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Bilateral structural reductions in both the hippocampi and the amygdalae can serve as possible biomarkers in those who possess certain risk for developing DID, pointing for preventive clinical measures to be taken

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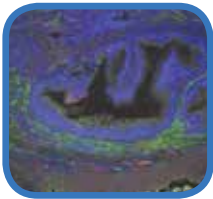
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Empowerment of Girl Child, Responsibility of All

## EDITORIAL

In the current issue of *School Science*, we have included articles from various disciplines of science and mathematics education.

The first article is ninth in the series of 'Problem-based Learning in Basic Physics'. The author has incorporated approximations with functions. The importance of these approximations and the order of magnitude calculations in various problems of physics have been discussed well.

In the article 'Constructivist Assessment Approaches in Science Pre-service Teacher Education Programme', the author exemplifies different constructive assessment approaches, like roleplay, story writing, concept map, student presentations and projects. Roleplay on global warming, water cycle story and concept map showing relationship, hierarchy and cross links has been depicted by the author.

In the next article, 'When you do not know who you are!', the authors have discussed about 'Dissociative Identity Disorder (DID), colloquially known as 'split personality disorder'. A person suffering from this ailment adopts one or more identities, which is distinct from the other in specific ways. Symptoms, causes, neuro-anatomical analysis of DID patients, diagnosis and therapy have been briefly discussed.

In the article 'g by Projectile Method', the author has derived the formula for calculating the value of 'g' through a simple method based on the principle of projectile.

In the article, 'Psychological Problems of Learners in learning Mathematics at Elementary Level: A Case Study', the author has thrown light on different case studies along with their results, which show that not only high order intelligence is responsible for learning mathematics, but there are some other factors too. The author has focussed on how the psychology of the learner proves to be a barrier in learning mathematics.

Like the other issues, this one also has Science News and Web Watch for our readers. Science News provides information on new inventions and investigations related to science. In the Web Watch section, we have included two free websites where you will get to read novels – classic and contemporary— and a website related to science.

We hope that our readers find the articles, features and news items interesting and educative. Your suggestions, observations and comments are welcome as they guide us to bring further improvement in the quality of the journal. We wish you a joyful reading.



# PROBLEM-BASED LEARNING IN BASIC PHYSICS – IX

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In this article, (ninth in the series), we present problems for a problem-based learning course based on the order of magnitude, approximations and errors.

## Introduction

In this article, ninth in the Problem-based Learning (PbL) series, we consider various examples from different areas of physics where we often make approximations. We are trying to discuss the meanings of these approximations.

## Approximations with Functions

$$\frac{1}{1+x} = 1 - x + x^2 - x^3 + x^4 \dots \approx 1 - x$$

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + x^4 \dots \approx 1 + x$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots \approx x$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots \approx 1 - \frac{x^2}{2}$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \dots \approx 1 + x$$

For all the above approximations to be valid, we must have  $x \ll 1$ .

The limit of approximation is defined by the value of the first term which is ignored with

reference to the actual value. For example, in  $e^x \approx 1 + x$ , if the term  $x^2/2$  is smaller than the accuracy we are looking for, then the term and higher order terms can be ignored.

Consider the following examples from physics to understand the importance of the above mentioned approximations and the order of magnitude calculations.

1. We say  $\sin \theta = \theta$  for small angle where  $\theta$  is in radians. Discuss up to what value of  $\theta$  is this approximation valid? Check for same value of  $\theta$ , if the approximation is valid for  $\cos \theta \approx 1 - \theta^2/2$ .

### Discussion

Let us consider

$$\theta = 30^\circ = \pi/6 \text{ radian} = 0.523598$$

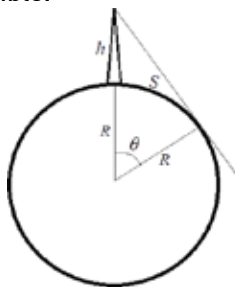
for which  $\sin \theta = 0.5$ . Thus, for at  $30^\circ$ , difference between  $\sin \theta$  and  $\theta$  is about 4%. Thus, depending on the accuracy we are looking for, we should say  $\sin \theta$  and  $\theta$  lie within that many per cent. In this case, the second term in the expansion becomes,  $\theta^3/6 = 0.024$  which now, at  $30^\circ$ ,  $\cos \theta = 0.866025$  and  $1 - \theta^2/2 = 0.862922$ . Here, the error would be about 0.35%. Next term,  $\theta^4/4 = 0.0031$ . Check similar difference for  $10^\circ$ .



2. Assuming earth to be a perfect sphere of radius 6,400 km and Mt. Everest to have a height of 8 km, find the greatest distance on earth's surface from where Mt. Everest will be visible.

**Discussion**

Consider the diagram shown in the figure below.



Here,  $h$  is the height of the mountain and  $R$  the radius of the earth. If a tangent is drawn from the peak of the mountain to the earth's surface, then  $S$  represents the maximum distance on the earth's surface from where the mountain would be visible [assuming (that a symbol) the earth's surface to be a perfect sphere].

Referring to the figure :  $R = (R + h) \cos \theta$   
 Considering  $h \ll R$  we can get  $\cos \theta = 1 - h/R$  Comparing this with approximation  $\cos \theta \approx 1 - \theta^2 / 2$ , we get  $\theta^2 = 2h/R = 16/6400 = 1/400$  i.e.  $\theta = 1/20$  radian or  $9/\pi$  degree. This gives  $S = R\theta = 6400/20 = 320\text{km}$  Note that here we used approximation  $\frac{1}{1+x} \approx 1-x$ , where  $x=h/R$  Here,  $x^2 = (1/800)^2$  and higher order terms can justifiably be neglected.

3. Calculation of g: When we calculate g near the earth surface, we take  $g = \frac{GM}{R^2}$  where  $M=6 \times 10^{24}$  kg and  $R = 6.4 \times 10^6$  m. Why do we ignore the effect of the sun and moon near the earth surface, despite the fact that the sun is huge?

**Discussion**

Let us check the contribution of each near the earth's surface.

For earth  $\frac{M}{R^2} = 1.46 \times 10^{11}$  SI units

For sun near earth  $\frac{M_{sun}}{r^2} = 8.89 \times 10^7$  SI units

For moon near earth  $\frac{M_{moon}}{r^2} = 4.97 \times 10^5$  SI units, using the data given in Example 4 below. Thus, contribution of the sun is 4 orders and that of moon is 6 orders smaller than that due to earth. Hence, for practical purposes, we ignore the effect due to the sun and the moon. However, when it comes to force on large masses as the earth and its ocean, even a tiny effect can prove to make a significant difference and due to the size of the earth can cause tides in the ocean (see Example 4 below).

4. What causes tides? We want to understand tides in the ocean based on Newton's law of gravitation. Light takes 500 seconds to travel from the sun to the earth and the diameter of the earth is 6,400 km. From this information, find out the difference in gravitational pull (acceleration) experienced by a body when it is near the sun to that when it is far. [Given:  $g = 6.67 \times 10^{11} \text{Nm}^2 / \text{kg}^2$  and mass of the sun =  $2 \times 10^{30}$  kg]

**Discussion**



$$g_{near} = \frac{GM}{(r-R)^2} = 0.005928889 \text{m/s}^2 \text{ and}$$

$$g_{far} = \frac{GM}{(r+R)^2} = 0.0059278772 \text{m/s}^2$$

Which gives  $\Delta g = 1.011 \times 10^6 \text{cm/s}^2$ .

Considering the mass of the oceans, which is a fraction of the earth, this generates a huge difference in the force causing tides.

Now, from the mass of the moon =  $7.3483 \times 10^{22}$  kg and earth-moon distance = 3,84,400 km calculate similar differential g, (say  $\Delta g$ ) at earth due to moon. Considering the relative position of the earth, sun and moon, can you estimate the magnitude that causes tidal effect on the earth on a new moon day, full moon day and first or third quarter? Here, assume that sun-earth-moon are along the same line on a new moon and full moon day (not in the same order as you can understand). What can happen if they align on the same line? Take the radius of the sun to be  $7 \times 10^8$  m

and that of a black hole to be  $R = \frac{GM}{c^2}$ ,

where  $c$  is the speed of light. Take the average height of a person to be 1.5 m. Calculate differential  $g$  between the head and the toe of an average height person on the surface of the earth, sun and black hole of one solar mass. This tidal gravity on the earth acts on the ocean which is a huge mass (that of ocean), say 100th of that of the earth. Can you calculate this tidal (differential) force on this mass on earth? Estimate this tidal (differential) force that a normal human (average mass 50 kg) would experience (difference of  $g$  between head and toe) on the surface of (i) sun (ii) 1 solar mass black hole. [Use a calculator and preserve at least 8 digits after decimal for all your calculations].

### 5. Why water vapour at 100°C burns the skin whereas at room temperature it does not?

Discussion: The average kinetic energy of a gas molecule is considered to be of the order of  $k_B T$  where  $k_B = 1.38 \times 10^{-23}$ .

$J/K$  is the Boltzmann constant and  $T$  is the absolute temperature. Accordingly, water molecule (of water vapour) at room temperature (300 K) has kinetic energy  $k_B T \approx 1/40 \text{ eV}$ , whereas at 400K,  $k_B T \approx 1/30 \text{ eV}$ . Can you explain why at 300 K water vapour is harmless, whereas at 400 K it feels hot and can even burn the skin?

[Hint: the distribution of molecules  $\Delta N$  in the energy range between  $E$  and  $E + \Delta E$  is given by Maxwell-Boltzmann distribution

$$\text{function: } \Delta N = \frac{2A}{(Ak_B T)^{3/2}} N e^{-E/k_B T} E^{1/2} \approx E.$$

For simplification, you may assume energy at  $E \approx 1 \text{ eV}$  (energy just sufficient to cause burn) in the interval  $E \approx k_B T$ . [You should get about  $10^4$  times more molecules having energy 1 eV at 400 K compared to that at 300 K].

### 6. Estimation of the size of an atom

Discussion: This means mass of one

aluminum atom is  $m_{Al} = \frac{M_A}{N_A}$ , where,

$N_A = 6.02 \times 10^{23}/\text{mole}$  is the Avogadro number. This means, the volume occupied by one atom (assuming cubic arrangement) is  $V = a^3 = \frac{m_A}{\rho} = 16.6 \times 10^{-30} \text{ m}^3$ . This gives

$a = 2.554 \times 10^{-10} \text{ m} = 2.554 \text{ \AA}$ . Here 'a' can be treated as diameter of the atom.

Actual crystal structure of aluminum is FCC that gives 4 atoms per cubic cell which modifies the calculation to get  $a = 4.05 \text{ \AA}$ . The separation of atoms in FCC gives the diameter of the atom. Thus, aluminum atom radius is estimated to be 1.43  $\text{\AA}$ . We can safely consider typical atomic radius to be of the order of 1  $\text{\AA}$ .

**7. What can exist inside the nucleus?**

Discussion: Consider an aluminum atom which has an atomic weight  $A = 27$ . The radius of a nucleus is given by  $R = R_0 A^{1/3}$ . Where  $R_0 = 1.22$  Fermi. [1 Fermi =  $10^{-15}$  m]. This gives  $R_{Al} \approx 4$  fm. Any particle — proton, neutron or electron, if inside the nucleus will have uncertainty in position of the order of 4 fm. From uncertainty principle, this gives,

$p = \Delta p \approx \frac{h}{\Delta x} = 1.66 \times 10^{-19} \text{ kg} - \text{m/s}$ . For electron, this gives speed greater than that of light. Which means electron will have energy  $E = pc = 5 \times 10^{-11} \text{ J} \approx 47 \text{ MeV}$ ,

whereas for proton and neutron

$$E = \frac{p^2}{2m} \approx 1 \text{ MeV}$$

Electrons observed in decay have much less energy, and thus cannot exist inside the nucleus as independent particles. Proton and neutron, on the other hand, can exist inside the nucleus.

**8. Discussion of Simple Harmonic Motion (SHM)**

In case of a pendulum, the differential equation is solved for small amplitude taking approximation  $\sin \theta \approx \theta$ . Thus, expression for period obtained would be approximate within those appropriated limits.

In case of spring, we estimate,

$$T = 2\pi \sqrt{\frac{m}{k}}$$

assuming spring to behave as elastic for extension and compressions produced. For a perfectly elastic spring potential energy,

$$V = \frac{1}{2} kx^2$$

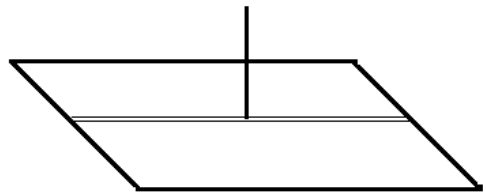
whereas in reality, spring can neither be compressed by indefinite amount nor extended. Thus,  $V$  must have higher order terms and should have expression of the

$$\text{type } V = \frac{1}{2} kx^2 + ax^3 + bx^4 + \dots$$

Here, the values of 'a' and 'b' are small compared to 'k' and thus, the corresponding terms become important only when 'x' is large. Time period is also accurate within this approximation.

**9. Infinity in Physics: Examples from Electrostatics and Magnetostatics**

Discussion: In electrostatics, we deal with infinite line of charge, infinite charge plane, and in magnetism, we deal with infinite straight wire carrying current. In real life, we do not have such infinite objects. Then, why do we derive such expressions? In each of the above mentioned case, we find an expression for field at some distance from these infinite objects. Consider an infinite plane. For any point outside this plane, we can have two elements exactly at the same distance from the foot of the perpendicular,



on the plane contributing to the field. The field contributions from these two elements have two components each. The components parallel to the plane cancel each other and the one perpendicular to the plane add up and survive. Thus, field will always be perpendicular to the plane.

