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Research Paper

Problem-Based Learning: Effects on Critical and Creative Thinking Skills in Biology

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Research Paper

Problem-Based Learning: Effects on Critical and Creative Thinking Skills in Biology

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This study determined the effects of problem-based learning (PBL) on critical and creative thinking skills of second year high school biology students in the Philippines. A quasi-experimental research design using pretest-posttest was employed. One class was exposed to instruction with PBL while the other class was exposed to conventional instruction (Non-PBL). Students exposed to instruction with PBL had higher posttest mean scores in the Critical Thinking Skills Test and Creative Thinking Skills Test than those who were exposed to instruction without PBL. In addition, critical thinking skill appeared to be a significant positive predictor of creative thinking skill. Hence, it is recommended that teachers use the PBL approach in biology classes to enhance the critical and creative thinking skills of the students.

Keywords: biology education, critical and creative thinking skills, problem-based learning

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INTRODUCTION

What is education in the 21st century? Many educators have been confronted by this question as they endeavor to equip learners with knowledge, skills, and attitude (Soulé and Warrick, 2015). Education experts would agree that education in the 21st century is about honing intelligences (Donovan *et al.*, 2014). As such, educators should embrace innovation and transformation in the teaching and learning processes. They have to make sure that teaching strategies and approaches address the needs of students. Indeed, they are realizing the importance of developing thinking skills (Tan, 2003; Tan, 2009). The role of teachers is indispensable in nurturing thinking skills. It requires enough time and effort to plan, design, execute and evaluate learning activities (Hancer, 2013).

The Constitution of the Philippines encourages all educational institutions to promote critical and creative thinking among Filipinos. The Bureau of Secondary Education endorses the following goals in science: (1) to promote student awareness of the relevance of science to life, and (2) to develop critical and creative thinking skills as well as skills in problem solving (Bureau of Secondary Education, 2009). Many education systems are characterized by learning through memorization, learning by imitation, and learning by modeling (Garcia-Retamero *et al.*, 2009; Hamidi *et al.*, 2011; Helikar *et al.*, 2015). These systems are important for acquiring fundamental knowledge and skills. However, these are not enough for students to develop necessary thinking skills in order to face real-world problems. Biology teachers have been criticized for giving numerous facts to students and

requiring those facts in the examination (Momsen *et al.*, 2010). As a result, the opportunities to stimulate curiosity, inquiry, engagement, and motivation in learning are reduced, if not lost (Tan, 2003).

Critical thinking can be developed through student-centered approach in teaching and learning (Snyder and Wiles, 2015), whereas creative thinking can be enhanced through open-ended questions during class discussion and incorporate problem-based scenarios in student learning activities (Awang and Ramly, 2008).

Problem-Based Learning (PBL) is a pedagogical approach originally developed for medical schools. A problem acts as the stimulus for students' learning activity. Learning is purposeful as students learn while searching for possible solution to problems and they learn in the context in which knowledge is to be used (Chin and Chia, 2004). PBL promotes higher-order thinking skills, knowledge construction, collaborative learning, and independent learning. Furthermore, PBL helps achieve the purpose of education which is to develop content experts, problem solvers, team players, and life-long learners (Tan, 2009).

Pepper (2009) replaced conventional tutorial and laboratory sessions in three first year course units with problem-based learning in science. The majority of the students indicated that they relished working in groups to share new knowledge, the flexibility in approaches and workload. On the contrary, some students were certain that their learning experience was enhanced but preferred greater direction in the use of PBL.

Akinoğlu and Tandoğan (2007) investigated the effects of PBL active learning in 7th grade science on the students' academic achievement, attitude and concept learning. They concluded that the implementation of PBL had positively affected students' academic achievement and attitude towards science. Moreover, the students' conceptual development significantly improved, keeping misconception at the lowest level.

Chin and Chia (2006) examined PBL for secondary school students using ill-structured problems in biology and proved effective in a case study involving nine students using PBL. They found that several students initially experienced difficulties in identifying a problem by themselves. Eventually, however, they formulated personally meaningful problems for investigation. So it turned out that the ill-structured problems stimulated the students to pose questions which charted their course of action leading to independent inquiry. Students were led to investigate a multidisciplinary element beyond the boundaries of typical school science.

Awang and Ramly (2008) investigated the effect of PBL on the creative thinking skill approach through problem-based learning: pedagogy and practice in the engineering classroom. The findings revealed that the over creativity of the students was characterized by originality and fluency. Students who got high scores on originality showed the ability to produce unexpected ideas while those students who got high scores on fluency showed the capability of producing a large number of ideas in response to problem-solving situations. However, the flexibility scores showed that most of the students were not flexible in their approach in relation to learning and acquiring knowledge.

The study of Yuan *et al.* (2008) on promoting critical thinking through PBL involved 23 baccalaureate nursing students and used quasi-experimental pretest- posttest based on the revised version of California Critical Thinking Skills Test. It was shown that students' critical thinking skills significantly improved in one semester using PBL. Most of the students involved in the study suggested that PBL allowed them to share their opinion with others, analyze situations in different ways and explore the possibilities of solving problems. However, a few of the participants felt very stressed and overloaded during the PBL process.

Edwards and Hammer (2007) pointed out several problems encountered on PBL: 1) Students

believed that the tasks were ambiguous; 2) Students experienced difficulties in group work; and 3) Students agreed that individual differences affected the results of their study. On the contrary, the benefits of PBL such as improvement on students' communication skills, ability to locate and evaluate relevant information, and increased capacity for problem solving were also revealed.

The study of Thummarpon and Thongkam (2002) involved 150 participants that were divided into three groups, namely: 1) science-based; 2) art-based and 3) combined group. Twenty-five (25) students per group were randomly assigned to the PBL teaching method and the other 25 were exposed to regular teaching. Findings revealed the following: 1) PBL had a greater effect on academic achievement than the regular teaching method, 2) different group characteristics had no significant effect on academic achievement, 3) teaching methods and characteristics had interaction effects on critical thinking. The results showed that PBL used on science-based students had a greater effect on critical thinking than the regular teaching method.

As a pedagogical approach, PBL has potential in enhancing thinking skills of the students (Chin and Chia, 2004). Although it has been used in other countries, this approach is not widely adopted in the Philippines and not much has been documented on PBL specifically, at the secondary level. Thus, it is conducted to examine if Filipino students' critical and creative thinking skills in biology would be enhanced by PBL.

METHODOLOGY

Sample

Two groups of second year high school biology students, with the age range of 14 to 15 years, in one of the Filipino-Chinese schools in Quezon City, Philippines, were involved in the study. There were 27 students in each group and they were randomly assigned to either the PBL or Non-PBL group.

The Instruments

Two instruments were used in the study, namely, Critical Thinking Skills Test in Biology and Creative Thinking Skills Test in Biology. Both of these instruments were developed by the present researchers from existing test instruments, sent to six experts in the teaching and learning field for review and then revised based on the comments received from the reviewers. These experts includes three science education specialists from the University of the Philippines - National Institute of Science and Mathematics Education Development and three college professors specialize in thinking skills and science education from the University of the Philippines, College of Education. The Critical Thinking Skills Test in Biology is based on the Watson–Glaser Critical Thinking Appraisal (Watson and Glaser, 1991). The test is made up of 39 multiple choice questions each worth one point for a total of 39 points. This test is divided into five-parts: Part I Making inference; Part II Recognition of assumptions; Part III Deduction; Part IV Interpretation; and Part V Evaluation of arguments. The Creative Thinking Skills Test in Biology is based on Torrance Test of Creative Thinking (Torrance, 2006). The test is made up of 13 open-ended questions which require the application of some important abilities in creative thinking skills such as originality, fluency, flexibility and elaboration. This test is divided into seven-parts: Part I Improve a product; Part II Unusual uses; Part III Make another product; Part IV What if; Part V Solve a problem; Part VI Make a story; and Part VII Design an experiment. The students' answers in this test were scored using the scoring rubric for creative thinking skills patterned after the work of Torrance (2006) which is shown in Table 1. <You may email the corresponding author for the copy of these instruments>

Data Collection Procedure

The study covered the first quarter of School Year 2012-2013, which is 40 days, or 8 weeks, long. The lessons included in the study were on ecology. The students had the biology class for one-hour and twenty-minute duration every day

from Monday to Friday. The two groups of students participating in the study had different class schedules every morning. The same teacher-researcher executed the two methods of instruction. One group was taught using PBL while the other group was taught using instruction without PBL. Learning activities for the PBL group included

short video presentation, group work using non-structured activities and post discussion using software presentation. Those for the Non-PBL group were the same as those of PBL group except for the group work using structured activities (Table 2).

Table 1 Criteria for Scoring Creative Thinking Skills Test Response

| Creative Thinking Skills | Criteria | Score |
|--------------------------|--|-------|
| ORIGINALITY | Formulation of ideas that are unique | |
| | Least original (common idea) | 0 |
| | Moderately original (partial/some) | 2 |
| | Most original | 4 |
| FLUENCY | Number of correct responses | |
| | No correct response | 0 |
| | 1-2 correct response/s | 2 |
| | 3 or more correct responses | 4 |
| FLEXIBILITY | Number of acceptable ideas/ products presented | |
| | No idea/product presented | 0 |
| | 1-2 product/s presented | 2 |
| | 3 or more products presented | 4 |
| ELABORATION | Completeness of the procedure presented | |
| | No procedure presented | 0 |
| | Almost complete procedure presented | 2 |
| | Complete procedure presented | 4 |

Table 2 Lesson Structure for PBL Group and Non-PBL Group

| | PBL Group | Non-PBL Group |
|-----------------------------|---|--|
| Pre-lecture Activity | Students were asked to watch short video clippings on ecology. | |
| Motivation | The teacher asked questions based from the short video clipping presented. | |
| Lesson Proper | Groups were given non structured student activities or problem-based scenarios from which they derived facts, what they need to know, learning issues, possible solutions, new learning issues, and dependable solutions (Lambros, 2004). | Groups were given structured student activities modified from existing workbooks and laboratory manuals. The format of the activity includes the title, materials, introduction, procedure, discussion, summary, and conclusion. |
| | One representative student for each group shared their output at the end of the activity. Post-discussion followed after the student activity. | |
| Assessment | Short written quiz about the lesson | |

Data Analysis

The data were analyzed using Microsoft Excel and the SPSS 20 for the following analyses: 1) *t*-test for independent samples was applied to the pretest mean scores on the Critical Thinking Skills

Test in Biology and Creative Thinking Skills Test in Biology of PBL and Non-PBL groups. It was also utilized to determine if the difference in the posttest mean scores between the PBL group and the Non-PBL group was significant, 2) *t*-test for

paired samples was used to determine whether the differences in the pretest and posttest mean scores of the Critical Thinking Skills Test and Creative Thinking Skills Test in Biology between the PBL group and Non-PBL group were significant, and 3) linear regression was used to determine if critical thinking skill predicted creative thinking skill.

RESULTS AND DISCUSSION

The presentation of the results is divided into seven parts: 1) comparison of pretest scores of PBL group and Non-PBL group on Critical Thinking Skills Test in Biology, 2) comparison of pre- and posttest scores of PBL group and Non-PBL group on Critical Thinking Skills Test in Biology, 3) comparison of posttest scores of PBL group and Non-PBL group on Critical Thinking Skills Test in Biology (sub-skills), 4) comparison of pretest scores of PBL group and Non-PBL group on Creative Thinking Skills Test in Biology, 5) comparison of pre and posttest scores of PBL group and Non-PBL group on Creative Thinking Skills Test in Biology, 6) comparison of posttest scores of PBL group and Non-PBL group on Creative Thinking Skills Test in Biology (sub-skills), and 7) critical thinking skill as predictor of creative thinking skill.

Critical Thinking Skills

Prior to the start of the intervention, the pretest mean scores in the Critical Thinking Skills Test in Biology of the PBL and Non-PBL groups were compared using two-tailed *t*-test for independent samples. There was no significant difference ($p=0.828$) in the pretest mean total score between the PBL group ($M=26.07\pm 6.10$) and the Non-PBL group ($M=25.74\pm 5.09$). The results establish that the PBL and Non-PBL groups were initially comparable in terms of critical thinking skills.

To determine if there was an improvement in the critical thinking skills in biology of the PBL and Non-PBL groups, the one-tailed *t*-test for related samples was used. There was a significant difference at the 0.000 level in pretest ($M=26.07$

± 6.10) and posttest ($M=31.52\pm 1.87$) mean total scores of the PBL group and there was also a significant difference at the 0.000 level in pretest ($M=25.74\pm 5.09$) and posttest ($M=30.04\pm 2.95$) mean total scores of the Non-PBL group in the Critical Thinking Skills Test in Biology.

To compare the posttest mean scores in the Critical Thinking Skills Test in Biology of the two groups, one tailed *t*-test for independent samples was used. There was a significant difference at the 0.032 level in the mean total scores of the PBL group (31.52 ± 1.87) and the Non-PBL group (30.04 ± 2.95).

Five Components of Critical Thinking Skills

The five components of critical thinking skills used in the present study were adopted from Watson and Glaser (1991). The five components of critical thinking skills are as follows: Making inference, Recognition of assumptions, Deduction, Interpretation of data, and Evaluation of arguments.

The posttest mean scores of the PBL and Non-PBL groups in the Critical Thinking Skills Test in biology are presented in Table 3.

On the inference skill the posttest mean score has no significant difference between the PBL group ($M=5.67\pm 0.88$) and Non-PBL group ($M=5.63\pm 1.18$) ($p>0.05$).

On the recognition of assumption skill, the posttest mean score has no significant difference between the PBL group ($M=4.96\pm 0.65$) and the Non-PBL group ($M=4.67\pm 0.78$).

On the deduction skill, the posttest mean score has no significant difference between the PBL ($M=5.47\pm 0.69$) group and the Non-PBL group ($M=5.47\pm 0.69$).

On the interpretation skill, the posttest mean score has a significant difference between PBL group ($M=7.59\pm 0.93$) and the Non-PBL group ($M=6.74\pm 1.56$).

On the evaluation of argument skill, the posttest mean score has no significant difference between the PBL group ($M=7.89\pm 1.42$) and the Non-PBL group ($M=7.59\pm 1.57$).

Table 3 Comparison of the Posttest Mean Scores in Critical Thinking Skills Test in Biology for the Two Groups

| Skill | Group* | Mean±SD | t-value | Sig.(p=) |
|----------------------------|---------|-----------|---------|----------|
| Inference | PBL | 5.67±0.88 | 0.131 | 0.100 |
| | Non-PBL | 5.63±1.18 | | |
| Recognition of Assumptions | PBL | 4.96±0.65 | 1.512 | 0.137 |
| | Non-PBL | 4.67±0.78 | | |
| Deduction | PBL | 5.47±0.69 | 0.000 | 1.000 |
| | Non-PBL | 5.47±0.69 | | |
| Interpretation | PBL | 7.59±0.93 | 2.438 | 0.018 |
| | Non-PBL | 6.74±1.56 | | |
| Evaluation of Arguments | PBL | 7.89±1.42 | 0.725 | 0.472 |
| | Non-PBL | 7.60±1.58 | | |

* N=27 for each group.

Creative Thinking Skills

Prior to the start of the intervention, the pretest mean scores in the Creative Thinking Skills Test in Biology of the PBL and Non-PBL groups were compared using a two-tailed *t*-test for independent samples. There was no significant difference ($p=0.899$) between the pretest mean total score of the PBL group ($M=5.63\pm 4.64$) and that of the Non-PBL group ($M=5.48\pm 3.87$). The results establish that the PBL and Non-PBL groups are initially comparable in terms of creative thinking skills.

To determine if there was an improvement in the creative thinking skills in biology of the PBL and Non-PBL groups, the one-tailed *t*-test for related samples was used. There was a significant difference at the 0.000 level in pretest ($M=5.63\pm 4.64$) and posttest $M=18.22\pm 6.91$ mean total scores of the PBL group and there was no significant difference at the 0.207 level in pretest ($M=5.48\pm 3.87$) and posttest ($M=6.37\pm 4.23$) mean total scores of the Non-PBL group in the Creative Thinking Skills Test in Biology.

To compare the posttest mean scores of the two groups in Creative Thinking Skills Test in Biology, one tailed *t*-test for independent samples was used. The difference between the posttest

mean score of the students exposed to PBL ($M=18.22\pm 6.91$) and that of the students exposed to Non-PBL ($M=6.37\pm 4.23$) was a significant at the 0.05 level.

The findings of the present study coincide with those of Tan (2003, 2009) and Awang and Ramly (2008). According to Tan (2009), PBL enhances creative thinking skills. He believes that PBL is a vehicle for cultivating creativity and, therefore, encourages the development of creative thinking skills. This was also validated by the study of Tan (2003) and Awang and Ramly (2008) that PBL has a positive effect on the different aspects or components of creativity.

Four Components of Creative Thinking Skills

The four components of creative thinking skills used in the present study were adopted from Torrance (2006). The four components of creative thinking skills are as follows: Originality, Fluency, Flexibility and Elaboration.

Table 4 shows the mean posttest scores of the PBL and Non-PBL groups in the Creative Thinking Skills Test in Biology.

On the originality skill, the posttest mean score of the students exposed to PBL ($M=6.96\pm 1.95$) was higher than that of the students exposed to Non-PBL ($M=2.96\pm 2.03$). There was a

significant difference in the posttest mean scores of the two groups at the 0.05 level. This means that the students in PBL group can produce more unique and unusual ideas in biology. The result

confirms the findings of Awang and Ramly (2008) who used Torrance Test of Creative Thinking that the PBL approach significantly improves the student's originality in the creative thinking skills.

Table 4 Comparison of the Posttest Mean Scores in Creative Thinking Skills in Biology for the Two Groups

| Skill | Group* | Mean±SD | t-value | Sig.(p=) |
|-------------|---------|-----------|---------|----------|
| Originality | PBL | 6.96±1.95 | 7.385 | 0.005 |
| | Non-PBL | 2.96±2.03 | | |
| Fluency | PBL | 9.04±4.13 | 6.423 | 0.005 |
| | Non-PBL | 3.11±2.44 | | |
| Flexibility | PBL | 0.90±1.01 | 3.362 | 0.001 |
| | Non-PBL | 0.15±0.53 | | |
| Elaboration | PBL | 1.33±1.24 | 4.561 | 0.001 |
| | Non-PBL | 0.15±0.53 | | |

* N=27 for each group.

On the fluency skill, the posttest mean score of the students exposed to PBL ($M=9.04\pm 4.13$) was higher than that of the students exposed to Non-PBL ($M=3.11\pm 2.44$). There was a significant difference at the 0.005 level in the posttest mean scores of the two groups. This implies that students in the PBL group can produce a large number of correct alternative solutions to problem-solving scenarios in biology. The result coincides with the findings of Awang and Ramly (2008) that the PBL approach positively affected the fluency of engineering students.

On the flexibility skills, the PBL group has a higher posttest mean score ($M=0.90\pm 1.01$) compared to the Non-PBL group ($M=0.15\pm 0.53$) and the difference in the scores was significant at the 0.001 level. It means that students exposed to PBL approach can generate more ideas from a different point of view in response to problem-solving situations in biology. The result supports the findings of Awang and Ramly (2008) where the PBL approach significantly improved the engineering student's flexibility.

On the elaboration skill, there was a significant difference at the 0.001 level in the posttest scores of the two groups in favor of the PBL group. This means that students exposed to the PBL approach can improve ideas by providing more details in response to problem-solving situations in biology.

Critical Thinking Skill as Predictor of Creative Thinking Skill

Simple linear regression analysis was used to test if critical thinking skill significantly predicted creative thinking skills. The result of linear regression analysis indicated that critical thinking skills accounted for 13.9% of the variation in the creative thinking skills posttest mean score ($R^2= 0.139$, $F(1.53)=8.40$) and the regression model was statistically significant ($p=0.005$). This means that critical thinking skills significantly predicted creative thinking skills. The result of the present study supports the claims of Paul and Elder (2004) that critical and creative thinking are interwoven, inseparable, and interdependent. They argued that "only when we understand critical and creative

thought truly and deeply, we recognize them as inseparable, integrated and unitary”.

CONCLUSIONS AND RECOMMENDATIONS

The study showed that students exposed to instruction with PBL had higher posttest mean scores in the Critical Thinking Skills Test and Creative Thinking Skills Test in Biology than those who were exposed to instruction without PBL. In addition, critical thinking skill appeared to be a significant positive predictor of creative thinking skill.

Several studies on PBL revealed that PBL promotes collaborative learning (Pepper, 2009), improves attitude toward science (Akinoğlu and Tandoğan, 2007), develops content knowledge (Chin and Chia, 2004), and enhances thinking skills (Awang and Ramly, 2008; Yuan *et al.*, 2008). In this study, it was indicated that PBL improved test scores of the students in the critical and creative thinking skills tests. Thus, Biology educators should incorporate PBL into the curriculum for the enhancement of thinking skills.

Most of the studies on PBL focused on college students such as in engineering (Awang and Ramly, 2008), nursing (Yuan *et al.*, 2008), medicine (Spencer and McNeil, 2009) and education (Semerci, 2006). This study focused on high school students and revealed that PBL was an effective teaching approach in teaching biology at the secondary level. Hence, teachers must use PBL in teaching biology to high school students for the development of students' critical and creative thinking skills.

For further studies, it is recommended: 1) to use PBL in other science subjects such as Physics and Chemistry to see more holistic perspective on the effects of PBL in critical and creative thinking skills, 2) to allot longer time in studying the effects of PBL in other lessons in biology for more thorough results, 3) to increase the sample size of student-participants for more reliable findings, 4) to consider the impact of language or the medium of instructions to generate possible correlation, 5) to

identify problems encountered by teachers, students, and researchers to determine hindrances and barriers in the implementation of PBL in secondary education.

REFERENCES

- Akinoğlu, O. and Tandoğan, R. Ö. (2007) The effects of problem-based active learning in science education on students' academic achievement, attitude and concept learning. *Eurasia Journal of Mathematics, Science & Technology Education* **3**(1): 71-81.13.
- Awang, H. and Ramly, I. (2008) Creative thinking skill approach through problem-based learning: pedagogy and practice in the engineering classroom. *International Journal of Human and Social Sciences* **3**(1): 18-23.
- Chin, C. and Chia, L. G. (2004) Implementing project work in biology through problem-based learning. *Journal of Biological Education* **38**(2): 69-75.
- Chin, C. and Chia, L. G. (2006) Problem-based learning: Using ill-structured problems in biology project work. *Science Education* **90**(1): 44-67.
- Donovan, L., Green, T. D. and Mason, C. (2014). Examining the 21st century classroom: Developing an innovation configuration map. *Journal of Educational Computing Research* **50**(2): 161-178.
- Edwards, S. and Hammer, M. (2007) Problem-based learning in early childhood and primary pre-service teacher education: Identifying the issues and examining the benefits. *Australian Journal of Teacher Education* **32**(2): 20-36.
- Garcia-Retamero, R., Takezawa, M. and Gigerenzer, G. (2009) Does imitation benefit cue order learning? *Experimental Psychology* **56**(5): 307-320.
- Hamidi, F., Kharamideh, Z. M. and Ghorbandordinejad, F. (2011) Comparison of the training effects of interactive multimedia (CDs) and non-interactive media (films) on increasing learning speed, accuracy and

- memorization in biological science course. *Procedia Computer Science* **3**: 144-148.
- Hancer, A. H. (2013) The correlation between the scientific process and creative thinking skills of the preservice teachers. *International Journal of Academic Research* **5**(3): 240-246
- Helikar, T., Cutucache, C. E., Dahlquist, L. M., Herek, T. A., Larson, J. J. and Rogers, J. A. (2015) Integrating Interactive Computational Modeling in Biology Curricula. *Plos Computational Biology* **11**(3): 1-9
- Lambros, A. (2004) *Problem-Based Learning in Middle and High School Classrooms: A Teacher's Guide to Implementation*. Corwin Press.
- Momsen, J. L., Long, T. M., Wyse, S. A. and Ebert-May, D. (2010) Just the facts? Introductory undergraduate biology courses focus on low-level cognitive skills. *CBE-Life Sciences Education* **9**(4): 435-440.
- Paul, R. and Elder, L. (2004) *Critical and Creative Thinking*. The Foundation for Critical Thinking, Dillon Beach, CA
- Pepper, C. (2009) Problem based learning in science. *Issues in Educational Research* **19**(2): 128-141.
- Semerci, N. (2006) The effect of problem-based learning on the critical thinking of students in the intellectual and ethical development unit. *Social Behavior & Personality: An International Journal* **34**(9): 1127-1136.
- Snyder, J. J. and Wiles, J. R. (2015) Peer led team learning in introductory biology: Effects on peer leader critical thinking skills. *Plos ONE* **10**(1): 1-18.
- Spencer, A. M. and McNeil, M. (2009) Interdisciplinary curriculum to train internal medicine and obstetrics-gynecology residents in ambulatory women's health: Adapting problem-based learning to residency education. *Journal of Women's Health* **18**(9): 1369-1375.
- Soulé, H. and Warrick, T. (2015) Defining 21st century readiness for all students: What we know and how to get there. *Psychology of Aesthetics, Creativity & the Arts* **9**(2): 178-186.
- Tan, O. S. (2003) *Problem-Based Learning Innovation: Using Problems to Power Learning in the 21st Century*. Thomson Learning Asia.
- Tan, O. S. (2009) *Problem-Based Learning and Creativity*. Cengage Learning Asia.
- Thummarpon, A. and Thongkam, P. (2002) Effects of problem-based learning on critical thinking enhancement and academic achievement of teacher students. *Songklanakarin Journal of Social Sciences and Humanities* **8**(3): 307-321
- Torrance, E. P. (2006) *Torrance Test of Creative Thinking*. Scholastic Testing Service, Bensenville.
- Watson, G. and Glaser, E.M. (1991) *Watson-Glaser Critical Thinking Appraisal Manual*. Psychological Corporation, London.
- Yuan, H., Kunaviktikul, W., Klunklin, A. and Williams, B. A. (2008). Promoting critical thinking skills through problem-based learning. *CMU Journal of Social Science and Humanities* **2**: 85-100.

WEBSITE

Bureau of Secondary Education, Department of Education, Philippines: Its Legal Bases. (2009)
Retrieved from
<http://www.bse.ph/index.php/component/content/article/34-mandate/159-ese.html>

Abstracts of the Papers Presented at the 26th Biennial Conference of the AABE

The 26th Biennial Conference of the AABE was held at the International Centre, Goa, India, from 20th to 24th September, 2016. More than one hundred people from India, Japan, Malaysia and Philippines attended (See picture below).

The conference was organized by AABE (Executive Director: Dr. Narendra D. Deshmukh; Convenor: Prof Suhas Godse), AABE India Chapter (President: Dr. Nirankush Khubalkar; Vice-President: Dr Sneha Gogte; Secretary: Dr Dinesh Khedkar; Joint Secretary: Jyothi Cherukurih), and Vidya Prabodhini College of Commerce, Education, Computer and Management, Goa. The following organizations collaborated in the conference:

Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, Mumbai; Rayat Education Society, Satara; Shri Shivaji Education Society, Amravati; Association of Teachers in Biological Sciences, India; St. Ann's College for Women, Hyderabad; the International Centre, Goa, India.

