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Articles suitable to the objectives mentioned above are invited for publication. An article sent for publication should normally not exceed ten typed pages and it should be exclusive to this journal. Illustrations should be drawn with pen and indelible ink. Photographs (black and white) at least of postcard size, should be on glossy paper and should be properly packed to avoid damage in transit.

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Gandhiji's Talisman

I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test:

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to Swaraj for the hungry and spiritually starving millions?

Then you will find your doubts and your self melting away.

M. K. Gandhi

CONSTITUTION OF INDIA

Part IV A

Fundamental Duties of Citizens

ARTICLE 51A

Fundamental Duties – It shall be the duty of every citizen of India —

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.
- (k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

Daulat Singh Kothari— A Saint Scientist*

A.R. VERMA

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THE LIFE and work of late Professor D.S.Kothari is a glaring example of how an individual can shape his own destiny and occupy the highest position in his or her field of work irrespective of a modest family background and financial hardships during formative years. His devotion to work, zeal for hard work, pursuit for excellence and, above all, ability to overcome any hurdle that comes on the way to accomplish set goals could be a source of inspiration to our younger generation as it was for many of us during his lifetime. One may have to write volumes to do justice with a towering personality like Prof. D.S.Kothari. This write-up, therefore, attempts to present only glimpses of his personality and work.

Let me begin with his early childhood. Professor Kothari was born on 6 July 1906 in Udaipur, Rajasthan. His father, Shri Fateh Singh Kothari, was a school teacher. Daulat Singh lost his father and grandfather when he was barely 12 years of age. The responsibility of up-bringing four young children, therefore fell on his mother

Smt. Leharbai, who was a simple lady with profound faith on Jain traditions. Her simplicity and courage to face the challenge of taking care of her family during those difficult days left a permanent impression on young Kothari, which guided him allthrough his life.

One may naturally ask how could Daulat Singh Kothari complete his education in spite of such adverse family circumstances. Luckily, the Chief Minister of the then Indore state Sir Seremal Bapna has been a close friend of his father. He invited Daulat Singh to Indore to study along with his children. Kothari passed his matric examination in 1922 from Maharaja Shiwaji Rao High School, Indore.

He came back to Udaipur as the city now had its own Intermediate College. D.S. Kothari passed intermediate examination in 1924 as a student of Intermediate College, Udaipur affiliated to the then Rajputana Board. He not only secured top position amongst all students of the Board but also had distinction in physics, chemistry and mathematics, a rare feat at that time. His achievement was recognised by the then Maharana of Mewar who awarded a scholarship of Rs. 50/- per month to Daulat Singh to pursue higher studies. The scholarship helped Prof. Kothari to complete his B. Sc. in 1926 and M.Sc. in 1928 from Allahabad University. Here too, Kothari topped among all students that appeared in M.Sc. examination. At that time, the Head of the Physics Department at Allahabad University was

* Adapted from a radio talk presented by Prof. Verma on All India Radio on the occasion of the tenth death anniversary of late Prof. D.S.Kothari.

none other than the famous Indian scientist Professor Meghnad Saha. Prof. Saha offered Kothari position of a demonstrator in the Physics Department of the university, which provided both of them more opportunities to know each other. Both of them felt a special liking for each other and this bond of affection and mutual appreciation led to a life long relationship between the two. Prof. Saha made it a point to stay with Dr. Kothari whenever he visited Delhi, although at that time Kothari used to reside in a rented house which was not very spacious. Dr. Kothari often used to mention about scholarly excellence, simplicity and frank behaviour of Prof. Saha.

Soon, the Government of U.P. offered Kothari a scholarship for higher education in England. He was faced with the dilemma that how would his mother and family members look after themselves in his absence. Dr. Kothari approached the Mewar State Government for a loan to overcome this financial problem. The Government was kind enough to lend him an interest-free loan of Rs. 3500/-, which he returned through monthly installments of Rs. 60/- on his return from England.

Daulat Singh Kothari, arrived in London in 1930. There is an interesting episode about the beginning of his life as a researcher in England. Kothari had an intense desire to do his research work with Ernest Rutherford at Cavendish Laboratory. At that time allocation of Indian students to different research centres was looked after by a British Officer of India House (equivalent to

Indian Embassy at present) in London. He decided that Kothari should join Oxford and refused to accept his request for Cambridge. This shattered the dreams of young Kothari, but the future had something else in store for him. Luckily he met a friend Shri Gulam Ali from Udaipur and his itinerary included a visit to Cambridge.

Shri Ali asked Kothari to accompany him to Cambridge, which he was to visit on a Sunday. Kothari readily agreed. On their arrival at Cambridge they went to see Cavendish Laboratory although they were apprehending that it may be closed on a Sunday. At the laboratory they met a lady who enquired about their purpose of visit and the place they have come from. The lady took them to the library where Lord Rutherford was busy in his study. Mustering his courage Kothari went to the great man and introduced himself as a student of Prof. M. N. Saha. Lord Rutherford immediately responded by saying that he was just reading through research paper of Kothari. It was really very interesting. He further enquired whether Kothari has completed all formalities concerning his admission to begin his work at the laboratory. Thus, Kothari's dream to work at Cambridge was accomplished even though the officer at India House had not agreed to it.

Dr. Kothari returned to India in 1933 after acquiring his Ph.D degree at Cambridge and continued to work as a demonstrator at Allahabad University. He was appointed Reader and Head of the Department of Physics at the University of Delhi in March 1934. At that time, the university used to offer

courses only up to B.Sc. degree and it was functioning from a rented building in Kashmere Gate area. The faculty of sciences of the university decided in June 1994 that it should extend study of physics and chemistry up to postgraduate level, which paved the way for establishment of now well-known faculty of science of the University of Delhi. At that time each Department in the university had only one position for a professor who also used to be the Head of the concerned Department. Dr. Kothari could persuade Sir Maurice Gwyer, who was the Vice Chancellor at that time, to bring renowned scholars to the university. Soon, distinguished professors, like Dr Majumdar, Dr Auluck, Dr Kitchloo, were donning the physics department.

Dr. Kothari was of the view that it is essential to study science subjects to a greater depth. Therefore, he extended the duration of degree courses in sciences from 2 to 3 years. A special paper on mathematics called Mathematics Relevant to Physics was introduced in B.Sc. (Hon.) course in physics. As a result, the physics students at the university received a good grounding in mathematics, which, in turn, provided the foundation necessary for pursuing research in physics.

Dr Kothari used to visit his native place Udaipur every year during summer vacation. Often a fellow professor accompanied him as his guest. Professor P.L.Bhatnagar, Prof. F.C.Auluck and many others used to discuss new research projects during these vacations. With these initiatives

Dr Kothari could create a congenial atmosphere to set high standards in teaching and research in the physics department. Soon this department became a front runner in teaching of physics in the country. A large number of brilliant and talented students were drawn to Delhi to join the University from different parts of the country. Many students of physics department of that time are occupying responsible positions in different organisations at present. I, too, had the good fortune to work as a Lecturer and later as a Reader in this department. We all learnt the lessons on working untiringly without any preconceived notions and prejudices. Dr Kothari was an excellent guide and teacher and all his students and colleagues always used to look forward to interact with him and listen to his brilliant discourses on cotemporary topics. He was an ideal teacher in all respects.

In 1948, Dr Kothari was appointed Scientific Advisor to the Ministry of Defence, Government of India. At that time, Defence Science Organisation (DSO) had only 140 scientists on its roll with opportunity to research on a limited number of fields. The credit for raising the status of Defence Science Organisation to its present position goes to vision and foresight of Dr Kothari. DSO is now a giant organisation with more than 25,000 scientists engaged in researches on a variety of defence problems relating to infantry, navy and air force including studies on hostile environments like deserts, mountains and other difficult terrains. The country

will always remain obliged to Dr Kothari for his contributions in this important field, which concerns welfare of all of us. Dr Kothari also wrote a book titled 'Nuclear Explosions and their Effect' during this period. The book, which has since been translated into German, Russian and Japanese languages highlights impending holocaust if nuclear weapons are used in future warfare.

In 1961, Dr Kothari was appointed Chairman of the University Grants Commission (UGC). He established Advance Centres in a number of universities to raise the standard of research as he was convinced that standards of teaching and research in universities should be at par with international standards. Dr Kothari was appointed Chairman of the Indian Education Commission, which the Government of India constituted in 1964. The report of this Commission, submitted in 1966, is often referred to as Kothari Commission Report. This is perhaps one of the most general reports, which considered all aspects of education in all its facets. In fact, the Commission deliberated on all aspects of the entire gamut of education, be it early childhood education, school education, university education, technical education, education of SC/ST and children from other economically backward classes or education of children of minority communities and made recommendations, which played a key role in shaping the education of future generations in the country. Dr Kothari knew the importance of education for the

society and the country. He often used to say that the future of our country is being moulded in our classrooms. The welfare of the country depends on the people who would come out through this process. Therefore, he always used to place a great emphasis on improving the standards of education in the country. In fact, he played a pioneering role in convincing the government in establishing the National Council of Educational Research and Training (NCERT), an organisation to work exclusively for the improvement of school education in the country. Dr Kothari was of the opinion that for proper mental development of the children, education should be imparted through the mother tongue. A commission, with Dr Kothari as its Chairman, was constituted to develop glossary of technical terms in different Indian language to facilitate mother tongue as the medium of instruction.

Now, I shall like to dwell upon humanistic character of Dr Kothari. In addition to a good scientist he was also a philosopher and spiritual thinker. He always adhered to his lessons on Jain philosophy, which he received as a child. Non-violence and working for the welfare of entire humanity inspired him all through his life. In this context, I would like to narrate an incident during the time when railway stations and other public properties were being destroyed by a group of people agitated over certain social issues. Many of those attending Indian Science Congress were of the opinion that stern action should be taken against people indulging in such

anti-national activities. When Dr Kothari was asked to express his views he said, "In my entire life, I have not come across a single incidence when an individual has set his own house on fire. If these people would have considered public property as their own, they would never have set it on fire. We must ask ourselves as to why people do not consider public property as their own".

Dr Kothari made significant contributions in science, improvement of education and defence, yet there is another field in which his contribution has been equally significant i.e. linking science with spiritualism. He always used to emphasise that there has been tremendous progress in modern times due to advancements in science, technology and production techniques; yet the level of violence, hatred and greed has never been as high as it is observed today. If the Weapons of Mass Destruction (WMD) continued to grow at this pace, the day may not be too far when the human race will be wiped out from the face of the earth. This was a matter of grave concern to Dr Kothari. He firmly believed that the solution to this problem could only be found through spiritually, that is, if religion and science come together to become a single entity in its true sense. According to him, science explores truth in the external world while spiritualism does the same in the internal world, that is, with an individual. Dr Kothari used to make a clear distinction between spiritualism and science; the former, according to him, was beyond science but not against

it. In other words, spiritualism is not anti-scientific and the two are not opposed to each other. Both are complementary to one another. But, at the same time, there should be no place in our lives for ideas like magic and superstition. Human beings require both science and spiritualism for their welfare as Einstein has said, "Science is lame without religion, and religion is blind without science."

Dr. Kothari always emphasised the need for striking a balance between science and spirituality in education so that it may facilitate development of morality and character. He was an ardent devotee of Gandhiji and firmly believed that welfare of human society needs both Gandhi and science. He had immense faith on Gandhian philosophy of truth and non-violence. He was of the view that human welfare is possible only by following the Gandhian philosophy.

Dr Kothari was a true teacher who inspired everyone like a saint. Whoever came in contact with him became his admirer. In the early hours of 4 February, 1993, this saint scientist set on his eternal journey peacefully in his sleep. India will always remember Prof. Kothari who as a scientist, educationist, administrator and above all a dreamer, played a key role in the post-Independent era to provide the country a sound educational system and a firm footing in scientific research. Much of the development in the field of science and technology in the country, as we see it today, are due to the untiring efforts of Prof. D.S. Kothari.

Some Aspects of Secondary Science Education*

D.S. KOTHARI*

THE ROLE of science and technology in the rapid progress of a country like ours is bound to be of the utmost significance. People in many lands, including our own, have contributed to the advance of science and its sustained progress. A fundamental example that immediately comes to one's mind is that all elementary particles in nature — be these electrons, protons or what not — are either Fermions or Bosons, these being named after the great Enrico Fermi and our great physicist Professor Satyen Bose of the University of Calcutta, who first studied the relevant quantum statistics about 1924. Science is a collective activity of mankind, and it is this which has led to its extraordinarily rapid, almost exponential growth. Scientific knowledge is doubling itself in some 15 years; and this means that a "normal individual" or must necessarily soon get out-of-date — in fact, far too much out-of-date — in relation to his awareness of the fast changing world around him. We cannot help this; but

what we must ensure is that the new generation studying in the schools, colleges and the universities is taught what is reasonably modern and not fed on what is obsolete. So rapid is the pace of progress in scientific research these days that, as has been aptly said, "What is in print is *ipso-facto* out of date". There is no time to pause to consider why in a relatively short period of time progress in science has been so much, and so rapid, as compared to other fields of human endeavour. The basic reason, of course, is that in the field of science — within the confines of the laboratory — the pursuit of excellence¹, objectivity and integrity, and rejection of narrow selfishness are much more easy to cultivate than in other fields, e.g., politics. Science encourages *co-operation* rather than *competition*, and its roots lie deep in man's highest aspirations and in his noblest motivations, more spiritual than material.

Everyone knows that nuclear physics, space exploration and micro- or molecular biology are the most exciting fields of current scientific research. It has been said, for example, that man has learnt during the last ten years more about the essential life processes, e.g., nature of genes, protein synthesis and so on, than during all the preceding centuries. As Weinberg (*Science*, 21 July 1961) has recently remarked: "The probability of our synthesising living material from non-living before the end

* Address by Dr D.S. Kothari, Chairman, University Grants Commission, at the sixth annual conference of the All India Science Teachers' Association, held at Udaipur on 26 December, 1961.

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of the century is of the same order as the probability of our making a successful manned round trip to the planets". In both cases the probabilities are high, provided the world is not plunged into a nuclear war. What our own contribution is likely to be in the things to come, great and small — and even our realisation of the welfare state — would depend primarily on the emphasis we place on education and pursuit of knowledge. As J.B. Conant (President Emeritus of Harvard University, U.S.A.) has recently observed: "The record shows it is a most difficult undertaking for a people to make a democratic government an effective, stable government. History has shown how readily a democracy may be destroyed by radicals to the right or to the left. Therefore, I say, the prime responsibility of educators in a democratic nation is to do what they can to ensure the preservation of that form of government which protects the maximum of political, social and cultural freedom."

The prosperity and strength of a country these days are directly dependent on the level of scientific and technical knowledge cultivated in the country and on its capacity to make use of that knowledge to serve practical ends. Let us note in passing that in the contemporary industrial and political climate, it is not too difficult for a newly developing country to build (with the assistance of industrially advanced countries) new fertiliser factories, steel plants, and so on; and these take only a couple of years or so to instal. But to

manage and run the plants efficiently and to maintain them properly, it requires a large number of competent technical men. It takes several years to train such men, and it is no easy task by any means. It demands a massive and reasonably sound educational system in the country. A very important part of the system, and specially so in relation to industrial development, is that of secondary education. As Sir Charles G. Robertson has observed in his inimitable book (*The British Universities*, p. 281, Benn's Sixpenny Library, London, 1930): "... if the nineteenth century was to prove up to the hilt one salutary truth it was that without an efficient and progressive system of secondary education, efficient and progressive universities were impossible."

At a recent conference, the Duke of Edinburgh (*Nature*, August 19, 1961) gave four basic reasons why every country should organise its technical training as efficiently as possible: "*Firstly*, the standard of intelligence, competence and workmanship in industry, commerce and agriculture controls absolutely the ability of any country to hold its own in the highly competitive business of international trade. *Secondly*, even in the least-developed countries, there is growing mechanisation has gone much farther. As a result, there is a growing need for technically competent persons capable of maintaining this increasingly complicated mechanical complex. *Thirdly*, technical training is essential if individuals are to make the best use of their aptitudes; and *fourthly* is the need for teachers, especially in technical

subjects. . . . It should be obvious that the less developed countries are less developed because the standard of technical knowledge is not very high, and the United Kingdom has the duty of providing more teachers not only for her own expansion but also for the developing countries of the Commonwealth”.

The Problem of Numbers

In this Conference we are concerned with the place of science in secondary education. Let us note the order of the numbers that are involved here. The total number of students at school these days is some 44 million — it was some 18 million in 1947. At the end of the Third Plan the number is likely to be 65 million. The number of school-going children beyond the 8th class (that is in the 9th, 10th and 11th classes) is at present 3 million. This is some 12 per cent of the population in the corresponding age group. The number is expected to rise from 3 million to somewhat more than 5 million by the end of the Third Plan. In the U.K. the number of students in school in the age group 11 to 14 is about 2.23 million and in the age group 15 to 18 it is about one-third of a million. These numbers are considerably less than what we have in India. About 60 years ago in the U.K., the percentage of all boys and girls aged 14 or 15 who were in school was only 4 per cent. In the case of the age of 16 to 17, the number was only 1 per cent. It was not until 1918 that full-time education up to the age of 14 was made compulsory.

The total expenditure on education in India is at present of the order of Rs. 3,500 million per year. It was some Rs. 580 million in 1947. (In the USA, in 1955, the total expenditure on education was \$14 billion, or 3.6 per cent of the gross national product, distributed as follows: Public elementary and secondary = \$9.4 billion, Private elementary and secondary = \$1.2 billion, Public higher education = \$1.5 billion, Private higher education = \$1.9 billion; the latest for 1961 is some \$26 billion).

Specialisation at School

At the stage of school education, specialisation should be avoided as far as possible. The bulk of the course should be common to all students. One of the serious defects of the present higher secondary school system in our country is that it requires a student hardly 13 years of age, to decide about the subjects he would later take up at the university. In other words, the choice of occupation has to be made when a student has hardly the ability or is in a position to make the choice. It is now widely recognised that school education should be wide in character and avoid specialisation. For example, the Science Masters' Association in the United Kingdom has recently issued a Policy Statement² which says: “All pupils should follow a balanced course of science subjects up to the end of their fifth form year... There should in fact be no division into science specialists and arts specialists until beyond this level, so that specialisation in arts or sciences.

Or even a combination of the two, may be available to all pupils of the necessary ability when they enter the sixth form... Science should be studied by all pupils in the sixth form". Again, in the USSR, all students, and not just those who would later take up science, do a considerable amount of mathematics and physics. Every student in his final year at school (the school course is from the age of 7 to 18) covers such topics as atomic structure, artificial radioactivity, energy released in nuclear reactions, cosmic rays, nuclear power stations, use of radioactive isotopes in agriculture and industry, and so on.³ Education should train young people for life and as such they all must do a good deal of physics, and "work, work and work". It is very important that some special attention (in 'course work' and other respects) is given to the talented students, the top 3 per cent or so of the student population. They constitute the nation's most precious asset. This and other basic problems of high school education are discussed in J.B. Conant's⁴ 'history-making' study of the American high school education — a 'must reading' for every one interested in school education.

School Curriculum

Another matter which should receive earnest consideration is that of the modernisation of the school curriculum.⁵ Let us take the example of physics. In the teaching of physics (and for that matter any science subject) great stress has to be laid on clarity of presentation, inclusion of adequate, *but not over-much*, mathematics; and encouraging the

students to think and apply the fundamental principles to concrete situations. It means that great effort and care are necessary in the selection of competent teachers and this is particularly so when dealing with those parts of the subject where emphasis is on concepts and ideas as distinct from information, data and facts. Bad teaching will generate confusion, and in worse cases may even distort science into superstition. The basic point is that the content of a syllabus must be directly related to the competency of the available teachers. A first-class syllabus, but without first-class textbooks and other essential teaching aids, would in the hands of third-rate teachers result only in chaos and confusion. In such circumstances a less ambitious, even mediocre syllabus, would yield better results.

The new science syllabus should emphasise science as a major human activity — as a means to discovering truth about nature. "As a human quest for truth, it (science) is much concerned with basic values and is indeed an active humanity, and it follows that schools have the duty of presenting science as part of our cultural and humanistic heritage, to be taught in harmony with, not in opposition to, the various arts subjects which alone have hitherto been called humanities.

Textbooks

The question of textbooks is the most important and urgent one for our country. Energetic action, on State and national basis, is required to progress the preparation of high-quality school textbooks.

In this task we can take real help from some of the excellent textbooks that have recently been prepared (particularly in the United States and the USSR), for example, the textbook on physics for secondary schools prepared by the Physical Science Study Committee (USA) under a grant from the National Science Foundation and also the Ford Foundation. The Committee consists of a group of university and secondary school physics teachers including some names internationally known for their contribution to research in physics. The school textbook apart from the fundamentals of classical physics also describes in simple language elementary ideas about atomic energy, wave mechanics and so on. The book opens with the statement: "Physics is the fundamental science of the Natural World. It tells us what we know about that world, how men and women found out what we know, and how they are finding out more today", and it concludes with the paragraph. "We have therefore come to the threshold of many new developments. In the years since 1925 (when wave mechanics was formally stated) wave mechanics has given us a great deal of understanding of the physics that was previously mysterious. There is much to be studied in these new fields, some of it already fairly well understood and a great deal of it the subject of the present work. This book is barely an introduction. A life can be well spent in a study of the physical world".

A new textbook on high school chemistry was prepared (under the auspices of the great chemist G.T.

Seaborg, now Chairman of the US Atomic Energy Commission) by nine college and university professors and nine high school teachers in a period of six weeks. "The high school teachers kept the college and university professors down to earth and the latter helped to raise the sights of the professional teachers. It was a mutually beneficial experience and this has been true of similar task forces in the other scientific disciplines". Of particular importance are the following observations of Seaborg at the annual banquet of the National Science Teacher's Association, March 27, 1961 — "I turn now to a discussion of what seem to me to be four definite trends towards improvement of science teaching in the secondary schools. They are: one — improving the course content; two — new emphasis on laboratory work; three — scaling up teacher training and standards; four — breaking down of barriers that for too long have cast the professional scientist and the professional teacher in the role of antagonists instead of collaborators".

Also, he pointed out: "The high school teacher should hold a B.Sc. or a B.A. with a major in the field that he is teaching, in addition to the required accreditation courses. Only a small fraction of our teachers are so prepared.

