School Science | A Quarterly Journal of Science Education

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To Our Contributors

School Science is a journal published quarterly by the National Council of Educational Research and Training, New Delhi. It aims at bringing within easy reach of teachers and students the recent developments in science and mathametics and their teaching, and serves as a useful forum for the exchange of readers' views and experiences in science and mathametics education and science projects.

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. A hard copy of the article including illustrations, if any, along with a soft copy should be submitted in CD. Photographs (if not digital) should be at least of postcard size on glossy paper and should be properly packed to avoid damage in transit. The publisher will not take any responsibility or liability for copyright infringement. The contributors therefore, should provide copyright permission, wherever applicable and submit the same along with the article.

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EDITORIAL

Research Studies in Science and Mathematics education show that problem-solving helps in understanding the concept and developing skills in the subject. From this issue, we are starting a series of articles that present a problem-based learning course which has been used successfully by Mody and Pradhan to build capacity of physics students. In the first article of this series, authors present the learning objectives in different areas of basic physics and explain what each problem tries to achieve with its solution.

"Experiment is the sole source of truth", wrote Henry Poincare in 1905 in his famous book, "Science and Hypothesis". Science activities form an integral part of teaching-learning of Science. However, the main obstacle in achieving this objective, in particular, in underdeveloped countries, has been the lack of resources. UNESCO launched its global micro science project in some countries 15 years ago to meet this objective. "Small is Beautiful" describes the UNESCO experiment and the success of the project. Mohapatra and Jha talk about LDL Cholesterol and its relation to human health. The article goes into details of LDL Cholesterol and mechanism of plaque formation that lead to blocked arteries. In this issue, Abhas Mukherjee also invites readers to 'Have Fun with Celebrating International Year of Chemistry - 2011'

A case study of Loktak Lake of Manipur has been made by A.A. Singh. It shows wetlands as the primary habitat for flora and fauna. It also emphasises the socio-economic importance of wetlands.

Concept map has emerged as an important tool for teaching-learning and assessment in science. Kanak Sharma talks about the importance of Concept Maps in Teaching Organic Chemistry. She also explains the method to construct the concept map. In the last article, we visit the topic of Laser and its Applications.

Like other issues, this issue also carries Science News and Webwatch.

Comments and suggestions are welcome from readers for improvement in the quality of the journal.

PROBLEM - BASED LEARNING IN BASIC PHYSICS - I

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In this article— first in the series of articles, we present a problem-based learning course that we have used successfully to build capacity of physics students. We present the learning objectives in different areas of basic physics and what each problem tries to achieve with its solution.

There is a criticism that at every stage of learning, success in examinations in present education scenario relied heavily on reproduction of material that the students had learned. No importance is given to development of necessary skills that can make students think like professionals. If carefully chosen as a part of learning process, problems can encourage the cultivation of a group of skills, which can be important constituent of the expertise of a professional. Problem-based learning is found to be a convenient method to teach subject/s. (Baden, 2000) and many experiments are being tried all over the world with a positive outcome. Problem-solving brings to bear essentially reasoning about the subject. Problem-solving is scaffolding/building up higher objectives of learning. As per Bloom (1980), these objectives are: comprehension, application, analysis and synthesis. Doing science itself in a way is problem-solving.

At a level of basic physics all problems chosen have to be well-defined and as Baden has described, in the subject of science, formal teaching has to precede problem-based learning. Apart from being used for testing, problems can become good instruments to help students construct their knowledge. This will also be in tune with NCF–2005 guidelines of 'promoting problem-skills, problem-solving abilities and applications of physics concepts/ content, useful in real life situations, for making physics learning more relevant, meaningful and interesting.

We have tried selecting our special problems for the course designed and following Redish (1994) termed them as **touchstone problems**.

Although we have used them in different sense than Redish.

By touchstone problem, we mean a problem which satisfies more than one of the following criteria:

(i) A problem which incorporates basic principle/s

(ii) A problem which is attractive enough or is rich in context

(iii) A problem which should be sufficiently difficult but not too difficult to put students off

(iv) A problem which should require steps that are not mechanical but involve some decision-making

(v) A problem which should have a reasonable goal

(vi) A problem which should guide students to comprehend the topic and/or application.

We have conducted such a problem-solving course covering topics from basic physics with similar problems. Most of the problems required one or more of the above-mentioned strategies to be used. The problems were of the level of standard textbook 'Fundamentals of Physics' by Halliday, Resnik and Walker (2004) and Young (2004). Most problems were chosen from the textbooks mentioned, competitive exams like JEE (Joint Entrance Exam for admission to Indian Institute of Technologies) and Physics Olympiads or equivalent. Source of some problem is unknown as authors have lost track of them over the period of time but found them to be indispensable. Some problems were specially designed as dictated by need.

The strategy we used to make students solve the problems can be called as constructivist, features of which are:

(i) Instructors should play a role of facilitator and help learner to get his or her own understanding of the concepts and let the learner play an active role in the learning process.

(ii) The learning environment should be designed to support (by making books available) and challenge through problems: touchstones and auxiliary (additional/smaller) and counter questions as well as guided intervention] the learner's thinking. This way learning becomes an active process where learner learns to discover principles, concepts and facts themselves.

(iii) Required instructor has culture, values and background to become an essential part of the interplay between learners and tasks in the shaping of meaning.

(iv) Students learn by building upon knowledge they already possess themselves and guided interventions correct errors, which creeps in their understanding.

(v) There should be enculturation. Students should be introduced to culture of the subject. In our case, students were introduced to culture of doing physics by solving problems.

(vi) Most importantly, there should be effective scaffolding. That is, students are not given answers to any questions, but have to be guided (using interventions like auxiliary problems, counter questions, cognitive conflicts) to converge to the answer themselves.

Based on how students work through, it can also be used for formative assessment (Mody, 2011). This way, students also get immediate feedback of their thinking and construction of knowledge as teacher uses her/his constructivist scaffolding. This is very much on par with the vision of National Focus Group on Examination Reforms (NCERT 2006a), which has noted. 'In the long-term (about a decade), we envision a vastly different system built upon entirely new foundations. This system would actually make the teacher the primary evaluator of students. This system would not be one-shot but continuous, would extend beyond the cognitive domain and beyond pen and paper; and, hopefully be seen by all not as a burden but as a tool for further learning. In this system, the primary role of boards would change radically – from direct testing at present to rigorous validation of school-based, teacher-based assessment. If any direct testing by boards were still to be needed it would be of a very different type – optional, open-book and on-demand. In this scheme emphasis is on students construction of knowledge and teacher can very much use it to assess students.

The problems on motion that we dealt with, are given as follows with the learning objectives and what each problem is expected to achieve along with solution. These problems can be used by teachers to teach finer aspects of concepts. Teacher may use any of the method they prefer: (i) could be done on board in the class, (ii) may be used as tutorials, (iii) may be given as home assignment, (iv) may be used as a tool to help students construct their own knowledge. We have used these problems as classroom work (as in (iv)) where teacher uses constructivist method as discussed above and described by Pradhan (2009a). As a result of such a course, we found students capacity increased and were ready to face challenges, which earlier they never thought of.

As per Downey (1967) , The core of good thinking is the ability to solve problems. The essence of problem-solving is the ability to learn in puzzling situations. Thus, in the school of these particular dreams, learning how to learn pervades what is taught, how it is taught, and the kind of place in which it is taught. The students gather around learning problems and study how they think and make conscious efforts to learn to think more effectively (as quoted in Joyce and Weil, 2005). Thus, we can achieve aim of education as per NCF-2005, which is to learn, how to learn and process of construction of knowledge through such problem-based method.

The methodology is discussed in detail with auxiliary problems by Pradhan (2009a). Results of our course were encouraging (Pradhan 2009b). Teachers have here responsibility to chose appropriate auxiliary problems, counter questions, etc... as per their strategy. We are presenting our course, based on problems as a series of articles starting with Mechanics—motion, with solution.

Mechanics

Learning Objectives

1. Understand motion without worrying about origin of motion, especially force.
2. Motion under constant acceleration, in one and two dimensions. Motion is always relative to an observer and hence how does

state of an observer changes description as we switch from one observer to another. In two dimensions there is a special class, which is circular motion.

3. Understanding motion: Linear and rotational (or equilibrium) in the light of Newton's Laws of Motion.
4. Understanding some of the interactions in the light of conservation principles (like momentum, energy, etc...). For example, the latest experiment in LHC (large Hadron Collider) also has these principles involved of course in much detail beyond the scope of this course. We have tried incorporating at a basic physics level.
5. To become familiar with mathematical structure of dealing with what is covered in above-mentioned points.

1. Kinematics in 1-D

An elevator ascends with an upward acceleration of 1.2 m/s^2 . At the instant when its upward speed is 2.4 m/s, a loose bolt drops from the ceiling of the elevator 2.75m from the floor. Calculate

(a) The time of flight of the bolt from the ceiling to the floor of the elevator.

(b) The displacement and the distance covered by the bolt during the free fall relative to the elevator shaft (Irodov 1988).

Tasks involved in this problem are:

1. To identify the reference frame.

   In this case students can work with either of two different frames: (1) elevator, and (2) ground based (what problem specifies as elevator shaft).
2. To specify value of velocity, acceleration and displacement using proper sign convention in each frame.
3. To recognise that time is same (Galilean invariant) in both the reference frames.
4. To be able to understand the difference between distance travelled and displacement.

This problem gives a thorough picture of use of Kinematical equations that are to be used for motion with constant accelerations.

The following problem can be used as an auxiliary problem to illustrate use of kinematical equations, sign convention and unit conversion.

A car moving on a straight highway with speed of 126 kmh^{-1} is bought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform), and how long does it take for the car to stop? [NCERT 2006b].

2. Projectile Motion

A ball starts falling with zero initial velocity on a smooth inclined plane forming an angle a with the horizontal. Having fallen the distance h, the ball rebounds elastically off the inclined plane. At what distance from the impact

point will the ball rebound second time? (Irodov, 1988).

Tasks involved in this problem are to:

1. use energy c onservation principle to find speed at the impact.
2. use momentum conservation principle and geometry to find direction of motion after impact.
3. understand meaning of elastic collision.

4. either break motion into two 1-D motion or treat it as a simple projectile motion problem.
5. make a decision about point of impact so that it can be incorporated into equations of projectile.

Smaller problems needed to do this problem need students to understand either how equations of projectile are used or how motion can be broken into two different 1-D motions.

The following auxiliary problem can be used to make students familiar with the use of equations that can be obtain for motion of a projectile.

A soccer player kicks a ball at an angle of 37° from the horizontal with an initial speed of 20 m/sec. Assuming that the ball moves in a vertical plane

(a) Find time (time of ascent) at which the ball reaches the highest point in its trajectory.

(b) How high does the ball go (maximum height reached)?

(c) At what instant the ball hits the ground (time of flight)?

(d) What is the horizontal range of the ball ?

(e) What is the velocity of the ball as it strikes the ground? [Take g = 10 m/s^2].

3. Relative Velocity

A motor boat with its engine on in a running river and blown over by a horizontal wind is observed to travel at 20 km/hr in a direction 53° East to North. The velocity of the boat with its engine on, in still water and blown over by the horizontal wind is 4 km/h eastward and the velocity of the boat with its engine on over the running river, in the absence of wind is 8 km/hr due South. Find

(a) The velocity of the boat in magnitude and direction, over still water in the absence of wind.

(b) The velocity of the wind in magnitude and direction. [Source: Unknown].

The following problem can be used as an auxiliary problem to illustrate use of Cartesian vectors to represent velocity in two dimensions and find relative velocity.

A girl riding a bicycle with a speed of 5 m/s towards north direction, observes rain falling vertically down. If she increases her speed to 10 m/s, rain appears to meet her at 45° to the vertical. What is the speed of the rain? In what direction does rain fall as observed by a ground-based observer? [NCERT 2009].

Tasks involved in this problem are

1. To find relative velocity, and
2. Rectangular resolution of vectors.

This problem was chosen as it involves basic idea of relative velocity and technique of using Cartesian representation of vectors.

Solutions to Touchstone Problems

1. Kinematics in 1-D

Inside the elevator

Initial speed $u = 0$,

Distance through which bolt falls $h = 2.75$ m

Acceleration of the bolt towards the floor

= acceleration of the elevator + acceleration due to gravity = $a + g$

= 11.0 m/s^2

$h = ut + \frac{1}{2}(a+g)t^2$ gives time of flight to the elevator floor = $\sqrt{1/2}$ = 0.707 s.

Outside the Elevator

u = 2.4 m/s and $a = g$

Time of flight being Galilean invariant remains same.

Hence bolt's displacement in time t is

$s = ut + \frac{1}{2}gt^2$ = - 0.753 m

(negative sign indicates downward displacement).

As seen from outside, bolt moves up and comes down (due to initial upward speed) crossing the starting point till it hits the floor. This upward motion upto the point when its speed becomes zero. Thus, $v^2 = u^2 + 2as$ gives H = 0.294 m.

Thus total distance travelled = $2H + s$ = 1.34 m.

2. Projectile Motion

Conservation of energy gives speed of impact

u = $\sqrt{2gh}$.

Since plane is inclined at an angle α to the horizontal and collision is perfectly elastic, the ball will be like a projectile launched at speed u and at an angle

90 – 2α to the horizontal. Taking point of impact to be origin, trajectory of the ball is given by

$y = (\tan\theta)x - \frac{g}{2u^2\cos^2\theta}x^2$, where x is horizontal distance and y is vertical distance. It hits the plane whose equation in the plane of the trajectory can be taken as $y = -x\tan\alpha$. The point of intersection (second impact if is at a distance L from first impact) on the plane ($L\cos\alpha$, – $L\sin\alpha$) substituted in equation of trajectory yields $L = 8h\sin\alpha$.

3. Relative Velocity

Taking west to east as x-direction, south to north as y-direction and taking $\mathbf{v}_b$ as boat speed with respect to still water, $\mathbf{v}_r$ river speed and $\mathbf{v}_w$ as wind speed, we have

$\mathbf{v}_b + \mathbf{v}_r + \mathbf{v}_w = 20\cos 37\ \hat{i} + 20\sin 37\ \hat{j}$

$\mathbf{v}_b + \mathbf{v}_w = 4\ \hat{i}$

$\mathbf{v}_b + \mathbf{v}_r = -8\ \hat{j}$

gives $\mathbf{v}_b = -12\ \hat{i} - 20\ \hat{j}$: 23.33 km/hr at 59°2' south of west

and $\mathbf{v}_w = 16\ \hat{i} + 20\ \hat{j}$: 25.61 km/hr at 51°21' north of east.

References

Baden, Maggi Savin. 2000. Problem-based Learning in Higher Education: Untold Stories, The Society for Research into Higher Education and Open University Press.

Benjamin, S. Bloom, Ed., Max, D. Engelhart, Edward, J. Furst, Walker, H. Hill, David R. Krathwohl. 1980. Taxonomy of Educational Objectives, Vol. I, Longman Inc.

HALLIDAY, RESNICK and WALKER. 2005. *Fundamentals of Physics.* 6th Edition. John Wiley & Sons.

IRODOV, I. E. 1988. *Problems in General Physics*. MIR Publication.

BRUCE, JOYCE and MARSHA, WEIL. 2005. *Models of Teaching*, PHI.

MODY, ATUL. 2011. *On New System of Grading for Students' Learning of Physics*, Epistme-4, HBCSE, Mumbai.

NATIONAL CURRICULUM FRAMEWORK – 2005, NCERT, New Delhi.

NATIONAL FOCUS GROUP ON EXAMINATION REFORMS. 2006a. A Position Paper. NCERT, New Delhi.

PHYSICS TEXTBOOK FOR CLASS XI, PART-I. 2006b. NCERT, New Delhi.

PHYSICS EXEMPLAR PROBLEMS, CLASS XI. 2009. NCERT, New Delhi.

PRADHAN, H.C. and A. K., MODY. 2009a. *Constructivism Applied to Physics Teaching for Capacity Building of Undergraduate Students*. University News, (21) 4-10.

PRADHAN, H.C. and A. K., MODY. 2009b. *Supplementary Programme for Capacity Building of Physics U dergraduate Students*. Physics Education, (2) 93-98.

EDWARD, F. REDISH. 1994. *Implications of Cognitive Studies for Teaching Physics*. Am. J. Phys. 62 (9), 796 - 803.

ALAN, H. SCHOENFELD. 1985. *Mathematical Problem Solving*, Academic Press INC.

YOUNG and FREEDMAN. 2000. *Sears and Zeemansky's University Physics.* 11th Edition. Pearson Education.

SMALL IS BEAUTIFUL*

When UNESCO first launched its global microscience project 15 years ago, many countries still took a purely theoretical approach to science teaching, not out of choice but of necessity. They simply could not afford the exorbitant cost of equipping schools and universities with laboratories. The miniature kits proposed by UNESCO offered a low-cost, safe alternative for experimentation.

Given their multiple advantages, it was not long before the miniature kits caught on. Cameroon, Tanzania and South Africa have invested massively in them, as have Russia and the U.K., Angola, Ethiopia, Namibia, Malaysia, Sudan, the Gambia and the Palestinian Authority have all held workshops to adapt the kits to the national curriculum, while other countries are still at the stage of demonstration workshops. Today, there is a growing demand for UNESCO's assistance in customising the miniature kits for national use — and nowhere more so than in Africa.

Teachers on Rodrigues Island in Mauritius using a microscience kit to oxidate ferrous sulphate at a workshop in August 2008

If there is little or no experimentation in many classrooms and university laboratories in developing countries today, one also finds virtual substitutes for laboratory experimentation in the developed countries, such as computer-based simulations and video sequences. This can hamper learning, as even the most practical notions will appear abstract to a student who cannot put theory into practice. 'Nothing compensates for the solid grounding in physics, chemistry and biology which experimentation provides,' observes Alex Pokrovsky, a chemist who retired from UNESCO several years ago but still keeps an active interest in the project. 'How can any country train scientists, let alone promote the national research which is indispensable to development, without experimentation?' he wonders.

The first microscience kits were designed in the 1990s by the Research and Development in Mathematics, Science and Technology Education (RADMASTE) Centre at the University of the Witwatersrand in Johannesburg (South Africa). Veritable mini-laboratories, the kits replace the traditional glass test-tubes, beakers, flasks and measuring cylinders with miniature plastic alternatives. The kits are inexpensive, compact, re-usable and difficult to break. In addition, the small quantities of chemicals employed make the kits environment-friendly and safe, with low operating costs.

In 1996, UNESCO and the International Union for Pure and Applied Chemistry (IUPAC) were searching for a means of proposing low-cost experimental equipment at a price that any country could afford. They found the answer in

* Reproduced from 'A Word of Science', Vol. 9, No. 3, July-September 2011

South Africa. Initially, RADMASTE focused on experiments in chemistry. However, the basic concept can be adapted to experimentation in many other areas of science including physics, material sciences, geology, hydrology, biochemistry, biotechnology and agriculture. Over the years, RADMASTE has added other kits to its repertoire, including the Basic and Advanced Microchemistry Kits, the Microburette Kit, the Bar LED Microconductivity Kit, Microbiology Kit, Microelectricity Kit and Microchem Water Field Kit. Most recently, it designed the International Year of Chemistry Global Experiment Kits for UNESCO and IUPAC (See the Big Splash).

Cameroon was one of the first countries to see the kits' potential for strengthening science and technical education. By December 2000 more than 7,000 kits were being used in secondary schools across the country. As the pilot project developed, it became urgent to provide a structure for the introduction and monitoring of microscience in the country's primary and secondary schools. UNESCO suggested setting up a Centre of Excellence in Microscience Experiments. The General Leclerc High School in Yaoundé, with a roll of almost 5,000, was chosen to host the centre. It trains teachers and organises sub-regional seminars for teachers and education specialists not only from Cameroon but also from the four other countries belonging to the Economic Community of Central Africa, namely, the Central African Republic, Chad, the Republic of Congo and Gabon.

Big Business

Today, the project is implemented within UNESCO's International Basic Sciences Programme, in collaboration with the teacher education section of UNESCO's Division of Higher Education. RADMASTE remains a key partner, as does the Islamic Educational, Scientific and Cultural Organisation (ISESCO) for participating countries from the Muslim world. ISESCO was a key partner, for instance, in the introduction of the microscience kits into Jordan, Lebanon, the occupied Palestinian territory and Syria in 2006 via a series of workshops. UNESCO's Ramallah office recently signed a contract with the Ministry of Education and Higher Education to provide 15 kits to 18 Palestinian schools for grades 1–9, or a total of 270 kits. The Ministry now plans to buy bulk quantities of the kits.

