BIOME

The BIOlogy Education MEssenger

(An ATBS eNewsletter)

CONTENTS OF THIS ISSUE:

From The Editorial Team.....

Greetings from the editorial team of The Biome – the ATBS eNewsletter!! We are truly apologetic that we have been laid back for the past year and hence missed out on putting together a couple of issues. However, better late than never is what keeps us going and we are happy that it is September again and to celebrate this teacher's month, here we are with the third issue of Biome.

For the first time in this issue we have an article by a student team member of the Indian team that participated at the International Biology Olympiad – 2014 held in Bali, Indonesia – Lajja Patel. She speaks about her experiences as she went along the process of making it to the IBO!

We also have an article by Prof. B. B. Nath who has a rich teaching experience and is an inspiring teacher. An article by Prof. Rekha Vartak, head of the Biology Olympiad Cell includes a few thought-provoking theoretical questions along with the analysis on how the students understand those concepts. We also have a lab section where an experiment from the Olympiad Lab is included. We hope teachers would be able to use them in their own labs.

Hope you enjoy what we have for you!! Happy reading and a very happy teachers day!!

With best wishes.....

Bimalendu B. Nath, Department of Zoology, University of Pune, Pune

Rekha Vartak, HBCSE, TIFR, Mumbai

Anupama Ronad, HBCSE, TIFR, Mumbai

Think like a biologist, prepare for the IBO, change your life!

Ms. Lajja Patel from Gujarat was a silver medalist at the International Biology Olympiad (IBO) – 2014 held in Bali, Indonesia. She is currently studying in class XII.

A usual day for a school student is like this: wake up, go to school, come back, complete homework, go to tuitions, etc.etc. But, from 23 July 2014, days (and lives!) of 4 high school students changed forever, and I was lucky enough to be one of them! Waking up to sound of melodious birds (sometimes crows !) , wondering about the photosynthesis going on in the banyan leaves outside my room, going to HBCSE Olympiad Building, dissecting crabs, sharks and what not ; extracting DNA , running gels, estimating starch content in leaves, discussing challenging questions…All in all learning and more importantly, doing the subject that I love---Biology !

But why was I lucky enough to get to do all this? Let's time travel and go back to 23 July 2013 when I, a 10th grade student, saw the dream of participating in the IBO. I surfed the HBCSE website, learnt about IBO and all the stages involved and also how to prepare. I also ordered the books required for preparing: Campbell biology, Bruce Alberts :The Cell, Lehninger : Principles of genetics , etc. Little did I know that these books would not only help me in my preparation, but also alter my perception of how to gain knowledge.

I began by reading Campbell Biology, which introduced me to basic concepts of biology. Alongwith that, I read some topics from Lehninger and Bruce Alberts which became my favorite books as I found answers to some very interesting questions. These books also taught me the scientific method – how scientists hypothesize, design and perform experiments and discover groundbreaking things, which no one in the world knows about! I also read many popular science books – like Microbe hunters, Emperor of all

TEAM INDIA
At
IBO – 2014
Bali,
Indonesia

1. Arnav Kalra: Silver medal
2. Lajja Patel: Silver medal
3. Mudit Agarwal: Silver medal
4. Vaidehi Rakholia: Silver medal

maladies and books by Richard Dawkins which made me fall in love with evolutionary biology. During this time I also subscribed to Nature, to read actual scientific papers. Every new issue of Nature brought with it cutting edge research and I thoroughly enjoyed indulging myself into it. And then it was time for the exams – NSEB and INBO. I must say that the questions in both the exams were brilliant. It truly stimulated me to think and apply the concepts that I had learnt. In March, I learnt that I had made it to the OCSC! My dream now seemed incredibly near!