The National Science Foundation reports that of the 22,000 mathematics and science teachers currently entering into service annually, only 6,000 are fully accredited. The other 16,000 recruited because of the desperate shortage of teachers, all too often have only partial or uncertain competence.

One big problem is low teacher salaries. Pay increases are coming through but not fast enough. I know that your organisation and the National Education Association are hard at work on this problem. Anyone thinking about improving science teaching in high schools must face the necessity for getting substantially increased funds for teacher salaries. These funds will come from local and state agencies and from substantially increased indirect aid to Schools from Federal funds. One of the purposes of the Education Bill now pending in this Congress is to step up the indirect Federal assistance."

Good textbooks are absolutely basic to the entire educational process. Further, really good teachers are a very scarce commodity and therefore things (e.g., textbooks, demonstration apparatus and other teaching aids) should be so organised as would make it possible for a teacher of average quality to impart proper education in content and quality. If science education is to be carried out on a massive scale, there is no other alternative. (This is borne out by what has been done in the USSR during recent years).

Participation of School Teachers and Students in College -University Work

A selected number of the specially meritorious teachers should be given some opportunity to participate in advanced study and research at university centres, National Laboratories and other similar institutions. This can be arranged during summer vacations.

Reasonably liberal grants should be provided for the purpose. Contact with research, with 'living science' as it were, could generate in the teacher a new enthusiasm and interest in the subject, and this in turn would pass on to his students. The research participation should be organised carefully at a few selected centres to begin with; and for (say) a few hundred teachers every year, Summer Schools for what are usually termed 'refresher courses' should also be organised for school teachers. These programmes would help to bridge to some extent the present wide gap between school and university teachers, and this would benefit both.

Complementary to the above scheme, provision should be made for a selected number of top students in schools to spend their summer vacation at first-rate university centres, National Laboratories and professional colleges (specially selected for the purpose). This would expose some of our gifted students during their most impressionable years to the inspiring and exhilarating influence of outstanding men in the academic profession. It would considerably accelerate their scholarly development. We should do the same for a selected number of college undergraduates.

The schemes described above, apart from their value in raising the standard and quality of science education, would also help, may be to a small extent, the process of 'emotional integration' and in generating a corporate academic atmosphere in the country.

Laboratory Equipment and Workshops

For the expansion of science education in our country, it is very important to develop simple apparatus and equipment of good instructional value. This is an important and urgent task. Sections, or even divisions, for this purpose could with profit be established in some of the National Laboratories and university departments.

Every high school should be provided with a reasonably good workshop, say carpentry tools, simple mechanic's kit, and possibly a manual lathe. Teachers and students should be encouraged to build simple apparatus in the school workshop. One learns a lot of good science by using a simple and inexpensive apparatus to the limit of its capability and accuracy. On the other hand, one hardly learns little of real value by using a first-rate instrument in a third-rate way, as unfortunately is very often the case in our laboratories.

In the case of school buildings, it should be possible to improve effectively their fundamental utility, and at the same time cut down costs. Much thought has been given to this subject in recent years. For example, see: Ministry of Education (UK), *The Story of Postwar School Building*, Pamphlet No. 33 (HMISO 1957).

Teacher Shortage

For the implementation of the programme of secondary education during the Third Plan more than 60,000 additional teachers would be required. The shortage of teachers in India is a

serious problem. In fact, this has now become an acute world problem, and it is much more accentuated in India. If we are to meet the problem of shortage of teachers, an approach, unconventional in many ways, would be required. For example, it may be desirable to introduce education as a part of the first degree course.

To meet the problem of serious shortage of mathematics teachers U.K. (University College, London) has recently launched a scheme of evening classes designed for teachers working in schools. As the well-known Crowther Report (1959) says: "It is necessary to do more than is being done to attract men and women of the highest intellectual calibre into teaching".

The teaching profession should be made really an attractive one. In this connection reasonable salaries are important, but by no means everything. Opportunities of professional advancement, possibility of migration to a college or university, recognition by the society of the value and importance of the teaching profession, and many such things would go a long way in attracting to the profession a modest proportion of men and women of high intellectual abilities and character. This is an essential requirement for realising as we must the kind of society we all have in view.

Education provides a good illustration of the 'feed-back' process. If things are so organised that every year an appreciable number of our best young men join as teachers in our schools and colleges, we shall have a continually escalating improvement in education. On

the contrary, if what we plough back into our schools and colleges are young men with less than average ability, then standards would rapidly (exponentially) go down as years roll by. The key to a

continuous improvement of standards is to feedback into the teaching profession every year a reasonable proportion of the best young men turned out from the universities.

References

1. The Pursuit of Excellence — Education and the Future of America. The 'Rockefeller Report' on Education (1958).
2. Published for the S.M.A. and A.W.S.T. by John Murray, London. 1961.
3. LEWIS, J.L. Education in the USSR with particular reference to physics. *Bulletin of the Institute of Physics* (London) July, 1961; *New Scientist*, 12 Oct. 1961; Physics Teaching in West Germany, *New Scientist*, 5 Oct. 1961.
4. CONANT, J.B. The American High School Today — a first report to interested citizens. McGraw-Hill (1959).
5. International Education in Physics. Proceedings of the International Conference on Physics Education, UNESCO House, Paris 1960. Also Bryan Thwaites, on Teaching of Mathematics. The Commonwealth Library (London), 1961.

Grains of Hope: Debate on Pros and Cons of Golden Rice in Biology Classroom

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THIS ACTIVITY is an exemplar for debate on challenging issues in biology.

Background Information

Genetic modification is not novel. Humans have been altering the genetic makeup of plants for millennia, keeping seeds from the best crops and planting them in following years, breeding and crossbreeding varieties to make them taste sweeter, grow bigger, last longer. From a weedy plant called teosinte with an “ear” barely an inch long has come our foot-long ears of sweet white and yellow corn.

The debate over the use of genetic engineering in developing countries recently went from simmer to boil about rice. This staple food is eaten by three billion people and grown on hundreds of millions of small farms.

According to the World Health Organisation, between 100 and 140 million children in the world suffer from

Vitamin A deficiency and another 50,000 go blind every year because of that deficiency, and half of those children die within a year of losing their sight. Most of these children live in countries where their only food consists of one or two bowls of rice a day.

In the late 1980’s Swiss plant scientist named Ingo Protrykus (Fig. 1) got the idea that perhaps rice could be genetically altered to produce β carotene, a building block precursor to Vitamin A. Thus, he reasoned, would allow local farmers to grow nutrient-enhanced rice, and which would prevent Vitamin A deficiency. He enlisted the help of German biochemist Peter Beyer. The purpose was to insert genes carrying a desired trait into a plant that does not have the trait.



Fig. 1: *Ingo Protrykus and Peter Beyer*

What They Did?

Two of the genes for the *desired* enzyme in the β carotene pathway were taken from daffodils (*Narcissus*

pseudonarcissus) that enable the rice (*Oryza sativa*) endosperm (the interior of the kernel) to produce in its grains β carotene. The genes (*psy* and *lcy*) that coded for the proteins phytoene synthase and lycopene cyclase respectively in daffodils were identified. The other two genes (*ctr 1*) which code together for one enzyme (phytoene desaturase) came from a plant bacterial pathogen *Erwinia uredovora* for antibiotic resistance marker that codes for hygromycin, an aminoglycoside antibiotics that inhibit protein synthesis. These gene expression constructs were snipped from isolated samples of DNA (Fig.2).

The gene for each enzyme never goes alone. It has to be accompanied by a promoter, the segment of DNA which signals the gene to turn it on, i.e. to transcribe the DNA sequence into RNA. At the end of the gene, there has to be another signal, a terminator, to make the RNA, so it can be translated into protein.

These gene constructs are inserted into the vector Ti plasmid: nature's genetic engineer, that occurs inside a soil bacterium, *Agrobacterium tumefaciens*.

These genetically modified agrobacterium are then added to a Petri dish containing rice embryos. As they infect the embryos, they transfer the genes that encode the instructions for making β carotene.

The transgenic rice plants are now crossed with strains of rice that are grown locally and are suited to a particular region's climate and growing conditions.

After over ten years of work, they announced success in 1999. And the

world got "Golden rice" so named for the pale yellow grains coloured by the β carotene contained within. In fact the term "Golden rice" was coined by a Thai businessman. It has been hailed by some as a potential solution to the suffering and illness caused by Vitamin A deficiency. This rice could save a million kids a year. In 2005, a new strain called "Golden rice 2" has been announced at biotechnology company Syngenta (Fig.3). This improved variety has 23 times more β carotene. Neither variety are available for human consumption, so far.



Wild type Golden Rice 1 Golden Rice 2

Fig. 3: Photograph of Golden Rice 1 and Golden Rice 2 as compared to white rice

However, the most significant part of this story which remains to be told is neither scientific nor logistical, but rather moral/ethical. We will examine a few scientific and moral/ethical concerns related to this technological achievement: about golden rice, in particular, and transgenic crops, in general.

Scientific Concern # 1

Are genetically modified foods better with respect to nutrition?

RESPONSE

Yes. White rice is low in protein. It has very little iron, and virtually no Vitamin A. "Golden rice" containing the β

carotene can help to prevent Vitamin A deficiency. Detractors like Dr Vandana Shiva from India says, even if golden rice is successfully introduced, it will likely do little to ameliorate Vitamin A deficiency, because it produces so little β carotene — just 1.6 $\mu\text{g/g}$ at present, with a goal of 2.0 $\mu\text{g/g}$ of rice. But the new strain called “Golden rice 2” has 23 times more β carotene (upto37 mg/g).

Scientific Concern # 2

Are genetically modified foods safe to eat?

RESPONSE

Yes, as far as we know, there is no risk to consumer health. Risks exist everywhere in our food supply. Since genes make proteins, it might be possible for some individuals to develop an allergic reaction to the new proteins found in golden rice. However, enzymes involved in biochemical synthetic pathways are not known to be allergenic. In addition, there is no reported case of anyone suffering ill effects from consuming the foods from the transgenic plants.

Scientific Concern # 3

What if you get too much β carotene?

RESPONSE

Possible, but highly unlikely. There are health problems known to be associated with too much β carotene, such as liver damage. If these people, who have only rice to eat, suddenly have only golden rice to eat, they could get way too much β carotene and fry their livers.

Scientific Concern # 4

Will it be absorbed into the body?

RESPONSE

Yes, but isn't something better than nothing. β carotene is not water soluble, it is fat soluble. Because rice contains virtually no fatty acids, absorption in the small intestine will occur at a very low rate. Thus, most of the β carotene produced in the rice will be excreted, doing no good what so ever to the person who ate it.

Scientific Concern # 5

What marker genes were used in the construction of these strains and what effect will this have on the environment where these plants will be grown?

RESPONSE

In the early days of genetic engineering, marker genes encoded antibiotic resistance and there was some concern that these genes could be transferred to disease-causing bacteria. The sequence of events necessary for such a transfer seems quite unlikely and there is no evidence that it occurs.

Scientific Concern # 6

How might the introduction of this crop affect the many species (“weeds” and “pests”) that live where it will be implanted? For example, could the genes for β carotene synthesis be transferred to another plant?

or

What would happen to insects that might eat the β carotene?

RESPONSE

Given the difficulty in constructing this strain, it seems unlikely that the entire biosynthetic pathway could be transferred to another plant or weed. Even if this did occur, it is difficult to imagine how β carotene would give another plant some sort of selective growth advantage. If an insect ate β carotene, it would most probably be like any other nutrient.

Scientific Concern # 7

Will super weeds arise as genes that give crops the ability to kill insect pests or to withstand herbicides find their way into weeds?

WHAT THE RESEARCH SAYS

Studies have found no super weeds, but anecdotal reports have surfaced. Because pollen from GM plant can often fertilize weedy relatives of those plants. GM crops should not be grown near such relatives.

Scientific Concern # 8

Will this strain require the use of additional pesticide or herbicides when compared with the strains currently grown?

RESPONSE

Before this strain of rice can be used, it will have to be crossed with local strains of rice that have been adapted to local growing conditions. This will produce varieties that require no additional herbicides or pesticides.

Scientific Concern # 9

Can the use of this crop and GM foods cause unexpected ecological effects possibly harm the environment for our children and all generations to come?

RESPONSE

Most scientists agree: The main safety issue of genetically engineered crops involve not people but the environment. There is, so far, no conceptual negative effect on the environment. Advocates of genetically engineered crops argue that the plants offer an environmentally friendly alternative to pesticides, which tend to pollute surface and ground water and harm wildlife.

Scientific Concern # 10

What if the transgene jump into a plant which does get a selective advantage or disadvantage from them?

RESPONSE

That's not very likely. The odds of a transgene jump are so utterly low that it is almost a non-issue.

Scientific Concern # 11

Will innocent creatures be hurt by insecticides built into many GM crops?

WHAT THE RESEARCH SAYS

Laboratory studies indicate that non-target insects, such as monarch butterflies could be harmed, but field studies suggest that the risk is small.

Scientific Concern # 12

Will GM crops suddenly fail because insect pests will evolve tolerance to built in insecticides and because weeds will evolve immunity to herbicides sprayed over fields of herbicide - tolerant GM plants?

WHAT THE RESEARCH SAYS?

No failures have been documented, but they are likely to occur. Critics and proponents of GM crops disagree over the adequacy of current preventive measures.

Scientific Concern # 13

Will the use of this crop reduce biodiversity?

RESPONSE

If the crop is successful, this is a real risk. However, this risk is not restricted to this crop or transgenic crop in general. Farmers will continue to adopt new varieties of plants when these plants provide the farmer with an improved product.

Scientific Concern # 14

What next?

RESPONSE

Proceed with caution. No doubt, those who benefit are poor and disadvantaged. But there are hazards as well as collateral damages. Genetic engineering is Pandora's box, and we are releasing uncontrollable forces into our environment and food supply. Modified crops can spread their novel genes to

wild relatives, and such altered organisms might become hard to manage. Whether GM food will deliver on their promise of eliminating world hunger and bettering the lives of all remains to be seen. But their potential is enormous.

Moral/Ethical concerns

1. Who will profit from this crop being adopted? How will this crop affect local economics?
2. What do potential consumers think and feel about the product? For example, will people accept this yellow rice, or will their fear of change or their preference for white rice prevent this market from living up to its potential? Are their views important?
3. What impact will the survival of an additional one million children a year have on the local countries? For example, will these countries be able to continue to feed these people and provide basic housing and medical care?
4. What effect will the survival of these children have on the population growth in these countries? For example, will these countries be able to continue to feed these people and provide basic housing and medical care?
5. What effect will the survival of these children have on the population growth in these countries? Should distribution of this product be contingent on the establishment of comprehensive family planning programs (i.e. birth control education) in these countries?

References

YE, XUDONG; AI-BABILI, SALIM; KLOTI, ANDREAS; ZHANG, LING; LUCCA, PAOLA; BEYER, PETER; Potrykus, Ingo Engineering provitamin A (beta-carotene) biosynthetic pathway into (carotenoid-free) rice endosperm. *Science* 287(2000): 303-305.

MADALEINE, NASH. Grains of Hope. *Time* 156/5 (31 July 2000) : 38-40.

C.V. Raman — A Physicist Extraordinary — Platinum Jubilee of an Indian Nobel in Physics

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CHANDRASEKHAR VENKATA RAMAN is the only Indian scientist who has got the Nobel Prize in science. Raman was also the first Asian to have won the Nobel Prize in science. Raman won the prize for his celebrated discovery, the Raman Effect.

In fact, a voyage to Europe in the summer of 1921 gave Raman the first opportunity of observing the wonderful blue colour of the Mediterranean Sea. He began to think why was it blue? Sitting on the deck of the sea he pondered over



C.V. Raman
(07-11-1888— 21-11-1970)

this and finally came to the conclusion that the blueness of the sea was due to the scattering of light by the water molecules. But, this hypothesis of Raman needed experimental verification. On returning to his laboratory in Calcutta (now known as Kolkata), Raman tested his hypothesis by studying the scattering of light from various substances.

Meanwhile, Arthur Compton was able to show that when scattered by electrons the frequency of X-rays undergoes a change. This effect was called the Compton Effect. It occurred to many scientists that light can also change its frequency when scattered by the molecules of a transparent medium. Some German physicists like Smekel, Hendrik Kramers and Werner Heisenberg were able to predict this theoretically. But, to prove it experimentally was not an easy task. Although many scientists were making efforts in this direction, only Raman met with success. In February, 1928, he was able to demonstrate experimentally that when light passes through a transparent medium, a certain part of it gets scattered resulting into a change in its frequency. This phenomenon is called *Raman Effect*. This effect is an experimental demonstration of the fact that light photons and the molecules of medium do exchange energy which manifests itself as a change in the frequency of the scattered light.

The explanation of *Raman Effect* in terms of quantum theory is very simple. When a photon of monochromatic light interacts with a molecule of a transparent medium, whether solid,

liquid or gas, three things might happen. The molecule interacting with the incident photon just scatters it without exchanging any energy with it. Thus, the frequency of the scattered light remains the same as that of the incident photon. In the second scenario, the molecule of the scatterer might absorb some energy from the incident photon. Consequently, the scattered photon has lower energy or lower frequency as compared to that of the incident photon. A third situation may also arise when the molecule of the scatterer might hand over some of its energy to the incident photon. The scattered photon thus have higher energy or higher frequency as compared to that of the incident photon.

Thus, the spectrum of the substance contains in addition to the unmodified line corresponding to the incident photon lines with lower and higher frequencies as well. Such a spectrum is called *Raman spectrum*. The lines of lower and higher frequencies on either side of the unmodified line present in the spectrum are known as *Raman lines* or *Stokes' and Anti-Stokes' lines*.

The study of Raman spectrum gives important information about the molecular structure of substances. The *Raman Effect* has also proved very useful in understanding the molecular structure of chemical compounds. Invoking this effect it has also been possible to determine the internal structures of many chemical compounds. The *Raman Effect* can also be used to advantage for determining the internal structure of crystals. In fact, the discovery of *Raman Effect* has led to the

development of a new branch of spectroscopy, known as *Raman Spectroscopy*.

Initially, monochromatic source of light was obtained by passing sunlight or light from mercury lamp through filters. Such light has single colour or wavelength. But, with the discovery of laser in 1960, *Raman Effect* has indeed proved to be a powerful tool in the hands of scientists. As is well known, laser is basically a highly monochromatic and coherent light source having high intensity.

Apart from Physics and Chemistry, *Raman Effect* has important applications in other branches of science too. Raman spectra can characterise minerals, detect trace amounts of organic substances and identify biological substances such as proteins, DNA, amino acids and plant pigments. The method is often used in medicine for tasks ranging from analysis of gases to detection of microbes.

In not too distant a future, perhaps in 2008, a rover on Mars will carry a compact Raman spectrometer along with a microscopically thin laser beam. Pressing its robotic arm against a rock, the rover will look for signs of any organic life and any signs of life that might have existed there. In the more distant future, a spacecraft hardened to withstand Jupiter's intense radiation may land on its icy moon Europa and may look for any signs of life there.

Raman spectroscopic studies have also been made on diamonds. Earlier, the scientists had studied the infrared absorption spectra of diamonds. The

infrared radiation on passing through a diamond gets absorbed. On the basis of this, the scientists were able to get information about two basic types of diamonds, known as type-I and type II. In type-I diamonds, two infrared absorption peaks were observed while in type-II only a single peak was observed.

Raman found that both the types of diamonds exhibit the same Raman line or Raman frequency. Then, why is it that different types of diamonds show different infrared absorption spectra? Based on his studies Raman concluded that the infrared absorption spectra of diamond is characteristic of its internal structure. He said that type-I diamonds have tetrahedral while type-II diamonds have octahedral symmetry. However, the scientists have now proved that the infrared absorption spectra of diamond is due to the presence of nitrogen in it.

Whatever may be the cause for the infrared absorption spectra of diamonds, the important question that remains to be decided is whether

diamond has tetrahedral or octahedral symmetry or it has been tetrahedral and octahedral symmetries. It is still an open question.

Although Raman was awarded Nobel Prize for his work in the field of optics, his initial work was in acoustics. He made a deep study of the Indian musical instruments like Dhol, Veena and Tanpura. Besides, he has also made many scientific discoveries in ultrasonics, magnetism and crystal physics. He also made major contributions in establishing Indian Academy of Sciences, Bangalore and the Raman Research Institute.

To commemorate the legacy of C.V. Raman, 28 February, the day the discovery of Raman Effect was announced, has been designated as the National Science Day. Raman was awarded the Nobel Prize in Physics in 1930. The year 2005, which has been declared as the World Year of Physics, also happens to be the Platinum Jubilee Year of Raman's winning the Nobel Prize.

Evidence of Scientific Reasoning: A Cross-Grade Study

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THE OBJECTIVE of science teaching is two-fold. One is transmission of theories, facts and principles and the other is to induce the young minds into the process of scientific reasoning. Unfortunately, the legacy of our education system is to place emphasis on the transaction and retrieval of information rather than the meta cognitive aspects of learning. The acquisition of content has its own significance, but in no way it means complete education. Mere accumulation of information devoid of the algorithm by which these information has been processed will nurture only 'school skills' that determine the learner's success within the school system. It is also to be noted that evaluation of content through set answers to set questions often has the danger of distorting reality in the minds of young learners. Unless we teach them the process along with the product, the agenda of developing proper human resources remain unresolved. The present day world and especially, the job market demands 'real world skills' like problem-solving or decision-making ability from its work force. Competency in the process of scientific reasoning may help the learners in that way. Moreover,

the conscious assimilation of content and context will help the learner in the long run (McCain, 2005).

Cognitive psychologists believe that the formal operational stage is the optimum period to attain scientific reasoning. Several researches, however, asserts that a large portion of high school and even college students failed to show the evidence of formal thought to solve problems in science and opined that attainment of scientific reasoning is not a universal phenomenon. Piaget suggested that interplay of several factors like the extent of neurological development, appropriate social environment and attainment of concrete operational skills may explain the evidence of scientific reasoning in a child. A meta-analysis of researches in scientific reasoning with central questions like i) What role does biological maturation in the development of formal reasoning? ii) Are Piaget's formal tasks reliable and valid? iii) Does reasoning constitute a unified and general mode of intellectual functioning revealed that although Piaget's work and what has spurred from it leaves a number of unresolved theoretical and methodological problems, it provides an important background from which to make a most significant education objectives (Lawson, '82).

