Report of the 27th Biennial Conference of the AABE and Abstracts of the Papers Presented at the Conference

The 27th Biennial Conference of the AABE (AABE27) was held at the Emerald Hotel, Bangkok, Thailand, from 30th November to 2nd December, 2018.

The conference was organized by AABE (Executive Director: Prof. Kiyoyuki Ohshika; Conference Convenor: Dr. Churdchai Cheowtirakul) and Biotechnology Faculty, Assumption University of Thailand (ABAC).

The main theme of the conference was "Biology Education for Future Asia." There were six sub-themes:

(1) Biodiversity and its conservation;
(2) Environmental issues in biology education;
(3) Genetics and molecular biology;
(4) Technology-based biology education;
(5) Interdisciplinary approach;
(6) Current trends in biology education and research.

Fifty-five people from China, Hong Kong SAR (China), India, Japan, Malaysia, Philippines, Singapore and Thailand attended (Figure 1).

At the Opening Ceremony of the conference, Rev. Bro. Bancha Saenghiran, President of Assumption University, delivered the opening address (Figure 2) and Dr. Churdchai Cheowtirakul (Conference Convener), Dean of School of Biotechnology, Assumption University, gave the welcome speech (Figure 3).

Four persons were invited as plenary speakers: Prof. Glenn M. Young of UC Davis, USA; Dr. Verawat Champreda, National Center for Genetic Engineering and Biotechnology, Thailand; Dr. Chen Zhong, National Sciences and Science Education, Singapore; Dr. Orasa Choosakul, The Institute for the Promotion of Teaching Science and Technology, Thailand.

Figure 1: The attendants of the AABE27 (photo provided by Assumption University)

There were 26 oral presentations, eight poster presentations (Figure 4), and six country reports. In addition, eight posters were presented by Assumption University students.

The Best Poster Presentation Awards were given to Ms. Tomomi Sawa (Most Excellent Prize), Dr. Takahiro Yamanoi (1st Prize), and Ms. Sae Katayama (2nd Prize).

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.

Figure 2: Opening Ceremony
Rev. Bro. Bancha Saenghiran, delivered the opening address

Figure 3: Opening Ceremony
Welcome speech was given by Dr. Churdchai Cheowtirakul (leftmost)

Figure 4: Poster presentations
Ms. Sawa (left) was awarded the Most Excellent Poster Presentation

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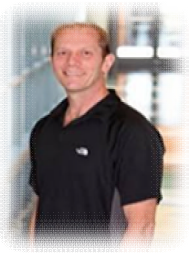
<Plenary Talks>

Education Aimed at Improving Food Safety for People of Low and Middle Income Countries



Glenn M. Young
University of California, U. S. A.

Our goal is to develop educational programs that improve value chains supporting safe food systems extending from farms to markets. For Low-Medium Income Countries (LMIC), food systems driven by consumer-driven markets are limited by value chain actors' (VCAs) lack of knowledge, capital, technology and technical training. Technical innovations and new techniques can improve food safety, but they must align with solving bottlenecks in food production and food quality. In addition, adoption of technologies and practices by VCAs is often hindered by social and logistical constraints. To address the wide range of problems experienced by VCAs seeking a higher standard of living, both natural science and social science solutions are required. Our research has defined a mechanism for overcoming multiple constraints VCAs face when attempting to change their food production, process-

ing and handling practices. Community-driven research projects were organized around the shared interests of individuals involved in various aspects of the agricultural supply chain in six villages in Cambodia. These Shared Interest Participatory Action Research projects were designed to serve 1) as an organizing platform for team building, 2) to collectively identify problems and test solutions, and 3) to provide education and dissemination outlets for early scaling of technologies resulting in food safety improvements. This case study proposes an innovative model for effectively mitigating multiple constraints that hinder LMIC food systems activities leading to healthier food consumption.

Keywords: consumption, food safety, technical innovation

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Exploration of Uncultured Microbial Bioresource Using Metagenomics Approach

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The world is now stepping towards the age of bioeconomy. Bio-resources are being explored as the renewable starting materials for conversion to biofuels, chemicals, and biomaterials and on another side, as a valuable genetic resource for searching potent microbes and enzymes for industries. The research activities at the Enzyme Technology Laboratory, BIOTEC aim to understand the complex cooperative microbial processes on plant biomass degradation in nature and translate the knowledge into efficient enzymes for greener industries. Our works span from searching potent lignocellulose-degrading enzymes from the rich microbial bio-resource of the country, developing synergistic enzyme systems for lignocellulose hydrolysis and modification as well as on biocatalyst fabrication in various immobilization designs, to optimizing bio-processes for enzyme prototype production. The culture-independent metagenomic technique has been applied as an effective tool to explore the world of uncultured microbes, which represents up to 99% of the total biodiversity. A collection of environmental metagenomes from ecosystems active in lignocellulose degradation e.g. peatswamp forest, termite gut, and bagasse collection site has been explored using combination of activity-based screening and next-generation sequencing with the use of advanced bioinformatics tools for gene mining and in-depth analysis of the dataset. This provides an insight into the diversity and dynamics of lignocellulolytic microbial communities and genes encoding for biomass-degrading enzymes, contributing to our capability to understand biochemical processes on plant biomass decomposition in nature.

Keywords: biodiversity, lignocellulolytic enzyme, metagenome, next generation sequencing, uncultured microorgamisms

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Innovation on Biology Education

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Biology is a natural science subject studying life and living organisms. Biology education faces challenges to explain the structure, function, growth, evolution, distribution, and taxonomy of living systems. At the same time, there is a need to elucidate how life form works and interconnects from molecule, cell, tissue, organ, organism and ecosystem levels. Currently a stereotype composition of university biology courses in-

cludes 2-hour sessions in classrooms with heavy use of PowerPoint slides accompanied by lecturer's monologue narration throughout the lecture. Such lecturing is a passive learning style that encourages note-taking and rote memorization as the means of assimilating knowledge. In the era of online learning it is imperative for educators to recognize that students have different learning styles, and hence to improve on the effectiveness of our methods of instruction. In recent years white board animations are popular in social media and commercial platforms. They are high-quality animations that instantly catch the attention of audience by means that whiteboard markers start squeaking and pictures magically appear, perfectly illustrating the narrator's words. Insightful illustrations by visualizing abstract ideas engage the viewer as the illustrator artfully captures the narrator's concepts. The words are temporally accompanied with the dynamic pictures which seamlessly present a powerful narrative cartoon instead of a dry monologue, adding further depth to the spoken terms. We foresee the huge application potential of whiteboard animation in the education industry. Hereby I will present our efforts in creating whiteboard animations in biology education done at National Institute of Education, Singapore. I will also briefly mention our latest project using virtual and augmented reality in biology education.