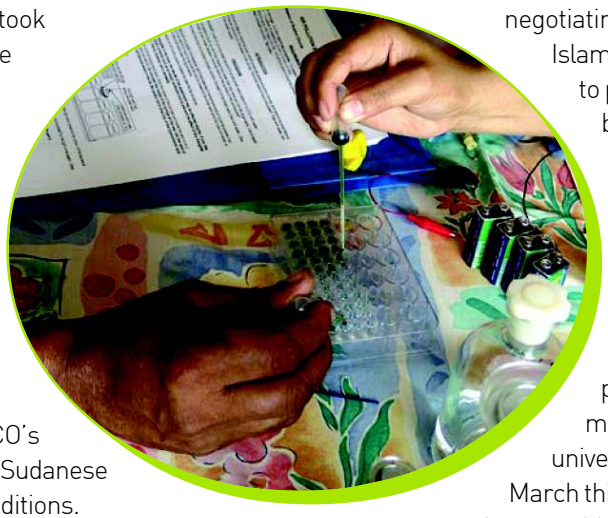
Various companies around the world manufacture the microscience kits. Prices vary but the kits can come with a price tag of as little as US$10–15 each. The sales price for bulk deliveries is negotiated directly by the country concerned and its chosen supplier.

UNESCO works primarily with three suppliers: Somerset Educational and RADMASTE in South Africa and Edulab in the UK. However, UNESCO encourages countries to develop their own kits from locally available materials. For those countries which prefer to purchase the kits from abroad, it might help to generalise use of the kits in schools if donors were to propose debt swaps in exchange for bulk purchases.

A Strong Demand from Africa: the Example of Sudan

Once a country expresses interest in the project, the first step is to organise a workshop in order to demonstrate how the kits work. In Sudan, for

example, this workshop took place on 9 July 2010 at the International Academy School in Khartoum attached to the Ministry of Foreign Affairs. UNESCO and the National Commission for UNESCO then organised a second workshop on 31 January this year to adapt the standard kits and UNESCO's teaching materials to the Sudanese curriculum and local conditions.



Teachers using the microelectricity kit at the workshop in Mauritius in 2008

For two and a half days, Alex Pokrovsky and Hassan Elfatih, the national microscience project co-ordinator and Dean of the College of Science of the Sudan University of Science and Technology, guided 50 curriculum planners, trainers, policy planners and teachers in creating their own teaching materials and kits for physics, chemistry and biology for children aged 14–16 years. The participants then appealed to the Ministry of Education to introduce the new Sudanese kits into the country's schools.

Six months on, a Sudanese version of the kits has been developed which is currently being tested in 30 pilot schools for a period of four months, with funding from the Ministry of Education. Two schools have been selected in each of the country's 15 states. In parallel, the National Microscience Team is training teachers how to use the kits in the classroom. Once the kits have been evaluated and modified as necessary, Education Minister Ustaza Suad plans to supply the kits to 3,500 schools. Sudan is currently negotiating a loan with the Islamic Development Bank to purchase the kits in bulk.

Ethiopia

Ethiopia is home to one of Africa's largest student populations with 14 million pupils and university students. In March this year, Ethiopia opted for a combined demonstration and adaptation workshop at the Ethiopian Management Institute, east of the capital. Run jointly by UNESCO and the Ministry of Education over three days, the workshop attracted more than 40 secondary school teachers, university professors, curriculum planners and policy-makers eager to see the kits being used in conjunction with the accompanying teaching materials. Three professors from the RADMASTE Centre demonstrated the kits, an exercise that has since been captured in a brochure distributed to universities and schools.

Alexandros Makarigakis from UNESCO's Addis Ababa office helped to organise the March workshop. 'Ethiopia began developing its own microscience kits in June,' he explains. The Ministry of Education plans to focus on secondary and tertiary education and is developing kits in biology, chemistry and physics.

'The Ministry has set up a steering committee to guide the process of adapting and testing the kits in pilot schools between September and March

next year,' he adds. It also plans to set up a national microscience centre by September this year, with UNESCO's assistance.

Teacher Training in Tanzania and the Gambia

Meanwhile, in the United Republic of Tanzania, UNESCO has been working within the United Nations Development Assistance framework to supply microscience kits and provide teacher training for 180 schools, at a cost of US$1.4 million. Tanzania is one of the eight pilot countries of the One UN Programme established on 20 July 2011.

In the Gambia, a consultative workshop for the introduction of microscience kits was run from 10–13 January this year at the request of the President. For lack of funding, most senior secondary schools lack functional science laboratories. The meeting report observed that even 'the small number of schools equipped with laboratories fail to utilise their facilities effectively due to the absence of a maintenance strategy and

THE BIG SPLASH!

South African pupils measuring the pH of water during the Big Splash in Cape Town in March

Schoolchildren of all ages are being invited by UNESCO and IUPAC to participate in what may turn out to be the biggest scientific experiment ever. With their teachers, children around the world are being asked to measure pH levels and salinity in water, to filter and purify the water and then desalinate it.

The United Nations' World Water Day on 22 March offered an ideal opportunity to use the microscience kits designed for conducting experiments in water chemistry. As this year's theme was Water for Cities: Responding to the Urban Challenge, the 1000 participating pupils from schools in different parts of Cape Town were first exposed to a key urban challenge: the difficulties Khayelitsha slum-dwellers face daily in obtaining clean water from a standpipe. The children were then transported to Ratanga Junction to watch a delightful play performed by the Jungle Theatre on the importance of conserving and preserving local water supplies.

The next day, the children were handed the microscience kits so that they could conduct their own experiments, under the benevolent eye of Erica Steenberg from the RADMASTE Centre and three volunteers. The children first discovered the pH of a water sample taken from Intaka Island, a wetland in Cape Town, then filtered and purified the water. For most of the children, this was the first time they had ever conducted a chemistry experiment. Their excitement at completing the exercise successfully and the torrent of questions they asked were a pleasure to witness.

The kits were donated to the participating schools by the South African Department of Science and Technology and Sasol, a South African petrochemical company. The brief opening ceremony was presided over by UNESCO and by the Deputy Minister of Science and Technology, Derek Hanekom.

The Big Splash was part of a global experiment on Water: a Chemical Solution being run by UNESCO and IUPAC within the International Year of Chemistry. Since the Big Splash in March, a further 6,303 students from 300 schools in 31 countries have registered the results of their own experiments in water chemistry at the dedicated website.

Rovani Sigamoney

in-service training on how to integrate practical work into lessons.'

A feasibility study conducted in 2003 by the Ministry of Basic and Secondary Education, in collaboration with UNESCO's Regional Bureau for Education in Africa (BREDA) based in Dakar (Senegal), concluded that the kits would be very beneficial. The Gambia then applied to be one of the 22 countries selected for the UNESCO project, which was essentially funded by the Gaddafi International Foundation for Charity Associations.

The 15 participants attended in the January workshop comprised heads of secondary schools, representatives of the Science Teachers' Association, science lecturers from Gambia College and the University of the Gambia, staff from the Curriculum Research and Development Directorate and the Standard and Quality Assurance Directorate, as well as staff from the Directorate of Science and Technology Education.

At the end of the four-day workshop, the participants recommended that the project be introduced simultaneously for all 12 years of schooling and that one kit be provided ideally for every three pupils, or a maximum ratio of one kit to five pupils. They recommended teacher training and observed that teachers would need more time than at present to prepare their classes. The participants recommended that Gambia College, responsible for teacher training in the country, incorporate the use of microscience kits in its training curriculum. It was also recommended that the kits be adapted to the national curriculum 'to suit the country's needs and aspirations.'

Better Teaching of Science and Mathematics

In April this year, the Pan-African Conference on Teaching in the Context of Education System Reform recommended that microscience kits be used to improve science and mathematics teaching. The conference was organised in Lomé (Togo) by the African Union, BREDA, UNICEF and other partners within the framework of the action plan for the development of human resources adopted by the New Partnership for Africa's Development.

The microscience kits will next be demonstrated on World Teacher Day on 5 October at UNESCO Headquarters in Paris. Meanwhile, several workshops are planned for Haiti, Kazakhistan and Kyrgyzstan before the end of the year.

Imteyaz Khudabux

Editor's Note: In India, the National Council of Educational Research and Training (NCERT) has been a pioneer in designing, developing and promoting science and mathematics kits for all stages of school education.

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LOW DENSITY LIPOPROTEIN (LDL) CHOLESTROL: THE BAD CHOLESTROL

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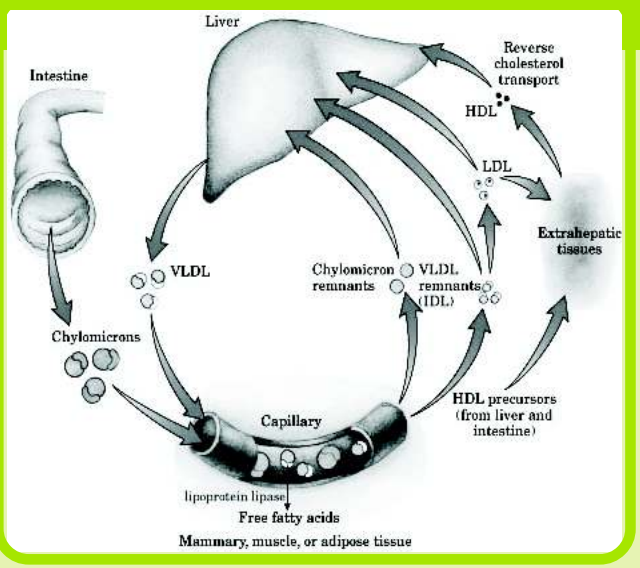
This article introduces cholesterol, its transport as a component of liproprotein and types of lipoproteins. Mechanism of plaque formation in arteries is also explained. High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) cholesterol, their relative importance and foods that fight bad LDL cholesterol are discussed.



Introduction

Cholesterol is a waxy steroid. Much of the cholesterol synthesis in vertebrates takes place in the liver. A small fraction of the cholesterol made there is incorporated into the membranes of hepatocytes (liver cells), but most of it is exported. The name cholesterol originates from the Greek word *chole* - (bile) and *stereos* (solid), and the chemical suffix *-ol* for an alcohol. François Poulletier de la Salle first identified cholesterol in solid form in gallstones, in 1769. However, it was only in 1815 that chemist Eugène Chevreul named the compound, 'cholesterine'.

It is an essential structural component of mammalian cell membranes. It is required to establish proper membrane permeability and fluidity. In addition, cholesterol is an important component for the manufacture of bile acids, steroid hormones and Vitamin D. Although cholesterol is important and necessary for mammals, high levels of cholesterol in the blood can damage arteries and are potentially linked to diseases such as those associated with the cardiovascular system (heart disease). Cholesterol is recycled. It is excreted by the liver via the bile into the digestive tract. Typically about 50 per cent of the excreted cholesterol is reabsorbed by the small bowel back into the bloodstream.

Transport via Lipoprotein Complexes

Cholesterol and cholesteryl esters, like triacylglycerols and phospholipids, are essentially insoluble in water, yet must be removed from the tissue of origin to the tissues in which they will be

stored or consumed. They are carried in the blood plasma as plasma lipoproteins, macromolecular complexes of specific carrier proteins, apoliproteins, with various combinations of phospholipids, cholesterol, cholesteryl esters and triacylglycerols. Lipoproteins are complex discoidal particles which have an exterior composed of amphiphilic proteins and lipids whose outward-facing surfaces are water-soluble and inward-facing surfaces are lipid-soluble; triglycerides and cholesterol esters are carried internally. Phospholipids and cholesterol, being amphipathic, are transported in the surface monolayer of the lipoprotein particle. The apoliproteins serve as ligands for specific receptors on cell membranes. In this way, the lipoprotein particles are molecular addresses that determine the start- and end-points for cholesterol transport.

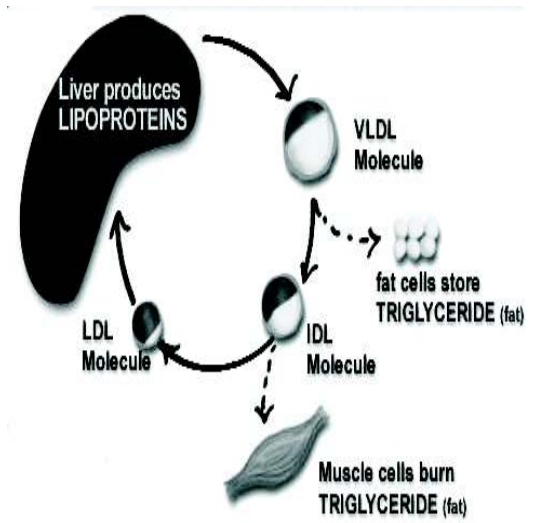


Fig. 1: Lifecycle of cholesterol carrying lipoproteins

Types of Lipoproteins

Different combinations of lipids and proteins produce lipoprotein particles of different densities. The densities are related to the relative amounts of lipid and protein in the complexes. Because, most proteins have densities of about 1.3 to 1.4 g/mL, and lipid aggregates usually possess densities of about 0.8 g/mL, the more protein and less lipid in a complex, the denser the lipoprotein. Thus, in order of increasing density, there are chylomicrons, Very-Low Density Lipoproteins (VLDL), intermediate density Lipoprotein (IDL), Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL). Each class of lipoprotein has a specific function, determined by its point of synthesis, lipid composition and apoliprotein content.

- **Chylomicrons** have the lowest protein-to-lipid ratio and thus are the lowest density lipoproteins. They are synthesised in the endoplasmic reticulum of epithelial cells that line the small intestine, then move through the lymphatic system and enter the blood stream. It carries dietary fatty acids to tissues where they will be consumed or stored as fuel. The remnants of chylomicrons (depleted most of their triacylglycerols but still containing cholesterol, apoliproteins) move through the blood stream to the liver. In the liver, remnants release their cholesterol and are degraded in lysosome.
- **VLDL:** When the diet contains more fatty acids than the needed immediately as fuel, they are converted to triacylglycerols in the liver and packaged with specific apoliproteins into VLDL. Excess

carbohydrates in the diet can also be converted to triacylglycerols in the liver and exported as VLDLs.

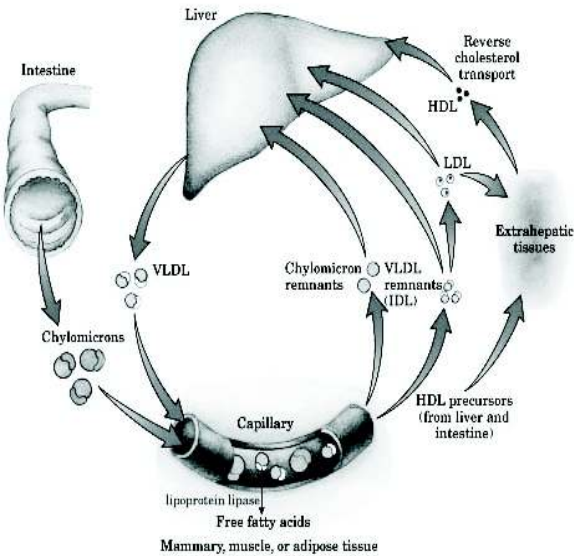


Fig. 2: Different classes of lipoproteins and fates

In addition to triacylglycerols, VLDLs contain some cholesterol and cholesteryl esters, as well as apoliproteins. These lipoproteins are transported in the blood from the liver to muscle and adipose tissue, where activation of lipoprotein lipase enzyme causes the release of free fatty acids from the VLDL triacylglycerols. Adipocytes take up these fatty acids, reconvert them into triacylglycerols, and store the products in intracellular lipid droplets; myocytes in contrast, primarily oxidise the fatty acids to supply energy.

- **IDL:** The loss of triacylglycerol converts some VLDL to VLDL remnants, also called as IDL. The IDL molecules have two possible fates: half are taken up by the liver for metabolism into other biomolecules and the rest is converted into LDL.

Table 1: Desirable, High and Very High Levels of Different Lipoproteins

Blood lipids measured	Desirable for those with heart disease	Desirable for general population	Borderline high	High	Very high
Total Cholesterol (mg/dl)		Less than 200	200-239	240 or more	
LDL Cholesterol (mg/dl)	Less than 100	Less than 130	130-159	160 or more	
HDL Cholesterol (mg/dl)		35 or more			
Triglycerides (mg/dl)		Less than 200	200-400	400-1000	1000 or more

- **LDL** particles are formed as IDL lipoproteins, further lose triacylglycerols through the action of lipoprotein lipase and they become smaller and denser (i.e., fewer fat molecules with same protein transport shell), containing a higher proportion of cholesterol esters.
- **HDL** (good cholesterol) originates in the liver and small intestine as small protein rich particle that contains relatively little cholesterol and no cholesteryl esters. These lipoprotein particles are thought to transport excess cholesterol back to the liver for excretion or to other tissues that use cholesterol to synthesise hormones in a process known as Reverse Cholesterol Transport (RCT). The higher HDL, the less bad cholesterol you'll have in one's blood.

Low Density Lipoprotein Cholestrol

LDL molecules are the major carriers of cholesterol in the blood. Each native LDL particle has a highly-hydrophobic core consisting of polyunsaturated fatty acid known as *linoleate* and about 1500 esterified cholesterol molecules. This core is surrounded by a shell of phospholipids and unesterified cholesterol, as well as a single copy of apoliprotein, i.e., ApoB-100, a large protein with 4,636 amino acid residues. LDL particles are approximately 22 nm in diameter and have a mass of about 3 million Daltons on the average since fatty acids of variable mass are associated with them. Determining structure of LDL has been a tough task because of its heterogeneous structure. First structure of LDL at human body temperature in native condition has been recently found using cryo-electron microscopy and it has resolution of 16 Angstrom.

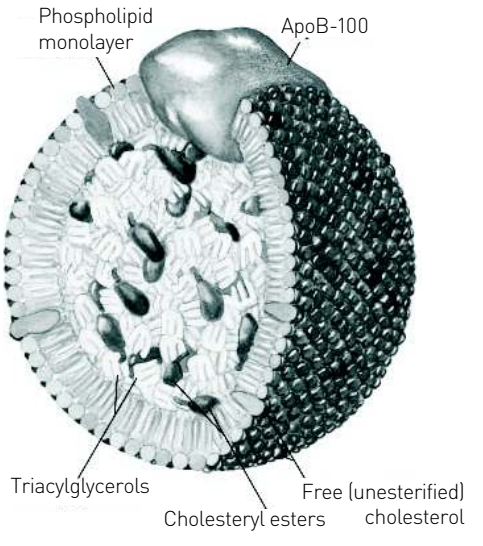


Fig. 3: Structure of LDL Cholestrol

Transport of LDL Particles into the Cell

When a cell requires cholesterol, it synthesises the necessary LDL receptors, and inserts them into the plasma membrane. The LDL receptors then diffuse freely until they associate with clathrin-coated pits. The shell of the LDL molecule contains just one molecule of apolipoprotein B-100, which is recognised by the LDL receptor in peripheral tissues. LDL particles in the blood stream bind to these extracellular LDL receptors. The clathrin-coated pits then form vesicles that are endocytosed into the cell. The vesicle then fuses with a lysosome, which has an enzyme, called lysosomal acid lipase that hydrolyses the cholesterol esters. Now, within

the cell, the cholesterol can be used for membrane biosynthesis or esterified and stored within the cell, so as not to interfere with cell membranes. The LDL receptors are recycled back to the plasma membrane.

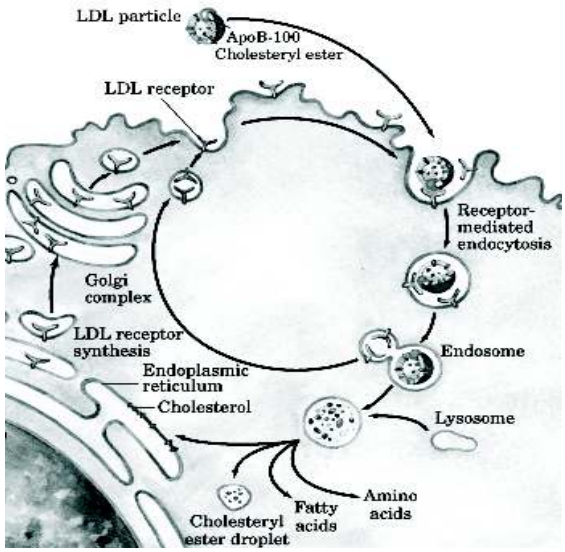


Fig. 4: Endocytosis and degradation of LDL

When the cell has abundant cholesterol, LDL receptor synthesis is blocked so that new cholesterol in the form of LDL molecules cannot be taken up. On the converse, more LDL receptors are made when the cell is deficient in cholesterol. When this system is deregulated, many LDL molecules appear in the blood without receptors on the peripheral tissues. These LDL molecules are oxidised and taken up by macrophages, which become engorged and form foam cells. These cells often become trapped in the walls of blood vessels and contribute to atherosclerotic plaque formation.

Mechanism of Plaque Formation and Atherosclerosis

LDL cholesterol is an important part of the process of narrowing arteries, called atherosclerosis.

Some LDL cholesterol circulating through the bloodstream tends to deposit in the walls of arteries. This process starts as early as childhood or adolescence.