What if we have a finite size plate? Even in this case, if we are sufficiently close to the plane surface (distance is very small compared to the dimensions of the plate), the result of infinite plane applies. In case of parallel plate capacitor, if the separation between plates is too small compared to the size of the plate, field lines are all perpendicular except near edges. These effects would not be negligible if plate separation is comparable to the size of the plates.

We encourage readers to construct similar line of arguments for linear charge distribution and straight wire carrying current.

## 10. Infinity in Exponential Equations

Now, consider famous equations like

- (i)  $N = N_0 e^{-\lambda t}$  from radioactive decay
- (ii)  $q = Q \left( 1 - e^{-\frac{t}{RC}} \right)$  for charging of a capacitor in an RC circuit
- (iii)  $q = Q \left( 1 - e^{-\frac{t}{RC}} \right)$  for growth of current in an LR circuit

Here  $\frac{1}{\lambda}$ ,  $RC$ , and  $\frac{L}{R}$  have dimensions of time and are called time constants. In each case, we can write time constant as  $\tau$  and exponential term can be represented as  $e^{-\frac{t}{\tau}}$ .

We say that as  $t \rightarrow \infty, e^{-\frac{t}{\tau}} \rightarrow 0$ .

What does infinite time mean here?

Consider the values

$$e^{-1} = 0.3679, \quad e^{-2} = 0.1353,$$

$$e^{-3} = 0.0498, \quad e^{-4} = 0.0183,$$

$$e^{-5} = 0.0067.$$

Thus,  $t \rightarrow 5\tau$  is good enough for infinity at 0.7% accuracy and system would stabilise for all practical purposes as the measuring instrument may not be sensitive enough to record 0.7% variation. Otherwise, we need to consider higher values of  $t$ .

Note: Even when we say

$e^x \rightarrow 1$  as  $x \rightarrow 0$ , (since  $e^x \approx 1 + x$ ), the value of  $x$  determines the limit of this approximation.

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# CONSTRUCTIVIST ASSESSMENT APPROACHES IN SCIENCE PRE-SERVICE TEACHER EDUCATION PROGRAMME

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Constructivist assessment approaches are based on the basic principles of the theory of constructivism. According to constructivism, learners construct knowledge through observation, experience, documentation, analysis and reflection (Dogra, 2010). According to the constructivist perspective, teaching or rather more precisely learning of science is not a search for the ultimate truth. It is a process which is of utmost importance in science than the content (Dogra, 2010). Assessment from constructivist perspective is a holistic process, which includes both content as well as process. Constructivist assessment is based on the collaborative activities of a teacher as well as learners. Constructivist assessment is subjective because it makes use of different qualitative strategies rather than quantitative ones. For implementing constructivist assessment approaches, the teacher needs to know the students well. This paper exemplifies how different constructivist assessment approaches can be used in science pre-service teacher education programme. The use of various constructivist assessment approaches, like roleplay, story writing, concept maps, student presentations and poster projects in school life experience comprise the pre-service teacher education programme of the Army Institute of Education, Delhi Cantonment (a B.Ed. college affiliated to the I. P. University), which find a detailed mention in this paper. Pre-service science teachers designed constructivist assessment tasks in collaboration with the author. Some of the examples of constructivist assessment approaches experienced by secondary school science students are presented in this paper. This paper exemplifies how assessment forms an integral component of learning and also an enjoyable and fun-filled activity for both pre-service science teachers as well as school students. Pre-service science teachers felt that such assessment approaches made students involved in their assessment and shifted the focus from tests to more subjective assessment tasks.

## Introduction

"We should be measuring what kids can do with knowledge, not how many right answers they can give to questions."

—Seymour Papert

What is the purpose of assessment?

Teachers transact curriculum through different methods and need assessment techniques to monitor the progress of students. Assessment also provides feedback to teachers about the effectiveness of their own teaching. In the last several years,

a lot has changed in the field of assessment. There is a major shift from 'outcome-based assessment' to 'assessment for learning'. Assessment tasks can be designed, which can assess understanding. This has also made assessment approach completely student-centred and humanistic. There is a lot of emphasis on designing assessment tasks, keeping in view the constructivist theory. Constructivist theory forms the basis for designing meaningful assessment practices. Constructivism is unique because it focuses on developing the learners' knowledge by constructing the world around them through experience, observation, documentation, analysis and reflection. In today's classrooms, learners are no longer passive recipients, nor are teachers 'the experts of knowledge', i.e., people who know everything. According to constructivist view, the learner is a sense-maker, whereas, the teacher is a cognitive guide or a facilitator who provides guidance and modelling on authentic academic tasks. The teacher's role is to create environments, in which the learner interacts meaningfully with academic material, including fostering the learner's processes of selecting, organising and integrating information.

The NCF (2005) recommends five guiding principles for curriculum construction.

They are:

- connecting knowledge to life outside school,
- ensuring that learning is shifted from rote methods,
- enriching the curriculum to provide for the overall development of children rather than remaining textbook-centric,
- making examinations more flexible and integrated into classroom life, and
- nurturing an over-riding identity informed by caring concerns within the democratic polity of the country.

These can also be the guiding principles for the evaluation process. The researcher motivated the pre-service science teachers to use different constructivist evaluation methods, like roleplay, logbooks, storytelling, concept maps, cartoons, presentations, poster projects and project work while teaching secondary school students. This paper discusses only five constructivist evaluation methods used by pre-service science teachers of the Army Institute of Education. It not only discusses different science topics assessed through these constructivist methods but development of criteria for the assessment for each method through collaborative effort between the author and pre-service science teachers. It presents collaborative assessment experiences of the pre-service science teachers as well as the author.

### **Assessment from a Constructivist Perspective**

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Assessment and evaluation in a constructivist environment should focus on the students' ability to "organise, structure and use information in context to solve problems" (Osberg, 1997). Brooks and Brooks (1993) describe what assessment in a constructivist classroom looks like.

Whenever a constructivist teacher does not get an expected answer from the students, then instead of replying in the negative, the teacher tries to understand the thinking of the students. Then, the teacher helps the students to construct new knowledge and acquire new skills by asking non-judgemental

questions to them. Generally, assessment is done to find out what the children know and what they do not. It should be treated as an important tool for improving students' understanding and teachers' understanding of students.

Constructivist learning is an active process and alternative assessment celebrates this process. In alternative assessment, the focus is on providing non-traditional means that allow students to show their understanding of a concept or process. It is also a complex and holistic approach to assessment. Alternative assessment techniques, such as criterion-referenced and performance-based assessment relate strongly to real world experiences (Rose, 1995 and Resnik, 1989). It is not easy to develop or administer performance-based or other alternative assessment procedures (Herman, Aschbacher and Winters, 1992). It requires more time and stronger bonding between the teacher and the learners.

We are discussing here the role of some non-traditional methods in science assessment of learners.

## 1. Roleplay as a Constructivist Assessment Approach

What is Roleplay?

Roleplay is an unrehearsed dramatisation, in which individuals improvise behaviours that illustrate acts expected of persons involved in defined situations. Teachers can encourage their students in roleplay activities by presenting realistic or hypothetical situations. The students can, then, list different characters and improvise dialogues and actions to fit the requirements of the situation and the character they are playing.

In successful roleplays, students understand the information provided about their role and then enact the given role in a fictional situation.

### **Roleplay in Constructivist Assessment of Learners**

Roleplay helps teachers to find out to what extent students have understood the concept taught in the class. Students can put up a roleplay in case they have understood the concept thoroughly. They cannot put up a roleplay just by rote memorisation of the concept. It requires assimilation on their part and then demonstrating their level of understanding in a realistic or hypothetical situation related to the concept. Even difficult topics can be presented through roleplay in a holistic manner. Roleplay helps the students to understand the concept in a better way because they work on their own individually as well as in a group for playing their respective roles. Creating a roleplay is not an easy task and a creative mind is needed for this purpose. The outcome of this act is fruitful and creates enthusiasm.

In Box I, a roleplay on 'Global Warming' is discussed in detail. But there are other topics in science, in which roleplay can be used for constructivist assessments, such as:

- food chains, food webs where different, human's trophic levels can be depicted.
- the process of digestion in humans, and
- the process of transportation of water in plants.

### **Criteria developed collaboratively by pre-service science teachers along with the author**

#### **Roleplay on 'Global Warming'**

- (i) Amount or level of knowledge imparted through a roleplay. This requires answering questions, like:

### Global Warming

Oxygen and Carbondioxide gases are talking to each other. They started discussing the issue of global warming. One student plays the role of Oxygen and the other plays the role of Carbondioxide and the third student plays a human being. The moderator introduces the roleplay to the audiences

Oxygen (O<sub>2</sub>): Hello CO<sub>2</sub>, how are you?

Carbondioxide (CO<sub>2</sub>): Hello O<sub>2</sub>, I am good.

O<sub>2</sub>: Yes, why you should not be good? You are increasing in quantity day-by-day.

CO<sub>2</sub>: O<sub>2</sub>, thanks to this human community for this. They burn fossil fuels, cut trees and do many other things which increase my quantity.

O<sub>2</sub>: Oh! I know that and I also know that increase in your amount leads to an increase in the earth's temperature.

CO<sub>2</sub>: Yes, this is the saddest part of the story. I am increasing, and hence, the temperature of the earth is also increasing.

O<sub>2</sub>: But how come you are responsible for that.

CO<sub>2</sub>: Look O<sub>2</sub>, my primary function is trapping outgoing sunlight/sun's radiation which gets reflected from the earth's surface.

O<sub>2</sub>: Okay, so your increased amount leads to increased trapping of outgoing sun's radiation.

CO<sub>2</sub>: And the atmosphere of the earth gets overheated leading to an increase in its temperature. This is called global warming.

O<sub>2</sub>: So, ultimately, humans are responsible for this global change. I think they should take some preventive measures.

Human being enters the room and turns towards O<sub>2</sub> and CO<sub>2</sub>.

Human being: Well, humans have signed many treaties and agreements.

O<sub>2</sub>: What kind of treaties and agreements have been signed by you?

Human being: Apart from CO<sub>2</sub>, methane, nitrogen oxides, etc., also lead to global warming.

Therefore, countries have signed agreements and treaties, wherein they promise to cut down the emission of such gases also called greenhouse gases.

CO<sub>2</sub>: Yes, human beings must reduce the emission of greenhouse gases. The increase in the earth's temperature by less than 10 will lead to the melting of ice caps and the sea level will rise.

O<sub>2</sub>: This will also lead to the sinking of coastal areas.

CO<sub>2</sub>: Yes, correct. Ecological shift will also take place.

O<sub>2</sub>: But CO<sub>2</sub> something should be done to prevent global warming.

CO<sub>2</sub>: Yes, something should be done but it is not you or me that can do anything about global warming. The human beings, who are responsible for the problem, should take preventive measures.

O<sub>2</sub>: What preventive measures?

CO<sub>2</sub>: We have human beings here; let us ask them what they would like to do on individual basis to reduce global warming.



- What is global warming?
  - What are the various reasons for global warming?
  - What measures should be taken to reduce global warming?
  - What day-to-day measures can be taken by common man for reducing global warming?
- (ii) Level of creativity used in imparting or expressing knowledge related to the topic includes—
- Characters from day-to-day life.
  - Manifestation of non-living.
- (iii) Development of script—
- Script to be of 3-5 minutes.
  - Proper organisation of the script.
- (iv) Dialogue delivery—
- Appropriate voice modulation.
  - Correct pronunciation of words.
  - Fluency in the language chosen for roleplay.
- (v) Types of props used—
- Maximum utilisation of easily available resources.
- (vi) Conclusion/culmination/end of roleplay—
- The end of the roleplay should be thought-provoking.
  - If not thought-provoking, the culmination of the roleplay should have a slogan or message.
  - Extra weightage will be given for involving audiences in the roleplay.

## 2. Story Writing/Pictorial Story as a Constructivist Assessment Approach

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Everybody loves stories. If we recall our childhood days, then we can remember the stories narrated by our grandparents. Many

a time, pre-service teachers are tempted to introduce a lesson by narrating a story. Why do pre-service teachers use stories in their teaching? This is because a good story is not only entertaining but is also capable of holding students' attention while they learn important concepts, attitudes and skills.

According to McClintock (2004), personal stories are useful for assessment because of their following attributes:

- Storytelling lends itself to participatory change processes because it relies on people to make sense of their own experiences and environments.
- Stories can be used to focus on particular interventions while also reflecting on an array of contextual factors that influence outcomes.
- Stories can be systematically gathered and the claims can be verified from independent sources or options.
- Narrative data can be analysed using existing conceptual frameworks or assessed for emergent themes.
- Narrative options can be integrated into ongoing organisational processes to aid programme planning, decision-making and strategic management.

### **Objectives of Water Cycle Story (Text-based and Pictorial)**

Students will be able to—

- define evaporation.
- define transpiration.
- list different sources of water.
- explain the process of condensation.
- explain the different states of matter.

