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Practical Note

Exploring College Biology Students' Understanding of Experimental Design

Meena Kharatmal, Mayur Gaikwad, Aashutosh Mule and Jaikishan Advani 2

Country Report

Using Live Animals in Biology Teaching and Research – a Comparison between Australia and Japan

Robert Wallis and Nobuyasu Katayama 8

Country Report from AABE India Chapter

Narendra D. Deshmukh 17

Conference Report of the 28th Biennial Conference of the AABE and

Abstracts of the Papers Presented at the Conference 21

From the Editor-in-Chief 61

Practical Note

Exploring College Biology Students' Understanding of Experimental Design

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INTRODUCTION

Experimentation is one of the key features of scientific methods and science teaching. Designing of experiments forms a crucial part in this process. As the design of an experiment reflects the objective and the research question that is being worked on, to design the experiment well is to yield data that either supports or rejects a hypothesis. It is essential for students to develop this ability as well as to understand various parameters, such as control and treatment and to assign variables which involve in their experimentation.

The present study is situated in a lab-based program called Collaboratively Understanding Biology Education (CUBE) that engages students in hands-on experimentation using simple model organisms (Arunan, 2011, 2013: *see Websites*; Arunan and Nagarjuna, 2013; Kharatmal, 2021). Model organisms, such as *Escherichia coli*, *Saccharomyces cerevisiae*, *Arabidopsis thaliana*, *Caenorhabditis elegans* and *Danio rerio*, have been used in the cutting-edge research in biology (Fields and Johnston, 2005), and even in laboratory exercises at school and college levels (Nagasawa and Katayama, 2021). Model organisms

are well suited for biology learning because they can be easily maintained and bred in laboratory settings, have a shorter life span, can produce a large number of offspring, and have a sequenced genome in addition to being well-known among students (Jacobs-McDaniels *et al.*, 2013).

The objective of the present study is to find out in what ways students formulate experimental designs while working on their experiments with two well-known model organisms, fruit fly (VijayRaghavan and Rodrigues, 2008) and snail (Balakrishnan, 2001). The fruit fly, *Drosophila melanogaster*, is probably the most popular model organism for studying genetics (Ray and Lakhotia, 2014). Though the sea snail, *Aplysia californica*, has been used as a model organism in neuroscience research studies, for the present study, we worked with *Achatina fulica*, a terrestrial snail, instead of *A. californica*, due to ease of availability in the local surroundings.

MATERIALS AND METHODS

Subject and schedule of the study

The sample for the current study was eight students involved in two groups of four each for two experiments. They had already been in the

CUBE lab's network and attended part of the discussion on experiments related to model organisms. They were three postgraduates, three second-year undergraduates, and two first-year undergraduate, with an age range from 19 to 23 year-old; five females and three males. Each group had a mix of all genders with a combination of first-year, second-year undergraduates and postgraduates. The postgraduates (microbiology or zoology major) had a research methodology course in their syllabus, while the second-year undergraduates had one paper on research methodology. One staff or a teacher, who was not research member, was assigned to a mentor for each group to guide the students in designing the experiment, doing hands-on activities, *etc.*

On each day of the workshop, the students worked on their experiments for about four hours in the morning and the following four hours in the afternoon were allotted to a discussion session with all the students. During their experimentation, students also worked on trapping, culturing and feeding their model organisms. The discussion session focused on inquiry- and conversation-based approach wherein all the peers took part in questions based on the objectives, hypothesis, and experimental design. As part of their exercise, we asked students to articulate their experiments on the following items:

- Draw and label your experimental design setup.
- Write in detail about the following in the context of your experimental design: Control, Treatment, Dependent Variable, and Independent Variable.

In order to provide their responses to the items, students required progressing in all along their experiment. As we were interested in understanding how students thought about their experimentation process, we sought students written responses after 10 days of their working in lab. Given the time constraint during the workshop,

students were not able to practically complete the experiment to meet the objectives of their study. However, given their interaction period during the workshop, we could study about their understanding about experimental design. All these students provided their individual responses using the paper and pencil task over a period of one and a half hour.

Fruit fly experiment

In the fruit fly group, the students' assigned task was to find out an answer to "*Is there difference in olfactory receptor present in lab-bred and native flies?*"

In this experiment, the olfactory receptor is being tested using a chemical Isoamyl Acetate (IAA) of a specific concentration, 1000-fold dilution with distilled water (DW), on two strains – lab-bred and native fruit flies, *D. melanogaster*. The native flies were collected from the wild. The lab-bred *D. melanogaster*, Canton Special Benzer (CsBz) wild type stock, which was originally procured from Canton's lab, was available to the CUBE lab from Tata Institute of Fundamental Research.

In the particular design of this experiment, the most important parameter that students need to identify first and foremost is the state of larva being in the second stage, or the second-instar larva. Extensive preparedness is ensured by the students where they need to trap the fruit fly first from the local surrounding and culture it by using a medium. Once the fruit flies mate and produce larvae, the students need to identify various stages of the larvae and procure those which are in the stage of second-instar.

The second most important parameter in the design is about the setup of the Petri plates (diameter 9 cm) on which the larvae are placed and DW (control) and IAA (treatment) will be introduced to observe the movement of larvae. This

experimental design is for measuring the olfactory response index (ORI), adapted from Khurana and Siddiqi (2013), of both the strains of larvae. The experimental design requires a setup of four Petri plates, two per each strain, one for control plate (DW on both sides) and the other for treatment plate (DW and IAA on each side). Then approximately 30 second-instar larvae are placed in the center of each Petri plate. After 2 minutes, which side the larvae have moved towards, DW or IAA, is observed. On the control plate, the larvae are expected to move toward both sides at random. The ORI is calculated by using the following formula: $\text{treatment} - \text{control} / \text{treatment} + \text{control}$. This is repeated for both the strains.