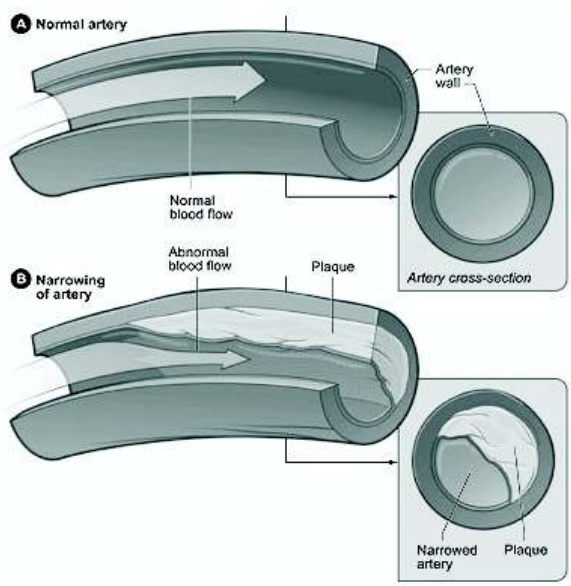


Fig.5: Plaque formation in artery

- White blood cells (macrophages) ingest and try to digest the LDL, possibly in an attempt to protect the blood vessels. In the process, the macrophages oxidise the LDL to a toxic form giving the macrophages foam like appearance.

- More macrophages and other cells migrate to the area, creating steady low-grade inflammation in the artery wall to form a visible fatty streak.
- Over time, more LDL cholesterol and cells collect in the area. The ongoing process creates a bump in the artery wall called a plaque. The plaque is made of cholesterol, cells and debris.
- Over time vulnerable plaques rupture, activate blood clotting and produce arterial stenosis, which if severe enough results in heart attack, stroke, and peripheral vascular disease symptoms and major debilitating events. The body's immune system sends in specialised white blood cells (macrophages and T-lymphocytes) to absorb the oxidised-LDL forming foam cells.

These white blood cells, though, are not able to process the oxidised-LDL, and ultimately grow then rupture, depositing a greater amount of oxidised cholesterol into the artery wall. This triggers more white blood cells to rush to the site, continuing the cycle. So the immune system becomes part of the causes of atherosclerosis. Eventually, the artery becomes inflamed. The cholesterol plaque causes the muscle cells to enlarge and form a hard cover over the affected area, where calcium and other substances accumulate that make the plaque hard and brittle. This hard cover is what causes a narrowing of the artery, reduces the blood flow and increases blood pressure. In addition, the brittle plaque can break off, travel through the blood stream and form a clot anywhere in the body. Also, blood clots can form on the plaque and cause obstruction of the artery or the plaque may weaken the artery wall so that it balloons out, forming an aneursm, which may burst and cause a haemorrhage or bleeding.

Atherosclerosis versus Arteriosclerosis

Healthy blood vessel should be flexible and strong, capable of containing the pulsating pressure of

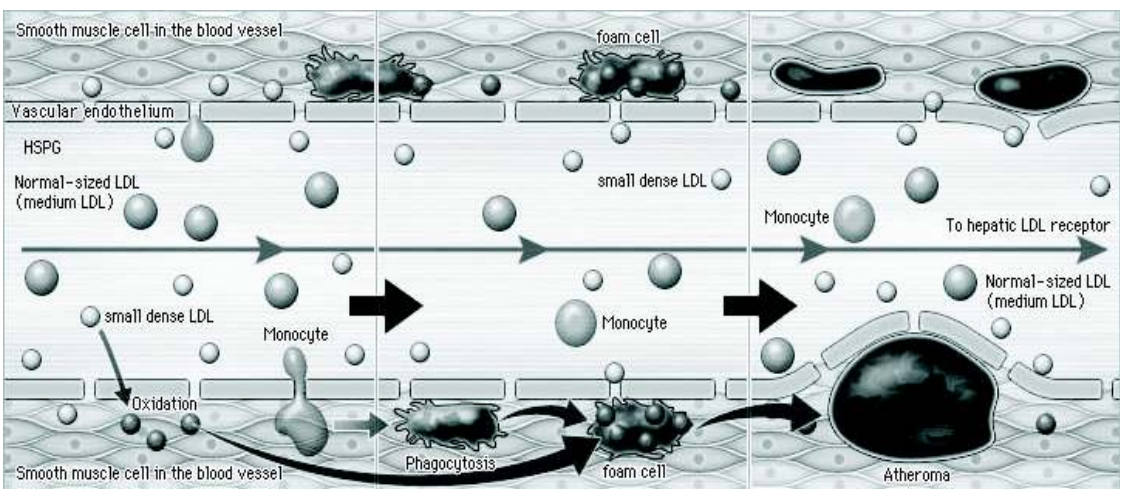


Fig.6: Role of white blood cells in atherosclerosis

rushing blood, heartbeat after heartbeat, for a lifetime. But they are also delicate and vulnerable and can easily get damaged.

Atherosclerosis is the most common form of arteriosclerosis, which refers to any hardening of the arteries with loss of elasticity. Atherosclerosis is a hardening of an artery specifically due to an atheromatous plaque which narrows the lumen of the arteries.

Atherosclerosis and Cholestrol

Although cholesterol in itself is not one of the main causes of atherosclerosis, the higher your LDL cholesterol level, the greater is the risk of developing life-threatening plaque and blocked arteries. This is why your LDL cholesterol should be low. According to the National Institute of Health (NIH), the optimal level of LDL cholesterol should be below 100 mg/dL. LDL level 160 mg/dL is considered as high but more than 130 mg/dL needs immediate attention.

HDL cholesterol, on the other hand, is like nature's plaque vacuum cleaner, because it picks up the vessel-clogging cholesterol and carries it away to the liver to be disposed of in the form of bile. The higher your HDL levels, the cleaner your blood vessels will be. So we need HDL to be high. According to the NIH, people with HDL of 60 mg/dL or higher have a lower risk of heart disease, whereas HDL below 40 mg/dL is considered too low. Because HDL is so important to the health of

Table 2: Factors which Raise or Lower the Levels of HDL and LDL

HDL		LDL	
Raise	Lower	Raise	Lower
Alcohol			
Niacin			Niacin
Fibrates	Certain drugs		Fibrates
Statins			Statins
		Dietary fats	Fat reduction
Smoking cessation	Smoking		
Estrogen	Progesterone		Estrogen
	Diabetes	Diabetes	
Weight loss	Obesity	Obesity	Weight loss
Metabolic syndrome	Thyroid disease		
		Renal disease	
Exercise	No exercise	Liver disease	
	Hightriglycerides	Genetics	Resins
			Bile acid sequestrants

blood vessels, some physicians prefer to talk about the cholesterol ratio — your total cholesterol divided by your HDL cholesterol. For example, if your total cholesterol number is 250 and your HDL is 50, your ratio is 250/50 or 5. A ratio of 3.5 is considered optimal and people are urged to aim for a ratio of 5 or less.

HDL versus LDL

Foods that Fight Bad LDL Cholesterol Levels

Several scientific clinical studies have proven the value and effectiveness of these foods in lowering bad LDL levels and/or increase good HDL levels.

- Almonds: Studies have found that eating just a quarter cup of almonds can lower LDL by 4.4 per cent.
- Oatmeal: Gives great results due to the high level of soluble fiber in oatmeal. The soluble fiber binds to the bile acids that are the precursor to the development of cholesterol and help flush it out.

Fig. 7: Foods that lower LDL level

- Fish: Omega-3 fatty acids are widely considered to be the best of the 'good' fats, and the best place to find them is in fish — especially fatty fishes like salmon, halibut and tuna. These fatty acids can also be obtained from walnuts and flaxseed (two tablespoons of flaxseed provides 3.5 grams) and in fish oil supplements.
- Red Wine: A glass of red wine, which contains *flavanols* (also found in red grape juice and dark cocoa), has been shown to have anti-inflammatory properties that may help lower cholesterol and stave off heart disease. But in this case, more is definitely not better.
- Soy Products: Like soybeans, soy nuts, and edamame beans, natto *(the green vegetable form of soybeans)*, plus any products made from soy (like tofu, soymilk, etc.) can help to reduce the production of new cholesterol. A little can go a long way—one may aim for about 25 grams of soy protein a day (the amount in a cup of edamame).
- Garlic: The active compound in garlic, called *allicin* seems to be responsible for lowering cholesterol. It also acts as a powerful antioxidant. It may affect the way LDL cholesterol is used in the body and reduce triglycerides. There is some evidence that garlic also lower homocysteine and reduce blood pressure.

Conclusion

One can safely take control of cholesterol levels by eating more of those foods that have scientific evidence for lowering bad LDL cholesterol levels and increasing good HDL cholesterol numbers. Lowering cholesterol can lower the risks for heart disease and other chronic illnesses.

References

GARRETT, R.H. and C.M., GRISHAM. 1999. *Biochemistry*. 2nd Edition. Harcourt College Publishers. USA.

GUYTON, A.C. and J.E., HALL. 2003. *Textbook of Medical Physiology*. Published by Elsevier.

NELSON, D.L. and M.M., COX. 2005. *Lehninger Principle of Biochemistry.* 4th Edition. W.H. Freeman and Company, New York.

http://en.wikipedia.org/wiki/Low-density_lipoprotein

http://www.webmd.com/cholesterol-management/ldl-cholesterol-the-bad-cholesterol

HAVE FUN WHILE CELEBRATING IYC–2011

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The United Nations has designated the year 2011 as the International Year of Chemistry —2011. The focal theme of the IYC—2011 is 'Chemistry—Our Life, Our Future.' The United Nations has also decided to celebrate the year 2011 as the International Year of Chemistry, primarily due to two reasons. First, the year 2011 marks the one hundredth anniversary of the Nobel Prize in Chemistry awarded to Marie Curie in 1911.This was Marie Curie's second Nobel Prize. The first Nobel Prize was received by her in Physics in 1903 along with her husband Pierre Curie and Henry Bequerel.

The International Union for Pure and Applied Chemistry (IUPAC) plays a very important role in the field of Chemistry. Formerly, it was known as the International Association of Chemical Societies. First established in 1911 in Paris, the year 2011 also happens to be its one hundredth anniversary.

In the Indian context, the IYC—2011 has significance too. The year 2011 is 150th birth anniversary of Acharya Prafulla Chandra Roy who started the tradition of research in modern chemistry in India and was also instrumental in laying the foundation of chemical industry.

What is Chemistry?

Chemistry is considered to be a very important branch of science. In brief, we can say that it is the scientific study of composition and properties of matter. It deals with the behaviour of matter and how different kinds of matter react to change from one form to another. Chemistry governs our understanding of the material nature of the world. In fact, all living processes are controlled by chemical reactions.

Chemistry is connected with every aspect of our life. In daily life also it plays an important role. Right from the moment we get up in the morning till we go to bed we encounter various chemicals and other things that are intimately connected to chemistry. From foodstuff, a dress, building material, fuels, drugs, fertilizers to a host of other items, chemistry has a key role in almost everything. Its all-encompassing role even extends

to such diverse areas of human endeavour as art and culture where paints, colours, fabrics, etc., which are all products of chemistry, are extensively used. No wonder then the chemistry is often called the 'central science'.

It may be mentioned that in popularising chemistry as central science, the book titled *'Chemistry: the central science'* played a very important role. Written by Theodore L. Brown and H. Eugene LeMay in 1977 the twelfth edition of this book has come out in the year 2011.

The Elements

Chemistry is primarily concerned with chemical elements and how they react with each other. What, after all is an element? The Greeks regarded earth, fire, air and water as elements. However, as early as 1660, the Irish born chemist Robert Boyle recognised that the Greek notion of elements was not correct. He, therefore, provided a new definition of element. We now define element as a fundamental substance which cannot be broken down further by chemical means. An element has only one kind of atoms. It was the English physicist, meteorologist and chemist John Dalton who in 1803 first propounded his atomic theory. In his theory, Dalton said that elements consisted of tiny, indivisible particles are called atoms. He also said that although all atoms of an element were identical, the atoms of different elements were different from one another.

So far 118 elements are known to us. Of these 92, starting from hydrogen (atomic number 1) to uranium (atomic number 92), occur in Nature. One must note that the atomic number of an element is the number of protons in the nucleus or the number of electrons in the extranuclear orbits of the atom of the element. The elements with atomic numbers greater than 92 are known as transuranic (the term transuranic means beyond uranium) elements. They have been produced artificially in the laboratory, their total number till date being 26.

The Vacant Places in the Periodic Table

Although now we know about 118 elements. In the 18th century at the time of Lavoisier, who discovered oxygen, only 23 elements were known. Slowly, more elements were discovered. By 1825 about 52 elements were known. Understanding and remembering the properties of all these elements proved to be a stupendous task indeed. However, in 1869 the Russian scientist Dmitri Mendeleev made the job easier by preparing a system of classifying the elements. He arranged 63 elements known till then in the periodic table designed by him in increasing order of their atomic masses. He arranged the elements with similar properties into nine vertical columns which he named as groups. The elements, when arranged in such a manner, also formed seven horizontal rows called periods. In a period, the elements exhibited gradual, periodic variation in their properties. Therefore, Mendeleev had to leave certain places in the periodic table vacant. He left four such vacant places and predicted that they would be filled by the new elements to be discovered subsequently.

The first of such elements predicted by Mendeleev, called *eka-aluminium* by him, was indeed discovered in 1875 by P.E.Lecoq

Boisbandran. It was named gallium. Subsequently, three other elements predicted by Mendeleev were also discovered. The element, called *eka-boron*, was discovered in 1879 by L. Nilson. It was named scandium. The element, called *eka-silicon*, was discovered in 1885 by Winkler and was named germanium.

After discovery of the three missing elements predicted by Mendeleev search for the fourth missing element, named *eka-manganese*, intensified. There were unconfirmed reports of its discovery from Russia and Japan. Even an apparently convincing report of its discovery came from Germany. However, the missing element could finally be discovered in 1937 by a group of Italian scientists working under the leadership of Carlo Perrier and Emilio Segre at the University of Pelermo in Sicily. Of the duo who led the research, Carlo incidentally was a mineralogist while Segre was a particle physicist who later shared the Nobel Prize in Physics in 1959 with Owen Chamberlain for the discovery of antiproton. The missing element discovered by Carlo and Segre was named technetium.

In 1913, the English physicist Henry Moseley suggested that the elements should be arranged in the periodic table in the increasing order of their atomic numbers and not their atomic masses. To Moseley, the atomic number of an element and not its atomic mass was more fundamental to its chemical properties. In this way, the new or modern periodic table came into being. It may be noted that the Moseley's classification of elements on the basis of their atomic numbers helped the chemists to remove most of the discrepancies of the Mendeleev's periodic table. However, as far as Moseley's personal life goes, he was killed in the First World War at a very young age of 27.

Symbols of Elements

Getting familiar with the chemical symbols of elements can be of great help in understanding chemistry. We, therefore, discuss some notable facts about the chemical symbols of elements.

Generally, the first or capital letter from the common English names of elements is used to write the symbols of elements. For instance, the element hydrogen has the symbol H; carbon has the symbol C while nitrogen has the symbol N. It may be noted that except J and Q there exist elements starting with all the capital letters from A-Z. As an interesting exercise you may ask your friends to find out how many elements are there starting with the first letter of their names.

Sometimes, the first two letters from the common English names of elements are used to write their symbols where the first letter is capital and the second is in lower case. For example, the symbol of the element lithium is Li, symbol of helium is He, the symbol of calcium is Ca and the symbol of silicon is Si. However, in some cases, although the first letter in the symbol is capital, the second letter (in lower case) need not be the second letter in the English names of the elements. For instance, the symbol of magnesium is Mg, the symbol of chlorine is Cl, the symbol of zinc is Zn and the symbol of zirconium is Zr. In all these cases, the second letter does not correspond to the second letter in the English names of these elements.

However, the above scheme of things is no longer applicable to a few elements like sodium,

copper, iron, silver, gold, etc. In such cases, the names are derived from the Latin words. For example, the element sodium derives its symbol from the Latin word Natrium (Na).Similarly, the symbols of copper, iron, silver and gold are, respectively, derived from the Latin words Cuprum (Cu), Ferrum (Fe), Argentum (Ag) and Aurum (Au).The symbols of elements tin, mercury and lead are also derived from the Latin words Stannum (Sn), Hydrargyram (Hg) and Plumbum (Pb), respectively. The element tungsten, however, derives its symbol from the German word Wolfram (W).

Nomenclature of Elements: Interesting Facts

There are some very interesting facts about the nomenclature of elements which we would like to share with the readers.

Some elements have been named after planets, the Sun, the Moon and even asteroids. The element uranium was named after the planet Uranus while the element selenium was named after Moon (which in Greek is Selene).The element palladium was named after the asteroid Pallas. You can find out some other elements named after planets, the Sun and asteroids.

Some elements have also been named after names of countries, cities, continents and villages. For example, the element germanium has been named after Germany; the element europium has been named after the continent of Europe while the element berkelium has been named after Berkeley, a city of California. As an interesting exercise, you may find out some other elements named after the names of countries, cities, continents and villages.

Some elements have also been named after the characters of Greek mythology. For example, the element titanium has been named after titans, the Gods of the Greek mythology. Some elements have even been named after colours. For instance, the element indium has been named after the Latin Indicum meaning indigo.

Some elements have also been named after the names of scientists, e.g. fermium has been named after Enrico Fermi, einsteinium has been named after Albert Einstein, etc. From the periodic table you may find many more elements whose names have been derived after the characters of Greek mythology, after the names of colours and after the names of scientists.

The International Year of Chemistry—2011 provides you an opportunity to collect more and more information about the chemical elements by connecting yourself intimately with them and share the information so collected with your friends. On this occasion, you may also make informative projects, models and charts on chemistry. At the same time, you may entertain yourself and your friends by making interesting quizzes on chemistry. In this way, you can have plenty of fun while celebrating chemistry during the IYC—2011.

WETLANDS AND ITS IMPORTANCE : A CASE STUDY OF LOKTAK LAKE IN MANIPUR

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Wetlands are the primary habitat for many flora and fauna. The *Loktak lake* was designated as "Wetland of International Importance" under *Ramsar Convention* in 23 March, 1990 due to its rich and unique biodiversity. The present study was undertaken to understand the resource linkage and livelihood options of the surrounding inhabitants of the Loktak lake. The sites chosen for the study included Sendra, Ithing, Thanga II and Karang Islands. The analysis of the socio-economic data collected from the regions shows that a large population of the study area depends upon the resources of the lake for their livelihood (fishery and vegetation for domestic consumption and commercial purposes). On the other hand, the study also shows that most of the inhabitants engaged in fishing lack modern scientific and technical knowhow of fishing which has adverse impacts in the production and efficacy of the whole process.

Women of the region were also found to be involved in making fishing-nets for income generation rather than weaving of traditional clothes, which later results in declining of small scale industries. Most of the inhabitants were found to be aware of the importance of the lake in their life and hence would actively support any conservation programme. The findings suggest that proper management of *Phum*, introduction of modern techniques, sustainable fishing, improved tourism, etc., will take care of most of the problems.

Introduction

Wetlands are the areas of lands where the soils are saturated with moisture either permanently or seasonally. Such areas may also be covered partially or completely by shallow water. They include swamps, marshes, and bogs, among others. The water found in wetlands can be saltwater, freshwater or brackish. According to the Wetland Conservation Act of 1991, a wetland is defined by the following criteria: (a) it has mostly hydric soils, (b) it must generally be inundated or saturated above or below the surface, and (c) support vegetation adapted to wet soil conditions. They are highly complex ecosystems due to interactions of diverse factors relating to land and water resources.

A large population consisting of about 1, 00, 000 people living in 55 rural and urban settlements in and around the *Loktak lake* depend upon the lake resources for their nourishment. But nowadays, increasing demands and pressures lead to the degradation of the lake which is threatening the livelihoods.

Ramsar Site

The 1971 *Ramsar Convention* held in the Iranian city of Ramsar has defined wetlands as 'areas of marsh, fen, peat land or water, whether natural or

artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.'

The Convention identified and listed certain wetland sites as wetlands of international importance or *Ramsar Site*. Under the Convention, 25 wetlands in India have already been declared (up to 2 February, 2007) as *Ramsar Sites* (Table 1). The *Loktak lake* has been designated as Wetland of International importance under *Ramsar Convention* on 23 March, 1990. Some of important reasons that make the *Loktak lake* as a *Ramsar Site* are:

- Its enormous socio-economic and cultural importance for the people living in and around the lake.
- Its extensively occurring floating *Phumdis* proving specialised habitat for many biota, besides being useful to the local peoples in several ways.
- Supports the only home of the endangered *Sangai (Cervus eldi eldi)* in the floating *Keibul Lamjao National Park (KLNP)* in the southern part of the lake.
- It is a significant home of a variety of resident as well as migratory waterfowls.
- Its being a suitable breeding ground of a number of riverine migrating fishes from the *Chindwin-Irrawady* river system, specially being a vital fish habitat.