Keywords: biology, education, innovation

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Biology Education and Research in a New Horizon

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Aiming to build Thailand to be a sustainable and advanced country in the areas of economics and society, the appropriate usage of research and innovation, knowledge and innovation is necessary. Biology education research can help expanding the frontier of biological knowledge, planning and developing a meaningful biology curriculum, assessment, and class teaching. Moreover, the trend information about the fields in biology education research is useful for career paths and academic publications. There are many articles in biology education research that were published in the international journals; 1) teacher education, 2) teaching, 3) learning students' conceptions, 4) learning-classroom contexts, 5) goals, policy and curriculum, 6) culture, social and gender issues, 7) history, philosophy, epistemology and the nature of science, 8) educational technology, 9) informal learning.

Keywords: biology education, biology education research

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<Country Reports>

Thailand Report

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Compulsory education system in Thailand is composed of six years in primary school and three years in lower secondary school. The National Scheme of Education B.E. 2560-2579 (2017-2036) emphasizes the importance of the national education development. Because of the 21st century employment trend to require high work skill, the demographic changes in Thailand that the number of elder population is increasing, and the unsustainable economic growth. Therefore, it is nec-

essary for Thailand to prepare the suitable future education. The Institute for the Promotion of Teaching Science (IPST) is the independent authority under the Ministry of Education, with the responsibility in the development of national curriculum, educational media/ tools, science standard and quality assessment, mathematics and technology education in primary to upper secondary school, training for teachers and students, science talents promotion activities, and giving advices in the science education policy. The 2008 national science curricula objective was set up by IPST based on the principles, concepts and theories of basic science, thinking skills development. It also clarified the decision-making based on diverse data/ evidences, and also demonstrated the applications of science and technology in daily life and society. The science curricula standard in Thailand is based on 8 strands composition; 1) biological science, 2) physical science, 3) earth and space science, 4) biology, 5) chemistry, 6) physics, 7) Earth astronomy and space, 8) technology.

Keywords: *Science curricula, Science strand, Thailand education*

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Japan Report: Features of the New Courses of Study for Japanese Elementary and Secondary Schools

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In Japan, the courses of study for elementary school education and lower secondary school education were revised in 2017 and the course of study for upper secondary school education was revised in 2018. In this presentation, I'll share features of the revised courses of study, with a focus on science education. These revisions emphasize more focus on proactive, interactive and deep learning. They also emphasize ways of thinking in various scientific disciplines. New courses of study for Biology haven't change much in content, but now stress scientific ways of thinking and the concept of 'unity and diversity' in living things.

Keywords: biology education, Course of Study, proactive, interactive and deep learning, scientific ways of thinking

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Hong Kong Report: An Update on Biology Education in Hong Kong – STEM Education

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Since the policy address delivered in 2015 by the Chief Executive of the Hong Kong Special Administrative Region (HKSAR), Science, Technology, Engineering and Mathematics (STEM) education has been initiated as a major developing direction in the education community of HKSAR. Apart from financial support from Education Bureau to the schools for organizing STEM-related activities, the curriculum of science education at the junior secondary level, as well as the curriculum of General Studies, the subject that accommodates all the science education in primary schools, has been updated in 2017 to incorporate more components of STEM in the learning and teaching of science subject. The curriculum of Biology at the senior secondary school level, however, has not been revised since 2015. Secondary biology teachers and universities' scholars (or university scientists) have formed small-scale communities to support each other on the biology-related STEM activities to be implemented in the schools. For example, secondary teachers, with the support of students, have cultivated Scleractinian corals in their schools for teaching modules like classification

and features of living organisms. The Education University of Hong Kong has assisted the Hong Kong Wetland Park to develop STEM-oriented modules to be implemented by local schools in the Park. Teacher training workshops were well received by both the local primary and secondary schools.

Keywords: curriculum, Policy Address, STEM education, teacher community

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<Oral Presentations>

SUB-THEME 1: BIODIVERSITY AND ITS CONCERVATION

Development and Practice of ESD Program to Understand Biodiversity and Alien Species in a Local Environment by High School Students

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In Japan, various ESD activities are being developed through school education, as a representative example of UNESCO ASPNet after the Decade of Education for Sustainable Development. These schools are engaged in activities on biodiversity issues such as endangered species and alien species as a main theme. A new environmental learning promotion project for high school students "Aichi's Future Creation Club" has begun in 2017. The objective of this project is to develop an educational program to solve regional problems based on the results of biological survey by high school students as the main body. The students of Chiryu East Senior High School, which is one of the schools participating in the project, conducted an ecological survey of various turtles inhabiting the rivers around schools, and clarified the differences in the number and eating habits between native species and alien species. Based on the survey results, they have developed an educational program "Kame-Masu" to understand the ecology of turtles. The high school students practiced classes at elementary and junior high schools using developed programs, and it allowed students who attended the classes to understand the ecology of turtles around the area. They consider how to apply the program not only to school education but also to lifelong education in the region in the future.

Keywords: alien species, biodiversity, ESD, high school student, local environment

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Freshwater Atyid Shrimps in Hong Kong: Integrating Teaching and Research in a Biodiversity Conservation Project

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Rapid economic development in Asia has threatened our high biodiversity, particularly the freshwater fauna. While more researches are necessary to yield information for rationalizing conservation strategies, it is increasingly important to educate the public about conservation. We conducted a most comprehensive ecological and genetic assessment of freshwater atyid shrimp species in Hong Kong, a highly developed city in East Asia. We recruited undergraduates to participate in this study to test if such experience could positively impact their conservation attitude. Our study uncovers a new atyid species record in Hong Kong and indicates that some species exhibit extremely strong population structure such that a stream-by-stream conservation

would be warranted. With an adequate guidance, undergraduates can conduct scientific research that yields important information for conservation planning. Participants' reflections indicate that the involvement not only taught them field and experimental techniques, but also granted them a mind-opening experience towards better understanding of the local fauna, and a sense of contribution towards conservation as well as formulating their career planning. We conclude that integrating teaching and research in biodiversity conservation projects creates a win-win situation: the new scientific knowledge improves imminent conservation plans, while the experience empowers the next generation to better conserve the environment.