### **Evaluation on the Basis of Story**

A rubric was developed keeping in mind the following characteristics—

- interesting

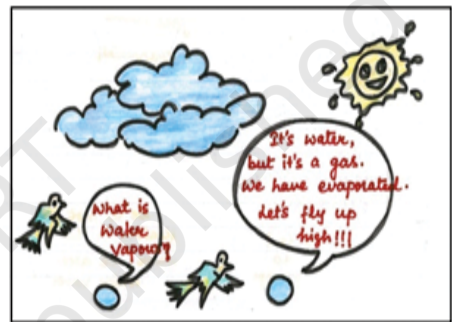
- related to the topic
- achievement of objectives
- language used in the story
- text/pictorial depiction

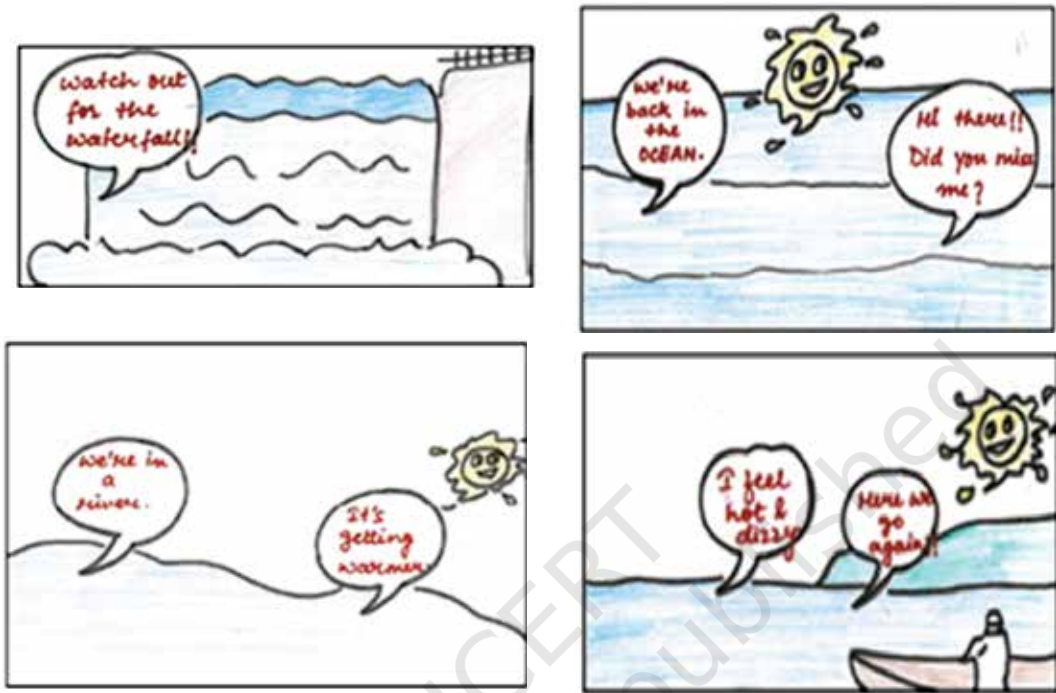
### What are Rubrics?

A rubric is a particular format for criteria—it is the written version of the criteria, with all score points described. The best rubrics are worded in a way that covers the essence

of what all teachers look for when they are judging quality and they reflect the best thinking in the field as to what constitutes good performance. Rubrics are frequently accompanied by examples (anchors) of products or performances to illustrate the various score points on the scale (Arter and McTighe, 2007).

### Pictorial representation of the Water Cycle





### Story of Water Cycle

Let us find out what will happen to the two water drops. The water cycle story starts as the sun looks down on the two water drops. The sun is full of energy and in its presence, these water drops start feeling hot, light and airy. The sun's heat provides energy to water to evaporate from the Earth's surface (oceans, lakes, etc.). The two drops of water feel strange because they feel as if they are floating in the air. They realise that they have now become vapours. Why? Because evaporation occurs when heat is placed on water. It becomes warm enough to change into gas. But what is water vapour? Water vapour is nothing but water in its gaseous state and we get water vapours through the processes of evaporation and transpiration. Now, these two drops of water in the gaseous state start rising higher. At a height, they get cooled and then condense. Now, what is condensation? Condensation is the cooling of vapours until they acquire a liquid state. As the dew point is reached, water vapours form tiny visible water droplets. Then these droplets form the clouds. droplets are now happy that they are a part of the beautiful cloud. Further cooling takes place and the droplets are now part of the snowfall. The droplets turn into snow and talk to each other. One says I have turned into snow and hate to be part of this water cycle. The other replies that now we are stuck on a glacier i.e., a river of ice. Gradually, they both become part of the river and finally end in the sea. Oceans are the largest source of water. So, water cycle is a continuous process. The water cycle which we discussed today, is the same that was present when dinosaurs roamed on the earth.

### 3. Concept Maps for Constructivist Assessment

“Concept maps are intended to represent meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels linked by words in a semantic unit. In its simplest form, a concept map would be just two concepts connected by a linking word to form a proposition. For example, ‘sky is blue’ would represent a simple concept map forming a valid proposition about the concepts ‘sky’ and ‘blue’ ”.

—Joseph Novak and Bob Gowin from  
Learning *How to Learn*

According to Novak (1984), concept maps work to make clear to both students and teachers the small number of key ideas they must focus on for any specific learning task. A map can also provide a kind of visual roadmap, showing some of the pathways we may take to connect meanings of concepts in propositions. After a learning task has been completed, concept maps provide a schematic summary of what has been learned.

There are many criteria for the assessment of concept maps. Concept maps can be assessed through rubrics. Bartel’s scoring rubric as well as scoring criteria for concept maps (Novak and Gowin, 1984) find a detailed mention in this paper.

#### **Bartel’s Scoring Rubric for Concept Maps**

##### **Concepts and Terminology**

- 3 points** show an understanding of the topic’s concepts and principles and use appropriate terminology and notations.
- 2 points** make some mistakes in terminology or show a few misunderstandings of concepts.
- 1 point** makes many mistakes in terminology and shows a lack of understanding of many concepts.
- 0 point** shows no understanding of the topic’s concepts and principles.

##### **Knowledge of Relationships among Concepts**

- 3 points** identify all important concepts and show an understanding of the relationships among them.
- 2 points** identify important concepts but make some incorrect connections.
- 1 point** makes many incorrect connections.
- 0 point** fails to use any appropriate concept or connections.

##### **Ability to Communicate through Concept Maps**

- 3 points** construct an appropriate and complete concept map and include examples, place concepts in an appropriate hierarchy and place linking words on all connections; produce a concept map that is easy to interpret.
- 2 points** place almost all concepts in an appropriate hierarchy and assign linking words to most connections; produce a concept map that is easy to interpret.
- 1 point** places only a few concepts in an appropriate hierarchy or uses only a few linking words; produces a concept map that is difficult to interpret.
- 0 point** produces the final product that is not a concept map.

Concept maps of children can be scored easily. According to Novak and Gowin, the primary basis of scoring scheme is Ausubel's cognitive learning theory, especially three ideas in it:

(1) Cognitive structure is hierarchically organised, with more inclusive, more general concepts and propositions subordinate to less inclusive, more specific concepts and propositions, (2) Concepts in cognitive structure undergo progressive differentiation, wherein greater inclusiveness and greater specificity of regularities in objects or events are concerned and more propositional linkages with other related concepts are recognised, and (3) Integrative reconciliation occurs when two or more concepts are recognised as relatable in new propositional meanings and/or when conflicting meanings of concepts are resolved.

## Scoring Criteria for Concept Maps (Novak and Gowin, 1984)

### 1. Propositions

Is the meaningful relationship between two concepts indicated by the connecting line and linking word(s)? Is the relationship valid? For each meaningful, valid proposition shown, score 1 point.

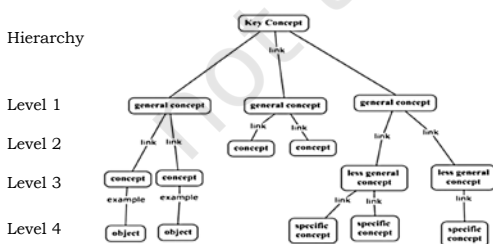


Fig. 1: A typical concept map showing relationships, hierarchy and cross links

Hierarchy

Level 1

Level 2

Level 3

Level 4

Level 5



Fig. 2: A concept map for water showing some related concepts and propositions

### 2. Hierarchy

Does the map show hierarchy? Is each subordinate concept more specific and less general than the concept drawn above it (in the context of material being mapped)? Score 5 points for each valid level of the hierarchy.

### 3. Cross links

Does the map show meaningful connections between one segment of concept hierarchy and another segment? Is the relationship shown significant and valid? Score 10 points for each cross link that is both valid and significant and 2 points for each cross link that is valid but does not illustrate a synthesis between sets of related concepts or propositions. Cross links can indicate creative ability and special care should be given to identifying and rewarding its expression. Unique or creative cross links might receive special recognition, or extra points.

### 4. Examples

Specific events or objects that are valid instances of those designated by the concept label can get a score of 1 point each. (These are not circled because they are not concepts).

5. In addition, a criterion concept may be constructed and scored for the material to be mapped, and the student score can be divided by the criterion map score to give a percentage for comparison.

### Scoring Model

Scoring for the model is given below:

Relationships (if valid)	= 12
Hierarchy (if valid)	= 20
Cross links (if valid and significant)	= nil
Examples (if valid)	= 04
Total Points	<u>36</u>

Let us take an example of a concept map of water for understanding the assessment of concept maps.

Relationships (if valid)	= 12
Hierarchy (if valid)	= 25
Cross links (if valid and significant)	= 10
Examples (if valid)	= nil
Total Points	<u>47</u>

### 4. Student Presentations (individual/group)

Student presentations are frequently assessed and may be awarded a percentage of the marks. At times, we have witnessed that under the pressure of assessment, students become nervous and are not able to present well. Therefore, if a teacher decides and conveys to students that some presentations are not to be assessed, then such opportunities can enhance their presentation skills. But what will be the drawback of introducing assessed

presentations along with non-assessed presentations? This will motivate students to invest all their time and effort on assessed presentations with little or no effort on non-assessed presentations. As teachers realise that the entire thrust of students is on marks/grade earned rather than learning from the entire experience, they shift back to only assessment-based presentations.

The use of assessment can have a positive advantage. For some students, presentations offer opportunities to score higher marks than they might achieve for a written test. Such students may exhibit better communication and presentation skills along with the use of technology than presenting it through the written mode. Such students may need suggestions for content rather than upgrading their presentation skills. Students presented individually/collectively on several topics of science. They made use of posters, bulletin boards, charts, hand outs, newspaper cuttings and power-point presentations. Some of the topics selected by the students were: a typical cell, respiration, living world, habitat, blood circulation, etc.

#### Criteria for Assessment

- Comfort level
- Attending presentations of other students. Give feedback, citing if it was—
  - ✓ a good learning experience.
  - ✓ interesting.
- Content coverage
  - ✓ Cover all objectives related to content
  - ✓ Interesting introduction
  - ✓ Use of good and relevant examples
  - ✓ Making it simple and understandable
  - ✓ Relating it to current or day-to-day events

- Aids used (newspaper cuttings, posters, bulletin boards, charts)
  - ✓ Making understanding better
  - ✓ Making it more colourful
  - ✓ If done collectively, then each member of the group was involved
  - ✓ Relevant
- Power-point presentation
  - ✓ Good presentation
  - ✓ Lucid explanation
  - ✓ Clear communication
  - ✓ Individual/group work
  - ✓ Use of examples

## 5. Poster Project

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A poster presentation is “an experiential learning activity that stimulates curiosity and interest, and encourages exploration and integration of concepts and provides students with a novel way of demonstrating understanding” (Handron, 1994, in Bracher; Cantrell and Wilkie, 1998). Students can present posters individually or collectively for the purpose of assessment in science teaching-learning process.

Pre-service science teachers assessed students knowledge after finishing a lesson or unit by giving them a task of poster making. With some basic art supplies and poster boards or papers, students were given an opportunity to create a visual display detailing some aspects of the lesson. At times, pre-service teachers imposed limitations to the poster, such as listing at least five facts learned. Poster presentation not only provides a great opportunity to assess students' knowledge, but it also provides a great display to students outside

the classroom. The assessment of the posters was done mainly on the basis of three main criteria:

- **Process**

It included planning (individual/group effort), dividing the time for each task of the project, collaborating with the team members (if group work), division of work, team leadership and group work.

- **Final Product**

- ✓ Visual impact/communication of the poster.
- ✓ Content knowledge displayed.

- **Verbal Communication**

It is the verbal explanation of poster by the individual/group members.

## Conclusion

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The use of five constructivist approaches— roleplay, story writing, concept maps, student presentations and poster projects in secondary school science teaching-learning process by pre-service science teachers is an effort to deviate from the traditional method of testing students in classrooms. These pre-service science teachers, having experienced paper and pencil test during their school days, were not satisfied with the most common assessment method used at the end of each instructional unit. Therefore, they experimented with alternative ways for assessing the students. As Price and Hein point out, current views of how students learn and how they express their thinking have opened the way to new methods of assessment. In these constructivist

assessment approaches, pre-service science teachers could assess reasoning of their students; provide opportunities to students to engage in the ongoing assessment of their learning along with their peers. These approaches diluted the boundaries between classroom life and examination, which is supported by constructivism. But pre-service science teachers also faced many challenges in terms of choosing a particular assessment approach, keeping in mind the nature of the topic and the level of

students. All constructivist assessment methods cannot be used for all types of science topics. Teachers need to plan and select different constructivist assessment methods based on their experiences and understanding of students. Therefore, initially, tests can be combined with these new assessment approaches and topics can be selected accordingly. Gradually, the system of constructivist assessment methods can be further improved through experience and feedback received from students.

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# WHEN YOU DO NOT KNOW WHO YOU ARE !

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### Introduction

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The entire class fell silent as the teacher, Mrs Baldwin, marched across the room. Mrs Baldwin wearily shouted, “Kim Noble, Stand up! I said you stand up!”. She shouted grabbing the arm of five-year-old Kim Noble. Mrs Baldwin questioned, “What did you



Fig. 1: Existence of more than one personality within an individual

do that for?”. The dress she was wearing was covered in splurges of black paint. Sitting in her drawing room, Kim Noble, now 51, recalls, “Of course, the teacher was

exasperated when I denied doing it because she had seen me smear it over myself.” But till date, Kim Noble, who now has a daughter, refuses to accept that she had blurred her dress with black paint. But as far as I was concerned, it was somebody else who did it, she says. What Kim could not have known then was that she was suffering from a rare condition called ‘Dissociative Identity Disorder’ (DID)— colloquially known as ‘split personality disorder’— and that over the next four decades her mind would regularly switch from one character to another without warning.