Table.1: List of Ramsar Site in India (up to 2 February 2007)

Wetland	Declaration	State	Area (Km^2)
Ashtamudi Wetland	19/08/2002	Kerala	614
Bhitarkanika Mangroves	19/08/2002	Odisha	650
Bhoj Wetland	19/08/2002	Madhya Pradesh	32
Chandertal Wetland	8/11/2005	Himachal Pradesh	49
Chilika Lake	1/10/1981	Odisha	1165
Deepor Beel	19/08/2002	Assam	40
East Calcutta Wetlands	19/08/2002	West Bengal	125
Harike Lake	23/03/1990	Punjab	41
Hokera Wetland	8/11/2005	Jammu & Kashmir	13.75
Kanjli	22/01/2002	Punjab	1.83
Keoladeo	1/10/1981	Rajasthan	28.73
Kolleru Lake	19/08/2002	Andhra Pradesh	901
Loktak Lake	23/03/1990	Manipur	266
Point Calimere	19/08/2002	Tamil Nadu	385
Pong Dam Lake	19/08/2002	Himachal Pradesh	156.62

Renuka Wetland	8/11/2005	Himachal Pradesh	0.2
Ropar	22/01/2002	Punjab	13.65
Rudrasagar Lake	8/11/2005	Tripura	2.4
Sambhar Lake	23/03/1990	Rajasthan	240
Sasthamkotta Lake	19/08/2002	Kerala	3.73
Surinsar-Mansar Lakes	8/11/2005	Jammu and Kashmir	3.5
Tsomoriri	19/08/2002	Jammu and Kashmir	120
Upper Ganga, Narora	8/11/2005	Uttar Pradesh	265.9
Vembanad-Kol Wetland	19/08/2002	Kerala	1512.5
Wular Lake	23/03/1990	Jammu and Kashmir	189

Importance of Wetland

Wetlands are primary habitat for hundreds of species of waterfowl as well as many other birds, fish, mammals and insects. They naturally filter and recharge the water that later comes out of our faucets downstream. They act like giant sponges, slowing the flow of surface water and reducing the impact of flooding. They also prevent soil erosion, and they buffer water bodies from potentially damaging land use activities such as agriculture. Wetlands can also remove and store greenhouse gases from the earth's atmosphere, slowing the onset of global warming. Traditionally, wetlands were considered wastelands, which bred mosquitoes. But, we have seen the importance of wetlands, not only for the environment, but also for humans. Development around wetlands is a major threat to how they function and their survival in general and therefore must be preserved.

Objectives

Keeping in view the importance of wetlands, the present study was undertaken with respect to *Loktak lake*. The main objectives of the study are given as follows:

- To access the resource linkages and livelihood options of the surrounding inhabitants.
- To study the social and economic profile of the communities living in and around.
- To analyse the various habitats of different plants found in the lake that supports their livelihood.

There are 55 settlements in and around *Loktak lake* located in the valley districts of *Bishnupur, Imphal East* and *Thoubal* which are directly or indirectly linked to the lake. For this study, 4 villages of *Bishnupur* district namely, *Sendra, Ithing, Thanga II, Karang Islands* were identified as study sites. It is located between 24°25'-24° 42'N latitudes and 93°46'-93°55'E longitudes (LDA, 2002). These 4 villages are adjacent villages and situated about 48 km. away from *Imphal*, the capital city of Manipur.

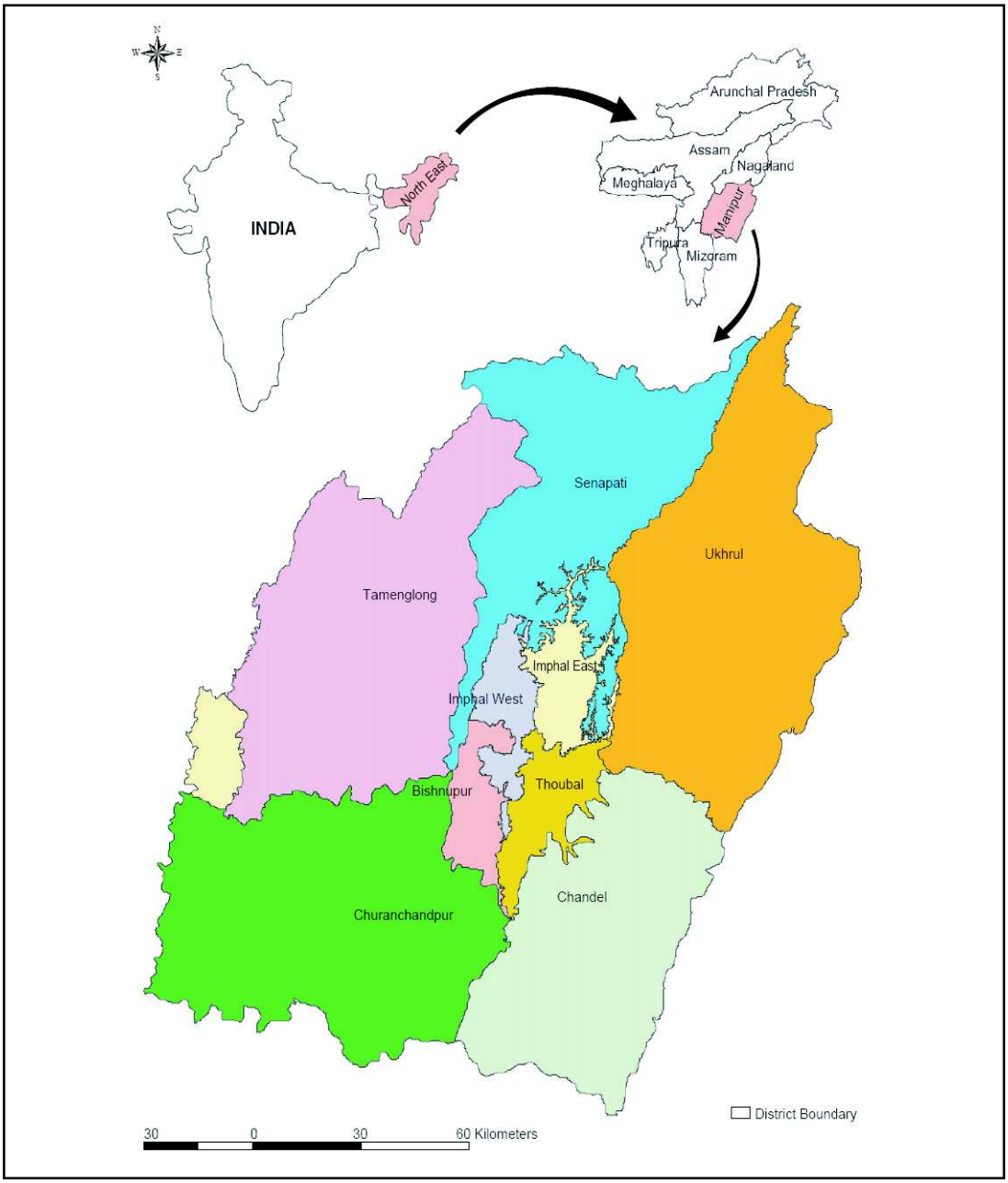

Fig.1: Location of Manipur in India

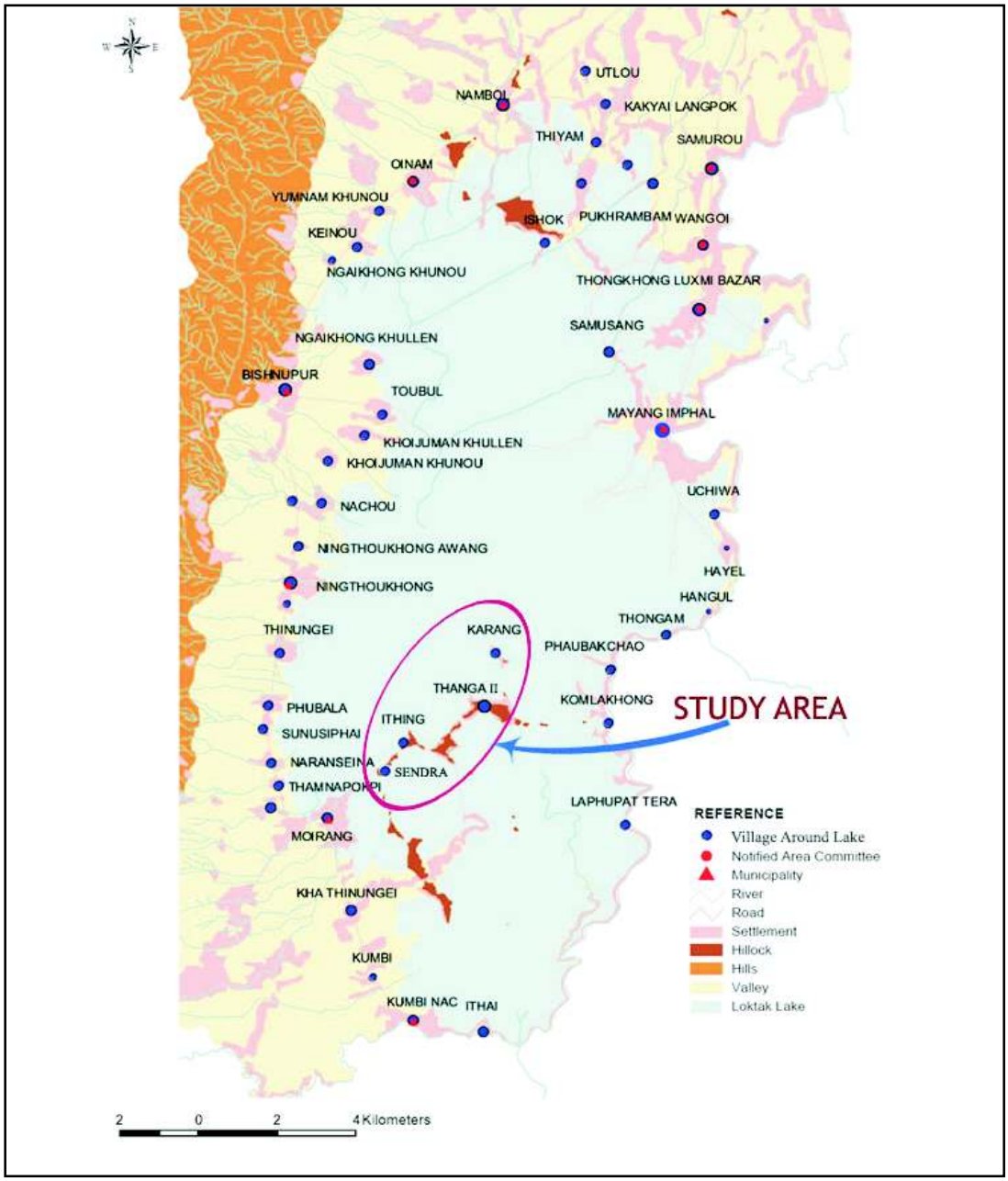

Fig. 2: Study area map

Study Methodology

This study has been conducted by collection and compilation of primary data and secondary information as per available household questionnaire survey with random visit to the study area was one of the study methodology components. The survey was done in 2008. The questionnaire for the survey was structured and covered the socio-economic data of the villages in and around the lake. Information gathered from interactions with the concerned agencies, local clubs and *Meira Paibi* (womenfolk's organisation) associations, governmental departments, researchers, institutions, etc., were also used while compiling this report.

Detail Profile of the Loktak Lake

The lake is the largest natural freshwater lake in the north-eastern region of India which occupies an area of 266 sq. km. which is approximately 1.3 per cent of the total geographical area of Manipur. The lake is oval shaped with maximum length and width of 32 km. and 13 km. respectively. The depth of the lake varies between 0.5 and 4.6m with average recorded at 2.7m. The commissioning of *Ithai* barrage in 1983 has brought about drastic changes in the character of the wetland from fluctuating water levels to more or less constant water level. The unique characteristic feature is the presence of floating islands, locally called *Phumdis* which are a heterogeneous mass of soil, vegetation and organic matter at various stages of decomposition (Trisal and Manihar, 2002). It plays an important role in filtering of mineral nutrients responsible for the deterioration of water quality.

The *Phumdis* occur in all sizes and thickness, occupying almost half of the lake area. The southern portion of the lake forms the *KLNP*, which is the only floating wildlife national park in India. The park covers an area of 40 sq. km. out of which approximately 15 sq. km. is covered by thick *Phumdis* constituting the core area of the National Park. The park is the natural habitat of

Fig. 3: Cervus eldi eldi (Sangai)

the most endangered ungulate species, the brow antlered deer, *Cervus eldi eldi (Sangai).*

Observations and Discussions

Demographic Profile

There are 1621 households in the study area with a population of 9714. The average size of the household is 6. These villages have sex ratio of 949. It also has 3316 schedule caste population. *Thanga-II* is the biggest village in the area with 1115 households and having a population of 6300 persons. *Sendra* is the smallest village with 60 household with a population of 450 persons. There is no schedule tribe population in these villages.

Thanga - II is the village which has both maximum number of schedule caste population and sex ratio. Almost all of the area has high sex ratio. While the lowest sex ratio is observed in *Ithing*. These four villages occupy about 5 per cent of the total population who live in and around the lake. There are about 421 *phum* huts located in these villages.

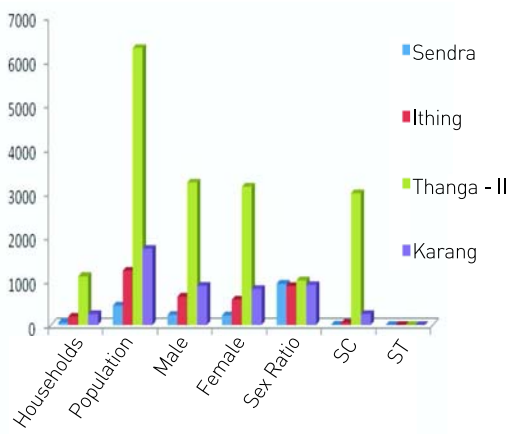

Fig. 4: Demographic profile

The maximum number of *Phum* huts is found in the *Karang* villages.

Occupational Pattern

The people perform different types of occupational practices for their livelihood. The primary source of income among the villagers is fishery. Apart from fishery, they are generally dependent on vegetable collection and agricultural practices. Other than fishery and agriculture livelihood, the people depend upon cattle farming, government and non-government jobs like teaching, business, etc.

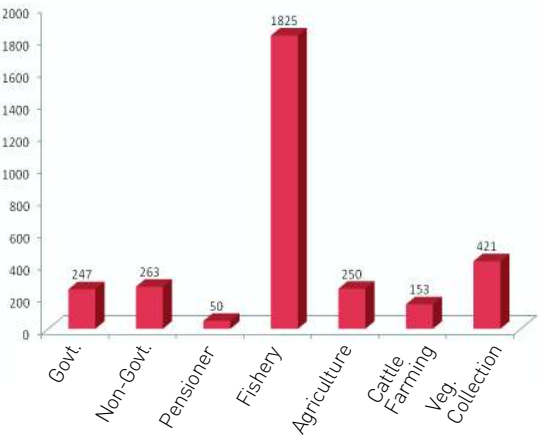

Fig. 5: Occupational profile

Main Occupations

A. Fishery

Fishery is the main occupation of the study area. It supports 65 per cent of the income to the household of the village living in and around the lake. Fishing is done throughout the year, but the maximum catch is during October to April. Every year around 1,440 kg of fish harvested by a common fisherman and traded in the nearest small markets around the villages like *Moirang Bazar, Kumbi Bazar, Thanga Bazar*.

However, lack of transport facilities and common market force them to sell their catch fish to the local middlemen often at a price much lower than the market price. Eighty five per cent of the catch fish is sold and remaining 15 per cent is used for either household consumption or future food security by smoking or simple drying methods. Average monthly income of a fishing household from sale of the fishes is ₹ 10,000 per month.

Generally, fishing is done together by both male and female members of the house. At least 2 members of the family are engaged in fishery. But mostly in case of fish trading, the female members of the household are involved. The main varieties of fishes are *Ctenopharyngodon idella (Napi chabi), Labeo rohita (Rhou), Cirrhinus mrigala (Mirgals), Catla catla (Puklaobi), Channa striatus (Porom), Notopterus notopterous (Ngapai) ,etc.*

Fish harvesting technologies and methods

Fishing gears, dip nets, lift nets, cast nets, hooks and gorges, traps, multi-pronged spear, etc., are the notable instruments used in the fishing. Nowadays, due to the rapid increase in fisherman population, there is a change in methodologies of the lake fisheries which has led the people to adopt several fishing techniques including use of small mesh size nets and *Athaphums* (making a circular enclosure with pieces of thick *phum*). The increase in *phum* fishing is due to various factors like inundation of agricultural fields after the construction of *Ithai Barrage*, increase in population, rising unemployment and overall decrease in fish yield. *Phum fishing* is a traditional practice while *Athaphum* is a recent innovation.

B. Aquatic Vegetable Collection

The lake provides several aquatic plants for fuel, fodder, vegetations and other materials for thatch and handicrafts. It has been estimated that 33 per cent of the villages' households harvest aquatic vegetation for use as food; 18 per cent for use as fuel; 2 per cent for use as fodder and 1 per cent for manufacturing handicrafts. The main plants species used for several purposes are discussed as follows:

I. Food

There are around twenty three (23) plant species which are collected from the lake. The main species are *Polygonum sp. (Yellang), Zizania sp. (Kambong), Nelumbo (Thambal), Nymphaea sp. (Tharo), Hedychium coronarium (Loklei), Alpinia galarga (Pullei), Oenanthe javanica (Komprek), Euryale ferox (Thangjing),* etc. They are widely found in the lake and harvested for local consumption as well as income generation of the household.

II. Fodder

There are around eighteen (18) plant species used as fodder which are collected from the lake. Some common species are *Echinochloa sp. (Hup), Alternanthera sp. (Kabo napi), Capillipedium sp. (Wanna manbi), Zizania sp. (Kambong)* and *Brachiaria sp. (Paragrass).* They are harvested by the villagers as feed for their cattle like cows, buffaloes, goats.

III. Fuel

There are around six (6) plant species which are commonly used as fuel especially for fish drying, smoking and cooking purposes. The main species are *Phragmites sp. (Tou), Coix sp. (Yawa chaning), Arundo sp. (Luwang tou), Erianthus procerus (Singnang), Saccharum sp. (Mom)* , etc.

IV. Medicinal Purpose

There are seventeen (17) plant species which are identified as medicinal plants. The most common amongst them are *Fuirena, Polygonum, Impatiens, Malaxis* etc. *Fuirena umbellata* are used for treatment of fever and jaundice. *Polygonum sp.* are used by communities as a health tonic. Rhizomes of *Arundo donax* are used as emollient and

diuretic. Flowers of *Eichhornia crassipes* are used traditionally for the treatment of skin diseases, particularly those of horses. *Enhydra fluctuans* is used in skin and nervous afflictions. Rhizome of *Hedychium coronarium* is used for stomach and liver disorders as well as for treatment of inflammations. Shoots of *Hedychium coronarium* as well as *Mikania cordata* are used as antidote for snakebites as well as fish poisoning.

V. Construction of Hut

There are around eight (8) plant species which are used for thatching, fencing and hutment construction.The main species are *Arundo sp. (Luwang tou), Phragmites sp. (Tou or tourel), Zizania sp. (Ehing kambong)* etc.

VI. Handicraft

There are two main plant species which are widely used for making mats, cushions, baskets, hats, handicrafts and other items of household utility as well as decoration. They are *Scirpus sp. (Kauna)* and *Cyperus sp. (Chumthang).* These products being ethnic are in high demand in other parts of the country.

Fig. 6: A view of Loktak lake (centre), clockwise pictures (from 3 O'clock position); fish fauna, different lake resources in the market, handicraft products, fishing activities, firewood collection, Hedychium coronarium, Phragmites sp. and Zazania sp. (Kambong).

VII. Cultural Purpose

There are around eleven (11) plant species which are used by villages for several religious and other cultural purposes. They use twigs of *Echinochloa stagnina (Hup)* for worship of their Gods and Goddesses. *Nymphaea* and *Nelumbo* sp. are used in several religious ceremonies.

Health and Sanitation

Adequate sanitation facilities are lacking in the entire villages. Only 38 per cent of the population has proper facilities of sanitation. There is no access to proper sanitation facilities. This leads to high amount of human wastes being discharged into the water bodies.

Similarly, access to safe drinking water facilities is critical in the villages also. Out of the 50 household surveyed, 81 per cent of the household depend on the lake as a main source of water for drinking as well as other uses. Though hand-pumps are available, only about 19 per cent of the household use them obviously because of adherence to certain cultural taboos since these were recently introduced and at the same time most people objected to the taste and odour of water. Types of water treatment methods used by the villagers included simple boiling, conventional method of filtration using cloth and modern water filter, etc.

The availability of safe and adequate drinking water and sanitary measures has a direct bearing on the working conditions and health of the people and their capacity for optimum output. While access to safe drinking water and sanitation have been proven to be essential to good health, and while the availability of water is a requisite for socio-economic development, there also exists a cause and effect relationship between water, health and development.

Public Opinion

A survey with respect to public opinion was carried out about the changes in the lake. Most of the people residing in the villages commented about the several drastic changes to their livelihood due to the construction of the *Ithai Barrage* in its downstream in 1983. The availability of fish in the lake has reduced in density and its diversity. They have witnessed the extinction of many plant species which were abundant earlier. Since fish and vegetable collection are the prime source of livelihood to poor villagers, such changes have a significant impact in their socio-economic life. Also the construction of hydraulic structures for irrigation and hydropower generation has further compounded the problem of lake siltation, nutrient enrichment and reduced migration of the fish fauna.