Snail experiment

In the snail group, the students' assigned task was "*To study whether the snail has learnt the bitter taste of quinine associated with the good smell of cucumber.*"

The most important parameters are terrestrial snails, a sheet of paper on which 18 cm diameter circle is drawn, a glass plate placed on the paper, DW (control), and a cucumber extract/slice (treatment). For the control plate, DW is placed on both sides of the glass plate and a snail is placed in the center. For the treatment plate, DW is placed on one side and cucumber slice is placed on the other side of the glass plate, and a snail is placed in the center. As the conditioning part, the snail is fed with a cucumber slice laced with quinine extract in order that the snail associates the bitter taste with cucumber smell. This conditioning is done between the two trials. Thus, the experimental sequence is as follows: control – pre-conditioning trial – conditioning – post-conditioning trial. This experimental design to measure the ORI of snail was adapted from Lemaitre and Chase (1997). The ORI is

calculated by the following formula: $\text{treatment} - \text{control} / \text{treatment} + \text{control}$. In the snail experiment, the ORI is measured for both the pre-conditioning and post-conditioning trials.

RESULTS

The independent and dependent variables are the two key variables in a science experiment. In the case of present two experiments, the independent variables are IAA in fruit fly experiment, cucumber/quinine in snail experiment, whereas the dependent variable is ORI in both experiments. A compilation of students' responses on listing the parameters of control, treatment, dependent variable, and independent variable from their experimental designs is shown in Table 1.

Most students (5/8) could think appropriately about control. This could be because, in all the experiments on model organisms, the control was DW. The rest, students F2, F3 and F4, seemed to be confused. Regarding the treatment, most students (6/8) could mention it appropriately. The other two students' (F2 and F4) responses indicate confusion. They mentioned both control and treatment incorrectly: in their drawings of the experimental design, DW and IAA were placed on the same Petri plates instead of two separate plates. Two students (S2 and S3) mentioned the dependent variable in the experiment on snail correctly, possibly without understanding it, because they mentioned the independent variable incorrectly. It was observed that all the students could not understand the independent variable and dependent variable. From the parameters mentioned in regard to the dependent variable, the students were aware that various factors can cause alterations in an experiment, but they did not understand that one factor has to be tested on one occasion.

Table 1 Students' listing parameters in their experimental design.

The parameters that students noted correctly are underlined. Each student is mentioned as a code with respect to the model organism group.

Student	Control	Treatment	Dependent Variable	Independent Variable
Fruit fly Experiment	Larvae with DW	Larvae with IAA	ORI	Extract
F1	<u>DW</u>	<u>IAA</u>	IAA, agar plate, sucrose solution, Ringers solution, larvae, banana peel, temperature, time	DW, number of flies
F2	Ringer's solution, acids	media and bottles autoclaved	time, temperature, light intensity	pH, temperature, humidity
F3	larvae's movement	<u>IAA</u>	temperature, duration of day and night, humidity, light intensity, type of waste	blank response
F4	media preparation	blank response	humidity, temperature, food	water
Snail Experiment	Snail with DW	Snail with cucumber extract	ORI	Extract
S1	<u>DW</u>	<u>extract</u>	using various different samples	using same snail
S2	<u>DW</u>	<u>extract</u>	<u>ORI</u>	sound, place, or location of experiment
S3	<u>DW</u>	<u>extract</u>	<u>ORI</u>	size of setup
S4	<u>DW</u>	<u>extract</u>	animal's orientation	odour of other food stuff, perfume, etc.

DISCUSSION

The explicit understanding of assigning variables in students' experiments seemed a challenging task. In the present study, the usage of the terms, independent variable and dependent variable, possibly got the students confused. The problem was that the students were not able to understand the relationship between independent variable, dependent variable, and control. In order to address this problem, the terms such as independent variable and dependent variable can be replaced with cause and effect in the context of each experiment. This may help students to understand the relation between variables.

There is a need for integrative approach in

teaching and research in all areas of biology in our country (Lakhotia, 2002) through the initiatives of universities-institutes interactions (Arunan, 2011: *see Websites*). Most of the undergraduate colleges in our country provide theory-based courses on research methodology and have separate labs or practicals that have no connection of understanding of experimentation with the theory classes (Vale and Dell, 2009). Apart from this, problems due to absence of basic laboratory exercises form a major limitation for teaching science in universities/colleges. These problems can be resolved by designing and developing simple experiments that can stimulate analysis and thinking abilities of the students and also are feasible even

in remotely located colleges (Lakhotia and Mukunda, 2008). The *National Curriculum Framework on Teaching of Science* recommends for science teachers to emphasize science process skills and scientific method (NCERT, 2006: *see Websites*). The teachers can play a critical role in collaboration with students (AAAS, 2011: *see Websites*; Arunan and Nagarjuna, 2013) in developing modules on the designing of experiments, assigning of variables, *etc.* that complement the research methodology course.

The experimentation not only provides students with a firsthand experience of doing real science, but also enables them to connect with the real world contexts (Nyutu *et al.*, 2019). The understanding of experimental process can be useful for students in developing critical thinking and evaluating the process of science. The practical skills of framing a research hypothesis about the questions, formulating a research design, and assigning parameters, such as control, variables, *etc.* can enable citizens to question pseudoscience and to value the process of science.

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Using Live Animals in Biology Teaching and Research – a Comparison between Australia and Japan

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Whilst their use in biology teaching has reduced in recent decades, live animals are still used extensively in university research and less frequently in teaching in both universities and schools. Both Australia and Japan have followed worldwide trends in ensuring that animal welfare is strongly considered in both teaching and research, and each jurisdiction has similar laws preventing animal cruelty and ensuring integrity in biology education. In universities, appropriate committees exist in both countries to scrutinise animal use. This includes the appropriateness of experimentation, the skills of researchers and teachers, and the quality of animal housing and care. However, while in Japan universities themselves regulate the care and use of animals through relevant Animal Experimentation (and Use) Committees, Australian institutions, and their Animal Ethics Committees (AECs) are audited by State government agencies to ensure adherence to the prescriptions of the National Code. The membership of the committees also differs markedly between the two countries. In both countries, the 3Rs (Replacement, Reduction and Refinement) are guiding principles. In Australian schools, teachers wishing to use live animals for science practicals must seek approval from the relevant State-based AEC although animals used for pets and rearing require no such approval. In Japanese primary schools there is strong interest in animal-assisted education as well as in animal-rearing – the latter emphasising children’s education through assisting animals rather than being a focus on animals assisting education. Teachers are required to consult with veterinarians about proper care and rearing of subject animals. In Japanese senior secondary schools, Biology experiments with animals must only comply with the relevant animal welfare legislation.