Deborah Bray Haddock in her book *The Dissociative Identity Disorder Sourcebook*, says, “Dissociative Identity Disorder, in short DID, is about survival! As more people begin to appreciate this concept, individuals with DID will start to feel less as though they have to hide in shame. DID develops as a response to extreme trauma that occurs at an early age and usually over an extended period of time.”

### Dissociative Identity Disorder — The Concept

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A person suffering from this ailment adopts one or more distinct identities,

which co-exist within him/her. Each personality is distinct from the other in specific ways. For instance, voice, posture, vocabulary and comprehensive mannerisms — almost everything will be distinct and all these virtues shall mark a separate personality.

There are cases, in which a person may possess as many as 100 or more identities, while some people may exhibit symptoms just of one or two. The psychiatric explicitness of this disease makes it unique to diagnose and study. Doctors consider that persons suffering from DID usually have one main personality that is referred to as the 'host'. This is generally not the person's original personality, but is rather developed along the way. It is usually this personality that seeks psychiatric assistance. Psychiatrists address the other personalities as 'alters' and the phase of transition between alters as the 'switch'. The frequency of alters in

that a completely different soul resides in a body. One study conducted in 1986 found that in 37 per cent of the total patients, alters demonstrated different handedness compared to the hosts. Eminent psychiatrists described DID as a severe condition, in which two or more distinct identities are present in an individual and alternatively take care of the body. It is a disorder characterised by identity fragmentation, where the patient also experiences extensive memory loss. DID reflects failure to integrate single self of blood and muscles with the same identity, memory and consciousness. Usually, the primary identity carries an individual's prescribed name and is passive, depressed, guilty and dependent. On the contrary, the alters are experienced as if the person has a distinct history, self-image and identity. Certain stressed circumstances can cause a particular alter to emerge, and substantially, the other identities may deny the knowledge of it. The various identities can be critical of each other or appear to be in open conflict.



**Fig. 2: Three different moods persisting at a time**

any given case varies across gender. For example, men can have female alters and women can have male alters. The most baffling aspect of this psychological disorder is the physical changes that occur in a switch between alter. A patient assumes a total new posture, voice, attitude and it seems

## **Etymology and Epidemiology of DID**

DID was called Multiple Personality Disorder until 1994, when the name was changed to reflect a concrete understanding of the condition. Since DID is characterised by a splitting of identity rather than by a proliferation of separate identities as considered earlier, the change of name was aptly justified. Some believe that because DID patients are easily hypnotised, their symptoms arise in response to the therapist's suggestions, but actually it is not the case. The high degree of epidemiology of this disorder makes diagnosis difficult. As a consequence, patients with DID are

commonly misdiagnosed with schizophrenia (severe psychiatric ailment) due to common symptoms, like obsessive compulsive disorder, major depression and so on. DID seems to favour mostly females according to several US studies. Cultural and social backgrounds seem to have a strong influence on the disorder and interpretation of the same.

### **What do the statistics say?**

Statistically, sufferers of DID have an average of 15 identities. As stated earlier, women are the favourable victims of this disorder as compared to men with a ratio as high as 9:1. The usual age of its onset is early childhood, generally by four or five years. If untreated, the disorder may last a lifetime, accumulating new identities. There are no reliable statistical figures as to the prevalence of this disorder, although the last few years have experienced a higher frequency. In nearly every case of DID, horrific instances of physical and sexual child abuse were present. It is assumed that juveniles and young children, who faced a routine of torture and neglect, create a hypothetical world of fantasy to escape this brutality. As a sufferer confronts forced sex in adolescence, an identity may emerge that deals with this aspect of life. People with DID tend to suffer from substance abuse, borderline personality disorder, depression, eating disorder, and in this way, DID seems to show its resemblance with post-traumatic stress disorder.

### **Symptoms**

The affected individual experiences two or more distinct identities each with its own enduring pattern of perceiving, relating and judging about the environment and self. The



**Fig. 3: Symptoms of Dissociative Identity Disorder**

identities recurrently take control of the person's behaviour, exhibiting its own distinct history, self-image, behaviours, physical characteristics and even a separate name. The circumstances determine the identities, and in this way, alternate identities are experienced taking control in sequence, one at the expense of the other and may deny the knowledge of each other. Transitions from one identity to another are often triggered by psychosocial stress. Frequent gaps or lapse of memory are found in personal history, including known people, places and events being washed away from the brain. Different alters may remember different events with passive identities and limited memories and hostile identities with complete memories. The symptoms of depression, anxiety, forgetfulness, dependence are quite evident. In childhood, problem in behaviour and inability to focus on academics are common symptoms. Self-destructive and aggressive behaviour takes place in addition to visual or auditory hallucinations. Patients with DID do not know that their other parts exist because of florid amnesia (pervasive loss of memory). They experience blackouts when another part has taken control of their action and consciousness.

## Causes

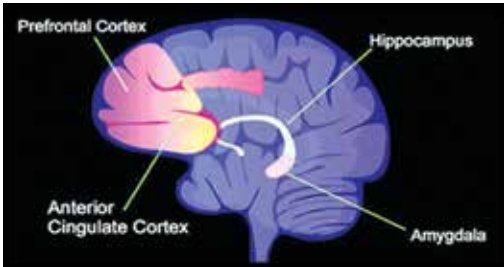
The reason behind people developing DID is not entirely understood. Frequent reports suggest that patients with DID have more or less experienced severe physical and sexual abuse, especially during the early childhood. Though the accuracy of such accounts is periodically challenged, they are often confirmed by objective evidence. Individuals with DID may also have post-traumatic stress disorder with symptoms, like nightmares, startled responses, etc. Several researches suggest that DID is more common among close biological relatives of persons, who also have the disorder than in the general population. Brain-imaging studies reveal identity transitions as the prime cause of DID. Causes of identity disorder are highly debated and fall under two models. The first is the post-traumatic model, which predicts that there is a correlation between the frequency of DID and childhood trauma and that the incidence of dissociation is a means of dealing with and reviving the trauma experienced. The other is the socio-cognitive model, in which a number of factors, including social cues, cultural aids and the therapist's influence attribute to the occurrence of DID but does not include the possibility of conscious *malingering*. The continual revision of these two models is important as far as the causes of this disorder are concerned. Several physicians argue that DID is actually a survival mechanism. The dissociation protects someone in the moment not only from emotional pain but also the physical pain, acting as endogenous opioids for the brain under high stress. Perhaps a girl child is often abused at night by her father. There she may begin to dissociate herself as soon

as she hears the crack of a beer can. It is a type of emotional and physiological response which develops and emerges as a conditioned state. Each time she hears the sound, the child gets triggered and gradually shifts states, so that one state may be aware of the pain and trauma, while in another state, only has a dim recollection of what happened. An extensive research on a rape victim probed out this result when she often described her state as "being out under the lilac tree" as she was being raped there. Rather it was recorded that she disconnected from what was really happening so that she could better endure it. Therefore, scientists and clinicians agree with the concept that trauma is an antecedent that has a causal role in DID. It is painful for an individual to deal with a numb pain, so they begin to dissociate while the experience is happening.

## Neuro-anatomical Analysis of DID Patients

### (A) Structural Neuro-anatomical Differences

Patients diagnosed with DID exhibit a bilateral reduction in hippocampal and amygdalar volumes in the brain. This reduction in the hippocampal volumes can possibly be explained by the fact that many patients suffering from DID have experienced trauma in their early developmental years of life. The stressful events that occur, while the brain is still undergoing major developmental changes, impair the viability of proliferating hippocampal cells due to excitotoxic levels of CRH (a hormone stimulated during stress). The CRH (Corticotrophin Releasing Hormone) is attenuated at the hippocampus by recurrent episodes of abuse, thus, resulting in a decreased hippocampus. This fact also



**Fig. 4: Brain showing hippocampus and amygdala**

puts light on the short memory of patients attributing to the function of hippocampus, an organ which plays a vital role in the formation of long-term memories. The memory loss or memory impairment exhibited by DID patients, thus, explains why they have issues remembering events that take place during the transition of identities.

A similar result was found in order to explain the reduced volume of the amygdalae in response to fear and anxiety. The amygdala (L, corpus amygdaloideum) is an almond-shaped set of neurons located in the brain's medial temporal lobe of higher vertebrates. The amygdala sends projections to the hypothalamus, the dorso-medial thalamus, the nuclei of trigeminal and facial nerve performing notable functions in emotional response. The shrinking of the amygdala implies further degradation of a patient's ability to form long-term memories as well as to regulate emotional relevance. The reduction in the amygdalae relates to the fact that patients with DID have often had some form of traumatic experience (inciting fear, anxiety and stress).

Thus, the bilateral structural reductions in both the hippocampi and the amygdalae can serve as possible biomarkers in those who possess certain risk for developing DID,

pointing for preventive clinical measures to be taken.

### **(B) Functional Neuro-anatomical Differences**

Studies on the functional side of the neuroanatomy show promising results for the discovery of the possible biological mechanism of DID. Using SPECT (Single-photon emission computed tomography) imaging techniques, it has been identified that there is a marked decrease in regional cerebral blood flow at the orbital region of the brain. The orbito-frontal region of brain is implicated in many higher order cognitive tasks, such as regulation of emotions, inhibitory control of information, decision-making, and so on. The study also found that blood flow was increased in the medial and frontal lobes as well as the temporal lobes in patients with DID relative to healthy controls. It supports Forrest's orbito-frontal hypothesis for Dissociative Identity Disorder which states that the orbito-frontal region of the brain is the origin from where the distinct mental states of the disorder emanate themselves. This rationale behind this hypothesis leads back to early childhood trauma as the prime cause of DID, due to the fact that the maturation of orbito-frontal region is experience dependent. It creates a huge impact on those brought up in an abusive surrounding. Detached methods of parenting, sexual torments and physical abuse create distinct mental states at the orbito-frontal region, forming a part of the brain's lateral inhibition. The basic idea is that due to vastly different ways in which the patient has been brought up will lead to two completely bifurcated identities that have been created by lateral inhibition. The lack of organisation

of temporal information is the alternative interpretation for the presence of distinct mental states.

### **(C) General Neuroanatomical Characteristics of DID Patients**

In patients with DID, the regional cerebral blood flow in the posterior associative cortices and the medial prefrontal cortex poses an exigent role when changing from one identity to another. This makes sense as the medial pre-frontal cortex is robustly related to holding one's conscious feel of self in the mind. The function of the posterior associative cortices is crucial as they supply conscious information to medial pre-frontal cortex for manifestation and expression of the same. The change in the regional cerebral blood flow during transition of alters stimulates two identities to procure in individuals, one is the neutral identity state (general state the patient is experiencing) and the second is the traumatic identity state (associated with traumatic memories and protection). In provocation studies (where patients read scripts that provoke the switching of identities), it has been noted that the regional cerebral blood flows distinctly in various areas of the brain while changing from neutral identity state to traumatic identity state. When in the traumatic identity state, the PET (Positron Emission Tomography) scan illustrates that there is an increased regional cerebral blood flow in the amygdalae which is involved in the processing of fear as well as the basal ganglia which deals with processing of anxiety.

There is little overlap between the areas that are activated in the neutral identity state and areas activated in the traumatic identity state. More efficient clinical interventions

with concrete evidence of neural circuits are paving their way to know the mystery behind this disorder.

### **Diagnosis and Therapy**

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There are four criteria for diagnosing someone with Dissociative Identity Disorder. The first being the presence of two or more distinct identities, the second being the regular control of different identities, third the exhibition of amnesia by patients (i.e., forgetting personal information) and finally, the condition must not have been caused by direct physiological effects, such as drug abuse or head trauma. On an average, the time that elapses from the presence of the first symptom to diagnosis is six to seven years. Diagnosis has become controversial as the symptoms are rarely recorded by patients or their relatives. Training in the assessment of DID is important to process structured clinical interviews to distinguish between fake and true disorders. Clinicians need to be diligent enough to interpret the patient's responses in a way which is indispensable to judge the disorder. Diagnosis through fantasy model (the model which says that the trauma is fantasised) should be governed to avoid the wrong notion that overzealous therapists reinforce the patients to believe that they have DID, even though they are unaffected. Even if fantasy model is found accurate for the patients, self report measures should be used, taking help from objective measures of trauma (e.g., police and school reports).

The therapy of this unfathomable psychological disorder is tedious to depict in the form of a doctor's prescription. The primary treatment of this disease is

long-term psychotherapy with the goal of reconstructing the different personalities and uniting them. Cognitive and creative therapies are also taken into consideration. Although there are no specific medications to treat this disorder, anti-depressants, anti-anxiety drugs or tranquilizers may be prescribed to assist patients to have control over their mental health. Sometimes, dissociation of identities is highest right after trauma. In these cases, patients should be immediately hospitalised to recover from the severe trauma to avoid interference with the memory. However, it is also seen that those patients show decreased level of dissociation when persistent mental therapy is bestowed upon them.