Conclusion

The lake is found to play an important role in ensuring ecological, economic and cultural security of the region for the following findings as per the studies conducted in the area. The lake is an important source of fisheries and vegetation both for home consumption and commercial purpose which provides sustenance to a large population dependent upon the lake resources for their livelihood. Most inhabitants engaged in fishing lack modern scientific and technical

knowhow of fishing. People were still found to be using traditional, outdated, primitive methods of fishing which was ineffective and low yielding. The lake vegetation is also harvested for use as food, fodder, fiber, fuel, handicrafts and medicinal purposes. Womenfolk are more eager in fishing-net making activities for income generation rather than weaving of traditional clothes resulting in decline of the latter small scale industry. The lake also provides water to the *National Hydro Power Corporation (NHPC)* for power generation while at the same time supporting agriculture by providing water for irrigation and domestic purposes. It also supports the world's only floating sanctuary – the *Keibul Lamjao National Park (KLNP)*, home for the endangered Manipuri brow-antlered deer (*Cervus eldi eldi*) locally called *Sangai*. This largest floating park is the only habitat and the last refuge for this highly endangered ungulate species which had attracted international community for its uniqueness. The denundation of lake catchments due to *jhum farming*, deforestation and increasing demands for fodder, fuel and other forest products contributed to enhanced siltation and reduction of water holding capacity of the lake. Most of the inhabitants were found to be aware of the importance of the lake in their life and hence would actively support the conservation programmes given a chance.

References

Loktak Development Authority (LDA) and Wetlands International - South Asia. 2002. Annual Report. *Sustainable Development and Water Resource Management of Loktak Lake*.

Trisal, C.L. and Th., Manihar. 2002. *Management of Phumdis in Loktak Lake*. Proceedings of Workshop Held at Imphal. Manipur.

Shamungou, Kh. 1999. *Conservation of Manipur Brow-Antlered Deer*. Vol. II. Mass Publication. Imphal.

Tombi Singh. 1992. *Impact of Hydel Project on the Environment of Manipur*. Technical Report, Department of Science, Technology and Manipur. Government of India.

www.wetland.org

www.ramsar.org

CONCEPT MAPS IN ORGANIC CHEMISTRY TEACHING

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The importance of chemistry is now recognised by all educationists. Owing to its complex nature, chemistry is often full of abstract concepts. It may lead to extensive misconceptions among students.

Researchers indicate (Pendley et al., 1994) that, instead of understanding the science concepts, students learn science concepts by rote learning. In our country various methods are being used to teach organic chemistry but the current methods of teaching organic chemistry are often didactic and do not involve pupil's prior knowledge actively. Therefore, there is a need to introduce a new method of teaching organic chemistry which gives easy explanations of principles so that students become interested in chemistry and do not develop chemophobia when later faced with systemised and scientific explanation of phenomena. Use of concept maps as a teaching method is one of them.

This article describes what are concept maps, why use concept maps, how to construct concept maps. It mainly describes how to construct and use concept maps. Example of phenol has been chosen to describe construction and use of concept map in teaching organic chemistry. It also emphasises on the advantages of using concept maps in teaching-learning process of organic chemistry as they can make learning an active process, can reinforce students' understanding and learning, can improve students' achievement in organic chemistry, can clarify misconceptions, and can be used as a tool to assess student's understanding, etc., which can be helpful for meaningful learning in organic chemistry.

The importance of chemistry is now recognised by all educationists. Chemistry has gained a secure position in the curricula of schools, technical colleges and universities, both as an essential part of general education for life and as a separate branch of science.

Planning the chemistry education of young people is all about selection of content to be included, selection of processes and skills to be practiced, and selection of appropriate activities to familiarise the students. This selection is normally carried out at the syllabus formulation stage or course production level. However, at the classroom level, it is rarely so. Keeping in mind the immense course content of the chemistry curriculum, some new teaching methods must be adopted by the teacher. It has been observed that the learners tend to depend on memorisation of concepts and mechanisms of chemistry instead of applying their rationale and reasoning. Such learning is rarely consolidated and easily forgotten. The interest in the subject is also not substantiated and wavers more often. Chemistry is considered as a difficult subject among the natural sciences. The fundamentals behind the phenomena, the world of atoms and molecules, are not simple to perceive by our sensory organs.

The common problem in learning chemistry is that even if students do well in examinations, they still may fail in solving basic textbook problems, which is a sign of rote learning (Pendley *et. al.*, 1994).

One way to avoid rote learning is to use concept map as a teaching strategy. The use of concept map as a teaching strategy was first developed by J.D. Novak in the early 1980's, derived from Ausubel's learning theory which places central emphasis on the influence of student's prior knowledge on subsequent meaningful learning.

Edmonson (1989) identified students as rote learners, meaningful learners, and those midrange between the two learning approaches. In a study that involved observations and videotaped stimulated recall interviews of college biology students in the laboratory, Robertson (1984) concluded that some students tended to use rote strategies in learning and others tended to formulate relationships, or learn meaningfully. Donn (1989) used a Likert-type instrument, adapted from the work of Entwistle and Ramsden (1983), to identify meaningful and rote learners and subsequently found a clear distinction in their approach to learn new concepts. Meaningful learners responded to novel problems by self-questioning and by relating and elaborating ideas. In contrast, rote learners responded by stating definitions and could not extrapolate their ideas (Donn, 1989).

According to Ausubel (1963, 1968), three things are most important for a meaningful learning to take place : (a) the concepts presented to the learner must be potentially meaningful and hence must provide opportunity for the learner to form non-arbitrary relationships with existing conceptual frameworks (meaningful learning tasks), (b) the learner must have a conceptual framework to which the new concepts can be linked (relevant prior knowledge), and (c) the learner must manifest the meaningful learning set. To fulfil this last criterion, the learner must actively attempt to relate what is known to substantive aspects of new concepts (Ausubel, 1963, 1968; Novak, 1988).

So to make our students meaningful learners and not the rote learners, teachers should use some new teaching strategies in the classrooms and concept map is one such strategy. According to several studies (e.g. Cardellini, 2004, Francisco *et. al.*, 2002, Markow and Lonning, 1998, Nicoll *et. al.*, 2001, Osman Nafiz, 2008, Pandley, *et. al.*, 1994, Regis, *et al.*, 1996, Stensvold and Wilson 1992), concept maps help chemistry learning both in classroom and laboratories. According to Francisco *et. al.*, 2002 and Nicoll *et. al.,* 2001, concept maps are a useful learning tool in chemistry. These can improve understanding of chemical concepts and help build connections among abstract concepts. These can also be used as a tool to correct misconception. Concept maps help make links between concepts. Linking words help students see connections among concepts and organisation of scientific knowledge hierarchically.

What are Concept Maps?

Concept map is a way of representing relations between ideas, images or words, in the same way as a diagram represents the grammar of a sentence, a roadmap represents the location of highways and towns and a circuit diagram represents the working of an electrical appliance. Concept maps are tools for organising and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts or

propositions (indicating by a connecting line and linking word) between two concepts.

A concept map is a structural representation consisting of nodes and labelled lines. The nodes correspond to important terms (standing for concepts) in the domain. The lines denote a relation between a pair of concepts (nodes), and the label on the line tells how the two concepts are related. The combination of two nodes and a labelled line is called proposition. A proposition is the basic unit of meaning in a concept map and the smallest unit that can be used to judge the validity of the relation (line) drawn between two concepts.

Concept maps are diagrammatic representations which show meaningful relationships between concepts in the form of propositions which are linked together by words, circles and cross links. In concept map, we hierarchically arranged the super ordinate concepts at the top of the map, and subordinate at the bottom which are less inclusive than higher ones. The various concepts are linked through lines and these linkages are well defined using words or phrases that highlights the relationships between concepts.

Why Use Concept Maps?

As a pedagogical tool, concept maps help to see the effects in teaching on learning, and to negotiate the concept meaning with the learner, as assessment tool, concept maps serve as a formative or summative assesment tool, as a knowledge organisation tool. The concept maps help as a research tool in investigating the students' understanding, their knowledge structure and capability for sharing the ideas. Concept maps have been useful tool as diagnostic, pedagogical, assessment, data collection, knowledge organisation tool. Concept maps have been effective in eliciting knowledge, depicting misconceptions, tracing conceptual changes in students' understanding of a domain.

A teacher can use concept maps to:

- clarify thinking and reinforcing understanding;
- stimulate creative thinking;
- integrate new knowledge;
- identify misconceptions;
- correct misconceptions;
- solve complex problems;
- solve rote learning problems.

How to Construct Concept Maps?

The process of preparing a concept map comprises five major steps:

1. Identify the key concept, intermediate concepts and specific concepts.
2. Arrange the most important concepts. Place the most important concept on the top of the map. Add the lesser important concepts on a layer below the top concept.
3. Connect the concepts with arrows or links.
4. Add verbs to the links.
5. Add more links and concepts, if required, to complete the map.

The concept maps can be drawn using paper and pencil, blackboard and computer software. The concept maps are user-friendly and easy to draw. To begin with, the mapper select a topic of

interest and reads the topic, for example Phenol (Fig. 1). While reading, around 10–15 major concepts are identified, for instance, Hydroxy derivatives, Chemical reactions, Benzene, Hydroxyl group, etc. The concepts are enclosed within an elipse outline. These concepts are arranged from general to specific levels, by placing the most important concept (Subordinate concept) on the top of the map and lesser important concepts (Subordinate concept) on a layer below the top concept. This is followed by labelling links by drawing lines to these concepts. These links provide meaning to the concepts and few such linking words are : on the basis of, are, can be, in which, due to, etc., which are written on the lines connecting the concepts.

Concept Maps in Organic Chemistry Teaching

In the teaching-learning process of organic chemistry, use of concept maps as a teaching strategy will be most useful for the students and teachers both. Figs. 1 to 5 at a glance, present how organic chemistry (Phenol) can be taught through concept maps in an effective manner.

Teaching organic chemistry through concept maps may lead to the development of the concept. In organic chemistry as a teaching strategy, concept maps can be used to help students to solve rote learning problems and to clarify their misconceptions so that the students' achievement in organic chemistry will be higher. The misconception , if identified after teaching, can be greatly reduced when the sources of these misconceptions were specifically addressed during teaching process. Using concept maps can reinforce students' understanding and learning. Concept maps can also be useful for teachers in evaluating the process of teaching. They can assess the students' achievement by identifying misconceptions and missing concepts. They can also help teachers plan lesson, teaching units, and course of study. One big advantage of using concept maps in organic chemistry teaching is that it provides a visual image of the concepts under study in a tangible form, which can be focused very easily. They can be readily revised any time when necessary. During the formulation process, it consolidated a concrete and precise understanding of the meanings and inter-relations of concepts. Thus it makes learning an active process, not a passive one.

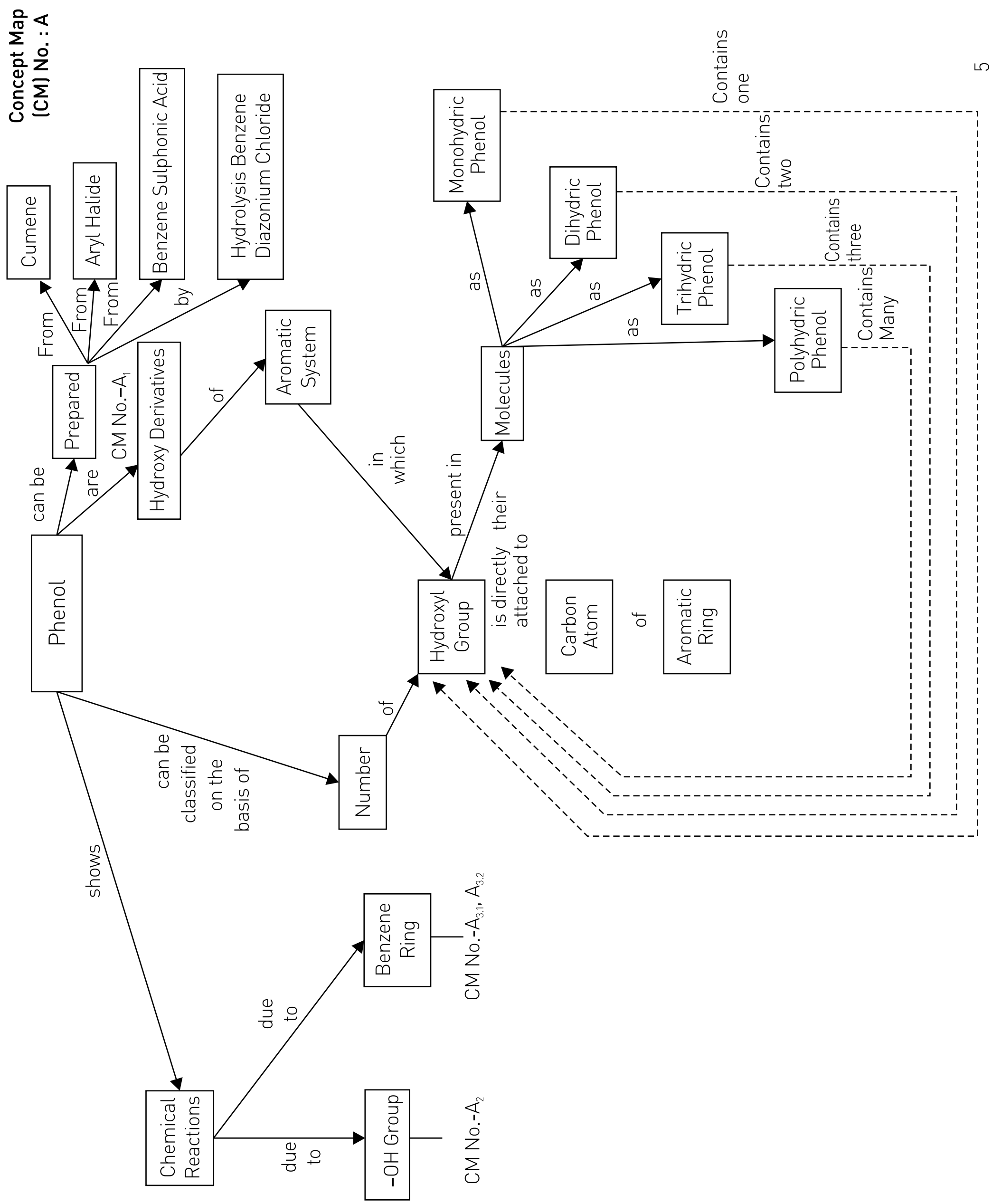
Concept Map
(CM) No. : A
Phenol
can be
Prepared
From
Cumene
From
Aryl Halide
From
Benzene Sulphonic Acid
by
Hydrolysis Benzene Diazonium Chloride
are
CM No.-A_1
Hydroxy Derivatives
of
Aromatic System
in which
Hydroxyl Group
is directly attached to
their
Carbon Atom
of
Aromatic Ring
present in
Molecules
as
Monohydric Phenol
as
Dihydric Phenol
as
Trihydric Phenol
as
Polyhydric Phenol
Contains one
Contains two
Contains three
Contains Many
5
can be classified on the basis of
Number
of
shows
Chemical Reactions
due to
Benzene Ring
CM No.-$A_{3.1}$, $A_{3.2}$
due to
–OH Group
CM No.-A_2

Fig. 1

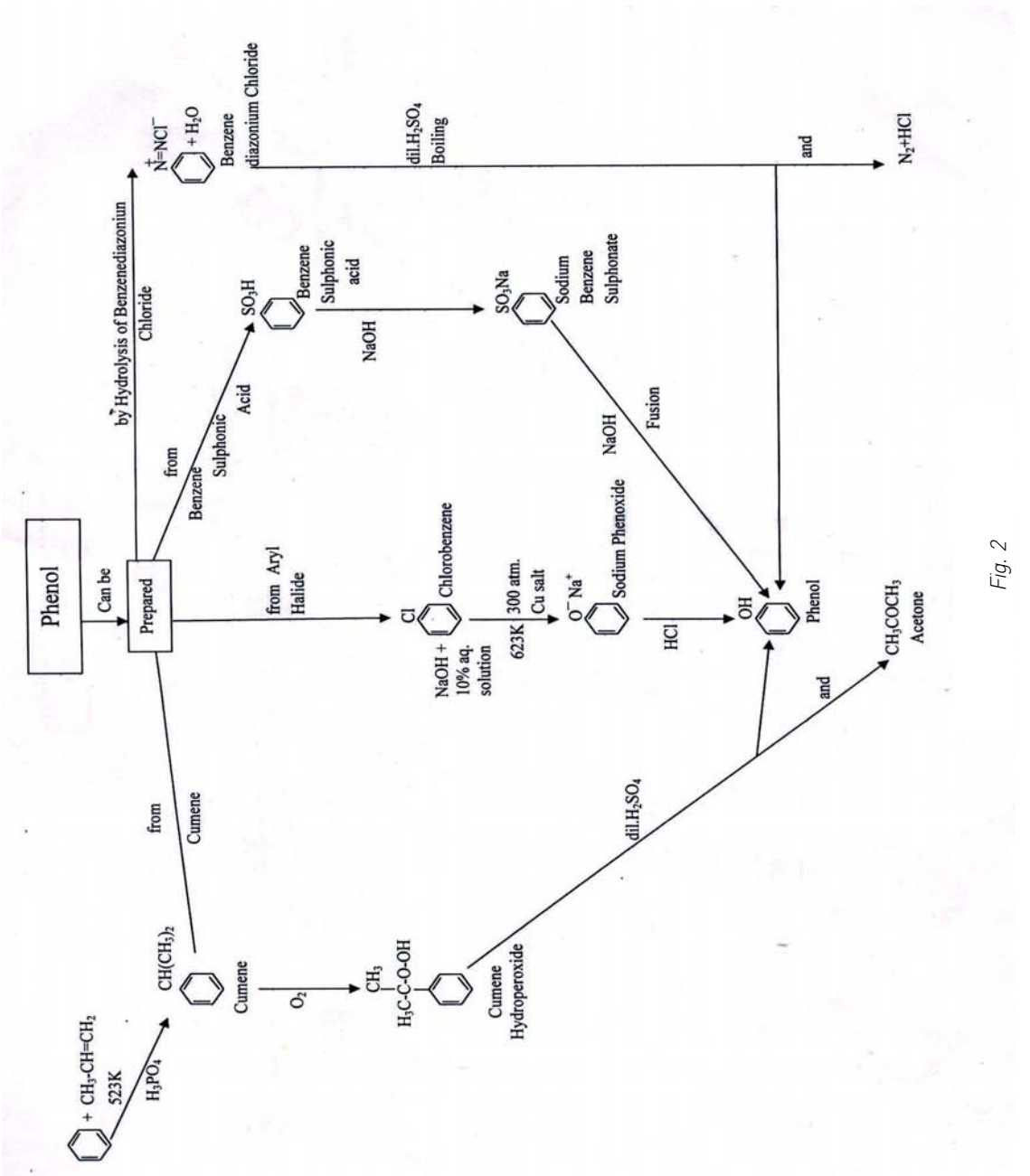
Phenol
Can be
Prepared
by Hydrolysis of Benzenediazonium Chloride
from Benzene Sulphonic Acid
from Aryl Halide
from Cumene
+ CH3-CH=CH2
523K
H3PO4
CH(CH3)2
Cumene
O2
CH3
H3C-C-O-OH
Cumene Hydroperoxide
dil.H2SO4
CH3COCH3
Acetone
and
Phenol
OH
HCl
O⁻ Na⁺
Sodium Phenoxide
NaOH
Fusion
Sodium Benzene Sulphonate
SO3Na
NaOH
Benzene Sulphonic acid
SO3H
Cl
Chlorobenzene
NaOH + 10% aq. solution
623K
300 atm.
Cu salt
+ H2O
Benzene diazonium Chloride
dil.H2SO4
Boiling
and
N2+HCl