Keywords: *animal ethics, Australia, Japan, live animals, research, teaching.*

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INTRODUCTION

Use of living materials in biology teaching has long been recognised to be important in educating students about important aspects of life as well as in carrying out biological research that produces significant outcomes for human welfare and the wider environment. As noted in the *Notice No. 71 of 2006* (The Ministry of Education, Culture, Sports, Science and Technology, Japan, MEXT, 2006, p. 1) “A scientific understanding of the bio-

logical activities of living organisms on the planet is essential for the solution of many issues, including human welfare, and conservation and restoration of the environment. Animal experiments and related activities are necessary and unavoidable for gaining scientific insights into the biological activities of living organisms...”

However, there have been recent and community-driven moves to consider the welfare of animals used in teaching and research and to en-

sure that subject animals are only used when absolutely necessary. The Council for International Organizations of Medical Sciences (CIOMS) and the International Council for Laboratory Animal Science (ICLAS) noted in their revised guidelines (ICLAS, 2015, see Website list): “The use of animals in research, education and testing is an essential component of the advancement of our understanding about human and animal function. This knowledge is important for advancing human and animal health and welfare through disease prevention and cures, new treatments, and drug and device development. The scientific community, understanding that using animals is a privilege entrusted by society, remains committed to ensuring the health and welfare of animals as an integral consideration when animals are used for these purposes.”

This has certainly developed with the acknowledgement of higher animals as sentient beings. As well, religions such as Buddhism view the sanctity of life and treat animals based on the philosophy of *Karma* (Kagiyama and Nomura, 2003) and the reincarnation of beings; such a philosophy can have an important effect on how teachers and scientists treat animals in their use and care. Accordingly, live animals are being used less frequently in the classroom and student learning.

In this paper we will examine the protocols and regulations for using live animals in both teaching and research. We will compare the animal ethics requirements in two countries that have been long-standing members of the Asian Association for Biology Education, Australia and Japan, noting significant similarities but also differences in approaches.

WHAT ANIMALS ARE CONSIDERED?

To a biologist, the term ‘animal’ refers to life that has features that belong to members of the

Kingdom Animalia. Thus, animals are heterotrophic, multicellular organisms that lack cell walls and chloroplasts and, at least at some stage of their life, are motile (Audesirk *et al*, 2020). Their DNA is typically in a membrane-bound nucleus.

However, in Australia and Japan when animal ethics are considered, the term “animal” refers only to certain taxa of higher forms of life. In Australia, regulations only apply to teaching and research that uses live vertebrates as well as members of the class Cephalopoda (octopus, squid, cuttlefish, nautilus) in the Phylum Mollusca (NHMRC, 2013). This latter group is included presumably because of their well-developed nervous systems. Some Animal Ethics Committees (AECs) include other taxa, such as decapod crustaceans (Phylum Arthropoda) and apply this extra group in their institution’s deliberations on animal ethics in the classroom and laboratory.

In Japan, the range of animals that must be considered by Institutional Animal Experiment Committees (IAECs) is even narrower – only mammals, birds and reptiles.

In both countries, all use of live animals must comply with relevant legislation of prevention of cruelty to animals. In Australia, the States and Territories have responsibility of these laws such as the *Prevention of Cruelty to Animals 1986 Act 1986* (Victoria) and *Animal Care and Protection Act 2001* (Queensland). In Japan, there is a national Law, the *Act on Welfare and Management of Animals 1973* (The Ministry of the Environment, 1973, 2007, see Website list). However, even these Acts use a limited definition of “animal”. For example, the relevant Act in Victoria defines an animal as any vertebrate and decapod crustacean, whereas the Queensland Act includes these groups and cephalopod molluscs. In contrast, the South Australian and Western Australian Acts do not include fish (Sharman, 2004, see Website list). The

Act in Japan only covers mammals and birds, including farm and companion animals but excludes wild animals because these are covered by laws and guidelines for wildlife protection and conservation.

RESEARCH USING LIVE ANIMALS

Australia

All use of live animals for research is governed by a national set of regulations outlined in the *Australian Code for the Care and Use of Animals for Scientific Purposes* (referred to as the *Code*) (National Health and Medical Research Council, NHMRC, 2013). This set of rules has been agreed on by relevant parties such as Commonwealth agencies that fund research (NHMRC and the Australian Research Council), all universities, the major Commonwealth research body the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as well as State and Commonwealth government departments. The *Code* is effectively the method implementing the requirements of the Animal Research Act 1985.

All institutions that undertake research using live animals must have a properly constituted AEC in which categories of memberships are defined. Each AEC hence must contain at least one veterinarian who has familiarity with the kinds of research being carried out on animals, a scientist, an animal welfare representative and a community/lay person with no association with animal experimentation or with the institution. If an AEC meeting lacks any one of these members, then its decisions are non-binding until a subsequent meeting can be arranged with the appropriate quorum. For this reason, many AECs (such as at Federation University Australia) have several members in each category. Because of their membership requirements, there are usually more members of an AEC who are external to the university than inter-

nal staff members. Membership of an AEC must be approved by the relevant State government agency – in my case, Animal Welfare Victoria. This body also regularly audits institutions' AECs, their operations, and licenced facilities.