The main theme of the conference was “Trends in Biology Education and Research: Practices and Challenges.” There were eight sub-themes:

- (1) Learning Biology through Enquiry;
- (2) Impact of Local Issues Relevant to Biology in Global Scenario;
- (3) Strategies for Awareness of Community health through Biology;
- (4) Ecological Approach to Learn Biology;
- (5) Educational Technology for Biology Education;
- (6) Classroom Teaching, Learning and Assessment;
- (7) Current Challenges and New Approaches for Biology Teachers;
- (8) Practices and Challenges in Biology Research and Education.

Keynote address “Trends in Biology Education and Research: Practices and Challenges” was presented by Prof. H. A. Ranganath. Six “plenary talks” were presented by guest speakers. There were three country reports, 51 oral presentations and 43 poster presentations. In addition, three workshops were carried out.

The Book of the Abstracts of Papers was published and provided to the attendants of the conference. The following abstracts are reprinted from the book.



The attendants of the AABE26 (provided by Dr. Dinesh D Khedkar)

<Keynote Address>

**Trends in Biology
Education and Research:
Practices and Challenges**

Prof. H. A. Ranganath
*National Assessment and
Accreditation Council, and
Indian Institute of Science, India*



It is claimed that 21st Century belongs to "Biology". Therefore, biologists of this century are expected to contribute extensively to the generation and synthesis of new knowledge, innovations and to the welfare of the society. Prerequisites for this is, with relevant teaching and research, generate new generation(s) of human resource to take up the challenges.

Let us make this as an Inter-active session, with a dialogue on a few of the challenges the system is confronted with, such as (1) courses and curricula, (2) faculty and brain drain, (3) Infrastructure, (4) career options (5) innovations and creativity, (6) Policy makers and management of institutions, and (7) Ethics and related issues.

Even though this is a deviation from routine 'key-note lecture', I hope this will generate fruitful discussion and will be more rewarding than mundane so called keynote address.

Prof. H. A. Ranganath (haranganath@gmail.com), Ex. Director, National Assessment and Accreditation Council (NAAC); Visiting Professor, Indian Institute of Science, Bangalore, Karnataka, India

<Plenary Talks>

**Using the Scientific Method
as a Structure to Teach
Biology: Personal
Experiences**

Prof. Swati Patankar
*Indian Institute of Technology (IIT),
India*



Being at IIT Bombay, where we have students ranging from B. Techs to PhDs, I have always been involved in both teaching and research. Over the years, it is clear to me that both these areas can complement each other enormously. For example, research benefits from understanding the fundamentals and being up to date, two aspects that are a crucial part of teaching. Conversely, I have found that teaching benefits from using the structure of the scientific method. For example, in the classroom, teaching biology through experiments leads to students gaining the ability to understand concepts, critically evaluate data and move away from rote learning. During practical's, when the experiments are posed as a research question, the students learn new concepts, experimental design, how to maintain lab-books and

time management. Finally, our M. Sc. students do a six-month long project that allows them to experience the scientific process and appreciate how much it takes to come up with the concepts that they studied from textbooks. During the talk, I will give examples from my own experiences as a teacher and a scientist to illustrate how biological inquiry can form a basis for teaching.

Prof. Swati Patankar, Dept. of Biosciences & Bioengineering, Indian Institute of Technology, Mumbai, Maharashtra, India

**Is Natural History Relevant
to the Practice and Teaching
of Biology Today?**

Prof. Rohini Balakrishnan
Indian Institute of Science, India



In this talk, I will trace the connections between natural history, biology and society and make a case for the importance of natural history in modern society and modern biology. I will use examples, both historical and current, to illustrate the vital place occupied by natural history in biology as a science and as a field critical to human health

and sustenance. I will then discuss the current scenario, including the decline of natural history in both research and teaching in biology, and possible ways to reverse this trend. Finally, I will describe a personal journey of research and teaching in biology that has been unabashedly grounded in natural history.

Prof. Rohini Balakrishnan, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, Karnataka, India

Unified Biology Education for Future Earth

Prof. L. S. Shashidhara

*Indian Institute of Science
Education and Research, India*



With increased human migration, exchange of living and non-living commodities across the globe, introduction of invasive species, new epidemic outbreaks, and more importantly the local and the global impact of climate change, we need to re-examine the dynamics of earth's ecosystem from a newer perspective. Its understanding and measures to sustain the health of the earth for the future requires multidisciplinary approaches. While multidisciplinary research is taken up to study ways to keep the Future Earth healthy, in parallel, we also need to develop school- and university-level curriculum that incorporates climate change *vis-à-vis* living earth in the education system so that future citizens would be better equipped to study these issues and identify appropriate solutions for sustainable and equitable development. I will discuss a research-based pedagogical approach to this – both at school and the undergraduate levels. It involves using a variety of teaching/learning material already available, but reorganized to help students and teachers to come out with their own research question related to a local biodiversity/ecosystem issue *vis-à-vis* climate change.

Prof. L. S. Shashidhara, Coordinator of Biology, Indian Institute of Science Education and Research, Pune, Maharashtra, India

Renaissance of Biological Knowledge Base in the Present Context of Sustainable Development

Dr. Bijaya Sarangi

CSIR-NEERI, India



Societies have evolved because knowledge has evolved in space and time. The manifestation of knowledge is a systematic enterprise known as education that builds up knowledge and explains the phenomenon of life through hypothesis, predictions, and testable propositions. There should be conflict that knowledge is the essence of any society; knowledge generation is the key of societal development which evolve in a dynamic manner. When we say we are developed, it means our actions, reactions and understanding in diverse aspects of life-society have evolved, and we are in a continuous mode of knowledge up-gradation. If we talk of development we must look to our knowledge base, it is imperative that it should be dynamic.

Seems not exaggerated-societal knowledge since existence started with Biology; the science of life/living beings in itself and around. Since, the day society/individuals started to understand what is happening around, it began with biology; its own existence, physical manifestation, to build up with living beings, to harvest the biological understanding recurrently, make living worry free in meeting the basic requirements so on and forth. The Origin of life entities; Microbes, Algae, Plant, Animals, the Human Being, all are the manifestations of the Biological Knowledge base whether natural or manmade. This present day 'Science' – is a systematic knowledge base that has been built-up through knowledge generations. Application of the Biological Knowledge base and its application, including the present day biotechnology are as old as human civilization; selecting and growing plants for crops yield, taking the ox to plough land, preparing curd, and so on. These know-hows have, subsequently transformed into

workable reproducible knowledge, better known as - Technology. In present time, the need for technological improvement in all aspects of human existence has become inevitable to cope up with the sparing gap between demand-production. Some of the great concerns are depletion of renewable resources, threat to sustainable development and destruction of ecological balance. Having understood the concern, restoration of ecological harmony is of prime importance for sustenance of human life. Hence, in all spares of knowledge business there is brainstorming what are the strategies to deal with the rapidly emerging situation?

Can the environment management issue be addressed through appropriate technologies that could ensure harmony of man and environment? What could be the salient features of such technology? Which knowledge base could be versatile in this context of sustainable environment management?

Having asked these questions, technology developers started looking back to the processes through reverse engineering that opened a new window in the technology front – ‘Green Process’ and ‘Green Technology’. This concept is being rapidly incorporated in the technology development domains to ‘Design, development and implementation of chemical products and processes to reduce / eliminate the use and generation of substances hazardous to human health and environment. Although ‘Green Chemistry’ and ‘Sustainable Process’ terms are used interchangeably, however both are not same in absolute terms. But, the basic condition for both Green chemistry & Sustainable process is environmental aspects that include economic and social aspects to provide additional features for sustainability. Sustainable development is built on three basic premises *i.e.*, economic growth, ecological balance and social progress. Economic growth achieved in a way that does not consider, the environmental concerns, will not sustain in the long run. Therefore, sustainable development needs careful integration

of environmental, economic, and social needs in order to achieve both an increased standard of living in short term, and a net gain or equilibrium among human, natural, and economic resources to support future generations in the long term. It is necessary to understand the links between environment and development in order to make choices for development that will be economically efficient, socially equitable and responsible, as well as environmentally sound. Are the technologies available in many fronts of societal development is acceptable in the present context of sustainable development, probably there are many concerns that does not conform to the requirements of ‘sustainable technology’?

Green technology entails:

All material and energy inputs and outputs should be non-hazardous as possible;

Waste production need to be prevented than to treat or clean up waste after it is formed;

Energy consumption and materials used should be minimized;

Mass, energy, space, and time efficiency should be maximized;

Should be "output pulled" rather than "input pushed" through the use of energy and materials;

Choices on recycle, reuse, recover or beneficial disposition should be embedded when choosing design;

Durability should be a design goal;

Design for performance in a commercial "after life";

Material and energy inputs should be renewable rather than resource depleting.

Under this paradigm shift in technology fitness assessment front, is it possible to develop such idealistic technology? Where is the model to follow up and emulate?

Reverse engineering assessment of a technology gives insight to integrate features to evolve it towards Green Technology. To my mind, technology development could be understood through its genesis.

Technology development is a learning process that begins with **Observation**, manifests through **Inquisition and Understanding** and matures through **Interpretation** in the context of present requirement. If technology becomes obsolete, there could be overshooting in one or more of the above aspects. However, technology metamorphosis takes through primary steps based on fundamental principles, which were introduced to us through the learning of the process. Thus, the role of teachers/guides is primary and fundamental to ignite our mind to think for new possibilities to meet the requirement.

Environmental education should include the following:

To ensure that the environmental considerations are explicitly addressed and incorporated

into the development and any decision-making process;

To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals;

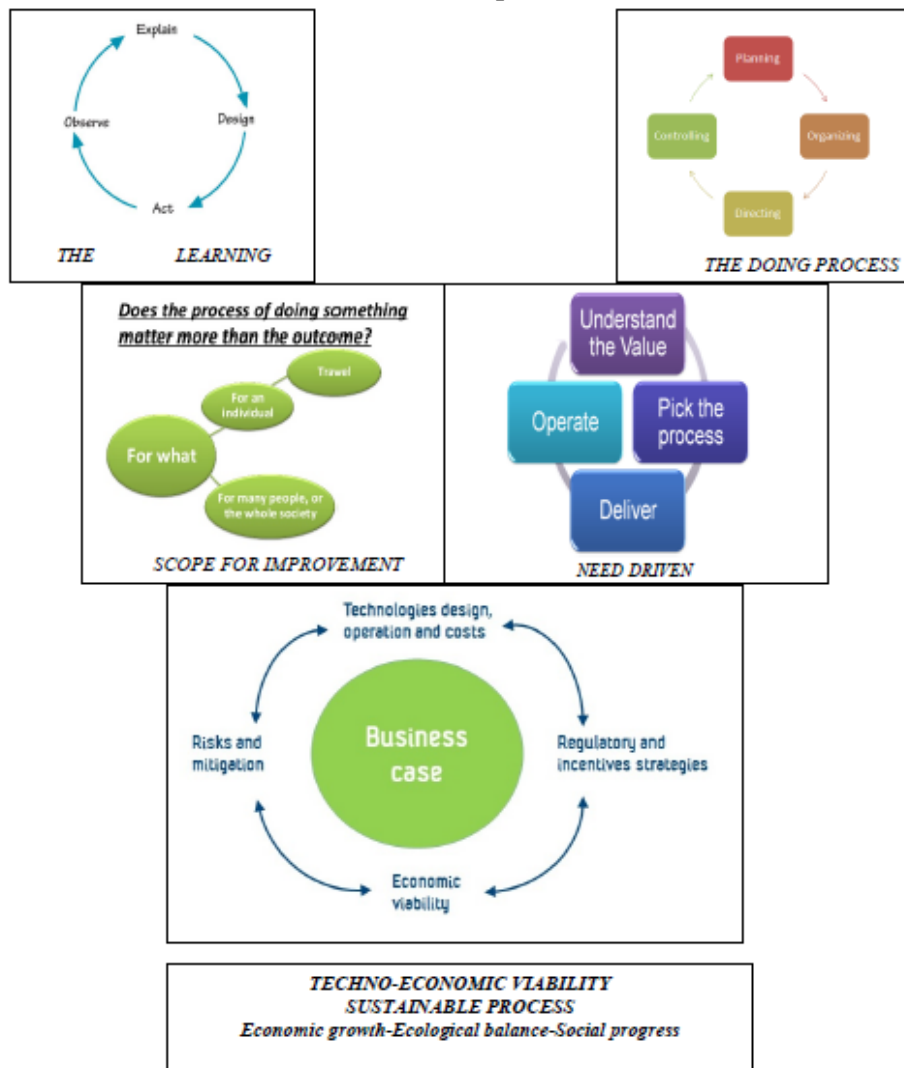
To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions;

To promote development that is sustainable that optimizes resource use as well as management opportunities.

The present environmental scenario dictates environmental education-learning should include features to evolve sustainable technologies.

The essential components to be inbuilt in the learning process are:

Purposive- should inform decision-makers and



result in appropriate levels of environmental protection and community well-being;

Rigorous- should apply 'best practicable' science, employing methodologies and techniques;

Appropriate to address the problems being investigated;

Practical-should result in providing information and acceptable and implementable solutions for problems faced by the proponents;

Relevant- should provide sufficient, reliable and usable information for development planning and decision-making;

Cost-effective- should impose minimum cost burdens in terms of time and finance on proponents and participants consistent with meeting accepted requirements of environmental impact of the technology;

Efficient- should achieve the objectives to assess its impact on environment using the best analysis of available information, time, resources and methodology;

Focused- should concentrate on significant environmental effects and key issues; i.e., the matters that need to be considered while making decisions;

Adaptive- should be adjusted to the realities, issues and circumstances of the proposed activity without compromising the integrity of the process, and be iterative; incorporating lessons learnt throughout the project life cycle;

Participative- should provide appropriate opportunities to inform and involve the interested and affected public, and their inputs and concerns should be addressed explicitly in the documentation and decision-making;

Inter-disciplinary- should ensure that appropriate techniques and experts in relevant biophysical and socio-economic disciplines are employed, including the use of traditional knowledge as relevant;

Credible- should be carried out with professionalism, rigor, fairness, objectivity, impartiality and balance, and be subject to independent checks and verification;

Integrated- should address the interrelationships

of social, economic and biophysical aspects;

Transparent- should have clear, easily understood requirements for EIA content; ensure public access to information; identify the factors that are to be taken into account in decision-making; and acknowledge limitations and difficulties;

Systematic- should result in full consideration of all relevant information on the affected environment, of proposed alternatives and their impacts, and of the measures necessary to monitor and investigate residual effects.

Sustainable technology should ensure that waste emissions from an activity should be within the assimilative capacity of the local environment to absorb without unacceptable degradation of its future waste absorptive capacity or other important services. Harvest rates of renewable resource inputs should be within the regenerative capacity of the natural system that generates them; depletion rates of non-renewable inputs should be equal to the rate at which renewable substitutes are developed by human invention and investment. The aim of sustainable technology is to curb overconsumption and unacceptable environmental degradation. But because of limitation in available scientific basis, this definition provides only general guidelines for determining the sustainable use of inputs and outputs. With this back ground of present crisis scenario for sustainable technologies, what could be the role of Biological Knowledge base in the development of such technology? Biological systems are the zenith of creations with myriad of processes in systems as small as one living single cell and an elephant. Revitalization of the existing technologies with of renaissance Biological Knowledge base is contextual in the present context of sustainable technology development.

The author will present some studies of revisiting Biological Knowledge base looking for sustainable technologies in the domain of environment management such as:

Natural dyes in place of synthetic dyes: Indigo and India;

Phytoremediation: Green process.

Dr. Bijaya Sarangi, Sr. Principal Scientist-F, Environmental Biotechnology Division, CSIR-NEERI, Nagpur, Maharashtra, India

Pedagogical Difficulties in the Domain of Individual/Community Health

Dr. Satyajit Rath

National Institute of Immunology, India



There would be little disagreement with the proposition that ideas of the interconnectedness of health of individuals and communities are important in any core education programme. Yet, what appears to happen in practical pedagogy is the reduction of this issue mostly to the terrain of ‘hygiene’ rather than ‘health’ and to ideas of individual responsibility to the exclusion of the community and political dimensions involved. I will try to explore the difficulties that lead to these reductions, and to initiate discussions about overcoming them. In order to do this, I will use, as a starting point, the experience of developing a textbook chapter on ‘health’ and ‘illness’ as well as some subsequent lessons learnt in the community.

Dr. Satyajit Rath, Senior Scientist, National Institute of Immunology, New Delhi, India

Practices and Challenges in Biosystematic Studies in India

Dr. Paramjit Singh

AJC Bose Indian Botanic Garden, India



Our existence on this planet is essentially dependent on biodiversity. Foods, medicines, as well as clean drinking water and fertile soils are created by living organisms. It is thus in our own vital interests to recognise and understand changes in biodiversity. Prerequisite for this is the

taxonomic cataloguing of this immense treasure. However, increasing cutbacks in taxonomic education and research at universities in recent decades is not commensurate with such a goal.

‘Schools of Taxonomy’ that offer their own master/doctoral study courses should be established at elected locations. The aim here is to combine intensified taxonomic research and teaching at internationally-oriented locations. One requirement for this is to maintain teaching courses based on broad and fundamental topics in taxonomy and systematics at all university locations. The curricula at the ‘Schools of Taxonomy’ must include not only broad exposure to species and traditional taxonomic methods, but also to OMICS technologies, bioinformatics and databases.

Summer schools and other training possibilities should lead to the expansion of interested target groups, and to the transfer of modern taxonomic teaching and research concepts. These would include courses on collecting samples and specimens for research purposes, expanding taxonomic knowledge, and particularly on applying OMICS research methods.

The documentation of many microbial groups still remains un- or underexplored. Our country is handicapped in terms of novel pharmaceutical products from potential microbial systems. The best example will be the underexplored *lichenized ascomycetes* as well as many similar groups, even though there is a global upsurge to tap these bio-resources to a greater extent using potential biotechnological applications based on accurate species identification s3. Hence, greater attention is required on research programmes targeting the so-far neglected microbial diversity with immediate effect. However, in the recent years, efforts are being made by various agencies to fill up the lacunae through all-India coordinated projects on grass and orchids.

The overriding importance of systematics and its creative role in fulfilling the emerging needs of science and society have never been realized so greatly as at this particular point of time. System-

atic studies are becoming increasingly relevant in the following priority areas:

- Inventorying and monitoring biodiversity;
- Biogeography, evolutionary biology and ‘hot spot’ analysis;
- Mapping biodiversity;
- In situ and ex situ conservation of biodiversity
- Prospecting and economic valuation of biodiversity;
- Ethnobiology – Documentation of indigenous knowledge associated with biodiversity use and conservation;
- Conservation biology of ecologically important and threat-prone species and fragile ecosystems; population biology, reproductive ecology and conservation genetics;
- Community and ecosystem dynamics;
- Study on demography, population and community ecology of indicator taxa, keystone mutualists, flagship species, umbrella species, etc.;
- Chemosystematics – Identification of potential biodynamic compounds in plants, animals, fungi and microbes for biochemical, pharmaceutical and drug prospecting; resolving taxonomic disputes and evolving creative classification systems using chemistry as a tool;
- Molecular systematics – Multidisciplinary characterization of biological and genetic resources at biochemical, cytological and molecular level; identification of potential genotypes of economic and other interest; conservation of genes and nucleotides in DNA libraries;
- Cladistics and phylogenetic assays;
- Environmental impact assessment;
- Biomodelling and bioenergetics;
- Bioinformatics;

For the general decline of systematics, it would be prudent if we ponder over the following questions:

(1) Why do systematic biologists fail to take the science of systematics to the forefront as a ‘cri-

sis management discipline’, especially in view of the gigantic task of completing biological inventories of major biomes in the world, particularly tropical forests?

(2) Why do governments/institutions fail to support systematic biology research, both classical and modern, through adequate capacity-building processes and infrastructure development?

(3) Why does systematics fail to attract universities and young talented researchers at a time when the world requires more trained taxonomists to fulfil the mandates of inventorying and monitoring biodiversity resources?

Systematic biologists have also failed to impress upon the scientific community and the governments about the creative role and potentials of classical taxonomy in comprehending the current crises of environmental degradation and biological extinctions. Lack of coordination, inability to make use of the tools of other emerging sciences, particularly information technology tools, failure to create better job opportunities, and inadequate training and capacity-building programmes have caused further decline of systematics and taxonomic researches, particularly in the developing countries like India.

Systematics and biodiversity research in India

India has a reasonably good institutional set-up for biodiversity research. A host of institutions administered under the Ministry of Environment and Forests (MoEF), Department of Science and Technology (DST), Department of Biotechnology (DBT), Department of Space (DOS), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), universities under the network of the University Grants Commission (UGC), science, technology and environment departments in various states, non-governmental organizations like Bombay Natural History Society (BNHS), M.S. Swaminathan Research Foundation (MSSRF), Tata Energy Research Institute (TERI), Foundation for Revitalization of Local Health Traditions (FRLHT), World Wildlife Fund for Nature (WWF-India),

etc. are currently involved in diverse fields of research and development on India's biodiversity. The broad spectrum of R&D pursued at these centres includes systematics and taxonomy, biogeography, biodiversity conservation, biotechnology, bioprospecting, bioinformatics, biosafety and environmental education. Completing survey and inventorying in the as yet unexplored regions in India and undertaking creative systematic research on the less known taxonomic groups are urgent tasks to be fulfilled in a foreseeable time frame, possibly before most of our remaining wilderness areas are degraded and their biodiversity depleted further.

The present trend of teaching and research in systematic at our colleges and universities is also equally disappointing. Even some of those esteemed departments or schools of biology at universities of Delhi, Kolkata, Mumbai, Chennai, BHU, etc. which once produced world class research in classical systematics, embryology, cytogenetics, phycology, mycology, entomology and ecology are now unable to sustain and carry forward basic research in classical systematics.

The current methods of teaching systematics through extensive classroom lectures but too little fieldwork, as practiced in many colleges/universities, should be discouraged. At graduate and postgraduate levels, students in biology or natural history may be given assignments to work on small time-bound dissertations or thesis work relating to taxonomy, biogeography or ecology of local flora and fauna near their colleges/universities. This kind of field biology project work will help enthuse students and give them the right orientation to take up future R&D programmes in systematic biology and allied disciplines. The field data generated through such student projects will also help improve our knowledge on biodiversity, its conservation, sustainable use and management at local levels.

Till today taxonomic research in our country remains mostly morphology-based, and it seldom incorporates data on biogeography, ecological

status, environment-induced phenotypic changes, knowledge of local people, chemical data (wherever applicable), wild relative status, other usefulness including its economic and ecological potentials. Today, molecular taxonomy is also an emerging field in resolving specific taxonomic problems, and this will lead us to the wise use of our biological wealth as part of a better conservation strategy.

Some of the major challenges of systematic biology research in India are:

1. Completing the unfinished task of inventorying floristic, faunistic and microbial diversity in the under- or unexplored regions.
2. Setting priorities for mapping biodiversity and its components in all the biogeographic zones through application of remote sensing, GIS, GPS and other relevant tools of space and information technology.
3. Conducting creative revision and monographic studies on important taxonomic groups, with special focus on lower plant kingdom, microbes and the less known animal groups.
4. Execution of flora of India and fauna of India work within a definite time frame.
5. Undertaking conservation biological studies on ecologically important and threat-prone species of flora and fauna on priority basis.
6. Conducting integrated taxonomic research for multidisciplinary characterization of biogenetic resources at morphological, cytological, biochemical, molecular and genetic levels.
7. Creating computerized online databases on various aspects such as taxonomy, nomenclature, biogeography, ecology, conservation, economic uses and potentials of flora, fauna and microbial diversity and dissemination of such up-to-date information system through internet.
8. Capacity building and infrastructure development in classical and modern systematics.
9. Documentation and maintenance of valuable collections of specimens, literature, manuals, etc. in herbaria, museums and biological ar-

chives, and computerization of data accession on the above for effective management and updation.

10. Documentation of rare, endangered and endemic species so as to aid their conservation, both ex situ and in situ.

There have been substantial initiatives to address such issues by several stakeholder institutions and agencies involved in biodiversity and systematic biology research in India. But, what we really lack is a holistic approach to streamline our R&D efforts, particularly systematic biology research, with a view to achieve tangible results in conservation and sustainable development.

However, the crux of the problem for decline of the biosystematic research in India is:

- (1) Taxonomic research in India is confined to the specialized institutions such as Botanical Survey of India (BSI), Zoological Survey of India (ZSI), etc. and a few research groups in universities and colleges. Lack of future opportunities and avenues has resulted in very few young scholars taking up taxonomic studies. Similarly, inter- and intra-disciplinary coordination involving taxonomists are negligible and in fact lack objectivity.
- (2) Lack of inter- and intra-discipline cooperation

and coordination among the research groups (lack of networking) and nature conservation agencies like the Forest Departments.

- (3) Lack of funding and suitable jobs.

The above issues drive the Indian students to select their disciplines based on lucrative carrier prospects like information technology, biotechnology, etc. from their early stages of education. Our present system of science education is not properly geared to take on the challenge of documenting the biodiversity of our country. In this system, students of biology have little or no contact with the rich tropical life all around them. Instead, they learn some routine facts from books, cut up some dead plants and animals and pass some boring examinations by memorizing such matter.

The Indian biosystematics (and obviously the biosystematists) can overcome these problems and complete the task of compiling biodiversity inventories, if we follow the well-established models which proved to be fruitful in achieving the goals in similar programmes elsewhere.

Dr. Paramjit Singh, Director, Botanical Survey of India, AJC Bose Indian Botanic Garden, Kolkata, West Bengal, India

<Oral Presentations>

SUB-THEME 1: LEARNING BIOLOGY THROUGH ENQUIRY

Development and Practice of a Special Teacher Training Program for Active Learning: A Plan for Enhancing Prospective Senior High School Teachers' Competency in Biological Observation and Experimentation

**Heiwa Muko, Masahiro Hizume,
Yoriko Nakamura**
Ehime University, Japan

Ehime University and the Board of Education of Ehime prefecture, Japan, started a special teacher

training program for Active Learning in 2015. The objectives of this program were to enhance teacher observation and experimentation skills, to incorporate ICT (Information Communication Technology) to develop method of active learning, and network between the faculty members of Ehime University and the senior high school teachers of Ehime prefecture. The format of this program was participation with students. The number of participants is over 20 teachers and 80 high school students. For two days, teachers and their students performed experiments and were observed by faculty members of Ehime Univer-

sity. School teachers assisted their students' learning. After that the students resumed their studies in each high school. Research results will be presented at the end of the year. The results of the questionnaire of 2015 indicate that teachers and students had been satisfied with this program. This presentation covers the practical report for 2015 and 2016.