Fig. 2

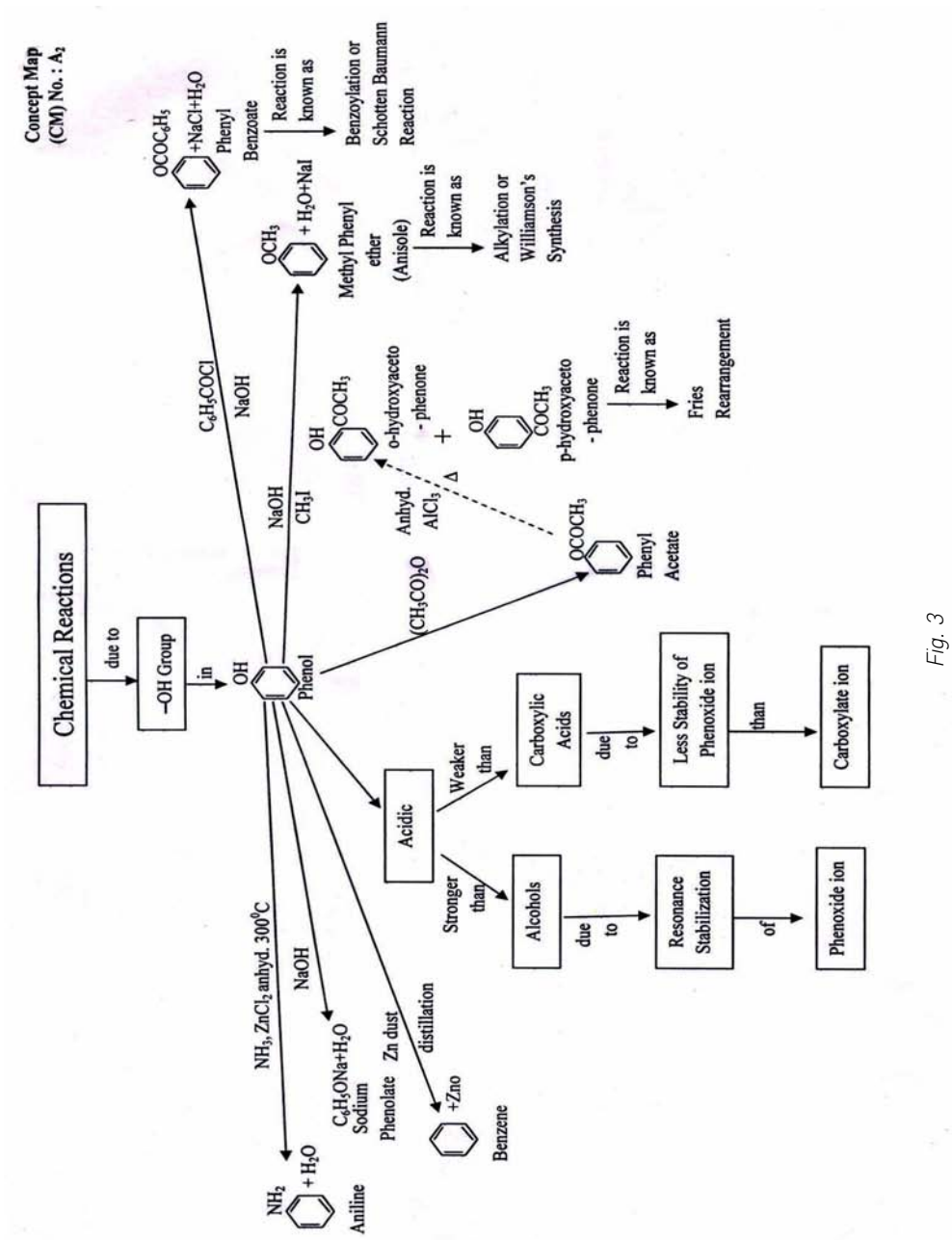
Concept Map
(CM) No. : A2
Chemical Reactions
due to
–OH Group
in
OH
Phenol
NH3, ZnCl2 anhyd. 300°C
+ H2O
NH2
Aniline
NaOH
C6H5ONa+H2O
Sodium
Phenolate
Zn dust
distillation
+Zno
Benzene
Acidic
Weaker
than
Carboxylic
Acids
due
to
Less Stability of
Phenoxide ion
than
Carboxylate ion
Stronger
than
Alcohols
due
to
Resonance
Stabilization
of
Phenoxide ion
C6H5COCl
NaOH
OCOC6H5
+NaCl+H2O
Phenyl
Benzoate
Reaction is
known as
Benzoylation or
Schotten Baumann
Reaction
NaOH
CH3I
OCH3
+ H2O+NaI
Methyl Phenyl
ether
(Anisole)
Reaction is
known as
Alkylation or
Williamson's
Synthesis
(CH3CO)2O
OCOCH3
Phenyl
Acetate
Anhyd.
AlCl3
Δ
OH
COCH3
o-hydroxyaceto
- phenone
+
OH
COCH3
p-hydroxyaceto
- phenone
Reaction is
known as
Fries
Rearrangement

Fig. 3

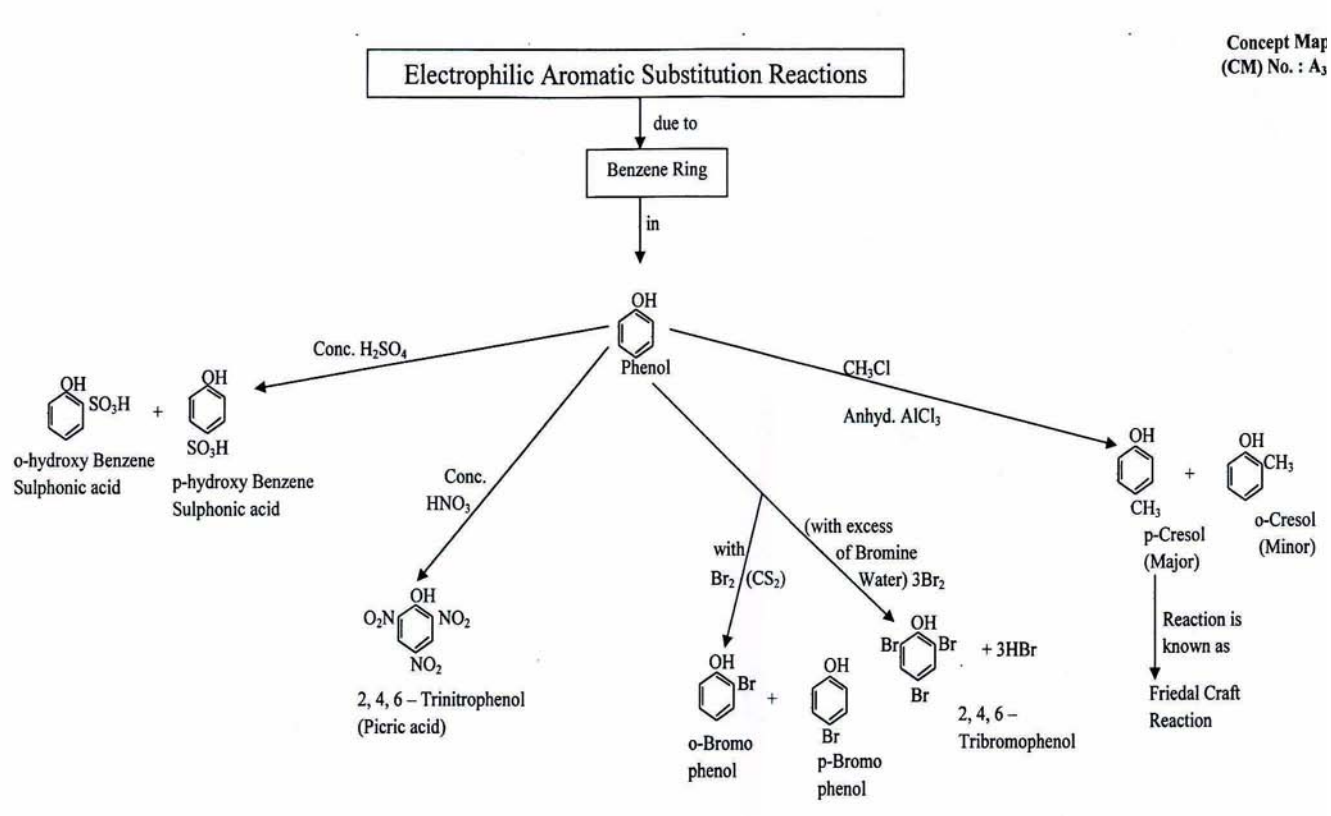
Concept Map
(CM) No. : A3
Electrophilic Aromatic Substitution Reactions
due to
Benzene Ring
in
Phenol
Conc. H2SO4
o-hydroxy Benzene Sulphonic acid
p-hydroxy Benzene Sulphonic acid
Conc. HNO3
2, 4, 6 – Trinitrophenol (Picric acid)
with Br2 (CS2)
o-Bromo phenol
p-Bromo phenol
(with excess of Bromine Water) 3Br2
+ 3HBr
2, 4, 6 – Tribromophenol
CH3Cl
Anhyd. AlCl3
p-Cresol (Major)
o-Cresol (Minor)
Reaction is known as
Friedal Craft Reaction

Fig. 4

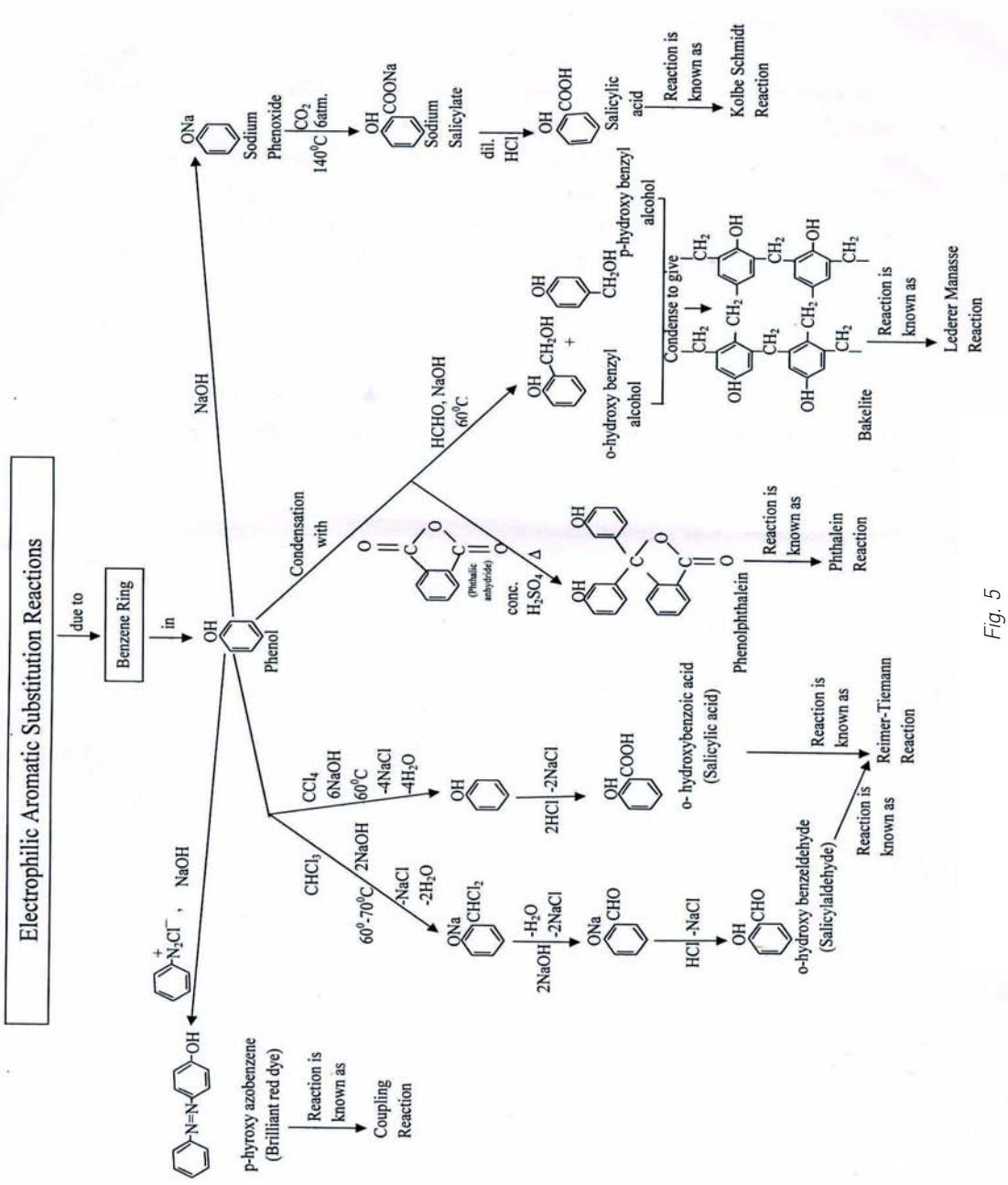
Electrophilic Aromatic Substitution Reactions
due to
Benzene Ring
in
Phenol
Condensation with
NaOH
Sodium Phenoxide
CO_2 6atm. 140°C
Sodium Salicylate
dil. HCl
Salicylic acid
Reaction is known as
Kolbe Schmidt Reaction
HCHO, NaOH 60°C
o-hydroxy benzyl alcohol
p-hydroxy benzyl alcohol
Condense to give
Bakelite
Reaction is known as
Lederer Manasse Reaction
conc. H_2SO_4 Δ
Phenolphthalein
Reaction is known as
Phthalein Reaction
CCl_4 6NaOH 60°C -4NaCl -4H_2O
$CHCl_3$ 2NaOH 60°-70°C -NaCl -2H_2O
2HCl -2NaCl
o- hydroxybenzoic acid (Salicylic acid)
-H_2O 2NaOH -2NaCl
HCl -NaCl
o-hydroxy benzeldehyde (Salicylaldehyde)
Reaction is known as
Reimer-Tiemann Reaction
$-N_2Cl^-$, NaOH
p-hyroxy azobenzene (Brilliant red dye)
Reaction is known as
Coupling Reaction

Fig. 5

References

Ausubel, D.P. 1963. *The Psychology of Meaningful Verbal Learning*. New York : Grune & Stratton, Inc.

Ausubel, D.P. 1968. *A Subsumption Theory of Meaningful Verbal Learning and Retention*. In R.G. Kuhlen (Ed.), Studies in Educational Psychology. Boston : Blaisdell Publishing Company.

Ausubel, D.P. 1968. *Educational Psychology* : A Cognitive View. New York : Holt, Rienehart and Winston.

Cardellini, L. 2004. Conceiving of Concept Maps to Foster Meaningful Learning : An Interview with Joseph D. Novak. *Journal of Chemical Education*, 81(9), 1303-1307.

Donn, S. 1989. *Epistemological Issues in Science Education*. Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching. San Francisco, CA.

Edmonson, K.M. 1989. *Differences and Similarities between Males' and Females' Conceptions of Scientific Knowledge and their Orientation to Learning*. Paper Presented at Research in Science Teaching. San Francisco, CA.

Entwistle, N.J. 1981. *Styles of Learning and Teaching : An Integrative Outline of Educational Psychology*, Chichester : John Wiley & Sons, Inc.

Entwistle, N.J. and P., Ramsden. 1983. *Understanding Student Learning*. London : Croom Helm.

Francisco, J.S., M.B., Nakhleh, S.C., Nurrenbern and Miller, M.L. 2002. Assessing Student Understanding of General Chemistry with Concept Mapping. *Journal of Chemical Education*, 79(2), 248-257.

Markow, P.G. and Lonning, R.A. 1998, *Usefulness of Concept Maps in College Chemistry Laboratories: Students Perceptions and Effects on Achievement*. Journal of Research in Science Teaching, 35 (9), 1015-1029.

Novak, J.D. and D.B., Gowin. 1984. *Learning How to Learn*. New York : Cambridge University Press.

Novak, J.D. 1988. *Learning Science and the Science of Learning*. Studies in Science Education, 15, 77-101.

Nicole, G., J.S., Francisco and M., Nakhley. 2001. An Investigation of the Value of using Concept Maps in General Chemistry. Journal of Chemical Education, 78(8), 1111-1117.

Osman, Nafiz, K. 2008. *A Student Centred Approach: Assesing the Changes in Prospective Science Teacher's Conceptual Understanding by Concept Mapping in a General Chemistry Laboratory*, Research in Science Education, 38(1), 91-110.

PENDLEY, B.D., R.L., BRETZ and J.D., NOVAK. 1994. *Concept Map as a Tool to Assess Learning in Chemistry*. Journal of Chemical Education, 71 (1), 9-15.

REGIS, A, P.G., ALBERTAZZI and E., ROLETTO. 1996. *Concept Maps in Chemistry Education*. Journal of Chemical Education, 73, 1084-1088.

ROBERTSON, M. 1984. *Use of Videotape-simulated Recall Interviews to Study the Thoughts and Feelings of Students in an Introductory Biology Laboratory Course*. Unpublished M.S. Thesis, Cornell University.

STENSVOLD, H. and J., WILSON, (1992). *Using Concept Maps as a Tool to Apply Chemistry Conepts to Laboratory Activities*. Journal of Chemical Education, 69(3), 230-232.

LASER AND ITS APPLICATIONS

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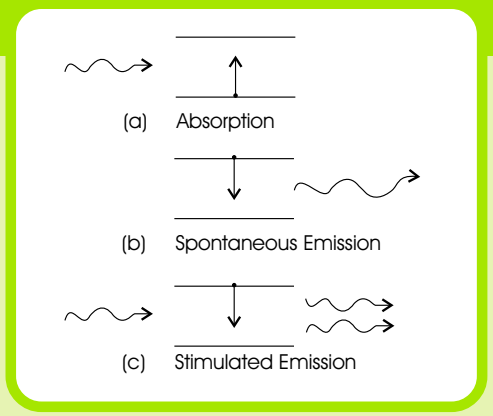
This article talks about laser, principle of laser action, different types of lasers and application of lasers.



Laser is undoubtedly one of the most significant inventions of the twentieth century which created a revolution in the world of science and technology. The laser has now permeated into almost all walks of life. It has been used for a number of applications in such important areas as communication, defence, space science, medicine, industry, etc.

T.H. Maiman of the Hughes Research Laboratory, California, U.S.A. developed the first ruby laser on 16 May 1960. Incidentally, this year the invention of laser has completed 50 years. It provides us an occasion to discuss about laser and its applications in some details.

What is Laser?

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. It is a powerful source of light having some unique characteristics which are not found in the normal light sources like tungsten bulbs, mercury lamp, etc.

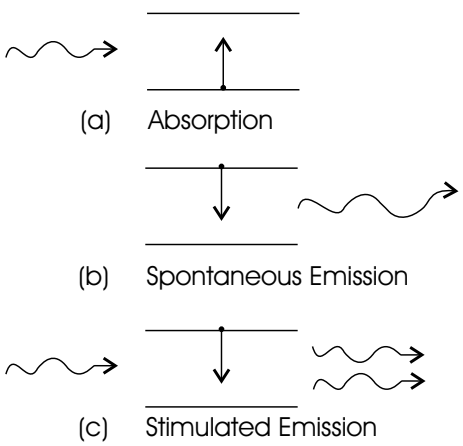


Fig.1: Phenomena of absorption, spontaneous emission and stimulated emission

The beam of ordinary light spreads out very quickly. It contains many colours or wavelengths and its waves are not in step with each other

which means that the ordinary light is neither monochromatic (of a single wavelenght) nor coherent. On the other hand, laser light can travel very long distances with very little divergence. It is monochromatic and its waves are coherent, i.e., they are exactly in step with each other and thus have a fixed phase relationship.

Thus, laser light is coherent and monochromatic and has a high degree of directionality. Also, it has very high intensity. As a result, very high laser energy can be focused on to a very small spot. This property of laser has important applications in welding, cutting, laser fusion, etc.

It may be noted that both temporal and spatial coherence exist simultaneously in laser light. Temporal coherence means that the relative phase difference between two points in time (i.e., separated by Δt) remains fixed; while spatial coherence means that the relative phase difference between two points in space (i.e., separated by a transverse distance Δd) remains fixed. In fact, temporal coherence is related to monochromaticity (or the spectral purity) while spatial coherence is related to directionality and uniphase wavefronts. The properties of monochromacity and high degree of directionality exhibited by laser light make it a completely coherent light.

The basic principle of laser is based on the phenomenon of stimulated emission that was predicted by Einstein in 1917. However, this principle remained on paper for more than three- and- a- half decades; it could not be put to any practical applications.

In 1954, Charles Hard Townes from the University of Coulombia, U.S.A. succeeded in amplifying microwaves using this principle. This device was named Maser (acrony for Microwave Amplification by Stimulated Emission of Radiation).

Incidentally, the idea of maser struck Townes while sitting on a bench of the famous Franklin Park. It is a mere coincidence that simultaneously two scientists working at Labedev Laboratiories situated in Moscow of the erstwhile Soviet Union, Alexander Mikhailovich Prokhorov and Nicolai Gennediyevich Basov, were also thinking along the same lines. However, Townes was the first who succeeded to produce the first maser. Nonetheless, the two scientists shared the 1964 Nobel Prize in Physics with Townes.

Principle of Laser Action

In order to understand the principle of laser action, we first need to clearly understand the concepts of stimulated emission and population inversion.

According to quantum theory, every atom can have energies only in certain discrete states or energy levels. Normally, the atoms are in the lowest energy or the ground state. However, when light from a powerful source, like a flash lamp or a mercury are, falls on a substance, the atoms in the ground state can be excited to go to one of the higher energy stated. This process is called absorption.

After staying in the excited state for a very short duration, which is about 10 nanosecond (10^{-8}s), the atom returns to its initial ground state by emitting a photon. This process is called spontaneous emission.

It is also possible that an outside photon strikes an excited atom and stimulates it to emit a photon.

This process is called stimulated emission. However, a necessary condition for this to happen is that the outside photon should have energy that is equal to the difference between the energies of the atom in its excited and ground states.

The important characteristic of stimulated emission is that the emitted photon has exactly that same wavelength as the outside photon and that the two photons are in the same phase.

If this process is repeated, more and more atoms will be forced to give up photons thereby initiating a chain reaction. This results in rapid build up of energy of one particular wavelength travelling coherently in a precise, fixed direction. This process is called amplification by stimulated emission which is fundamental for laser action. However, one more condition, called population inversion, is also essential for laser action.

The number of atoms in any level at a given instant of time is defined as the population of that level. Normally, the population of the ground state is greater than that of the excited state. If somehow the situation could be reversed the population of the excited state will exceed that of the ground state. This would lead to the state of population inversion.