Decisions of an AEC must be unanimous. So, what happens if one member votes against approving a proposal while the remainder approve it? The Chair should try to negotiate a compromise and bring the issue to the next meeting; only then can a vote be taken on the application. Small organisations can access State-run AECs especially established for clubs and other groups, while schools wishing to undertake biology research with live animals must seek approval from their relevant State education department AECs.

Furthermore, animals can only be held at licenced establishments. Many universities would have either an animal house or a facility for holding animals. The university's AEC would have to inspect the facility and approve its use. Similarly, AECs are meant to visit field sites for which they have approved animal work, for example, vertebrate surveys.

Japan

Japanese research institutions including universities are responsible for self-regulation in terms of animal experimentation. Most voluntarily set up an Institutional Animal Experiment Committee (IAEC) that is sometimes called an Institutional Animal Care and Use Committee (IAEUC). Here we use IAEC to cover both types of committees. Typically, IAECs comprise scientists who actively use animals in their work as well as researchers from other fields of study. Most of the members are thus internal appointments.

Whilst there is no regulation of the committees (or equivalent if committees as such are not set up), the National Government and other agencies have strong advisory roles. There are *Stan-*

Standards Relating to the Care and Management of Laboratory Animals 1980 (The Prime Minister's Office, 1980, see Website list), which was amended to *Standards Relating to the Care and Keeping and Reducing Pain of Laboratory Animals* in 2006 and revised in 2013 (The Ministry of the Environment, Japan 2006, see Website list), and *Standards Relating to the Methods of Destruction of Animals* (The Prime Minister's Office, 1995, see Website list). Based on them, *Fundamental Guidelines for Proper Conduct of Animal Experiment and Related Activities in Academic Research Institutions* (MEXT, 2006) and *Guidelines for Proper Conduct of Animal Experiments* (The Science Council of Japan, 2006, see Website list) were produced. As well, the Government has published explanatory documents on the *Standards Relating to the Care and Keeping and Reducing Pain of Laboratory Animals* (The Ministry of the Environment, Japan 2006, 2017, see Website list).

The Japanese Association for Laboratory Animal Science (JALAS), a nongovernment organization of researchers, published the *Guidelines for Animal Experimentation* (JALAS, 1987) and released their opinion very early (JALAS, 1992, see Website list).

The terms of reference for university IAECs are generally similar. For example, the *Regulations on Animal Experimentation at Kyoto University* stipulate that the Committee should be made up of:

- (i) One of the professors and one of the associate professors of each Department that conducts an Animal Experiment.
- (ii) Several professors and associate professors of Departments other than the Department prescribed in the preceding item.
- (iii) Some other persons if deemed necessary by the President.

The Committee described in paragraph 1 shall include at least one member who has excellent

judgement regarding Animal Experiments, at least one member who has excellent judgement regarding Experimental Animals, and at least one member who has other academic knowledge. (Kyoto University, 2020, see Website list).

Ogden *et al*, (2016) provide a useful section on animal laws, regulations, guidelines and standards in Japan and also those in China and Korea.

COMPARING THE TWO SYSTEMS

In both countries, experiments using live animals must abide by the 3Rs, Replacement, Reduction and Refinement (Russell and Burch, 1959). Researchers must also comply with laws relating to animal welfare and prevention of cruelty. Research institutions also have established committees that approve use of live animals in research (Baumans, 2004).

Differences exist, however, in the regulation and oversight of the committees' operations and the institutions' use of animals. In Australia, the presence of AECs is compulsory, and governments inspect licenced research and animal holding facilities as well as audit the AECs. In Japan, organisations self-regulate and there is no compulsory registration or inspections. This is very similar to the situation in the USA and Canada (Kagiyama and Nomura, 2003). As well, Australian AECs must have members who are veterinarians, scientists, animal welfare representatives and members of the general community. There are strict rules on quorums for meetings (each category of membership must be present), voting and consensus protocols and even minimum proportions of each category of members present at each meeting.

Nomura (1995) made an interesting observation: Japanese scientists working with European and Australian colleagues are sometimes frustrated by the more stringent regulatory environments of Western institutions whose members view the

Japanese system as lenient and ambiguous. Kagi-yama and Nomura (2003) also made a point that Japanese more generally have a less exploitative view of animals that is related to their Buddhist philosophy in which all life is considered equally precious.

What are the strengths of each country's systems? In Australia, it could be argued that the regulation assures the community that animal welfare concerns are being addressed and that having such a broad AEC membership ensures that community expectations and standards are being met. On the other hand, it does suggest a level of distrust of scientists. This view is probably unjustified since there have been very few breaches in research of animal welfare laws and standards. There have been cases of hard-line views of certain non-scientist appointees on AECs who believe animals should not be used at all in research. This must be frustrating for researchers as well as the others on that AEC. The Japanese system is thus likely to be more efficient but provide less assurance to the animal welfare lobby that community standards and expectations are being met.

Finally, a lot of the emphasis in the Japanese system is geared to laboratory animals such as rats and mice. The Australian *Code* covers all forms of research, including field-based studies of wild fauna, as well as laboratory animals.

TEACHING USING LIVE ANIMALS

There is debate on the effectiveness of student learning using living versus dead animals. Sherwood *et al.* (1989) found there was no difference in cognitive learning of fourth graders who used live animals compared with dead specimens, but that only using live animals positively increased their affective learning (attitudes and feelings about animals). Nevertheless, use of live animals

in the classroom has been steadily declining in both Australia and Japan.

What then are the regulations for using live animals in the classroom?

Australia

Teachers in universities and schools that use live animals as part of their student learning activities also must abide by laws relating to animal protection and welfare. For universities, the requirements are the same as for research. Thus, the teaching staff (professor/ lecturer) would apply to the university's AEC describing the planned work and must not commence it until approval has been given. Examples at Federation University Australia of teaching projects that have been approved by its AEC include wildlife surveys (how to live trap and release animals as part of teaching about field survey techniques), animal behavioural studies, and handling, shearing, taking care and monitoring of sheep.