Keywords: active learning, ICT (Information Communication Technology), observation and experimentation skills, teacher training

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Development of Scientific Abilities and Skills by Inquiry Activity Using Fast Plants for Junior High School Students

Kiyoyuki Ohshika¹⁾, Orié Oshika²⁾

¹⁾ Aichi University of Education, ²⁾ Sippo Junior High School, Japan

In the new Course of Study, Japan, in 2008, "Scientific Inquiry and Scientific Method" are highlighted as the main concept of science education. At the same time, it is also emphasized for students to practice natural and scientific experiences through science class. In biology education, it is important for students to cultivate plants. Through cultivating plants, students can not only learn scientific knowledge, but also develop scientific abilities and skills. In Japanese 7th grade, Science students learned various topics about plants comprehensively in first semester. So, we have practiced long-term project using Fast Plants to develop scientific abilities and skill in junior high school students during summer vacation in this research. One hundred and seventy four (174) students were asked to perform research about life cycle of Fast Plants in 40 days. During their investigations, students had recorded all the life stages and processes of plant life cycle including germination, growth, flowering and maturing fruits. Students had analysed the data and made final report at the end of summer vacation. As a

result of this research, 70% students had recorded germination, 21% students had recorded flowering, but no students had recorded maturing fruits in 40 days. They had made final report using their date, 49% students had used pictures and 24% students had inserted graph in final report. After research, we had given a questionnaire to the students. As a result, 67% students had responded this investigation as "interesting" and 57% students had responded "try again". Moreover, they have learned scientific abilities and skills like carrying out investigation, interpreting data, constructing explanation and more.

Keywords: Fast Plants, plant cultivation, scientific ability, scientific attitudes

Dr. Kiyoyuki Ohshika (ohshika@aecc.aichi-edu.ac.jp), Department of Science Education, Aichi University of Education, Kariya, Japan

Creating Learning Resources at School Level for Integrated Teaching by Using Inexpensive and Easily Available Material

Rajesh Bhaskar Patil

Saraswati Junior College, India

The world is now opening up. Gone are the days when science subjects were treated in watertight compartments. Classroom learning demands resources that can be used for diverse subjects they should be creative, inexpensive and made of easily available material. When we think about learning Science, the very next thought comes to our mind is of big and well equipped laboratories, expensive apparatus and other costly material. Rural and non-aided schools can hardly afford this equipment and meet the expense of their maintenance. The present research paper aims at using inexpensive, discarded and easily available material. These materials include matchbox labels, postage stamps, feathers and self-taken photographs. The assistance of library has been taken for authenticity of information. The investigations involve the collection of national and international matchbox pictures, and postage stamps depicting

pictures of flora and fauna. Added to that were hundreds of self-taken photographs of local birds. Students also contributed handsomely culminating into a huge collection of matchbox labels, postage stamps and feathers. Assistance of library confirmed our information and sheets were made with the help of students. These resources proved helpful in learning Environment Science with joy. Students made projects on various Science themes focusing on birds and animals by collecting their own material. This not only added to their learning but also appealed to their curiosity. The study resulted in the production of a permanent learning resource for learning Science and Environment Science.

Keywords: feathers inexpensive material, integrated teaching, learning resource, matchbox labels, postage stamps

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Learning Biology through Inquiry: Undergraduate research activities at Patna Women's College

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²⁾ Homi Bhabha Centre for Science Education, India

Serious undergraduate biology research is a regular feature of only a few colleges in India. But this activity began at Patna Women's College way back in 2004. However, initially students took up projects mainly related to community health, but these studies were not followed up subsequently. Remarkable change in biology research took place in 2013 when some of the students joined CUBE (Collaborative Undergraduate Biology Education) of Homi Bhabha Centre for Science Education (HBCSE), TIFR. First group of students joined the Earthworm Regeneration group and successfully completed their project on the topic 'Study of segmental regeneration and healing of ventral nerve cord in *Eisenia fetida*' in 2014. These students mentored and guided their

juniors and further questions emerging from this study are being pursued currently by more students. This continuity is the hallmark of CUBE. Second group of students began working on *Drosophila* learning and memory and successfully completed the project in November 2015 in collaboration with HBCSE, TIFR, Mumbai, along with DY Patil College, Mumbai. Students have been studying in textbooks about the harmful effects of Ultraviolet (UV) radiation. A group of students addressed this aspect through their study titled 'Effects of UV Radiation on the Learning and Memory Aspects of *Drosophila melanogaster*'. The *Drosophila* group has passed on the culture techniques to their juniors. Now another group is comparing the learning and memory of wild and lab-bred *Drosophila melanogaster*. They have also captured *Zaprionus* sp. from the college campus and would be testing Gause's competitive exclusion principle by keeping robust *Zaprionus* and *Drosophila melanogaster* together. It will be discussed how the CUBE program has changed the thinking ability, attitude and performance of the students in doing authentic science, evaluating claims and seeking explanation using evidence.

Keywords: collaboration, inquiry activities, undergraduate research

Prof. Shahla Yasmin (shahla_apex@yahoo.co.in), Patna Women's College, Patna, India

Comparative Study of Science Curriculum and Learning Contents which Treat Inquiry: Focus on Japanese and South Korean Biology Education

Takayuki Sato

Hirosaki University, Japan

In recent years, a few global achievement evaluation methods have been performed to analyze student's abilities of basic/inquiry level about science. These tests include PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). Furthermore, a few case studies have been

carried out regarding research curriculum by comparing Asian countries with the same achievement level. The present study was an attempt to assess and compare research science curriculum and learning contents in Japan and South Korea, distinguishing strong points about inquiry learning in both the countries. The method of this study was based on comparative education research. National Course of Study, textbooks which were in conformity with them and, some books about curriculum and learning contents were selected as the subject of study. The results of this study revealed some strong points in both countries focusing on biology education. It clearly showed that the curriculum of primary school during 3-6 grades has 4 themes (Comparison, Relation, Condition Controlling and Inference) in Japan whereas that of South Korea has only 2 themes (Basic Inquiry and Integrated Inquiry) in 3-6 grades. In addition, at lower middle schools in Japan, majority of observations and experiments and Inquiry-based activities are performed in the class. On the other hand, in South Korea many Inquiry Activities are done as class activities and STEAM (Science, Technology, Engineering, Arts and Mathematics) Activities are done after each teaching unit. The significant observation was that the contents of Inquiry Activities in South Korea are of the same level of Observations and Experiments in Japan. This makes difficult to judge and infer the better science curriculum. The culture and the national characteristics of countries must be considered for judgement. It was found that though the learning contents of science were of the same level in both the countries, the analysis of textbooks showed that the inquiry and science related to everyday life were treated by allusion in/after teaching units in Japan enabling the students learn basic science abilities. In comparison, inquiry and science related to everyday life were treated directly with STEAM activities in South Korea after teaching units making students learn basic science abilities.

Keywords: curriculum, inquiry, Japan, learning

contents, South Korea

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Reintroduction of Hydra for Research and Teaching in India: Fifteen Satisfying Years with Some Successes and Many Failures

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Way back in the year 2000, an interesting study by Hobmayer *et al.* on role of Wnt signaling in pattern formation in hydra appeared in the journal Nature. It prompted me to consider using hydra to address a major question being addressed in the lab at that time: cell signaling during induction and patterning of nervous system. Prof. Sivatosh Mookerjee of Jawaharlal Nehru University (New Delhi) had worked rather extensively on aspects of pattern formation and ecology of hydra till the mid-1980s. This interesting model system was kind of 'lost' in India after that. We reintroduced hydra to study cell-cell signaling during pattern formation. This has led to identification of some signaling molecules, such as, Noggin, Gremlin, VEGF and FGF from hydra, and has provided important insights into evolution of developmental signaling in animals. Hydra is a freshwater cnidarian that has been around for at least 600 million years. It has a simple tissue grade organization, a remarkable capacity of regeneration and three distinct stem cell populations. Hydra exhibits the first organized nervous system during evolution and is potentially an immortal organism. Due to such peculiarities it has been one of the favorite model systems for developmental biologists. What makes hydra an exceptionally good teaching tool at all levels - Schools, Colleges and Universities, is its capacity to regenerate lost body parts. Regeneration in hydra allows one to study pattern formation at morphological, cellular, biochemical and molecular levels, day in and day out. While demonstrating regeneration in hydra in col-

leges I have seen students amazed and excited at this biological wonder unfolding in front of them. It is time that we seriously consider using hydra as a teaching tool in biology classes. If we can do it, an organism whose biological attributes have provided foundation to many fundamental theories in biology, such as morphogen gradients and positional information, will become available for exciting the young minds.

Keywords: developmental biology, pattern formation

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A Simple Inquiry-Experiment on Saliva α -Amylase for Elementary School Science

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At present, pupils use their own saliva for the α -amylase inquiry- experiment in elementary school science in Japan. It is very important for pupils to carry out the α -amylase experiment by using their own saliva because they can notice that their own enzymes digest food inside their digestive organs. However, regrettably, pupils dislike this method. The major reason is "I do not want my saliva to be seen by others." In addition, various germs may be contained in saliva. So, many teachers hesitate to implement this experiment. In this paper, to remove such obstacles, introducing the step of preparing saliva powder in the experimental procedure is proposed. In practice, the saliva powder (crude enzymes) was prepared by cold ethanol precipitation. Since Ethanol precipitation procedure is not safe for pupils, the preparation of saliva powder was done by the teacher as a demonstration of the procedure. A question "whether living things other than human beings secrete α -amylase in order to saccharify starch" was put to pupils. To give an answer to the question, pupils investigated seeds and rhizomes

of several species whether these plant parts included starch or not. Pupils noticed these parts contained starch, and then, they set up a hypothesis that a plant which stores starch secretes the α -amylase in order to saccharify starch. Thus, pupils checked if the same saccharification would occur when the crude extract from germinating seeds, such as corn, was used. In their experiment, a polythene small bag and a plastic straw were used instead of a test tube and a syringe, respectively, to reduce the cost of experiment.

Keywords: α -amylase, elementary school science, inquiry-experiment

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Enhancement of Beginners Cognition to Learn Biology through Enquiry Strategy: An Infusion of Thinking Processes in Selective Content of Environmental Sciences

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Background: Thinking processes (TPs) are vital in the enhancement of cognition of learners. Education system advocates teaching-learning of all subjects should cross the boundaries of transformation of knowledge to inculcate certain skills, attitudes and develop in pupils specified competencies and thinking processes. Constructivist paradigm advocates development of learning competency of pupils to construct own knowledge for which enhanced cognition is essential. It can be built by providing a toolkit of the questions to activate TPs of pupils. Interaction with environment provides first hand, natural and informal learning experiences to children. Hence, Environmental Sciences (EVS) play key role in the development of cognition of pupils. **Introduction:** Teaching-learning of EVS is a platform to lead learners towards Biology. Sizable amount of research in Biology Education Research (BER) and the research papers based on meta-analysis of

BER literature shows need of research in development of cognition for learning Biology. Primary education is a stage where this can be done through EVS. Hence researchers put objectives: 1) To identify TPs essential to enhance the cognition of lower primary pupils to learn Biology; 2) To develop TPs infused programme comprising questioning toolkit to learn EVS; 3) To test the effectiveness of the developed programme.

Methodology: The experimental design with following steps will be used for present study: 1) The content of EVS at primary level will be analyzed to identify the content compatible to infuse TPs; 2) The Infused Programme comprising questioning toolkit to learn EVS will be prepared & its validity will be checked by experts; 3) Pre-test - post-test control group design will be used for testing effectiveness of the programme; 4) The programme will be implemented in randomly selected primary school in Kolhapur city with the permission of administration; 5) The concept mapping strategy will be used for evaluation of TPs; 6) Mean, percentage and *t*-test will be used as statistical techniques. **Results and Conclusions:** Results will reflect whether TPs can be enhanced through EVS and whether infusion approach of teaching thinking comprising questioning toolkit is beneficial for enhancement of cognition of beginners.

Keywords: cognition to learn biology, enquiry strategy, environmental sciences, infusion, thinking processes

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Exploring Biology in Nature

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Nature provides one of the best sources of scientific curiosity and enquiry in both science and education. The learner finds it most exciting platform to explore, learn and acquire realistic knowledge, skills, attitude and values. We have

conducted more than 700 biology/nature exploration camps in past two decades and have promoted enquiry based biology/science education for children, teachers and teacher educators in all states of India. More than 4000 Master Trainers have been trained in this endeavour to take it to around two lakh science communicators in India. These camps have been conducted in partnership with government, development partners, science movement and various science promoting organisations in every state. In the camps, initially the participants are familiarised with salient features of nature and the approach to explore biology in a scientific manner. As per their areas of interest, exploration teams are constituted on various themes including plants, animals, soil, water, sky, energy, society, etc. They are guided how to discover their world using locally available, low cost tools and resource persons. They are provided guidebooks, notebooks and simple exploratory tools enabling them to observe related material, note down, collect samples, discuss in the surroundings before they classify their collections and organise in a scientific manner under the guidance of resource persons. Each team presents their findings and share experiences with other groups. In addition, they prepare a wide range of low cost observation, homes for plants and animals in the form of aquarium, formicarium – ant house, terrarium, vivarium, observation jars, earthworm farm, wormery, green house, mini-ponds, mini-gardens, bird houses, herbarium, etc. to observe and study animals and plants. They also develop various handmade tools, such as, insect nets, insect collectors, sweep net, different traps, under-water viewer, etc. to safely catch small animals for observations and then release back to nature. These biology study camps have guided teacher educators and teachers about how children can learn biology/science through enquiry and hands-on explorations. This could help inculcate deeper understanding of biological and science concepts in them along with the enquiry-based pedagogical processes facilitating

effective biology/science classrooms for their children in schools and society. These learning camps have generated extremely high level of curiosity among both teachers and children and have increased their interest in science. They have experimented in different Indian states to explore life in different environmental set ups, including hilly terrains, sea shores, and even desert lands. Other than observing and learning various aspects of nature, they have also become more sensitive towards life and issues associated with nature and life. There are many examples, where these biology/nature clubs have reflected their concerns and ideas regarding how to protect nature and endangered animals and plants. Many groups have initiated work related to vermin-composting, organic farming, water conservation, bird preservation, prevention of cruelty to animals, etc. in different parts of the nation.

Keywords: enquiry-based, exploration camps, hands-on, master trainers, nature

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Pre-service Elementary Teachers' Perspectives about Learning Biology through Inquiry-Based Field Work

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Current trends in teaching biology using conventional practical classes must move away to avoid boredom, low achievement and poor understanding of biological concepts among pre-service elementary teachers. Besides sharpening teaching skills, inquiry-based field work is one of the strategies that may improve this situation among educators. Using an interpretive research methodology, this study investigated the influence of employing an inquiry-based field work in teaching biology from pre-service elementary teachers' perspective on one of the Education Institutions in

Malaysia. This study explored three pre-service elementary teachers who took courses in General Biology— 2016 Session. The analysis of the collected data revealed four important themes namely: Understanding the Conceptions of Inquiry, The Mismatch between Beliefs and Actions, The Merits of Inquiry and Suggested Changes, In Teaching and Learning Strategies in Biology Course. The study also found that participants were generally supportive of inquiry-based field working learning biology as they felt it added value through experience. These findings pose a challenge to educators in teaching biology; therefore, support should be devoted to encourage the continuation and development of inquiry-based field work to better prepare pre-service elementary teachers.

Keywords: inquiry-based field work, learning Biology, pre-service elementary teachers

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SUB-THEME 2: IMPACT OF LOCAL ISSUES RELEVANT TO BIOLOGY IN GLOBAL SCENARIO

Case Studies on Teaching through Interdisciplinary Research in Regenerative and Developmental Biology using Model Organisms

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There is a growing disconnect between current pedagogical practices in biology and the process of scientific discovery. Students are taught that cells are the building blocks of life, and are given an inventory of their contents (from the endoplasmic reticulum to ribosomes). Yet, they have little idea how dynamic the processes within the cell are, nor how any of the content they are being taught was ascertained in the first place. Some students are afforded the opportunity to use their hands and work at the bench conducting tests and

experiments where the results are usually so well-rehearsed that the only measurable gain students may make is exposure to a specific technique (be it PCR, or field observations). While such experiences can be valuable, the concepts of experimental design, control, methods of analysis, data collection and interpretation are almost completely lacking in most curricula of undergraduate biology programs. Moreover, the interdisciplinary nature of contemporary scientific practices is almost entirely ignored. Using three case studies in the areas of regenerative and developmental biology, I will discuss the utility of using independent research projects to address these issues. Students are involved in the entire process, from the introduction of an appropriate model organism into the lab (along with necessary infrastructure and materials), learning culture techniques, choosing a feasible problem to address, designing the experiment, building the experimental setup and collecting and analyzing data. Students were given some initial information and potential questions to be pursued were presented to them. They were given complete freedom to choose the direction of their work, but gently steered away from unrealistic goals. The projects were initially slow to take off, students were sometimes irresponsible of their charges, forgetting to feed them, or being careless in their treatment. Some became frustrated very quickly as they felt they were not collecting any data, and dropped out. Interestingly, around the same time, the pace of the projects and interest of the students who had the patience to persevere began to ramp up. Students became much more observant, and consequently asked deeper questions about their model organisms, and began to do literature searches. When left to themselves, students were usually able to discover their mistakes and misconceptions on their own. Interestingly physics students were extremely successful in these biology projects as they gravitated toward collecting quantitative data, were less hesitant to build required equipment (such as a time-dependent light switches), and were quick to

exploit their programming skills for data analysis. The three projects, and corresponding model organisms being studied, are at very different stages – largely due to student commitment. Overcoming the lack of student motivation has been a challenge in some cases. However, allowing students complete freedom, also acts as a filter to help unmotivated students introspect on their interests and encourage the truly interested ones to shine through.

Keywords: developmental biology, interdisciplinary, model organism, regenerative biology

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Creating Awareness for Local Students through Conservation Education around Tiger Habitat of Central Indian Landscape

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The Bengal Tiger, *Panthera tigris* a unique apex carnivore and a national pride. This apex predator plays a vital role in maintaining the health and diversity of an ecosystem. At least 400 tigers live in the Central Satpuda hills. These protected areas are under ever-increasing pressure from habitat fragmentation, degradation and conversion, poaching and persecution, and indiscriminate and poorly planned development projects. With prey species, potential mates and space in decline, tigers are increasingly ranging beyond protected areas, drawing attention to the need for a more holistic landscape approach towards the conservation of one of the world's most iconic and endangered species. From 2005, BNHS has been working in this landscape to create awareness and develop people's support for tiger conservation in the fringe areas of the selected tiger reserves. The focal areas for this intervention are fringes of Tadoba-Andhari Tiger Reserve, Pench (Madhya Pradesh and Maharashtra) Tiger Reserve, Navegaon-Nagzira Tiger Reserve, and Bor Tiger Reserve along with Umred-Karhandla. This inter-

vention has reached around thousands of students in 100 schools and 50 fringe villages. The main targeted groups for conservation education are mainly students and teachers. For these awareness programmes, BNHS made simple environmental education modules for the students. BNHS mainly focuses on local biodiversity which should be understood by the students and the teachers so that they could know about peripheral biodiversity, and tiger habitat. The programmes are divided into indoor and outdoor activities. Lectures, slide show, film show are the indoor programmes and nature trails, nature camps, nature fair are some outdoor activities. With an objective to make aware the students and the community regarding the importance of forest and the tiger for the community who live in the fringes of protected area, BNHS is conducting these awareness programmes since the last 11 years. It is difficult to access the impact of these conservation education activities but when we see that one of the students saves an injured bird, or villagers help the forest department to control forest fires, we could say that conservation message is spreading among the local people.

Keywords: conservation education, tiger

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Evaluation of Wild Edibles for Nutraceutical Attributes

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Nutraceutical is “a food or a part of a food that provides medicinal or health benefits including the prevention and /or treatment of disease.” In developing countries like India as well as several developed countries in the world, many persons still are deprived from sufficient food/two meals. Those who are fortunate to have food may not be able to meet the adequate protein and other nutritional requirement. As a result they have poor

health status and are prone to diseases very easily. On the other hand, in developed countries, such as, Europe and America excess food availability has led to increasing obesity and related serious health problems. The food science, therefore, is facing a challenge to identify niches to counter both the conditions. The knowledge of “Functional Food” is a solution for the problem. Functional food is the one that contains some health promoting component/components beyond traditional nutrients. In routine life, people are cultivating a few exotic species while, advocacy of wild vegetables can provide a solution for both nutrition and health benefits. Tribal groups and folk people all over the planet have their own habitat knowledge, culture and life style. Comparatively little attention was given to documentation and transformation of this inhabitant knowledge about wild edibles. Least care is taken by younger generation about their knowledge heritage. Now it is necessary to introduce this branch and enrich the student knowledge and health. Such research base education can be promoted to students and is the first step by inquiry and documentation method and further by experimental evaluation. Out of 125 wild edible plant species surveyed, 16 were selected for nutritional and nutraceutical evaluation to find out their food value as well as medicinal value. Nutraceutical potential of the wild edibles studied here is discussed in light of the role of nutrient components and bioactive molecules they contain, and also their medicinal uses. Most of the wild leafy vegetables are higher in protein content than conventional leafy vegetables, and flowers, as well as fruits are rich in bioactive molecules. Presence of various bioactive molecules in the wild edibles studied suggests their potential as nutraceuticals. Value addition to food science and technology through educating students for better products is the need of the time.

Keywords: medicinal, nutraceuticals, tribal, wild edibles

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Biological Psychology in Mild Autism Spectrum Disorders (ASD): A Case Study with a Potential for Teacher Education

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In the past decade there is a surge in pre and primary school children exhibiting a variety of autistic disorders. WHO and UNESCO have already predicted this to be a major problem in the coming decade. Past and present studies have looked at it within an occupational therapy mode. A few studies have elaborated methods from camel milk to restrained diet. However reports are not convincing and have not proved beneficial to a majority of cases. Studying biological psychology of autism has led to an interesting hypothesis that it can be reduced by studying gut flora and provides a base for a number of investigations that are being worked out. The presence of yeast has prompted this investigation and has yielded results in this case study. The literature on problems created by yeast in the gut of children is many but this aspect, its association with autism, is unique. The procedure began by analyzing the yeast present, and replacing it with a probiotic supplement. This led to a primary disturbance in child behaviour with rise in body temperature. Coupled with a special diet, gluten free, reducing sugar (refined only) produced positive results. The child was diagnosed with autism by NIMHANS and inferred as a child with special needs (CWSN). This diet was kept up for a two years and much of the yeast was displaced. The results were positive with the child turning almost normal and not exhibiting the previous behavioural disorders, Dabrowski's over excitability (Deshmukh, D. V., 2014), hand wringing phenomenon, biting reflex, social isolation, selective mutism, no response to name, repetition of tasks, no empathy and no fear of the unknown. However, writing skills are yet to develop, which may be attributed to slow response to this specific skill. Occupational Therapy

(OT) and other speech therapy have been tried out and proved useless while this change in diet has been a major success factor. It is assumed that delayed life span milestones development was genetic but this phenomenal biological change has overshadowed the other routine prescribed therapy. Whether this is a single or a more complex phenomenon needs further detailed investigation. The validity of the CARS test as a valid tool of diagnosis is maintained in the study. This study will help biology teachers to provide assistance to regular pre and primary teachers gain a better management insight to this problem in children and advise parents. This will certainly be a milestone in realizing the aims and objectives of Education for All (UNESCO) and the Right to Education Act 2009 (RTE, 2009), in encouraging the concept of inclusive education towards a better national perspective in doing away with special education. This child is now a regular primary student with a background in home schooling and interacts in an acceptable formal social mode.

Keywords: Autism Spectrum Disorders, biological psychology

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Comparing Changes in the Biodiversity in the Western Ghats Based on the Generational Understanding Captured by Students

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A participatory survey-based study was conducted through a group of students from a rural hilly school to explore and understand the inquiry-based learning faculties among students using a generation-based inquiry. A group of 10 students from 6 hilly villages of Western Ghat in Satara region was selected for the study using purposive sampling. The group of student research partici-

pants were provided with an instrument that was aimed at capturing the changes in the biodiversity in their village and surrounding. The instrument was developed in a participatory manner by the principal investigators and study participants. In the first phase of observations, study participants were told to collect information from two previous generations in their village alongside their individual observations about the present state of biodiversity, plants, and animals. In the second phase of extrapolation, study participants were suggested to collect similar information from the local forest department. The data was analyzed through participatory method to map the emerging 'learning through inquiry' model and its pedagogical processes. The study provided a conceptual model for 'inquiry-based learning' in biology education and its utility in 'active learning faculty development' among school-going students.

Keywords: biology education, communication, generational knowledge, inquiry-based learning, inquiry cycle

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SUB-THEME 3: STRATEGIES FOR AWARENESS OF COMMUNITY HEALTH THROUGH BIOLOGY

Contextualizing Vector Biology in Education

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Background: Vector-borne disease persists in society in spite of concerted efforts by various organizations to curb vector population. Foremost among these are the diseases carried by hematophagous vectors, particularly the mosquitoes. The resurgence of Malarial, Filarial and Chikungunya infections across continents causing morbidity and mortality is of concern, especially in the context of global climate change. The best way to manage and mitigate disease is through education.

An understanding of vector biology and behaviour contributes to prevention of disease and management of infection. This paper presents a perspective on experiments introduced as research component in undergraduate and postgraduate academics and interprets possible offshoots of the learning paradigm directed towards community health. **Methods:** Locality survey, sample collection, morphological observation and documentation, comparison with standard keys, breeding and behavioural assays were performed using locally available mosquito species. **Results:** A survey of the students prior to and after the experiments were performed and shared through peer presentations indicate enhanced environmental awareness in terms of: vector breeding-site preference, morphological identification of local mosquito species, breeding and oviposition behaviour and associated morphological features and also adaptation of the vector to environment, its survival and propagation. **Conclusions:** Incorporating survey and observation-based experiments relating to vector biology as extensions of the curriculum at the undergraduate level would lead to greater awareness and also help in information dissemination in society, promoting early preventive measures to reduce disease burden.

Keywords: health education, mosquito, vector biology, vector-borne diseases

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Weeds: Probable Mosquito Control Agents against Dengue Vector, *Aedes aegypti* L.

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Background: Weeds, simply known as unwanted or undesired plant species, are considered to be competitive, invasive, persistent and pernicious plants. They have tendency to inhabit all environments and may interfere negatively with human activity. Present investigations were carried

out to explore the potential of five common weeds as probable control agents against Dengue fever mosquito, *Aedes aegypti*. This mosquito species is primarily associated with the transmission of dengue, Chikungunya and Zika, which are of major public-health concern in tropical and sub-tropical regions of the world. **Methods:** Leaves and Stems extract of five weeds, *Achyranthes aspera*, *Cassia occidentalis*, *Catharanthus roseus*, *Lantana camara* and *Xanthium strumarium*, were prepared using polar hexane and non-polar ethanol solvent and screened for their larvicidal potency against early fourth instars of dengue vector. The extracts which could cause 80 - 100% mortality were selected and further evaluated for their anti-mosquito potential. Behavioural and morphological observations in the larvae were also carried out to assess their after exposure effects of extracts. **Results:** The preliminary screening of five weed extracts recognized the potency of hexane extracts which caused 100% larval mortality, as compared to the ethanol extracts which could result only 5 - 50% deaths. Further investigations conducted with the hexane leaf and stem extracts of all the five weed plants clearly revealed the maximum larvicidal potential of *A. aspera* extracts against *Aedes aegypti* early fourth instars. The stem extracts exhibited higher potential with an LC₅₀ value of 68 ppm in comparison to 83 ppm obtained from leaves extract. Moreover, the hexane leaves extract of *A. aspera* showed 5% to 86% higher larvicidal activity as compared to that exhibited by the hexane leaf extracts of other plants, while the *A. aspera* hexane stems extracts proved to be 23% to 85% more efficient than the other four extracts. Behavioural observations of the treated larvae revealed excitation, restlessness and aggressive anal biting behaviour indicating the probable effect of the weed extracts on the neuromuscular system of larvae. Microscopic observations of the dead larvae showed shrunken internal membrane of anal papillae, abnormally stretched body and distorted alimentary canal with loss of pigmentation and partial or total cell de-

struction. **Conclusion:** Present investigations suggest the possible use of hexane stem and leaf extracts of *A. aspera* in the development of efficient larvicidal agents as an ideal eco-friendly approach for the control of dengue vector, *Ae. aegypti* and simultaneously provides a solution for weed management which opens up many routes for further exploration of their hidden values. The combined efforts of weed management and recovery of valuable anti-mosquito product would substantially boost the environmental profile and decrease over-reliance on the synthetic insecticides for mosquito control. The proposed method is an eco-friendly, safe, and cost-effective technique, especially in view of the growing awareness for environmental contaminants. Future studies are, however, required to explore and identify the bioactive component involved and their mode of action.