This disease is formidable and a debilitating illness for both the patient and others in his/her life. The relatives should try to empathise and listen to the patient. The patient may feel like "left in a dark place" or may report that he/she hears voices calling him/her. The relatives should not accuse him/her of "faking" or "lying" when the alter identities take control of the patient. These are some common complaints from the patient's side. Sometimes, alters express ideas or beliefs that may be completely contradictory to what the person thinks when in dominant personality. The relatives should pay his/her respect to every thought. It should be carefully seen that the information of a person being affected by DID is kept private as this is hurtful for the person when trivialised. Since people with DID have often been through some severe incidents, they may have trouble trusting others and can get scared. The relatives should never argue, rather pacify the patient. Eye Movement Desensitisation and Reprocessing (EMDR), a

method that integrates traumatic memories with the patient's own resources, is widely used in the treatment of people with DID. Hypnosis is sometimes used to assert the personality states in the hope of gaining better control. Medications are meant to manage emotional symptoms that occur in addition to DID but caution is exercised in order to avoid re-traumatisation. People with DID can neither maintain a job nor a family. While there is no definite 'cure', long-term treatment, like talk therapy or hypnotherapy or adjunctive therapies, such as art or movement therapy are helpful if the patient stays committed.

## Conclusion

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Shirley A. Mason (1923–1998) was an American commercial artist who was known to have Dissociative Identity Disorder. Her life was fictionalised in 1973 in the book *Sybil* which was further adapted into films (in 1976 and 2007). Both the book and the films used the name 'Sybil Isabel Dorsetto' to protect Mason's identity. Indian cinema witnessed a Bollywood movie *Bhool Bhulaiya* (2007) and a Tollywood movie *Aparichit* that showed this disorder. Once rarely reported, this disorder has become common nowadays, due to increased physical lust, mental torment, parental anguish, psychological ordeal and social upheaval. Many people mistakenly think and classify trauma patients as a group of liars. A considerable research is paving their way to support patients with DID. The tragedy of being betrayed and sadistically abused makes these people almost equal to 'hell'. Thus, it is the responsibility of every individual close to these patients to emotionally guide them so that they can get out of this situation.



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# 'G' BY PROJECTILE METHOD

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### Introduction

This method is based on the principle of a projectile. Water is projected from a glass tube of narrow internal diameter. This tube is fitted in a vertical plane making an angle 'a' to the horizon. It is connected to a constant level water tank by means of a rubber tube. Water is sent at constant pressure in this tube, so that it comes at constant velocity. After leaving the glass tube, the stream of water forms a parabolic path due to gravity. Its range is measured by a meter scale and initial velocity is calculated with the relation given after this formula.

We know that:

$$R = \frac{u^2 \sin^2 \alpha}{g} \dots\dots\dots(1)$$

Here, R= Range on the horizontal plane.

u= Initial velocity of water just leaving tube)

a= Angle of projection (slope of glass tube with the horizon)

g = Acceleration due to gravity equations

$$\frac{u^2 \sin^2 \alpha}{2H} \dots\dots\dots (2)$$

The value of 'g' can also be calculated by measuring the maximum height 'H' on the horizontal plane instead of measuring the range because we know that:

$$R = \frac{u^2 \sin^2 \alpha}{2g}$$
$$\therefore g = \frac{u^2 \sin^2 \alpha}{2H} \dots\dots\dots(2a)$$

Now, suppose 'r' be the radius of the glass tube and 'Q' the volume of water collected per second

$$\pi r^2 \times u = Q$$
$$u = Q / \pi r^2$$

From this relation, the initial velocity of water can be calculated. Substituting the value of 'u' in equation (2),

$$g = \frac{(Q^2) \sin^2 \alpha}{(\pi r^2)^2 \times R} \dots\dots\dots(3)$$

First of all, the value of 'g' was measured by this method. It was 979.7 cm/sec<sup>2</sup>.

A glass tube of internal diameter 0.325 cm was taken. The smaller arm is about 2 cm. The bigger arm is connected to a constant level water tank. The smaller arm is fitted at an angle 45° to the horizon. This tube can be named projecting tube. A meter scale is fitted horizontally in the level of projecting tube. Now, water was sent to this tube at different velocities by adjusting the constant level of the water tank at a different height.

The corresponding values of 'Q' is determined by graduated cylinder and stop-watch. but

here, 'r' is constant for a tube, 'g' is also constant

Therefore,  $R = K Q^2$

Now,  $Q^2$  plotted against R,

The graph was a straight line passing through origin which is shown in figures 3 and 4. But in this apparatus  $2a = 90^\circ$

$$Q^2 = 90, R = 13.33\text{cms}, \sin^2 \alpha = \sin 90^\circ = 1$$

$$\pi = 22/7, \text{ and } r = 0.1625$$

$$R = \frac{Q^2}{\pi r^2} \cdot 1/g \therefore g = \frac{Q^2}{\pi r^2} \times 1/R$$

$$g = \frac{90}{(22/7)^2 \times (.1625)^4 \times 13.33}$$

$$g = 979.7\text{cms/ Sec}^2$$

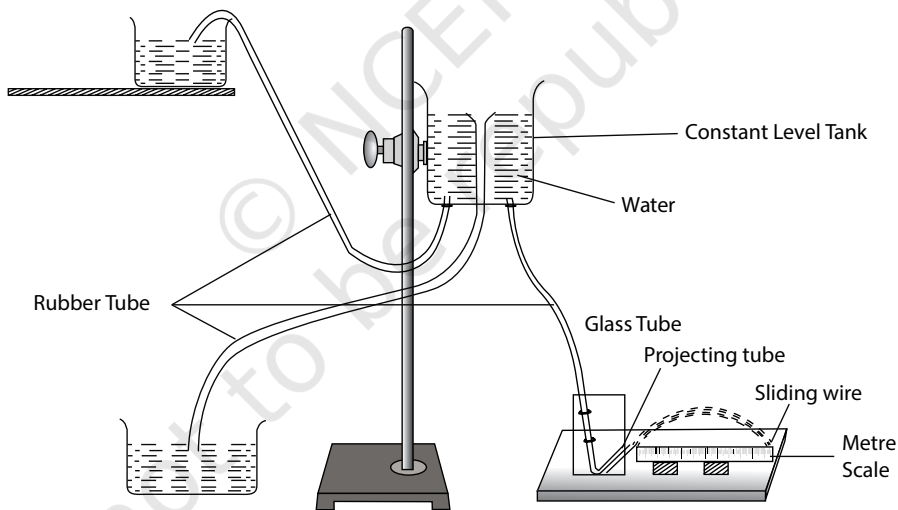


Fig. 1: 'g' by Projectile Method

**Observation by discharging Nacl solution**

Similarly, observations were taken by discharging the solution of Nacl through the glass tube at a constant angle of 45°. The heights of constant level water is same as in case of water. In this case, the corresponding values of Q and R are decreased due to increase in viscosity. The Q vs R graph is given in fig. 2.

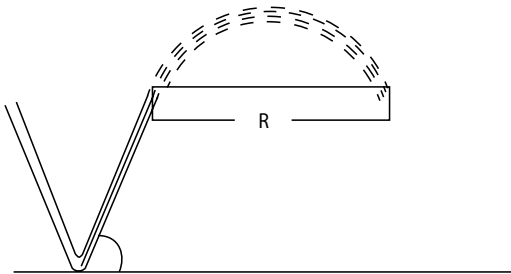


Fig. 2

S. No.	Range R Cms	Time taken Seconds	Volume collected C.	QC Cs/ Sec.
1.	7.3	40	278	6.950
2.	11.6	40	355	8.875
3.	15.5	40	410	10.250
4.	18.4	40	455	11.125
5.	21.4	40	480	12.00
S. No.	R. Cms.	O <sup>2</sup>		
1.	7.1	48.3		
2.	11.6	78.7		
3.	15.5	105.0		
4.	18.4	124.7		
5.z	21.4	144.0		

For point 'B' in the graph :  
 $Q^2=90$ ,  $R=13.33$  Cms,  $r=1625$  Cms,

Observations by discharging water				
S. No.	Range R Cm	Time taken (Seconds)	Volume collected C.	QC Cs/ Sec.
1.	7.3	40	280	7
2.	11.5	40	357	8.925
3.	16.1	40	417	10.425
4.	19.3	40	457	11.425
5.	22	40	485	12.125
S. No.	R. Cms.	O <sup>2</sup>		
1.	7.3	49.0		
2.	11.5	79.6		
3.	16.1	108.6		
4.	19.3	130.5		
5.	22.0	147.0		

The value of 'g' can be calculated from the following relation with the help of graph in figure 3.

1. There should be no insoluble impurities in the water or solution used. In the presence of these impurities the rate of discharging will not be constant.
2. The diameter of the glass tube should be measured accurately by a micrometer microscope as we need only the internal diameter of the top of the glass tube.
3. The range should be measured horizontally in the level of projecting tube. It will be equal to the horizontal distance from the mid-point of the top of the glass tube to the mid-point of falling stream of water as shown in fig. 2.
4. The volume collected in the graduated cylinder should be correct, because the square of the volume collected per second occurs in the relation 3.
5. The range is the maximum at 45°. Hence, it is better to make an observation at this

angle, both for simplicity of calculation and accuracy.

6. Water is better than other highly viscous substances.
7. The velocity of water should not be very high. The initial velocity of water will be the average velocity of all layers. The velocity of water should be so adjusted that the stream of water could not break up into droplets. If the initial velocity of water is high, the stream of water breaks into many parts. In this case, it will be difficult to adjust the sliding wire in the middle. The velocity of internal layers will be the maximum and outer layers will be the minimum. Therefore, the range will also differ for different layers. For low velocities stream will be cylindrical and we can easily adjust the sliding wire in the middle of the streams. It is good for accuracy to take this tube of least internal diameter (2 or 3 millimetre.) The value of 'g' is free from all factors, such as radius of the tube and the liquid used.

8. Resistance of air can be neglected. If it is not neglected, the supposed range would be greater by 'x'. The factor 'x' had there been no air can be eliminated by taking two observations at different heights.

For first (1)  $g = \frac{u_1^2 \sin^2 \alpha}{R_1 + x}$  (or)  $g R_1 + gx$

$= u_1^2 \sin^2 \alpha$

(2)  $g = \frac{u_2^2 \sin^2 \alpha}{R_2 + x}$  or  $g R_2 + gx$

$= u_2^2 \sin^2 \alpha$

$\therefore g = \frac{(u_2^2 - u_1^2) \sin^2 \alpha}{(R_2 - R_1)}$

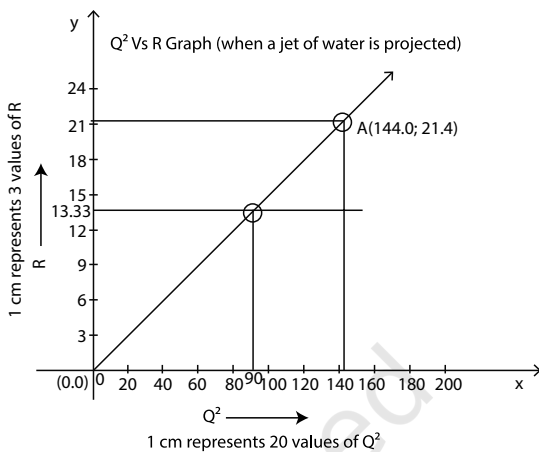


Fig. 3

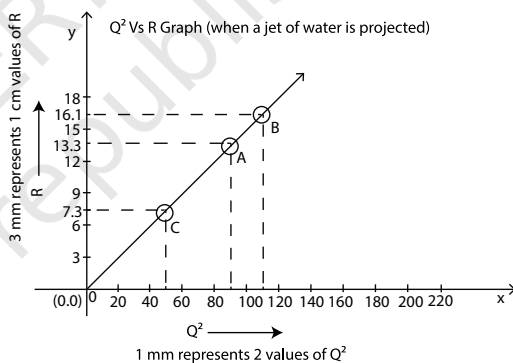


Fig. 4

The range should be measured by a sliding wire fitted on the horizontal metre scale. At the time of measuring the range, it should be adjusted in the middle of the falling stream. For small differences of two ranges error 'x' can be taken approximately the same. Actually, it will be different from different ranges. This method of elimination error due to resistance of air needs further detailed examination and experimental trial, which someone among the readers may perhaps like to take up.

# PSYCHOLOGICAL PROBLEMS OF LEARNERS IN LEARNING MATHEMATICS AT ELEMENTARY LEVEL : A CASE STUDY

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The present study is based on the interview of 100 students (50 boys and 50 girls) of Class VII of different CBSE schools in Varanasi district. The objective of the study was to explore the psychological factors related to the learners in learning mathematics. Is only higher order intelligence responsible for learning mathematics or are there some other factors too which are responsible for learning and non-learning of mathematics at the elementary level? Focusing on the responses of each student, we found that it is not only intelligence that influences mathematics learning, but there are some other factors too which are responsible. One of the most important factors is the psychology of the learner. It proves to be a barrier in the process of learning mathematics. There were also some major psychological factors which are responsible for the outcomes of mathematics learning in both ways positively and negatively.

### Key words

Abstract, Psychological, Mathematics

## Introduction

Mathematics is a subject of reasoning and abstract concepts. Its nature is purely logical and hierarchical. Therefore, it requires step-by-step concept clarification using different ways of thinking, which varies from person to person. We all know that every individual has varied mental abilities as stated by Howard Gardener in his *Theory of Multiple Intelligence*. Since the abilities and ways of thinking are different in different persons, most people face problems in learning mathematics. They face problems due to their ways of thinking and perceptions towards

mathematics, which they further apply in the process of learning the subject.

Mathematics is one of the important subjects in our curriculum. With a lot of learning problems to solve, it is important to throw light on the myth that mathematics is a difficult subject, which can only be studied by few. Mathematics should be considered as a subject of cerebrum magic, a subject of numbers, number games and joy, as well as the most useful subject in every sphere of our life. Some myths that have been created are— it is an extremely abstract subject that can be studied only by intelligent people, and this thought is the actual barrier in effective

teaching-learning process of mathematics. We all know a famous quote: "If there is a will, there is a way". We all have to believe in this, if we want to produce a number of good mathematics students across the country.