For schools, the situation is similar. If experimental (*i.e.* scientific) work is planned, for example in senior Biology classes, then approval from the State-based schools animal ethics committee is also required. As with research, it is the different Australian States and Territories that have responsibility for administering the use of live animals in student learning activities. I will describe the situation in my home State of Victoria as an example, but other states are very similar.

The first step is to ensure the school is covered by a Scientific Procedures Premises Licence. All government schools are covered by the one licence, but private schools would need their individual licence. Teachers would then need to ascertain whether approval was required from the Victorian School Animal Ethics Committee (one committee serves all schools). Some animal rearing activities are pre-approved, but the Committee would still need to be notified of the intended work.

Application for study that disrupts an animal's normal condition or behaviour is also required. Any activity that invasively subjects an animal to pain or survival is banned (Education Victoria, see Website list).

There are several activities that are typically carried out in primary schools that do not require animal ethics approval. These include rearing young animals, introducing companion animals or having pets in the classroom. Chick hatching programs, however, do require ethics approval. Animal Welfare Victoria (see Website list) provides advice to schools on ensuring the welfare of pets in the classroom.

Japan

Using live animals in Japanese elementary school classrooms has been practiced for many years and the MEXT has produced guidelines for housing and using animals for each grade and covering several fields of study (Nakajima, 2017). The Ministry also requires schools to consult with veterinarians on the proper care of animals (Hakui, 2010). "Animals" in this sense only refers to mammals, birds and reptiles.

The MEXT notes that one of the purposes of science teaching is the nurturing of attitudes of love for nature and respect for the life of living things by students. This is clearly stated in the guidelines of the current Course of Study. On the other hand, the Ministry indicates that conducting animal dissections in science learning is important as they help students develop an understanding of the structure and function of animals. Thus the Ministry asks each school to decide whether such practical activities should be conducted, while simultaneously considering respect for the life of living things (According to the Japan Anti-vivisection Association, see Website list).

While the biology curricula in secondary schools contain student research activities (Nakamichi and Katayama, 2018), it is unlikely these

would involve the kinds of animal experimentation that would necessitate approval of a school equivalent of an IAEC.

TEACHING USING PRESERVED ANIMAL SPECIMENS

Unless the animals that are to be used for activities such as dissections are killed on site before or during the class at the institution, no ethics approvals are required for using dead specimens.

Dissecting preserved or freshly killed vertebrates was once common in school and university biology classes but has declined recently as substitute learning resources like videos, YouTube clips, interactive computer games and simulations and models become more widely available (Balcombe, 2000; Iwama *et al.*, 2010; Oakley, 2012). There is now active debate around the ethics of dissection and scholars urge teachers to include discussions about these and the welfare of animals if dissections are to continue (Madrazo, 2002).

CONCLUSIONS

In both Australia and Japan, use of live animals in biology teaching and research is underpinned by the '3Rs'. Animals should be **replaced** using other methods wherever possible. If animals are to be used, then the number of animals used should be **reduced** to the maximum number needed. Techniques used on animals should be **refined** to cause minimal distress.

Researchers in both countries must seek approval for their work from their organisations' relevant authorising committees. In Australia, it is mandatory for organisations such as universities to have an AEC with a designated constituency of mainly members who are external to the institution, whereas in Japan IAECs are only recommended and are usually made up of internal (staff) appointments.

The use of live animals in teaching in both schools and universities in Australia must be approved by an AEC. There is no such requirement in Japanese primary and secondary schools, although it seems experiments using live animals in both countries are uncommon nowadays. In both countries, no approvals are required for animal care and companion and pet animals in classrooms.

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Country Report

Country Report from AABE India Chapter*

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India organized the 12th Biennial Conference of the Asian Association for Biology Education (AABE) in New Delhi in 1988, and the 26th Biennial Conference of the AABE at Goa from 20 to 23 September 2016 (Figure 1, from AJBE vol. 9, p. 11).

During this conference AABE India Chapter was formed (Deshmukh, 2019). Under the umbrella of AABE, India Chapter has been working actively in biology education from kindergarten to college level. Many members of the AABE India Chapter are doing wonderful work in the area of biology education on their individual level. In addition, we are trying our best to work together and disseminate our AABE activities among Indian students, teachers and researchers. The President and other Executive Committee (EC) members of our AABE India Chapter also participate in the publication of AABE journal (AJBE) and other AABE activities.

Recent Activities

Since March 2020, because of COVID 19, there was a total lockdown all over the India. During this pandemic period we conducted various activities (both online and offline modes) related to life sciences for school students and teachers (Figure 2), such as project-based learning (PBL) on measurement of leaves (Figure 3) and model making by means of dough (Figure 4), and activities on detection of soil pH (Figure 5) and chromatography (Figure 6).

The AABE India Chapter has been organizing interactions with scientists, science teachers' workshops, Science Village, science film screenings and a Science Film Competition and Exhibition every year (Figure 7). Our team members actively participated in these activities and demonstrated science activities, conducted session on microscopes, delivered various lectures on health, environment and life science topics, etc.