Keywords: *Aedes aegypti*; dengue; larvicide; weeds; weed management

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Maintaining Community Health by Introducing Essential Oils as Vector Control Strategies against Dengue Vector *Aedes aegypti* L.

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Aedes aegypti L. is a well known disease vector which transmits several diseases including dengue, Chikungunya and Zika. Since long, the unwanted effects of mosquito control strategies employing chemical insecticides on the community health and environment has been an area of concern. As an alternative for chemical pesticide, the essential oil extracted from the leaves of Rosemary, *Rosemarinus officinalis* was investigated for its repellent ovicidal and oviposition deterrent potential against dengue vector *A. aegypti*. The repellent efficacy of rosemary oil against adult mosquitoes assessed by human bait technique revealed effec-

tive repellency of the oil. The exposure of the adult mosquitoes to the arm applied with rosemary oil provided 100% mosquito bite protection for duration of 30 min; 1 - 2 bites were scored in 3 hours of exposure as compared to 6 - 9 bites recorded on control arm. A noticeable observation was the knocked-down effect of the papers against adults, when impregnated with 10% oil. The oviposition deterrent and ovicidal potential of the rosemary oil was evaluated using multiple concentration assays. The oviposition cups containing 1 ml of different concentrations of the oil (100%, 10%, 1%, 0.1%) and 199 ml of water were kept in the cages. The number of eggs laid in each cup was scored. Our investigations revealed that the cups containing 100% oil caused complete oviposition deterrence, which reduced to 54% - 75% with decrease in oil concentration. When the eggs laid in different concentrations of rosemary oil were allowed to hatch, the effect of the oil on egg hatchability was found similar to that observed during the oviposition. The studies revealed 100% mortality in eggs laid in water containing 100% oil. Understandably, the ovicidal efficacy of oil reduced with decreasing concentration of the oil, with the egg hatchability ranging between 28% - 51% in cups containing 10% to 0.1% oil concentration. Our results indicated that rosemary oil can be used as a repellent, oviposition deterrent and ovicide against dengue vector, *A. aegypti*. Repellent creams can be made by using the isolated eco-safe and cost-effective components. Future investigations are, however, essential to discover and recognize the bioactive components. The identification of the bioactive components and their mode of action could help in devising mosquito management strategies, which could improve the community health standards across the globe to a great extent.

Keywords: *deterrent, ovicide, repellent, rosemary oil*

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***In vitro* Comparative Assessment of Shatavari Adulterants and Substituent Using Antioxidant, Antibacterial and Phytochemical Methods**

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Background: *Ayurveda* is Indian traditional system of medicine in which shatavari is commonly referred as *Rasayana* which prevents ageing, increases longevity and improve mental function as well as adds vitality to the body. Adulteration and substitution are frequent in raw material trade of shatavari due to its increased demand in the global market. Herbal adulteration is one of the common malpractices in herbal raw material trade. At present, the adulteration and substitution of shatavari is the burning problem in herbal industry. The purpose of this work is to study medicinally active constituents of the shatavari adulterants and substituent present in various extracts obtained from plant parts. **Methods:** In the present study, crude alcoholic and aqueous extracts from roots, leaves and stem of six shatavari samples (cultivated and wild) from different locations of Pune region were subjected to compare the *in vitro* antibacterial activity by Broth Micro-dilution method against *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Antioxidant profiles of all the plant samples were assessed by DPPH method. In addition, Phytochemical analysis was also performed for the detection of bioactive compounds. **Results:** *Asparagus adscendens* Roxb. and *A. gonocladus* Baker are traded under the name shatavari where as per the flora and literature *A. racemosus* Wild. is the real shatavari. The current experimental analysis showed that the methanolic extracts of wild shatavari significantly inhibit the growth of selected bacterial species with $\leq 1.95 \mu\text{g/ml}$ MIC. All the extracts exhibited potential activity against *B. subtilis* with $\leq 0.48 \mu\text{g/ml}$ MIC and less potent against *E. coli*. Results generally indicated that the extracts are potential source of antioxidants of natural origin. Wild shatavari showed signifi-

cantly high amount of antioxidants (98% inhibition) in aqueous extract of leaf whereas one of the cultivated samples had noticeable antioxidant profile. The phytochemical analysis of extracts studied, revealed the presence of important primary metabolites, such as, carbohydrates, sugars, amino acids, proteins and several bioactive secondary metabolites, such as, steroid, glycosides, saponin, alkaloid, tannins, flavonoids and phenols. **Conclusions:** The plant extractive method studied could be an answer to people seeking for better therapeutic agents from natural sources which is believed to be more efficient with little or no side effects when compared to the commonly used synthetic chemotherapeutic agents. Adulterant and substituent used under the name shatavari did not show potential antioxidant and antibacterial profiling.

Keywords: Asparagus, broth micro-dilution, DPPH minimal inhibitory concentration

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Evaluation of Hypoglycemic Potential of the Methanol Crude Extract of *Bougainvillea spectabilis*

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Diabetes mellitus is a very common and the most prevalent metabolic syndrome which is characterized by an elevated blood plasma glucose concentration. Due to the multifactorial nature of the disease, intervention of diabetes is complicated. Scientists have reported the pivotal role of *Bougainvillea spectabilis* in cellular signaling pathway. The present investigations were carried out to study impact of methanol extracts of *B. spectabilis* (100 and 400 mg/kg) on the blood glucose levels of mice. The study was performed *in vivo* using alloxan-induced diabetic mice. Each methanol extract of *B. spectabilis* was administered in the rat separately and the effects were observed within 7 days. The results clearly

showed that the mice induced with *B. spectabilis* extracts showed a decrease in blood glucose level. The group induced with 100 mg/kg of the extract showed the higher hypoglycemia as compared to the group injected with 400 mg/kg *B. spectabilis* extract. It was remarkable to note that administration of methanol extracts could reverse the permanent hyperglycemia in alloxan-induced diabetic mice after seven days. It thus shows that the *B. spectabilis* crude methanol extract exhibit potential hypoglycemic property and can be explored for the diabetes treatment.

Keywords: alloxan, Bougainvillea spectabilis, diabetes, hypoglycemia, in vivo, mice

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A Survey of Hygiene Awareness with Relation to Food Consumption

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India, being a country, where endemics and epidemics are quite rampant, more so when monsoon hits, it is much needed that proper hygiene is observed. The current research aims to analyse the hygiene observed by food vendors and the level of consciousness amongst the consumers regarding the safety of the food they consume. The area under observation was a busy college area in New Delhi keeping in view that the hustle bustle of city life and the population per km^2 in such localities of Delhi are almost equivalent to a small village. The main focus of the investigation was to elucidate the level of awareness among local people regarding safety regulations or hygiene in their food. Efforts were made to devise a better model of public education in order to increase the level of awareness regarding health or hygiene concerns. The data was collected through surveys, interviews and field studies, which throws light on the various schemes and regulations made available by the government regarding food safety. The Government regulations and schemes col-

lected from official government sites (FSSAI-Food Safety and Standard Acts) and open government records were compiled for comparative study. The observations clearly show the lack of hygiene maintenance in majority of the food stalls and complete lack of awareness among the general public about the certification of the food they consume. In addition, the study also proves that education regarding the safety of food consumption is either almost negligible or being neglected amongst people. Lack of awareness regarding government procedures and a preference for cheap food over qualitative food seems to be another major cause for the neglect towards personal health issues. Our results stratify the level of awareness among bachelors and those living with their families, elucidating the fact that a sense of responsibility sinks in with a family like institution. Methods or some existing models of public education and awareness would be discussed wherein, a more effectively enforced mode of public education and awareness has been stressed upon. This will, consequently result in the realization of great neglect towards food hygiene, especially amongst the youth in India; understanding that it is indeed a major cause for a number of widespread diseases and comprehend that how this needs to change in order for a healthy nation to evolve.

Keywords: awareness, food consumption, health education, hygiene, safety

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SUB-THEME 4: ECOLOGICAL APPROACH TO LEARN BIOLOGY

Clinical Approach to Learn Biology through Ecology: An Overview

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Biology has been considered as a 'Science' which means understanding while ecology as an 'Art'

which means an implementation of science for the welfare of mankind. To understand biology, the role of ecology can be traced back to prehistoric man, who utilized environmental information for food, shelter, medicine etc in order to survive the hardships of nature. Though biology has its basic divisions like morphology, genetics, evolution, molecular biology, taxonomy, etc., ecology is an integral part of it. Biology attempts to define and explain patterns within and among organisms with the help of ecology. There has been a paradigm shift in the education process and also the modus operandi of teaching process has tremendously changed during the last few decades due to the burst of educational software. There is a shift from the teacher centric approach where the instructor imparted knowledge to a learner-directed approach where the teaching process is more interactive with emphasis on planning learning goals, learning environments composition, and learning resources. As it is said 'To apply the requirements of learner-directed learning design one needs to consider the learning process as an emergent phenomenon'. Ecology now a day has made learning biology easier for students as it needs minimum time and labour for its introduction to laymen. Present day problems of varied nature in human life directly or indirectly relate to ecology as their solution needs an ecological knowledge. Now it's just not about understanding biology for students as a life science, but also the need to protect the plants and animals and this has been intensified during last twenty years. Both scientists and general public have realized that we are living in a state of unprecedented mass extinction. Around the globe, biological communities that took millions of years to develop are being devastated by human activity. The main cause includes habitat destruction, forest cutting, overgrazing grasslands, draining wetlands and polluting the ecosystem. These kind of human activities emphasise the need of imparting an ecological learning approach among students. Ecology not only can be used as a teaching aid for learning

biology but also it can inculcate love for nature, respect for fellow organisms and adore life among students and researchers. Various activities like 'Swachh Bharat,' 'Grow More Trees,' 'Yoga,' 'Don't Waste Energy' are highlighted through biological classes to explain what is "Life Form", i.e. the sum of adaptation of living organisms to climate. This study will highlight the ecological approach to learning processes. Also, it will help in understanding the various ecological principles and approaches that can be useful for learning every aspect of biology. This paper will also focus on the usefulness and the impact of ecological approaches to learn biology.

Keywords: biology, ecological approach, ecology, learning process

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Influence of Different Coloured Light for the Orientation Behaviour of Lepidopteran Insect Pest *Spodoptera litura* (Fab.)

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The present study was taken up to know the behaviour of a serious Lepidopteran pest, *Spodoptera litura* (Fab.) using simple techniques. The approach favoured here is to treat learning as a biological phenomenon by first placing the insect within a functional system of behaviour- orientation behaviour of different instar larvae of *Spodoptera litura* administered to different coloured light source. Irrespective of 1st instar (L1), 3rd instar (L3) and 6th instar (L6), all larval stages were receiving the visual stimulus from different light sources. These larvae were attracted significantly more towards the green light (70%) as compared to other light sources, viz. red, blue and normal light. Moreover, among red, blue and normal light source, red light showed better (50%) effect by attracting the larvae towards it. The insect model, *S. litura* commonly called as tobacco caterpillars are phytophagous insect pests which

are resistant against many insecticides causing massive damages to the crops and vegetation. We did the experiments by taking both single insect as well as group insects test. This work elucidated how the present insect pest responded to different coloured light source; thus finding the way to reach the host plants. During special occasions of celebrations, it's customary to decorate our houses with colored lights or with paints- all of which invariably attract the insect pests, which then establish themselves in the immediate vicinity that includes our kitchen gardens, or fields even. Subsequent control measures to eradicate the same through use of insecticides, results in ecosystem disturbance, not just limited to an adverse effect on our health. Our findings would aid in raising awareness about the resultant effect of the coloured light and paints, and how best to avoid attracting the insect pests by making judicious selection of the colour.

Keywords: eco-friendly, ecological, insecticides, Lepidoptera, orientation behavior

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Pollination Biology between Insects and Flowers: a Fieldwork Course in the Undergraduate-level of University

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Pollination between flowers and insects is not only an important ecological research theme on biotic interactions in nature but also a profitable and enjoyable education topic of fieldwork. One of the authors, Shimada, has conducted the course, "Pollination Biology between Insects and Flowers", for undergraduate students for 20 years. In 2015, we set up its new version for the International Course, PEAK Environmental Sciences. PEAK is a brand-new international course of the University of Tokyo, founded in 2013, and brings

together international students from mainly Pan-Pacific countries. After teaching basic knowledge on pollination biology in flowers and insects, a fieldwork was conducted twice to catch insects that are attracted to flowers, in Nikko Botanical Garden (at the foot of mountain, Nikko-city, Tochigi) and our university, Komaba Campus (Meguro-ku, Tokyo). The aim of fieldwork in Nikko Botanical Garden was to collect various generalist pollinators, flies, beetles (flower chafers, longicorn beetles, etc), butterflies, wasps, honeybee. Further, pollinating behaviour of specialist pollinators, three species of bumblebees (*Bombus*), was observed. In the Komaba campus, a field experiment was carried out where *Bombus ardens* was marked individually beforehand and sugar-dissolved water was added to *Azarea* flowers. Recording the arriving time at the flowers and leaving time for the colony, their regular pollinating behaviour was grasped quantitatively like the swing of the pendulum. Keeping in view the possible problem of language gap between the teacher and TA while using Japanese illustrated books, it was taken care to always use scientific names of plants and insects to avoid any trouble. Based on the fieldwork, the student could deeply understand biodiversity and ecosystem function of pollinators in nature.

Keywords: biodiversity, bumblebee Bombus, ecosystem function, generalist pollinators, pollination, specialist pollinators

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Ecological Learning through Ecosystem Immersion: A collaboration of a School and a Botanical Sanctuary

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The conventional approach to learning about biological systems and interactions happens in laboratories. While there can also be a strong case

made for learning about these systems in the field (outside the labs), there is often a shortage of ideas of sustaining this learning experience and measure its impact. This presentation details the experience of a school in Bangalore, Centre for Learning, which has made immersive ecological experiences a central part of the curriculum over the last twenty years in close collaboration with a botanical sanctuary in Kerala. The presentation outlines various facets of this long-standing collaboration and introduces some key ideas that can be adopted in biology education to get a different perspective of biological systems.

Keywords: biological systems, ecological immersion, ecosystems, field biology, interactions

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Reactions of Bioluminescent Bacteria to Heavy Metals Lead Acetate and Cadmium Acetate

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There are microorganisms found in the oceans capable of emitting light, the phenomenon which is called bioluminescence (Shimomura, 2016). Bioluminescent bacteria are used as indicator of the toxicity of environment, such as water, soil and atmosphere; it is also used for the detection of organic pollutants and heavy metals (Gu, 2005; Girotti, 2005). This study aims to use bioluminescent bacteria as a potential alternative test for detecting heavy metals, specially lead acetate and cadmium acetate. Bioluminescent bacteria isolates from the gut of the saltwater fish, *Lutjanus argentimaculatus*, were used for testing heavy metal concentrations and were subjected to normal inoculation process. The standard concentration set by the Food and Drug Administration for lead and cadmium were multiplied x1000 to increase the concentration before the four times serial dilution. Application of the different diluted concentrations of lead acetate and cadmium acetate was added to

bioluminescent bacteria plates through spraying. There were ten replicates used per heavy metal concentration in order to validate the results. Plates were observed for two hours with five minutes interval. Photos were computed in percentage using *Image J* macro software. Bioluminescent bacteria can detect concentrations between 20 mg/l to 200 mg/l of lead acetate, and results on the cadmium acetate were consistent, with all having reduced brightness than that of the control.

Keywords: bioluminescence, bioluminescent bacteria, environmental toxicity, heavy metals

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A New Tool of Nanoscience for Eco-Control of Mosquitoes: Strategic Innovative Plan for Community Health

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Mosquitoes are serious insect pest vectors, widespread throughout the world. Mosquito bite causes disease like malaria, filariasis, dengue and Chikungunya. Human filariasis is a main health hazard and common socio-economic problem within tropical countries. It is strongly felt that total eradication of world mosquito population is impossible and that the only remedy remains is to avoid mosquito bites. There are many mosquito management strategies, inclusive of the use of myriad pesticides, to which the mosquito has developed resistance. Public awareness campaigning is necessary, and often the only effective measure. Present paper focuses on the formulation of herbal mosquito repellent with nanotechnology and eco-friendly eradication of mosquito population. Chemical mosquito repellents contain parathrene, an agent which affects skin and nervous system causing rashes on skin, swelling and eye irritation, and many other problems including brain swelling in children, anaphylactic shock, and low blood

pressure. Hence, there is preference for herbal mosquito repellents, as they are safer and eco-friendly. Silver nanoparticles are synthesized by using plant leaves having insecticidal properties. The resultant biosynthates are then characterized with UV spectrophotometer, transmission electron microscope and scanning electron microscope. The mosquito repellency was tested against mosquitoes in captivity. This experiment was carried out during 2014 - 2015. It was found that formulated mosquito repellent was effective against mosquito.

Keywords: herbal plants, insecticidal properties, mosquito repellent, silver nanoparticles

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The Planktonic Algae of Guagua River

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This study aims to determine the phytoplankton species present in seven sites along the Guagua River - Duck Island; Sasmuan Town Proper; Malusac, Sasmuan; Sebitanan, Sasmua; Bancal Pugad, Lubao; Batang First; and Batang Second, Sasmuan using standard procedures. Water samples were collected from seven sampling sites during three sampling periods: May, August and December. The collected samples were preserved with Lugol's iodine. Physicochemical parameters were also taken from each station for analysis. The samples were viewed under light microscope in wet mount and counted in Neubauer's haemocytometer using Schoen's method. Identification was done using keys given by Round, Martinez-Goss and Statistical Package (MVSP v. 3.21). Version 2 of PAST Software Design was used for performing multivariate analysis of ecological data by canonical correspondence analysis conducted to detect patterns of distribution of phyto-

plankton groups related to physical and chemical parameters. A total of four major groups of phytoplankton species were observed in the collected water samples. Based on the abundance estimate, Bacillariophyta was found to be the most dominant species in all sampling sites with percent abundance of 56.8, followed by Chlorophyta (22.3%), Cyanophyta (19.1%) and lastly Euglenozoa (1.8%). The sites of Batang Second, Sasmuan and Bancal Pugad were observed to be majorly similar in terms of absence and presence of species, based on Jaccard's Coefficient. The highest number of species identified is in Duck Island with 19 species.

Keywords: diversity index, Guagua River, phytoplankton, planktonic algae

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Classrooms as Learning Centers of Environmental Security and Food Wastage

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The present study aims at building schools as awareness centers to ensure the environmental security which is tampered due to burning issue of generating green house gases because of dumping of tons of food waste from restaurants, in house, mess, supermarkets, parties, marriages etc. The present Big Bazaar/Supermarket/Food Plaza culture has brought the kitchen out of home and sadly is responsible for creating more greenhouse gases than our transportation system, uses unimaginable quantity of water and degrades the quality of our air, water and soil. A survey on marketing habits and concept of recycling of food waste was done by eighty students of two Science schools (10+2 level) of Kanpur. Students were allowed to take the help of parents in writing the answers which eventually gave the clue on actual awareness of the public on environmental issues.

It was observed that although children (and also the parents) theoretically know about recycling, they are unaware of the possible recycling of the leftover food. Maximum admitted that they do not take care of waste food and are least knowledgeable of the greenhouse gases released by it in the landfills. Hardly few knew that waste food can be directed for composting. They were surprised to find that maximum food going to dump yards is due to its unutilization before the expiry, purchase in bulk due to attractive schemes in malls. At the end of the study students showed keen interest in adopting maximum ways of recycling food, donating the unconsumed clean and untouched food to needy without getting influenced by any external motivating factor.

Keywords: classroom learning, environmental education, environment security, food wastage

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SUB-THEME 5: EDUCATIONAL TECHNOLOGY FOR BIOLOGY EDUCATION

Traditional and Theatre-Oriented Education: A Psychoanalytic Study of the Students

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Interactive theatre practices that could aid the educational process have been tried since long as a way of fostering effective learning. Though these practices are still followed at school levels to some extent, yet at higher education students are imparted rote education instead of creative education using discussions and contributions through performance. In today's competitive world, we stress upon an extraordinary talent to stand out in the crowd. Yet, with increasing longevity of life and decreasing amount of time one has for leisure in one's life, the current education system has not yet been effectively able to teach students how to manage their life, i.e. they have been given the ammunition, yet not enough time

has been spent on properly using those arms. Keeping this in view a comparative study was carried out between the students who have taken a theatre-oriented course and students educated under the traditional model of education. The test group included the undergraduate students enrolled in the Colleges of University of Delhi. The objective behind the study was to understand the psychological effects and the physical manifestations of theatre education on students. The results were deduced after psychological evaluation tests, interviews with theatre-educationists and students, and survey models. Our results expounded the importance of an all-round development system incorporated into the education model being followed in India. The study showed that though being armed with vast knowledge, our youth still faces underemployment and scrams much beneath its actual potential. It evidently demonstrates that theatre education increases the vitality and optimization of a person's personality, thus providing a better model citizen. This study aims to devise the biological/psychological process that goes on in the mind and further help prove the effectiveness of incorporation of a theatre-oriented model into our education system for better learning.

Keywords: creative, psychoanalysis, theatre, traditional learning

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Changing Trends in the Biology Education –IIT (Inquiry, Innovation and Technology)

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Biology is truly a land of unlimited possibilities. We may expect it to give us the most surprising information, and we cannot guess what answers it will return in a few dozen years. They may be of a kind which will blow away the whole of our artificial structure of hypothesis (Sigmund Freud). The recent technological expansion has opened

many new doors for teachers. There exists now new, clearer, and more exciting ways to present almost any content. The internet is a storehouse of knowledge, that which is readily available to students. The educators too are presented with equal number of different ways to present the information in the classrooms. The rapid growth of biological knowledge has already placed it at prominence among other sciences. The responsibilities of biologists are changing as new technological devices are redefining Biology. The biology teacher has to ensure that he or she is current in the content matter, method and technological devices. However, a good teacher in Biological Sciences knows that technology should only be used when it serves to enhance or facilitate instruction already in place. It has the potential to revitalize a classroom and build interest in the students, since it helps to cater to the multiple intelligences, learning becomes more effective. This paper makes an attempt to put forth the different ways in which technology can be used to engage learners in biology, offer opportunities in different types of scientific enquiry and draw simple conclusions in both elementary and secondary school education.

Keywords: effective learning, multiple intelligences

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ICT in Biology Education: The Indian Scenario

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Information and Communication Technology (ICT) is increasingly becoming an integral part of the education system globally, as it promotes student-centred education and catalyzes free choice learning. Biology can be seen as the convergence point of multiple disciplines that describe the complex interactions between biotic and abiotic components, at microscopic as well as biosphere

level. Hence it has been argued that the study of biology involves holistic and deductive approach that would benefit from ICT tools. Information technology is quickly becoming an indispensable component of life in India; yet there are few success stories describing the utilization of ICT for enhancing the effectiveness of biology education from our nation. Several pedagogical practices and socio-cultural factors such as the rote-based learning system, rigid power structure and plurality in educational approaches ensure that the application of digital technology to teaching and learning biology at the classroom level is not a cakewalk. This paper will explore the scope and hurdles of IT enabled biology education in India.

Keywords: biology education, ICT teaching, student centered education

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Effective Computer-Aided Instruction for Biology Classroom: A Case Study

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Effective science teachers use instructional technologies in science classrooms. Many teaching ICT tools are available for Biology in schools and universities. Yet, it is challenging to conduct student-centred classroom experiences. The researcher sought to understand the extent of use, and the reasons for using ICT in urban biology classroom, so as to diagnose the challenges, advantages and perceptions of biology teachers when using educational multimedia in urban junior colleges. The researcher sought to study the theoretical basis for using multimedia in biology education in an urban college, so as to formulate effective and pragmatic policies for the use of computer-aided biology instruction. Interviews of biology teachers reveal that ICT infrastructure, motivation levels of students, and their learning styles influence the use of ICT in the classroom.

Keywords: computer-aided instruction, ICT, jun-

ior college, learning styles, motivation.

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Greening the Science Education for Better Tomorrow

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To involve the students directly in the deliberations on scientific development and communication is one of the best methods to understand the concepts of science and technology. To know about the Nature, to safeguard the biodiversity, to preserve and conserve it so as to secure the future of all biological forms, and to learn its importance directly, it is desirable to mingle in Nature; and it is also essential to learn the experimental work to understand its principles and experience the joy. The environmental deterioration is the result of population explosion, massive urbanization, deforestation, and rapid industrialization. Young students take a keen interest in the science and environmental issues in the country like removal of illiteracy, poverty, superstition, and control desertification, pollution, waste-disposal etc. Therefore, it is necessary that the students and youth should be made aware about the root-cause of the problem, and their role in resolving the same. Keeping these issues in mind, the project titled "Science and Environment Fair" is operational as an extension activity in Vidarbha region, Central India, particularly Nagpur District, under the auspices of *Marathi Vidnyan Parishad, Indian Science Congress Association, UNESCO Club, Nagpur*, and other non-Governmental Organizations, since last more than two decades. Through these 3-day- to a week-long Science Fair, we try to deliver clean and green message to the students and teachers directly, and the parents and society in general. The impact of the fair has been creation of awareness to follow scientific principles, and getting motivated to pursue career in Biological Sciences. Over 6,000 students, and 600

teachers from about 60 secondary and higher secondary schools in Vidarbha region, Central India, have been involved in this activity. This project involves a number of activities like 1) the guidance from experts, scientists, and activists in the field from the region in the form of seminars, lectures, demonstrations etc., 2) screening of related videos, 3) taking the students to the gardens and nearby forest vegetation, lakes and rivers, zoos and museum, scientific laboratories etc., 4) and involving their participation in tree plantation programs, and simple experimental work, various competitions like essay, drawing, elocution etc., 5) to organize rallies about the awareness of various issues concerning the environment, and organizing small exhibitions on medicinal plants of the region, and to carry out small biodiversity projects. To motivate the students involved, prizes are also given to the deserving students. This feature has now become more or less a perennial one.