Keywords: atyidae, caridea, conservation, genetic diversity

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Terrestrial Macrophytes Assessment in Camp Higher Ground, Barotac Viejo, Province of Iloilo, Philippines

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This study was conducted to establish baseline data on the terrestrial macrophytes in Camp Higher Ground (CHG), Brgy. San Nicolas, Barotac Viejo, Iloilo. Specifically, this study determined the terrestrial macrophyte level of plant diversity in terms of species richness, species composition, and relative abundance; and determined the conservation status of plant species in the area. The assessment was on September 2017–January 2018 employing descriptive survey method. The sampling area was 1000 m^2, 10 quadrats of 10 x 10 m. Results revealed 123 plant species, 100 genera and 61 families. Specifically, trees were 56.9%; shrubs, 13.8%; vines, 13.0%; herbs, 7.3%; ferns, 5.7%; and palms, 3.3%. Shannon-Weinner diversity index for CHG was high (H'=3.867). Thirty-one (25.2%) macrophytes were categorized threatened. Among these, two were critically endangered: *Mussaenda philippica* L.C. Rich. and *Clerodendrum quadriloculare* (Blanco) Merr. The endangered species were Duklitan (*Planchonella duclitan* (Blco.) Bakh. f.), *Ormosia calavensis* Azaola, and *Cratoxylum formosum* Benth & Hooker. However, 30 (24.3 %) plant species were considered endemic. During the conduct of the study, some forest clearing, wood harvesting, and minor charcoal-making operations were observed which posed threats to this natural habitat especially of threatened and endemic macrophytes. Proper conservation program should be implemented by the CHG management to prevent further biodiversity loss.

Keywords: conservation, critically endangered, endemic, macrophytes, terrestrial, threatened

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Preliminary Study on Weaverbirds Distribution and Density along Two Selected Rivers in Batu Pahat District, Johor, Malaysia

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The weaverbirds are often found to make nests on the banks of a river as much agricultural land has been planted with palm trees in Batu Pahat District, Johor, Malaysia. This preliminary study was conducted to estimate the weaverbirds distribution and density along two selected rivers. Data were collected three times through on-site observations and the point-count method from June 2018 to September 2018. River I had fifteen point-count stations, while eighteen point-count stations were set for River II. The total mean of weaverbirds and nests distribution along the two rivers were 101.3±62.9 weaverbirds and 50±30.6 nests. Meanwhile, the

mean density of weaverbirds and nests for both rivers were 6.14±1.06 weaverbirds per kilometre and 3.03±0.48 nests per kilometre. River I had a higher mean weaverbirds and nests distribution and density compared to River II. Statistical analysis showed that the distribution and density of weaverbirds and nests differed significantly between the two rivers (p<0.05). In this study, only one species of weaverbirds was found which means the two selected rivers possesses a low variety of weaverbirds. Overall, low findings in distribution, density and variety of weaverbirds in this area indicate that conservation programs may be needed to prevent their extinction in the future.

Keywords: weaverbirds, distribution, density, variety, extinction

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Morpho-Biochemical Characterization of Cutaneous Bacterial Isolates of Three Endemic Frogs from Mindanao Island, Philippines

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Morphological features and some biochemical tests were used to characterize bacterial isolates from the skin of three endemic frog species: *Kalophyrnus sinensis* (Peters, 1867), *Limnonectes magnus* (Stejneger, 1910), and *Megophrys stejnegeri* (Taylor, 1920) from Mt. Andapon Barangay Campawan, in Baganga, Davao Oriental, Philippines. The bacterial isolates were acquired through skin swabs from five representative adult individuals per species, grown in select solid media, and subjected to various standard biochemical tests. Nine bacterial isolates were obtained: *Citrobacter* sp., *Salmonella* sp., *Pseudomonas* sp., *Enterobacter* sp., *Micrococcus* sp., *Proteus* sp., *Staphylococcus* sp., *Staphylococcus aureus*, and *Diplococcus* sp. Eight of these isolates were found in *Megophrys stejnegeri* (Taylor, 1920). Many of the bacterial isolates obtained were associated with soil. *Citrobacter* sp. was the common bacterial isolate found in all the frog species on both dorsal and ventral sides. The presence of bacterial isolates on these frogs may be suggestive of a mutualistic relationship. Further studies maybe done to decipher role of these bacterial isolates and to validate if these are the only microorganism thriving on the skin of these Philippine endemic frogs.

***Keywords**: anurans, biochemical features, cutaneous microbiota, ecological associations, morphology*

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SUB-THEME 2: ENVIRONMENTAL ISSUES IN BIOLOGY EDUCATION

Limnological Survey and Heavy Metal Analysis of Fishes from Estero de Sampaloc, Manila, Philippines

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Estero de Sampaloc is one of the biggest polluted creeks that flow into the Pasig River found within Metro Manila, Philippines. Rapid industrialization and urbanization have caused its degradation which needs rehabilitation. Different types of solid wastes and heavy metals are dumped in the creek that may undergo bioaccumulation inside the bodies of fishes particularly *Gambusia affinis* and *Rasbora maculate*. Limnological survey of the creek water was done to determine the extent of pollution of the creek using fishes as biological

indicators. The study of the physicochemical parameters showed that the water was shallow, slow-moving, warm, basic, turbid, with less DO, high BOD and COD, and high total suspended solids, total nitrogen and total phosphorus count. Average values of these parameters fell under the Class D water quality criterion indicative of a highly degraded estero. Heavy metal analysis in fishes showed an average of 0.01 ppm, 0.003 ppm, and 0.001 ppm for lead, cadmium, and mercury, respectively. These values fell below the limits set by US-EPA. However, the heavy metal concentrations can biomagnify in the tissues of fishes as well as in humans. Shannon Index value of 0.093 indicated a low diversity of estero fishes. Evenness index of 0.309 showed uneven distribution of fishes per species. A 0.895 dominance index value was confirmed by the high population count of resilient fishes *Gambusia affinis* over *Rasbora maculata*.