OCSC was an excellent experience. I performed practicals for the first time. The practicals were very ingeniously made and I could sense the hardwork put in by the team in preparing them. Theory questions were also thought provoking. After the tests were over, came D-DAY, when our results were going to be announced. I was overwhelmed but ecstatic when Dr. Rekha announced my name. I had made it to the team! My dream was realized. My hard work of one year had paid off! My mind was screaming: Bali, here I come !
Then came 23 July 2014, the day I was talking about. The start of our intensive but very interesting training !

Preparing for the IBO brought about a transformation in the way I thought about biology. I realized that biology is not a subject to be crammed, but to be felt, experienced and loved. I now wonder about "the endless forms most beautiful" around me, try to find answers to various interesting questions and practice thinking like a biologist. The world around me has suddenly expanded. I am now sure that whatever I do in my life, I am always going to be receptive to the biology around me at every moment. I also wish to incorporate scientific thinking into other young minds and inspire them to be as passionate about biology as I am.

I would like to thank ATBS, HBCSE and IBO for introducing me and giving me an opportunity to participate in the greatest adventure man has ever started - BIOLOGY!

--------- Ms. Lajja Patel

TEAM INDIA At IBO – 2015 Aarhus, Denmark

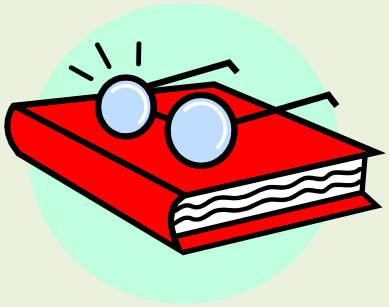
1. Mudit Agarwal: Silver medal
2. Oshin Bhatia: Silver medal
3. Rishikesh Choudhari: Bronze medal
4. Vaidehi Rakholia: Bronze medal

TEAM INDIA – IBO 2014

TEAM INDIA – IBO 2015

Through The Teacher's Glasses...

Prof. Bimalendu B. Nath is from the Department of Zoology, Savitibai Pune University, Pune. He is actively involved in teaching as well as research for over three decades now.



Evolution of documentation in Biology

Bimalendu B. Nath
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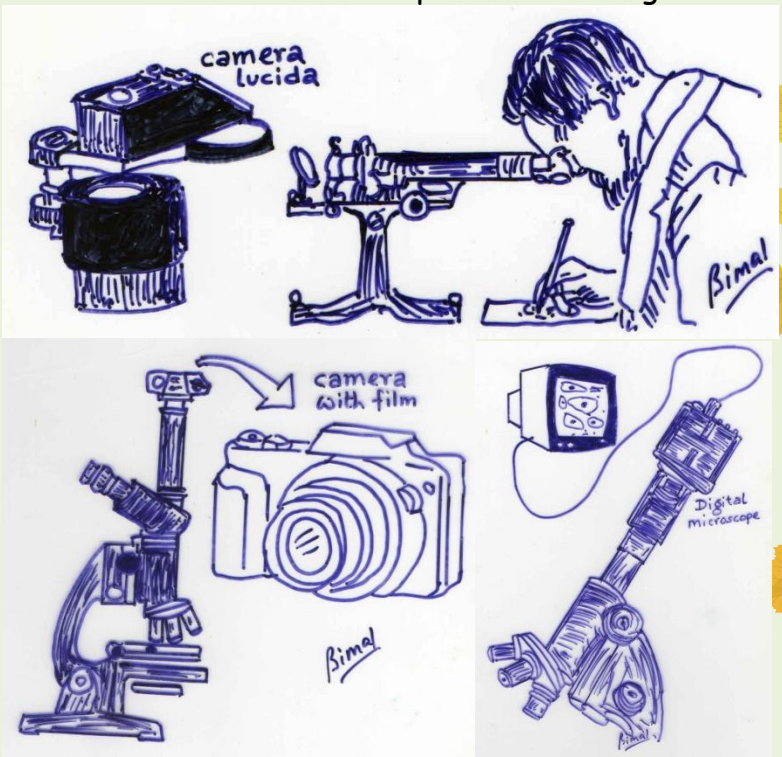
Documentation of flora and fauna probably dates back to the prehistoric days of human civilization when cave paintings and imprints on stones remained as the only depiction of the living world of bygone era. The observations of plants and animals made by Aristotle (384-322 B.C.) in his writings were supported by drawings. Unlike his predecessors, who used to carry out all their work in their mind without keeping a record, Aristotle made elegant drawings of parts of animals to find out the logistics of their functions. In the post-Aristotle period, several books, monographs and treatises of biology were published which enriched our knowledge about the living system. However, only available option of biological documentation was 'drawings'. Nevertheless, emergence of biology as a formal branch of science in the 19th century witnessed development of tools and techniques for the documentation of morphology and anatomy of plants and animals.