Keywords: biodiversity, science education, science fair

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SUB-THEME 6: CLASSROOM TEACHING, LEARNING AND ASSESSMENT

A Garden-Based Approach to Teach Life Science at Elementary Level with Integration of Assessment in the Teaching-Learning Process

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Learning can become inherently spontaneous, meaningful and learner-centered when moved from the confines of the classroom into the world at large. The purpose of this study was to discover if teaching life science outdoors had an influence on the ability of elementary children to recall the information being taught better than when taught indoors. In a study conducted at Jawahar Navo-

daya Vidyalaya, Mundali, Cuttack (Odisha, India), the concept of food chain and food web was taught to a section of class VIII students through constructivist approach and to the other section of the same class through traditional approach; each section comprised of 35 children. The pre-test and post-test was done through questionnaires containing ten multiple choice questions and three open ended questions. A delayed post-test was done to study the retention ability of the two groups. The analysis of the results of the present study revealed that children who were taught food chain and food web in school garden through constructivist approach learnt better and showed an increased positive attitude towards content material and learning in general in comparison to children taught inside the class room. The study points out that school gardens are a wonderful and exciting way to make learning alive and provide an opportunity for children to participate in hands-on learning besides teach responsibility, teamwork, expand their ways of thinking or habits of mind to include curiosity, flexibility, open-mindedness, informed scepticism, creativity, and critical thinking.

Keywords: constructivism, cooperative learning, critical thinking, peer group, teacher-centered teaching

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Environmental Education in High School for Understanding River Environment Changing Over Long Periods of Time: A Class Activity Using Preserved Diatom Slides, Simulation Software and Video Images of an Old River

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A river environmental research using aquatic organisms is often introduced in text books of Japanese high school biology as an activity of

inquiry-based learning to understand the relationship between the immediate natural environment and human activity or society. However, it is difficult to predict how human activity affects water quality of a river, because restoration of river environment always needs a long period of time. Novel teaching materials and a lesson plan are developed for students' understanding of the relationship between anthropogenic effect and river environment. We prepared diatom slides collected from a current river and compared with old slides of diatoms collected from the same site in the same river and preserved in herbarium. After observation of these slides, students operated "Sim-River", simulation software for understanding relationship between human activity, river water quality and diatom community. Finally, they watched a video of an old river and photographs showing heavily polluted conditions. Analyses of pre-test and post-test showed that the students' awareness of river environment became more specific and constructive after the class activity.

Keywords: diatoms, herbarium, inquiry-based learning, SimRiver

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Efficacy of Blended Learning - A Study

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Learning is defined as permanent change in behaviour. The surroundings induce a child to observe, analyse, imbibe the experiences and frame suitable responses when needed. This results in change in behaviour. We get educated by being in the surroundings. Science is systematic study of everything around us. Life sciences, especially includes interactions of biota among themselves as well as with Abiota. Inquiry thus is a natural urge of living being basically to analyse problems and get solutions. It is an urge to know what is unknown. Blended learning goes a step beyond this by integrating a core subject of science and

mathematics with vocational skills. This method ensures acquisition of knowledge and its application in day to day life through psychomotor competencies. Present study is a four year training module designed for school boys and girls in the age group of 11 to 15. It is named as "Science and skill programme" which is blended learning incorporating conceptual understanding. The outcome is construction of knowledge and competencies. Students carry out Hands On activities in which they learnt three major aspects: Clothing-Shelter-Food. The trades learnt were FIBER TO FABRIC, SEED TO PLATE and RAW TO FINISHED which included Carpentry, Electricity, Masonry, etc. The mapping of the class syllabus with learning of all the trades was carried out beforehand. This study includes over 120 students. At present ongoing projects and earlier completed similar projects make the data size of 1000. The weekly assignments slip tests and outcome as product made by each student not only gave satisfaction to the learners but served as evaluation method for the trainers. As rightly said in a research article by Christine Collier Judith Johnson -Lisa Nyberg (2016): "You are spending time supporting thinkers and helping their minds develop so that they can approach new learning creatively energetically. Students are learning how to learn." This study strengthened these valuable comments. If child is oriented, trained to use this approach as learning methodology it helps the child to gain knowledge, develop skills and these together leads to acquire the right attitude to learn science was the conclusion of our observations. The feedback from students over four years was obtained in the form of a questionnaire given to them. The statistical analysis was carried out. The feedback from students over four years indicated that learning was a joyous experience. Students expressed that it helped them develop interest in science. 95% students enjoyed the activities. They felt this experiential learning as it was all hands on activities helped in deep thinking and long lasting. Students feedback in-

licated that it helped them understand science easily. Our experience as Educators indicates that this blended learning process was more inquiry-based, more task-centric approach in a joyous manner. The details of these process and analysis of feedback will be discussed in this paper.

Keywords: blended learning, hands-on, inquiry, skill and science

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Effect of R2D2 Model for Acquisition Science Process Skills

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In the Constructivist approach learning is an active construction of knowledge rather than acquisition of knowledge which is geared towards use of learning rather than instruction. This paradigm has now shifted from instructional approach to learning design (LD) which supports the construction of knowledge rather than communicating knowledge. The emphasis of LD is on what learners are doing, how to support their activities and how to support their individual needs and personalize their learning experiences which supports the constructivist learning. Constructivist Design Model supports psychological, pedagogical, technological and cultural foundations of Constructivism. For major difference advocates designing instructional sequences, the emphasis of constructivism is on the design of a learning environment. With this background researcher will develop & use the Willis's R2D2 (Recursive, Reflective, Design & Development) constructivist design model for the concept 'Respiration' from biology subject. For the present study the researcher has selected the concept 'Respiration' from the first year Botany subject. To enable the students to acquaint this concept and develop related science process skills, the researcher has selected R2D2 Model. The learning design will be developed using Willis's R2D2 constructivist de-

sign model and actual experimentation will be conducted. The effect of this model will be measured on acquisition of concept and science process skills.

Keywords: Constructivist Design Model, science process skills

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Assessment of Scientific Graphical Literacy Skills of Secondary School Students

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Recently scientific graphs have become vital descriptive tools that are widely used in various fields, such as, education, business and media. Individuals should have the basic skills of interpreting and constructing scientific graphs in order to cope with the demands of 21st century. The purpose of this study was to assess the scientific graphical literacy level of the 10th grade science students; and explore the extent to which these students have the essential skills to process and interpret visual scientific graphs in secondary schools. This study was an exploratory survey design in which a Graphical Literacy Test was developed to assess the student ability to interpret and construct graphical information. A total of 125 (female: 62; male: 63) science students studying in 10th grade participated in the study. The result showed that students have better performance in graph interpretation than in graph construction. Moreover, students exhibited graph interpretation misconceptions related to graph "visual perception", "graph recognition", and "reading multiple graphs". Misconceptions related encoding to information into a line graph and mathematical knowledge of graph construction were also detected. A statistically significant relationship was observed between graphical literacy of 10th grade student and their level of graph interpretation, and graph construction. Interestingly,

female students significantly outperformed the male students in graph literacy level and graph interpretation performance; while both female and male students showed poor performance in graph construction. This study has educational implications for curriculum planners and developers, science teachers and students, in relation to how to adequately develop graphical literacy among students. More research studies are needed to further explore students' difficulties with graphical skills and how graphical literacy is developed by students.

Keywords: construction, graph, graphical literacy, interpretation, misconceptions

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An Exercise to Enhance the Ability of Students to Solve Multiple-Choice Questions in Biology

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There is apparently a thorough confusion in the teaching-learning-evaluation system being experienced at the critical pre-university stage. The admission to most of the courses in demand is not on the basis of the examination being conducted by various boards of education. Instead it is based on the performance in separate entrance tests. These tests mostly involve answering a certain number of multiple-choice questions in a limited period of time. There may be a deduction of marks for giving wrong answers. Moreover, the questions mostly test memory rather than the capacity to logically analyze, or apply the principles of science to derive the appropriate answer. The number of students increases every year but the number of seats for the courses in demand, does not increase in the same proportion thus making the competition increasingly severe. The students are under tremendous pressure and try to cope up by rote learning. To improve their skills in an-

swering multiple-choice questions and to encourage self learning an experiment was designed and executed in a small suburb of Mumbai. It involved 100 higher secondary students studying in XII-standard. The students were segregated in two matched groups with identical gender representation, identical score in secondary school certificate examination, identical socio-economic status and comparable skills at languages. Students of both the groups were given a surprise test on the same day, time and using the same questions. The papers were assessed to determine their performance. Students of one group were familiarized with the technique involved in setting good quality multiple-choice questions. They were subsequently asked to prepare at least 20 questions, on the topics in Biology they had studied, within the following 4 weeks. They were warned against picking up the questions directly from published books or other sources. Subsequently, another unannounced common test was given to both the groups on the same day. The performance was assessed. Using appropriate statistical tools, the performance of students in the two groups was compared. The results were analyzed in the light of current understanding of psychology of learning. Through this, the necessity of change in teaching methodology was established in a view to improve the performance of students in competitive tests.

Keywords: competitive entrance tests, learning psychology, multiple-choice questions

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Effectiveness of Constructivist Classroom Activities on Conceptual Change in Biological Science Concepts at Secondary Level

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A major theme of science education research throughout the past three decades has been stu-

dent's misconceptions of scientific phenomena. Research has shown that misconceptions among pupils are resistant to change and they persist even with formal science instruction. This paper highlights conceptual change in pupils for shaping a future ideal classroom which is totally based on constructivist classroom activities. In this present study, an investigator identified biological misconceptions held by IX-standard pupils from a unit, Highway to health. For removing these misconceptions conceptual changes are needed, *i.e.* replacing misconceptions with correct conceptions. For that, various constructivist classroom activities had been used. A sample of 80 pupils was drawn from IX-standard of one school of Khanapur block, the pupils were divided into two groups, 40 pupils were in experimental group while 40 pupils were in control group and a pre-test was conducted for both groups. The control group pupils were taught through conventional method of teaching. The treatment was given to experimental group through collaborative learning strategies and constructivist classroom activities. After completion of this approach, the post-test was administered to the pupils of experimental and control group. The pre-test and post-test were used to arrive at the following conclusion: The pupils of the experimental group achieved more than those of the control group in science at the secondary level. This is due to the favourable impact of the constructivist classroom activities.

Keywords: constructivist, misconception

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Body Language as a Tool for Clearing Biological Concepts and Making Classrooms More Dynamic

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In D. B. F. Dayanand College of Arts & Science, Solapur, in true sense a mini India resides. Stu-

dents from different backgrounds and different native languages like Marathi, Kannada, Telgu and Hindi take admission. When these students come to the college, the medium of instruction changes to English. Initially, students find it difficult to cope up with the English language. Additionally, in many schools, any science teacher, graduate of any science subject, is supposed to teach biology. This way, teaching biology remains only up to reading and learning to remembering the topics. Also, students develop strong ideas that biology is descriptive, non-creative and a lethargic subject. This study is based on 5 - 6 years of actual work in a class of 75- 80 students, on how to tackle this problem. Current paper presents a study by mixed method (quantitative and qualitative methods). It suggests how a biology teacher can use his/her body language to help students understand some biological concepts, along with making the classroom more dynamic. This way, a teacher can make students realize that biology is a virtual subject, where their own body itself is the model to experience, to understand and to study. The study is mainly focused on dealing with few concepts related with animal tissues, circulation and locomotion in animals and movement of synovial joints, all through body language. The feedback is the ultimate visible changes in student's behaviour. Their behaviour exhibits positive response in terms of their increased attendance, attentiveness, interest, academic performance and a friendly open dialogue with teachers. The elaborated account regarding suitable body language, the concepts cleared and behavioural changes observed are discussed in detail.

Keywords: behavioural changes, biological concepts, body language, dynamic classroom

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SUB-THEME 7: CURRENT CHALLENGES AND NEW APPROACHES FOR BIOLOGY TEACHERS

Replacing Classroom Animal Laboratories into Digital Laboratories: Creating E-Repository of Organisms

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In India and many other countries, the experimentation on animals and dissections in the classrooms utilizing live organisms has been restricted or completely prohibited because of inordinate amounts of suffering, stress and inhumane treatment to animals. In India, statutory body of the Government of India, UGC (University Grants Commission), has issued guidelines to phase out experimentation and dissections on live organisms in various biology courses. This has created an urgent need for digital alternatives to study diverse animals. Keeping the constraints and the wants of educational establishments in view, efforts have been taken to replace classical classroom animal laboratories into digital laboratories by creating a repository of biological specimens using open platform. It would not only help in creating digital library to understand the variety but is expected to be as one of the significant instruments of the teaching-learning practices in academics. The main objective for creating digital laboratory of animals is to spread awareness among stakeholders regarding the biological diversity found in India and the world through digital tools. It is a platform that contains all information about various animals, including their classification, habits, habitats and characteristic features. The resource is being enhanced and harmonized with the sketches of organisms drawn by the students and the pictures clicked by them illustrating the detailed structural aspects of the species. The animations and videos unfolding their behaviour, structure and physiology are also being prepared. It would not only make the resource more fascinating and instructive, but would also help engaging students through interactive and collabora-

tive technologies. In addition, it is being supplemented with pioneering scholastic tools, such as, skill-based questions, quizzes and MCQs to develop it as an innovative library appropriate for inclusive education. These tools will ignite the inquisitive youth minds, support their knowledge and extend a sense of conscientiousness and compassion towards the organisms. Furthermore, the resource not only documents existing species but also records the rare and endangered species so that the successive generations can comprehend the diversity once existing on Earth. This will arouse curiosity among students and educators augmenting the quality of teaching in Biology. The digital laboratory of animals is a flexible, well-informed and easily accessible resource available to all educators and academicians. These resources can be effortlessly adapted, reused, tailored, amended and augmented with the information as per the need of stakeholder, educator and institutions. The developed resource is intended to be delivered in different formats; text, audio mode and videos, for every kind of educational approach. The digital laboratory of animals created has been made accessible under Creative Commons license making it open access and open resource for all educators.

Keywords: biological diversity, Creative Commons, digital laboratory, repository

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Perception about use of ICT in Classroom Teaching-Learning

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During the period of 2014-16, we organised five pre-conference workshops at different places in India on various sub-themes of the 26th AABE conference. Three workshops were organised on use of Information and Communication Technol-

ogy (ICT) in biology education where 76 school and college biology teachers were participated. The study aims to investigate biology teachers' perceptions of technologies and of their usefulness in promoting a meaningful learning. Data analysis allows us to conclude that teachers are willing to use ICT recourses and are aware of the existing potential, they are facing problems in relation to accessibility to ICT resources and lack of in-service training opportunities. Researches in this field showed that an adequate preparation is essential for teachers to cope with technology-rich classrooms. The teachers' perception towards ICT integration into teaching-learning process increases if ICT usage is encouraged and vice versa. As biology educators, we also have to deal with the need to lead teachers to develop a more suitable and effective awareness of the usage of ICT in teaching-learning.

Keywords: biology teaching-learning, ICT integration, perception

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How to Use ICT for Teaching Materials about Mechanisms of Evolution in the Secondary Education

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Scientists have already revealed the basic mechanism of evolution, and understanding evolution is essential necessity to learn biology. In junior and senior high schools of Japan, however, few teachers have good skills to teach evolution, and then inaccurate or inappropriate views of evolution are spread among students, citizens, and even younger teachers. Why does such a serious problem occur? In fact, the 'mechanisms of evolution' have been rarely taught for a long time in the course of scientific education in Japan. For the purpose of teaching mechanism of evolution to students, we have developed lecture material with

an animation using ICT (Power Point software) and have been getting exciting results since 2004. The contents of this program file consists of the following chapters: 1) mutations, generating variation in a population; 2) natural selection, causing adaptive evolution in a population with variation; 3) genetic drift, causing neutral evolution in a population with variation; and 4) breeds of dogs caused by artificial selection similar to natural selection. We have used versions of this presentation for junior and senior high school classes, teachers' competition for elementary school education, and in several conferences on scientific education. Our lectures and presentations amongst the elementary, junior high and senior high school students have resulted in inspiring deep understandings of the mechanism of evolution. Consequently, the current versions of Japanese official textbooks of high school biology have incorporated evolutionary biology in prominence in the volume prescribed. Continued up-gradation and innovations, it is believed will yield greater appreciation of the subject amongst the students.

Keywords: evolution, genetic flow, ICT, mutation, natural selection, teaching materials

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SUB-THEME 8: PRACTICES AND CHALLENGES IN BIOLOGY RESEARCH AND EDUCATION

Plagiarism in Education Programs – Dishonesty or Lack of Awareness?

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Background: Data and literature available due to technological advancements in computation and internet connectivity has encouraged plagiarism in under graduate and post graduate students. Due to availability of electronic resources in public domain, assignments and thesis submitted by the students are usually heavily plagiarised. We ad-

dressed the question whether this is because of lack of awareness about plagiarism amongst students and teachers and its serious consequences or whether a plagiarism is permitted as a soft crime. **Methods:** A survey was conducted amongst students and teachers using a questionnaire method. The major questions focused on were related to whether the student/faculty been informed about plagiarism explicitly, whether students/faculty considered plagiarism a legitimate misconduct, know it is wrong instinctively but do not consider it a serious offence. Questions were also formulated to find out whether students/staff recognize various types of plagiarisms and know about 'referencing' and citations. **Results:** On the basis of our study, we suggest that there is lack of awareness about seriousness of the issue of plagiarism. There appears to be a feeling in the academic community that it is somewhat permitted. Poor writing skills and perceived lack of time also encourage plagiarism. Teachers play a major role as explicit instructions about what constitutes plagiarism and about referencing are not always provided in any class. **Conclusions:** We propose some ways to minimize instances of plagiarism amongst students and ensure development of skills for original writing. This would bring in academic honesty among learners during their course work. The faculty must recognize, promote and reward the students for their originality of ideas, as well as for citation of appropriate literature.

Keywords: biology education, plagiarisms

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Synthesis of Silver Nanoparticles in Acrylic Acid Solution and their Application for Estimation of Dopamine

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Nanoparticles (nps) of silver and gold have been

explored by researchers because of uniqueness in their optical properties and facile synthesis. Spectrophotometric detection of various species based on the optical properties of metal nps has recently been reported. Change in the spectral position or intensity of absorption spectra of nanoparticles due to interaction of metal nanoparticles with biological analyses is the basis of widely applicable colorimetric sensing. Polyacrylic acid (PAA) capped silver nanoparticles have been synthesized in aqueous solution by green chemical method using polysaccharide as reducing agent. Nanoparticle synthesis and polymerization of acrylic acid occurred simultaneously *in situ*. The anionic carboxylate groups of deprotonated PAA effectively stabilizes the nanoparticles, resulting in the formation of extremely small size (about 20-30 nm) nanoparticles. Effect of different parameters such as precursor concentration and alkalinity on nanoparticle formation has been studied. These silver nanoparticles were tested for estimation of dopamine (DA) by monitoring surface plasmon band of nanoparticles at various DA concentrations. The result showed that the response of spectral change towards DA concentration is linear in the DA concentration in the range of 5.27×10^{-7} to $1.58 \times 10^{-5} \text{ mol dm}^{-3}$. The interference of ascorbic acid (AA) in estimation of DA has also been studied. AA concentration up to $1.0 \times 10^{-4} \text{ mol dm}^{-3}$ does not interfere in the estimation of DA. The peak maxima (I_{max}) as well as the absorbance of the surface Plasmon resonance spectrum of noble metal nanoparticles (Ag, Au) is highly sensitive to the nanoparticle size, shape and external dielectric environment. This property of silver nanoparticles helps in developing a new class of nanoscale affinity biosensors. This method thus can be used for estimation of dopamine in presence of large concentrations of ascorbic acid.

Keywords: ascorbic acid, dopamine, poly acrylic acid, silver nanoparticles, spectrophotometric detection

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Detection of Phytoplasmas by Nested Polymerase Chain Reaction in Plant

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The phytoplasma are very small prokaryotes which are related to cell wall less bacteria (pathogens) of important plants, including agricultural, horticultural and ornamental crops, causing a wide variety of symptoms that range from mild yellowing to death of infected plants. During the feeding activity of the inoculative vector, insect leafhoppers (*Cicadellidae*) and psyllids are primarily responsible for phytoplasma transmission in nature. Thus the phytoplasmas are found in the phloem cells of host plants. The present study was carried out on the collection of symptomatic and asymptomatic plant samples and processed for DNA extraction by C-TAB method (1 M Tris, 1 ml; 0.5 M EDTA 0.4 ml; 5 M NaCl 2.8 ml; 10% C-TAB 3.5 ml; β -mercaptoethanol 0.05 ml; distilled water 2.28 ml). DNA quality and quantity were assessed by biophotometer for concentration and the optical density 260/280 nm and 260/230 nm to assess the purity of the sample. The quality of the DNA was checked by Gel electrophoresis (0.7% agarose gel). Subsequently, 2 μ g of total DNA was amplified in first round PCR for conserved region of 16S rRNA gene (using P1/P7 universal primer pair), amplicons of ~1.5 kb PCR product in a total volume of 20 μ l reactions followed by second round (Nested PCR) reaction involving two sets of primers (IF7/7R2 or R16F2n/R2), used in two successive runs of polymerase chain reaction. The second set was intended to amplify a secondary target spacer region (tRNA) within the first run product. The PCR products were resolved on 1% agarose gel in Tris EDTA (1X TAE) containing EtBr. 10 μ l of PCR product was mixed with 2 μ l of 6X loading dye and loaded into gel; 1 kb or 100 bp ladder was used as molecular marker. Electrophoresis was

carried out at 70 volts for 45 min. to 1 hr. Gel was observed under an UV transilluminator Gel-doc to observe 1.25 kb bands. Notably, since the Phytoplasma is restricted to the phloem tissue, its concentration in infected plants is very low. PCR assays universal primer pair P1/P7 and nested primer pair R16f2n/R16r2n greatly increased the sensitivity, as well as specificity in detection of phytoplasma in plants.

Keywords: C-TAB, insects, nested PC, phytoplasma
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Birds, the Indicators of Biodiversity, Choose Indigenous Trees over the Exotic Trees in Urban Green Spaces

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Urbanisation is a global trend but has negative impact on overall environment. Green spaces seem to help in ameliorating the same. However, many green spaces are known to support relatively poor faunal diversity. Hence to sustain faunal biodiversity in green spaces, right choice of tree species may be the crucial factor. As a validation to this point of view, studies on preference of trees by one of the major faunal group, the birds, was taken up in the present work. Avian fauna on three species each of exotic and indigenous trees was studied for one year from July 2014 to June 2015. The results revealed that indigenous trees supported significantly higher bird species compared to exotic tree species. Among the indigenous tree species, *Bombax ceiba* harboured maximum resident as well as migrant species of birds. The present study suggested that plantation of indigenous trees in green spaces can enhance the bird diversity along with other ecosystem services provided by them. The choice of tree species in the green spaces is of utmost importance during the landscape planning and must be considered by urban developers to maintain sustainable development.

Keywords: birds, exotic trees, indigenous trees, urban green spaces,

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Bioprocessing of Rice Straw for Production, Partial Purification and Characterization of Endocellulase using *Aspergillus niger* by SSF

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Cellulases are a group of hydrolytic enzymes and are capable of degrading lignocellulosic materials. Agro wastes are good carbon source and provide rich growth media for a range of fungi which produce industrially important enzymes. The present study investigates the potential of the *A. niger* isolated from Anand region of Gujarat, India, for endocellulase production by solid state fermentation (SSF) using rice straw as a model agricultural waste. This study focused on optimization, partial purification and characterization of endocellulase.

After parametric optimization, maximum endocellulase production was achieved when pH of mineral salt medium 4.0, by maintaining moisture content of 80%, after 168 hrs of incubation at 28°C, using 3g rice straw as whole carbon source with inoculation of 8 discs of 96 hrs old *A. niger*. Among different nitrogen sources, yeast extract and among different sugars-xylose enhance the endocellulase production. The crude enzyme partially purified led to an overall purification of 8.45 fold with a 18% yield at 70% ammonium sulfate concentration. Optimum temperature and pH for endocellulase activity was 40°C and 6.0, respectively. The results indicated that rice straw might be a good potential source of carbon and might be used at larger scales for endocellulase production due to its cost effectiveness and ease of availability.

Keywords: Aspergillus, characterization, endocellulase, optimization, purification

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<Poster Presentations>

SUB-THEME 1: LEARNING BIOLOGY THROUGH ENQUIRY

Effectiveness of Inquiry Based Learning in Teaching Biology

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New methods and practices are constantly being introduced in education with an objective to get students understand and interpret his/her learning. Learning is a very personal and individualized experience for students who usually have to adapt to an educator's pedagogy or strategy of teaching. This study was designed to evaluate the effectiveness of inquiry-based-learning (IBL) teaching methods over traditional lecture instruction in the context of biology concept. Random selection

process was used to select the schools. Four were kept as control and four were selected for experimentation and grade 8 students (n = 30) were selected for the study. A teaching intervention was designed on the basis of IBL and was put into practice. Study was conducted for duration of one month. The activities involved in this study included inquiry-based activities and traditional activities on topics, such as, photosynthesis, food and nutrition, transportation in plants, sense organs, respiration, bio-diversity, etc. Students were given a pre-test to assess prior knowledge of the units that would be covered in the classroom lessons. The same assessment was also administered at the completion of the unit. When comparing unit test scores, inquiry students' scores were significantly higher than the traditional lectures. If

inquiry activities are executed properly, implementing them into the Biology curriculum can increase learning gains in Biology topics. This suggests that classroom interactions taking place in inquiry laboratories closely resemble the thinking involved by scientists. Inquiry Based learning approach will show a positive impact on students' conceptual understanding and scientific skills. It was also observed that children were more open to activities and were enjoying when they were learning by Inquiry method.

Keywords: IBL, scientific skills, strategy, traditional lecture method

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Implementing Kath Murdoch's Science-Inquiry Model on the Topic "Structure of Cell" of Grade VIII Students

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The purpose of this research paper is to detail how 'science-inquiry' as pedagogy based on Kath Murdoch's model can achieve critical thinking skills and concept attainment in grade VIII students. The instructional module on the unit "Structure of cell" was developed based on Kath Murdoch's model. A quasi-experimental design for this research was implemented. A quantitative and qualitative analysis was carried out and the findings presented a significant difference between the experimental group and the control group. The Quasi-experimental research design of two groups post-test only was employed. The subjects of the study were Std. VIII students of SSC board of Maharashtra. It was found that the inquiry-based questions initiated by the students helped in achieving learning outcomes more effectively. The diverse questions initiated by the students helped solving and understanding complex issues. It was seen that promoting students' autonomy enhances science learning. Thus, science-Inquiry pedagogy can be implemented in teacher training institutes. A paradigm shift in the

teachers approach to teaching concepts for effective implementation of science-inquiry approach is envisaged. Teacher training institute can incorporate training in science-inquiry for student teachers for further changes in training techniques. Supporting texts should be provided for better contextual understanding of the subject for higher order thinking skills and greater interest in the subject.

Keywords: concept attainment, critical thinking, Kath Murdoch's model, pedagogy, science-inquiry

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Study of Efficacy of Activity Based Learning Model on Learning Life Science among Upper Primary School Students

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Being process of inquiry, science can be learned best by doing. Therefore, the kind of pedagogical strategy the teacher is employing for authentic engagement of learners so that they can do science, emphatically by inquiry, is most important. Designing teaching learning activity that facilitates learner to adapt to science process skills and to construct concept of life science is always challenging. The present research has tried to study the efficacy of Activity Based Learning Model (ABLM) designed to ensure engagement – exploration – explanation - elaboration stages in inquiry-based learning process on the basis of constructivist pedagogy, in terms of enhancing science process skills and concept formation. The quasi-experimental study involves pre-test – post-test non-randomized control group design. The experimental group comprising of ten students of class-VIII-standard was taught two lessons of life science by ABLM, whereas the control group of same size was taught by conventional teaching method. The relevant descriptive statistics along with qualitative judgment of

learners revealed that application of ABLM has enhanced the science process skills and clarity of concepts in life science. Thus the efficacy of the Activity Based Learning Model (ABLM) is found to be positive in optimizing science learning at the upper primary level.