Teachers are the main catalysts in inducing these changes in learners. Because it has been observed that, when the students used an indepth approach in understanding a concept in Science, they could explain it with it's mechanism, or with cause-effect relationship

prediction or could resolve discrepancies in knowledge. They could be engaged in 'On-line theorising'. Whereas students with surface approach, gave explanation which were reformulations of the questions referring to basic factual information (Chin et al., 2000; Nuthall, 2000). It goes without saying that the former one provides more desirable approach to classroom instruction. But how far our students are attaining the basic reasoning processes in science and how far are the teachers capable of providing it is a question of pedagogical importance. The present study aims to that end.

Sample

The participants in the study are 794 school children from 7th to 10th grade from different schools and 150 pre-service trainee science teachers from different Teacher Education Institutes in Kolkata suburbs. The mean age of the children is 14.5 and that of the student teachers is 25.1.

Materials

1. Raven's Progressive Matrices Test.
2. Two tests to assess conservation of liquid and solid as developed by – J. Piaget.
3. One test to assess proportional reasoning (developed by – Karplus & Karplus)
4. A test to assess proportional cum

probabilistic reasoning (developed by – Railey).

Method

The R.P.M. test was given to 1200 school children in (grade 7 to 10) from which 794 school children were identified with scores & above the 1st quartile but below the fourth quartile. The reasoning tests were administered within a fortnight of administration of R.P.M. test. Student teachers were given the tests after the completion of their examination on teaching practice.

Scoring of the conservation tests were done on all-or-none basis in which zero indicated pre-operational level and one indicated concrete level. Performance in Tests 3 and 4 were scored as below:

1. Score 0 : Pre-operational level : When data were analyzed in an illogical way.
2. Score 1: Concrete level: Data were analyzed additively the difference uncoordinatedly with other conditions.
3. Score 2 : Transitional level : Some partial approach of proportional reasoning were used but failed to generate a complete and correct procedure.
4. Score 3 : Formal level : When a correct procedure of deriving a proportional ratio was adopted.

Result and Discussion

Table 1: Performance of School Children in Conservation Tasks

Grade	<i>Frequency of Responses in Conservation Task (%)</i>			
	<i>Liquid</i>		<i>Solid</i>	
	<i>Pre-operational</i>	<i>Concrete</i>	<i>Pre-operational</i>	<i>Concrete</i>
7	33	67	38	62
8	27	73	50	50
9	11	89	39	61
10	08	92	35	65

Table 2: Performance of School Children in Formal Operational Tasks

Grade	<i>Frequency of Responses in (%)</i>							
	<i>Proportional Reasoning</i>				<i>Proportional cum Probabilistic Reasoning</i>			
	<i>Pre-op.</i>	<i>Concrete</i>	<i>Transitional</i>	<i>Formal</i>	<i>Pre-op.</i>	<i>Concrete</i>	<i>Transitional</i>	<i>Formal</i>
7	34	46	0	20	65	35	0	0
8	23	42	0	35	59	41	0	0
9	37	15	0	48	52	45	2	1
10	29	24	0	47	50	48	0	2

Table 3: Performance of Student-Teachers

Test	<i>Frequency of Response in (%)</i>			
	<i>Pre-operational</i>	<i>Concrete</i>	<i>Transitional</i>	<i>Formal</i>
Conservation Liquid Solid	7	93	N.A.	N.A.
Proportional	37	63	N.A.	N.A.
Proportional cum Probabilistic	66	18	0	16

The tables show that a significant number of students at the upper secondary grades, and even the trainees in different Teacher Education

institutes, who aspire to be science teachers in near future, fail to show the evidence of scientific reasoning. The result is at par with some earlier

research works which observed that the proportion of college students consistently using formal thought for scientific tasks to be as low as 25% to 50% (Lawson and Snitgen, '82, Hilman and Agne, '78, Killian, '79, Thorton & Fuller, '81).

In the test on proportional reasoning, 20% of 7th grades were found to be in formal operational level and in proportional cum probabilistic test, not a single student responded in formal operational level. Same trend was observed consistently for the upper graders as well. The large number of responses at the concrete level implies the use of ample concrete examples in the teaching of science. Use of computer simulation, if available, may also help the teacher in this aspect.

The most significant part of the findings is the insignificant number of student teachers at the formal level. One of the Central Concerns of Education is to induce rationality in young minds. But, if the teachers are not capable of producing the required ambience, who

else will do that? This has a serious implication for the curriculum makers in the Teacher Education. A study would be worth mentioning in this context. Lawson and Snitgen, ('82) examined the possibility of teaching the scientific thinking skills using an inquiry based approach on biological science for the elementary teachers. A substantial gain was observed in performance on tests of proportional reasoning and control of variables. No gain, however was observed due to training in conservation concepts. If the Teacher Education programme can provide with adequate experience to enhance scientific reasoning skills in student teachers, a subsequent improvement and direction will be observed in the application of scientific principle in later life of school children. Because, 'it is not lab-activity perse that induce science learning, instead student must be encouraged to think scientifically about situations to control variables, to test hypothesis and so on' (Mayer, '87).

References

- IRWIN, A.R. 2000). Historical Case Studies : Teaching the Nature of Science in Context. *Science Education*. Vol.84 (i)
- LAWSON, A.E. 1985. A Review of Research on Formal Reasoning and Science Teaching. *Journal of Research in Science Teaching*, Vol. 22 (7)
- LAWSON, A.E. 1991. Is Piaget's Epistemic Subject Dead? *Journal of Research in Science Teaching*, Vol. 28 (7).
- MAYER, R.E. 1987. *Educational Psychology : A Cognitive Approach*.
- McCain, T. 2005. *Teaching for Tomorrow*. Corwin Press.

Levels of Some Heavy Metals in *Pennisetum Purpurem* (Elephant Grass) Growing Around Auto Mechanic Dumpsites

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DEPENDENCY of herbivores on plant via the food chain concept is of great concern and deserves careful examination. As reported by Wild 1973, most plants, grown on heavy metals polluted soil, absorb and translocate these metals which eventually bioaccumulate in their tissue (1). Unfortunately, large number of these plants show no heavy metal toxicity sign after being accumulated beyond the threshold limit (2). In ecosystem concept, plant serves as a primary food source for animal and human beings (3). Basically, plant depends on the local soil on which it grows for mineral intake, and therefore

soil can be described as the ultimate primary source of trace metals in plants and animals (4).

Of importance in animal husbandry is a plant species, *pennisetum purpurem*, a monocotyledon that belongs to a class of weed (grass), which thrives in a habitat that is continuously disturbed by human activities (5). Re, M. et. al., (2) reported that in the process of plants mineral uptake, trace metal e.g. Cd and Pb, are absorbed, translocated and accumulated without any sign of phytotoxicity. Accumulation, of these metals, in the plant tissue is reportedly responsible for the entry of some heavy metals into animal food chain (6). This, therefore suggests the importance of carry out leave analysis in order to determine the level of these metals bioaccumulated this vegetable, popularly known as "Achara" in eastern part of Nigeria, where it is considered a delicacy (5). In this context, it is appropriate to describe this plant a gateway for some hazardous metal ingestion by human beings which if bioaccumulated beyond their respective human safe limit could lead to a serious health disorder. For instance, Cd bioaccumulative effective in human includes sterility, heart diseases, liver damage (7) and kidney dysfunction (8). In the case of Pb, its adverse biological effect is its activity as a potent enzyme inhibitor in human and animal biochemical systems (9). Pb toxic concentration in bone marrow is a major inhibitor of the synthesis of haem part of haemoglobin and this results in anaemia (10,11). Similarly, continuous ingestion of Cu in excess of its nutritional requirement among farm animals

biomagnifies in their livers which results in necrosis of liver cell, loss of appetite and death from appetitic coma (6, 12). Zinc is significantly known as one of the essential micronutirents; however, excess concentration can be more detrimental to plants than animals (1, 13).

This study, therefore, centers on the determination of Cu, Pb, Fe, Zn and Cd levels in *pennisetum purpurem* which grows wildly on and around selected automechanic dumpsites in order to establish if these metals have been excessively accumulated, in this plant species, which in turn may be fed on by ruminants and human beings.

Materials and Methods

A total of six representative *pennisetum purpurem* samples; three from each auto mechanic dumpsite were collected. Three references samples (controls) were also collected from 200 metres away for each auto mechanic dumpsites villages (4). Each fresh sample was gently, rinsed with deionised water, air-dried for ten days (4), finely grounded and sieved through 2 mm pore size rubber sieve. The samples were stored in pre-cleaned and dried polythene bags prior to digestion. 1.0 g of each sample was digested in 100.00 mL Pyrex beakere, concentrated nitric acid was added in two successive aliquots (12.0 mL and 8.0 mL), by gentle boiling on hot plate set at temperature of 60 C. The digestion continued slowly until the digest was almost dried. The residue was dissolved in 20 mL of 0.1M HNO₃ acid, boiled and cooled [2]. The mixture was then filtered through Whatman filter paper (No. 1) into

a 50.0 mL volumetric flask and made to volume with deionised water. Each metal concentration was determined by aspiration of each sample filtrate into an Atomic Absorption Spectrophotometer (PYE) UNICAM 2900A, equipped with various metals Hollow Cathode Lamp (HCL), using air-acetylene flame. The wavelengths used were 217.0 nm, 213.9 nm, 228.8 nm, 248.3 nm and 324.8 nm for Pb, Zn, Cd, Fe and Cu respectively.

Results and Discussions

Presented in Table 1 is a summary of the results of the concentrations (dry weight) of Cu, Pb, Fe, Cd and Zn obtained in the plant. Critical examinations and comparisons of the results, control and natural values of these metals in plant as presented in Table 1 revealed that pennisetum purpurem growing on and around Elekahia auto mechanic dumpsites contained copper which ranged between 10.00 - 22.77 $\mu\text{g g}^{-1}$ with mean concentration of $14.26 \pm 7.37 \text{ g g}^{-1}$ while its co-efficient of variation fell within its natural concentration range of 5.00 — 20.00 $\mu\text{g g}^{-1}$ but its mean concentration was considerably higher than the value ($9.55 \pm 0.64 \text{ g g}^{-1}$) obtained in the control. It could therefore be inferred that significant amount of Cu are in the species around the dumpsites. Except Zn, the mean concentration of Pb ($89.91 \pm 59.91 \text{ g g}^{-1}$), Fe ($871.80 \pm 102.36 \text{ g g}^{-1}$) and Cd ($3.01 \pm 1.87 \text{ g g}^{-1}$) were significantly higher than the respective values obtained in the control. If grazed by ruminants, as evidenced by McDonald *et al.*, (13), or its succulent pseudostem tillers were eaten by human

being as reported by Akobundu, (5), this plant specie appears to be a gateway for some hazardous metals ingestion by herbivores (sheep and goats) and human beings. Similarly, this plant species growing wildy on and around Mile III auto mechanic dumpsites contained $15.46 \pm 5.46 \text{ g g}^{-1}$ of Cu, $67.98 \pm 20.10 \text{ g g}^{-1}$ of Pb, $728.83 \pm 185.94 \text{ g g}^{-1}$ of Fe, $13.31 \pm 10.98 \text{ g g}^{-1}$ of Cd and $67.73 \pm 30.12 \text{ g g}^{-1}$ of Pb. Lead, Iron and Cadmium in this plant were significantly higher in concentration than their respective values in the control. These could simply be described as poison to ruminants and human beings as considerable amount of these metals were accumulated by these plants that were found striving on metal-polluted soil relative to the controls.

Recommendation and Conclusion

Considering the Long term toxic effect via gradual bioaccumulation of these metals in ruminants and human beings, it is scientifically considered recommendable, to discourage grazing animal on this plant specie growing on and around any dumpsite, most especially auto mechanic dumpsite. Also, the populace should be educated of the danger involved in eating the pseudo tiller of this plant specie that grow on metal-polluted soil and thus should be totally discouraged. Our previous study showed that soil around the auto mechanic settlement/village were heavy metals polluted which appeared to have been from an indiscriminate disposal of metal scraps and metal containing materials [14]. These metal scraps undergo oxidation/corrosion stages and thus free them into the soil, which in turn is absorbed by the

Table 1: Concentration of some metals (mg g⁻¹ dry weight) in elephant grass (pennisetum purpurem) wildy growing in and around Elekahia and Mile III auto mechanic village dumpsites.

<i>Automechanic Village</i>	<i>Cu</i>		<i>Pb</i>		<i>Fe</i>		<i>Cd</i>		<i>Zn</i>	
	<i>A</i>	<i>B</i>	<i>A</i>	<i>B</i>	<i>A</i>	<i>B</i>	<i>A</i>	<i>B</i>	<i>A</i>	<i>B</i>
Sample pt.1	10.00	21.82	46.05	72.37	756.41	916.67	1.06	3.73	71.67	104.17
Sample pt.2	10.00	10.00	157.90	85.53	955.13	724.35	3.19	4.79	126.67	56.67
Sample pt.3	22.77	14.55	65.79	46.05	903.85	544.87	4.79	4.79	100.00	48.33
Mean	14.26 ±59.91	15.46 ±5.46	89.91 ±59.91	67.98 ±20.10	871.80 ±103.17	728.63 ±185.94	3.01 ±1.87	4.44 ±0.61	99.45 ±19.45	69.72 ±30.12
Co-efficient of variation (%)	51.68	38.56	66.40	29.57	11.74	62.13	62.13	81.82	19.56	43.20
Range	10.00 -	10.00 -	46.05 -	46.05 -	756.41 -	1.06 -	1.06 -	3.73 -	71.67 -	48.32 -
	22.77	21.82	157.90	85.53	955.13	4.79	4.79	4.79	126.67	104.17

A = Elekahia Automechanic Dumpsite

B = Mile III Automechanic Dumpsite

plants and finally accumulate in the plant tissue. In conclusion, proper waste management should be enforced on the authority of these auto mechanic

villages, by the state government. The auto mechanic professionals also should be educated on the danger poised to life and environment.

References

- (1) WILD, A. 1973. *Rusell's Soil Conditions and Plant Growth*, (11th Edition) Longman Publishing Company, New York, USA.
- (2) RE, M., GARAGIOLA, M.G. and CROVATO E. 1983. Cadmium Distribution within Corn Plants as a function of Cadmium Loading of the Soil, *Environmental Research.*, 30, pp. 44- 49.
- (3) GREG, O. 1992. *Soild, Vegetation, Ecosystem*, (5th Edition). Oliver and Boyd, U.K.
- (4) ADEYEMI, O.G., ADEDIRAN, G.O. and ABDULRAHAMAN, F.W. 1995. Level of Some Heavy Metal in Blood Samples of Selected Mechanics, Drivers and their Working Environment. Proceedings of Symposium: Chemistry and Biotechnology for National Development, *SHEDA Science and Technology Complex Abuja. 17-18 th August, 1995.*
- (5) AKOBUNDU O.I. 1987. *Weed Science in the Tropics. Principle and Practices.* John Wiley & Sons. New York, USA. First Edition, pp. 24-57.
- (6) NYLE, C. B. and WEIL, R. 1999. *The Nature and Properties of Soils.* 20th Edition. Prentice Hall, USA.
- (7) DANIEL, B.B. and EDWARD, A.K. 1982. *Environmental Studies.* Charles E. Merrill Publishing Co. Ohio, USA.
- (8) CHANG L.W. and SPENCHER J.A. 1976. Pathological Changes in the Kidney after Methyl Cadmium Intoxication. *Environmental Research* :12, 92-109.
- (9) LANDRIGAN P.J. and BAKER E. L. 1981. Exposure of Children to Heavy Metals From Smelters: Epidemiological and Toxic Consequences. *Environmental Research*: 25, pp.204-224.
- (10) ALLOWAY, B.J. and AYRES, D.C. 1993. *Chemical Principles of Environmental Pollution.* (1st Edition), Academic and Professional Press, U.K.
- (11) PHILIPPE, G. 1978. Widening Perspective of Lead Toxicity: A Review of Health Effects of Lead Exposure in Adults. *Environmental Research*: 17, 303-321.
- (12) HORSFALL, M. Jnr. and SPIFF, A.I. 2000. *Principles of Environmental Chemistry* (1st Edition). Metroprints Limited, Port Harcourt.
- (13) McDONALD, P., EDWARDS R.A., GREENHALGH, J.F.D. and MORGAN, C.A. 1995. *Animal Nutrition* (5th Edition). Longman Publishing Company, UK.
- (14) OBUZOR, G.U. and AKINSOLA, K. 2004. *Determination of Some Heavy Metal and Their Various Forms in Selected Automechnic. Dumpsite in Port Harcourt Metropolis.* *International Journal of Science & Technology*. No.3, Vol.1.2, p. 45.

Implementation of Biotechnology at Secondary Level in Orissa

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THE WORD biotechnology came into existence in the middle of 1970's with the advances in biosciences and their different disciplines. It is a wide term, which explores a linkage between biological sciences, physical sciences and technological achievements. In real sense, it may be referred to as the "*clever science of biology*". Biotechnology is one of the fast growing sectors in India as well as all over the world. This emerging field of biological sciences is going to take a leap forward in the next five years with a global share of 10 to 15 per cent. The importance of biotechnology in India was recognized after the establishment of National Bio-technological Board in 1982. In 1986, Government of India formed a full-fledged department within the Ministry of Science and Technology. The application of biotechnology results have a significant effect on the solution of current problems in the production of food, feed, fuel and fibres. Beneficial results are foreseen in the manufacture of drugs, processing of food, control of pollution, improvement of crop plants,

energy production, biomass utilization, animal fertilisation and other biological and bio-chemical processes. To live effectively in the society in future, knowledge of bio-technology is a must. So incorporation of biotechnology in secondary school curriculum is the need of the present situation.

Need and Importance of Bio-technology at Secondary Level

The educational implications of biotechnology are many and their influence on the general public are profound. The nature of the subject matter is such that it attracts the attention of the public through mass media such as radio, television, newspapers and magazines. The various articles and features published in newspapers and magazines, from time to time, inform the public of the results and material products of biotechnology. They no doubt arouse curiosity in the minds of the people but such news items and information can have only temporary or causal value because of their impermanent nature.

Analysis of present bioscience curriculum revealed that problems associated with improvement of the quality of life and solutions to these and other problems faced by modern society are rarely included in the curriculum. It is high time that a general review of biology syllabuses at the school level is undertaken on a global scale to include the outstanding biological problems that we are facing today. The need for developing such a process and its implementation in teaching is imperative

for many reasons. It would make young biologists aware of the scientific principles that govern the advances being made in biotechnology; on the other hand, it would also prepare students suitably to face the challenges that lie ahead. While certain countries are living in peace and plenty, others are going through hardship and famine. One of the main objectives of biology education at school level should be to analyze such situations and indicate the solutions that are available to improve condition of humans and the quality of life. Curriculum modules have already been developed in advanced countries for the teaching of certain aspects of biomedical technology at the school level. On the other hand, a general review of the syllabuses in biology, human and social biology and agricultural science would reveal the most of the topics covered are designed to teach only the biological principles involved.

Developments and Innovations in Biotechnology and their Applications

Following are some recent developments and innovations, which need to be included in the secondary school curriculum:

Genetic Engineering

DNA is the master molecule of all the living beings except few viruses. Genetic Engineering is the science that involves manipulation of genetic material by insertion or elimination of DNA into a cell. It is otherwise called as *recombinant DNA technology*, which renders the

bringing together, and joining of pieces of DNA from unrelated organisms to achieve something new and advances. It helps in cloning of animals and DNA finger printing etc.

Monoclonal Antibiotics

The same antibody produced by same close of all hybrid is called *monoclonal antibody*. They are created by fusing normal antibody producing cells with myolema cells. The resulting hybrid cells are known as *hybridomas*. These cells produce only one kind of antibody on a large scale. The triple antigen injection (DPT) given for children is a good example. Many diseases caused by bacteria, virus, protozoan and metazoan and diseases like diabetes can be prevented by developing suitable antibodies. Similarly, health of plants can be considerably improved by identifying the viral, bacterial and fungal pathogens and can be cured or eliminated by using monoclonal methods.

Production of Hormones

Growth hormones are secreted from pituitary gland. A longer and more regular supply of this hormone can be obtained by using DNA cloning technique. Similarly, the reproductive hormones can also be produced by the same method; these will be useful to correct fertility problems in men and women, to test for pregnancy and to facilitate childbirth.

Production of Vaccines

Vaccine development is important for the cure or prevention of many human

diseases like dengue, rabies, malaria, tuberculosis, hepatitis, AIDs and hemorrhagic fever caused by bacteria, virus and other microbes. Similarly, vaccines need to be developed for many animal diseases and all these problems could be tackled effectively only through the application of biotechnology.

Animal Husbandry

In the area of animal husbandry, elimination of infectious diseases are important. Transportation of disease-free embryos and semen by air, the establishment of embryo replication capabilities and use of monoclonal antibody techniques are identified as important areas for the improvement of both quality and quantity in animal production. This can again be solved by the application of biotechnology.

Fermentation Industries

Fermentation is one of the ancient methods of biotechnology, which is applied to produce various kinds of solid and liquid foods such as bread, cheese, soya sauce, beer and wine. Improved methods of fermentation on an industrial scale have helped us to manufacture antibiotic drugs, alcohols, acids, vitamins, chemicals, feed supplements and other products. Different types of micro-organisms are employed and they are grown on various inexpensive raw materials to obtain useful proteins and other materials.

Energy Production

At present, vast quantities of biomass are allowed to decay or burnt to avoid

pollution. Lignocellulose and other plant wastes can be hydrolyzed and converted into sugar syrups and other compounds. Poor quality starch could be used as a growth medium of yeasts, bacteria and fungi which would enrich the substrate with proteins, to be used either in animals or in human food. All the above are possible only by the application of biotechnology.

Plant and Animal Tissue Culture

Plant tissue culture methods are useful in clonal propagation, disease elimination, germ plasm storage and exchange, gene transfer by wide hybridization obtaining secondary natural products etc. The quality of the plants and animals can be improved by using genetic engineering method incorporating the genes responsible for disease resistance, higher growth and better yields.