Figure 1: Attendants of the 26th Biennial Conference of the AABE at Goa

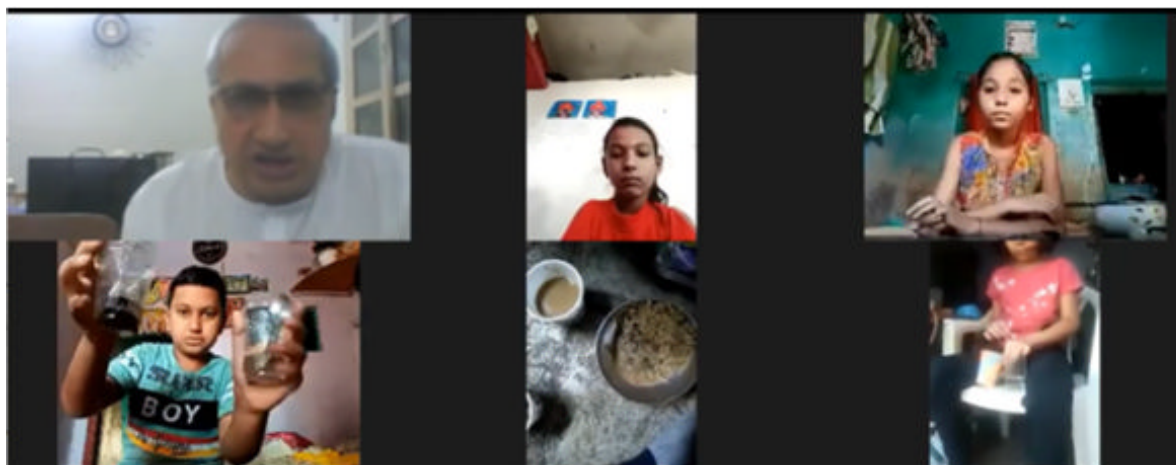


Figure 2: Online workshops for students

Picture of leaves	Name of leaves	Length of leaves	Type of leaves
	Coral Jasmine	7.1 cm	Simple leaf
	Tulsi	1.9 cm	Simple leaf

Figure 3: Project based learning - Measurement of leaves



Figure 4: Project based learning - Model making



Figure 5: A school level activity – Detection of soil pH



Figure 6: A school level activity- Chromatography

Under the umbrella of Discovery Science Exploratory we conducted various biological sciences activities for school students, teachers and community (Figure 8).

We also conducted teachers’ workshops on various biological topics, such as online tools for biology education, virtual biology practical, careers in life sciences, COVID awareness, etc. In



Figure 7: Science Village (left) and Science Film Competition and Exhibition (right)



Figure 8: Demonstration of sciences activities for school students, teachers and community

collaboration with other organizations we have been working on various biology-related projects and conducting seminars, workshops and research activities for students and teachers. Similarly, our AABE members conducted and actively participated in seminars, conferences and workshops, such as

- September 6, 2019, 'CUBE-STEM Meet', Acharya Narendra Dev (AND) College, University of Delhi;
- November 4-5, 2019, National Conference on Insect Plant Biology in 21st Century, Deshbandhu College, University of Delhi;
- February 22-28, 2022, International e-Conference on Mitigating Contemporary Environmental Issues by Sustainable Approaches (ICMCESA-2022), AND College, New Delhi;

- October 16-17, 2020, International e-conference 'NeuroEunoia 2020: A Neuroscience Affair', organized by Gargi College, University of Delhi.

In India there are various state and national level associations, institutions and organizations which are working in biological sciences, life sciences, health sciences, environmental sciences and agricultural sciences from KG to PG level. Apart from state and national level research laboratories, universities and colleges, state and national level associations and organizations are involved rigorously in biology education, research, training and material development.

The Homi Bhabha Centre for Science Education (HBCSE) is the nodal centre of the country for Olympiad programmes in mathematics and sciences including astronomy. Indian National Biology Olympiad (INBO) is for students studying in

Classes 11 and 12. The selected Indian teams undergo a rigorous training programme at HBCSE in theory and experiment.

The National Association of Biology Teachers empowers educators to provide the best possible biology and life science education for all students. *IndiaBioscience* is facilitating networking of undergraduate teachers in life sciences to share their ideas, experience and expertise in pedagogy and research (Figure 9).



Figure 9: IndiaBioscience-Manual

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Conference Report of the 28th Biennial Conference of the AABE and Abstracts of the Papers Presented at the Conference

The 28th Biennial Conference of the AABE (AABE28) was held as a virtual convention from the 28th to 30th, April 2022.

The conference was organized cooperatively by AABE (Executive Director: Prof. Dr. Kiyoyuki Ohshika) and BIOTA (Biology Teachers Association of the Philippines; President: Marie Christine M. Obusan, Ph.D.). The main theme of the conference was “Biology Research and Education in a Changing World: Recalibrating under the New Normal.” Five hundred people, more or less, attended as auditors on a Zoom platform free of charge. They could freely give a comment or a question to each presenter by using the chat function of the software.

At the Opening Ceremony of the conference, the presidents of both organizations gave their welcome messages, and then Dr. Diosdado M. San Antonio, the Undersecretary for Curriculum and Instruction at the Department of Education, Philippines, gave a keynote address.

In the conference, there were four Plenary Sessions, five Country Reports, one Seminar Lecture Session, one Virtual Interactive Session, in which Poster Presentations and BioTakTik were carried out simultaneously, and a Young Biologist Forum. The BioTakTik and Young Biologist Forum were of BIOTA events. In Table 1, plenary lectures, country reports, seminar lectures and poster presentations are listed.

Six persons were invited as plenary speakers: Mr. Joel Bautista, Chief, Knowledge Innovation Division, Philippine Science High School System, Department of Science and Technology, Philippines; Professor Robert Wallis of Federation University, Australia; Professor Shigeki Mayama of Tokyo Gakugei University, Japan; Professor Ernelea P. Cao of the University of the Philippines-Diliman, Philippines; Dr. Kwan Siew Wai, National Secondary School, Malaysia, and Mr. Yves Miguel Zuniga, Co-Founder and Deputy Director of Mental Health PH, Philippines.

The Best Presentation Awards were given to G. E. Santos *et al.*, R. J. D. Flores *et al.*, and J. G. Campang *et al.* for lectures, and R. A. A. Calpo *et al.*, M. R. B. Pineda-Cortel *et al.*, and G. Katayama *et al.* for posters.