Keywords: activity based learning model (ABLM), concept formation, constructivist pedagogy, science process skills

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Attitude, Self-Efficacy of Biology Teachers towards Inclusive Education

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Teaching Biology in a classroom with varied learning ability students is a challenge. Inclusive approach in the teaching-learning process is the right way for it. Attitude and self-efficacy of biology teachers are important aspects for successful inclusion of varied ability students in the classrooms. This research inquires level of attitude and self-efficacy of biology teachers of junior colleges towards inclusive education. Objectives of the study are: 1) To assess biology teachers attitude towards inclusive education; 2) To assess biology teachers' self- efficacy toward inclusive education. Investigators applied survey method with the help of SACIE scale and SEIIP scale. Data was analyzed with the help of spss-16.0. The major findings of study are: 1) Gender wise attitude of biology teacher towards inclusive education are almost equal; 2) Age wise attitude of biology teacher towards inclusive education is almost equal; 3) Qualification wise (graduate and Post graduate) attitude of biology teacher towards inclusive education is nearly equal; 4) Gender wise self-efficacy of biology teachers towards inclusive education is about equal; 5) Age wise self- efficacy off biology teacher towards inclusive education is almost equal; 6) Qualification wise self-efficacy of biol-

ogy towards inclusive education is almost same.

Keywords: attitude, biology teachers, inclusive education, self-efficacy

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Biomimetics-Inspiring Biology Students beyond the Obvious

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Introducing students to the field of biomimetics has potential to add new, stimulating and creative dimensions in the study of biology. Biomimetics, also known as biomimicry is about drawing inspiration from nature's inherent forms, processes and systems to find innovative and sustainable solutions to human challenges. In the study of biology, students have opportunity to acquire knowledge about living systems. This would broadly include study of life forms, their origin, functioning, growth, development, distribution and correlations with each other and surroundings. This knowledge may then further extend to applications of biology addressed in subjects like medicine, biotechnology, biomedical engineering, etc. Biomimetics offers potential to supplement the existing "learning about" with "learning from" biology. For instance, with biomimetics, knowledge acquired from the study of biology could extend beyond the utilization of living systems for our needs. It would involve being inspired by that understanding to design innovative strategies of our own. Bio-inspired design will challenge students to not only deepen their understanding of biology but also integrate their learning by establishing connections with other disciplines – be it maths, physics, chemistry or other. With advanced understanding, biomimetics holds relevance not only for technological innovations; but also in (community/industry/organization) management and policy making. This work 1) outlines some aspects related to the field of biomimetics that could enrich biology students' learning ex-

periences, and 2) reports preliminary analysis of written responses obtained from high school students who attended an interactive talk on biomimetics. The responses stated here are students' answers to questions posed to them during the talk delivered by the first author, as a part of an enrichment session for students. Themes and values that emerged from this analysis are reported. For example, some students' responses related to recycling of waste, environmental balance and sensible resource use were indicative of sustainability values. Some writings seemed to draw inspiration from the social life of insects and conveyed values of harmony.

Keywords: bio-inspired design, biology, biomimetics, multi-disciplinary, sustainability, technology

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SUB-THEME 2: IMPACT OF LOCAL ISSUES RELEVANT TO BIOLOGY IN GLOBAL SCENARIO

Country Report from Japan: The Current State of Biology Education and the Prospects for Revision of the Course of Study

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Since 1947, beginning of a new mandate for education in Japan led to revision of the Course of Study (CS) about every 10 years. The current CS has three principles, "Solid academic prowess", "To be Rich in Humanity" and "Health and Fitness"; all of which support the fundamental philosophy of the CS, "Zest for Life". Current CS for Science for upper secondary schools, enforced in 2012, has 10 science subjects, which includes two new subjects "Science and Our Daily Life" and "Science Project Study." The former subject aims for raising students' interests in nature, science and technology, while the latter subject intends to enrich students' inquiry abilities. The traditional subject areas have four 2-credit basic subjects;

Basic Physics, Basic Chemistry, Basic Biology and Basic Earth Science. Further, there are four 4-credit advanced subjects for respective science fields. Basic subjects are organized for almost all the students, while advanced subjects are provided to the students interested in a particular field of science. In current year 2016, approximately 98% of the students selected Basic Biology, while 25% of students selected Advanced Biology. Basic Biology is composed of three units, and Advanced Biology is composed of five units; and has been supplemented with inquiry activities at the end of each unit. The key words for Basic Biology are DNA, Health and Environment. In addition, Basic Biology emphasizes the concept of "unity and diversity" in relation to evolution. Moreover, Biology-related subjects in the current CS have been modernized by reflecting the rapid progress in life science research in recent years. While such modernization is desirable, it has led to new problems, especially in the case of Advanced Biology where the quantity of topics has increased and the contents have become more challenging. In addition, teachers feel that they must give a lot of information to students in preparation for university entrance examinations, instead of allotting time for inquiry activities. Keeping all the constraints and challenges in view, MEXT (Ministry of Education, Culture, Sports, Science and Technology), Japan, is going to revise the CS. The revised course for upper secondary school is aimed to be enforced in 2022. The guiding concept of the revisions is to enable students to cope with the changes in Japanese society when they reach adulthood and face reduction in the working-age population, progression of globalization and technological innovation in Japan. Thus, the strategy of school education needs improvement, as it is important for the students to be aware of the connection between their learning and the changing society. There is a dire need to emphasize on the quality of contents, *i.e.* "what is to be learnt," and the quality of learning method, *i.e.* "how to learn" to deepen students' learning. It

is also important to evaluate “what kind of ability students have acquired” because of innovative learning. Thus, the new CS will shift from the traditional content-based teaching to competency-based learning by introducing some innovative methods, such as active learning.

Keywords: *active learning, Advanced Biology, Basic Biology, Course of Study, inquiry activities*
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SUB-THEME 3: STRATEGIES FOR AWARENESS OF COMMUNITY HEALTH THROUGH BIOLOGY

Dietary Safety Assessment of Cooked Taro Leaves and Smoked Fish

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The acute and sub-chronic toxicity of two Filipino dishes, cooked taro leaves (Pinangat) and smoked fish (Tinapa) were assessed in mice. The investigations were carried out by providing a dose of Pinangat and Tinapa to the mice at 400, 800, 1600 and 3200 *mg/kg* body weight. Corn oil served as the vehicle control. Results revealed no mortality in all the control and treated groups. No observed adverse effect level (NOAEL) for Pinangat is 400-1600 *mg/kg*, whereas NOAEL for Tinapa is 400-800 *mg/kg*. Signs of toxicity as manifested in terms of sickness-like behaviour, lethargy and mild ataxia, were observed in the group with the highest dose of Pinangat and medium dose of Tinapa. During the 60-day sub-chronic toxicity study, the animals were exposed daily with graded doses of Pinangat and Tinapa. Biochemical analyses revealed significant increase in the total blood cholesterol, VLDL and triglycerides of the mice fed with 1500 *mg/kg* smoked fish. Hepato-renal enzymes were also significantly elevated in all the treated groups compared to the control. Results of Pinangat treatment revealed no significant change in the lipid profile and hepato-renal markers of all treated mice. However,

creatinine ($\mu\text{mol/l}$) was significantly elevated in the group fed with 3500 *mg/kg* Pinangat. The results of the study suggest safety of the food products when taken at appropriate doses. However, findings also confirm the adverse effects of excess dietary salt loading on kidney and liver.

Keywords: *acute toxicity, hepato-renal, NOAEL, Pinangat, sub-chronic toxicity, Tinapa*
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Application of Data Mining Methodologies to Improve Animal Production and Health

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Data mining methodologies are being widely used to analyse the large size of animal genetic and breeding data to estimate the genetic co-relations and to study the performance of animals, as well as animal's health. Mortality rate in ruminants can only be reduced through disease prevention. In this regard, timely disease prediction remains an effective tool to manage the disease cycle, and thereby reduce the rate of transmission or infection to other ruminants. A precise prediction model is necessary to develop disease forecasting. This model can be built using disease data and data mining methodologies. The disease data can be collected from large number of diseased animals at different stages of infection in the form of different data matrices. These data matrices will then yield various attributes, which will help to identify the particular disease. Data mining provides lot of methodologies to build the prediction model such as Random Forest, Support Vector Machines (SVM), Naïve Bayes (NB), Logistic Regression (LR), C 4.5, and many more. These methodologies are all derived from disease data collected from diseased animals at different stages of the disease. One area of concern remains the need for large size of disease data with effective attributes to standardize the methodologies, to be

effective in final prediction and recognition of the disease. The present model will not just be helpful in taking preventive measures to safeguard the ruminants against probable disease, but additionally will result in greater yield (productivity), and reduce economic losses to the farmers.

Keywords: animal health, data mining methodologies, disease data, disease prediction

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Carbon Nanoparticle Based Smart Fabric: An Efficient Antimicrobial Platform for *Escherichia coli*

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Emergence of pathogenic infectious diseases and drug resistance in pathogens impose absolute questions to modern day life. Unhealthy drug disposal and complex growth of superbugs as drug resistant microbes is a serious issue of concern. Necessity of sterile surface or bacteria free surface remains a major area of interest in hospital environment, as microorganisms have begun to develop resistance to the commonly used antimicrobial agents, the antibiotics. It is therefore necessary to develop new approach and materials to act against pathogenic bacteria. Strategies to develop bacterial free surface involve use of disinfectant, chemical treatments either by alcohols or hydrogen peroxide. Antimicrobial coating with bactericidal metals, such as Au, Cu, I along with phenols and some heavy metals is a facile approach to develop sterile surface. Although bactericidal metal coating is a promising strategy to address complexity of pathogens, cost effectiveness and toxicity related to heavy metals makes their use impractical. Photocatalysis is a possible strategy to induce bacterial inactivation is a sustainable approach. Till date metallised silica and TiO₂ nanoparticles with plasmonic property have attracted considerable attention in photocatalytic inactivation of bacteria. In the present study, we

demonstrate efficient bactericidal property of cheap, metal free, low cost and easy to synthesise carbon nanoparticles (CNPs). CNPs have drawn significant attention within the scientific community due to its superior light absorption capacity in the whole spectral region and are able to generate photothermal heat for various applications. In the current study, CNPs are immobilized in chitosan in the form of a fabric by simple admixing of CNPs with chitosan. The fabric coated with Chitosan-CNPs (CNPs-Fab) has shown exceptional antibacterial behaviour in light. Disinfection has been done by using water on wheel system with CNPs-Fab dipping into contaminated water sample (contaminated with gram negative *E. coli* bacteria). The contaminated water was kept in a closed circular container and dragged for two hours to stimulate water on wheel concept. The CNPs-Fab exposed to 1000 W/m² sunlight, showed complete removal of bacteria in 120 min of light illumination. We propose that CNPs-Fab possesses exceptional disinfection property in presence of light, and that it can practically be applied for disinfection of surface water, especially in rural areas, where the problem of safe drinking water is more acute.

Keywords: antibacterial activity, CNP fabric

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Synthesis, Characterization and Antimicrobial Studies of Some Transition Metal Complexes of Schiff Bases

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Versatile ligands, which are prepared from the condensation of primary amines with carbonyl groups, are called Schiff bases. Schiff bases are very important compounds in various fields, especially in medicinal and pharmaceutical fields, because of their wide spectrum of biological activities. These are very effective against several

cancerous cell lines. Schiff bases combines with different transition metals and produced complexes. A vast range of processes in biology are controlled by metal ions. Metal complexes having multi dentate ligands containing delocalized and π -orbitals, such as Schiff bases or porphyrins are used as models in biological sciences. Coumarin and Pyrrole aldehyde-based Schiff bases were investigated against different cancerous cell lines; which displayed mild anticancer activities. A series of transition metal complexes of Cu(II), Ni(II) and Zn(II), with a tetra dentate Schiff base ligand, were prepared by the condensation of 2-amino thiazole and dimedone. The metal complexes have been characterized on the basis of elemental analysis, conductance and magnetic data, infrared and ¹HNMR spectra. From elemental analysis, the complexes have been found to be 1:2 (metal:ligand). According to this data, we propose an octahedral geometry for metal (II) complexes. The ligand and metal complexes were screened for their physiological activities against *E. coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Salmonella typhi*. Schiff base behaves as a neutral tetra-dentate ligand, and is coordinated to the central metal ion through the azomethine. The biological activity of all the complexes is higher than free Schiff base ligand. This means that metal chelation significantly affects the antimicrobial behavior of the organic ligand.

Keywords: 2-amino thiazole, antibacterial activity, dimedone, metal complexes, octahedral geometry, Schiff base

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Prevalence of Anemia among Female Undergraduate Students

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Anemia is a general disorder which shows decrease in the amount of haemoglobin in blood, and the capacity to carry oxygen is decreased.

Symptoms of anemia vary based on the underlying cause. There are three main types of anemia: due to blood loss; due to decreased red blood cell production, and due to increased red blood cell breakdown. Haemoglobin in the blood carries oxygen from the respiratory organs (lungs or gills) to the rest of the body (*i.e.*, the tissues). It releases the oxygen there to permit aerobic respiration to provide energy for metabolism in organisms. The iron molecule or atom or ion in haemoglobin helps to maintain the normal shape of the red blood cells. Anemia is a general public health problem, and is a non communicable disease affecting the people of both developed and developing countries. It occurs in people of all ages, but it is more often seen in pregnant women and our future young ladies (under graduate students), who will form the next generation of the society. So, in the present study, it was planned to conduct hematological tests for under graduate students of SR and BGNR Govt. Arts and Science College, Khammam, Telangana, with due permission from the head of the institution, to find out the prevalence of anemia, and it was also decided to conduct ESR tests, and a questionnaire was given to the students to know the duration of menstrual cycle, bleeding period, abdominal pain, usage of sanitary pads which reflects the maintenance of personal hygiene. **Materials and Methods:** Five ml of blood was collected from 154 female students in EDTA vials and analyzed in calorimeter method for identifying the hemoglobin percentage; ESR is measured by Westergren method. **Results:** The results are very surprising and are very sensible to be taken care. The prevalence of anemia in this study was found to be nearly 50% and further steps need to be taken to correct the problem. Based on ESR values, some infections were also present in few members. Based on the questionnaire, it was also identified that most of the girls are not following personal hygiene. **Conclusion:** Immediately, an awareness program needs to be conducted with the help of DMHO, Khammam, gynaecologists and physicians Iron-

folic acid tablets have been given for three months to correct the anemia problem. It is decided to repeat the procedure for all girl students.

Keywords: anemia, ESR, female undergraduate students, haemoglobin, personal hygiene

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Implementing Water and Sanitation Hygiene Education in Schools

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Diarrheal diseases are a major cause of morbidity and mortality in infants and young children in the developing world. On average a young child suffers 3.3 episodes of diarrhea in a year, and each year over 3 million children under five years die from diarrhea. Of the interventions to reduce the risk of diarrheal diseases, the promotion of improvements in personal and domestic hygiene ranks among the potentially most effective, with recorded median reductions in incidence of between 14% and 48%. The epidemiological review indicated that programmes should focus on preventing the fecal contamination of the environment and removing or destroying pathogenic organisms before they contaminate the new host. Working through schools involves the development of a curriculum, which may not necessarily be formalized, for hygiene education and the provision or upgrading of school hygiene facilities. Ideally, it would not just focus on the school facilities and the teaching but would reach out to the homes and community with messages and activities to promote visible improvements in water supply and sanitation in hygiene behaviors. The potential for schools to make a large impact on community knowledge, beliefs, attitudes and practices is great. During various health and hygiene awareness programs in schools we realized that schools are highly regarded in communities. School students whatever learned in schools they

passed in communities. If sustainability and community are to be achieved, long term needs of hygiene education programmes must be addressed. Greater efforts must be made to disseminate more effective approaches to sanitation hygiene education especially through participatory methods and greater emphasis on schools, school children, child to child and child-to-parent approaches.

Keywords: community health and hygiene, sanitation, water borne diseases

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SUB-THEME 4: ECOLOGICAL APPROACH TO LEARN BIOLOGY

Phytoremediation: A Novel Technology for Water and Soil Pollution Control Using Plants

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Water and soil pollution by heavy metals, metal ions and other organic or inorganic pollutants is a major environmental problem as it poses a threat to human health. The conventional methods to cleanup such contaminated sites are not always practical as they are costly, environmentally intrusive and cannot be used for larger contaminated sites. Phytoremediation is an emerging technology that uses plants to remediate soil and water contaminated with various contaminants. Research and studies indicate that it is a novel strategy that is cost effective, nonintrusive to the environment and can be applied to remediate large contaminated sites. This study reviews the concept and application of phytoremediation based on our current knowledge in the field of science. Heavy metals and, other inorganic and organic pollutants are present in the soil and water as natural components or as a result of human activities. Mining metal, smelting, energy and fuel production, burning of fossils fuels, use of fertilizers and pesticides in agriculture, dumping of industrial wastes and chemical spills incorporate

hazardous pollutants into the environment. These pollutants accumulate in the environment and eventually translocate in plant tissue or contaminate water sources and pose a threat to human health. Once absorbed by plants, some of these contaminants either degrade (organic contaminants) into non-hazardous materials or concentrate (inorganic contaminants) within the plant body. Consumption of such polluted plants by herbivorous animals introduces contaminants like heavy metal ions into the food chain. Soil contaminants such as Cu, Zn, Ni, Al, Cd, Pb and other heavy metals, have been proven to cause hazardous effects in animals and humans. Commonly used methods dealing with remediation of metal polluted soils and waters are soil venting washing, chemical treatment, excavation and burial or simple isolation of contaminated sites. Such methods are only practical in small areas, as they are extremely costly. These processes dramatically disturb the landscape, may reduce soil fertility and are intrusive to the ecosystem. It was estimated that between 1995 and 2000, the United States might have spent \$7 billion in cleaning up sites contaminated with only metals and another \$35 billion treating sites contaminated with organic and inorganic contaminants. Therefore, alternative remediation methods, which are cost effective and environmentally friendly, need to be established.

Keywords: bioremediation, chelation, heavy metal pollutants, hyperaccumulators, phytoremediation, sequestration, volatilization

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Using Ants to Teach Ecological Concepts and Quantitative Skills in Undergraduate Biology Classroom

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Inquiry-based active learning, as opposed to a traditional fact-based passive learning has been

shown as an effective tool to aid student understanding. Inquiry-based learning lends itself quite effectively while teaching science classes, as science is often question driven, open-ended and has a hands-on component. At Azim Premji University (APU), Bangalore, we employed inquiry-based learning techniques to teach various concepts in biology to undergraduate students. In this paper, I discuss an example where first year students of Introductory Biology class learnt certain ecological concepts, together with observation and data collection. Ecological concept: species interactions form the basis for many ecosystem properties and processes. Competition, where individuals, either of the same or different species vie for same resources, is one such extremely common and important interaction. Competition can be studied in social insect colonies, where individuals in a colony/nest compete for resources with neighbouring colonies. Nest-mate recognition allows workers in social insect colonies to discriminate between nest-mates and others. We used weaver ants (*Oecophylla smaragdina*) to observe their behavioural responses to members of their own as well as other ant species. Inquiry based activity: this lab was tested with class 12 (100 students at DST INSPIRE workshop) and undergrad students at APU in 2015/2016. A guided- or structured-inquiry technique was used depending on the level of the students. During the class, students were divided into small groups (3 to 5 per group) to observe ant interactions. Students were then asked to come up with a claim about ant nest-mate behaviour and an experiment to test their claim. Control, and experimental groups, importance of replicates, time period to run the experiment, behaviours to measure were discussed. Interestingly, student groups had come up with different ways to measure various aspects of ant behaviour. As a facilitator, I gave them feedback on feasibility of certain methods, and guided students to use only a few parameters to measure behaviour of ants. Making sense of data: students collected data on the duration and fre-

quency of certain behaviours (antennation, trophylaxis, frequency of mandible openings, and bites). Data entry and plotting graphs using excel was taught. As a class, students analyzed their results, and found that ants from the same colony spent more time antennating and trophylaxing each other, whereas ants of different species showed aggression by opening mandibles or biting each other. The use of ants as a tool to learn ecological concepts and quantitative reasoning skills is advantageous, as, ants are readily available, inexpensive and can be easily housed in any schools or colleges. Students were treated as 'scientists' who were required to frame a hypothesis, design and carry out experiment, collect and interpret data thru an inquiry-based experiment.

Keywords: ants, ecology, inquiry, quantitative reasoning

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Adaptive Capability of Different Goat Breeds Under Adverse Climate

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Heat-shock protein 70 (HSP70) is a prominent marker of stress in livestock. This marker is best characterized for heat shock protein amongst HSP10, 27, 40, 60, 90, 110. This highly conserved protein expressed at the time of stress, plays an important role in adaptation to the environmental stress. Although, the expression pattern of HSP70 gene is species- and breed-specific, variations in adaptation and thermal tolerance are due to the nature of environment and adaptive capacity of a species. The present study was conducted to evaluate the adaptive capability of different goat (*Capra hircus*) breeds, i.e. Jamunapari, Barbari, Jakhrana and Sirohi under adverse climate conditions (peakdry summer, humid and cold). The targeted gene HSP70 (HSPA6) was evaluated for this purpose using specific primers. The expression of HSP70 gene and protein was

estimated by RT PCR and ELISA kits, respectively. The expression of HSP70 gene and estimation of HSP70 protein in blood indicated that the Sirohi breed of goats was more adapted, followed by Barbari, Jakhrana and Jamunapari during peak summer season; Jakhrana was found more adapted during humid season, followed by Barbari, Sirohi and Jamunapari. Barbari breed of goat was found most adapted during cold season, followed by Jamunapari and Jakhrana. These results indicate that during adverse climatic stress, the expression of HSP70 (gene and protein) was observed in every season (peak period), but its quantum of expression was found more in peak summer season. These results conclude that HSP70 gene and protein is a prominent marker to estimate the stress condition in goats during adverse climatic conditions.

Keywords: adaption, adverse climate, goat, heat-shock protein

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Management of *Parthenium hysterophorus* through Biocontrol Agent *Zygotramma bicolorata* to Save Environment, Health and Biodiversity in Nagpur (MS)

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Parthenium hysterophorus L., commonly known as carrot weed or congress grass in India has been considered as one of the worst weeds. It is responsible for causing health problems in human beings as well as animals, besides loss to crop productivity and plant biodiversity. The weed has infested million hectares of land in India since its first notice in 1955. Now it has become one of the main weeds in almost all types of agricultural lands besides infesting wasteland, community land, road and railway track sides and forests. In an attempt to explore biological control agent

against *P. hysterophorus*, the Mexican beetle *Zygogramma bicolorata* was found to be an effective biological control agent in India as it feeds primarily on this weed. Different life stages of the beetle were collected from the field and mass rearing of the beetle was undertaken in laboratory condition. After the successful rearing, the beetles were released in *Parthenium* invaded field. The multiplication of the beetles in the fields was monitored for three consecutive years to check the effect of beetles on *Parthenium* and performance of the beetles in successive years. It was found that the abundance of *Parthenium* in the infested area had declined after three months of introduction of *Z. bicolorata*. At the start of second year, the emergence of adults of Mexican beetles was observed from the soil indicating that the insect was successfully acclimatized in Nagpur region. This study can help the people to make strategy for the control of exotic weed *P. hysterophorus* using eco-friendly approach.

Keywords: *biological control, Parthenium hysterophorus, Zygogramma bicolorata*

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Need and Alternatives for Animal Dissections in Science Education

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Every year, millions of animals are dissected in elementary, secondary, pre-college science courses, and by educators. The present study investigates attitudes of biology students and teachers towards animal dissections, and the need and alternatives for animal dissection was studied by giving questionnaire to 50 college students and 20 teachers from University of Mumbai. Some students favour traditional dissections, whereas teachers expressed concerns with dissection and said they need to engage more deeply with ethical questions. However, more teachers and students were aware of how these animals suffered and

their horrific conditions. Many teachers and schools have replaced animal dissection altogether in favour of modern alternatives. The dissection movies are large and clear, the anatomy/physiology and didactic material is superb and the ecology section continually reminds us that animals are living beings connected to a much larger web of life. Classroom dissection desensitizes students to the sanctity of life. Research has shown that a few students at every educational level are uncomfortable with the use of animals in dissection and experimentation. Studies also suggest that exposing young people to animal dissection as “science” can foster callousness toward animals and nature, and even dissuade some from pursuing careers in science. Teachers suggest that computer graphics have become very useful alternatives to actual dissection. Dissection alternatives are also more environmentally sound. They eliminate the use of carcinogenic chemicals (such as formaldehyde) to preserve dead animals. Innovative programs available on CD include “The Digital Dissection Works” and “The Ultimate Human Body films”, charts, audiovisual aids, realistic models and multimedia presentations provide an effective option. Alternatives save not only animals’ lives but also impact school budgets by dramatically reducing dissection lab costs. Using alternatives, each body system can be studied and virtually “dissected” repeatedly until students are confident with the material, unlike actual dissection in which each system is ablated and displaced and the specimen is discarded at the end of the lesson. Studies show that students prefer these alternatives and find them to be a more enjoyable learning tool. Dissections teach students to abuse animals. The knowledge that dissections can bring is valuable in many job positions, but it also teaches how to hurt and kill innocent animals.

Keywords: *animal dissection, alternatives, biology, students, teachers*

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***Ocimum basilium* (Basil) Essential Oil: An Eco-safe Potential Control Agent against Dengue Fever Mosquito *Aedes aegypti* L. (Diptera: Culicidae)**

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Aedes aegypti L., being the most ubiquitous disease vector in tropical and sub-tropical countries, can cause more human suffering than any other organism. Diseases, like Dengue, Yellow Fever and Chikungunya spread by this vector, are undergoing revitalization, while new diseases, such as Zika, are on the rise. Driven by the increasing number of reported cases year after year, the dengue fever mosquito, *A. aegypti*, continues to remain one of the most prevalent and serious disease vectors. Knowing that the extensive use of chemical insecticides is creating devastating impact on human beings, environment and non-target organisms, the botanicals have emerged as successful alternatives and are being proven as an efficient line of defense against the increasing mosquito-borne diseases. In the present investigation bioassays were carried out to evaluate the effect of basil, *Ocimum basilicum*, essential oil on different life stages of *A. aegypti*. The larvicidal bioassay carried out against early fourth larval instars of *A. aegypti* resulted in LC₅₀ and LC₉₀ values of 142 and 445 ppm, respectively. The repellent test performed against female adults resulted in 120 min of complete protection time with no bites observed on application of 0.1 ml of basil oil on the arms of human volunteers. It was remarkable to note that first mosquito bite was observed after 135 min of application, in comparison to 8 - 10 bites observed on control arms. Furthermore, the basil essential oil also proved to be efficient oviposition-deterrent against *A. aegypti*, causing 100% avoidance when added as pure oil to the oviposition medium. The addition of 10% oil also resulted in significant 96% deterrence, which reduced to 58 - 61% with decrease in oil concentration from 0.1% to 1.0%. Present

study also discovers 100% ovicidal potential of 1.0% oil, whereas 76% egg mortality was observed on addition of 0.1% oil. Our observation shows that basil essential oil can be used as a promising larvicide, repellent, oviposition-deterrent and ovicide against *A. aegypti*. Formulation of water soluble tablets and air sprays utilizing basil essential oil is under consideration for future research. The recognition of the components and the mode of action can help us to build defence strategies against *A. aegypti*.