Biotechnology and Agriculture

Biotechnology can be used to improve various practices associated with agriculture. Some of the main areas are — improving the quality and quantity of superior crop plants, control of pests and pathogens, nitrogen fixation, increasing productivity, tissue culture, animal production.

By DNA technology, the organisms that prevent the growth of *Rhizobium* may be controlled; so the nitrogen fixing bacterium grows more luxuriously. Also many scientists are working in different parts of the world to transfer nitrogen-fixing genes (*nif*-genes) to non-legumes and even to cereals. So this can help in

soil with rich in nitrogen, making it more fertile.

Analysis of the Existing Bioscience Curriculum at Secondary Level

Researcher had analysed the existing Bioscience Curriculum (Board of Secondary Education, Orissa), chapter-wise and identified the contents in which biotechnology and its related topics are included. After that the researcher had

discussed with ten school science teachers, two teacher educators and two college biology teachers. Their suggestions were collected.

In the existing curriculum in science (Board of Secondary Education, Orissa) subjects, topics on bioscience are presented separately except in class VIII. Different chapters and their contents, which include the topics of biotechnology in detail for Class VIII, Class IX and Class X are discussed below:

Table 1: Class and Chapter-wise Analysis of Biotechnology Contents

<i>Class</i>	<i>Title of the Textbook</i>	<i>Title of the Chapter</i>	<i>Contents of Biotechnology</i>
VII	<i>Bigyana O PrajuktibidyaI</i> (Science and Technology) (Revised, 1st Edition, 2004) Board of Secondary Education, Orissa	Atmosphere	Nitrogen Fixation
		Microorganism	Economic Importance of bacteria, production of antibiotics, Economic importance of fungi, fermentation.
		Some common diseases	Vaccination
		Food production and management	Crop Improvement
IX	<i>Madhyamika Bigyana</i> (Secondary Science), Paper I, Revised 1999, B.S.E., Orissa	Science, Technology and Society	Tissue culture, biotechnology, test-tube baby, genetic engineering.
		Food Yield	Use of good hybrid seeds. Artificial insemination
X	<i>Madhyamika Bigyana</i> (Secondary Science) Paper I, Revised 1999 B.S.E., Orissa	–	–

New Topics to be Incorporated

Review of the existing secondary school curriculum, B.S.E., Orissa shows that innovative challenges of the new millennium are needed to be incorporated. Some of the topics suggested for inclusion were monoclonal antibodies, production of hormones, fermentation and its application in industries, energy production, animal production, as these are the applications of biotechnology.

Strategies for Implementation of Biotechnology at Secondary Level

In the existing curriculum some topics are already in one of the chapters while some others have been integrated with other chapters; but some new chapters need to be incorporated. So taking into account the suggestions of teachers and experts, the new topics that could be incorporated in the existing curriculum and how that can be done is shown in the Table 2.

Besides this, if a separate chapter on biotechnology is added at the end of Class IX and X Science books then the students will give more importance to desired content. In brief, the advantages of biotechnological methods, its application and the benefits derived from it should be highlighted at appropriate places so that students could be made aware of the changes and progress taking place in the field of biotechnology.

Problems of Implementation of Biotechnology at Secondary Level

These days students have become more information hungry as compared to the earlier generations. The proceeding of the class often becomes boring if students receive mere information usually known to them. Some revolutionary changes are, therefore, immediately needed to engage the students actively in the class and to nurture their creativity. Teachers need to be motivated and more

Table 2: Class and Chapter-wise Inclusion of New Topics in Biotechnology

<i>Class</i>	<i>Title of the Textbook</i>	<i>New Topics Suggested for Inclusion</i>
VIII	Food Production and Management	Application of biotechnology In animal production
IX	Wasteful Food Practices and Food Spoilage	Application of biotechnology In energy production
	Essentials for Good Health	Application of biotechnology in production of hormones, monoclonal antibiotics.
X	Life Processes	Application of biotechnology in fermentation industries.
	Heredity and Variation	Application of biotechnology in production of hormones.

responsible to accomplish this. The problems a school might face if biotechnology components get incorporated into curriculum could be gauged by addressing three questions such as: How can new materials be accommodated in the existing curriculum? Who will teach the Course? and Where are the resources?

To accommodate new material on biotechnology a broad outline of syllabus should be provided to the teachers so that she/he can teach them in the class. The syllabus should provide a general guidelines only for the teachers. Creativity and flexibility is necessary for the teacher depending upon the level at which these topics are expected to be taught. Orientation programmes may be organized at the state level for the secondary teachers.

Another problem arises regarding the selection of method of teaching. In order to develop self-reliance among the students, the teacher should make judicious use of problem-solving method, project method, individualised instruction, participatory learning and cooperative learning method of teaching. The transparencies/slides using OHP or multimedia may be quite effective to understand the concepts. Development and inclusion of flow chart or concept map of the topics included in the syllabus may help in bringing objectivity and highlighting interlinkages while the teacher deliberates on the topics in the

class. Each syllabus should include flow chart or concept maps beginning with basic ideas and extending them to the level envisaged for a given class. To design and update the general structure of the curriculum, there should be a central monitoring agency at the national level. All institutes must develop expertise in designing and developing the curricula. The agency may sort out the key areas needed to be incorporated at different levels of study keeping in mind level of the students and the global demands of the subject.

8. Conclusion

Biotechnology is one of the fastest growing fields today. It finds application in every aspect of daily life and industrial activities ranging from the chemical, pharmaceutical and textile industries to genetics and agriculture. So, biotechnology should be included from grass roots level i.e. school stage. But, at secondary level, biotechnology is rarely included in the curriculum. Implementation of biotechnology at secondary level is desirable for two reasons. One is that young biologists should be made aware of the scientific principles that govern the advances being made in biotechnology and the other is the need to prepare students suitably to face the challenges that lie ahead. So, the curriculum should be analyzed and incorporation of these topics should be decided.

References

- LAYTON, DAVID. 1989. *Innovation in Science and Technology in Education*. Sterling Publishers (P) Ltd., New Delhi.
- SHARMA, B.L. 1995. *Introductory Microbiology*. Jai Prakash Nath and Co., Meerut-2.
- SHARMA, R.L. 1998. *Modern Science Teaching*. Dhanapat Rai Publishing Company (P) Ltd., New Delhi.
- SIDDIQUI N.N. and SIDDIQUI, M.N. 1998. *Teaching of Science Today and Tomorrow*. Doaba House, New Delhi.
- SURI, R.K. 2000. *Science and Technology in India*. Spectrum India, New Delhi.

Homeostasis — A Coordinate Mechanism in Animals

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WHAT MUST an animal accomplish to survive and reproduce? Most students' initial response to this question focuses on the anatomical and behavioral characteristics that help animals secure food, protection, and mates. But animals' internal characteristics have also been honed by generations of competition for limited resources. Natural selection has favoured body plans and processes that use resources efficiently and extract the most benefits from them at the lowest possible cost. The result of this selection for efficiency is a diverse array of elegant systems for crucial functions such as extracting energy and nutrients from food, exchanging gases with the environment, sensing and moving around in the environment, producing new individuals, and defending against microbial attack.

Many of these adaptive physiological systems function by regulating the exchange of materials between an animals' body and its external environment. Molecules are constantly entering and leaving the body, but physiological systems control this exchange such that the body's internal

state is relatively constant. The body's cells are thus insulated from the vagaries of the external environment and can go about their biochemical business without interference from drastic fluctuations in their immediate surroundings. Whales can dive from sea level to depths at which the water pressure is tremendous; desert scorpions can survive the daily switch from hot days to cold nights; and penguins can stay active on the frigid ice floes of the Antarctic. The typical intricate mechanisms of regulation and control that provide are among Nature's true marvels.

Over a century ago, French physiologist Claude Bernad made the distinction between the external environment surrounding an animal and the internal environment in which the cells of the animal actually live. The internal environment of vertebrates is called the interstitial fluid. This fluid, which fills the spaces between our cells, exchanges nutrients and wastes with blood contained in blood capillaries. Bernad also recognised that many animals tend to maintain relatively constant conditions in their internal environment, even when the external environment changes. A pond-dwelling hydra is powerless to affect the temperature of the fluid that bathes its cells, but the human body can maintain its "internal pond" at a more-or-less constant temperature of about 37°C. Our bodies also can control the pH of our blood and interstitial fluid to within a tenth of a pH unit of 7.4, and regulate

the amount of sugar and other dissolved substances in our blood so that it does not fluctuate for long from their required normal concentration. Because the body's cells cannot survive if the conditions of the internal environment deviate from a small range of acceptable states, the cells devote a large portion of their energy to actions that serve to keep the environment stable.

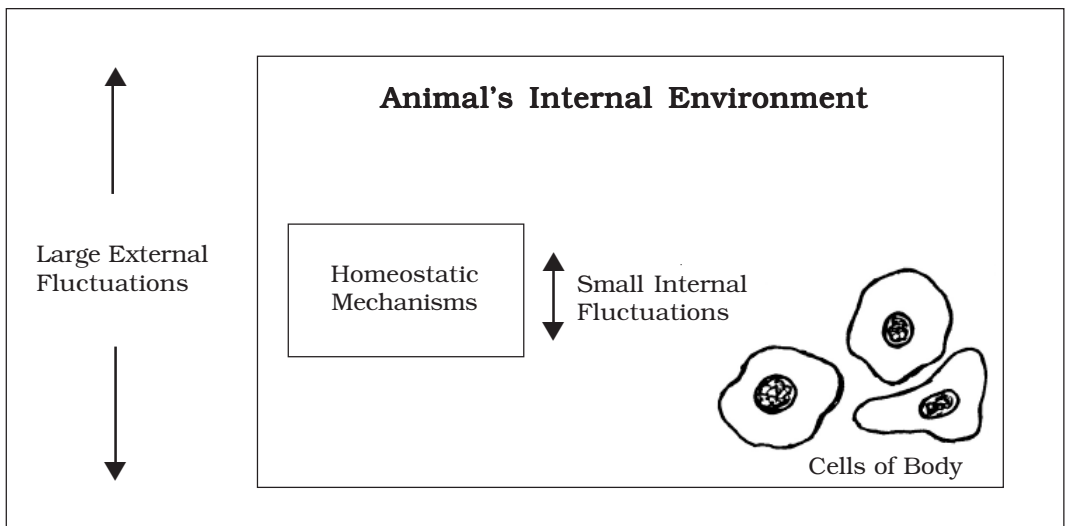
There are times, of course, during the development of an animal when major changes in the internal environment are programmed to occur. For example, the balance of hormones in human blood is altered radically during puberty. Still, the stability of the internal environment is remarkable.

This "constancy of the internal milieu" recognised by Bernad was termed "**homeostasis**" by Walter B. Cannon in

the 1920s. Although the word homeostasis (derived from Greek words meaning "to stay the same") implies a static, unchanging state, the internal environment in fact seethes with activity as the body continuously adjusts to internal and external changes.

Homeostasis depends on feedback circuits

The internal state of an animal body is thus better described as dynamic equilibrium. Many physical and chemical changes do occur, but the net result of all this activity is that physical and chemical parameters are kept within the narrow range that cells require to function. These equilibrium conditions are maintained by a host of mechanisms that are collectively known as *feedback systems*. *Negative feedback systems*



(An animal has homeostatic mechanisms that regulate the fluid environment bathing its cells).

counteract the effects of changes in the internal environment; less common *positive feedback systems* reinforce changes when such reinforcement serves a physiological need.

Any homeostatic control system has three functional components: a receptor, a control centre, and an effector. The *receptor or sensor* detects a change in some variable of the animal's internal environment, such as change in body temperature. The *control centre* processes information it receives from the receptor and directs an appropriate response by the *effector*.

A. Negative feedback reverses the effects of changes

The most important mechanism governing homeostasis is negative feedback, in which the response to a change is to counteract the change. In other words, an input stimulus causes an output response that "feed back" to the initial input and decreases its effects. Because the initial change triggers a response that reverses its effects, the overall result is to return the system to its original condition. This kind of feedback is called "negative" because it reverses or negates the initial change. Negative feedback mechanisms abound in physiological systems. A familiar example of negative feedback is regulation of body temperature.

Body Temperature Homeostasis

Despite wide fluctuations in environmental temperature, homeostatic mechanisms can maintain a normal

range for internal body temperature. If the rate of body heat production equals the rate of heat loss, the body maintains a constant core temperature near 37 C (98.6 F). Core temperature is the temperature in body structures deep to the skin and subcutaneous layer. Shell temperature is the temperature near the body surface – in the skin and subcutaneous layer. Depending on the environmental temperature, shell temperature is 1-6 C lower than core temperature. Too high a core temperature kills by denaturing body proteins, whereas too low a core temperature causes cardiac arrhythmia that results in death.

The control centre that functions as the body's thermostat is a group of neurons in the anterior part of the hypothalamus, the *preoptic area*. This area receives impulses from thermo receptors in the skin and mucous membranes and in the hypothalamus. Nerve impulses from the preoptic area propagate to two other parts of the hypothalamus known as the *heat-promoting centre* and the *heat-losing centre*, which, when stimulated by the preoptic area, set into operation a series of responses that raise body temperature and lower body temperature, respectively.

If body's core temperature declines, mechanisms that help conserve heat and increase heat production act via several negative feedback loops to raise the body temperature to normal. Thermoreceptors in the skin and hypothalamus send nerve impulses to the preoptic area and the heat-promoting centre in the

hypothalamus, and to hypothalamus neurosecretory cells (NSCs) that produce thyrotropin-releasing hormone (TRH). In response, the hypothalamus discharges nerve impulses and secretes TRH, which in turn stimulates thyrotrophs in the anterior pituitary gland to release thyroid-stimulating hormone (TSH). Nerve impulses from the hypothalamus and TSH then activate several effectors. Each effector responds in a way that helps increase core temperature to the normal value:

- Nerve impulses from the heat-promoting centre stimulate sympathetic nerves that cause blood vessels of the skin to constrict. Vasoconstriction decreases the flow of warm blood, and thus the transfer of heat, from the internal organs to the skin. Slowing the rate of heat loss allows the internal body temperature to increase as metabolic reactions continue to produce heat.
- Nerve impulses in sympathetic nerves leading to the adrenal medulla stimulate the release of epinephrine and nor epinephrine into the blood. The hormones, in turn, bring about an increase in cellular metabolism, which increases heat production.
- The heat-promoting centre stimulates parts of the brain that causes shivering (repetitive muscular contraction) which greatly increases the rate of heat production.
- The thyroid gland responds to TSH by releasing more thyroid hormones

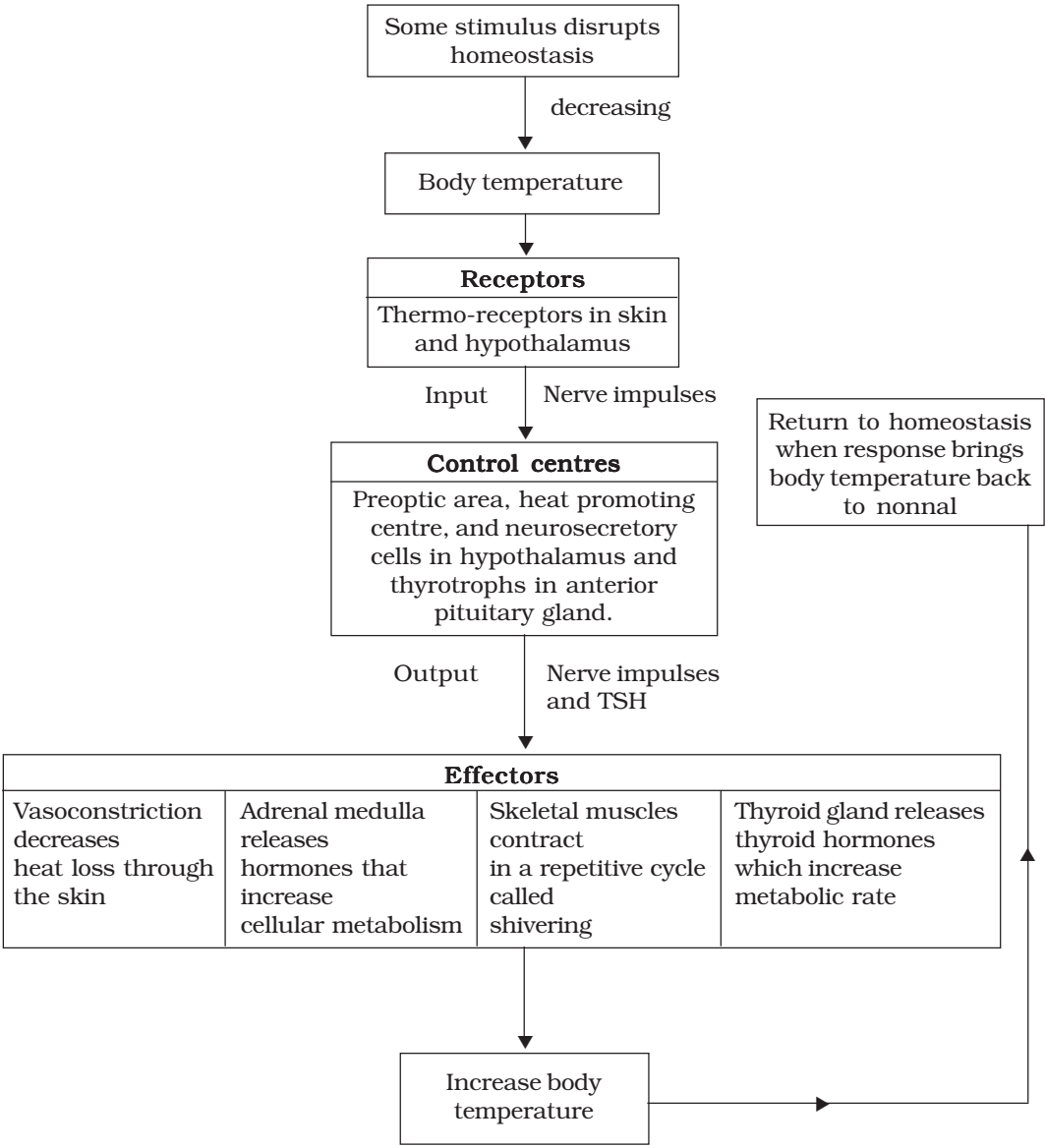
into the blood. The increased level of thyroid hormone increases metabolic rate, body temperature rises.

If core body temperature rises above normal, a negative feed back loop opposite to the one depicted in the above figure goes into action. The higher temperature of the blood stimulates thermo receptors that send nerve impulses to the preoptic area, which, in turn, stimulate the heat-losing centre and inhibit the heat-promoting centre. Nerve impulses from the heat-losing centre cause dilation of blood vessels in the skin. The skin becomes warm, and the excess heat is lost to the environment via radiation and conduction as an increased volume of blood flows from the warmer core of the body into the cooler skin. At the same time, metabolic rate decreases and shivering does not occur. The high temperature of the blood stimulates sweat glands of the skin via hypothalamic activation of sympathetic nerves. As the water in perspiration evaporates from the surface of the skin, the skin is cooled. All these responses counteract heat promoting effects and help return body temperature to normal.

Number of negative feed back homeostatic control system operates in the body of animals such as regulation of body water, electrolytes in body fluid, blood sugar level, acid-base balance and many other components of “internal milieu”.

B. Positive feedback drives events to a conclusion

In a positive feedback system, in contrast to a negative feedback system, a change

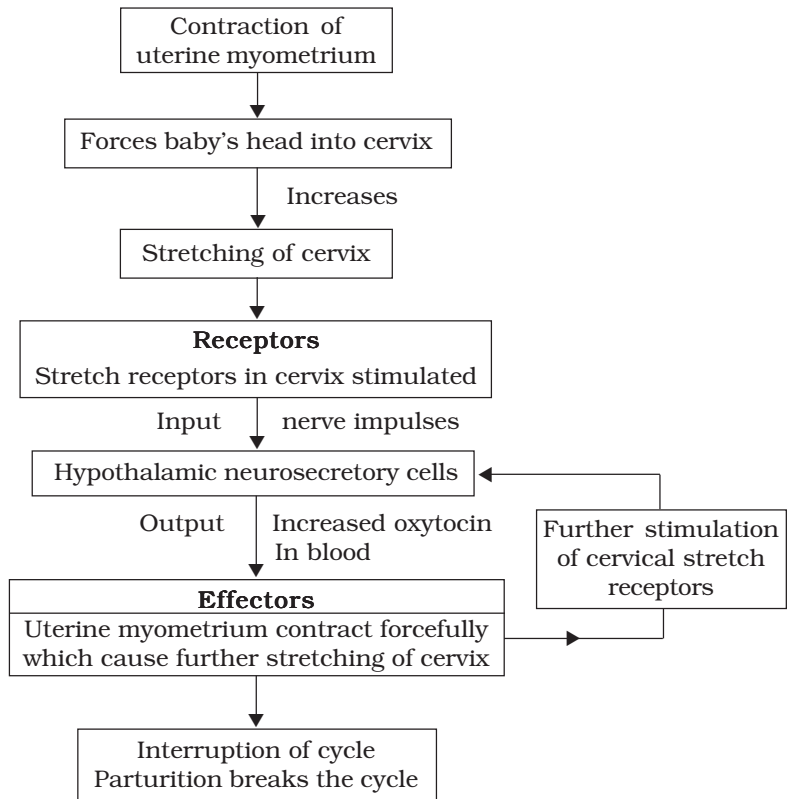


(Negative feedback mechanisms that conserve body temperature).

produces a response that intensifies the original change. The end result is that change tends to proceed in the same direction as the initial stimulus (rather than reversing to return to a set point). In the body of animals, events governed by positive feedback mechanisms are generally self-limiting and occur relatively infrequently.

Labour is the process by which the fetus is expelled from the uterus through the vagina. Control of labour contractions during parturition (child birth) occurs via a positive feedback

mechanism. Contractions of uterine endometrium force the baby's head into the cervix, thereby distending (stretching) the cervix. Stretch receptors in the cervix send nerve impulses to neurosecretory cells in the hypothalamus, causing them to release oxytocin into blood capillaries of the posterior pituitary gland. The blood to the uterus then carries oxytocin, where it stimulates the myometrium to contract more forcefully. As the contractions intensify, the baby's body stretches the cervix still more, and the resulting nerve



(Positive feedback mechanism that controls labour).

impulses stimulates the secretion of yet more oxytocin. With birth of the infant, the positive feedback cycle is broken because cervical distention suddenly lessens.