If between the ground and excited states, an intermediate state, called metastable state, having lifetime higher than that of the excited state be present then the atoms could pause at the metastable state for more time. This would result into a higher population of atoms in the upper energy (metastable) state relative to that in the ground state leading to population inversion which is an essential condition for laser action. The lifetime of the metastable state may be about a millisecond (10^{-3}s) which is fairly large compared to the lifetime of the excited state of the atom (10^{-8} s).

Main Components of a Laser

A laser generally requires three main components for its operation: (a) an active medium which may be in the form of solid, liquid, gas or semiconductor; (b) a pumping source to provide energy to the active medium for obtaining the state of population inversion; a xenon or krypton flash lamp or electrical energy is used as pumping source; and (c) an optical or cavity resonator for amplification action; two mirrors, one having cent per cent reflectivity while the other having 90 per cent or less reflectivity generally serve as cavity resonator.

The stimulated radiation resulting from population inversion multiplies by bouncing forth between the two mirrors and passing through the active medium. As a result, the radiation gets amplified and passes in the form of a narrow beam through the semi-transparent mirror.

Different Types of Lasers

T.H. Maiman, who demonstrated the first laser action in 1960, used a cylindrical rod ruby crystal to produce laser light in the visible red region. After ruby laser, attempts were made to produce different types of lasers. Although numerous types of lasers are available, depending on the production technique seven broad categories of laser have been identified. These are solid laser, gas laser, liquid (dye) laser, chemical laser, semiconductor laser, gas dynamic laser and free electron laser.

Besides producing light in the visible region, some of these lasers produce light in the ultraviolet and infrared regions too.

Scientists have also succeeded in producing X-ray that produce radiation in the X-ray region. Raman lasers, based on the Raman effect discovered by the celebrated Indian Nobel laureate C.V. Raman, have also been developed. It may be noted that Raman lasers are different from the conventional lasers as laser action is possible in them even without population inversion.

The scientists are currently busy in developing state-of-the-art lasers such as nano lasers, quantum dot lasers, etc. Some success in this direction has already been achieved.

Applications of Laser

Different types of lasers have been put to different kinds of applications. In the field of medicine, laser is used for performing cataract operation and surgery for correcting refractive errors of eyes; and for the welding of detached retina. Urinary stones in the kidney can be shattered with the help of laser. The blocked arteries can also be cleared using laser angioplasty. Laser is also being used for dental treatment and for the treatment of many different kinds of cancer.

Great strides have also been made in the area of communication by using laser as the carrier and optical fibre as the medium. Known as optical fibre communication, this has made communication of information or data very fast and reliable.

Laser has many applications in industry as well. It can be used for cutting of metals. Welding of even dissimilar metals is possible using laser. Holes can be drilled in such hard materials as diamond with the help of laser.

Another important application of laser is in the production of three-dimensional (3-D) images. This is done by using a technique called holography. To prevent counterfeiting, credit/debit cards, mobile batteries, books, etc., carry plastic stickers on them called holograms. These are made with the help of holographic technique using laser.

Laser printers, another spin-off of laser technology, have virtually created revolution in the field of printing. Besides providing high printing speed and high degree of character flexibility, laser printers provide excellent print quality. They are being used worldwide for printing of books and other material.

Laser has many applications in the field of environmental pollution, seismology and metrology as well.

Applications of laser even extend to agriculture. Using laser, the rate of sprouting of seeds can be increased and even the crops can be reaped relatively early.

In our day-to-day life too, laser has many applications. Bar codes containing information about price and other details are printed on the food packets, consumer items, books, etc. Laser is used for scanning of these bar codes and all the information automatically come on the attached computer.

In scientific research too, laser has a variety of applications. In physics, it plays a significant role in the field of spectroscopy and thermonuclear

fusion. In chemistry, laser is used for separation of isotopes, measurement of impurity present in materials and for the study of ultrafast chemical reactions.

In defence and warfare too, laser has important applications. Using laser systems, enemy missiles may be destroyed. Underwater ranging using laser makes possible detection of submerged submarines.

Besides, laser has plethora of applications in various other areas as well. Lasers are also being used for testing the validity of some basic scientific theories. The basic postulate of Einstein's special theory of relativity that the velocity of light in vacuum is constant was an outcome of the Michelsonn-Morley experiment that led to negative result regarding the existence of hypothetical medium called ether. After the invention of laser, this experiment was performed again using helium-neon laser source. However, this experiment also negated the existence of ether which lent support to the Einstein's special theory of relativity.

Scientists are hopeful that many more applications of laser would emerge in the near future. Today laser is greatly benefitting human society at large. However, for the sake of world peace and the welfare of humanity, laser should be used only for peaceful purposes and not as a weapon of destruction in wars.

SCIENCE NEWS

Where Does All Earth's Gold Come from? Precious Metals the Result of Meteorite Bombardment

During the formation of Earth, molten iron sank to its centre to make the core. This took with it the vast majority of the planet's precious metals — such as gold and platinum. In fact, there are enough precious metals in the core to cover the entire surface of Earth with a four-metre thick layer.

The removal of gold to the core should leave the outer portion of Earth bereft of bling. However, precious metals are tens to thousands of times more abundant in Earth's silicate mantle than anticipated. It has previously been argued that this serendipitous over-abundance results from a cataclysmic meteorite shower that hit Earth after the core formed. The full load of meteorite gold was thus added to the mantle alone and not lost to the deep interior.

To test this theory, Dr Matthias Willbold and Professor Tim Elliott of the Bristol Isotope Group in the School of Earth Sciences analysed rocks from Greenland that are nearly four billion years old, collected by Professor Stephen Moorbath of the University of Oxford. These ancient rocks provide a unique window into the composition of our planet shortly after the formation of the core but before the proposed meteorite bombardment.

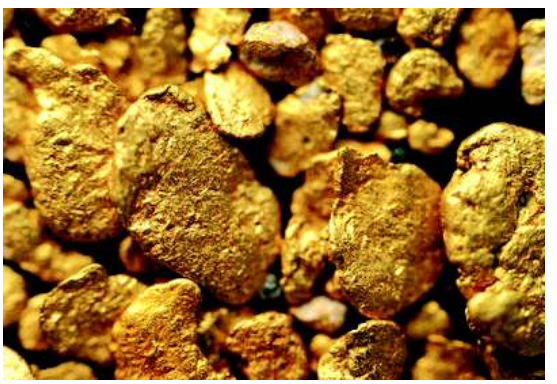
The researchers determined the tungsten isotopic composition of these rocks. Tungsten (W) is a very rare element (one gram of rock contains only about one ten-millionth of a gram of tungsten) and, like gold and other precious elements, it should have entered the core when it formed. Like most elements, tungsten is composed of several isotopes, atoms with the same chemical characteristics but slightly different masses. Isotopes provide robust fingerprints of the origin of material and the addition of meteorites to Earth

would leave a diagnostic mark on its W isotope composition.

Dr Willbold observed a 15 parts per million decrease in the relative abundance of the isotope 182W between the Greenland and modern day rocks. This small but significant change is in excellent agreement with that required to explain the excess of accessible gold on Earth as the fortunate by-product of meteorite bombardment.

Dr Willbold said, "extracting tungsten from the rock samples and analysing its isotopic composition to the precision required was extremely demanding given the small amount of tungsten available in rocks. In fact, we are the first laboratory worldwide that has successfully made such high-quality measurements."

The impacting meteorites were stirred into Earth's mantle by gigantic convection processes. A tantalising target for future work is to study how long this process took. Subsequently, geological processes formed the continents and concentrated the precious metals (and tungsten) in ore deposits which are mined today.



Gold
(Credit: © Martin Kreutz / Fotolia)

Dr Willbold continued, "our work shows that most of the precious metals on which our economies and many key industrial processes are based have been added to our planet by lucky coincidence when the Earth was hit by about 20 billion billion tonnes of asteroidal material."

This research was funded by the Natural Environment Research Council (NERC), the Science and Technology Facilities Council (STFC) and the Deutsche Forschungsgemeinschaft (DFG).

(Source: Science Daily Online)

New Material: Possible Boon for Lithium Ion Batteries

A team led by Hansan Liu, Gilbert Brown and Parans Paranthaman of the Department of Energy Lab's Chemical Sciences Division found that titanium dioxide creates a highly desirable material that increases surface area and features a fast charge-discharge capability for lithium ion batteries. Compared to conventional technologies, the differences in charge time and capacity are striking.

"We can charge our battery to 50 per cent of full capacity in six minutes while the traditional graphite-based lithium ion battery would be just 10 per cent charged at the same current," Liu said.

Compared to commercial lithium titanate material, the ORNL compound also boasts a higher capacity — 256 versus 165 milliampere hour per gram — and a sloping discharge voltage that is good for controlling state of charge. This characteristic combined with the fact oxide materials are extremely safe and long-lasting alternatives to commercial graphite make it

well-suited for hybrid electric vehicles and other high-power applications.

The results, recently published in *Advanced Materials*, could also have special significance for applications in stationary energy storage systems for solar and wind power, and for smart grids. The titanium dioxide with a bronze polymorph also has the advantage of being potentially inexpensive, according to Liu.

At the heart of the breakthrough is the novel architecture of titanium dioxide, named mesoporous TiO_2-B microspheres, which features channels and pores that allow for unimpeded flow of ions with a capacitor-like mechanism. Consequently, a lithium ion battery that substitutes TiO_2-B for the graphite electrode charges and discharges quickly.

"Theoretical studies have uncovered that this pseudocapacitive behaviour originates from the unique sites and energetics of lithium absorption and diffusion in TiO_2-B structure," the authors write in their paper.

Paranthaman noted that the microsphere shape of the material allows for traditional electrode fabrication and creates compact electrode layers. He also observed, however, that the production process of this material is complex and involves many steps, so more research remains to determine whether it is scalable.

Other authors of the paper are Zhonghe Bi, Xiao-Guang Sun, Raymond Unocic and Sheng Dai. The research was supported by DOE's Office of Science, ORNL's Laboratory Directed Research and Development programme and ORNL's (Shared Research Equipment) SHaRE User Facility, which is sponsored by Basic Energy Scmiences.

(Source: Science Daily Online)

Potatoes Reduce Blood Pressure in People with Obesity and High Blood Pressure

But don't reach for the catsup (ketchup), vinegar or mayonnaise. The research was not done with French fries, America's favourite potato, but with potatoes cooked without oil in a microwave oven. Although researchers used purple potatoes. They believe that red-skin potatoes and white potatoes may have similar effects.

"The potato, more than perhaps any other vegetable, has an undeserved bad reputation that has led many health-conscious people to ban them from their diet," said Joe Vinson, Ph.D., who headed the research. "Mention potato and people think 'fattening, high-carbs, empty calories'. In reality, when prepared without frying and served without butter, margarine or sour cream, one potato has only 110 calories and dozens of healthful phytochemicals and vitamins. We hope our research helps to remake the potato's popular nutritional image."

In the new study, 18 patients who were primarily overweight/obese with high blood pressure ate 6-8 purple potatoes (each about the size of a golf ball) with skins twice daily for a month. They used purple potatoes because the pigment, or colouring material, in fruits and vegetables is especially rich in beneficial phytochemicals. Scientists monitored the patients' blood pressure, both systolic (the higher number in a blood pressure reading like 120/80) and diastolic. The average diastolic blood pressure dropped by 4.3 per cent and the systolic pressure decreased by 3.5 per cent, said Vinson, who is with the

University of Scranton in Pennsylvania and has done extensive research on healthful components in foods. The majority of subjects took anti-hypertensive drugs and still had a reduction in blood pressure. None of the study participants gained weight.

Vinson said that other studies have identified substances in potatoes with effects in the body similar to those of the well-known ACE-inhibitor medications, a mainstay for treating high blood pressure. Other phytochemicals in potatoes occur in amounts that rival broccoli, spinach and Brussels sprouts, and also may be involved, Vinson added.

The potato's stereotype as a fattening food for health-conscious folks to avoid is getting another revision as scientists report that just a couple servings of spuds a day reduces blood pressure almost as much as oatmeal without causing weight gain.
(Credit: © JMB / Fotolia)

Unfortunately for French fry and potato chip fans, those high cooking temperatures seem to destroy most of the healthy substances in a potato, leaving mainly starch, fat and minerals. Potatoes in the study were simply microwaved, which Vinson said seems to be the best way to preserve nutrients.

The purple potatoes used in the study are becoming more widely available in supermarkets and especially in food stores and farmers' markets. Vinson said that he strongly suspects a future study using white potatoes, now in the planning stages, will produce similar results. Funding for the study came from the United States Department of Agriculture-Agricultural Research Service (USDA-ARS) State Cooperative Potato Research Program.

(Source: Science Daily Online)

Mathematics will Increase Aluminium Recycling

The objective of the five-year project is to develop technical production 'recipes' which will enable aluminium scrap to re-emerge in the form of high quality consumer products — everything from foil to window frames.

"The results are promising," says Yanjun Li, a project manager at SINTEF.

Accumulation of impurities

The recycling of aluminium requires only five per cent of the energy used in producing new aluminium. This means a potential 95 per cent reduction in greenhouse gases in connection with production.

However, every time aluminum is recycled, various alloy constituents such as iron, silicon and zinc, as well as trace elements such as sodium and lead, accumulate in the resulting material.

Until now this has placed clear limitations on what recycled aluminium can be used for, even when a high proportion of pure aluminium is added to dilute the concentration of undesirable elements. However, these limitations are now to be eased.

Casting is the Past

Recycled aluminium has so far mainly been used in cast products, which may be anything from car wheel rims to engine blocks.

However, in just a few years' time of the casting market will probably be too small to absorb the rapidly increasing amount of recycled aluminium which will enter the material stream.

Rolling and Extrusion are the Future

If the world is to benefit from the increased availability of recycled aluminium, new routes must be opened to the market for such materials.

Put simply, this means that rolling and extruding plants must be adapted to accept far higher proportions of recycled material.

These are factories designed for aluminium-based mass production.

Sheets and Mouldings

Rolling produces aluminium material in the form of sheets, foil and strips.

Aluminium which has been put through an extrusion plant ends up as mouldings or profiles. These can be found in the light fitting above your head, in the front panel of your radio, in the window frames of quality buildings or as heat exchangers in car radiators — to mention just a few examples.

Specialist Project

The desire to make recycled aluminium a raw material for rolling and extrusion mills is the background for the specialist project, MOREAL (2009-2013).

SINTEF and NTNU are running the project in collaboration with Hydro Aluminium and the Swedish company Sapa Technology, with partial financing from the Research Council of Norway.

Focus on Tempering Process

"The impurities which accumulate in aluminium through repeated recycling affect the mechanical properties of the recycled material. However, by changing the alloy composition and temperature conditions, and the speed of the homogenisation process — the initial stage in a tempering process carried out in rolling and extrusion plants — it is possible to compensate for this," says Yanjun Li.

According to the research scientist, by effecting such changes it will be entirely possible to make use of recycled aluminium in rolled products and aluminium mouldings which satisfy any required mechanical properties, such as strength and malleability.

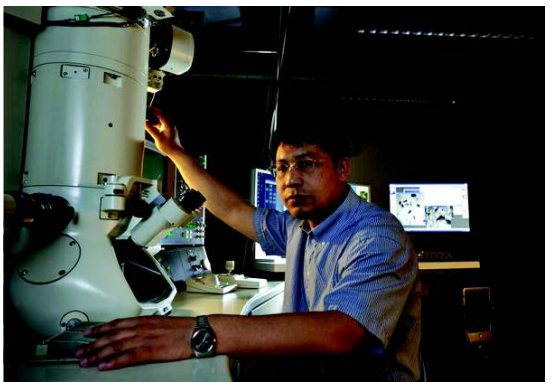
The PC as a Test Lab

The SINTEF employee explains that it is both expensive and time-consuming to determine the right process changes by trial and error in physical experiments in the factories. Instead, the researchers prefer to use mathematical models — in other words, tools which describe real conditions by means of mathematical formulae.

"In the MOREAL project, we are developing advanced mathematical models as a supplement

to laboratory experiments. These are powerful tools which make the development of recycling-friendly aluminium alloys cheaper and less time-consuming," says Yanjun Li.

The project will lead to three different models, all of which will show how the microstructure of recycled materials is affected by various modifications in homogenisation during the extrusion and rolling processes.



Research Scientist Yanjun Li studies the microstructure of aluminium alloys using an electron microscope.
(Credit: SINTEF / Thor Nielsen)

Promising Results

"Using mathematical modelling as a guide, we have carried out physical laboratory experiments with an aluminium alloy in the so-called '3xxx family.' This is a commonly used alloy group in which manganese is an additive, providing good malleability, increased tensile strength and high corrosion resistance. We demonstrated that the yield point of the alloy, we investigated can be increased by 50 per cent by modifying the homogenisation process. In plain language, this means that the material will tolerate far more bending before it breaks," says Li.

In 2009, around one-fifth of the world's aluminium production originated from recycled materials. Most of the recycled raw material comes from the transport sector and packaging products, but in recent years aluminium from the construction industry has been increasingly recycled.

"The aim of our project is to enable our industrial partners to produce more tailored, recycling friendly aluminium alloys. Expertise in this field will be increasingly important for sustainability and global competitiveness in the materials industry," says Yanjun Li.

(Source: Science Daily Online)

Zero-Gravity Experiments

Dr Niel Crews, assistant professor of mechanical engineering, and Collin Tranter, a graduate student with the Institute for Micromanufacturing (IfM) say the instrument could be used to monitor the health of astronauts exposed to cosmic radiation beyond Earth's protective atmosphere.

"Our goal is to understand how the system behaves under conditions similar to actual deployment in space missions," said Crews. The Louisiana Tech-developed devices are beneficial to NASA because they are small, consume less power and require little to no human operation.

The Louisiana Tech researchers will subject themselves to extreme conditions in order to conduct sensitive testing of the miniature device. NASA has used these same flights to train their astronauts.

The instrument attracted the attention of NASA scientists for possible use on the International

Space Station, during inter-planetary travel and even for unmanned missions to search for life within the Solar System.

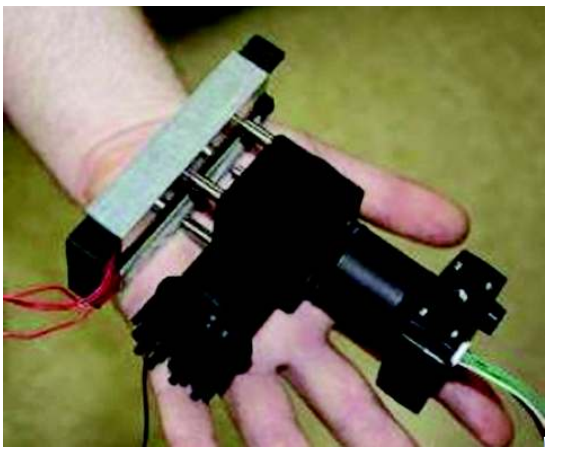
"We hope that by working with NASA, one of our DNA analysis devices will be sent into orbit to study the effects of space environments on living things, first studying DNA then cells," said Tranter. "Some further testing has to occur first, such as making sure the device works properly in low-gravity conditions. This will be done on a parabolic aircraft flight hopefully before the end of the year."

The tests will take place on a NASA airplane operating out of Ellington Field at Johnson Space Centre in Houston. The flight pattern will consist of forty steep dives and climbs over the Gulf of Mexico. A controlled dive of nearly 10,000 feet in less than one minute will result in approximately 20 seconds of weightlessness for the researchers and the payload onboard. An abrupt climb back to the starting altitude will create a gravitational force twice the normal amount.

Even Hollywood has gotten into the act, using these flights to depict weightlessness on the silver screen. All of the zero-gravity scenes in the movie Apollo 13 were filmed during these flights. The alternation between zero-gravity and 2G forces can so disorienting that NASA astronauts call the aircraft the "vomit comet."

NASA recently selected this system for a week-long series of flights as part of their Facilitated Access to the Space Environment for Technology (FAST) programming, which focuses on expanding new technologies to be used in space flight applications.

Tranter is pursuing a Ph.D. in Nanosystems Engineering at Louisiana Tech and will continue to work with Crews on the project. He says they hope to learn very soon if their device can stand up to space environments.



DNA analyser developed at Louisiana Tech University. (Credit: Image courtesy of Louisiana Tech University)

"Low gravity can cause all kinds of unpredictable problems," Tranter said. "Eventually, I hope our system can reveal more about space radiation effects on DNA and cells, leading to options for safe space travel and exploration by humans. Our lab has studied some effects of radiation on DNA, such as UV exposure, but nothing on Earth compares to the environments we hope to study outside of the Earth's atmosphere."

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Louisiana Tech University. The original article was written by Catherine Fraser.

(Source: Science Daily Online)

Microscope on the Go: Cheap, Portable, Dual-Mode Microscope Uses Holograms, not Lenses

Their prototype weighs about as much as a medium-sized banana and fits in the palm of a hand. And, since it relies in part on mass-produced consumer electronics, all the materials to make it add up to between $50 and $100 USD.

It also has a two-in-one feature: a transmission mode that can be used to probe relatively large volumes of blood or water, and a reflection mode that can image denser, opaque samples. The spatial resolution for both modes is less than two micrometers — comparable to that achieved by bulkier microscopes with low- to-medium power lenses.