Keywords: *Aedes aegypti*, basil oil, deterrent, larvicide, ovicide, oviposition, repellent

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SUB-THEME 5: EDUCATIONAL TECHNOLOGY FOR BIOLOGY EDUCATION

Evolution of Technology in Biology Education

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Life without technology is just like lunch without meal. It is difficult to find the parts of the universe where technology is not reached. In ancient times, knowledge was found in manuscripts. There were so many limitations of preserving such knowledge manuscripts. After the industrial revolution, it became easy to save this knowledge in form of books. Later on various images, diagrams were introduced. But due to the invention of computers, the process of learning is made easy; the books are also available in audible formats. Teaching-learning process which was considered as 'bilateral' is now completely centered on students. There was problem of drawing figures manually, but due to this technology, now it has become easy. PowerPoint presentations, slide show, Internet are playing the role of knowledge centers, where the role of teachers in completely changed. Today, knowledge is available in innumerable formats. It is up to the learner from where he or

she is willing to gain the knowledge.

Keywords: bilateral, industrial evolution, Internet, PowerPoint slide

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Technology Initiatives to Enhance Quality in Biology Teaching

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Biology teachers make us understand the concepts from abstract to concrete. But with the advent of technology, teaching of biology has become more exciting and interesting for both teacher and taught. The technological tools like of Power Point Presentations (PPTs) with visuals and videos were used over a period of four years for undergraduate B. Sc. Zoology students; mostly belonging to rural area, with Telugu as medium of instruction to teach part of their syllabus. The annual results assessment was made and the results indicated improved performance of students from 89.07% to 95.3%. These technological tools are playing a pivotal role to improve skills of teachers and knowledge, understanding and application level of students in biology. The PPTs and videos helped to understand biological concept easily after teaching though the students are from Telugu medium and the visuals and videos gave scope to visualize the chunk of knowledge, like an animal structure, physiology of a process, an experimental procedure or a life cycle. This indicates that technology definitely supports biology teaching and strengthens the skills of teachers to impart quality teaching.

Keywords: biology, education and quality, PPT, technology, videos, visuals

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Effectiveness of Multimedia Use in Teaching Food and Nutrition at Primary School Level

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Educational technology plays a significant role in classroom learning for understanding and comprehension of basic biology concepts. Teaching-learning by using multimedia technology at primary school level helps students to construct understanding of key science concepts and channelize for future learning of more abstract ideas. 'Food & Nutrition' for primary school students. The Objectives are: 1) To develop multimedia on food and nutrition; 2) To study the effectiveness of developed multimedia over conventional teaching method. From grade seventh, eighty (N = 80) students were randomly selected for this study. The research design adopted for the study was quasi-experimental pre-test and post-test non-equivalent group design. The findings revealed that students who studied topics food and nutrition by multimedia have higher achievement than the conventional teaching control group.

Keywords: educational technology, food & nutrition, multimedia, primary school students

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SUB-THEME 6: CLASSROOM TEACHING LEARNING, AND ASSESSMENT

Classroom Teaching-Learning and Assessment

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With the dwindling interest in taking up pure sciences by students, it is a great challenge to teachers to sustain students' interest in biology, and not allow such courses to die. The simple and the best method is classroom teaching, through which

better learning can be achieved and assessments made. Classroom assessment techniques should be made more interesting and interactive among students so that their interest in learning more and showcasing their knowledge should go on increasing. "Effective teaching" requires a great effort from teacher, who should have a thorough idea regarding the course work to be taught, and likewise categorize, and give different topics for group discussion or class tests. This can be done by giving in brief, an insight into the day's topic, and site some references, and ask students to prepare thoroughly for a power-point presentation, followed by group discussion, and finally, with a multiple-choice question-test, to know whether the students have understood the crux of the topic. Assessment and evaluation can be done through class-tests and oral question-answer sessions. The teacher should be sharp enough to know the weak points of students, and accordingly, should take measures to rectify them. Also periodic reports should be made, such that students' progress can be easily analyzed. Reports should be sent to parents from time-to-time, to make them know the progress of their wards. Some students are fond of listening to stories and other unrelated things, which may not pertain to the course. A teacher may indulge in such things to gain popularity amongst students. But, whether it serves the purpose of making them thorough in their curriculum, such that they can face examination with full confidence is to be seen? Hence, class assessment and evaluation are a must to judge a student's progress. If the examinations were to be conducted only twice or thrice in a year, it might not give the teachers a clear-cut assessment regarding a student's progress. It has to be a continued process throughout the teaching span of the curriculum, so that effective measures can be taken in the overall improvement of the class and bring the results to good percentage. The assessment can be done in the following ways: Assessing the students' academic skills, Interaction and finding out how they are assessing their own learning skills, and Stu-

dents' interest in various assignments and display of interest in classroom teaching. Based on this feedback, faculty can adjust the teaching to help students learn. Assessment and evaluation, no doubt, are the essential components of teaching-learning process. Without an effective evaluation program, it is impossible to know, whether students have learned, whether teaching has been effective or how best to address students' learning needs. The quality of the assessment and the evaluation in the educational process has a profound and well-established link to students' performance. Research consistently shows that the data analysis, regular monitoring and feedback are essential to improving the students' learning.

Keywords: classroom assessment techniques, feedback, interaction with students, students academic skills, students' reactions

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Using Drawings for Diagnosing Students' Misconceptions

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Various research on students conceptions revealed that students do not come to school as blank slates to be filled with instruction. Actually, students come to school with considerable knowledge, some correct and some not. This students' knowledge is based on intuition, everyday experience, as well as what they have been taught in other settings. Before beginning instruction on any new topic, as teachers we need to know their students' preconceptions. This is because learning and, therefore, instruction itself varies depending on whether preconceptions agree with the concepts being taught or contradict those concepts. For understanding students' prior knowledge and identifications of their misconceptions, researchers and teachers have been using various tools and techniques. Drawings may be used as a tool to investigate students' prior knowledge and their

misconceptions about various biological concepts. There are several ways, such as, interviews, concept maps, open-ended questionnaire, concept based objective tests or two-tier multiple-choice tests, etc for obtaining information about students' knowledge. These may effectively bringing students' in-depth thinking, but these are difficult to quantify and sometimes subjective. Drawings have been considered as simple research instruments that enable easy comparisons at the international level. The study explored whether the drawings of students accurately reflect their conceptual understanding about photosynthesis and transpiration in a manner that can be interpreted by others. Data gathered from drawings of 146 students from high school classes and interview of 15 students. These drawings were analyzed and categorized based on five levels of drawings criteria by Kose. Several misconceptions were found, some of them with both relationship between photosynthesis and transpiration in plants. Some of these misconceptions were similarly previous studies and distributed across all age classes. Drawing and interviews have been successfully used to diagnose students' conceptual understandings and misconceptions about photosynthesis and transpiration.

Keywords: biology education, misconceptions, photosynthesis and transpiration

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Effect of Teacher Knowledge Programme (TKP) on Teacher Trainees Cognition

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A comprehensive definition of science would be "Science is a body of knowledge, a way of thinking, a way of investigation and a way of experimentation in the pursuit of exploring nature." Nature of science: Science is a combination of process and product. Science is based on evidence.

Scientific knowledge is durable. Science is based on inquiry. Science is an enterprise. Various commissions have given different objectives of teaching science at primary school level in India. Learning science is never only about learning to know the natural world. Students also learn how the social world is perceived and science education necessarily contains values. Science has to be recontextualised in order to be meaningful in school. Students entering the science classroom have previous experiences, ideas, beliefs and expectations about the natural world. The content taught in the classroom is interpreted in the light of this prior conception and often are remain at variance with accepted scientific ideas. These have been labelled alternative conceptions. Knowledge is constructed through interaction with the physical, as well as the social environment. Alternative conceptions therefore need to be seen in terms of the context of learning, including the socio-cultural and linguistic background of students and its relation to classroom climate. On the basis of various Government projects and NGO's survey, studies, research, observation and self experience of researcher, the present status of science teaching at primary level is not satisfactory for achieving the objectives laid down. Many research in science education clearly state that students from early school education to PG level education come out with very poor understanding of science. This is also true in case of biology, where it has been found that there are number of misconceptions at higher cognitive level developed by the students. In other words, if the students have to be acquainted with biological concepts they should be exposed to the learning situations appropriate for deep conceptual understanding. Deep Conceptual Understanding is the ability of student of recall many connected concepts, at once, having deep understanding of each of them. It involves connection between the webs of concepts, formation of new concepts and building an accurately connected web structured 'Concept Map.' The present study is focused to-

wards the development of TKP for the concept “Human Body System” and finding out its effect on teacher trainees’ cognition. The study is conducted in three steps: 1) identification of misconceptions, and difficulties in teaching the concept; 2) preparation of multimedia and its execution; 3) effect on cognition.

Keywords: concept mapping, misconceptions

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Self-Assessment and Retention Techniques for Effective Biology Instructions in Indian High Schools (Grade 10 – 12)

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Unlike other science subjects, biology learning is mainly memory based and thus requires higher capacity of mental storage. Higher secondary teachers are required to deliver a high volume of information to students during an academic year. Time allotted per subject allows teachers only one or two classes a week thus creating a large gap between successive lectures. Students are expected to retain a significant percentage of this information to be able to perform well at various entrance examinations, creating a stressful learning environment. The retention ability of students in the current generation is also challenged by the ubiquity of smart-phones in the classroom, which can be sources of distraction and can impact their attention span. To address these challenges, I have proposed an empirically tested recap-and-quiz technique for biology teachers in India. Accordingly I have developed a recap template for botany and zoology classes that should be displayed on the blackboard before each class. It refreshes the memory of the student and provides context for the current lecture. This is followed by a quiz consisting of multiple questions with one word answers, which can be answered with or without referring to the recap template on the blackboard.

This self-assessed quiz challenges students to remember previously taught concepts while maintaining a friendly and low-stress learning environment. This method has been found to be effective in biology instruction over my 38 years of classroom teaching. This is validated using interview responses from several past-students. Further, an extensive study for the learning hypothesis is planned in some sections of the biology class at S.K.S. Jr. College during the current academic year.

Keywords: multiple questions with one word answers, recap-and-quiz, recap template, self-assessment and retention, self-assessed quiz

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Designing Concept Inventory on Nervous System for Class 12th Students

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In our classroom teaching, we observed that the students are generally unfamiliar with the variety of structure and function of many biological concepts, such as of glia cells in the vertebrate brain. If questioned, they will likely describe glia as protecting and surrounding neurons, failing to recognize the diverse and complex roles played by glia in the development and functioning of the brain. Similarly, they may not fully realize that the autonomic nervous system, including the sympathetic, parasympathetic, and enteric divisions, is not truly autonomous within an integrated body. Conceptual understandings of such complex biological concepts involve abstract mental process. These concepts are highly crucial for the students of higher secondary because it creates the knowledge base for higher studies and helps in dealing with daily experience. But stu-

dents at these levels have many preoccupied beliefs and misconceptions about various terms that are nurtured by various sources, such as, misinterpretation of their own daily observation and experiences. Therefore, for concept clarity, it is essential for teachers to understand what prior knowledge already exists among students and what alternative belief they might be possessing as a hindrance to conceptual understanding. Various tools and formative assessment techniques are being developed and used by various people to assess the students' conceptual understanding. Concept inventories (CI) are extensively employed as a standardized assessment tool to evaluate students' prior understanding of concepts and to bring out the misconceptions, and thereby providing inputs for necessary adjustment in instruction pattern. The use of CI ranges from diagnostic, formative and summative assessment tools for evaluation of overall learning and instructional effects at different levels and analyze the value-added to student learning by new ways of teaching important materials. Considering the importance and dire need of Biology Concept Inventory, the present study aimed to develop the tool and validate Biology Concept Inventory on the Nervous System. The objective of this tool is to reveal student's understanding and misconceptions about various sub-concepts of the nervous system. In the development process of CI, findings from the preliminary stage which involved discussions with teachers and students showed that there are a lot of problems faced by learners due to confusion, language, multiple information sources, different perceptions, etc. In the Secondary analysis, students were asked to answer analytical and logical reasoning questions based on the central concept, co-relation of same with another process (nervous and endocrine) and daily experiences. This study consists of 38 samples from secondary investigation and interview of around 30 students and 6 teachers in the preliminary step. The collected data shows that when questions were twisted or slightly modified, the

students get puzzled. This happens as learners are not helped to construct their own understanding, have their own ideas on the basis of experiences or work with some information and create or co-create information in order to go beyond that information. Many answers given by students lacked an in-depth understanding of concepts and various kinds of misconceptions were observed. This ongoing research purpose is to design CI and its descriptive and qualitative study.

Keywords: biology concept inventories, conceptual understanding, misconception, nervous system

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Some Misconceptions of Prospective Teachers about Science

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World is changing from agro-based to industrial to technology-driven society very speedily, yet the teaching-learning of science is not retaining the popularity as it used to have in past. One of the detrimental factors in this scenario is the way science is being taught in primary schools. The nitty-gritty of how to teach a science concept to primary students is in purview of science education that is offered in universities' degree programs. The required number of students is admitted to the program; whether these admitted students have learned science in its true sense or whether they just managed to pass examination is not a theme of this paper. What they have or have not understood properly while learning science in primary schools was a matter of worry as observed by the authors while teaching science groups in B. Ed. degree program at one College of Education. This basic observation stimulated the authors to find out if these student teachers have learned the basic science concepts at the time of their primary schooling correctly or what. The

subjects were given 09 pairs of basic science-related terms for comparison, such as Breathing and Respiration, Heat and Temperature, Evaporation and Boiling, Pollination and Fertilization, Physical Breakdown and Chemical Breakdown, Vertebrates and Invertebrates, Ingestion and Excretion, Insects and Arachnids, and Food Chain and Food Web. The research revealed that the prospective teachers were unable to explain some basic scientific terms that are being used even by a layman. Their misconceptions were categorized as non-scientific belief or conceptual misunderstanding, factual misconception or confusion with other scientific terms with different frequencies.

Keywords: conception, misconception, science education

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SUB-THEME 7: CURRENT CHALLENGES AND NEW APPROACHES FOR BIOLOGY TEACHERS

Impact of ICT Integrated Teaching Method on the Learning Process – A Critical Review

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Modernization in the teaching-learning and evaluation (TLE) methodologies has taken up great pace these days. National and international TLE agencies evaluated the performance of educators and facilitated use of Information and Communication Technologies (ICT) in the process. Global research revealed that ICT-enabled teaching significantly achieved better understanding in terms of Knowledge, Comprehension, Practical skill and Presentation skill in the subjects of science. Compelled promotion by authorities to use ICT as computer aided TLE achieved great success and nowadays having a virtual classroom/AV theatre became status symbol-cum-mandatory infrastructure. However,

teaching methodology, a great resource to TLE process is now experiencing change. Stakeholders of education system are now whispering about utility of ICT in every subject and, about understanding and entertainment levels of this mode. Present investigation deals with the exploration of the pros and cons of ICT enabled teaching. The objectives focused were to evaluate applications, limitations and threats of ICT teaching for students and teachers. An attempt was made to evaluate understanding level of students in classical and ICT mode during teaching subject Botany. Transpiration - a topic Botany was selected to explain to the two groups of 40 students each from TY B. Sc. The same topic was taught through classical chalk/talk method to one group and by using power point including text, images and videos to the other. The class scheduled for 50 minutes was followed by a MCQ test for 30 minutes for both the groups including questions based on basic understanding, interpretation, applications and practical utility as outcomes of lecture. Further a review was conducted amongst students and teachers about their views in applications and limitations of the ICT in teaching. The study showed that classroom ambience was good in classical mode but students enjoyed more in the ICT class. Further, basic understanding, interpretation in the classical mode was higher. The teachers believed that ICT facilitates teaching and makes it easier helping completion of long portions faster, increase level of understanding of complex phenomenon by animation and executes planned lecture better. Survey showed that though ICT cannot replace chalk/talk method, it can be used in combination with optimum use of both the methods. It was also found that students could not maintain the pace of teachers and could not grasp while using the multimedia facility. Moreover, the diagrams used in ICT could not be drawn manually and animated explanations could not be summarized in words. The study shows that ICT teaching cannot be alternative for the classical mode. It reduces the value of teachers and their

involvement with the students. Optimum integrated use of various teaching aids is the best technique to achieve maximum benefit of the learning process.

Keywords: evaluation, ICT, multimedia, teaching aids, teaching-learning

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Teaching the Vertebrate Skeletal System with Cast and Models Avoiding Animal Dissection

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Teaching and the study of the vertebrate skeletal system is an integral part of any undergraduate/post graduate animal sciences curricula. The traditional method of teaching skeletal systems has been through dissection of an animal to expose the various systems. However, with the growing concern regarding discontinuation of animal dissections and implementation of animal ethical rules in many countries, it is becoming increasingly difficult for the teaching fraternity to cover these topics in the classroom/ laboratories. Here we present a method to replicate the skeletal systems of various animals using foam fibre material. The imitations of skeletons made of this material are sturdy and can last for several years without degradation. Since they can be made to look exactly like the true biological specimen, they can be easily and interestingly used in teaching the vertebrate skeletal systems. Thus, using these models can facilitate teaching the vertebrate skeletal systems without having to sacrifice animals.

Keywords: discontinuation of animal dissection, teaching model, vertebrate skeletal system,

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SUB-THEME 8: PRACTICES AND CHALLENGES IN BIOLOGY RESEARCH AND EDUCATION

Taxonomy – The Indispensable Discipline of Natural Science

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Objective: Taxonomy is the science of identifying, describing and classifying our world's vast biological resources. Linnaeus's *Systema Naturae* published in 1735 unleashed a revolution that shaped taxonomy for a long time. Almost 280 years later, taxonomy provides important basic principles for nearly all research areas in the life sciences. This paper emphasizes the inevitable importance of taxonomy amid present day's alluring botanical researches. The objective of the paper is to present an overview of the taxonomic research in India, causes behind the fading charisma of the subject, and proposals for its sustainability and improvement. **Methodology:** Based mainly on review of literatures, open discussion and interactions involving young researchers, scientists, teachers and various experiences of fields it appears that in this long progression through centuries the real and classical taxonomy has profoundly changed and transformed into integrative taxonomy. Despite the rapid advances in molecular techniques, classical taxonomy is still useful and necessary in the 21st century. **Conclusions:** India, with four biodiversity hotspots and with reasonably good institutional setup, provides great opportunities in taxonomic research. Conversely the research trends show a decline of systematic science in India. The high subjectivity has pushed taxonomy through endless processes of conceptualization and theorization. It leads to the genesis of divergent schools of sub-disciplines and deviation from the ultimate objectives of the classical taxonomy. At the same time the methods of teaching, failure of government and institutions to support systematic biology research, lack of inter and intra-institutional coordination, inability to make use of the tools of

emerging sciences, lack of better job opportunities, inadequate training and capacity-building programmes have caused further decline in taxonomic researches in India. In addition the 'impact factor syndrome' is one of the major reasons why young researchers are not attracted to taxonomy. Consequently the Indian students are driven to select their disciplines based on lucrative carrier prospects like molecular biology, cytogenetics, biochemistry, information technology, biotechnology, etc. from their early stages of education. **Suggestions:** Today's young researchers can become good taxonomists if mentored by experienced taxonomist. Establishment of Schools of Taxonomy, amendments in syllabus, methods of teaching, hired and voluntary services of experienced retired taxonomists, conducting short-term training programmes in taxonomy, increasing number of systematic researchers, publication of identification manuals for creating awareness and linking the importance of biodiversity with the human interests, publishing dedicated journals etc. are some of the suggested measures towards improving the critical crisis in this subject.

Keywords: decline, prospects, research, taxonomy
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Handling Intra-Class Diversity in Biology Classroom: A Microcosm Approach

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Introduction: In addition to multicultural and multilingual differences, classrooms in India are characterized by inequalities of income, wealth, opportunity and access to resources. No matter how efficiently we conduct students' placement, there is always diversity in classrooms. Hence teachers should understand the classroom demography and the academic needs of a diverse body of students, which impose serious pedagogic challenges. Here I present a case study of teaching

a complicated topic in biology, such as biological classification, to a diverse classroom of students. Learning topics like biological classification can be rather boring, as it often involves rote learning (names of taxa on a classification tree). In most instances this becomes overwhelming and daunting to most students. Students often lack the ability to link these taxonomic groups on a phylogenetic tree, to understand how certain taxa have evolved. Hence, making such a topic informative as well as interesting becomes a challenge. This challenge becomes greatly augmented when intra-classroom diversity comes into play. **Methods:** To efficiently address this challenge, I employed a three-way strategy which included short and interactive lecture series, in-class research assignment, and the microcosm approach. Each classroom session (3 hrs) was initiated with a short, yet interactive lecture, where students were introduced to a particular taxonomic group. The interactive lecture series involved a short lecture (40 - 45 min.) that introduced the broader characteristics of a taxa accompanied by questions and discussions. This was followed by a short break and an in-class research assignment. In this section, students were divided into smaller groups (3 students each) and were randomly assigned a taxonomic group (*e.g.* ferns, mosses, ants, spiders, etc.), on which they were expected to do research and discuss the similarities and differences of the taxonomic groups at the end of the class. Last but not the least was the microcosm assignment that gave an ecological approach to learn biology. In this, each student was expected to grow varied taxonomic groups within a microcosm throughout the semester and display it at the 'biodiversity show' at the end of the semester. While assessing the biodiversity show, greater points was given to students who were able to raise more biologically diverse microcosms as well as efficiently answer questions. **Conclusion:** Previous studies have shown that socioeconomic background can be a good predictor of academic performance. In this class I also found a similar trend, where students

from advantaged background were able to perform well in the classroom as well as the interactive research sessions. However interestingly, in the biodiversity show this difference was not noticed. Since the current batch of Biology students at the Azim Premji University, most socio-economically disadvantaged students are from an agriculture background, the biodiversity assignment seemed to have allowed them to explore their full potential and experience of growing living things in field, which students from privileged background lacked. The biodiversity show was well appreciated by students of all backgrounds, but more importantly it seemed to lower the strong correlation between socioeconomic background and grades which is typically found.

Keywords: assessment, biological classification, ecology, intra-class diversity

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Need of Understanding Research and Career Opportunities through Biological Studies

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Biology is one of the subjects in which each and every person, from his childhood, is oriented and curious about activities going on around them *e.g.* difference between non-living and living, why do plants prepare their own food by photosynthesis, difference between plant and animal cell, etc. But when students have to think about their career, they do not choose Biology due to being unaware of scope and job opportunities. Hence, there is a necessity to make students aware of Biological research and career opportunities.

Keywords: biology, career opportunities, research

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Amphibian Population Decline – A Chytrid Fungal Connection

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The amphibian population decline has been in the news since 1950s; but the modern-day mass-decline/ extinction only dates back to 1980s. It became clear only in 1993, that the populations of about 500 amphibian species are facing this situation. Various studies carried out world-over, pin-pointed the *habitat-modification, habitat-fragmentation, pollution, ozone depletion* as the physical and environmental causes of the decline; and interestingly a biological cause was also noticed *i.e.*, a Chytridiomycetous fungus. This last-mentioned cause *i.e.*, Chytrid fungal infection is more virulent when combined with other environmental factors. In fact, natural calamities or catastrophes are responsible for mass destruction and/or decline or extinction of species, one well-known example being that of Dinosaurs in Mesozoic. In addition, many man-made factors are often found directly or indirectly responsible for the destruction of healthy environment, which then becomes the *secondary cause* of decline or extinction of the organisms *en-masse*, in many instances. The chytrid fungus becoming one such cause of mass destruction and decline of amphibian population in many parts of the world was surprising and unbelievable fact. Studying this aspect seriously is imperative, for the reason that amphibian population destruction, in turn, affects thousands of other species in all types of ecosystem. Therefore, this world-wide decline of amphibian population due to chytrid fungal infection is recently recognized as one of the most severe examples of the Holocene extinction, with severe implications for global biodiversity. Scientists are of the opinion that this (amphibian population decline) is the largest mass extinction in the last 65my, after the mass extinction of Dinosaurs. The detailed studies on this fungal cause have revealed

that this Chytridomycotina fungus causes amphibian infection recognized as *chytridiomycosis*; and the main causative agent is *Batrachochytrium dendrobatidis* (commonly referred to as *Bd*-infection). The destruction is particularly severe in the Western United States, Central America, South America, Eastern Australia and Fiji, although chytridiomycosis has been reported allowed the world. It is believed that the chytrid fungus might have been exported to these parts from Africa. The organisms under amphibian population severely affected include frogs (*Xenopus laevis*), toads, salamanders, newts and cicilians. Fortunately, such a phenomenon has not been observed in India, though Global Amphibian Assessment (GAA) has confirmed the decline of amphibians from India due to several other environmental causes, excluding chytridiomycosis. In this background, considering the chytrid fungal role in mass extinction of amphibians the world-over, it may well be possible that the fungus may migrate to India too (as in case of other parts of the world) with migratory birds, fish and insects. We suggest the preventive role to be adopted by the biologists in Indian subcontinent and other the Asian countries. So we thought of bringing this threatening issue to the notice of Asian biologists/educationists at this apt forum.

Keywords: *chytridiomycosis, Global Amphibian Assessment, mass-decline/extinction of amphibian species*

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Effect of Selected Heavy Metal (Zinc and Cadmium) on Seed Germination and Vigor Index of *Trigonella foenum-graecum*

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The aim of the present study was to find out the effect of selected heavy metals, e.g., Zn and Cd on seed germination and vigor index of *Trigonella foenum-graecum* in comparison with the treat-

ment of distilled water, which was used as a control. *T. foenum-graecum* is cultivated worldwide as a semi-arid crop, and its seeds are a common ingredient in dishes from the subcontinent. It is used in the preparation of pickles, vegetable dishes, dals, and spice mixes such as panchphoron and sambar powder. They are often roasted to reduce bitterness and enhance flavour. In the present study, different concentrations (25, 50, 75, 100 mg/l) of ZnSO₄ and CdCl₂ were prepared and applied on the sterilized seeds of *T. foenum-graecum*. The seeds were then allowed to grow in sterilized Petri dishes at room temperature. Each of the treatment was performed in triplicate. It was found that ZnSO₄ enhances maximum seed germination (93%) at a concentration of 50 mg/l, while CdCl₂ enhances seed germination (90%) at low concentration (25 mg/l). Also, as concentration of CdCl₂ increases, percentage of seed germination decreases. At a low concentration (25 mg/l), ZnSO₄ enhances maximum vigor index in *T. foenum-graecum*. As compared to ZnSO₄, CdCl₂ was less effective in increasing vigor index, which at a low concentration (25 mg/l) was 157. In conclusion, it was observed that among treatment of ZnSO₄, CdCl₂ and distilled water, ZnSO₄ was found to be effective in increasing seed germination and vigor index of *T. foenum-graecum*.