The Body's Internal Systems Act in Concert

A coordinated, integrated network of systems maintains the constancy of an animal body's internal environment. The job of regulating a multitude of factors throughout the body cannot be accomplished by a few, independent feedback mechanisms. Instead numerous mechanisms are constantly at work, responding to various stimuli that change continuously as the animal's activities and circumstances change. If all these control systems worked independently, without regard to the activities of all the other systems, it

would not be possible to maintain homeostasis in the body as a whole.

Fortunately, evolution has ensured that the various systems work together. For example, the systems that take substances into the body act in concert with the systems responsible for removing substances from the body. This kind of coordinated action is possible because the body has mechanisms for moving substances and signals from one part of the body to another. Each cell in the body is indirectly connected to all of the others by an elaborate network of vessels and nerves that can carry molecules and messages to the appropriate locations. Molecules can be transported to the sites where they are needed and away from locations where their presence is harmful. Messages can be carried from sensors to effectors and back again.

Moving Nigeria from Hydrocarbon-Based Economy to Carbohydrate-Based Economy

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MODERN INDUSTRIAL economies have been built on crude oil, which can be converted easily into fuels, chemicals, fibres, fertilizers, pesticides and other products. This hydrocarbon economy has fuelled industrial expansion around the world. It is however based on a non-sustainable resource - the declining reserves of international oil supplies. This energy capital is being depleted at such a rate that new discoveries are not keeping up with the depletion of reserves and most recent discoveries have been small fields of less than a billion barrels of oil. Oil supplies will run out! It is a matter of time! The UGDP (the Uppsala University Global Energy Study Group) depleted base case scenario of global oil and natural gas depletion, shows that now in the year 2005, oil production is at its peak and that the combined oil and

natural gas will be at peak in 10 years time. Further 10 years ahead, the oil production will be at its 1970 years levels, before the first oil crises and 30% down from today's level. It is imperative, therefore, that the world will have to develop alternatives, such as a shift from a hydrocarbon-based economy to a carbohydrate-based economy. This means the conversion of renewable biomass resources such as cassava, graincrops, wood, baggasse, straw, etc. into useful chemicals and fuels.

Biomass resources contain the same basic compounds of carbon, hydrogen and oxygen that constitutes oil, in the form of cellulose, hemicellulose and lignin. These compounds, however, need to be broken down and rearranged into useful chemicals for industry. The Agri-refinery or the Bio-refinery is a factory that breaks down the celluloses and lignin in biomass and converts them into chemicals, fuels and fibers. Nigeria-made 'renewable cassava-based fuel, ethanol will directly displace the amount of petrol and kerosene we need to import, offering our country critically needed independence and security from foreign sources of energy.

Ethanol and Sub-Saharan Africa Energy Insecurity

According to the World Oil Markets/ International Energy Outlook 2001 Report, oil demand in Africa is projected to grow at an average annual rate of 3.6 per cent, from 2.5 million barrels per day in 1999 to 5.4 million barrels per day in 2020. Considering the price evolution of crude oil, the demand will continue to

exert heavy burden on national budgets of most Sub-Sahara African countries. A significant chunk of the national budgets of African nations is simply “burnt away” through the import of crude oil, and therefore not enough financial resources are left over to contribute to the necessary increase of the economic growth rate. It is obvious that the development of a cassava-based ethanol/bio-fuel industry will be a significant bonus for any African nation especially Nigeria.

The staggering figures of bills linked to crude oil importation could be minimized if ethanol/bio-fuel is blended with gasoline from a 10/90-ratio mixture to 85/15 as already performed in Brazil’s fuel industrial average. Global ethanol production is estimated at 41 million tonnes, valued at over \$16 billion, with a growth-rate of 3% per year. Americas 68%, Europe 21 %, Asia and others 11%.

- Only about 10% of global ethanol production are traded, the rest is utilized locally.
- All available statistics point to the fact that there are not enough ethanol to meet export demand. Current supply deficits is estimated at 6 billion litres and is expected to grow by 5% annually.
- Cassava is the cheapest feeds took for ethanol production. It’s cheaper than sugar, molasses and maize, the key feedstock currently in use.

Ethanol is considered a renewable fuel. Pure fuel ethanol contains chemical properties identical to that of other grain alcohol. As such, it must be denatured

or made unfit for human consumption. In the U.S., the most common denaturant is gasoline, while it is Bitrex in Nigeria.

Economy and Job Creation Benefits

The production and use of ethanol benefits our economy at all levels — local, state, and national. From the local communities where the crops are grown processed to the metropolitan areas where drivers fill up with a domestically-produced fuel. Nigerian-made ethanol fuel will propel the economy.

An E10 blend and ethanol Gel Cooking Fuel use, targeting 10% kerosene substitution, will cut the Nigerian import of kerosene and petrol by over \$6.1 billion through 2012. Doubling ethanol use in Nigeria, as called for in the Renewable Energy Programme suggested above, will create nearly 100,000 permanent jobs, with indirect employment totalling over 300,000 new jobs.

In their 1997 study of the economic impact of the demand for ethanol, the USA-based Northwestern University’s Kellogg School of Management found the following for establishing a typical 60,000 litres/day plant valued at \$7 million:

- During ethanol plant construction, approximately 370 local jobs are created.
- During ethanol plant operation, up to 4,000 local jobs are created.
- Ethanol plant construction creates \$60 million to \$130 million in additional income.

- Ethanol plant operation creates \$47 million to \$100 million in additional income.

In their 2002 study, “Ethanol and the Local Community”, a US Consultant and SJH and Company found that:

- With an approximate cost of \$60 million for one year of construction, an ethanol plant expands the local economy by \$110 million each year.
- Ethanol production will generate an additional \$19.6 million in household income annually.
- Tax revenue for local and state governments will increase by at least \$1.2 million per year.
- Nearly 700 permanent jobs will be created in the area of an ethanol plant.

Agriculture, Farmers and Rural Communities

Ethanol production and use benefit U.S. agriculture and leads rural economic development. Because it is made primarily from corn and other agricultural products, ethanol increases demand for these crops, and bring economic development opportunity to the rural areas where the ethanol is made. Today, farmer-owned ethanol plants are driving the growth in the ethanol industry in and around the world.

- In 2003, 32 of the USA's 72 ethanol plants were farmers - owned.
- In the U.S.A., of the 15 ethanol plants under construction in 2004, 12 were farmer-driven projects.

- Farmers who invest \$20,000 in a local ethanol plant receive an average of 13.3% per year on their investment over ten years.

- Ethanol production and use increases the demand for and the price for cassava.

- The local price of cassava increases by an average of 5-10 per cent per tonne, adding significantly to farm-income in the general area surrounding the plant.

- It is projected that the increased demand for cassava to support the additional ethanol production to meet requirement for a 10% replacement of kerosene and petrol will increase cash receipts for farmers by \$2.3 billion between 2005 and 2010j (Cassava Agro Industries Services (CAIS) Ltd., the renewable energy consultant, March 20, 2005).

- CAIS estimates that the Renewable Fuels Programme would increase demand for cassava by an additional 10 million tonnes for ethanol production by 2010.

- CAIS estimates that the Renewable Fuels programme would generate an additional \$2 billion to \$4 billion in net cassava farm income by 2010.

Conclusion

From the foregoing, Nigeria stands to benefit both industrially and commercially if shee moves from a hydrocarbon based economy to a carbohydrate-based economy. This will

bring an era of economic prosperity to both the government and the citizens. It has seen said that a cassava-based economy is the next “oil boom” for Nigeria.

References

World Oil Markets/International Energy Outlook Report, 2001.

Cassava Agro Industries Services Ltd. (CAIS) Bulletin March 20, 2005.

Role of Multimedia in Science Education

Advantages and Capabilities

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WHAT IS MULTIMEDIA?

What is multimedia? Multimedia is a carefully designed interaction of text, graphics, sound, animation, video, and user interaction. When you allow a user to control the tempo and the direction of information that is being presented with a computer, or the internet, the information becomes interactive multimedia. The World Wide Web has rapidly become a vehicle for the delivery of multimedia in education.

Why to Use Multimedia?

In its best uses, multimedia presents subjects and materials to students in an easier to remember and more interesting way than books or a single medium can. Multimedia is able to address different learning strategies—allowing students to learn at their own pace. Research has proven that students learn better and are able to retain more when audio-visual aids are added to a classroom lecture. The combination of technology and instruction has occasionally been a rocky

one, but has usually resulted in a raised quality of education for the learner. Few Schools and Universities are currently taking steps into the area of computer enhanced instruction. This article is an overview of the advantages and capabilities of multimedia enhanced instruction in classroom and outside, and the decisions to be made and steps to be taken in the process of making Schools and Universities into a modern multimedia campuses.

Advantages of the New Technology

The term “multimedia” has meant many things through the years. Strictly defined, multimedia refers to a combination of communicative elements — text, sound, graphics (photos and diagrams), and motion visuals (animation and video) — used in a classroom or other presentation. The key words are communication and interaction. Multimedia has often been used in the classroom presentation setting with good result. Usage of still graphics combined with audio in slideshow and filmstrip projections were pioneered in the fifties and sixties. Sixteen millimeter film brought with it the ability to add motion to the presentation. In the 1970’s and 80’s, the popularity and affordability of the VCR allowed greater ease of use for these powerful communications media. The question is: What is different in 2001, and how can the instructional process be streamlined or improved? Today we still use still graphics, audio, motion visuals, and animation. Now, however, these media elements are under the control of the

personal computer. Modern technology offers us several powerful advantages we have not had before, including:

- The ability to easily create our own media
- The ability to use a single machine to present ideas
- Very rapid access over the media elements
- A higher degree of control over the presentation of information
- The ability to reuse the media
- The ability to easily redesign instruction
- The ability to easily update instruction and instructional media
- The ability to use personal computers to greatly extend our instructional capabilities

Potential Disadvantages of the New Technology

With any new, positive strides there are always negatives. Any negatives that do exist tend to fall into three areas: (1) cost, (2) potential problems with equipment, and (3) greater amounts of time needed to develop multimedia presentations and software.

Cost: The cost of the computers and software needed to create multimedia is actually not substantial, especially considering the ability of those computers to perform so many tasks.

Equipment Problems: The systems that will be used for playback of multimedia need to be fault tolerant and well maintained. The hardware and software

needs to be configured in such a way as to make their usage as simple and as straightforward as possible.

Time: Multimedia assisted instruction can take more time than standard modes of presentation. The extra time varies according to the manner in which the new tools will be used. In most instances, however, there is very little difference in preparation time for multimedia and that of standard classroom instruction. Occasions when multimedia preparation takes a larger amount of time are usually associated with the development of instructional materials that, up to now, have been virtually unavailable to the teacher. The extra time that is taken results in great improvements in the results of instruction. Moreover, teacher prepared multimedia software is infinitely more reusable than standard instructional materials. This reusability typically results in decreased preparation time in future years of teaching the material.

The Use of Multimedia in Classroom Instruction

Using Text

Current everyday classroom usage of text entails the usages of the blackboard, or overhead transparencies. In a multimedia presentation, text is entered into a slideshow or authoring program in advance of entering the classroom. Essentially, the text used in a multimedia presentation is much like that of using an overhead, but with added marker board capabilities. The process of using text in a multimedia

presentation is no more difficult than typing on a typewriter or word processor. The advantages available with the multimedia presentation include the addition of coloured or animated text, and the ability to easily include other media such as video, audio, or graphics with the text. The ability to use a blackboard as a freeform instructional tool can also be recreated on the computer. Software such as Microsoft's PowerPoint (packaged with Microsoft Office) allows the presenter to use the mouse to draw directly on the computer screen. This enables the instructor not only to use the screen in a sense like a standard blackboard, but also to annotate or label graphics or video directly on the screen. The direct comparison between standard presentation and multimedia presentation yields the following conclusions: Once the teacher is able to learn the software, the time needed to create an overhead master style of presentation is far less than standard, and the time needed to use the computer as a marker board is equal to the time needed to use a standard blackboard. The quality of the multimedia presentation is far superior to the standard overhead transparency or blackboard.

Using Colours

Choosing the best colours for a presentation can play a vital role in winning over any student. Colour is not just for decoration; it can help to determine whether the text is legible, emphasize important points, and even help to establish the emotional response

of the students. Studies have shown that proper use of colour can dramatically improve the ability of the students to understand and remember what is said. Proper colour selection is an important factor in determining the success of a presentation. Since the typical multimedia software package offers a complete spectrum of colours, the challenge is to select those that will be most effective. It is common when creating a presentation to begin by selecting a consistent set of colours for the background, text, bullets, and other elements in each frame. This set of colours is called a palette. Typically, multimedia software packages provide a number of palette selections and may even suggest palettes based on the type of presentation. The palette should generally be consistent throughout a presentation, allowing the introduction of different colour choices for emphasis. To select intelligently among the standard palettes available or to design a custom palette, it is essential to understand some basic ideas about using colour. It is important to have a strong contrast between the text colours and the background so that the text will be easy to read. Consequently, dark background colours are the most common choice. A pastel background often makes the text, no matter what colour it is, difficult to see from the back of a large classroom. In addition, a good background will establish a desired mood. Some colours, like bright yellow, may seem attractive because they are bright and cheerful, but they can also become visually tiring rather quickly.

The three most commonly recommended background colours are dark blue, dark green, and dark red. The two most common text colours are white and yellow, because these colours will give a strong contrast with the deep background colours recommended above and make the text most readable. Reds, oranges, and yellows are described as advancing colours, because they attract attention and are the first things noticed on a frame. This is exactly what is needed for the text. On the other hand, blues and greens are receding colours; they are normally overlooked at first, which makes them excellent background colours. Pastels and other weak colours are to be avoided for both background and text because they not only make the frame harder to read, but also they tend to be viewed as weaker colours.

Using Graphics

Traditionally, teachers can bring a set of photographs into the classroom to be passed around among students, or the teacher could take the same photos and scan them into a computer to be used in a multimedia presentation or slide show. Now, rather than create slides or transparencies from the photographs (or other graphic media), the teacher will be able to create computer graphics from the same photographs. Editing and creation of diagrams from scratch are essentially the same process. The difference is that now, rather than carrying around a stack of slides and photos, and a cumbersome slide projector, the teacher can carry all of their images on a floppy disk or CD-ROM.

That material on that disk can then be integrated into an easy to use slideshow program such as Microsoft's Power Point. Moreover, the teacher is no longer tied down to a linear presentation, as with a slide projector. The teacher can now move quickly and easily to any graphic, in any order they choose. The direct comparison between standard presentation and multimedia presentation yields the following conclusions: The time needed to use still graphics in a presentation is approximately the same as using slides. The instructional power of the computer based graphics eclipses that of the instructional slideshow, or passing of the photographs around the room.

Using Sound

Typically, most people think of sound in the classroom as being used in conjunction with other elements. Actually, sound is probably the most used instructional media element. Most teachers teach at great length, but the computer cannot replace the teachers' quickness of thought, knowledge, and ability to interact with students in lecture and discussion. Multimedia, however, can offer sound as an accompanying sound effect, musical interlude, or as a narrative accompanying other media. This usage of sound is usually not used in the classroom, except in the standard video format (or in some cases, just for fun!). Occasionally, sound in the form of an audiotape may be used. This usage of sound can certainly be ported over to the CD-ROM for use with a computer. Again, the advantage of this use is the

ability to edit or reuse the audio easily, and the ability to store the audio information in the same location as other media for quick and easy access. The process of using audio information in a multimedia presentation depends on the nature of the audio. Narration can be recorded, either by the teacher themselves or another narrator, and other forms of audio can simply be copied onto the CD. The interesting thing is that the computer gives us recording studio capabilities that allow us to mix sounds, and video studio capabilities that allow us to link sound to video. These capabilities may open up new avenues for teachers' that were previously unavailable. The direct comparison between standard presentation and multimedia presentation yields the following conclusions: The time needed to create and use audio is approximately the same for multimedia and standard presentation modes. The quality of the sound is the same for each. The instructional power and flexibility of each presentational mode depends on the teacher, but is probably about equal if sound is to be used alone.

Using Video

Video offers the teacher a great deal of power in their presentation. The ease of use of videotape is also a contributing factor. Video does, unfortunately have a few drawbacks: Video is linear, and typically requires the students to sit through some less instructional material in order to get to the instructional material. The nature of video makes it difficult for the teacher to present it in a

non-linear fashion. An example of this concept is the teacher who must spend a considerable amount of time pressing the fast forward or rewind buttons in order to find a specific portion of the videotape. This problem is compounded if the teacher wishes to use a short snippet of video to help answer a specific question by a student. The teacher is, once again, at the mercy of the video producer. The material, no matter how good it may be in some areas, may be poorly sequenced, or surrounded by less important material that will cause the students' attention to wane. Using the computer, specific short portions of an existing videotape are copied to the digital format. Using an authoring system, the teacher can then create an interface that allows rapid access to those short portions, thus bypassing larger amounts of unimportant information. Moreover, the teacher is no longer tied down to the linear sequencing of the video tape. No more boring and time consuming fast-forwarding or rewinding is necessary. The direct comparison between standard presentation and multimedia presentation yields the following conclusions: Using digital video also takes slightly more time, but no more so than identifying photographs to be made into slides has taken. Recent Improvements in computer hardware and software have allowed the quality of digital video to meet or surpass that of videotape.

Using Animation

Standard presentational usage of animation is limited to playing a video

tape. Using a videotape in class is a simple process of finding good material and playing it back in the classroom. Animation of processes (particularly those which cannot be readily observed using real examples) is a particularly potent form of demonstration. Often, however, "good material" simply cannot be found. Then the teacher finds themselves wholly at the mercy of the video producer who will decide what is or is not good instructional material. Using the computer, the teacher can work to create any animation they desire. Moreover, the level of control that the teacher has over the instructional material is much greater than the use of videotape. Summary: Does animation creation take a lot of time? Definitely! Is the quality of the animation high? Very high! Is the presentational power high? Very High! How does animation creation using multimedia compare with standard usage of animation? There is no comparison . . . The costs in time, money and other resources prior to the advent of multimedia made the creation of animation prohibitive. In comparison with using pre-created videotape, it is easier to use videotape, provided a good videotape can be found. Animation on video can, of course, also be used in the multimedia presentation, as can standard video.

Definition of Courseware: Recent definitions of courseware vary widely but most include some reference to computer-based instruction (CBI) and/or computer-assisted learning (CAL). We will define courseware as the content and technique applied to instructional

materials in electronic format. Thus, courseware would include the following categories of instructional material:

1. Class notes, scanned images, syllabi, textbooks, tutorials and assignments made available by teachers over the Internet/WWW.
2. Fully developed, interactive products available commercially or as shareware from publishers, educational consortia, or individual author/developers.
3. A diverse body of applications used to develop instructional materials in electronic format. These would include relatively simple tools such as HyperCard, PowerPoint, etc. as well as more complex authoring packages such as Macromedia Director, Toolbox, or Authorware.

The Use of Multimedia Outside the Classroom

Enhancing Student Learning

Multimedia presentation in a classroom setting is only the tip of the iceberg. The power offered by a reasonably fast micro-computer allows instruction to expand far beyond the classroom in ways that can greatly enhance the retention of the learned material, improve the depth and mastery of learning, and reach students who might not normally be able to attend the School. Using the computer, we can now deliver interactive multimedia instruction to the individual student in a campus based computer lab, or at their home.

Review of Classroom Material

Any multimedia presentation that a teacher develops for the classroom can be made available for the student to review. This will require no extra effort or time on the part of the teacher.

Non-Linear Presentation of Material

Some authoring systems allow the creation of presentations that can be accessed in a non-linear or branching fashion. This has implications for both the classroom and the laboratory. Teachers often do not like to be tied down to a linear presentation, opting for a more free-form teaching process. Using the same materials in a lab or home setting would allow the student to choose any topic, thus bypassing already learned material and allowing them to concentrate on areas that they understand less. The teacher could also place learning modules into the software that could explain material in greater detail, or using a different method than may be used in the classroom. Development of this type of material is a simple matter of adding new modules to the original classroom presentation. The new material can be added at any time, offering the teacher a dynamic, growing tool for both lab access, as well as future classroom presentations.

Drill and Practice

Drill and practice has been used for many years in computer assisted instruction. The level of interactivity allowed by well designed drill and practice can certainly enhance the

learning process. The level of expertise necessary to create a computer-based drill and practice software module is a bit higher than needed for a simple presentation. The multimedia capabilities of modern computers offer even more, as will be discussed in the section that follows.

Testing and Evaluation

Using higher level authoring systems, software can be developed that can record almost any action the user takes at the computer. We can, therefore, create many types of testing modules, including multiple choice quizzes, tests of proper manipulation of simulated materials, assessment of time spent on a task, recording the lessons covered, and many others. These results can be saved in a format that can be reviewed by the teacher, or used to give the student instantaneous feedback. Multimedia offers even more. The evaluation no longer need be strictly textual in nature. Using a combination of the computer's ability to record actions and the computer's ability to allow the user to directly manipulate graphic representations of actual objects, the instructional software can evaluate a learner's ability more directly using simulation.

Simulation

In some cases, presentation of information could be augmented by allowing the learner more interactivity with the material in the form of computer based simulation. Many simulations

have been created, ranging from flying an aircraft to performing a chemistry experiment, to manipulating an atomic structure at the submicroscopic level. Allowing the learner to explore the concept to be learned directly by manipulating a computer based object can greatly enhance the learner's depth of knowledge and mastery of the concept.

Discovery and Exploratory Learning with Computer Based Manipulatives

One of the best ways for a student to be able to learn something is through hands-on exploration. In many domains, however, this type of learning activity is difficult to come by. For example, a student can learn a great deal about chemistry in the lab, but many chemistry experiments are either too difficult or too dangerous to recreate. On the other hand, in the virtual world of a multimedia computer, any activity can be experienced safely and inexpensively. Simulations can be created that approximate even microscopic or theoretical environments. Parameters can be altered, and results can be recorded. This capability to allow the student to discover concepts through guided trial and error can increase retention dramatically. The move to this type of learning tool is a natural progression for multimedia enhanced

instruction. The time and effort needed to create this type of software is the greatest of all of the uses of the computer in instruction. The rewards, however, should be just as great.