<Convention Theme & Rationale>

Biology Research and Education: Recalibrating the New Normal

The COVID-19 pandemic caused massive changes, that happened rapidly and abruptly affecting people’s daily lives. For Biology educators, a major challenge is the shift of the learning environment from face-to-face to online. As educators, we need to ensure a seamless adjustment for our students to ensure effective and efficient instruction. Within the two years of the pandemic, we have come to realize that what normally works in the face-to-face mode may not necessarily do so in online learning mode. Thus, the “new normal” of teaching requires not only planning and preparation but also in the degree of expertise of using adaptive teaching-learning tools. For effective teaching in the new normal, it is imperative that students are actively engaged – an essential consideration for educators in developing their instructional design. Amidst the challenges of the new normal, we see varied opportunities arise in the scientific community. There are new ways to connect new applications for teaching and research, as well as new and more opportunities for collaboration that transcend not only borders, but even pandemics. Thus, we have observed during virtual meetings and connections which are easier and more effective than previous in-person versions. Adapting to the “new normal” can greatly affect our works in the future. It is likely that these ways we did to overcome this global crisis, like the way we communicate and connect with one another, will change more permanently even when life’s goings-on proceeds to hopefully a “better normal”.

Table 1: List of lectures and presentations

Author and Title	Page
Plenary lectures	
Bautista, J.: Haynayan AR: An augmented reality-based gamified lesson for cell biology and basic microscopy for high school	25
Wallis, R.: Using live animals in biology teaching and research: a case study of two countries and how the 'new normal' might develop post-COVID	26
Mayama, S. : Simulation-based science learning promotes global competencies in biology education	26
Cao, E. P.: Future proofing biology research and education: lessons from the COVID-19 pandemic	27
Wai, K. S.: Borderless classroom: A case study of biology teaching and learning in Malaysia during pandemic time with professional learning community (PLC)	27
Zuniga, Y. M.: Mental health and education during the pandemic from #Mental Health PH	28
Country reports	
Cheang, C. C.: The improvisation of Hong Kong biology educators in response to COVID-19: Country report of Hong Kong SAR, China	28
Deshmukh, N. D.: Country report from Asian Association for Biology Education, India Chapter	29
Ohshika, K.: Direction and characteristics of biological education in the new curriculum of Japan	29
Ramos, J. D. A.: Challenges and opportunities on the practice of biology education and research in the Philippines during the COVID-19 Pandemic	29
Tandhanskul, A.: Direction and characteristics of biological education in the new curriculum of Thailand	30
Seminar lectures	
Banaay, C. G. B.: Leveraging remote learning for advancing ecological concepts for a sustainable food system	30
Solar, N. J. B. & Moreno, R. B.: Quality evaluation of wine from native white pomelo (<i>Aurantium decumana</i> (L.) M.)	30
Santos, G. E., Nicdao, M. A. C., Bagunu, J. V., Totaan, E. V. & Micalat, A. F.: Isolation, characterization and molecular identification of lactic acid bacteria from cockroaches: Implication to poultry industry	31
Bacani, M. R. B., Arangorin, L. A. & Alfonso, R. B.: Growth of selected vegetable crops on mined-out soils from Sta. Cruz, Zambales inoculated with <i>Pseudomonas putida</i> BIOTECH 1507	31
Degamon, L. S.: Carapace length–weight and carapace width–weight relationships of <i>Thalamita crenata</i> from Siargao Island, Philippines	32
Funa, A. A. & Prudente, M. S.: Teachers' perceived knowledge, attitudes, and behaviors on sustainable development: focus on pili (<i>Canarium ovatum</i>)	32
Bawingan, P. A., Montevirgen E. M. Jr., Canuto, P. P. L., Lucas, L. E. & Pumaras J. C.: Plant identification mobile apps: Reactions and difficulties encountered by users	32
Patubo, R. S. & Macugay, E. B.: Gamified approach in teaching life sciences: Its effect on students' engagement and performance	33
Tsuzuki, I. & Matsuda, R.: Use of mobile microscopes in Cambodian high school biology class – potential as inquiring observation tools	33
Capilitan, S.: Designing citizenship science and project-based learning +1 pedagogy modules in teaching Philippine ecology and biodiversity	34
Nakamichi, T. & Saigo, T.: Revised biology textbook features for the latest course of study in Japan	34
Iwama, J. & Matsubara, S.: Educational significance of “fish dissection” in elementary school science education	35
Daganasol, R. O.: A scoping review on the students' misconceptions in natural selection	35
Avila, A. C. G. & Martin, A. R.: Exploring students' creative confidence in disaster readiness and risk reduction using design thinking-based lessons	35