Keywords: bioaccumulation, estero, fishes, Gambusi affinis*, limnological survey, physicochemical parameters,* Rasbora maculate

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Environmental Education for Conservation of Borneo's Ecosystem Using Role-Playing

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In Japan, most people eat palm oil used in bread, cake and many other foods. The annual consumption of palm oil per one Japanese is about 4 kg. Then, palm oil is closely related to Japanese life. Borneo's people expand plantation of oil palm trees to produce palm oil. Borneo's native forest were cut down and burned down for expanding the plantation. The orangutan, the Borneo pygmy elephant and many other species are on the verge of extinction by reduction of native forests. Oil palm has enriched the Borneo's economy, though oil palm is destroying Borneo's ecosystem. It is important for students to know this fact and to think about how to solve the situation. Therefore, I carried out a role-playing lesson in which students could learn about the mechanism of destroying Borneo's ecosystem and the difficulty of conserving the ecosystem. In this lesson, almost all students decided to expand the plantation of oil palm despite the fact that we destroy the ecosystem. Then, students thought how to solve the situation. This lesson seemed to be effective for teaching conservation of ecosystem. I'll report details of this class and I'd like to exchange opinions how to teach conservation of ecosystem.

Keywords: Borneo, ecosystem, environmental, role-playing

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SUB-THEME 3: GENETICS AND MOLECULAR BIOLOGY

Simple and Reproducible PCR Protocols Using Petals from Ornamental Plants to Promote Student Understanding of Molecular Biology

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Molecular biology, and the technologies based on it, has advanced considerably since the end of the 20th century. Indeed, molecular techniques are used extensively in a variety of biological fields, including evolutionary and developmental biology, physiology, and ecology. In addition, numerous advances in the medical and agricultural fields have been facilitated by molecular biology, and technologies such as recombinant DNA, gene diagnosis, and gene therapies have become important in our lives. Although knowledge of molecular biology has become increasingly im-

portant, molecular biology is difficult for high school students to understand and it is still unfamiliar to most people. We therefore developed simple and reproducible experimental protocols to promote an understanding of molecular biology. Experiments are based mainly on the polymerase chain reaction (PCR), but also DNA isolation, electrophoresis, and DNA detection. The protocols provide ways to understand plant genetic diversity at the DNA level and illustrate the scientific basis of genetic diagnosis. Experience with the protocols helps students to better understand molecular biology; indeed, all of the experimental methods were designed with this aim. To optimize PCR, we used plant materials to prepare DNA. We intend to present simple yet robust PCR protocols to high school students.

Keywords: crude DNA from petals, DNA analysis, genetic diagnosis, genetically modified organisms (GMO), plant genetic diversity, polymerase chain reaction (PCR)

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SUB-THEME 4: TECHNOLOGY-BASED BIOLOGY EDUCATION

Fostering Global Competence in Environmental Education: A Class Activity Using Web-Based Teaching Materials Combined with Real Specimens and Historical Photographs

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Global competence requires the capacity to examine and understand international issues, an attitude toward cultural diversity and tolerance, and it acts for collective well-being and sustainable development. As OECD adopted it in PISA 2018, it is an important idea to foster in curriculum. Over the past 18 years, our team has developed web-based simulation software, SimRiver, which is accompanied by several modules. This educational system is open to the public in 25 languages at the DiatomProject web site. Content is continually revised in response to user's feedback. SimRiver allows students the opportunity to participate in a hands-on environmental management and manipulation activity that allows an understanding of the relationship between organisms and environmental disturbance. Class activities with SimRiver have been implemented in various lesson plans containing proactive learning for inquiry. In this study, we focused on evoking and fostering of global competence with newly developed teaching materials and teaching plan. Today developing countries suffer from severe water pollution and more developed countries have a negative history with riverine environment. From locations in Japan, America and India, we utilized historical and modern river photographs as well as diatom specimens as a proxy for aquatic environments. This combination of materials and SimRiver lead students to think about intercultural issues without stereotype and provided normalized perspective to share the experience of pollution.

Keywords: diatoms, global competency, inquiry, pollution, proactive learning, river environment, simulation.

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The Application of Augmented Reality in Biology Students' Academic Performance

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One of the most powerful forms of contextual mobile learning is Augmented Reality (AR). AR brings a remarkable potential to complement information with the use of computers and mobile

phones in the classroom where instruction can be made more collaborative with the use of technology. While AR has been used in other countries, the documented use in the Philippines is scarce. Quite a few researches have been done in the Philippines integrating AR as a tool for learning but rarely about bringing this technology in the Basic Education setting. With these in mind, the study aims to determine the effect of AR application using mobile devices in learning Biology for Grade 8 junior high school students, specifically in the topic on biodiversity. A quasi-experimental non-randomized pretest and posttest group design was used in this study. Two groups were classified into traditional and AR learning groups, each with 32 students. Both groups received the same classroom instructions except that the AR group used AR applications through their mobile devices. Results showed an improvement in their posttest academic performance for both traditional and AR learning group however, normalized gain score analysis revealed that AR learning group ($\bar{x}$ = .6806, s = .1151) had a statistically significant higher academic performance than the traditional learning group ($\bar{x}$ = .5087, s = .1672) with a p-value of .007 at 0.05 level of significance.

Keywords: Augmented Reality (AR), AR learning, academic performance, biodiversity, mobile devices, Biology, technology

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Active Learning Utilizing ICT in Biology Class

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Osaka Public School Association for Biology Education Study Group and Osaka Private School Informatization Study Group organized "The iPad Workshop for Beginners" and created "The Digitized Experimental Procedure" on iBooks in 2013. We later published it on the Apple iBooks Store. It is currently available not only in Japan, but also in 14 countries around the world. In the unit on kidneys, I used iBooks for experiments and the camera time-lapse function in order to track the urine movement route and concentration ratio of each component in the kidneys. Additionally, each student was tasked with physically performing a specific role of the urine movement route on the school ground. In the unit on the Central Dogma, I utilized the Stop Motion Studio and Google Drive apps. To explain the Central Dogma, the students made a stop motion video, organized a lot of specialized words and constructed knowledge of gene expression. My students and private school students in Yokohama shared Google Cloud files and exchanged a "Codon Letter", in which 3-letter words are used to express DNA sequence information. Each student at both schools translated and transcribed the letter in order to read a cipher message.