Getting Information to the Students

Delivery of software to a lab or to the home can be handled with a CD-ROM checkout system or through the campus network. Nearly all School and University campus computer labs can be conveniently networked. Home computers can access material and download it through a modem from a campus based FTP server. Recent developments will now allow the learner to access material through the internet, giving the School and the University a global instructional presence. Connectivity can even allow students and teachers to communicate across long distances through e-mail. In many cases, this communication can be live. The future will certainly be a bright one for future students. Many teachers have already begun to use new and exciting instructional tools. The potential for drawing new students who have been previously unable to attend is high. We will have to determine the directions instructional technology will take, and will have to explore the new innovations and their potential for use by our teachers and students.

Few Most Important Chemistry Links on the Internet

General Chemistry online:

<http://antoine.frostburg.edu/chem/senese/101/index.shtml>

Periodic Table online:

<http://www.webelements.com>

Web applications in chemistry:

<http://chemistry.csudh.edu/webapps.html>

Atoms, Symbols and Equations:

<http://ourworld.compuserve.com/homepages/RayLec/atoms.htm>

Atoms, Bonding and Structure:

<http://www.rayslearning.com/bonds.htm>

Journal of Chemical Education:

<http://Jchemed.chem.wisc.edu/>

Molecular Modeling:

<http://hi-ce.org/sciencelaboratory/eChem>

Chemistry Textbook:

<http://library.thinkquest.org/3310/higraphics/index.html>

Encyclopaedia:

<http://encarta.msn.com/EncartaHome.asp>

Teaching Science Through Concept Maps at Upper Primary Level

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THE PAPER describes the usefulness of concept maps to teach science at upper-primary level. The various types of simple concept maps have been illustrated. Also, the instructional strategies and materials for using concept maps have been described.

Introduction

Many theorists (Ausubel, 1963 and Schwab, 1982) and educators are concerned with developing instructional models for teaching concepts. It is held by them that when the pupil uses the concepts, he or she learns to process information. One way to develop concepts is to give experiences in categorization. According to Joyce and Weil (1990), all categorizing activities involves identifying and placing events into classes by using certain cues or criteria and ignoring others. This done by asking students to compare and contrast examples called *exemplars* that contain the characteristics called *attributes* of the concept with examples that do not contain those attributes.

Joyce and Weil further say that a

concept has four elements: (1) a name ; (2) examples ; (3) attributes (essential and non-essential) ; and (4) attribute values. Understanding a concept means knowing all of its elements.

At the upper primary level, when a few concepts have been attained. to learn *Environmental Studies* (EVS) or science, the concepts get interrelated, then concept maps become helpful for integration for various concepts as well as understanding a given concept from the point of view of new application.

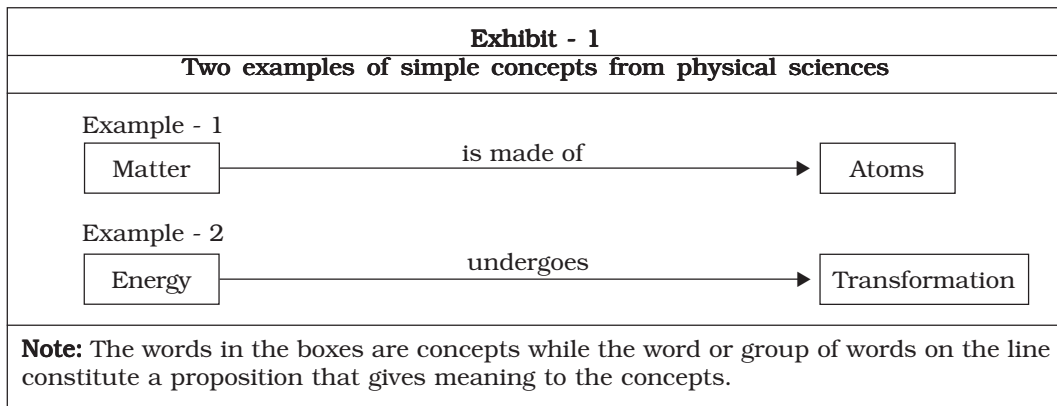
Defining Concept Map

A concept map: is a device for representing the conceptual structure of a discipline or part of a discipline. It is represented as a diagram showing the relationship between concepts. The nature the relationship between the concepts is stated on lines drawn between two appropriate concepts.

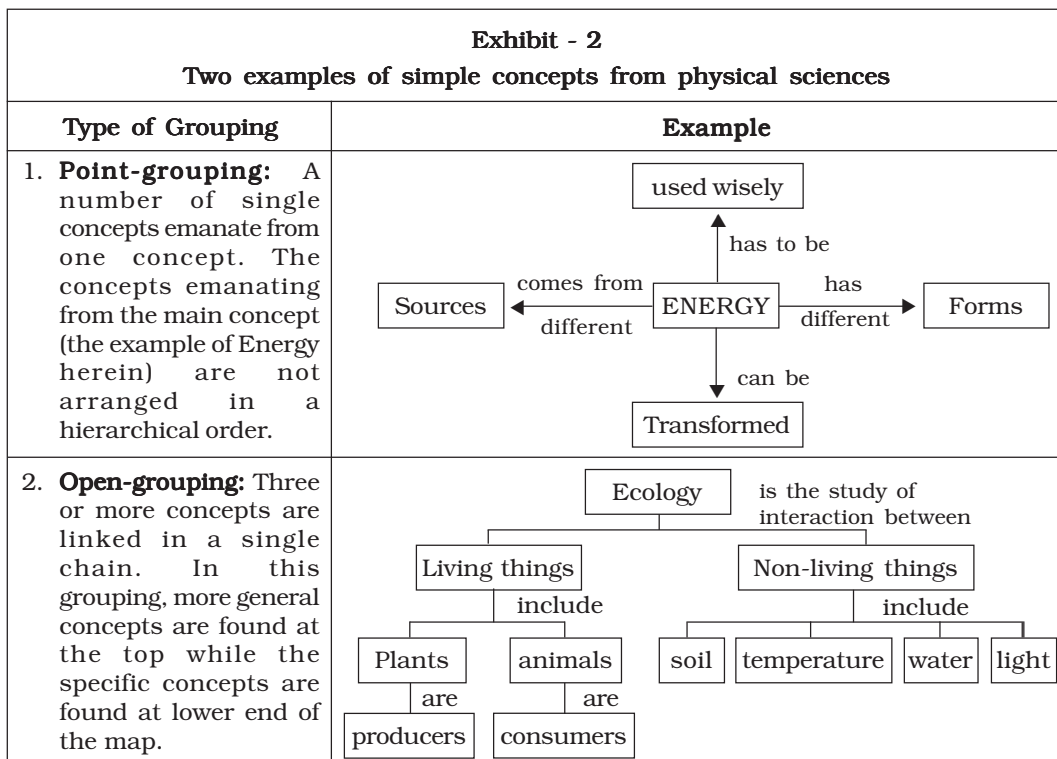
Concept Mapping as Instructional Strategy

According to Tan (1990), concept mapping can be used as instructional strategy to facilitate meaningful learning. A simple concept map consists of two concepts. A concept may be a situation or properties of things designated by a label or symbol. They can be linked by logical connectives. For two simple examples see Exhibit - I.

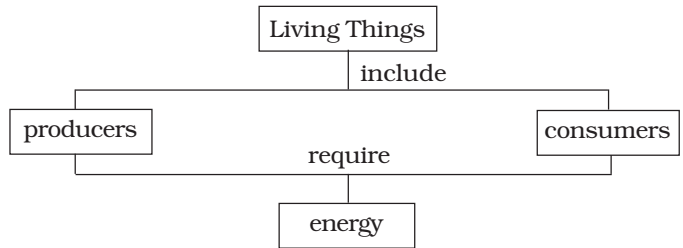
The proposition written on the line joining any two concepts may be simple words or phrases or made of scientific propositions. The more scientific propositions used, the better the understanding of concepts.



Concept maps can be of different types. For elementary classes, wherein a few concepts need to be grouped together, the following three concepts grouping are involved (see Exhibit -2).



3. **Closed-grouping:** The concepts for a closed group when by relating two or more concepts (branches) to a single concept



In the concept mapping, there is more extensive branching of concepts starting with a general concept or a central idea to more specific concepts or ideas. Furthermore, concept maps for the same topic may vary depending on the developer of the maps and the focal concepts. Tan (1990) further says that the topic of 'alcohol' may be developed from three perspectives: as an energy alternative; as a pollution issue; and as a health problem.

Classroom Transaction of Concept Maps

For classroom use of concept maps, either the charts or overhead projector transparencies can be made as talking and discussion points with students. Alternatively, a stack of cards with important related concept written on them can be made. These can be placed in a pocket-board or flannel board. The lines can be drawn or talked about in terms of phrasal proposition, telling the nature of relationships. Or else, write the concept names or words on the blackboard in boxes and talk about or discuss the relationships between concepts and complete the concepts, maps. Even the concept cards can be placed on the ground along the pegs and

joining them with threads to make lines to show relationships. The phrasal strips to show relationship can be attached to the threads using clothes clips.

While using the overhead projector for the concept maps for the over-lapping method, two transparencies can be used. The first transparency has the boxes and the concepts labels. A brief recall and recapitulation or prior knowledge level of students can be talking point. The second transparency has the lines only with phrasal or scientific propositions written on them. This transparency is laid on the first transparency to talk about the relationships.

In Conclusion

At the upper primary level, when a lot of information and number of concepts occur together in a lesson, it is quite appropriate to use the concept maps so that the interrelationship between concepts stands out and becomes clear to students. It will also help students to process and reorganise information from the textbooks into concept maps to gain better understanding the textual material. A science teacher needs to make use of concepts maps often through a variety of ways to make textual information meaningful to students.

References

- AUSUBEL, D.P. 1963. *The psychology of meaningful verbal learning*, New York: Grune and Stratton.
- BRUNER, J. 1961. *The process of education*, Cambridge: Harvard University Press.
- SCHWAB, J.J. 1982. *Science, curriculum and liberal education: selected essays*, Chicago: University of Chicago Press.
- TAN, M.C. 1990. Planning and developing curricula on environmental education. In R.C.Sharma and Merle C.Tan (eds). *Source Book of Environmental Education*. Bangkok: Unesco.

Senior Secondary Chemistry Teacher's Imagination of Phosphorus Burning

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SINCE AGES man had been using imagination to solve problems. This allows anticipation of good/bad happenings either immediately or in the near future. Persons of eminence and scientists quite often employ imagination in higher-order schematisation of thought. Creativity experts cite snakes holding each others tail as an act of imagination through which Kekule solved closed ring characteristic of benzene. Concrete data are handled logico mathematically by employing schemes of ordering, grouping and their union in numbers. At the abstract level,

data are analysed through hypothetico-deductive schemes/reasonings (propositional logic, etc that employes if ... then ... therefore format, Piaget, 1950). Hence, it goes without dispute, that imagination/creativity and logical thinking processes legitimately form part and parcel of natural and/or biological explorations. If, *Science* is to be understood like the scientists by the children, then, imagination/logical thinking cannot be left out of the classrooms. Through this study, an attempt has been made to know, whether senior secondary chemistry teachers utilise imagination or just feel happy in reproducing book-laden information in ordering events of phosphorus burning. Collected data shall be useful in offering appropriate suggestions for their orientation programmes.

Subjects: 18 senior secondary chemistry teachers from tribal schools of Madhya Pradesh/Chhattisgarh formed the sample. They had minimum 7 years of teaching experience of XI/XII classes. At the time of data collection, they were

Table shows number of the teachers giving sequence of the events.

No.	Description of the events	Number (%)	Steps given
I.	Consequence of the sun rays	3 (16.66)	One III/IV 2
II.	would raise the temp of the phosphrous piece	3 (16.66)	Two I-IV 1
III.	when it reaches ignition point	3 (16.66)	II-VIII 1
IV.	then it burns	13 (72.22)	III-VIII 1
V.	by forming a vaporous mass	-	IV-VI 1
VI.	of tri/penta oxide	2 (11.11)	IV-VIII 5
VII.	that dissolves slowly in H ₂ O	-	Three I,IV - VIII 2
VIII.	to form phosphoric acid	12 (66.66)	II,IV -VIII 1
IX.	invariance of quantity before/after exp	-	III, IV-VIII 1
X.	No reply/ scribblings	2 (11.11)	Four II,IV,VI- VIII 1

attending an orientation programme at the Regional Institute of Education, Bhopal.

Data Collection: Data were collected through the following experimental set-up. 200ml of tap water was poured in a 500ml flask. A small piece of phosphorus was inserted through the defragating spoon and kept well above the water surface. The apparatus was made airtight and sealed. It was placed on a stool. A convex lens was so fixed in the stand that a beam of sun rays would converge on the piece of phosphorus. The teachers were requested to imagine and record all the events in the sequential order, in case, the apparatus was left as such for about 15 minutes in the open sun.

Results: Table provides description of the nine ordered happenings and the number and percentage of the sampled teachers who made these sequences.

One teacher refrained from sequencing the events. Yet another one just scribbled only. One teacher each wrote steps III/IV. Nine teachers (50%) wrote two steps. Seven of them (77.77%) wrote IV/VIII steps. Four teachers (22.22%) wrote three steps. Here too all of them had mentioned steps IV/VIII besides another steps of II and III, respectively. Only one teacher wrote four steps (II, IV, VI, VIII). First three steps were written by three (16.66%) teachers. Steps V, VII and IX were not written by any sampled teacher.

Discussion: It is difficult to conjecture why two teachers desisted in sequencing the events. Why steps V /VII were not

written can be explained on the ground that these steps, in general, are not mentioned in the textbooks in the needed form. Step IX requires logical connecting of initial and final states of quantities in the experimental setup, i.e., that the quantities shall remain invariant because the equipment was sealed. They all knew it (principle of indestructibility of matter), but did not extend it in the present context of the happenings. It is also interesting that only three teachers wrote steps I, II and III. Bulk of these sampled teachers wrote steps IV and VIII. These steps occur in the textbooks. Hence, the teachers retrieved them easily and felt as if they were the only sequential events in the experiment. They failed to imagine events wholistically. It is unfortunate that not even a single teacher of this study wrote all the eight happenings. Question of sequencing, for them, therefore, did not matter at all.

Educational Implications: It appears, for one pretext or the other these teachers failed to apply their imagination in sequencing of the happenings pertaining to this experimental set-up. Sciencing involves imagination (Kekule)/ intuition (Yukawa) and experimentation (Spallanzini). If understanding of science is to be perceived like the scientists by the + 2 level of the students, then, teaching and learning processes cannot ignore them. (Imagination, Intuition and Experimentation). Imagination/ intuition give birth to new propositions that need experimental or mathematical validation. Sampled teachers very poor display of imagination suggests they need

orientation in what and how of imagination. Chemistry-educators have to bear this grunt. Development of such an exemplar material should be on the basis of the following steps:

- Drafting of the exemplar materials;
- Its churning by the experts/ch-trs;
- Pilot testing in some targeted classes; and

- Finalisation of revised material and its dissemination.

It is hoped, this new material shall be liked by the conscious teachers and interested +2 chemistry students. In the author's opinion, imagination-based learning of some chemistry concepts by the students would be innovative in character as well.

A Study of Student's Performance on Mathematics in Relation to Teaching Technique

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THE STUDY of Mathematics had perhaps begun with the use of numbers by the humans. The use of numbers might have begun when barter system was prevailing in the society and all transactions were held in terms of goods against goods. With time mathematics began to assume a wider spectrum as it gradually evolved through algebra, geometry, trigonometry, and more recently operational research besides statistics. All these areas now come within the scope of mathematical study.

India has a long tradition of practicing mathematics and astronomy, which extends over two thousand years. **Aryabhata** and **Varahamihir** were two of the great mathematicians that India has produced in that era. Apart from these two, **Chanakya** had made immense contribution to mathematics and accountancy. Many scholars have contributed in the development of mathematics during medieval and modern periods as well. Srinivas Ramanujam has been one of them.

Now-a-days mathematics is taught as a compulsory subject in schools right from the primary stage. Mathematics is

often dreaded as many students consider it a difficult subject. That is why there is a need to evolve innovative and child centred techniques for teaching mathematics so as to make its study more interesting and enjoyable to all students. Individuals and institutes engaged in the field of research in mathematics and mathematics education through out the world are continuously trying to improve the quality of teaching/learning of mathematics at all levels especially in schools. Universities and research institutes in India are also giving lot of emphasis on research studies on various aspects of mathematics education.

According to Prof. J.N. Kapur, research in mathematics education in India has been mainly focusing up on — “mathematics education at the primary level, history of mathematics, professional preparation of teachers, development of mathematical concepts, curriculum development, methods and techniques of teaching mathematics, preparation and use of instructional material including textbooks and teaching aids, programmed instruction materials, mass media communication, behavioural problems in mathematics classrooms, psychological aspects of learning mathematics education at various levels and their actual realisation.”

Many researchers and intellectuals, from time to time, have expressed their considered views on various issues and concerns pertaining to mathematics education. Views expressed by two of them are presented being relevant to the discussion to follow.

“Throughout the world, mathematics education is in a ferment, and everywhere there is a search for new ways. Probably there are many different solutions to the basic problem of how new generations of mathematicians are to be educated and the optimisation of these solutions is at present humanly impossible” — S.L.SOBOLEV (1976).

“Investigation can play a vital role in the learning of mathematical concepts and in problem-solving. At all stages, the teacher has an essential part to play. He sets the scene, providing real materials or a challenging problem where necessary. He observes what his pupils do with these and asks questions which will help their learning.” EDITH BIGGS(1976).

The present study relates to the teaching of mathematics at the primary level, particularly focusing on effectiveness of structured material used in schools. Most commonly used structured material that were evaluated through this study are – (a) The Montessori Apparatus (b) The Dienes Apparatus (c) The Lowenfield Apparatus (d) The Clews Fraction Board and (e) The Counting Frame.

In addition to the above, the teaching techniques adopted in the teaching of mathematics in higher classes were also evaluated under the present study. These teaching techniques are — (a) Lecture method, (b) Demonstration method (Model demonstration), (c) Participatory method, (d) Play way method, (e) Group discussion, (d) Inductive deductive method, (e) Practice of problems and (f) Using laboratory of mathematics.

The student’s concept about mathematics depends to a large extent on the technique their teacher uses to teach them. The idea of the study was thus derived from this basic assumption. By evaluating various teaching techniques used to teach mathematics, an attempt has been made this through study to identify those methods, which are enjoyed by the teachers while teaching and also those that the students enjoy to learn.

Objectives of the Study

- (i) To evaluate various methods of teaching mathematics.
- (ii) To determine a method of teaching mathematics which is liked by students and that which enhances performance.

Need and Justification for the Study

Mathematics is one of the subjects that every individual, belonging to any strata of the society, has been using in some way or the other. For instant, in deciding the selling price of vegetables, the calculations done by the vendor involve some elementary ideas about mathematics. On the other hand, in solving complex equations space scientists apply their knowledge and understanding of mathematics, although it involves much higher mathematical skills. In spite of mathematics being an essential tool for every one in the society, it often is a cause of great scare amongst students. Over the years it has been observed that our students in the secondary classes are not able to do well in mathematics. As an academic subject

mathematics needs a lot of patience. What might be the possible causes of failure of our students? Is it lack of adequate training or a purely psychological cause of fear of numbers or social cause that students due to modern day gizmos are left with less time to practice mathematics. There are some of the problems that have been studied in this paper.

Methodology

The research has been undertaken with a set of questionnaire. This contained a mixture of open ended, dichotomous, and multiple choice questions. This has been given to the sample under study. We observed the teaching system in some schools located at Ajmer (Rajasthan). The sample under study consisted of 120 (80 students, 20 teachers, 20 parents) of various schools.

The data that was collected had been put under MS Excel and did all the analysis. This was for the first objective, for the second one we conducted

brainstorming session at Regional Institute of Education, Ajmer. The participants of the session were the teachers of the various schools of the city. With the students and parents we held one to one meetings.

The research questions that were answered by the study:

- (i) What are the various methods of teaching mathematics?
- (ii) What are the methods students like?
- (iii) Is teaching solely responsible for performance of students?
- (iv) If not, what are the other factors?
- (v) What are the ways in which fear of numbers can be solved?

These are the responses given by the students to questions on the various ways in which the teachers teach mathematics. We have found the following as the common methods used by the teachers to teach mathematics. We have found the following as the

Results

<i>Sl. No</i>	<i>Methods</i>	<i>No. of responses</i>
A	Various methods by which teachers teach mathematics — as told by students	
1	Blackboard method	80
2	Simple example	40
3	Practical method	23
4	Repeated practice	55
5	With diagrams	75
6	Class tests	47
7	Daily life example	13

B	Various methods by which teachers teach mathematics — as told by teachers	
1	Lecture method	20
2	Demonstration method (Model demonstration)	18
3	Participatory method	5
4	Play-way method	3
5	Group discussion	8
6	Inductive-deductive method	6
7	Practice of problems	12
8	Using laboratory of mathematics	3
C	Ways by which students like to be taught maths	
1	Simple lucid way	80
2	Frequent use of examples	70
3	Encourage students to practice maths	80
4	Maths teachers should be friendly	36
5	Teachers should teach them with patience	30
6	Laboratory should be used frequently	10
7	All queries must be cleared on the subject stepwise	44
8	Test must be taken after every chapter	52
9	Repeated revision of the topic	35
10	Daily life example	25
11	Frequently holding inter-departmental quiz	17
12	Relating mathematical problems to nature	12
13	Taking help of other related books	17
14	Historical examples can make mathematics more interesting	5
D	The teacher's view on reducing the fear of numbers	
1	Being friendly with the students	80
2	Teaching the basics clearly	80
3	Knowing their views	72
4	Motivating them to learn	66
5	Teaching them the importance of numbers	55
6	Using teaching aids	22
7	Playing with numbers	17
8	Teaching according to the level of students	70
9	Relating teaching maths with worldly examples	15
10	Encouraging practice of mathematics	80

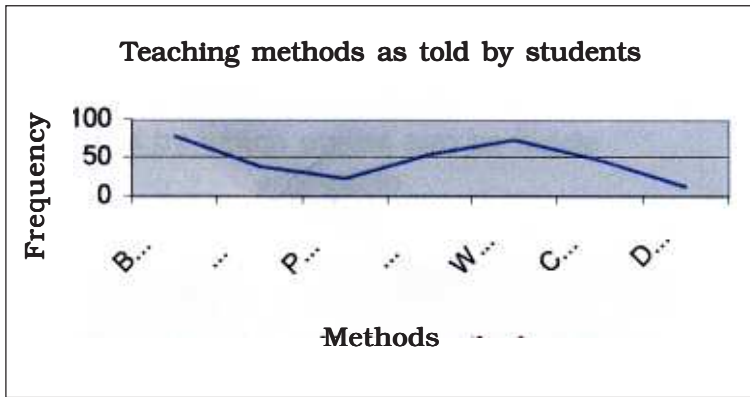


Fig. 1

common methods used by the teachers to teach math's of the various methods the black board method was found to be most common and all the 80 samples suggested that teachers taught on black-board, while only 13 of them said that teachers taught by use of daily life examples.

