9. What is your preferred activity:

   Field trip / Excursion or Science Park or Science Museum visits?

10. Do your parents encourage in activities related to science but not taught in the school?

    (Y/N)

11. Would you willingly spend one hour in seeing Animal planet/Discovery/National geographic etc type programmes?

    (Y/N)

12. Do you any time feel you have better method to describe a thing?

    When?

13. If given free hand what kind of science activity you will like to involve in?

    Describe

14. Will you maintain a diary in which you may note analogous systems you have seen elsewhere to the one described in the book? And also write new ideas that come to your mind?

    (Y/N)

15. In which field you feel you can achieve expertise in no time?

    Mention

16. How much time you feel would be lost from your regular studies if you do activities?

    Give details

17. Do your teachers encourage making models?

    (Y/N)

18. How much time you spend in the making of a model or some body else makes that for you?

    Be Honest to write

19. Will you make a like-minded student group to discuss different activities related to science?

    How?

20. We propose that students can construct knowledge for themselves. If you are one such prospective student what kind of facilities you would like to have?

    Provide your views

21. If answers to above questions is affirmative what all you have done all these years of your schooling?

    Mention briefly

Important note

Coordinator would like tell students not to take answers provided to them by the teacher/expert as valid. She/he should try to see pros and cons of it before accepting them.

Tour report

(*Visit to schools during 12th to 15th February 2007*)

Dr M N Bapat, Dr G V Gopal and Sri P Tamilselvan took up the task of conducting the survey and on the spot feedback of randomly selected secondary schools in Andhra Pradesh.

On 12th February 2007 the team visited Mehboob College High School, R P Road Secunderabad. The School is Government aided and caters mostly to the education of the unprivileged class children. Mr Charles Studd, the science teacher was very enthusiastic and has influenced the management for seeking approval for all kinds of science related activities. He has knack of organization and making of winning presentations. Interaction with VIII and IX class pupils was undertaken along with the faculty members.

On 13th February 07 the team visited Aliya High School, a Government run School for minority students in Hyderabad. Two interactive sessions were organized one for IX class and VIII and X class students. The two science teachers were present all through.

Students were promising and were prepared to undertake activities to their fullest ability. The manual of the project was given to the school, as this school had not represented in the orientation programme.

On 14th February 07, the internship school, Ramnath High School run by NSTL in Visakhapatanam was chosen for interaction. Class VIII, IX and X; all science faculty and Principal of the school actively took part in inspirational cum motivational session. The manual was also given to the school along with a floppy. The Principal assure that the Suggestive Poster will be made and displayed. This school has won laurels from the President Abdul Kalam for doing a variety of activities.

15th February 07 was devoted for Sri Andhavarapu Varahnarsimham (Varam) Municipal High School Gujrathi Peta Shrikakulam, and JNV Sarubujjili. Physical Science at MH School Mr. Venkateswar was very active and has motivated more than 7 students and involved them in many research-based activities. He has also formed a teacher team from surrounding places to guide students in different projects. The students and he have got commendations in competitions at state and national levels.

Afternoon session was spent in J NV at Vennelavalasa where interaction was done with VIII, IX and XI class students. Those students were bubbling with energy to ask questions related to their curiosity in science. The response was excellent.

The message propagated through interactive session is highlighted below:

1. Students should inculcate the habit of keen observation for each happening around them and record anything that appears unusual / interesting / thrilling / inspiring / encouraging / mystical or that thwarts the mind to bother for enquiring.
2. Students should make a habit of asking questions to self, and to peers, to parents, to teachers, to experts and involve in seeking answers through interactive or passive media. Any sequence may be followed but self-questioning should be given top priority.
3. Students should learn to *question an answer* and try to seek for its validity, tapping several other sources.
4. Questions should not be let down by the teacher, if teacher suggests it must be further explored through experimental tests. Various parameters must be considered for collecting the data. The teacher may guide how to utilize it for making it scientific.
5. Students must form a habit of writing their findings and hypothesizing.
6. School should provide slots in terms of time and space for all creative / constructive activities of pupils. Since human has a tendency to emulate, they must be exposed to science history, scientists, science inventions and personal interventions as also to interactive media.

Suggesting during the interaction some no cost research based projects also provoked student inspiration.

Views of 5 HM/Principals, 12 Science teachers and 27 pupils from 5 schools about research-based projects were recorded through questionnaire. The samples were '3' from *teacher-oriented* (experimental group) schools and '2' from non - oriented (control group) schools. They hint at that this is only a pilot study. No big conclusions need be drawn as such. Yet the responses clearly indicate that the pupils are eager to undertake projects. They had many questions to explore and need help and guidance. The teachers, it appears will do whatever they can but for constraints. HMs in general showed their willingness to undertake responsibilities and do the motivation required.

Though there was no dramatic change expected, yet the organization of such activities we strongly believe will produce the desired impact by and by. This much at least we can infer from the feedback received.