Keywords: *active learning, Codon Letter, iBooks, ICT*

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Flipping the Classroom for 21st Century Learning: A Student-Centered Approach in Teaching Biology

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The utilization of technological tools in educating the new breed of 21st century learners helps in the development of student learning through provisions of a wide range of multimedia information, which can enable the students to conduct their own investigation and search for answers to their queries. A new method of blended learning that can be implemented to explore the potential value of technology-infused instruction is the Flipped Class-

room. This study aims to design instructional materials in Biology wherein learner-centered principles are applied to help students discover new knowledge and explore at their own pace. A group of teacher-observers quantitatively analyzed the instructional materials through descriptive statistics. Results revealed that the instructional materials possess high evidence of remarkable qualities of flipped classroom based on the following parameters: academic involvement, student-peer-teacher involvement, and time allotment. To strengthen the analysis, the teacher-observers' perceptions towards the utilization of flipped classroom in biology were qualitatively analyzed through thematic coding, and results showed the student-centered characteristics of the instructional materials. The quantitative and qualitative assessment of the instructional materials signifies that the flipped classroom promotes collaboration and engagement among students, which can contribute to better learning in biology. Therefore, flipping the classroom in teaching biology concepts appears as a novel way of teaching that promotes highly evident collaborative, and active student-teacher and student-student interaction for better learning.

Keywords: *biology, blended learning, flipped classroom, instruction, technology*

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Use of Multimedia for Dislodging School Students' Misconceptions

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Researches on the use of multimedia for remediation of students' misconceptions and increasing students' subject understanding revealed that the technology is useful not only to facilitate classroom learning-teaching process but also to create curiosity, interest and zeal among the learners. It is also employed in the conceptual change approaches with other instructional methods such as traditional methods, hands-on activities and field study in the remediation of students' misconceptions and increasing students' understanding of science in general and abstracting biological concepts. Multimedia technology may be used for identification of students' common misconceptions and to measure students' levels of understanding. This study explores the effectiveness of multimedia during the implementation of remedial modules in the classroom. The aim of the study was to understand high school students' conceptions and to develop remedial material to dislodge potential misconceptions about life processes. The researcher used the purposive sampling procedure and selected one semi-urban school, where science and AV laboratory facility was available. The strength of this class was 73 students. Each module on life processes was implemented by using multimedia. Many of the life processes cannot be observed in real life but they can be presented to the students using video clips having simulations. The results of the study showed that the use of technology in implementation of remedial material is significantly effective for rectification of students' misconception.

Keywords: remedial module, school science, students' misconceptions, technology

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Biology in Cinema: *Bridging Fantasy with Reality*

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Today, our students arrive in the classrooms equipped with wide array of knowledge from current and controversial science issues, most of which were acquired through watching popular science movies. These movies with varying degrees of accuracy have undoubtedly influenced students'

understanding of science content and process. Moreover, the National Science Foundation and other researches' investigation of the impact of fictional science movies to the public understanding of science have argued that fictional cinema and television have proven very effective at blurring the distinction between fact and fiction and that it has corroded the public's critical skills and hindered the development of a scientifically literate society. With the growing list of movies depicting biological concepts, it is very evident that the media particularly Hollywood, have long exploited biology as a source of bankable plot material. The rationale for this paper lies in the notion that movies with biology underpinnings can be effectively integrated in the classroom to present difficult to visualize concepts such as movies with genetics and molecular biology themes. However, educators must play a pivotal role not only in extracting the kernels of scientific truth from these popular movies by teaching students how to discern what is viable from what is improbable but more importantly in developing critical thinking skills through case-based analysis needed for today's information-rich society. The paper also presents a process-oriented framework to help biology educators integrate these resources into a minds-on and technology-infused learning environment to build deep interest for real science while capitalizing on the motivational "cinemagic" of popular movies.

Keywords: active learning, case-based analysis, science fiction, science issues, technology-infused learning

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SUB-THEME 5: INTERDISCIPLINARY APPROACH

Application of STEAM Activity in Japanese Biology Education

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STEAM is the abbreviated name for "Science, Technology, Engineering, Arts, and Mathematics" that integrates some teaching subjects. It has already been conducted in South Korea, especially almost of all teaching units have each activity about it in science textbooks on lower secondary schools. On the other side, integrated subjects education has been conducted on curriculum in Japan. But, it is very difficult to connect students' abilities directly between each subjects and integrated subjects education. If STEAM is used in science class activities in Japan, the effectiveness of STEAM appears in solving the problem. I focused on a teaching unit which is studied about evolution, because it had rare activities in biology education in Japan. Therefore, I implemented STEAM activity "Creating Living Things in Future" to university students in my class. As the result, they created plants, animals, insects, human, and fusing living things in future by drawing on paper. And they wrote explanation about the living things concretely that was made based on the present information. I think that ideas of STEAM bring new activities and effectiveness to biology education in Japan.

Keywords: *evolution, integrated education, Japanese biology education, STEAM*

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Entrepreneurship-Based Biology in Teaching and Learning: Students' Academic Achievement

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This study aimed to investigate the effects of integrating entrepreneurship in teaching biology on the students' academic achievement. There were two groups of 31 student participants se-

lected for Control (Traditional Learning Group, TLG) and Experimental (Entrepreneurship-based Biology Learning Group, EBLG). A fifty-item examination regarding the topic was given to determine their mental ability. The pretest mean scores of the TLG ($\bar{x}$ = 14.8; S = 3.93) and EBLG ($\bar{x}$ = 15.7; S = 4.28) have no significant difference (p = 0.390) which suggests that both groups started with the same level of understanding. The traditional way of teaching and learning were applied for both the TLG and EBLG but the experimental group was given additional basic entrepreneurial activities. The students experienced taking loan, designing goods' labels, marketing, and paying off loan. After the intervention, t-test analysis showed that the students' levels of understanding of both TLG ($\bar{x}$ = 23.19, S = 4.91) and EBLG ($\bar{x}$ = 30.6, S = 7.16) had significantly improved (t (60) = 6.77; $p < 0.001$); however, analysis of the normalized gain score showed that the EBLG's achievement in learning biology was significantly higher than the TLG ($\bar{x}$ = 0.24; S = 0.12). The significance therefore proves that integrating entrepreneurship positively affects the students' academic achievement in biology education. The result of this study shows that the method of integrating entrepreneurship in biology stimulates deeper scientific knowledge while attaining entrepreneurial skills which could be used for gainful employment.