In daily teaching and learning practices, various factors contribute to good performance in learning mathematics. These include students working hard, effective instructional methods in classroom, applying effective learning skills, and being good at mathematical thinking, etc. However, there are many reasons that can cause students' difficulties in learning mathematics. For example, students with poor performance may fail in mathematical learning due to the lack of proper guidance and interest or not understanding mathematics learning. There are different types of learning difficulties in mathematics. Therefore, it is necessary to apply proper strategies not only to improve their learning but also to find out the actual cause of this decline in learning this subject because remedy can be provided only if we diagnose the problems or causes. It is well-known that teachers, curriculum, environment and other social factors related to children are responsible for their learning both positively and negatively. However, this does not happen in every case. Sometimes it could be something else, and hence, the present study is meant to research the psychology of the learner.

Several studies have investigated the prevalence of learning difficulties in mathematics due to attitude towards the subject, (Miller, 1993; Ashutosh 1989; Choudhury and Kumar; 2009 and Stella and Purushothaman, 1995). Much of the work has been done based on the assumption that attitude affects mathematics achievement. The results differ according to the nature of the samples and the criteria used. The

main conclusion one can draw from most studies is that many children face difficulties in mathematics, and a significant number has relatively specific difficulties related to the various dimensions of learning. Such difficulties appear to be equally common in both boys and girls.

## **Need of the Study**

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Mathematics learning has always been a topic of debate. What are the mathematical difficulties? What kind of pedagogical practices should be adopted for better learning? What kind of teaching methods should be adopted for better learning? All these are questions of the hour. To reach a meaningful conclusion, it is the demand of the circumstances to conduct researches that can produce answers to these fundamental questions of mathematics teaching and learning. We have found many learning difficulties, like ineffective teaching, unavailability of appropriate teaching learning materials (TLMs), and unsuitable curriculum. But there is another problem on which the present study tries to focus — psychology of the learner. Every time it is not the teaching methods, teacher and curriculum, and other related factors responsible for downfall in mathematics learning but there are some other issues related to the problem as well. There is a desperate need for this type of study or a related study to contribute to mathematics education.

Wang and Liu (2009) conducted a 'Case Study on Improving High School Students with Learning Difficulties in Mathematics'. This study focused on investigating factors that lead to learning difficulties in mathematics,

and developing strategies for improving mathematics learning of students with learning difficulties. Two types of learning difficulties were identified — learned helplessness and defensive attribution. The students enhanced their learning in mathematics with the use of appropriate strategies in the interventions.

Karimi and Venkatesan (2009) conducted a study on mathematics anxiety, mathematics performance and academic hardiness in high school students. The sample comprised 284 (144 male and 140 female) Class X students from Karnataka. Pearson correlation analysis and two independent sample t-tests are used to analyse the data. The results have revealed that mathematics anxiety has a significant negative correlation with mathematics performance but no significant correlation is detected with academic hardiness. It is also found that gender differences in mathematics anxiety are significant, whereas no significant differences are detected between boys and girls in mathematics performance and academic hardiness. This study has established the fact that the performance of students in mathematics can be perceived by mathematics anxiety and females scored slightly higher on this variable but this relation was not observed with academic hardiness.

The National Curriculum Framework–2005 emphasised that "mathematisation (ability to think logically, formulate and handle abstractions) rather than knowledge of mathematics (formal and mechanical procedures) is the main goal of teaching mathematics". It further says that "the teaching of mathematics should enhance

children's ability to think and reason, visualise and handle abstractions, formulate and solve problems. Access to quality mathematics education is the right of every child." (NCF 2005, p. 127).

## Objective

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The objective of the study is to identify the psychological problems related to the learners in learning mathematics.

## Methodology

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A case study is an exploration of a "bounded system" or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context (Creswell, 1998). In the present study, the researcher has interviewed the students, and analysed their views. It is basically a qualitative case study, based on the personal interviews of 100 (50 male and 50 female) students of Class VII of different CBSE schools in Varanasi district.

The researcher has used open-ended questions to interview the students and collect data for the study.

## Sample

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Sample for the present study consisted of Class VII students of different CBSE schools of Varanasi district. For the study, those students who are having learning problems in mathematics have been randomly selected.



Table 1

S. No	Psychological Problems/ Perceptions/ Identified Case
1.	Learned Helplessness
2.	Maths Anxiety
3.	Solidity of the Subject (Content Material)
4.	Apathetic towards the Subject
5.	Ineffective Ways of Teaching
6.	Bored Subject
7.	Defensive Attribution

## Procedure

The students were interviewed at a quiet place away from their classrooms and playgrounds. They were told that the interviewer was interested in knowing their views and experiences about 'Mathematics learning and problems they face in learning mathematics'

## Data Analysis

A critical task that the researcher faced in the analysis process was to identify the cases and summarise them in the categories of problems.

The answer to each question was written by the researcher, and finally, after the collection of responses from the students, the answers were qualitatively analysed. Then, the categorisation of the students was

done on the basis of the responses analysed. Finally the analysis of the percentage in each category was calculated from the total number of students (100).

## Psychological Problems/ Perceptions/ Identified Case in the Study

### Discussions

#### Case 1

#### Learned Helplessness (13%)

##### What is Learned Helplessness?

If there is hopelessness and lack of motivation to face new challenges resulting in stagnation of learning for the student due to the perceived belief, then this phenomenon, termed as 'learned helplessness' is 'helplessness' (Fowler and Peterson, 1981). According to Slavin (2003), learned helplessness is the anticipation based on the experience that one's actions will ultimately lead to failure. It is an internal factor and speaks about the student's confidence. Sometimes, learned helplessness is also related to external factors. For example, some students lack help in learning mathematics. They failed in mathematics because they rarely got any help in their learning process.

#### Result

After interviewing and analysing the responses of the students of Class VII, it was found that 13 per cent of the students were suffering from learned helplessness.

Of these, 6 per cent are boys and 7 per cent are girls. They achieved academic success in certain mathematics exams. Otherwise, failures are based on uncontrollable factors, such as knowledge of mathematics and loss of interest in the subject, low ability to achieve in mathematics or lack of interest in the subject due to absence of proper guidance and care regarding maths learning. Their self-confidence and negative attribution have been a major issue of their downfall in mathematics learning.

### **Case 2**

#### **Mathematics Anxiety (21%)**

##### **What is Mathematics Anxiety?**

Mathematics anxiety is a common problem. Pradeep (2006) defined mathematics anxiety as a state of a sinking feeling, uncertainty and despair at doing and understanding mathematics. Mathematics anxiety affects students' achievement and attitude towards mathematics (Hembree, 1990). As far as empirical evidence of the relationship between mathematics anxiety and achievement is concerned, correlations have been found to be negative (the higher the anxiety, the lower the achievement tends to be).

Mathematics anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with mathematics performance. The construct of mathematics anxiety typically refers to the emotional and mental distress that occurs in some students while attempting to understand mathematics. Mostly, students suffer and put themselves on the back side of learning mathematics.

### **Result**

The effect of mathematics anxiety was apparent that it has a considerable correlation with a student's success in the subject. And it also appears during interviews. Twenty-one per cent of students were suffering due to mathematics anxiety, out of which 11 per cent were boys and 10 per cent girls. They do not want to study the subject because they have a different feeling towards mathematics, we can call it mathematics anxiety.

### **Case 3**

#### **Solidity of the Subject (Content Material) (24%)**

##### **What is the Solidity of the Subject (Content Material)?**

As the nature of mathematics is purely logical and sequential, it is quite different from other subjects as it demands more attention and cognition. Therefore, here, solidity of the subject means hardness in terms of concept material and its logical nature. Generally, students explained it as a tough 'subject', and this mentality proves to be dangerous in terms of mathematics learning.

### **Result**

It is kind of a pre-determined idea in the mind of learners towards mathematics. While analysing the responses, it makes a clear sense that most of the students have this perception that mathematics is a tough subject. Under this category, 24 per cent of students (boys 13 per cent and girls 11 per cent) were not interested in learning mathematics because they think that it is a tough subject and cannot be handled by them at prospective levels.

#### **Case 4**

##### ***Apathetic towards the subject (12%)***

###### ***What is the apathy towards the subject?***

Apathy or dislike towards the subject matter, not in terms of content but in reference to the utility in other spheres of life. Mathematics is definitely an important school subject, but is it equally important and useful for every learner, is the emerging question from this study. The result suggests that it cannot be treated as useful and important for every student. For example a student who is interested in fine arts will definitely search the ways in arts, or any other field of life where they want to go. So, the utility and scope of mathematics for them in further studies becomes narrow, because they have decided that they are not going to study mathematics at higher levels, so why waste time in learning mathematics.

###### **Result**

Apathy towards the subject is thinkable and a major issue for conducting of this study, after interviewing minutely. It was found that 12 per cent of the students (5 per cent boys and 7 per cent girls) do not want to study mathematics just because they do not find its utility in future with reference to further studies, as we all know mental readiness is a key to the learning, also stated by Thorndike's Law of Readiness.

#### **Case 5**

##### ***Ineffective Ways of Teaching (13%)***

###### ***What is Ineffective Teaching?***

We have a lot of discussions, seminars and researches over what is effective teaching? What are effective pedagogy practices?

What are the kinds of approaches, what are effective teaching learning materials (TLMs), and many more. Ineffective teaching refers to the case that child has not grasped the communication between him/her and the teacher. Purposeful modification in behaviour has not taken place. The interaction of thoughts, ideas and contents is not done between the learner and the teacher. These circumstances can be collectively termed as ineffective teaching.

###### **Result**

This is serious issue that should be considered by the teacher. Thirteen per cent of the students (6 per cent boys and 7 per cent girls) complain that they do not want to learn mathematics because there is a lack of proper teaching. They felt themselves to be in a problematic situation over who could teach them the toughest subject of their schooling and prepare them for higher mathematics.

#### **Case 6**

##### ***Boring Subject (9%)***

###### ***What is meant by Boring Subject?***

Usually, a boring subject means a subject of which people are fed up and psychologically not ready to deal with its content. But this thought of boredom is due to individual differences of the learners and varies from person to person.

###### **Result**

Nine per cent of the total students (boys 4 per cent and girls 5 per cent) are not interested in learning mathematics because they feel that it is a boring subject and they do not want to study it for any reason.

**Case 7****Defensive Attribution (8%)****What is Defensive Attribution?**

Some students are having 'defensive attribution,' with mathematical learning difficulties. They usually do not work hard, do not take the initiative, lose interest and always complain. For example, they complain that mathematics curriculum materials are not good enough, mathematics is boring and teachers do not teach well. Never do they try to find problems within themselves. Therefore, it is believed that students with repeated failures may develop a defensive attribution to protect themselves, or they are not guided properly towards learning mathematics.

**Result**

The researcher found that 8 per cent students (boys = 5 per cent and girls = 3 per cent) were suffering from defensive attribution. They felt that mathematics curriculum is not suitable for them. They have developed a perception towards the teacher, curriculum, school and

the nature of the subject. They felt that all are mutually responsible for their failure in maths. A girl named Shambhavi, a student of Class VII of St. John's School D.L.W., said, "if I get less marks in the maths test, then I am not responsible for my failure because it is a difficult subject as compared to other subjects." The above statement gives a clear idea that she is not ready to make changes in her thoughts, she is indirectly blaming the content of mathematics rather than her own potential and hardwork.

**Conclusion**

The study addressed one research objective and is an outcome of the interview of 100 students studying in Class VII of various CBSE board schools in Varanasi district of U.P. During the study, the researcher found that various kinds of perceptions, attitudes, misconceptions and psychological factors affect mathematics learning. The study focuses on seven major cases. Other cases can be considered as the sub-group of the seven cases.

**Table 2**

S. No	Cases	Boys	Girls	Total	%
1.	Learned Helplessness	6	7	13	13
2.	Maths Anxiety	11	10	21	21
3.	Solidity of the Subject (Content Material)	13	11	24	24
4.	Apathetic towards the Subject	5	7	12	12
5.	Ineffective Ways of Teaching	6	7	13	13
6.	Bored Subject	4	5	9	9
7.	Defensive Attribution	5	3	8	8
	Total	50	50	100	100

The study makes an attempt to draw the picture of learned helplessness, mathematics anxiety, solidity of the subject (content material), apathy towards the subject, ineffective ways of teaching, bored subject and defensive attribution. apart from this some other factors have also come into the research, like home environment and socio- economic status. But focusing on some major factors, which are categorised into seven cases have been identified for causing poor performance in mathematics learning.

Among these the most important factor is the psychology (different ways of perceiving mathematics) of the learner and it proves to be a barrier in their mathematics learning. Effective teaching does play a role of scaffolding in the teaching-learning of mathematics and the lack of it has also proved to be challenging for the learner in learning mathematics. As many researches support the co-relation between maths

anxiety and achievement, here also, it appears as a major factor in the decline of mathematics learning.

It should be concluded that every child has a lot of factors to drag him/her backward in learning mathematics. Therefore, our aim as a mathematics teacher should be to make mathematics learning cognitive fun, so that the learner can enjoy and take interest in learning it rather than treating it as a tough subject. Teachers need to develop a culture and environment for learning mathematics for every child as NCF-2005 has also recommended to 'Mathematisation'. We all can achieve it by minimising and providing proper guidance to learners because in this study it is evident that all cases are somewhere linked with improper guidance.

If we want to achieve the target of mathematics for all and want to produce young mathematicians from our arena, we have a road ahead to go.