Sixteenth century, known for the beginning of the modern era of science, witnessed invention of microscope. Subsequently, microscopes opened a new world of the living

system beyond the resolution limit of human eye. Anthonie von Leenwenhoek's (1632-1723) drawings happened to be the first documentation of microscopic entities of living system.

In the beginning of 19th century, Sir William Wollaston patented a prism-based device which became popular by the name 'Camera lucida'. In fact, camera lucida does not have anything to do with a camera but it simply allows you to trace what you see! During the Victorian times, small camera lucida was developed which could be affixed to a microscope. A large body of literature on taxonomy, morphology and anatomy could be found in the archival record where camera lucida drawings were the predominant tools of documentation of biological data.

The development of 'Twin-lens reflex' (TLR) and 'Single-lens reflex' (SLR) cameras led to the optimization of design to facilitate image acquisition through a microscope. The birth of 'photomicrography' revolutionized documentation of sub-cellular components of living cells.



Activities during 2014 till mid-2015!!

One day conference eon 'Wetlands for Environmental Health' was held on 2nd February, 2015 at SDSM's Sonopant Dandekar College, Kharekuran Road, Palghar.

Activities during 2014 till mid-2015!!

- **National Seminar on 'Modern Tools and Techniques in Plant Sciences' on 14th March, 2015 at Shri Mathurdas Mohota College of Science, Nagpur.**

Before the advent of dedicated specialized cameras attached to microscopes, images used to be captured by an interesting method. Magnified images seen through an objective lens of a microscope was projected either on a wall or onto a white screen. Subsequently, the projected image was captured by a conventional camera. Development of accessory camera as an attachment to microscopic system brought hassle-free documentation of biological materials.

In the beginning of the 20th century, photomicrographic cameras used to be horizontal which was replaced by microscopes with vertical photomicrography set up. Over the following decades, photomicrography attained a sophisticated level of quality. Many of us, who used reels of film for microphotography in the laboratories, gradually shifted to digital cameras. Whether it is wildlife photography or capturing images under a microscope, digital acquisition of images certainly offer better control over images and hassle-free operation. Photos captured by digital camera are not stored on film and the optical information is stored on electronic software aided memory devices. Moreover, one can conventionally replicate the digital image files by 'copy-paste' function and store on personal computers or burn on compact discs, pen-drives, memory cards and in other external devices. Such an option of huge storage facility was not available with film-based cameras. In recent years, the video-based digital cameras facilitated live cell imaging through 'time-lapse' microscopy for a better understanding of *in-vivo* events of many biological functions. The digital image and videos are going to provide new insights into the dynamic nature of cellular and molecular processes of activities that define "life".

Indian National Biology Olympiad – 2015

Prof. Rekha Vartak is the Head of the Biology Olympiad Cell at HBCSE (TIFR) as well as the Academic Coordinator of the Biology Olympiad Programme in India.

The second stage selection exam leading to the International Biology Olympiad is the Indian National Biology Olympiad (INBO). This is a theoretical exam held at about 16 centres across the nation. A total of about 300 students appear for this examination of which the top 35 students get selected to attend the next stage ie Orientation Cum Selection Camp (OCSC) which is a week-long camp held at Homi Bhabha Centre for Science Education (HBCSE).