Keywords: *heavy metals, seed germination, Trigonella foenum-graecum, vigor index*

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Inventory of Strawberry Associated Arbuscular Mycorrhizal Fungi for the Socio-Economic Development of the Local Community

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Modern agriculture, though contributed profoundly in improving the overall production, has inevitably caused degradation of soil, primarily

ascribed to the excess use of chemical fertilizers. There is a need to develop biological alternatives to improve mineral nutrition of plants and soil fertility. In this regard, mycorrhizal biotechnology has been the thrust area of research for past few decades. There are emerging trends in linking the Arbuscular Mycorrhizal (AM) biofertilizer to correct the imbalance in the ecosystem. An attempt has been made in the present research to isolate and identify AM fungi in strawberry fields in the Melghat area of Maharashtra, India. Since strawberry is the most economically competent crop of the area, the focus has been to isolate, characterize and identify its most dominant AM fungal species. The two varieties of Strawberry (*Fragaria* sp.) namely winter down and tissue culture were collected for the study. Assessment of rhizosphere soil samples and roots was carried out. All the samples showed presence of AM fungus propagules. The genus *Glomus* was found to be the most frequent morpho-taxonomically identified AM fungi. The process of establishing the natural level of AM fungi can be a promising alternative to conventional fertilization practice. The research finds its extension in the industrial produce on large scale by mass multiplication of these native AM fungal strains and its wider application in the farming. Future scope of research is to explore below ground interactions focusing on isolation of dominant AM fungal species, raise the inoculums and test its efficacy on strawberry for its better growth and yield.

Keywords: AM fungi, Melghat forest area, strawberry
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Goat Breeds and Breeding Improvement for Milk and Meat Production in Mathura - Uttar Pradesh Region

Saket Bhusan, Manali Baghel

ICAR-Central Institute for Research on Goats, India,

Goat keeping has been a traditional activity in

India and primary source of livelihood of people below poverty line. They significantly contribute to the rural economy and complement their food with nutritious milk and meat. A survey was conducted in Nagla Chandrabhan and Barka Nagla villages from Mathura District of Uttar Pradesh. A total of fifty three (53) goat rearing farm women were identified and selected for the study. Most of the goats found were grades of four breeds in the area which were Barbari type (73%), Jakhrana type (17%), Sirohi type (7%) and Jamunapari type (4%) and most of them had low production potential due to lack of elite breeding stock and lack of breeding knowledge. Monthly average milk production was 21.3 ± 2.3 l and average body weight at the age of twelve month was 15.4 ± 0.3 Kg which were very low. Therefore to improve the goat productivity in this region, a location-specific scientific breeding strategy must be developed and implemented keeping in view the availability of resources and utility of breed in the region.

Keywords: breeding strategy, goat, meat production

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Superoxide Dismutase Activity in Response to Heat Stress in Jamunapari Goat in Semi-Arid Region

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Oxidative stress causes cell damage and is also associated with physiological and pathological conditions. Superoxide radicals cause damage to cell by inhibiting some critical enzyme activities of the cell, lipid peroxidation in the membranes and DNA damage. Superoxide dismutase (SOD), considered being antioxidant enzymes plays a critical role in regulating the oxidative stress. Since SOD regulates cell defense during heat

stress, the present study was designed to analyze the SOD activity in lactating animals and in growing kids of 8 - 9 months of age in Jamunapari goats during peak heat stress period. SOD activity (inhibition percent) was to be 32% and 37% in lactating goats and kids at 9 months of age, respectively. The SOD activity of heat stress susceptible (HSS) individuals was significantly higher ($P < 0.01$) from heat stress tolerant (HST) animals in lactating goats. There was no significant difference observed in SOD activity of kids within HSS and HST phenotype. Sex and birth type had significant effect ($P < 0.01$) on SOD activity at 9 months of age of growing kids. However, females showed significant higher ($P < 0.01$) SOD activity than males at 9 months of age.

Keywords: cell damage, heat stress, Jamunapari goat, lactating animal

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Quantification of HIV-1 RNA Using TaqMan Probe by Roche Real Time PCR

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HIV infection in humans is considered pandemic by the World Health Organization (WHO). HIV, a great threat to humanity, is a lentivirus (a member of the retrovirus family) that causes acquired immunodeficiency syndrome (AIDS), condition that progressively reduces the effectiveness of the immune system and leaves individuals susceptible to opportunistic infections and tumors. AIDS killed more than 25 million people moreover, an estimated 22.5 million people (68% of the global total) live with HIV in sub-Saharan Africa, an estimated 2.6 million people were newly infected in 2009. A new technique was developed to quantify proviral HIV-1 using a TaqMan real-time PCR assay. One copy of proviral HIV-1 RNA could be detected with 100% sensitivity. The HIV

viral load can be monitored utilizing The COBAS® AmpliPrep/COBAS® TaqMan 48 real time PCR from Roche. This technique uses thermostable recombinant enzyme DNA polymerase (ZO5) for reverse transcription as well as PCR amplification. Advances in the molecular diagnosis of drug resistance using highly, sensitive methodologies such as DNA Amplification by PCR can further detect upcoming viral resistance at an early stage when the variant represents only a minor fraction of the total viral population. Such new tools are especially relevant for patients at high risk for disease progression or acute exacerbation.

Keywords: AIDS, disease progression, HIV

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The Adsorptive Removal of Cationic Drug from Aqueous Solution Using Hydrogel – Poly-(N-isopropyl-acrylamide)

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University of Delhi, India

Hydrogels based on Poly-N-isopropylacrylamide (PNIPAM) are of a great interest in biomedical applications because of their tuneable chemical composition, and three dimensional network structure. They can be designed to have optimal water or biological fluid content in an aqueous medium without dissolution, good mechanical properties, and permeability to oxygen, bio-compatibility, shape-stability and softness, similar to that of the soft surrounding tissue. These materials are also interesting, because of good chemical and biochemical stability, absence of extractable and high permeability for water-soluble nutrients and metabolites. This study describes adsorptive removal of the antibiotic drug Ofloxacin hydrochloride from the simulated water using PNIPAM as adsorbent. The adsorbent, PNIPAM, was characterized by various instrumental techniques such as fourier transforms infrared (FTIR) and 1H-NMR

spectroscopy, X-ray diffraction (XRD) and differential scanning calorimetry (DSC). The adsorption equilibrium data, as studied at different temperatures, were best interpreted by the Langmuir Adsorption Isotherm Model. It was found that an increase in temperature reduces the drug uptake. A pH of the adsorption system in the range of 5.0 to 8.0 causes maximum adsorption of the drug. The presence of drug molecules in the adsorbent particles was shown by various techniques: XRD, DSC, FTIR and SEM (scanning electron microscopy) analysis. Antibacterial studies also reveal the adsorption of the drug from solution. From this study, it may be concluded that PNIPAM sorbent appears to be quite effective in removing antibiotic drug Ofloxacin from simulated wastewater.

Keywords: adsorption, fourier transforms infrared spectroscopy, Langmuir isotherm, Ofloxacin, scanning electron microscopy X-ray diffraction

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Isolation of RNA from Different Sources for mRNA Expression Level

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² ICAR-Central Institute for Research on Goats, India

RNA is present in major concentration in tissues rather than in blood. In tissues the liver is the richest source of RNA, thus the RNA can be obtained in higher yield from tissue which requires the process of tissue homogenization, followed by the use of TRIzol reagent. The present study was carried out to analyze the expression of different genes in different tissues and blood. Total RNA was isolated from tissues by the TRI reagent method; TRIzol reagent for obtaining good and higher yield of RNA. RNA quality and quantity were assessed by biophotometer for concentration and the optical density 260/280 nm and 260/230 nm to assess the purity of the sample. The quality

of the RNA was checked by gel electrophoresis (1% agarose gel). Subsequently, 1 µg of RNA was treated with DNase (1 IU/µl) and incubated at 37°C for 15 min. One microgram of total RNA was reverse transcribed with a transcript first strand complementary DNA (cDNA) synthesis kit in a total volume of 20 µl reactions and was incubated at 55°C for 30 min in a thermal cycler. The cDNA was stored at -70°C for further use. Controls without reverse transcriptase were carried out to exclude the possibility of DNA contamination. To exclude genomic DNA contamination, total RNA was treated with RNase free DNase I. The absence of contaminant genomic DNA in RNA preparations was tested further using RNA as a template in Real-time PCR assays. Gene expression levels were quantified with Cp (cycle threshold) values; Cp value is the number of PCR cycles required for the fluorescence signal to cross threshold line. Cp values are inversely proportional to the amount of target nucleic acid. The formed cDNA can be further utilized for the purpose of analyzing mRNA Expression level which can be a beneficial step in disease diagnosis and gene expression pattern.

Keywords: gene expression, PCR cycle, RNA

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Effect of Pesticide Endosulfan on Biochemical Parameters of Freshwater Snail, *Pila globosa*

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In the present work short-term sub-lethal toxicity studies were conducted to find out the functional response of the freshwater snail, *Pila globosa* under stress of sub-lethal doses of the toxicant, endosulfan. The sub-lethal concentrations of the toxicant used for the study were 1/6 (0.2 ppm) and 1/3 (0.4 ppm) of the 96 hour LC₅₀ (0.12 ppm)

value. Further these animals were used for extraction and detection of various biochemical parameters including alkaline phosphatase, GOT, GPT, protein, triglyceride, cholesterol and minerals. The organs such as hepatopancreas, mantle and foot were considered for the study. The observations reveal that endosulfan has an acute toxicity potential for bioaccumulation.

Keywords: bioaccumulation, biochemical parameters, pesticide

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Evaluating Apoptosis Induced by the Semi-purified Fraction from *Quisqualis indica* Linn. against Selected Human Cancer Cell Lines

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Recent studies on the treatment and prevention of cancer focus on cytotoxic activity of natural compounds and derivatives of plants against cancer cells. Phytochemicals found in plants are able to inhibit the growth and migration of abnormal cells, therefore preventing the formation of tumors. The use of bioactive compounds in making anticancer drugs has the advantage of having minimal toxicity. This study aimed to determine the cytotoxicity of the semi-purified fraction from the leaves of *Quisqualis indica* Linn. against human colon (HCT-116), lung (A549) and breast (MCF7) cancer cell lines, to estimate its selectivity using the non-cancer cell line Chinese hamster ovarian fibroblast (AA8) and to assess its apoptotic potential using various assays. Crude extract from *Q. indica* was subjected to solvent partitioning using hexane and ethyl acetate. The more active partition based on 3-(4,5-dimethylethyl-thiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) cytotoxicity assay, was then subjected to isocratic silica gel column chromatography. The most active fraction from the isocratic column chromatogra-

phy was subsequently run through gradient silica gel column chromatography using gradients of determined using MTT assay. The most active fraction from the gradient column was then tested using DAPI, TUNEL assay and Annexin V staining to check for hallmarks of apoptosis. Results show that the fraction Q6d was significantly cytotoxic against HCT-116, A549 and MCF7. Moreover, its cytotoxicity was selective against cancer cells as shown by its low cytotoxicity against the non-cancer cell line AA8. Using apoptosis assays such as DAPI staining, TUNEL assay and annexin V staining, induction of apoptosis by Q6d was confirmed based on the presence of chromatin condensation, DNA laddering and externalization of phosphatidylserine. Based on the results of this study, the leaves of *Q. indica* is a potential source of an anti-cancer drug that acts selectively against cancer cells. This can be useful in the advancement of cancer research especially in the Philippines.

Keywords: apoptosis, bioassay-guided purification, MTT assay

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Study of Mercury Neurotoxicity and Its Antioxidant Defenses in Wistar Rats

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Mercury is a heavy metal and plays an important role in oxidative stress which impairs energy metabolism due to reactive oxygen species (ROS) and other free radicals. Present study evaluates the oxidative stress in brain following mercury treatment. The study was carried out on *wistar rats* in three groups, namely control and mercury treated and with the herbal drug which is used as antioxidant defences group for 21 days. As herbal plays an important role in reducing the oxidative stress which is caused by mercury toxicity as it binds with free radicals. The LPO was measured

in terms of reduced glutathione (GSH) and thio-barbituric acid reactive substance (TBARS). Antioxidant enzymes such as catalase (CAT), glutathione reductase and glutathione transferase (GST) were measured biochemical significant increase in the TBARS animals was observed in comparison to controls. The GSH levels were found to be reduced in both the treated groups compared to the control. A significant reduction in the activities of GST was also observed in comparison to the control. Enzymatic activities of CAT, and glutathione reductase were found to be

significantly reduced. Increase in LPO and reduction in enzymes GST, CAT, glutathione reductase following mercury neurotoxicity suggests mitochondrial dysfunction and acute oxidative stress that may impair functioning of brain along with elevation of neurodegenerative conditions in the affected animals.

Keywords: catalase, glutathione transferase, reduced glutathione

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<Workshops>

Simple Model Systems and Sophisticated Research Questions – The CUBE (Collaborative Undergraduate Biology Education) Approach –

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CUBE (Collaborative Undergraduate Biology Education) launched by the Homi Bhabha Centre for Science Education, TIFR, Mumbai (India) in the Summer of 2012 is developing a sustainable network consisting of schools, colleges and research centers through collaborative research-based education, using simple model systems while addressing sophisticated research questions. Its success, so far, depended on (a) simplicity (to initiate the program) and (b) sophistication (through the collaborative approach, to sustain it). Currently, the CUBE network in India consists of 10 active hubs and 40 nodal centers connected to these hubs; all participants interacting through the new media facilities including easily accessible mobile phones. Sophisticated model systems like transgenic *Drosophila*, too, are used to address, for example, the role of specific genes (like A-beta42 in Alzheimer's disease) by undergraduate students at different parts of the country, collaboratively, just because they be-

come familiarized with the maintenance of culture conditions, earlier, by mapping native fruit flies. Native fruit flies are trapped by students, including those from middle school (especially on Sundays and holidays), to study the activity pattern leading to understanding the phenomena of biological rhythm, in collaboration with scientists at research centers. Questions on front-line genetic, developmental, behavioral plasticity studies, among others, are initiated and pursued in the fly, snail, the nematode *C. elegans*, zebrafish, *Daphnia*, *Hydra*, *Euglena*, rotifers, *Chlamydomonas*, *Dictyostelium*, bacteria (including giant bacteria), plant systems like *Cardaminehirsuta* (a close relative of *Arabidopsis thaliana*) by undergraduate students and teachers in colleges across the country. Several outfits called "Regional Resource Center for Model Organisms (RRCMO)" are being established in hubs and nodal centers so that no institution in any region will find it difficult to start scientific hands-on programs, for want of model organisms. Needless to say, mapping of seasonal changes in local flora and fauna is a part of this program for sustainable utilization of tropical bio-resources, in order to develop alternate model systems for the region.

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Current Trends in Ecological Research - Understanding the Web of Life

Asha Gupta

Manipur University, India

The biological organization from organelles to biosphere all are connected in a hierarchy. Further the web of life the brilliant web-work (wheels within wheels within wheels....) makes one realize that no one can understand without looking at both the patterns it comprises, as well as the greater patterns it is a part of in the biological organization. Further a holistic and ecological view suggests that the survival of humanity depends on ecological literacy, on our ability to understand the principles of ecology and that the roots of life reach down into the realm of non-living matter.

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Classroom Teaching, Learning and Assessment

Geetha Iyer

Consultant-Education, India

My workshop will be an interactive one and will explore the following aspects of the theme.

- Role of assessment and how can it contribute towards an interesting learning experience?
- Questions - diversity of questions and their significance to the teaching learning process.
- Importance of language and communication for assessment to fulfil its role.
- How to talk so learners listen, listen so learners talk.
- Structured for teachers who teach at school level, from primary to senior secondary.

Dr. Geetha Iyer (scopsowl@gmail.com), Suchindrum, Kanyakumari, Tamil Nadu, India

Publication

Biology Education for Social and Sustainable Development (ISBN: 978-94-6091-925-1) was published in 2012 by Sense Publishers, Rotterdam, Netherlands (<http://www.sensepublishers.com/>). Some papers presented at **the 23rd Biennial Conference of the AABE** which was held in Singapore in October 2010 were compiled in this book by Dr. Mijung Kim and Dr. C. H. Diong. You can refer to the abstracts of these papers in **the sixth volume of the *Asian Journal of Biology Education*** (2012).

Biology Education and Research in a Changing Planet (2015) (ISBN 978-981-287-523-5) was published by Springer (<http://www.springer.com/in/book/9789812875235>). Some papers presented at **the 25th Biennial Conference of the AABE** which was held in Malaysia in October 2014 were compiled in this book by Dr. Esther Gnanamalar Sarojini A Daniel. The abstracts of these papers were included in **the eighth volume of the *Asian Journal of Biology Education*** (2015).

From the Editor-in-Chief

The ninth volume of the *Asian Journal of Biology Education* (AJBE) contains only one research paper and the abstracts of the presented papers at the 26th Biennial Conference of the AABE which was held in India this year.

I still have some articles contributed from the AABE members and others. These articles are in the reviewing process and some of them may be included in the next issue which will possibly be published in 2018. The next issue will include the abstracts of papers presented at the next (27th) Biennial Conference of the AABE which will be held probably in Bangkok, Thailand, in 2018. The first announcement of the conference will be on the AABE website next year.

Everyone can contribute their research paper, practical report, or a report on biological resources to AJBE. So, I would like to ask the readers to prepare their manuscripts referring to the “Instructions to Contributors” (in this volume p.79 - 83) and send them to me.

Dr. Nobuyasu Katayama
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Instructions to Contributors for the *Asian Journal of Biology Education*

The Asian Journal of Biology Education (Asian J. Biol. Educ.) is published electronically by the Asian Association for Biology Education (AABE).

The Journal is on the AABE website: <http://www.aabe.sakura.ne.jp/>

Objectives of the *Asian J. Biol. Educ.*

The main objectives of the Journal are as follows:

- To publish proceedings of AABE conferences;
- To promulgate results of research into the teaching, learning and assessment of biology;
- To present investigatory, experimental, and novel teaching/learning techniques suitable for use in teaching biology;
- To update educators on the advances in biology;
- To review resources for teaching biology;
- To comment on the current policy developments affecting the biology education, especially in the Asian-Pacific region.

The Journal attaches considerable importance to research that is applicable to educational practice. Articles relevant to primary, secondary, tertiary, vocational, adult, and continuing education will be considered. Authors should remember that the Journal has a wide-ranging and international readership hence all papers should contain a clear description of the settings to which they relate.

The Journal seeks to publish papers presented at a biennial conference of AABE by AABE members and other articles submitted by both AABE members and non-members.

Categories

Papers can be in six categories:

1. **Review:** this category aims to provide a link between scientific research findings and the classroom. The aim is to provide teachers with up to date information on key areas. The reviews should give a clear and concise summary of a biological or educational topic. Articles for this section are intended to review educational topics relevant to a biology curriculum. Articles based on biological topics or those of relevance to the management and design of curricula are also of interest. Theoretical or discussion papers which are intended to deal with key points relevant to biology education may be suitable for this section.
2. **Research Paper/Research Note:** these will form the main body of the Journal and may be case studies into any aspect of education practice. Their importance will be introduced against the background of a critical review of the relevant literature. The methods and results will be described along with both conclusions and implications for future research and teaching practice. In addition to full research papers, "Research Notes" will be acceptable. Research Notes are intended to be a short paper which report novel findings worthy of urgent publication. Research Note does not require an abstract and the demarcation between sections may not be clear.

3. **Practical Report/Practical Note:** this section aims to give practical advice. Papers should clearly describe a laboratory or classroom-based exercise or fieldwork which can be related to biological curriculum. The exercise described should have been trialed within an educational setting. This section may also include descriptions of other innovations and developments, such as the use of teaching aids and the implementation of software packages. The emphasis will be on the nature of the practice, a clear description of the implementation procedure, and an evaluation of its success. The full papers are desirable to contain an abstract, introduction, methodology (materials and methods), results, discussion, and references. Authors are recommended to present details of the suppliers listed in the materials section. Short articles (Practical Notes) which describe a novel teaching/learning aid are of interest. Such manuscripts do not require an abstract, and the demarcation between sections may not be clear.
4. **Country Report:** this section aims to give readers the latest information about science/ biology education in the Asian and neighboring countries.
5. **Biological Resource:** this section aims to give information about biological science research whose results are considered to be useful for resources of biology education at a certain level of education. The author(s) should refer to how the results or the research itself are useful for biology education at that level.
6. **Miscellaneous Article:** the other articles which give some information about biology education, teaching aids, printed and electronic references, etc. will also be included in this category. These will generally not be refereed. Abstracts of the papers presented by oral or poster at the latest AABE conference will automatically be published.

Editorial organization and reviewing process

The Editor-in-Chief is appointed by the Executive Committee of the AABE and has final responsibility for all editorial decisions. The Editorial Board processes all manuscripts that are received.

When a manuscript is received the Editor-in-Chief will first judge whether its content falls within the scope of the AABE Journal. Manuscripts that are simply to confirm previous work, are too highly specialized, or are felt not to be of interest to the general readership of the Journal will be returned without review. At least two members of the Editorial Board will be involved in these decisions.

After this preliminary review, the manuscript of a paper categorized as "Review," "Research Paper," "Practical Report" or "Biological Resource" will be sent to two referees to ensure that the paper is applicable to biology education and that the science and/or educational research is sound. The review process is completely anonymous. Referees are selected based on their competence in specialized areas of biology and education. If referees disagree, or if in the opinion of the Editor the paper has not been sufficiently considered, it will be sent to a member of the Editorial Board to aid in arbitration.

If the manuscript is returned for revision the author should reply to the specific recommendations in a covering letter stating how each point has been addressed. If any recommendations have been disregarded the reasons should be given. The revised manuscript should be re-

turned to the Editor-in-Chief within three months, after which it will be considered a new submission and will undergo the full review process.

Submission of manuscripts

Sending files

Only electronic submission is acceptable. Manuscripts should be sent by e-mail to Dr. Nobuyasu Katayama (katayama@u-gakugei.ac.jp), the Editor-in-Chief, *Asian Journal of Biology Education*.

Formats

MS-Word document files are preferable, but we can accept MS-Excel spreadsheet document files and Acrobat PDF files.

Authors should ensure that the paper meets the guidelines listed below for the preparation of manuscripts. Manuscripts including Tables and Figures (not including the first cover page) should not exceed the number of pages given below:

Review: 12 pages, Research Paper: 12 pages, Research Note: 6 pages, Practical Report: 12 pages, Practical Note: 6 pages, Country Report: 12 pages, Biological Resources: 8 pages, other articles: 4 pages.

Authors are requested to indicate which category above the paper fall into among the six mentioned.

Presentation of manuscripts

All contributions must be in English and be as succinct as possible. They should not be under consideration by any other journal. Authors should emphasize the educational setting and the relevance to biology education or environmental education. Papers should contain a clear description of the context to which they relate, and should show the relevance of the results and insights in both their specific setting and in any general setting to which they may also relate.

The manuscript should be typed on A4-sized page using single line spacing (ca. 42 lines/page) throughout. The recommended font is 11 point, Times New Roman. The margins should be 2.5 cm wide and pages numbered consecutively.

Cover page layout

The first page will be a cover sheet and should include:

- (1) A title which clearly describes the content of the manuscript;
- (2) The name(s) and affiliation(s) of the author(s) – the author for correspondence with his/her address and e-mail address should be clearly indicated;
- (3) A running title of no more than 50 characters including spaces;
- (4) Up to seven key words;
- (5) A brief description of the article (less than 200 characters).

The second page

The second page should contain the title of the paper, and an abstract (more or less 200 words). In order to ensure anonymous and fair refereeing, the name(s) or affiliation(s) of the author(s) should not be indicated on the second and following pages.

A manuscript which is categorized into Miscellaneous Article does not need the cover page. The

title, the name(s) and affiliation(s) of the author(s), the corresponding author's address and e-mail address, a running title, and key words should be included in the first page and the abstract is not necessary.

General notes

Footnotes and appendices

Footnotes are discouraged except the cover page, and all material should be placed in the main body of the text. If notes are required they should be numbered sequentially and placed at the end of the paper. Appendices may be used if they are essential to understand the manuscript.

Units, symbols, abbreviations and nomenclature

The International System of Units (SI) should be used throughout. All symbols or abbreviations should be defined when first used. Full stops are not used after unit symbols. For biological nomenclature the use of scientific names is recommended. If desired, the common name of the organism should be shown in parentheses after the recommended name. For chemical nomenclature the rules of the International Union of Pure and Applied Chemistry (IUPAC) should be followed.

Tables

Tables should be numbered consecutively. Each table with its number, heading and any footnotes should be embedded in the text where it should most naturally occur. The table caption or heading should be self-explanatory. The width of a table should be less than 16 cm.

Figures

Graphs, line drawings and photographs should be numbered consecutively. Each figure with its number and caption should be embedded in the text where it should most naturally occur. The journal will accept color pictures. The width of a figure should be less than 16 cm. If you have any queries, please consult with the Editor-in-Chief.

- Line illustrations

Graphs and drawings must be presented to a high professional standard. It is desirable to prepare each figure in one cluster. Because of the requirements of editorial treatment, every figure should be prepared to be edited easily by the MS-Word software.

- Photographs

Photographs must be clear, good quality black and white or color pictures, and JPEG-formatted. The vertical/transverse proportion should not be changed from the original. Any lettering required should be printed directly on the photograph by the author. The insertion of a scale on the photograph is preferable to a statement of magnification in the caption.

References

References must be selected thoughtful by considering whether it is indispensable for the paper. It is expected that the references will be easily accessible to a wide range of educators. Therefore, inaccessible materials, such as unpublished manuscripts, unpublished documents and newspaper articles, are not appropriate for the references. All references cited in the text should be listed in the Reference section at the end of the paper. All references in the list should be cited in the text, too.

References in the text should be given as follows:

Pell and Wörman (2009) or **(Pell and Wörman, 2009)**. Papers with three or more authors should be cited as **Vlaardingerbroek et al., 2014**. When an author has published two or more papers in one year, the references should be distinguished by referring to **Hedde et al. (2007a)** and **Hedde et al. (2007b)**, etc. Where more than one reference is given at the same point in the text, they should be listed chronologically.

The reference list should be arranged alphabetical order by the family names of the first authors and should include the author's initials and the full title of the paper. Titles of journals must be given in full, followed by the volume number, and the first and last page numbers in full:

Vlaardingerbroek, B., Neil Taylor, N. and Bale, C. (2014) The problem of scale in the interpretation of pictorial representations of cell structure. *Journal of Biological Education* 48: 154-162. DOI: 10.1080/00219266.2013.849284

References to books and monographs should include in the order as follows: author or editor, year of publication, title of book, edition, chapter, and/or page reference (if desired), publisher and town of publication. For example:

Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P. (2014) *Molecular Biology of the Cell*, 6th ed. Garland Science, NY. U.S.A.

Waterman, M. (2012) Actions and opportunities: a North American perspective on undergraduate biological education for social and sustainable development. In: Kim, M. and Diong, C. H. (eds.) *Biology Education for Social and Sustainable Development*, pp. 29-39. Sense Publishers, Rotterdam, Netherlands.

Web-based resources should be included in the reference list. These should include the name of website and corresponding webpage, its address (URL), and date of access to or date of retrieved from:

Science and Plants for Schools (SAPS). SAPS – Technical notes for copper germination practical. In: *How Science Works - Copper Pollution from Mines*. <http://www.saps.org.uk/secondary/teaching-resources/135> <accessed: March 15, 2015>.

U. S. Environmental Protection Agency. Species Information. In: *Pesticides: Endangered Species Protection Program* <http://www.epa.gov/oppfead1/endanger/species-info.htm> <retrieved: 15/03/2015>

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