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## Tissue-engineered Colon from Human Cells Develop Different Types of Neurons

A study carried out by scientists at the Children's Hospital Los Angeles (CHLA) has shown that tissue-engineered colon derived from human cells is able to develop many specialised nerves required for function, mimicking the neuronal population found in native colon. These specialised neurons, localised in the gut, form the enteric nervous system, which regulate digestive tract mobility, secretion, absorption and gastrointestinal blood flow. In addition, in a condition called Hirschsprung's disease or aganglionosis, where those neurons are not present, the team was able to replace them.

The study — the first report on the enteric nervous system in human-derived tissue-engineered colon — was published online ahead of print in the journal, *Tissue Engineering, Part A*, on September 28.

In healthy intestines, food passes through the digestive tract through peristalsis — a series of wave-like contractions. Special nerve cells called ganglion cells are required for this movement, but there is also a rich mixture of other types of nerve cells. In children with Hirschsprung's disease, these cells are missing. Without these, the intestine becomes blocked and surgical removal of the affected segment of colon is required.

To help children suffering from intestinal diseases that may require surgical removal of all or part of their intestines, the CHLA team — led by principal investigator Tracy C. Grikscheit, MD, a paediatric surgeon and researcher at the Saban Research Institute of CHLA — is developing tissue-engineered options.

One objective of growing tissue-engineered organs is to generate new tissues from a patient's cells. Grikscheit and her team first needed to determine what parts of the enteric nervous system were present in tissue-

engineered colon when it is grown from normal human cells.

"The diversity of neuron types that grew within the human tissue-engineered colon was a revelation to our team because, previously, we had only documented that some ganglia were present," said Grikscheit, who is also a tenured associate professor of surgery at the Keck School of Medicine at the University of Southern California. "The next step was to determine if these neuronal elements could be supplied to tissue-engineered colon that was missing neurons — like in Hirschsprung's disease," Grikscheit added.

The scientists initially grew cells from patients with Hirschsprung's disease and from mice with a genetic mutation that causes aganglionosis. In both the cases, the tissue-engineered colon derived from these cells did not have all-important components of the intestinal nervous system. In a second set of experiments, again testing both mouse and human cells, the investigators added neurospheres, which are clusters of purified neural progenitor cells. The cells had been stained with green fluorescence, so the scientists could readily visualise where the nerve cells ended up in the tissue-engineered colon, as well as determine the source of the nerve cells.

"After growing the colon for four weeks, we saw that the green nerve cells had been incorporated into the colon engineered from human tissue derived from a patient lacking those elements and that the different nerve subtypes were present," said first author on the study, Minna Wieck, MD, an investigator and surgical resident at CHLA.

## **New colon cancer culprit found in gut microbiome**

Changes in the gut bacteria of colon cancer patients indicate that some virulent bacteria could be linked to the progression of the disease, according to a research published in the open access journal *Genome Medicine*. The findings could eventually be used to identify a virulence signature in these cancers and help doctors predict how bacterial changes in patients' guts could affect their prognosis.

The human gut microbiome, a collection of microorganisms, their genomes and habitat that contributes to maintaining a healthy intestine, is thought to play an active role in colon cancer progression. Previous studies have shown that changes in the bacterial community occur in the gut microbiome of colon cancer patients, with tumours harbouring increased bacterial diversity and an abundance of pathogenic bacteria compared to surrounding healthy tissues.

Although researchers have uncovered a variety of potentially pathogenic bacteria associated with colon cancer, little work has been done to determine if there is a single signature that might unify their findings.

Lead author Michael Burns from the University of Minnesota, USA, said, "It was surprising that the results were so clear. We were able to clearly identify the presence of two virulent strains of bacteria, including the discovery of a new potential culprit, *Providencia*."

"This has obvious implications for colon cancer patients and by analysing the similarities among these pathogens, we have uncovered a single signature of colon cancer



when analysing the gut microbiome that might help researchers identify these cancers in future.”

This was the first study to focus on the pathogenic potential of the bacterial genes present in the colon cancer ‘tumour microenvironment’, the environment of surrounding blood vessels, immune cells and other cells. The genes of the gut microbiomes were predicted in 44 primary tumor and 44 patients-matched normal colon tissues to analyse the general microbial function.

The team in Ran Blekhman’s lab noted changes in the abundances of helpful, harmless and pathogenic bacteria, including *Fusobacterium* and *Providencia*. *Fusobacterium* has previously been implicated as a cancer-causing group of bacteria, but this is the first time that *Providencia* has been linked to colon cancer.

Analysing the major changes that take place in the gut microbiome could help researchers categorise the role a particular bacterium plays and identify the key players.

Additionally, by showing that the microbial genes which are predicted to be present in colon cancer tissue, are enriched for virulence functions. Clinicians could use this signature to uncover what bacterial changes in the gut mean for a patient’s health.

At this stage, the research cannot determine a definite causal link between *Providencia* species and colon cancer. While the study’s methods are robust for analysing human gut samples, more research will be needed to assess the interactions between gut bacteria and the progression and development of colon cancer.

## Medical Nanoparticles: Local Treatment of Lung Cancer

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Nanoparticles can function as carriers of medicines to combat lung cancer. Working in a joint project at the NIM (Nanosystems Initiative Munich) Excellence Cluster, scientists from the Helmholtz Zentrum München (HMGU) and the Ludwig-Maximilians-Universität (LMU) in Munich have developed nanocarriers that site-selectively release medicines/drugs at the tumour site in human and mouse lungs. In the journal, *ACS Nano*, the scientists reported that this approach led to a significant increase in the effectiveness of current cancer medicines in lung tumour tissue.

Nanoparticles are extremely small particles that can be modified for a variety of uses in the medical field. For example, nanoparticles can be engineered to be able to transport medicines, specifically to the disease site while not interfering with the healthy body parts.

### Selective drug transport verified in human tissue for the first time

The Munich scientists have developed nanocarriers that only release the carried drugs in lung tumour areas. The team headed by Silke Meiners, Oliver Eickelberg and Sabine van Rijt from the Comprehensive Pneumology Center (HMGU), working with colleagues from the Chemistry Department (LMU) headed by Thomas Bein, was able to show nanoparticles’ selective drug release to human lung tumour tissue for the first time.

### **Tumour-specific proteins were used to release drugs from nanocarriers**

Tumour tissues in the lung contains high concentrations of certain proteases, which are enzymes that break down and cut specific proteins. The scientists took advantage of this by modifying the nanocarriers with a protective layer that only these proteases can break down, a process that then releases the drug. Protease concentrations in healthy lung tissues are too low to leave this protective layer and so the medicines stay protected in the nanocarrier.

"Using these nanocarriers, we can very selectively release a drug, such as a chemotherapeutic agent specifically at the lung tumour," reports research group leader Meiners. "We observed that the drug's effectiveness in the tumour tissue was 10 to 25 times greater compared to when the drugs were used on their own. At the same time, this approach also makes it possible to decrease the total dose of medicines and consequently to reduce undesirable effects," the research group's leader added.

Further studies will be directed to examine the safety of the nanocarriers in vivo and verify the clinical efficacy in an advanced lung tumour mouse model.

### **Engineered Cardiac Tissue Model Developed to Study Human Heart**

When it comes to finding cures for heart diseases scientists are working to their own beat. That's because they may have finally developed a tissue model for the

human heart that can bridge the gap between animal models and human patients. These models exist for other organs, but for the heart, this has been elusive. Specifically, the researchers generated the tissue from human embryonic stem cells with the resulting muscle having significant similarities with human heart muscle. This research was published in the February 2014 issue of *The FASEB Journal*.

"We hope that our human engineered cardiac tissues will serve as a platform for developing reliable models of the human heart for routine laboratory use," said Kevin D. Costa, PhD and a researcher involved in the work from the Cardiovascular Cell and Tissue Engineering Laboratory, Cardiovascular Research Center, Icahn School of Medicine at Mt. Sinai, in New York. "This could help revolutionise cardiology research by improving the ability to efficiently discover, design, develop and deliver new therapies for the treatment of heart disease, and by providing more efficient screening tools to identify and prevent cardiac side-effects, ultimately leading to safer and more effective treatment of patients suffering from heart disease," he said.

To make this advance, Costa and colleagues cultured human engineered cardiac tissue, or hECTs, for 7–10 days and they self-assembled into a long thin heart muscle strip that pulled on the end-posts and caused them to bend with each heart beat, effectively exercising the tissue throughout the culture process.

These hECTs displayed spontaneous contractile activity in a rhythmic pattern of 70 beats per minute on an average, similar to the human heart. They also responded to electrical stimulation. During functional analysis, some of the responses known to occur in the natural adult human heart were also elicited in hECTs through electrical and pharmacological interventions, while some paradoxical responses of hECTs more closely mimicked the immature or newborn human heart. They also found that these human engineered heart tissues were able to incorporate new genetic information carried by adeno virus.

## What Molecules you Leave on your Phone Reveal about your Lifestyle

Molecular traces left on cell phones allowed UC San Diego researchers to construct lifestyle sketches of each phone's owner.

We leave behind trace chemicals, molecules and microbes on every object we touch. By sampling the molecules on cell phones, researchers at University of California San Diego School of Medicine and Skaggs School of Pharmacy and Pharmaceutical Sciences were able to construct lifestyle sketches for each phone owner, including diet, preferred hygiene products, health status and locations visited. This proof-of-concept study, published on November 14 by the Proceedings of the National Academy of Sciences could have a number of applications, including criminal profiling, airport screening, medication adherence monitoring, clinical trial participant stratification and environmental exposure studies.

You can imagine a scenario where a crime scene investigator comes across a personal object, like a phone, pen or key, without fingerprints or DNA, or with prints or DNA not found in the database. They would have nothing to go on to determine who that belongs to," said senior author Pieter Dorrestein, PhD, Professor in UC San Diego School of Medicine and Skaggs School of Pharmacy and Pharmaceutical Sciences. "So we thought — what if we take advantage of left-behind skin chemistry to tell us what kind of lifestyle this person has?"

In a 2015 study, Dorrestein's team constructed 3D models to illustrate the molecules and microbes found at hundreds of locations on the bodies of two healthy adult volunteers. Despite a three-day moratorium on personal hygiene products before the samples were collected, the researchers were surprised to find that the most abundant molecular features in the skin swabs still came from hygiene and beauty products, like sunscreen.

"All of these chemical traces on our bodies can transfer to objects," Dorrestein said. "So we realised we could probably come up with a profile of a person's lifestyle based on chemistries we can detect on objects they frequently use," he added.

Thirty-nine healthy adult volunteers participated in Dorrestein's latest study. The team swabbed four spots on each person's cell phone — an object we tend to spend a lot of time touching — and eight spots on each person's right hand, for a total of nearly 500 samples. Then, they used a technique called mass spectrometry to detect molecules from the samples. They identified as many

molecules as possible by comparing them to reference structures in the GNPS database, a crowdsourced mass spectrometry knowledge repository and annotation website developed by Dorrestein and *co-author* Nuno Bandeira, PhD, *Associate Professor* at the Jacobs School of Engineering and Skaggs School of Pharmacy and Pharmaceutical Sciences, UC San Diego.

With this information, the researchers developed a personalised lifestyle "read-out" from each phone. Some of the medications they detected on phones included anti-inflammatory and anti-fungal skin creams, hair loss treatments, anti-depressants and eye drops. Food molecules included citrus, caffeine, herbs and spices. Sunscreen ingredients and DEET mosquito repellent were detected on phones even months after they had last been used by the phone owners, suggesting that these objects can provide long-term composite lifestyle sketches.

"By analysing the molecules they've left behind on their phones, we could tell if a person is likely a female, uses high-end cosmetics, dyes her hair, drinks coffee, prefers beer over wine, likes spicy food, is being treated for depression, wears sunscreen and bug spray — and therefore, likely spends a lot of time outdoors — all kinds of things," said first author Amina Bouslimani, PhD, Assistant Project Scientist in Dorrestein's lab. "This is the kind of information that could help an investigator narrow down the search for an object's owner," she added.

There are limitations, Dorrestein said. First of all, these molecular read-outs provide a general profile of person's lifestyle, but they

are not meant to be a one-to-one match, like fingerprints. To develop more precise profiles and for this method to be more useful, he said more molecules are needed in the reference database, particularly for the most common foods people eat, clothing materials, carpets, wall paints and anything else they come in contact with. He would like to see a trace molecule database on the scale of the fingerprint database, but it's a large-scale effort that no single lab will be able to do alone.

Moving forward, Dorrestein and Bouslimani have already begun extending their study with an additional 80 people and samples from other personal objects, such as wallets and keys. They also hope to soon begin gathering another layer of information from each sample — identities of the many bacteria and other microbes that cover our skin and objects. In a 2010 study, their collaborator and co-author, Rob Knight, PhD, *Professor* in the UC San Diego School of Medicine and Jacobs School of Engineering and director of the Center for Microbiome Innovation at UC San Diego, contributed to a study, in which his team found they could usually match a computer keyboard to its owner just based on the unique populations of microbes the person has left on it. At that time, they could make the match with a fair amount of accuracy, though not precise enough for use in an investigation.

Beyond forensics, Dorrestein and Bouslimani imagine that trace molecular read-outs could also be used in medical and environmental studies. For example, perhaps one day physicians could assess how well a patient is sticking with a medication regimen by monitoring metabolites on his/her skin.

Similarly, patients participating in a clinical trial could be divided into sub-groups based on how they metabolise the medication under investigation, as revealed by skin metabolites — then the medication could be given only to those who can metabolise it appropriately. Skin molecule read-outs might also provide useful information about a person's exposure to environmental pollutants and chemical hazards, such as in a high-risk workplace or a community living near a potential pollution source.