Since the INBO exam is a theory exam and the expected outcome of conducting this exam is to select the students who do well, several multiple choice questions of good quality have to be designed. While designing these multiple choice questions, the following points are required to be considered:

1. The question should test student's logical reasoning or analytical abilities.
2. Question should not be testing merely the knowledge of the subject but the ability to process the acquired knowledge and co-relate.
3. Difficulty level of the question should be appropriate for the students who are likely to appear for the test.
4. All the choices provided should be equally attractive to the students.

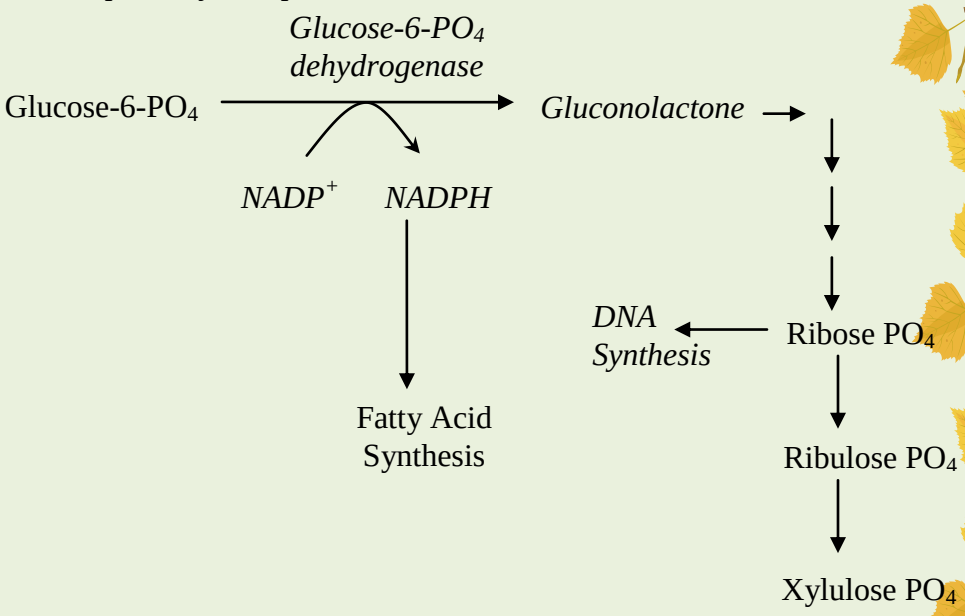
Two questions that appeared in the INBO-2015 Theory paper are given below. The answers given by top 35 students selected after the examination are also tabulated. The findings have been analyzed and discussed.

Activities during 2014 till mid-2015!!

- **Thane Creek Convention was held on the Occasion of the World Mangrove Day on the 26th of July, 2015 at B. N. Bandodkar College of Science.**

Question 1

In addition to glycolysis, there also exists another "glucose direct oxidation" pathway in the cell cytoplasm. This pathway is depicted below.



Enzymes of this pathway will be found abundantly in:

i. *Bone marrow cells*
ii. *Liver cells*
iii. *Adipose tissue*
iv. *Skeletal muscles*

a. *i and iii only*
b. *iii and iv only*
c. *i, ii and iii only*
d. *ii and iv only*

Question 2

Red blood cells also possess the same pathway that is shown in Question no. 6. What is the role of this pathway in these cells?

i. *To provide pentose sugars required for nucleic acid synthesis.*

Activities during 2014 till mid-2015!!

- **National Seminar on 'Wetlands: Present Status, Ecology & Conservation' was held on 12th August, 2015 at Maharshi Dayanand College of Arts, Science and Commerce.**

ii. *To provide reducing equivalents required for fat synthesis.*

iii. *To provide extra energy by direct glucose oxidation.*

iv. *To generate NADPH that can provide protection against reactive oxygen species.*

a. *i and iv only*

b. *iii and iv only*

c. *i, ii and iii only*

d. *iv only*

Response of students:

QUESTION 1		
Option	No. of students who chose the option	Response
a	3	8%
b	2	6%
c	29	83%
d	0	0%
Not attempted	1	3%

QUESTION 2		
Option	No. of students who chose the option	Response
a	3	9%
b	10	28%
c	22	63%
d	0	0%
Not attempted	0	0%

Activities during 2014 till mid-2015!!