In the Fig.2, we have shown the diagram which represents the various plotted in a line diagram.

When asked on how they would like to be taught maths the students gave the above points. In these points all the students said that they would like to be taught in simple way and to be encouraged to practice maths. All the common points that came up as recommendations from the students have been plotted as a line diagram below.

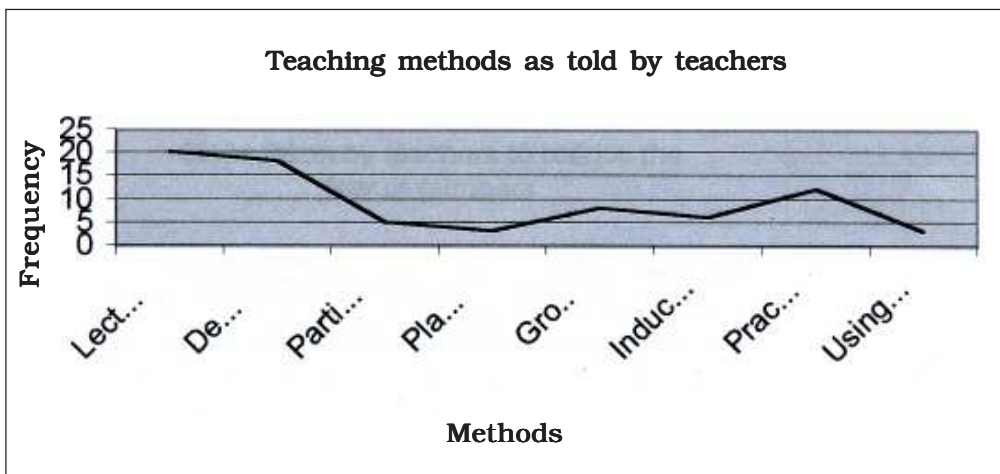


Fig. 2

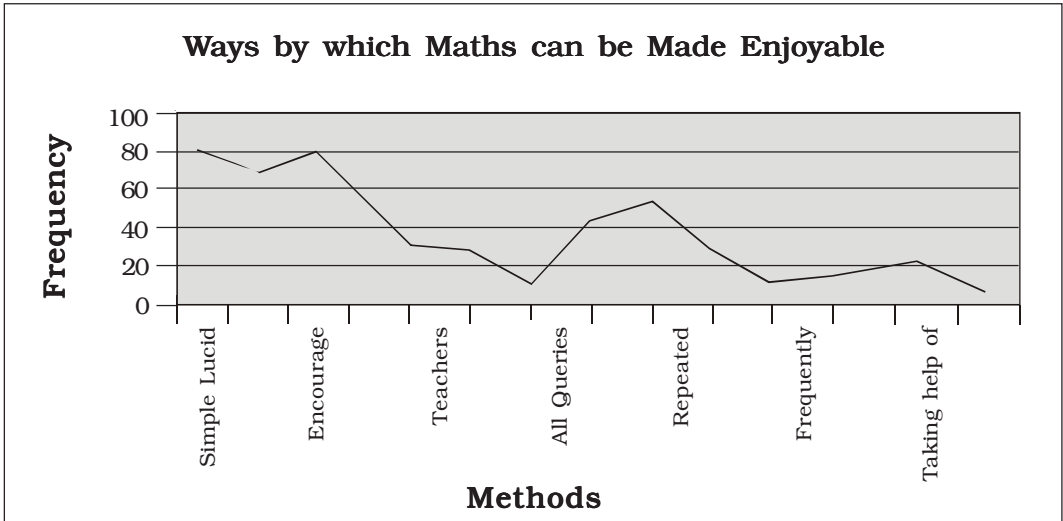


Fig. 3

When asked on the ways teachers' take to reduce the fear of number among the students they gave the above points. Of all these points teaching the friendly way, encouraging practice among students and teaching the basics properly were the most common. All the common points that came out as response have been shown in the line diagram.

Parents view on performance of their children in mathematics

We interviewed some 20 parents on if they were happy with the performance of their child in mathematics — a majority of them answered in the negative. They attributed the failure of their children to learn the subject on the fact that today children hardly have the

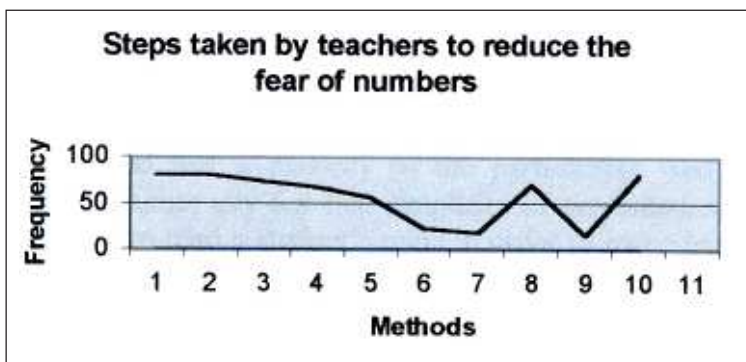


Fig. 4

time to do intense practice of mathematics which is a must to do well in this subject. The parents feel that the modern day gizmos have made life so fast and busy for the children that they hardly have time to practice mathematics. They feel that apart from using innovative method to teach mathematics the teachers have also to see that their students practice it at home. Only then they will perform well.

Response on if the students are afraid of numbers

We tried to find an answer to this from the students, where 62% said that they are not afraid and 18% said they were afraid. This finding was contrary to our belief that students were afraid of numbers that resulted in their failure to perform well in mathematics.

Findings and conclusions

The project was undertaken with two objectives, so we are going to state the conclusions based on these.

The first objective was to evaluate the various methods of teaching mathematics. In the process of our study we came across various methods that teachers make use of in teaching

mathematics. All these methods along with the number of responses are given in the above pages. From our findings we can conclude that the use of blackboard to explain mathematics is the most commonly used method. However there were a few teachers who also use new methods like the visual aids and other laboratory equipment to make the students understand better. The students on the other hand have said that they like the subject when taught from the basics and in a simple and lucid way.

The second objective was to find a way of teaching mathematics, which is liked by the students and that which enhances their performances. For this we had organised a brain storming session to evaluate the various teaching techniques of mathematics. At the end of the session we found that a majority of the participants who came from various premier institutions of Ajmer city felt that simplicity of presentation, clarity of the topic covered, and the ability to read a student's mind in order to make him understand, made a good mathematics teacher. Therefore, the students will like the teacher, the subject and perform well in it.

References

- KAPUR, J.N. 1990. "Fascinating World of Mathematical Sciences", Vol. VI.
- SOBOLEV, S.L., EDITH, BIGGS. 1976. "Published in Mathematics Teacher (India)" Vol. XI.

Training of KRPs in Preparation and Use of Low Cost TLM in Science

An Experience at Regional Institute of Education, Ajmer

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SCIENCE OPERATES through its processes; it must be experienced, if it is to be learned effectively. Hence teaching and learning of science needs a number of process skills to be acquired like experimentation, taking observations, collection of data, classification, analysis, making hypothesis, drawing inference, arriving at conclusions, which ultimately develops spirit of scientific temper. Appropriate Teaching Learning Materials (TLM) and real activity based teaching help the development of these abilities in a child.

In the age when we have dream of education for all, our first effort should be in the direction of making teaching joyful, interesting and fascinating so that the system attracts the learners and they become ready to learn. The developing countries like ours, which cannot afford even the physical facilities needed for educational institutions, have to rely mainly on human resources. It is, therefore of utmost importance that our teachers should make full use of the equipment made available, improvise apparatus and make low cost teaching

aids because if we wait for fully equipped institutions we will never begin. Since India is a land of art and craft and full of natural resources, inexpensive/no cost materials can be improvised with resources available from the nature easily. Hence steps need to be taken in this direction to make teaching meaningful, functional and creative with the use of such materials. Teaching learning material (TLM) acts as a vehicle to transact content to the students by providing an opportunity to learn by doing. It could also be utilised to facilitate learning of complex phenomena involving even three dimensional view of certain objects or situations.

“What is Low Cost-No Cost Teaching Learning Material ?”

The Teaching aids prepared by simple and locally available materials which are not very costly, involving children, parents and community resources

National Curriculum Frameworks of NCERT assume that the learner at upper primary stage is better equipped to understand the process through simple scientific activities. At this stage the child should be engaged in learning principles of science through familiar experiences, working with hands and continuing to learn through activities. It also intended to make the teaching learning process more interesting by using improvised/low cost teaching aids. It is important to ensure that the majority of activities and experiments are inexpensive and use readily available materials so that science curriculum

can be implemented successfully in all schools including those with inadequate infrastructure specifically in rural areas. Any Sophisticated instrument not available in the school may be improvised from the locally available materials and apparatus. Through improvisation, the students will develop certain manipulative skills which would also help in developing creative abilities in them.

Therefore, it is necessary to prepare teachers who can make teaching more natural, creative, child centred and meaningful with the help of self-made low cost no cost teaching aids. In the light of the above a training programme was planned for Key Resource Persons (KRPs) of Uttaranchal state in teaching of Science and Technology at upper primary level using Low Cost No Cost Teaching Learning Material (LCNCTLM) at regional Institute of Education (RIE), Ajmer in 2005.

Objectives

The objectives of the programme were as follows:

- To identify the content areas at upper primary level which require the use of LCNCTLM.
- To impart training to KRPs in preparation and use of low cost teaching aids for the explanation of concepts at upper primary level.
- To study the impact by taking feed back on the instructional material developed.

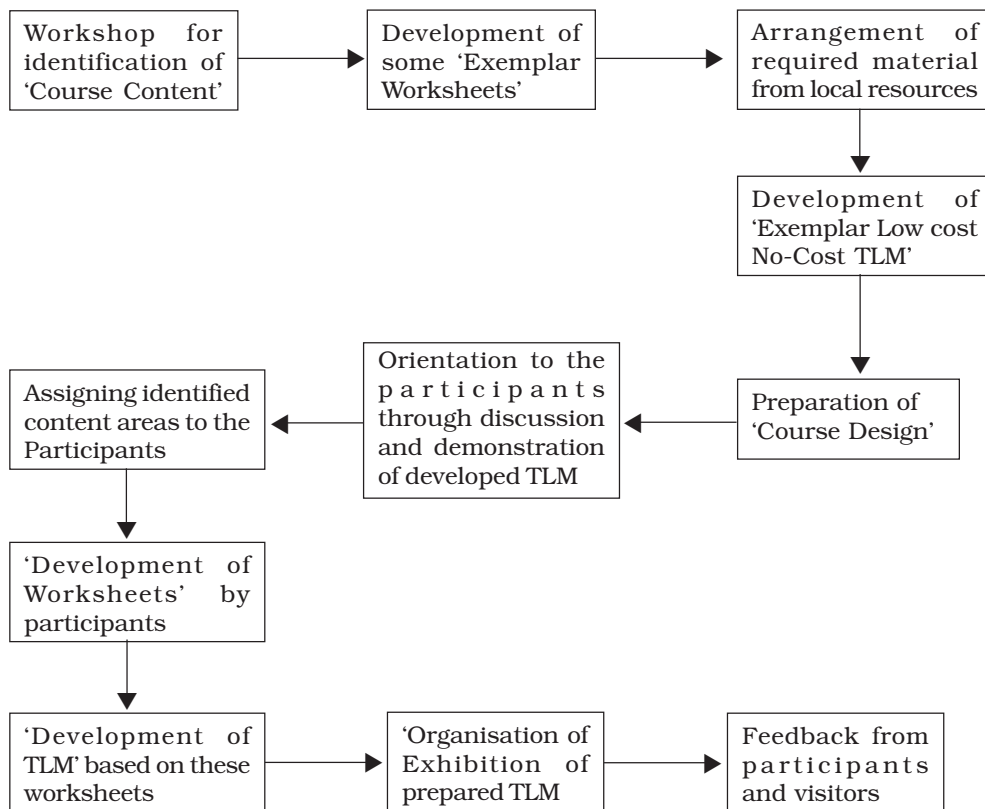
Procedure

Five Resource Persons/experts including the Principal and some faculty members of RIE, Ajmer, identified the course content in Science and Technology at upper primary level on which Exemplar low cost teaching aids could be prepared. Materials needed to prepare these teaching aids were arranged from local resources. Instructional material was developed in the form of worksheets in a format that has separate sections on objectives, materials required, procedure, discussion, precaution and diagrams. Low Cost No Cost Teaching Learning Materials were prepared by Resource Persons on some of the content areas as an exemplar material on the basis of prepared work sheets. Training programme was organised for KRPs' of Uttaranchal State at R.I.E. Ajmer. Prepared Teaching Learning Materials were demonstrated to the participants and discussed with them about their need, importance, development and uses.

Some themes were identified from content areas at upper primary level on which TLMs/Improved apparatus were listed out. Groups of 2-3 participants were formed. TLMs to be developed on different themes were distributed between them. They were asked to develop worksheets in discussed format on allotted TLNs/improvised apparatus like different types of improvised heating devices, improvised apparatus to demonstrate preparation of different gases and their uses, various types of weighing and measuring devices,

Methodology

The following flow chart explains the methodology adopted:



demonstrations on different types of Energy (electric, solar, wind, thermal), properties of air, Experiments on light, Science through fun games, various activities on living world and a number of improvised laboratory equipment and working models. At the end of the workshop 80 LCNCTLMs were prepared. Only four of them are given in the following chart.

On the last day of Training Programme an Exhibition was organized to display the prepared TLM. Pupil Teachers visited the exhibition. It was also visited by the teachers and students of Classes VI, VII and VIII of the DM School attached with the RIE, Ajmer besides some faculty members of RIE, Ajmer. Participants were given an opportunity to demonstrate the TLMs

TLMs Developed

S. No.	Theme	TLM	Material Required	Use	Diagram
1.	Atomic Structure	Play with atom	Hard board, white sheet, coloured glazed Paper, Periodic Table, beads.	To teach atomic structure, symbol of elements and electronic configuration.	<p>Fig. 1</p>
2.	Tetravalence of Carbon	Model of Methane	Plastic balls, (white and black spring, round magnets, beads, wooden blocks	To demonstrate formation of covalent bond	<p>Fig. 2</p>
3.	Measuring weight	Micro balance or soda straw balance	Wooden block, 2 blades, needle, graph paper straw-1	To weigh up to 0.1mg	<p>Fig. 3</p>
4.	Living world	D.N.A (Three Dimensional Model)	Wooden blocks, iron wire, thermocol coloured balls, wooden sticks, coloured paper	To explain double helix structure and bonding within 2 strands of DNA	<p>Fig. 4</p>

prepared by them and to explain their relative advantages in teaching science at the upper primary level over the traditional equipment and apparatus. The main emphasis has been on:

- low cost and no cost materials used in the development of TLM,
- process of development of a particular TLM,

- functioning of each TLM developed and
- its utility in teaching learning process to enhance conceptual learning.

This exhibition also provided participants an experiential learning in giving demonstration, which is one of the strategies to enhance conceptual learning and effective use of TLM. At the end of the workshop it was realized that a tremendous amount of activities can

be conducted using low cost, no cost and easily available materials. This is more important in the context of majority of the schools that are not well equipped.

On the basis of feedback received from visitors, it could be concluded that the programme proved useful and educative as it gave insight to the teachers and pupil teachers in developing worksheets and Low Cost Teaching Learning Material for use in the schools so as to make teaching child centred, more attentive and interesting.

Science News

Nobel Awards 2005

The Royal Swedish Academy of sciences announced Nobel prizes in physics, chemistry and physiology or medicine in the first week of October 2005. Eight scientists from USA, Germany, Australia and France shared the prestigious awards in three disciplines.

The Nobel Prize in Physics 2005

This year's Nobel Prize in physics was awarded to three physicists for their pioneering work that throws a new light on modern optics. The citation for the award stated, "As long as humans have populated the Earth, we have been fascinated by optical phenomena and gradually unravelled the nature of light." Roy J. Glauber, Harvard University, Cambridge, MA, USA, was awarded half of the Prize money for his theoretical description of the behaviour of light particles. John Hall, JILA, University of Colorado and National Institute of Standards and Technology, Boulder, CO, USA and Theodor Hänsch, Max-Planck-Institut für Quantenoptik, Garching and Ludwig-Maximilians-Universität, Munich, Germany shared the other half of the Prize for their development of laser-based precision spectroscopy, that is, the determination of the colour of the light of atoms and molecules with extreme precision.

Just like radio waves, light is a form of electromagnetic radiation. Maxwell described this in the 1850s. His theory

has been utilised in modern communication technology based on transmitters and receivers: mobile telephones, television and radio. If a receiver or a detector is to register light, it must be able to absorb the radiation energy and forward the signal. This energy occurs in packets called quanta and a hundred years ago Einstein was able to show how the absorption of a quantum (a photon) leads to the release of a photoelectron. It is these indirect photoelectrons that are registered in the apparatuses when photons are absorbed.

Thus, light exhibits a dual nature — it can be considered both as waves and as a stream of particles. Roy Glauber has established the basis of Quantum Optics, in which quantum theory encompasses the field of optics. He could explain the fundamental differences between hot sources of light such as light bulbs, with a mixture of frequencies and phases, and lasers, which give a specific frequency and phase. In simple terms, how light emitted by a candle differs from the beam produced by a laser in a CD player, or how the accuracy of atomic clocks could be improved further, are among questions this year's laureates have tackled successfully. Glauber first reported on his research on the application of quantum physics to optical phenomena in 1963. Quantum optics explains the fundamental difference between sources of warm light like light bulbs, which have a mixture of frequencies and phases, and cold lasers, which give a specific frequency and phase.

Glauber also described quantum 'noise', what the American Institute of

Physics describes as jittery and unavoidable fluctuations in the properties of light. This in turn provides information on the limits of measuring light. Glauber was also on the staff of the Manhattan Project that developed the nuclear bomb for the US during World War II. The American Institute of Physics says this has helped scientists to define physical units, like the metre, which Hall and others helped to redefine as the distance light travels in one 299,792,458th of a second.

The important contributions by John Hall and Theodor Hänsch have made it possible to measure frequencies with an accuracy of fifteen digits. Lasers with extremely sharp colours can now be constructed and with the frequency comb technique precise readings can be made of light of all colours. This technique makes it possible to carry out studies of, for example, the stability of the constants of nature over time and to develop extremely accurate clocks and improved GPS technology. Looking to the future, the researchers say their work might be used to giving extremely accurate measurements that could one day be used in deep space travel or to develop 3D holographic television. In particular, they were honoured for their so-called optical frequency comb technique, in which ultra short pulses of light create a set of equally spaced frequency peaks that look like a comb. The duo's techniques open the way to even more accurate atomic clocks, which in turn can make GPS navigation systems more precise, and will allow astronomers to have better control over their telescopes.

Nobel Prize in Chemistry 2005

The Royal Swedish Academy of Sciences has awarded the Nobel Prize in Chemistry for 2005 jointly to **Yves Chauvin** Institute Français du Pétrole, Rueil-Malmaison, France, **Robert H. Grubbs**, California Institute of Technology (Caltech), Pasadena, CA, USA and **Richard R. Schrock**, Massachusetts Institute of Technology (MIT), Cambridge, MA, USA "for the development of the metathesis method in organic synthesis".

Take a humble carbon atom and turn it into something exciting and extraordinarily versatile, a zinger in chemistry's periodic table. That's the achievement of the trio of scientist who were awarded the 2005 Nobel Prize in Chemistry.

The three chemists were singled out for revolutionising organic chemistry, specifically for the process of metathesis. In metathesis, a catalyst is used to slice through the bonds of carbon-based molecules, enabling them to re-form in different ways to create new compounds.

The process has already led to new forms of plastics capable of coping with high stress, exotic shapes and extreme temperatures to better industrial coatings, fuel additives, insecticides, fertilisers and even synthetic pheromones to trap or repel insects. The process has not only widened the range of synthetics, it has also made production leaner and greener. Another big area of organic interest is in drug research, helping scientists who seek new molecules to attack HIV, bacteria, cancer, Alzheimer's disease and other ailments.

According to the Nobel Jury, only a tiny fraction of the enormous diversity of organic molecules has been explored by synthetic chemists, yet it has already given us new pharmaceuticals, agrochemicals, materials that we cannot live without. Jury opined that further exploration of this diversity will result in even greater benefits to mankind; the potential is enormous.

What is metathesis? Metathesis is like a dance, in which a caller gets clusters of dancers to swap partners. In this case, the dancers are atoms of elements such as hydrogen, sulphur, chlorine and oxygen that team up in a molecular chain or a ring with carbon atoms. And the caller is a catalyst, which selectively breaks bonds between the partners, enabling the dancers to team up with others and thus make a new structure.

The importance of carbon bonds was recognised in the last century as petroleum began to be widely used. Chemists were long able to produce new substances using a catalyst, although their understanding of how it worked was poor and catalysts were often inefficient and dirty.

But it was not until 1971, when Chauvin explained how metathesis worked and outlined candidate metal catalysts that could do the job. Chauvin's goal was a catalyst that would be both stable and selective, able to slice through the strong double-carbon bonds rather than single ones and leave other parts of the molecule intact.

Nineteen years later, Schrock produced the first efficient metal catalyst,

based on molybdenum. But it was sensitive to moisture and oxygen, which shortened the catalyst's life. Schrock's catalyst was bettered in 1992 when Grubbs used a ruthenium alternative that is stable in air and moisture and is the basis for many catalytic processes in science and industry today.