## Heavy Cell Phone use linked to Oxidative Stress

A new study finds a strong link between heavy cell phone users and higher oxidative stress to all aspects of a human cell, including DNA. Uniquely based on examinations of the saliva of cell phone users, the research provides evidence of a connection between cell phone use and cancer risk.

To further explore the relationship between cancer rates and cell phone use, Dr. Yaniv Hamzany of Tel Aviv University's Sackler Faculty of Medicine and the Otolaryngology Head and Neck Surgery Department at the Rabin Medical Center, looked for clues in the saliva of cell phone users. Since the cell phone is placed close to the salivary gland when in use, he and his fellow researchers, including departmental colleagues professors. Professors Raphael Feinmesser, Thomas Shpitzer, Dr. Gideon Bahar, Rafi Nagler and Dr. Moshe Gavish of the Technion in Haifa, hypothesised that salivary content could reveal whether there was a connection with developing cancer.

Comparing heavy mobile phone users to non-users, they found that the saliva of heavy users showed indications of higher oxidative stress—a process that damages all aspects of a human cell, including DNA—through the development of toxic peroxide and free radicals. More importantly, it is considered a major risk factor for cancer.

The findings have been reported in the journal, *Antioxidants and Redox Signaling*.

### Putting stress on tissues and glands

The researchers examined the saliva content of 20 heavy-user patients, defined as speaking on their phones for a minimum of eight hours a month. Most participants speak much more, Dr. Hamzany says, as much as 30 – 40 hours a month. Their salivary content was compared to that of a control group, which consisted of deaf patients who either do not use a cell phone, or use the device exclusively for sending text messages and other non-verbal functions.

Compared to the control group, heavy cell phone users had a significant increase in all salivary oxidative stress measurements studied.

"This suggests that there is considerable oxidative stress on the tissue and glands which are close to the cell phone when in use," he says. The damage caused by oxidative stress is linked to cellular and genetic mutations which cause the development of tumours.

### Making the connection

This field of research reflects long-standing concerns about the impact of cell phone use, specifically the effects of radio frequency non-ionising electromagnetic radiation on

human tissues located near the ear, say the researchers. And although these results don't uncover a conclusive "cause and effect" relationship between cellular phone use and cancer, they add to the building evidence that cell phone use may be harmful in the long term, and point to a new direction for further research.

One potential avenue of future research would be to analyse a person's saliva prior to exposure to a cell phone, and then again after several minutes of exposure. This will allow researchers to see if there is an immediate response, such as a rise in molecules that indicate oxidative stress, Dr. Hamzany says.

## Study examines Role of Vegetable Food Pairings in School Plate Waste

School meals paired with popular vegetables are less likely to wind up in garbage bins, research has shown. A research team measured food waste in three elementary schools in Bryan and Dallas.

A study, led by a team of Texas A&M AgriLife Research and the Institute for Obesity Research and Program Evaluation, researchers found that school meals paired with popular vegetables are less likely to end in garbage bins.

The schools are participants in the U.S. Department of Agriculture National School Lunch Program both in pre- and post-implementation of the new standards.

The study was funded by the Alliance for Potato Research and Education and is published in the journal, *Food and Nutrition Sciences*.

"Our research team looked at whether there is a relationship between consumption of certain entrees and vegetables that would lead to plate waste," said Dr. Oral Capps Jr., an AgriLife Research Economist in College Station. "We found that popular entrees such as burgers and chicken nuggets contributed to greater waste of less popular vegetables," Capps added.

"Conversely, entrees paired with potatoes — served as potato tots, oven-baked French fries, and wedges — experienced the least amount of overall waste," Capps said.

"Our study shows that optimising entree-vegetable pairings in school meals has the potential to positively impact vegetable consumption, which is especially important for those students relying on school meals for their energy and nutrient needs," Capps said.

The data were collected by a team of 'plate waste warriors', Texas A&M students who were paid by the hour, Capps said. Each wore a different coloured apron that is associated with the assigned waste bin in which the entree is discarded. A minimum of eight workers were needed at each school during the lunch periods, which were typically from 10:45 a.m. through 1 p.m. The A&M students gathered the trays containing leftover portions.

Leftovers were separated into different waste bags and each bag was weighed on a scale for plate-waste measurement. When the students went through the lunch line, a sticker was placed on the food tray to identify the vegetable and entree chosen. Students on the free lunch programme were also evaluated for plate waste. The tray with the corresponding sticker was weighed and

recorded to help calculate the overall food waste.

### **Growing interest: School-grown vegetables increase salad selection**

If children grow vegetables, they are more likely to eat them. A new study shows that when garden grown vegetables were slipped into school salads, children were over four times more likely to eat salad.

"This is a small study, but it suggests gardens can help children's diets — even in the snow belt," said lead author Brian Wansink, PhD, *Director of the Cornell Food and Brand Lab* and author of *Slim by Design*.

This pilot study, conducted in upstate New York, measured the change in vegetable selection and plate waste when school grown salad greens were incorporated in the cafeteria school-lunch. The researchers measured the selections and plate waste of a total of 370 enrolled high school students for over three days.

When the salad bar contained produce grown by the students, the percentage of those who selected salad with their meals increased and on an average, students ate two-thirds of their salad. Unfortunately, in addition to increased salad selection, the amount of plate waste also increased. The overall salad consumption for the entire student body increased from approximately 5 to 12 servings per day.

This study implies the larger potential benefits of school garden programmes. "We see great promise with this research. The first hurdle in increasing vegetable consumption is simply getting children to

put them on their plate," concluded *co-author* Drew Hanks of the Ohio State University.

### **The recess swap: Getting kids to eat their veggies at school**

Many schools have reported that fruits and vegetables are feeding trash cans rather than students. This new study published in *Preventive Medicine* shows that one simple no-cost change, holding recess before lunchtime, can increase fruit and vegetable consumption by 54 per cent.

Students participating in the National School Lunch Programme are required to select a fruit and a vegetable side. This regulation is intended to get students to eat more fruits and vegetables; however, just because an apple and green beans made it on to the tray doesn't mean that they will be eaten. Many schools have reported that fruits and vegetables are feeding trash cans rather than students. "Recess is often held after lunch so children hurry to 'finish' so that they can go play — this results in wasted fruits and vegetables," explains *co-author* David Just, PhD of Cornell University. "However, we found that if recess is held before lunch, students come to lunch with a healthy appetite and less urgency and are more likely to eat their fruits and vegetables."

Lead author Joseph Price, PhD, Brigham Young University and Dr. Just conducted their study in a school district in Orem, Utah. Seven schools within the district (grades 1–6) participated in the study, three of which switched recess to before lunch and the rest continued to hold recess after lunch. For four days in the spring of 2011 and nine days in the fall of 2011 the researchers measured fruit and vegetable waste by standing next to

the trash cans and recording the number of servings of fruits and vegetables that each student consumed or threw away. They also measured whether or not each student ate at least one serving of fruits or vegetables.

After analysing a total of 22,939 observations, the researchers concluded that in the schools that switched recess to before lunch children ate 54 per cent more fruits and vegetables. There was also a 45 per cent increase in those eating at least one serving of fruits and vegetables. During the same time period, the consumption of fruits and vegetables actually decreased in the schools that didn't switch.

Not getting a balanced meal can leave children feeling hungry for the rest of the day in school leading to decreased academic performance and excessive snacking when they reach home. The researchers note that, "increased fruit and vegetable consumption in young children can have positive long-term health effects. Additionally, decreasing waste of fruits and vegetables is important for schools and districts that are faced with high costs of offering healthier food choices." Because moving recess is a no-cost way to make kids healthier and make the school meal programme more successful, Price and Just recommend that every school makes the switch.

## Seven Reasons to Eat Insects

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Eating bugs may not seem appetising, but according to John Coupland, PhD, CFS, *Professor of Food Science at Penn State University, and spokesperson for the Institute of Food Technologists (IFT)*, insects are a sustainable alternative

protein source with nutritional benefits that can't be ignored.

1. **High in protein:** A cricket has 65 per cent protein whereas beef has about 50 per cent.
2. **High in other nutrients:** Insect protein contains a good range of amino acids and they also contain vitamins, minerals, unsaturated fatty acids and polyunsaturated fatty acids.
3. **Low in fat:** Many insect species have less than 5 grams of fat per serving.
4. **Good for the environment:** Insect farming can be a more sustainable practice because insects don't need much space, can live under all sorts of conditions and are easy to feed.
5. **Can be eaten in a variety of ways:** Insects can be pan-fried, boiled, sautéed, roasted, or baked with a bit of oil and salt. They can also be made into flour and used for bars, breads, crackers and cookies.
6. **Abundant:** Some parts of the world have over 300 species of insects. Something for everyone!
7. **Taste great:** People describe the taste of insects as nutty with a similar flavour to shrimp and chicken. Grasshoppers, ant eggs and wasps are considered a delicacy in several countries.

## Around 40 per cent Diabetic Women more likely to suffer Severe Heart Problems than Diabetic Men

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A systematic review and meta-analysis of 19 studies, containing almost 11 million patients shows that diabetic women are around



40 per cent more likely to suffer from acute coronary syndromes (heart attack or angina) than diabetic men. The study has been conducted by Dr Xue Dong, the Affiliated ZhongDa Hospital of Southeast University, Nanjing, China, and colleagues, and is presented at this year's annual meeting of the European Association for the Study of Diabetes (EASD) in Stockholm.

### **'Survival' Protein a Target in Drug-resistant non-Hodgkin Lymphomas**

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Targeting a cell 'survival' protein could help treat some lymphomas, including cancers with genetic defects that make them resistant to many existing therapies, researchers have discovered. T-cell and B-cell lymphomas are types of white blood cell cancer known as non-Hodgkin lymphomas. T-cell lymphomas account for approximately 20 per cent of non-Hodgkin lymphomas.

### **How Green Tea could help improve MRIs**

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Green tea's popularity has grown in recent years. People can drink it, enjoy its flavour in their ice cream and slather it on their skin with lotions infused with it. Now, the tea could have a new, unexpected role — to improve the image quality of MRIs. Scientists report that they successfully used compounds from green tea to help image cancer tumours in mice.

Sanjay Mathur and colleagues note that a recent research has revealed the potential

usefulness of nanoparticles — iron oxide, in particular — to make biomedical imaging better. But the nanoparticles have their disadvantages. They tend to cluster together easily and need help getting to their destinations in the body. To address these issues, researchers have recently tried attaching natural nutrients to the nanoparticles. Mathur's team wanted to see if compounds from green tea, which research suggests has anticancer and anti-inflammatory properties, could play this role.

Using a simple, one-step process, the researchers coated iron-oxide nanoparticles with green tea compounds called catechins and administered them to mice with cancer. MRIs demonstrated that the novel imaging agents gathered in tumour cells and showed a strong contrast from surrounding non-tumour cells. The researchers conclude that the catechin-coated nanoparticles are promising candidates for use in MRIs and related applications.

The authors acknowledge funding from the University of Cologne and the EU Project Nanommune.

### **Humans can empathise with Robots**

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Researchers have presented the first neuro-physiological evidence of humans' ability to empathise with a robot in perceived pain. Event-related brain potentials in human observers, reflecting empathy with humanoid robots in perceived pain, were similar to those for other humans in pain, except at the beginning of the top-down process of empathy. This difference may be caused by humans' difficulty in taking a robot's perspective.

Empathy is the basic human ability. We often feel empathy towards others in distress and console them. Is it possible for us to emphasise with humanoid robots? Since robots are becoming increasingly popular and common in our daily lives, it is necessary to understand our interaction with robots in social situations.

However, it is not clear how the human brain responds to robots in empathic situations.

Now, researchers at the Department of Information Science and Engineering, Toyohashi University of Technology, in collaboration with researchers at the Department of Psychology, Kyoto University, have found the first neuro-physiological evidence of humans' ability to empathise with robots in perceived pain and highlighted the difference in human empathy towards other humans and robots.

They performed electroencephalography (EEG) in 15 healthy adults, who were observing pictures of either a human or robotic hand in painful or non-painful situations, like a finger being cut by a knife. Event-related brain potentials for empathy towards humanoid robots in perceived pain were similar to those for empathy towards humans in pain. However, the beginning of the top-down process of empathy was

weaker in empathy toward robots than toward humans.

"The ascending phase of P3 (350-500 ms after the stimulus presentation) showed a positive shift in the observer for a human in pain in comparison with the no-pain condition, but not for a robot in perceived pain. Then, the difference between empathy towards humans and robots disappeared in the descending phase of P3 (500-650 ms)," explains *Associate Professor* Michiteru Kitazaki. "The positive shift of P3 is considered as reflecting the top-down process of empathy. Its beginning phase seems related to the process of perspective taking, as was shown in a previous study," says Kitazaki."

These results suggest that we empathise with humanoid robots in a similar fashion as we do with other humans. However, the beginning of the top-down process of empathy is weaker for empathy towards robots than towards humans. It may be caused by humans' inability in taking a robot's perspective.

It is reasonable that we cannot take the perspective of robots because their structure is very different from ours. The researchers are trying to manipulate humans' perspective of robots in a further study. This study will contribute to the development of human-friendly robots whom we feel sympathy for and are comfortable with.

## 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. The sites have been suggested on the basis of their possible utility to school systems.



- <http://www.psychologytoday.com/conditions/dissociative-identity-disorder-multiple-personality-disorder>
- <http://neurowiki2014.wikidot.com/group:dissociative-identity-disorder-potential-genetic-facto>
- <http://neurowiki2014.wikidot.com/individual:neuroanatomy-of-dissociative-identity-disorder>
- [http://www.medicinenet.com/dissociative\\_identity\\_disorder/article.htm](http://www.medicinenet.com/dissociative_identity_disorder/article.htm)
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