Keywords: academic achievement, entrepreneurship, entrepreneurship-based biology learning, traditional learning

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Creating Indigenous Learning Resources through Environmental Projects Using Inexpensive Materials in Collaboration with Students of Saraswati Junior College, Paras

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The present research paper is about classroom efforts which resulted in developing perennial learning resources to promote interdisciplinary approach. Participation of students, constructivist approach, and the use of inexpensive and easily available materials are main features. The researcher used match box pictures, coins, currency notes, postage and philately stamps, feathers and self-taken photographs of India and abroad to activate the students. Small efforts taken at local level crossed regional boundaries and reached global level. Also these resources proved helpful in learning other subjects. Educational institutes inviting for programs confirmed the validity and novelty of the work. With each passing year, the enrichment mounted. The projects highlight hidden potential around us. Also it marks that each challenge has a silver lining. Focusing on available materials is what one has to consider. Environment projects are actually unique opportunities to understand nature in its minutest parts. Simplicity, collaboration and cooperation are the underlying currents of the humble efforts.

Keywords: collaboration, creating, indigenous, inexpensive material, junior college, learning resources

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Medical Consultation Role-Playing Game for Internal Environment of Human Body in Basic Biology

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Having the good knowledge of biology is crucial to human life today. It helps us to sustain healthy life and also allows for the prevention and the early detection of severe diseases. Most of the high school students in Japan learn how the internal environment of a human body functions in a subject called Basic Biology. In order to deepen students' learning in classes, I have carried out an activity that en-

ables students to understand more effectively the details of some of the diseases and how the corresponding treatment works. This was done in the form of role-playing. One student plays the role of doctor and he/she explains the details of the disease until another student, who plays the role of patient, fully understands. The student who plays the role of patient has the responsibility to ask questions until he/she is fully convinced with the doctor's explanation and is able to select an appropriate treatment of method. This activity has successfully made students be aware of the importance of listening to the doctor's explanations carefully and ask questions when necessary. In addition, those students who did the activity now pay closer attention to their families' health conditions.

Keywords: Basic Biology, healthy life, internal environment of human body, role-playing

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SUB-THEME 6: CURRENT TRENDS IN BIOLOGY EDUCATION AND RESEARCH

China's Policy on Construction of World Class Discipline and Its Impact on Biology and Bio-Engineering

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China has replaced its traditional elite university program "211" "985" with a new scheme "world-class university" and "world-class discipline". The new scheme takes a dynamic standard and the status of the universities and disciplines is reevaluated for every five years. The new policy poses a significant impact on the discipline biology: financial investment, research grants and prominent researchers will be gradually accumulated to the very few top universities, causing an imbalance nation-wide and eventually hurting biology education in China. Meanwhile, with the establishing of the new discipline of bio-engineering, many universities are seeking to move to a cross-disciplinary development from biology to bio-engineering, seeking a new breakthrough in the competition.

Keywords: bio-engineering, biology, world–class discipline, world-class university

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A Survey on The Implementation Status of Research Ethics Education by High School Teachers in Japan

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Recently the importance of research ethics education (including bioethics) has been recognized by many researchers. In Japan, researchers are obliged to take research ethics education when applying for research grants. In addition, project research is promoted at high school in "*Risu Tankyu* (A new subject of the next Course of Study in Japan)" and Super Science High School project, etc. Therefore, enrichment of research ethics education is indispensable. I conducted a survey on the implementation status of research ethics education. The subjects of the survey are high school teachers in Ehime prefecture, with a total of 38 teachers, including 19 science teachers, 6 mathematic teachers and 13 others. About 40% of the respondents in the questionnaire were conducting research ethics education, but except for one teacher, almost all those teachers did not use reference of research ethics. This result revealed that it is hard to say that a comprehensive research ethics education is being implemented. It is necessary to develop teaching materials for research ethics education.

Keywords: bioethics, project research, research ethics, Super Science High School project

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Efforts into the International Biology Olympiad of Japan – Past Results, Problems and Preparing for IBO2020 Held in Japan (Nagasaki) –

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The International Biology Olympiad (IBO) is an international contest for high school students interested in biology. Japanese representatives first participated in the IBO in 2005, the 16th convention. Since 2005, "Japan Biology Olympiad (JBO)" has been held every year, selecting Japanese representatives and sending them to the international convention. The selection procedure is as follows: Participants' application → Preliminary test → Secondary selection test → Final selection test. In the past 13 years, the number of participants of preliminary test has been increasing remarkably. In 2018, over 4600 students participated in the JBO. The reasons of the increase are, first, having good grades of the test is advantageous for entrance examination of university, and second, students interested in biology can get good chance to talk with scientists and to interact with biology-lover students after the secondary selection. At recent international conventions, all four Japanese representatives won medals, and deepened relationships with colleagues around the world. In 2020, the 31st IBO2020 will be held in Nagasaki, Japan. This is the second IBO hosted by Japan following IBO2009 in Tsukuba. One Japanese person was elected as the 3rd chairman of IBO. Around 2020, International Olympiad of many science fields including biology will be held in Japan. The Science Olympiad Promotional Council has been organized for supporting all the fields. The problem for us is to establish a sustainable organization and to get funds.

Keywords: contest, high school students, International Biology Olympiad, Nagasaki

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Influence of Nematode Taxa on Labile Carbon of Soil Planted with *Brassica rapa chinensis* (Bok Choy)

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Our study focused on the influence of soil nematodes on the labile carbon content of soil planted with *Brassica rapa chinensis* (Bok Choy). We collected nematodes from a soil sample using the Baermann Funnel technique. The nematodes were introduced in a sterile soil and thereafter planted with Bok Choy. The labile carbon concentration of the soil was obtained before inoculation of the nematodes, after inoculation, and after planting using spectroscopy. The isolated nematodes belong to the orders Dorylaimida and Rhabditida. We noted a statistically significant decrease in soil labile carbon and significant changes in the growth of Bok Choy based on root and shoot length as well as number of leaves compared to the control set-up. Our data implies the significance of maintaining diverse nematode taxa in soil to promote better soil health which may also have positive implications in agriculture.