"This is the first demonstration of essentially a hand-held version of a microscope that can do dual-mode imaging within a very compact and cost-effective form," says Aydogan Ozcan, an associate professor of electrical engineering and bioengineering at UCLA and senior author of the paper.

"With just a small amount of training, doctors could use devices like these to improve health care in remote areas of the world with little access to diagnostic equipment," Ozcan says. The handheld microscope could help ensure water quality, test patients' blood for harmful bacteria, and even be used for semen-quality monitoring on animal farms.

It could also prove useful in health crises such as the recent outbreak of E. coli in Europe.

"It's a very challenging task to detect E. coli in low concentrations in water and food," Ozcan says. "This microscope could be part of a solution for field investigation of water, or food, or may be pathogens in blood."

Part of the device's success is the weight it shed when researchers got rid of the bulkier, heavier, more expensive pieces that most microscopes rely on for collecting and focusing light: the lenses. Instead of lenses, this microscope uses holograms.

Holograms are formed when light bouncing off (or passing through) a three-dimensional object is made to interfere with a 'reference beam,' or light that has not hit the object. Consider this analogy: drop a stone into a still pond and the ripples will move outward in a circle. Drop two stones and the circular ripples will interfere with each other, making a new pattern of crests and troughs. A person (or computer) analysing the interference pattern created by those two stones could trace the source back to the stones and recreate what had happened to make the waves.

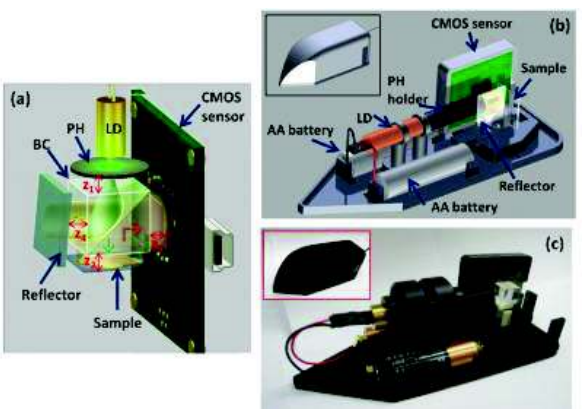
The UCLA team's device uses a similar principle to recreate images from interfering light waves.

An inexpensive light source is divided into two beams — one that interacts with microscopic cells or particles in the sample, and the other that does not. The beams then pass to an adjacent sensor chip, where their interference pattern is recorded.

Software then analyses that pattern and recreates the path taken by the light that passed through or bounced off of the objects being imaged.

"Each component of the device is fairly inexpensive," Ozcan says. The laser light could come from a $5 laser pointer. The sensor chip that collects that light is the same as the ones in the backs of iPhones and Blackberrys and costs less than $15 per chip. And the whole image-collecting system runs on two AA batteries.

Where the researchers have reduced weight and expense in doing away with lenses, they have added the power of the cloud. The microscope captures raw data; but a computer is required to reconstruct the images. Workers in the field could use their laptops to process the information or send it over the Internet or mobile phone networks to a remote server. Mobile phones could also have sufficient processing power to do the analysis on the spot.



In reflection mode, the holographic microscope can create images of dense, opaque materials, such as water filters: (a-b) Laser light from a laser diode ("LD" in the diagrams) is projected through a pin hole ("PH") and then split into two beams by a beam cube (labeled "BC"). One beam of light hits the sample; the other does not. The beams are then reunited to form an interference pattern, which is recorded on a CMOS image sensor. (c) This photograph shows the microscope in reflection mode, with its cover removed. (The inset shows what the microscope looks like with its cover on.) The device weighs about 200 grams and is 15 cm long, 5.5 cm high, and 5 cm wide. (Credit: Ozcan BioPhotonics Group at UCLA/ Biomedical Optics Express.)

Essentially, Ozcan says, "we are replacing an expensive and bulky, heavy component with computer codes."

The next steps for Ozcan's team include commercialising the device. Ozcan says he has founded a company that is developing this technology, trying to make a version of the microscopes that can be manufactured and sold to healthcare workers and hobbyists.

"Global health is a big field that requires better diagnostic tools, because resource-poor countries don't have the infrastructure for conducting essentially accurate diagnostic tests," Ozcan says. "There are so many problems that innovative solutions [like this microscope] would impact."

(Source: Science Daily Online)

New Device Helps the Blind to Move Independently

EYE 21 is an electronic tool that allows blind people to move autonomously in any environment. The blind, thanks to a pair of sunglasses equipped with two micro cameras and headphones, are able to perceive an acoustic image of the space at which they point their *new eyes*. This tool has been developed as a continuation of the European project Casblip.

In its first version, the system recognises shapes and replaces them with sounds positioned on the surface of the recognised

forms. The two micro cameras analyse space, create a three-dimensional model of it and associate sound points to point on the surface that is being analysed. In this way, a blind person *can hear space*, and their brain reconstructs its shape from that spatialised sound.

"We all have a natural ability to talk at the same time as we detect the position of coin that has just hit the ground. This ability to represent space with sounds without disturbing other activities of the brain is the basis of how this system works. Combining object recognition technology with sound representation of space allows a blind person to recreate those sounds and perceive their original shape," said Guillermo Peris.

Testing the new system
(Credit: Image Courtesy of Asociación RUVID)

According to this researcher from the Universitat Politècnica de València's CITG, with this system, users will have a new sense of perception of 3D space, different from sight: "We still do not know its limitations, but we do know many of its possibilities." At the moment, there are four prototypes of it and ten new ones are intended to be put into operation in the coming weeks.

"This step forward, which is the fruit of several years' work and of several research projects, is a further help for blind people to integrate into society and improve their quality of life," adds Peris.

The above story is reprinted (with editorial adaptations by Science *Daily* staff) from materials provided by Asociación RUVID, via AlphaGalileo.

(Source: Science Daily Online)

Hand-Held Unit to Detect Cancer in Poorer Countries

Syed Hashsham, a professor of civil and environmental engineering at MSU, is developing the Gene-Z device, which is operated using an iPod Touch or Android-based tablet and performs genetic analysis on microRNAs and other genetic markers. MicroRNAs are single-stranded molecules that regulate genes; changes in certain microRNAs have been linked to cancer and other health-related issues.

He is working with Reza Nassiri, director of MSU's Institute of International Health and an assistant dean in the College of Osteopathic Medicine, on the medical capabilities for the device and establishing connections with physicians worldwide.

"Cancer is emerging as a leading cause of death in underdeveloped and developing countries where resources for cancer screening are almost non-existent," Nassiri said.

"Until now, little effort has been concentrated on moving cancer detection to global health settings in resource-poor countries," he said. "Early cancer detection in these countries may lead to affordable management of cancers with the aid of new screening and diagnostic technologies that can overcome global health care disparities."

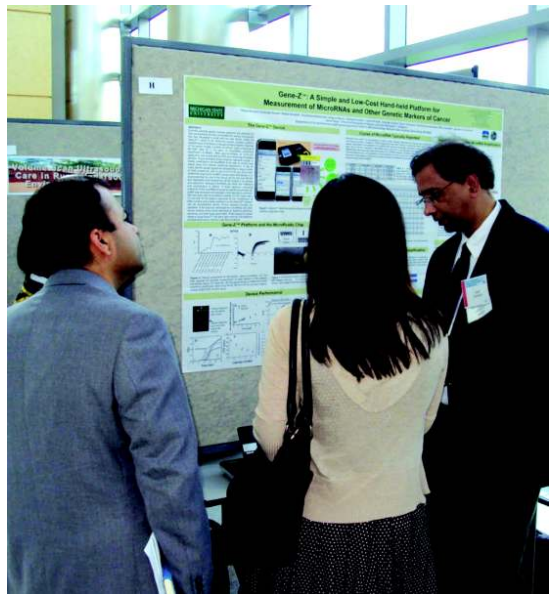
Hashsham demonstrated the potential of the Gene-Z at the National Institutes of Health's first Cancer Detection and Diagnostics Conference. The conference, held recently in Bethesda, Md., was sponsored by the Fogarty International Center and the National Cancer Institute.

"Gene-Z has the capability to screen for established markers of cancer at extremely low costs in the field," Hashsham said. "Because it is a hand-held device operated by a battery and chargeable by solar energy, it is extremely useful in limited-resource settings."

The NIH conference was attended by several U.S. research institutions, including MSU. One of the primary objectives of the meeting was to address the utility of new cancer detection technologies.

Since cancer diagnostics and rapid screening methods currently are not suitable for low-income and resource-limited countries, Nassiri said a concentrated effort should be made to develop more appropriate and cost-effective technologies such as the one developed by Hashsham for widespread global use.

Nassiri said the goal is to continue the partnership between Hashsham and MSU's Institute of International Health to promote his Gene-Z device globally and validate it in the field with clinical care partners across the world.



MSU engineering professor Syed Hashsham (right) talks with conference delegates about his diagnostic development project Gene-Z, which has the potential to offer low-cost cancer detection technology to resource-poor countries.
(Credit: Image courtesy of Michigan State University)

In addition to cancer detection, the Gene-Z device also is being developed to diagnose routine tuberculosis and drug-resistant TB, determine HIV virus levels during treatment and monitor overall antibiotic resistance.

Working with Hashsham in the development of the Gene-Z device was a team of MSU students, led by Robert Stedtfeld including Farhan Ahmad, Dieter Tourlousse and Greg Seyrig. The cancer marker approach was led by Maggie Kronlein, a civil and environmental engineering undergraduate researcher.

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Michigan State University.

(Source: Science Daily Online)

World-Record Pulsed Magnetic Field Achieved; Lab Moves Closer to 100-Tesla Mark

The scientists achieved a field of 92.5 tesla on Thursday, August 18, taking back a record that had been held by a team of German scientists and then, the following day, surpassed their achievement with a whopping 97.4 tesla field. For perspective, Earth's magnetic field is 0.0004 tesla, while a junk-yard magnet is 1 tesla and a medical MRI scan has a magnetic field of 3 tesla.

The ability to create pulses of extremely high magnetic fields non-destructively (high-power magnets routinely rip themselves to pieces due to the large forces involved) provides researchers with an unprecedented tool for studying fundamental properties of materials, from metals and superconductors to semi-conductors and insulators. The interaction of high magnetic fields with electrons within these materials provides valuable clues for scientists about the properties of materials. With the recent record-breaking achievement, the Pulsed Field Facility at LANL, a national user facility, will routinely provide scientists with magnetic pulses of 95 tesla, enticing the worldwide user community to Los Alamos for a chance to use this one-of-a-kind capability.

The record puts the Los Alamos team within reach of delivering a magnet capable of achieving 100 tesla, a goal long sought by researchers from around the world, including scientists working at competing magnet labs in Germany, China, France and Japan.

Such a powerful non-destructive magnet could have a profound impact on a wide range of scientific investigations, from how to design and control material functionality to research into the microscopic behaviour of phase transitions. This type of magnet allows researchers to carefully tune material parameters while perfectly reproducing the non-invasive magnetic field. Such high magnetic fields confine electrons to nanometer scale orbits, thereby helping to reveal the fundamental quantum nature of a material.

Thursday's experiment was met with as much excitement as trepidation by the group of condensed matter scientists, high-field magnet technicians, technologists, and pulsed magnet engineers who gathered to witness the NHMFL-PFF retake the world record. Crammed into the tight confines of the Magnet Lab's control room, they gathered lab notebooks or caffeine of choice in hand. Their conversation reflected a giddy sense of anticipation tempered with nervousness.

With Mike Gordon commanding the controls that draw power off of a massive 1.4 gigawatt generator system and directs it to the magnet, all eyes and ears were keyed to video monitors showing the massive 100 tesla Multishot Magnet and the capacitor bank located in the now eerily empty Large Magnet Hall next door. The building had been emptied as a standard safety protocol.

Scientists heard a low warping hum, followed by a spine-tingling metallic screech signaling that the magnet was spiking with a precisely distributed electric current of more than 100 megajoules of energy. As the sound dissipated and the monitors

confirmed that the magnet performed perfectly, attention turned to data acquired during the shot through two *in situ* measurements — proof positive that the magnet had achieved 92.5 tesla, thus yanking back from a team of German scientists a record that Los Alamos had previously held for five years.

Yates Coulter (left) and Mike Gordon of Los Alamos National Laboratory make final preparations before successfully achieving a world-record for the strongest magnetic field produced by a non-destructive magnet. Working at the National High Magnetic Field Laboratory's Pulsed Field Facility at Los Alamos, a team of researchers achieved a field of 97.4 tesla, which is nearly 100 times stronger than the magnetic field found in giant electromagnets used in metal scrap yards.
(Credit: Image Courtesy of DOE/Los Alamos National Laboratory)

The next day's even higher 97.4 tesla achievement was met with high-fives and congratulatory pats on the back. Later, researchers Charles Mielke, Neil Harrison, Susan Seestrom and Albert Migliori certified with their signatures the data that would be sent to the Guiness Book of World Records.

The NHMFL is sponsored primarily by the National Science Foundation, Division of Materials Research, with additional support from the State of Florida and the DOE. These recent successes were enabled by long-term support from the U.S. Department of Energy's Office of Basic Energy Sciences and the National Science Foundation's 100 Tesla Multi-Shot magnet programme

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by DOE/Los Alamos National Laboratory.

(Source: Science Daily Online)

TV Time: Why Children Watch Multi-Screens

A sedentary lifestyle, linked to spending lots of time watching TV and playing computer games, is thought to lead to obesity, lower mental well-being, and cause health problems in later life, including diabetes. It is now possible to watch TV 'on demand' via the internet, play computer games on laptops, on hand-held devices or mobile phones, to keep in contact with friends using text, Facebook, Skype, and MSN, and to do all this concurrently. However previous studies have not examined if children take part in multi-screen viewing or children's reasons for doing so.

Questioning 10–11 year olds, researchers at the University of Bristol and Loughborough University found that the children enjoyed looking at more than one screen at a time. They used a second device to fill in breaks during their entertainment, often talking or texting their friends during adverts or while they were waiting for computer

games to load. TV was also used to provide background entertainment while they were doing something else — especially if the programme chosen by their family was 'boring'.

Dr Jago from the University of Bristol explained, "Health campaigns recommend reducing the amount of time children spend watching TV. However the children in this study often had access to at least five different devices at any one time, and many of these devices were portable. This meant that children were able to move the equipment between their bedrooms and family rooms, depending on whether they wanted privacy or company. So simply removing the TV from a child's room may not be enough to address the health concerns and we need to work with families to develop strategies to limit the overall time spent multi-screen viewing wherever it occurs within the home."

(Source: Science Daily Online)

School Children can also Learn Complex Subject Matters on their Own

Calculating the surface area of Gran Canaria is not an easy task for a 14-year-old child. It's not simply a question of learning the right formula. Students have to develop a strategy that enables them to put mathematical theory into practice — working out the information that is important and applying the right geometric models and tools. Realising that the island has an almost circular shape and so its surface area can be approximated using the area of a circle is not as straightforward as it sounds. Are schoolchildren capable of developing these kinds of solutions themselves or should teachers explain the strategies before asking the pupils to tackle the problems?

To find the answer, researchers in mathematics education from TUM worked with approximately 1600 eighth grade high-school (Gymnasium) students in various German states. Following an introduction on the general topic by their teachers, the school children were given a workbook of geometric tasks that they had to solve on paper and using a computer over four school periods. Calculating the surface area of Gran Canaria was just one of the real-world, free-form assignments the students had to tackle. The workbook material included explanations and examples of various problem-solving approaches. The teachers took a back seat during the session but were on hand to answer questions from the children, who worked in pairs.

After testing the students' skills before and after the session, the TUM researchers recorded a significant improvement in their capabilities. "They learnt to apply mathematics more effectively," explains study leader Professor Kristina Reiss. The students were also able to call on these skills in a further test three months later.

The researchers also wanted to find out what degree of child direction is most effective. One group, therefore, worked on the tasks in a fixed ascending order of difficulty. The other group was free to choose from the assignments provided. This greater degree of freedom did not enhance the learning experience, however. Another discovery came as an even bigger surprise to the researchers: "We expected students who were weaker at math to benefit more from a greater

degree of guidance through the module," reports Reiss. "But we didn't see a significant difference between these and stronger students." There were also no differences between boys and girls. "We now know that students — also those who are weaker in math — have the skills to master even very complex subject matters at their own pace," continues Reiss. "Although extended phases of self-directed learning are often advocated, they are still not part of the everyday school curriculum. But they are an important option for teachers as varied lesson formats ensure a lively and interesting learning experience."

The trial was financed by Germany's Federal Ministry of Education and Research and was supported by psychologists from the Ludwig-Maximilians-Universität München (Prof. Reinhard Pekrun).

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Technische Universitaet Muenchen.

(Source: Science Daily Online)

Social Networking's Good and Bad Impacts On Kids

"While nobody can deny that Facebook has altered the landscape of social interaction, particularly among young people, we are just now starting to see solid psychological research demonstrating both the positives and the negatives," said Larry D. Rosen, Ph.D., professor of psychology at California State University, Dominguez Hills.

In a plenary talk entitled, "Poke Me: How Social Networks can Both Help and Harm Our Kids," Rosen discussed potential adverse effects, including:

- Teens who use Facebook more often show more narcissistic tendencies while young adults who have a strong Facebook presence show more signs of other psychological disorders, including antisocial behaviours, mania and aggressive tendencies.
- Daily overuse of media and technology has a negative effect on the health of all children, pre-teens and teenagers by making them more prone to anxiety, depression, and other psychological disorders, as well as by making them more susceptible to future health problems.
- Facebook can be distracting and can negatively impact learning. Studies found that middle school, high school and college students who checked Facebook at least once during a 15-minute study period achieved lower grades.

Rosen said new research has also found positive influences linked to social networking, including:

- Young adults who spend more time on Facebook are better at showing 'virtual empathy' to their online friends.
- Online social networking can help introverted adolescents learn how to socialise behind the safety of various screens, ranging from a two-inch smartphone to a 17-inch laptop.
- Social networking can provide tools for teaching in compelling ways that engage young students.

For parents, Rosen offered guidance. "If you feel that you have to use some sort of computer

programme to surreptitiously monitor your child's social networking, you are wasting your time. Your child will find a workaround in a matter of minutes," he said. "You have to start talking about appropriate technology use early and often and build trust, so that when there is a problem, whether it is being bullied or seeing a disturbing image, your child will talk to you about it."

He encouraged parents to assess their child's activities on social networking sites and discuss removing inappropriate content or connections to people who appear problematic. Parents also need to pay attention to the online trends and the latest technologies, websites and applications children are using, he said.

"Communication is the crux of parenting. You need to talk to your kids, or rather, listen to them," Rosen said. "The ratio of parent listen to parent talk should be at least five-to-one. Talk one minute and listen for five."

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by American Psychological Association, via EurekAlert!, a service of AAAS.

(Source: Science Daily Online)

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WEB WATCH

In this Section, we present websites and a brief introduction about them. Inclusion of a site does not imply that School Science endorses the content of the site. Sites have been suggested on the basis of their possible utility to school systems.

- **Cmap Tools**
  http://cmap.ihmc.us

  These tools were developed at the Institute of Human and Machine Cognition (IHMC), Florida University, USA. It is a software toolkit which can be downloaded free. It empowers users to construct, navigate, share and criticise knowledge models represented as concept maps. CmapTools are used worldwide in all domains of knowledge.

- **Imagine the Universe**
  http://imagine.gsfc.nasa.gov

  This website from NASA is intended for students of age 14 and up, and for anyone interested in learning about universe. It has links, namely Science, Special Exhibits, Satellite and Data, Teacher Corners, Dictionary and Resources. The website also provides the, 'Ask an Astrophysicist' service though which users can ask a question. It also provides pathways to astronomy education resources.

- **Microbe Passports**
  www.microbiologyonline.org.uk/students/microbe-passport

  Microbes are microscopic organisms and we can not see them. They are of different sizes and exist inside the bodies of animal and plants. They are found in soils and rocks also. Microbes include photosynthetic bacterias,HIV viruses, bifida, measles and TB. The site also provides a virtual microscope to see the images of different types of microbes.

- **ScriberBrains**
  www.scriberbrains.org

  It presents a collection of resources covering the theme of stem cells, genetic engineering, brain chemistry, vaccinations, drug trials and evolution. It is intended for pupils aged 14–16. Resources include teachers guide, classroom activities, and presentations explaining the science, the issues and the opinion concerning each theme. It also touches upon ethical issues.

- **Diagnostic /Remedial tools in Introductory Physics**
  www.physics.monash.edu.au/community/tests.html

  These tasks are designed by Professor Bill Rachinger of School of Physics, Monash University, Australia. They address to the preconceptions /misconceptions which students bring to the classrooms of introductory physics. The tasks cover the theme of light. Mechanics, and Heat and are available in both word (DOC) format and Acrobat (PDF) format ready for downloading free. The questions are set on odd-numbered pages and answers on even-numbered pages. For self-diagnostic purposes, students can work through the questions keeping the answers covered. They can check their responses against the answer.

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Corrigendum

On cover page III, School Science*, Vol. 49, No.1, March 2011 issue, the details given on Form IV (See Rule 8) may be read as:

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