- A Resource Generation Camp (RGC) for the Stage I exam of the Biology Olympiad was held on 7th and 8th August, 2015 at Homi Bhabha Centre for Science Education (HBCSE), Mumbai.

Discussion:

Question 1

It is clear from the question and the options that it refers to the utilization of glucose- 6 - phosphate in mammalian cells. Analysis of the pathway and some prior knowledge is helpful in arriving at the correct answers.

The pathway indicates generation of reducing equivalents in the form of NADPH - used in fatty acid synthesis and pentose sugars – required for nucleic acid synthesis. Thus it hints towards organs whose major functions are either fatty acid or nucleic acid synthesis. Rapidly dividing cells of bone marrow need continuous supply of nucleic acids while liver and adipose tissue are the major sites of fatty acid synthesis. Thus options i, ii and iii are the correct answers. Muscles have a very small amount of the enzymes of this pathway as it is neither the site of fatty acid synthesis nor of nucleic acid synthesis.

Question 2

Question No. 2 tests student's prior knowledge about mature human erythrocytes, their major functions and the correlation of these to the given pathways.

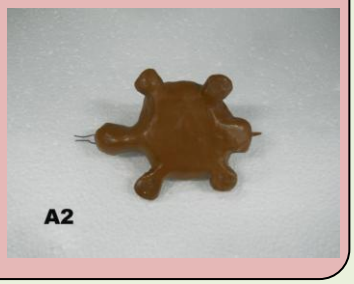
Since mature erythrocytes are devoid of all cell organelles including nucleus and are the major oxygen carrying cells, there is also generation of reactive oxygen species that can affect viability of these cells. Hence compounds that help in maintaining reducing environment in the cell (such as NADPH) are of great importance in these cells. Hence the correct option is d. As can be seen from analysis, none of the top 35 students got the correct answer. All the students went either for option a or b or c, not realizing that erythrocytes are devoid of any organelles.

Since almost every student attempted both the questions, it indicates that students found the questions approachable.

In the Bio Lab……..

Animal taxonomy in an undergraduate lab is many a times restricted to memorizing various morphological characters of animal specimens. However, if one specimen is studied in comparison with another specimen it makes the study of these characters more relevant. Based on characters that are similar between the specimens, a similarity matrix can be generated leading to the construction of a cladogram. In this lab, we have developed a very simple exercise in numerical taxonomy using animal models. Such exercises could be developed for actual animal/plant specimens as well.

Materials Used:
Set of 6 Animal Models. Pictures of these models (dorsal & ventral view) are shown here:



NUMERICAL TAXONOMY

Plants or animals can be classified by different methods:

1) **Traditional Taxonomy (uses LinneanTaxonomy):**

It defines grades = taxa that reflect ancestry and degree of evolutionary change and classifies organisms into groups by structure, origin, common ancestor etc.

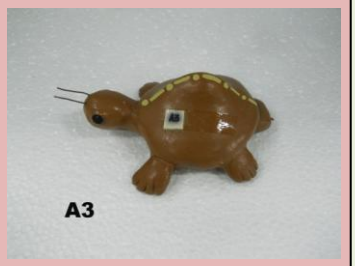
2) **Cladistics (Phylogenetic):**

This classification reflects only evolutionary history and ignores overall similarity unless that similarity reflects close family relationships.

3) **Phenetics or numerical Taxonomy:**

Here, the similarity between organisms is the main guidance in classification, even if this similarity (in whatever character used, including genetic information)

does not necessarily reflect evolutionary family relationships.