Keywords: Davao City, environment, labile carbon, soil health,

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Observation and Experiment Using Insects at Scientific Events in Chubu Area of Japan

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Biology Laboratory of Faculty of Education of Kogakkan University conducted observation and experiment classes using insects at the "Bio Laboratory" of Nagoya City Science Museum

and the "Children's Experience Festival" at Ise City Lifelong Learning Center, Isetopia. The purpose of the "Bio Laboratory" is to learn immunity by observing the phagocytosis using insect hemocytes. The purpose of the "Children's Experience Festival" is to have interests in and attention to insects and living things by actually observing and touching insects. The latter exhibition was divided into four categories: "Insect body and characteristics", "Observation and experiment", "Let's touch it", and "Craft". We conducted a questionnaire survey on understanding about, interests in, and attention to insects and immunity before and after children had participated in each class. As a result, observation and touching of insects and detailed explanation from university students who were studying insects and immunity tended to increase children's understanding and interests in insects and immunity.

Keywords: Chubu area in Japan, immunity, insect, Mythimna separata, observation and experiment, scientific event

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Inquiry into the Onion

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In Japan, inquiry activities have been introduced into science subjects for upper secondary schools since 1994. However, these activities are still being under-utilized. Through these inquiry activities students are expected to address issues actively, think deeply by themselves, and feel pleasure in solving problems. Here, I will present a sample of inquiry activities which relate to the morphology and growth of the onion bulb. At first, the question, "Which part of the onion do you eat: root, stem, leaf, flower or fruit?" is asked. Usually most of the students cannot give the correct answer. This gap between students' answers and the correct answer can foster students' interests. This part is easy and inexpensive, and it can be carried out within one school hour. The next part is also inexpensive, but more challenging. The question, "How does the onion bulb get bigger?" is asked. Students are required to carry out the following activities to verify their answers: making a hypothesis, designing an experiment, carrying out experiment and observation, collecting data, analyzing and discussing the results, and finally deciding whether the hypothesis is acceptable. These activities are usually done in groups. Through these activities and writing a report, students can cultivate their abilities of logical thinking, decision-making, and expression.

Keywords: *expression, inquiry activities, logical thinking, observation, onion*

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House Dust Mites as Tools for Biology Education and Research

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House dust mites (HDMs) are microscopic arachnids considered as clinically important sources of allergens that trigger allergic diseases such as allergic asthma, allergic rhinitis and atopic dermatitis. HDMs are ubiquitously found in indoor environments in tropical to temperate countries. Cultures of house dust mites are invaluable specimens in invertebrate zoology as well as important sources of biological reagents for allergy-related research. In this lecture, the use of the HDM species *Dermatophagoides farinae* (Df), *Blomia tropicalis* (Bt) and *Suidasia pontifica* (Sp) cultures to study the life cycle of arachnids, their morphological features, response to environmental stresses, and other biological characteristics will be presented as a specimen in an undergraduate Biology laboratory class. Likewise, the lecture will focus on the House Dust Mite Allergy Project of the University of Santo Tomas, Manila, Philippines, where Df, Bt, and Sp cultures were used in the cloning, expres-

sion, and characterization of fourteen (14) HDM allergens as performed by graduate and undergraduate biology students. Sensitization profiles of Filipino allergic patients to the allergens from Df, Bt, Sp and other HDM species; and the screening of natural products for acaricidal activities will also be presented. As an example of an applied research on allergy diagnostics, a prototype HDM allergen detection kit using recombinant HDM allergens for the monitoring of HDM sensitizations will be discussed.

Keywords: allergy, Blomia tropicalis*,* Dermatophagoides farinae*, house dust mites,* Suidasia pontifica

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<Poster Presentations>

Ecological Diversity of Three *Nothofagus* Species in Isla Navarino, Southern Chile: A Comparative Study of Chile and Japan

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Three *Nothofagus* species in close lineage are distributed in cool temperate Isla Navarino, southern Chile. *N. antarctica* and *N. pumilio* are deciduous trees, while *N. betuloides* is evergreen one. This study examined ecological characteristics of the diversified *Nothofagus* species, comparing them with tree species in Japan. Typical forests of this island were mixed forests of deciduous *N. pumilio* and evergreen *N. betuloides*. Saplings of *N. betuloides* existed in understory of its evergreen canopy, while those of *N. pumilio* did not. Under canopy gap, both species inhabit, and their elongation growth rates were similar. At open site out of the forests, elongation growth of *N. pumilio* saplings was faster than that of *N. betuloides*. These results suggest that deciduous *N. pumilio* is early successional fast-growing species demanding high light intensity, while evergreen *N. betuloides* is late successional shade-tolerant species. These regeneration strategies of deciduous and evergreen species are similar with those in Japan. On the other hand, *N. antarctica* was not found in the forests but found in wasteland. It had a short form with branched trunks, thick leaves, and heavy wood. These traits might contribute to the adaptation to strong wind in Patagonia.

Keywords: *cool-temperate forest, early successional species, ecological diversity, forest regeneration, late successional species, relative growth rate*

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Isolation of Bacteria in Sea Sand and Seawater in San Pedro College – Marine Station

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The objective of this study is to identify isolated bacteria found in sea sand and seawater in San Pedro College – Marine Station. Isolation of bacteria was used by three media agars: Nutrient Agar; Mueller-Hington Agar and Inorganic Salt Starch Agar. A total of four isolated bacteria were identified using biochemical tests and morphological characteristics. These isolates were *Actinomyces* spp., *Micrococcus* spp., *Staphylococcus* spp., and *Enterobacter* spp. Most isolated bacteria were gram-negative, belonging to the family of Enterobacteriaceae. In conclusion, Island Garden City of Samal has the potential for

future natural antibiotics, mainly because of *Actinomyces* spp. found.

Keywords: biochemical tests, isolation of bacteria, marine ecology, morphological characteristic

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Are Unicorn Beetles Insects? - Development of Junior High School Class to Investigate Arthropod Morphology from an Evolutionary Perspective -

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Japanese junior high school students learn invertebrates, including arthropods, in their regular curriculum. However, students rarely perform any laboratories in this class, and most students cannot recognize arthropods as invertebrates even after the class. Therefore, we developed a class to expand students' understanding of arthropod body structure, focusing on a main feature of body structure, that each segment has a pair of appendages. Unicorn beetles have the typical insect body plan of head, thorax and abdomen, and the thorax has six legs, but the prothorax is separated from the rest of the thorax. We hypothesized that students would gain understanding of the central feature of insect body structure, that each segment has a pair of appendages, when they attempted to explain that unicorn beetles are an insect on the basis of their body structure. Students performed observations of centipedes and juvenile plecopterans, in addition to unicorn beetles, to better understand evolutionary processes within arthropods. Results of questionnaire surveys indicated that, after completing the class, students could explain precisely that unicorn beetles are an insect on the basis of their body structure, and that students' understanding of the arthropod body structure and the evolutionary processes was enhanced.