In addition to smashing the previous limits of making synthetic compounds, the trio are warmly praised for their contributions to environmental health. Improved metathesis means that making plastics requires fewer steps and can be carried out at lower temperatures and pressure, which in turn entails less energy and wastage of raw materials than before. In many cases, production needs less harmful solvents and results in less hazardous waste.

Metathesis is now widely used in the chemical industry, mainly in the development of pharmaceuticals and of advanced plastic materials. Thanks to the contributions made by the three chemists, synthesis methods have been developed that are

- more efficient (fewer reaction steps, fewer resources required, less wastage),
- simpler to use (stable in air, at normal temperatures and pressures) and
- environmentally friendlier (non-injurious solvents, less hazardous waste products).

This represents a great step forward for "green chemistry", reducing potentially hazardous waste through smarter production. Metathesis is an

example of how important basic science has been applied for the benefit of man, society and the environment.

The 2005 Nobel Prize in Physiology or Medicine

The Nobel Prize in Physiology or Medicine for 2005 has been awarded jointly to **Barry J. Marshall** and **J. Robin Warren** for their discovery of “the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease”.

This year’s Nobel Laureates in Physiology or Medicine made the remarkable and unexpected discovery that inflammation in the stomach (gastritis) as well as ulceration of the stomach or duodenum (peptic ulcer disease) is the result of an infection of the stomach caused by the bacterium *Helicobacter pylori*. In 1982, when Marshall and Warren discovered this bacterium, stress and lifestyle were considered the major causes of peptic ulcer disease. It is now firmly established that *Helicobacter pylori* causes more than 90% of duodenal ulcers and up to 80% of gastric ulcers. The link between *Helicobacter pylori* infection and subsequent gastritis and peptic ulcer disease has been established through studies of human volunteers, antibiotic treatment studies and epidemiological studies.

Robin Warren (born 1937), a pathologist from Perth, Australia, observed small curved bacteria colonising the lower part of the stomach (antrum) in about 50% of patients from which biopsies had been taken. He made the crucial observation that signs of

inflammation were always present in the gastric mucosa close to where the bacteria were seen.

Barry Marshall (born 1951), a young clinical fellow, became interested in Warren’s findings and together they initiated a study of biopsies from 100 patients. After several attempts, Marshall succeeded in cultivating a hitherto unknown bacterial species (later denoted *Helicobacter pylori*) from several of these biopsies. Together they found that the organism was present in almost all patients with gastric inflammation, duodenal ulcer or gastric ulcer. Based on these results, they proposed that *Helicobacter pylori* is involved in the aetiology of these diseases.

Even though peptic ulcers could be healed by inhibiting gastric acid production, they frequently relapsed, since bacteria and chronic inflammation of the stomach remained. In treatment studies, Marshall and Warren as well as others showed that patients could be cured from peptic ulcers only when the bacteria were eradicated from the stomach. Thanks to the pioneering discovery by Marshall and Warren, peptic ulcers are no longer a chronic, frequently disabling condition, but a disease that can be cured by a short regimen of antibiotics and acid secretion inhibitors.

The Nobel Prize in Physiology or Medicine to Barry Marshall and Robin Warren, has once again established that tenacity and a prepared mind could challenge prevailing dogmas even in present era where research at the frontiers of science is often not conceived without laboratories with highly

sophisticated gadgets and equipment. By using technologies generally available namely fibre endoscopy, which involves silver staining of histological sections and culture techniques for microaerophilic bacteria, the Nobel awardees made an irrefutable case that the bacterium *Helicobacter pylori* is the cause of peptic ulcers. By culturing the bacteria they made them amenable to scientific study.

Helicobacter pylori is a spiral-shaped Gram-negative bacterium that colonizes the stomach in about 50% of all humans. In countries with high socio-economic standards infection is considerably less common than in developing countries where virtually everyone may be infected. Infection is typically contracted in early childhood, frequently by transmission from mother to child, and the bacteria may remain in the stomach for the rest of the person's life. This chronic infection is initiated in the lower part of the stomach (antrum). As first reported by Robin Warren, the presence of *Helicobacter pylori* is always associated with an inflammation of the underlying gastric mucosa as evidenced by an infiltration of inflammatory cells.

The severity of this inflammation and its location in the stomach is of crucial importance for the diseases that can result from *Helicobacter pylori* infection. In most individuals *Helicobacter pylori* infection is asymptomatic. However, about 10-15% of infected individuals will sometimes experience peptic ulcer disease. Such ulcers are more common in the duodenum than in the stomach itself. Severe complications include bleeding and perforation.

The current view is that the chronic inflammation in the distal part of the stomach caused by *Helicobacter pylori* infection results in an increased acid production from the non-infected upper corpus region of the stomach. This will predispose for ulcer development in the more vulnerable duodenum.

In some individuals *Helicobacter pylori* also infects the corpus region of the stomach. This results in a more widespread inflammation that predisposes not only to ulcer in the corpus region, but also to stomach cancer. This cancer has decreased in incidence in many countries during the last half-century but still ranks as number two in the world in terms of cancer deaths. Inflammation in the stomach mucosa is also a risk factor for a special type of lymphatic neoplasm in the stomach, MALT (mucosa associated lymphoid tissue) lymphoma. Since such lymphomas may regress when *Helicobacter pylori* is eradicated by antibiotics, the bacterium plays an important role in perpetuating this tumour.

Helicobacter pylori is present only in humans and has adapted to the stomach environment. Only a minority of infected individuals develop stomach disease. After Marshall's and Warren's discovery, research has been intense. Details underlying the exact pathogenetic mechanisms are continuously being unravelled.

The bacterium itself is extremely variable, and strains differ markedly in many aspects, such as adherence to the gastric mucosa and ability to provoke

inflammation. Even in a single infected individual all bacteria are not identical, and during the course of chronic infection bacteria adapt to the changing conditions in the stomach with time.

Likewise, genetic variations among humans may affect their susceptibility to *Helicobacter pylori*. Not until recently has an animal model been established, the Mongolian gerbil. In this animal, studies of peptic ulcer disease and malignant transformation promise to give more detailed information on disease mechanisms.

Helicobacter pylori infection can be diagnosed by antibody tests, by identifying the organism in biopsies taken during endoscopy, or by the non-invasive breath test that identifies bacterial production of an enzyme in the stomach. An indiscriminate use of antibiotics to eradicate *Helicobacter pylori* also from healthy carriers would lead to severe problems with bacterial resistance against these important drugs. Therefore, treatment against *Helicobacter pylori* should be used restrictively in patients without documented gastric or duodenal ulcer disease.

Many diseases in humans such as Crohn's disease, ulcerative colitis, rheumatoid arthritis and atherosclerosis are due to chronic inflammation. The discovery that one of the most common diseases of mankind, peptic ulcer disease, has a microbial cause, has stimulated the search for microbes as possible causes of other chronic inflammatory conditions. Even though no definite answers are at hand, recent data clearly suggest that a dysfunction

in the recognition of microbial products by the human immune system can result in disease development. The discovery of *Helicobacter pylori* has led to an increased understanding of the connection between chronic infection, inflammation and cancer.

(Source: Press Release Swedes Academy of Sciences)

New Moons of Pluto Discovered!

Using NASA's Hubble Space Telescope to probe the ninth planet in our solar system, astronomers have discovered that Pluto may have not one, but three moons.

Pluto was discovered in 1930. The planet is nearly 4.8 billion kilometres away from the sun in the heart of the Kuiper Belt, a vast region of icy, rocky bodies beyond Neptune's orbit. Astronomers discovered the only confirmed moon of Pluto, Charon, in 1978.

A team of astronomers at the Johns Hopkins Applied Physics Laboratory, Laurel, Md with Hubble telescope has discovered new moons of Pluto. According to Hal Weaver co-leader of the team that made the discovery the new Hubble images indicate that Pluto has not one, but two or three moons. If it were so, Pluto will become the first body in the Kuiper Belt known to have more than one satellite. The Hubble telescope's Advanced Camera for Surveys observed the two new candidate moons on May 15, 2005. The new satellite candidates are roughly 5,000 times fainter than Pluto, but they really stood out in these Hubble images, says Max Mutchler of the Space Telescope Science Institute and the first

team member to identify the satellites. Three days later, Hubble looked at Pluto again. The two objects were still there and appeared to be moving in orbit around Pluto.

The candidate moons, provisionally designated S/2005 P1 and S/2005 P2, are approximately 44,000 kilometres away from Pluto—in other words, two to three times as far from Pluto as Charon. These are tiny moons. Their estimated diameters lie between 64 and 200 kilometres. Charon, for comparison, is about 1170 km in diameter, while Pluto itself has a diameter of about 2270 km.

The team plans to make follow-up Hubble observations in February 2006 to confirm that the newly discovered objects are truly Pluto's moons. Only after confirmation will the International Astronomical Union consider permanent names for S/2005 P1 and S/2005 P2.

A re-examination of [older] Hubble images taken on June 14, 2002 has essentially confirmed the presence of both P1 and P2 near the predicted locations based on the 2005 Hubble observations, says Marc Buie of Lowell Observatory, Flagstaff, Ariz., another member of the research team. The team looked long and hard for other potential moons around Pluto, but they didn't find any.

These Hubble images represent the most sensitive search yet for objects around Pluto, says the team member Andrew Steffi of the Southwest Research Institute. He further ascertained that it is unlikely that there are any other moons larger than about 15 km across in the Pluto system.

(Source: NASA news)

An Explosion on the Moon

The NASA scientists observed an explosion on the moon on Nov. 7, 2005 when a 12-centimetre-wide meteoroid travelling at 27 km/s struck on its surface. The blast, equal in energy to about 70 kg of TNT, occurred near the edge of Mare Imbrium (the Sea of Rains). The event was accidentally recorded while they were testing the telescope and video camera that the researchers Rob Suggs and his colleague Wes Swift have assembled to monitor the moon for meteor strikes at Marshall Space Flight Centre (MSFC).

According to Bill Cooke an expert with MSFC, the object that hit the moon was, "probably a Taurid". In other words, it was part of the same meteor shower that peppered Earth with fireballs in late October and early November 2005. The moon was peppered, too, but unlike Earth, the moon has no atmosphere to intercept meteoroids and turn them into harmless streaks of light. On the moon, meteoroids hit the surface—and explode.

Suggs estimates that the flash due to the impact of meteor was about as bright as a 7th magnitude star. In other words, it was two and a half times dimmer than the faintest star a person can see with their unaided eye. However, it was easily recorded by the for the 10-inch telescope that the researchers were using.

Cooke estimates that the impact gouged a crater in the moon's surface "about 3 metres wide and 0.4 metres deep." It is much smaller in size than the craters moon usually has. "Even the Hubble Space Telescope couldn't see it," notes Cooke. The moon is 384,400 km away. At that distance, the smallest

things Hubble can distinguish are about 60 metres wide.

This isn't the first time meteoroids have been seen hitting the moon. During the Leonid meteor storms of 1999 and 2001, amateur and professional astronomers witnessed at least half-a-dozen flashes ranging in brightness from 7th to 3rd magnitude. Observers located in different parts of the world simultaneously photographed many of these explosions at that time.

Looking out for lunar meteors has gained importance once again as the NASA is planning to make regular flights to the moon by 2018. There are many questions that need be answered: "How often do big meteoroids strike the moon? Does this happen only during meteor showers like the Leonids and Taurids? Or can we expect strikes throughout the year from 'sporadic meteors'? Explorers on the moon would need such information quite precisely to keep themselves safe even though the chances of being directly hit by a big meteoroid are remote. Furthermore, while the danger of a direct hit is almost nil for an individual astronaut, it might add up to something appreciable for an entire lunar outpost. Another greater concern, according to Suggs, is the spray—"the secondary meteoroids produced by the blast". No one knows how far the spray reaches and exactly what form it takes.

Suggs and his team plan to make more observations. The researchers are contemplating a long-term monitoring program active not only during major meteor showers, but also at times in between. This could be accomplished by

developing software that records these flashes automatically.

(Source : NASA News)

Malaria Parasites Modifies Blood Cells in its Host

The reports of two research studies, conducted by different teams of researchers independently, suggest that the malaria parasite devotes a surprising amount of energy to modifying its host, the human red blood cell. The research studies have found hundreds of proteins that allow the parasite to survive in the cells of the host with damaging effects. The discovery, in the most significant malaria parasite, *Plasmodium falciparum*, opens up new possibilities for antimalarial drugs.

According to Professor Alan Cowman, from Walter and Elisa Hall Institute of Medical Research, Melbourne, Australia, research scientist of one of the studies, the red blood cell is actually a very poor cell to invade so the parasite has to basically renovate it. Apart from having no nucleus, the red blood cell has no transport proteins to move nutrients and other chemicals around. And when the malaria parasite invades the red blood cell it has to get its own transport proteins into the cell if it is to survive and attack the body. Parasite proteins have to be transported through two membranes and in some cases through the red blood cell membrane itself, to ferry nutrients for the growing parasite. Proteins transferred to the surface of the red blood cell also help it to stick to parts of the body, such as

the brain and lungs. This stops the red blood cell from circulating and being destroyed by the spleen and also clogs up the capillaries, causing one of the key fatal effects of the parasite. Proteins on the outside of the red blood cell also help the infected cell to evade the body's immune system.

A few years ago scientists only knew about three or four of these proteins. The team had been looking closely at these few proteins when they found that each of them had a particular motif, consisting of five amino acids, which they suspected was important in transporting the parasite proteins around the host cell.

According to researchers it is the code that tells the machinery that this protein is to be taken out of the parasite and into the host cell.

By looking for other proteins that also had this special motif, Cowman and his team identified 400 proteins involved in the malaria parasite's remodelling of the host cell.

The researchers found 8% of the parasite's genome was dedicated to producing these 400 proteins. It is a large percentage; which is actually quite surprising ascertains Cowman, particularly because other types of parasites were not known to have such proteins.

At present, the researchers are comparing the genomes of six different species of malaria parasite to look for genes that code for the telltale motif.

They think there may be around 10 remodelling proteins that are shared by the six species of parasite. These proteins

are likely to be critical to the parasite's survival, said Cowman. And they could be good targets for antimalarial drugs that interrupt how these proteins work.

Although Cowman and his team was surprised to learn that their findings were replicated independently by another laboratory, they consider it to be a confirmation of their findings.

(*Source: News in Science*)

Carbon dioxide levels highest for 650,000 years

According to research studies conducted on the Antarctic ice cores, the levels of CO₂ are now 27% higher than at any point in the past 650,000 years. The study, which provides more evidence of human interference in the climate system, pushes back our greenhouse gas record by 210,000 years and now encompasses four glacial cycles.

The evidence comes from the world's deepest ice core, drilled at a site called Dome Concordia (Dome C) in East Antarctica. European scientists battled blizzards and an average year-round temperature of -54 C, making a 1000 kilometre trek to bring up supplies. The core, extracted using a 10 centimetre wide drill bit in 3 metre sections, brought up ice that was deposited by snows up to 650,000 years ago, as determined by estimated layers of annual snowfall. Analysis of CO₂ in tiny bubbles in the ancient ice showed that at no point during this time frame did levels get anywhere close to today's CO₂ concentrations of around 380 parts per million.

In pre-industrial times, the CO₂ concentration was just 278 parts per million.

The Dome C core, extracted by the 10-country European Project for Ice Coring in Antarctica, outstrips by 210,000 years the previous record-holder, drilled at an Antarctic site called Vostok. According to Professor Thomas Stocker, University of Berns, Switzerland and the team leader, their study have added another piece of information showing that the time scales on which humans have changed the composition of the atmosphere are extremely short compared to the natural time cycles of the climate system.

The ice core documents the stable relationship between Antarctic climate and the carbon cycle during the Pleistocene (390,000 to 650,000 years before present).

It extends our knowledge of CO₂ levels by two glacial cycles, to a time when the warm interglacial periods were milder and longer than more recent warm periods, say the scientists.

(Source: News in Science)

How Much Does Soy Help Lower Cholesterol?

In an advisory issued by the American Heart Association (AHA) says that soy does little to help lower cholesterol levels. However, this does not mean the soybean, which showed so much promise in controlling cholesterol levels, is not effective in controlling cholesterol levels. In fact, soy is still a worthy food to include in one's diet, but in order for it to help, people need to make sure their *entire diet*

is one that is heart-healthy. In other words, while soy all by itself doesn't have significant anti-cholesterol super-powers, it does work in concert with other healthy foods.

The AHA advisory has been based on a review of 22 randomised trials of people consuming either soy or components of soy. Researchers concluded that many soy products should be beneficial to cardiovascular and overall health because of their high content of polyunsaturated fats, fibre, vitamins, and minerals and low content of saturated fat.

Over the years the foods containing soy has been promoted as protective foods against heart disease. While such a health claim can encourage people to eat specific, healthy foods, some people might think that they can get a health benefit without changing anything else in their diet or lifestyle. A claim can give the impression that a food acts like a medication. The AHA advisory points out that good quality evidence for the cholesterol-lowering power of soy was weak, and confounded in some studies by the fact study subjects changed entire dietary patterns with soy being only one component.

If one specifically desires to know whether the soy protein really give something more than a healthy dietary pattern could? The answer is, no. So, there is no need to give soy protein an advantage over, say, other beans, nuts, fish, poultry, other sources of protein. Soy, alone, won't lower cholesterol significantly, especially if the other foods in daily diet consist of greasy hamburgers and fried dishes full of polysaturated fats.

But soy helps if it is used as a substitute for unhealthy foods — replacing a hamburger with a soy burger. If one does not like soy, then opt for another food that lacks cholesterol as a substitute.

A new study from the *American Journal of Clinical Nutrition* found that cholesterol-lowering foods work even better when they are eaten together. The study showed a diet consisting of healthy foods such as soy protein; almonds, oats, barley and plant-sterol enriched margarines, lowered cholesterol in subjects as much as medications for lowering cholesterol did. The researchers, from the University of Toronto (U of T), however, caution that high-risk people who are already taking medications for lowering cholesterol shouldn't stop the medication, but that a healthy diet should be part of their treatment.

(Source: News in Science)

Brain Centre for the 'munchies' Found

Scientists have found the part of the brain that compels many individuals crave for pizza, chocolate and chips. The discovery of the part of the brain that creates the 'munchies' could help to develop pharmaceuticals for anorexia or obesity, with minimal side effects. The findings are based on a study conducted with rats by Dr Paul Mallet, a biological psychologist at the University of New England, Australia. According to the researcher because smoking cannabis increases appetite, it was believed that this was somehow related to the effects

of cannabis on some brain centre but that was until now not identified. We've actually identified which part of the brain is responsible for THC's (tetrahydrocannabinol; the active substance in cannabis) effect on the stimulation of appetite.

In the study, the researchers injected THC, into a specific region of brain's hypothalamus in rats, known to control feeding behaviour, called the paraventricular hypothalamic nucleus (PVN). And they found it stimulated the laboratory animals' appetite. They found that these rats crave for food or the munchies.

The brain has long been known to have a cannabinoid system involving receptors that react with both THC and a naturally occurring substance called anandamide.

Mallet and team are part of a research effort focused on trying to understand the reason why the brain has evolved this system.

"It's very unlikely we evolved a brain cannabinoid system so that we can get stoned at parties," says Mallet. So far the cannabinoid system has been found to play a role in perceiving pain, motor control, storing memories and feeling hungry.

And it's this last role that has led to the development of new pharmaceuticals that could either stimulate appetite or suppress it by either blocking or stimulating cannabinoid receptors.

(Source: News in Science)

(Compiled and edited by R. Joshi)

Book Review

Effective Communication Skills

Handbook of Science Communication, compiled by Anthony Wilson with contributions from Jane Gregory, Steve Miller and Shirley Earl; Publisher: Overseas Press India Pvt. Ltd., 7/28, Ansari Road, Daryaganj, New Delhi 110 002, pp. 159, Rs 190.00.

Science and technology play a major role in most aspects of our daily lives. Therefore, like basic literacy, public should also have scientific literacy, i.e. the basic level of understanding of science and technology. There are many arguments in favour of improved scientific literacy. For example, science is part of our culture and heritage, and everyone therefore has a right to scientific knowledge. Many of the choices people make every day on a personal level require some scientific knowledge, namely, what to eat, how to eat, how to travel, how to cool or heat their homes, or how to safeguard their health. Without scientific and technological information it can be difficult to make even these comparatively simple decisions. Here comes the role of science communicators or science writers to improve the public understanding of science and technology.

A science communicator should know how to effectively communicate with general or lay public, in a popular style that is easily comprehensible. The communication may generally be through print media or through electronic media (like Radio, TV, etc.).

The first step in science (or general) communication is to equip oneself with the source material. Then comes the presentation. A successful science communicator must be an expert in communicating with the lay public.

The book under review is a guide for science communicators who need to communicate their work to wider public (it serves as a general communication guide also). The book is divided into two parts. The first part, 'Practical Science Communication', is a basic collection of practical advice and guidance for science communicators with particular emphasis on written communication. It contains four chapters titled, 'The Public Understanding of Science', 'Gathering Information', 'Written Communication' and 'Working with the Media'.

The second part of the book, 'Communication Theory and Practice', is an introduction to the academic study of communication and its application to many aspects of spoken communication. It is divided into three chapters titled, 'Basic Concepts and Principles of Communication Theory', 'Spoken Communication' and 'Working in Groups and Teams'. The chapter 'Spoken Communication' is devoted to the art of spoken communication, namely, how to speak up, how to hold the attention and interest of audience, how to vary intonation, the value of pauses, how to use body language, and how to make the effective use of visual aids.

We are fully well aware that many a talk at a conference is marred by speakers who think only of the content of their material without considering the importance of their presentation. We can

all recall the speaker who never raises his eyes to look at those they are addressing, and of visual aids only legible from the first couple of rows.

Meetings are unavoidable, and perhaps essential, in the modern world. People may meet formally, as on a committee, or they may meet simply because of some spontaneous need. The chapter 'Working in Groups and Teams' is about functioning effectively in various sorts of groups and teams. It considers the importance of these skills, which too many of us assume are obvious and that every one possesses, when this certainly not the case.

The book under review is intended

for use in higher education science departments and is appropriate for Science Communication courses. It will also prove to be useful to science communicators/writers who want to improve the public understanding of science and technology. Also, it will generally benefit scientists and others who want to improve their communication/presentation skills.

All in all, the book is an effective guide on how to speak and write effectively.

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