This activity mainly involves grouping the animals together based on the similarity that they share and classifying them on the basis of external morphological features.

The percent similarity of external characters that animals share with each other is called the "Similarity Coefficient". This can be used to construct a "Similarity Matrix".

A set of 6 animals numbered A_1 – A_6 is given to you. Observe these animals for the 10 features given below and then determine the similarity coefficients between them as follows:

Animals A_1 and A_6 share total 5 features out of 10. Hence, their similarity coefficient is 50%. This figure is filled in the similarity matrix (Fig.1) at the point of intersection of A_1 and A_6. In the same way, find out similarity coefficients between all the different animals and complete the similarity matrix.

Gross features to be observed:

1. **Head shape**
2. **Overall body shape**
3. **Presence or absence of tail stub (body extension at the rear end)**
4. **Presence or absence of hump**
5. **Antennae (Number and type/ shape)**
6. **Tail length**
7. **Eyes (ring colour)**
8. **Design of the vertebral line**
9. **Variations in limbs**
10. **Texture of the ventral side**

A classification key is given below (Fig 2). Based on the "Similarity Matrix" that you have completed, place the correct animal numbers in the empty boxes.

Fig.1: Similarity Matrix

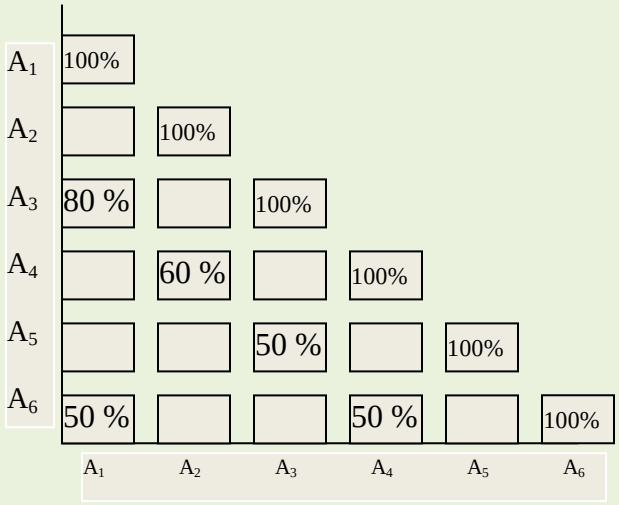
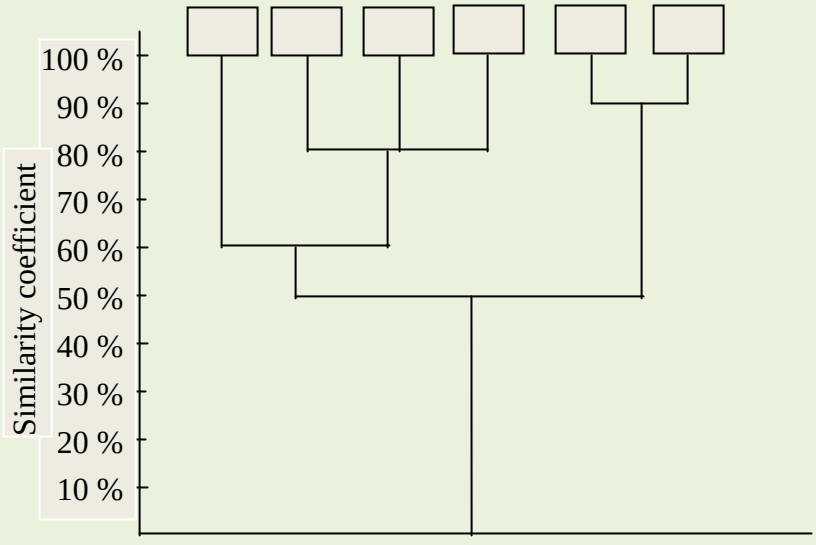


Fig. 2: Classification based on similarity matrix:



---- By the Biology Olympiad Cell, HBCSE, TIFR

Recreation Corner .....

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