Keywords: evolution, insect, Japan, teaching method

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Biology Teacher "Today's Course"

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Currently, we are trying to develop interesting teaching materials in science for university students who aim to become science teachers in junior high and high schools. The purpose of this report is to present "Today's Course," a collection of science and biology teaching materials and equipment that interest students, which can be introduced in science classes and observation-based experiments at university-level teacher training courses. The meaning of "Today's Course" is different from the one used for a la carte meals, and the expression is used to represent high-quality teaching materials. Some examples of the topics are: 1) Mammalian skulls and deer antlers, 2) Physical laws on the falling and reflection of a paper money, 3) Cross-sectional structure of early-stage amphibian embryos made of clay, 4) Inversion phenomenon in mirror reflections, 5) The bracts of *Houttuynia cordata* and *Lysichiton camtschatcense* (Schott), 6) Distinction between *Erigeron philadelphicus* and *Erigeron annuus*, 7) See a rainbow in the room, and 8) Introducing the examination paper for fish dissection. These topics can be utilized as teaching materials that can be confirmed by students using visual and tactile perceptions, which may lead to an increased interest and motivation and enhanced educational impacts.

Keywords: biology teacher, science, Today's Course, teaching materials, university students

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Examination of Experimental Methods of Phagocytosis

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Experiment of phagocytosis by hemocytes in Biology textbooks of Japanese high schools is not easy to carry out. Therefore, we studied in the following three aspects in order to find a method of experiment which is easy for high school students. 1) Test insects: It is necessary to have the following conditions: It is easy to collect hemolymph, there are many hemocytes showing phagocytosis, and phagocytosis is exhibited in a short time. As a result of examination, the insects that fulfill these conditions are larvae of the order Lepidoptera. 2) Foreign substance: India ink was the easiest to observe, and then an acrylic paint was effective. The best concentration of India ink was obtained when an ink stick was rubbed 10 times on an ink stone with 2 ml of water. 3) Experimental method: We improved an existing method and developed a new one. In the improved *in vivo* method, foreign substances were injected into the body cavity of insects, and the hemolymph was collected after 15 minutes and observed. In the newly developed *in vitro* method, foreign substances were uniformly applied on a slide glass with a drop of insect hemolymph, and it was observed after 15 minutes.

Keywords: hemocyte, high school, immunity, insect, Lepidoptera, phagocytosis, teaching material

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Observation Practice on Phagocytosis Using Armyworm Hemocytes

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Information about studying insect immunity in high school biology has increased after the recent revision of the Course of Study and its guidelines in Japan. Examination of phagocytosis by hemocytes of several kinds of insects was described in one of the Basic Biology textbooks. The main species consist of crickets and grasshoppers in the order orthoptera were used to observe the insect hemocytes that have incorporated the foreign substances such as ink particles. Orthoptera has high glutinous body fluid that is difficult to be collected and it takes more than 24 hours to complete the examination. On the other hand, armyworm (*Mythimna separata*) of Lepidoptera; Noctuidae has a large amount of body fluid and it is easy to be observed by insect hemocytes. Thus, it is appropriate to use armyworm in this experiment. Furthermore, we developed a new *in vitro* method by which the hemocytic activity was easily observed within 50 minutes. *In vitro* experiments were also evaluated: drops of insect's hemolymph on the slide glass were mixed with ink particles without using injectors. We practiced the *in vitro* method for high school students in Ise City and surveyed by questionnaire. The results will be shown in this presentation.

Keywords: Basic Biology, hemocyte, high school, insect immunity, Mythimna separata*, phagocytosis, teaching material*

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Study on Observation Method of Cytoskeletons without Using Fluorescence Microscopes

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The commentary "to deal with the structure and function of cytoskeletons" is described in the current Course of Study for Japanese high school Advanced Biology (announced in 2009). So, the pictures of cytoskeletons appear at the unit of biological matter

and cell in all high school *Advanced Biology* textbooks that have been screened by the Ministry of Education, Culture, Sports, Science and Technology of Japan. As almost all pictures of cytoskeletons in *Advanced Biology* textbooks were taken by a fluorescence microscope (partially by an electron microscope), the same microscopic observations are impossible unless we use fluorescence microscopes. Since few Japanese high schools have fluorescent microscopes, we attempted to develop teaching material for high school students in biology laboratory classes in order to observe the cytoskeletons without using fluorescence microscopes. As a result, microtubules and actin filaments could be observed with student optical microscopes, by using enzyme-antibody technique instead of fluorescence-antibody technique. Also, by using this method, we had a lecture for advanced experiment in high school classes. Through this practice, the students could deeply understand cytoskeletons.

Keywords: cytoskeletons, high school biology, microscopic observation, student's optical microscope,

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Mouse Macrophage Engulfs Color Emulsion Particles: A Study toward the Development of Novel Observation Method for Animal Cells

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Generally, the cells of multicellular animals are more dynamic than the cells of multicellular plants. Observation of living animal cells might be effective for understanding the formation of multicellular animal body. However, such observation experiments are hardly done in secondary schools. This is because most of the schools do not have the facilities and budget necessary for animal cell culture. Therefore, I have tried to develop an inexpensive culture method for the cells. Here, I report the culture technique of mouse peritoneal macrophages without using centrifuge, clean bench and CO_2 incubator. In addition, I introduce the observation method for phagocytosis using color emulsion. The cells were obtained from mouse peritoneal cavity. These were incubated in culture dish with Hanks' balanced salt solution (HBSS) at 37°C for 30 min. Then, adherent cells were used as macrophages. For long time culture of them, the HBSS was replaced with RPMI 1640 medium supplemented with serum. The dish was immediately transferred to a sealed container with a beaker containing sodium bicarbonate solution and incubated. For observation of phagocytosis, the emulsion solution (*New Sakura Color*, Sakura Color Products Co., Japan) was added to the medium at a low concentration. Phagocytosis was confirmed by phase contrast microscopy. Since the color particles have translucent and fluorescent, it could be reconfirmed by combined microscopic observations of bright field, dark field and fluorescence image.

Keywords: *animal cell culture, endocytosis, macrophages, microscopic observation, phagocytosis*

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