Okamoto, G.: Key concepts of the revised Course of Study can change upper secondary biology classes	36
Sano, H.: Effect of evaluation on students in inquiry basic biology class in Japan	36
Rau, K., Uppaluri S., Sriram, D. U. & Mukherjee, J.: Using a capacities based approach to teach undergraduate biology	37
Villanueva, J. C. P. M., Lagunzad, C. G. B. & Libatique N. J. C.: Demonstration of the enriched virtual model in teaching respiratory system using an open educational resource-based mobile learning cloud network	37
Bisht, N. & Janakivalli: Experiential learning-biology teaching at secondary and senior secondary school	37
Deshmukh, N. D. & Shrouthy, V. A.: The role of gamified e-quizzes on student learning: an interactive gamification solution for a formative assessment in science education	38
Flores, R. J. D., Banaay, C. G. B., Macandog, D. M., Adorador, Z. M., Lambio, I. A. F., Pleto, J. V. R., Beringuela, R. T., Ma. Tiquio, G. J. V., Maranan, F. S., Deyto, R. C., Lit, I. L. Jr. & Dupo, A. L. B.: Planetary health as a transdisciplinary lens for biology education in the new normal	38
Ariola, J. N. & Guiriba, A. B.: Status of the seagrass and seaweed beds in Albay Gulf, Bicol, Philippines	29
Capilitan, S., Lamoste L., Ramallosa, J. M. & Retone L. E.: Determining the spatial distribution of urban and non-urban birds in NCR, Philippines, prior and during COVID-19 lockdown using eBird data	39
Campang, J. G., Pleto, J. V. R., Diaz, J. M. S. & Magcale-Macandog, D. B.: Assessment of fish diversity and distribution and water quality in lakes Caliraya and Lumot in Laguna, Philippines	40
Sumayao, E. D., Felicio, F., Bodanio, C. & Alejandro, B.: Identification and assessment of benthic foraminifera in Biliran Island, Philippines	40
Murillo, C. R.: Avifaunal diversity in selected areas of Central Mindanao University, Musuan, Bukidnon	40
ePosters	
Mesa, M. J. O. & Pondevida, H. B.: Ethnobotanical study and phytochemical screening of selected medicinal plants in Agusan del Sur	41
Funa, A. A. & Prudente, M. S.: Teachers' perceived knowledge, attitudes, and behaviors on sustainable development: focus on pili (<i>Canarium ovatum</i>)	41
Abastillas, M. K., Bagolcol, T. J., Buro, P., Gayoba, M. I., Segurada, J., Deocampo, J. E. Jr. & Caipang, C. M. A.: Anesthetic response of freshwater ornamental fish to sodium bicarbonate	42
Deocampo, J. E. Jr., Fenol, J. T., Paguntalan, G. S., Jimenez, A. G. M. & Caipang, C. M. A.: Utilization of plant wastes for biofloc production during the culture of ornamental fish	42
Arabaca, M. L. C., Sanchez J. M. B, Tornalejo J. A., & Taunan V. O.: Morphological and molecular identification of cave cyanobacteria	42
Naive, M. A. K., Demayo, C. G., Alejandro, G. J. D., & Yu, W.-B.: Deciphering the first complete plastid genome of the genus <i>Etilingera</i> : genome structure, comparative and phylogenetic analyses within family Zingiberaceae	43
Caipang ¹⁾ , C. M. A., Trebol, K. M. P., Abeto, M. J. S., Coloso, R. M., Pakingking Jr., R. V., Calpe, A. T. & Deocampo Jr., J. E.: Sustaining the Shrimp Aquaculture Industry in the Philippines through the Use of Biofloc Technology during the Nursery Production Phase in Tanks	43
Suan, K. A. P. & Campilan, J. R. H.: Behavioral study on <i>Hirundo rustica tahitica</i> (barn swallow) in Koronadal City	44
Ordanel, A., Andallon, J., Gangoso, S. J., Pacifico, R. M., Sarabia, J. A., Fenol, J. T., Deocampo, J. E. Jr. & Caipang, C. M. A.: Rapid screening of probiotic candidates from brackish water enriched with organic sources with high carbon to nitrogen (C:N) content	44
Cataluña, E. M., Arabaca, M. L. C., Tornalejo, J. A., Yerro, E. B. S, Deocampo, J. E. Jr., Fenol, J. T. & Caipang, C. M. A.: Screening of bacteria from a freshwater river in Iloilo City as potential sources of bioplastics production	44

Estampador, F. R. F., Esteva, M. S. D. S., Garcia, N. F. G., Baylousis, D. C. G., Dagamac, N. H. A. & dela Cruz, T. E. E.: Home-based research with slime molds: natural and synthetic substrates as spore traps of myxomycetes	45
de Venecia, L. M. L., Cristal, M. L. D., Pecundo, M. H. & Gazo, S. M. T.: First survey of slime molds in mangrove forests of Negros Occidental, Philippines	45
Caporal, E. J. S., Cawaling, C. L. E., de Guzman, A. M. M., Reyes, R. T. S., Tambalo, L. J. T., & Salut, Z. T.: An investigation on the microplastic contamination of <i>Oreochromis niloticus</i> present in Laguna de Bay	46
Balana, M. R., Obias, J. F., & Artiaga, K. E. M. O.: Media optimization using synthetic foliar fertilizer on tissue culture taro (<i>Colocasia esculenta</i> (L.) Schott)	46
Cauguiran, R. Jr., Cabral, S. S., Cunanan, M. G., Lorenzo, M. R. B., Suba, M. dL., Tabangay, L. G., Pineda, J. S. & Pagulayan, R. C.: Preliminary survey of urban trees along Friendship Circumferential Highway	47
Montemayor, O. Q., Cabral, S. S., Lorenzo, M. R. B., Pineda, J., Suba, M. dL. & Pagulayan, R. C.: Carbon content and capture potential of rain trees along Filipino-American Friendship Highway	47
Mercado, A. C. T., Cabral, S. S., Lorenzo, M. R. B., Pineda, J., Suba, M. dL., Malong, E. A. C. & Pagulayan, R. C.: Assessment of the selected ecological and socio-cultural conservation values of urban trees in Friendship Highway	48
David, R. E. P., Cabral, S. S., Lorenzo, M. R. B., Pagulayan, R. C., Pineda, J. S., Suba, M. D. & Tan, Z. S.: Stomatal characterization of rain trees (<i>Albizia saman</i> (Jacq.) Merr.) along Fil-Am Friendship Highway, Angeles City, Philippines	48
Calpo, R. A. A., Bautista, J. L. C., Jardiolin, J. G., Abellanosa, E. A. M., Mayor, A. B. R., Devanadera, M. K. P., Nuñez, O. M., Acuña, D. C., Santiago-Bautista, M. R., Peña, G. T. & Guevarra, L. A. Jr.: T's for fears: Anti-anxiety activity of Philippine tarantula venom	48
Katayama, S., Sawakami, K. & Tateno, M.: Effect of phosphorus leaching from <i>Fallopia japonica</i> litter on volcanic ash soil in cool-temperate zone	49
Rotulo, J. J., Labrador, A. M., Aquino, C. A. P., Mamawag, K. B. & Devanadera, M. K. P.: Identification of bacterial community and morphology of skin ulceration disease in sea cucumbers (<i>Holothuria scabra</i>)	49
Dumaguít, E. A., Iligan, H. E., Nuenay, D. G. & Ronquillo, C. A.: Assessment of knowledge, attitude and practices on solid waste management in the province of Dinagat Islands	50
Barbaso, P. A. P., Castro, A. E. & Obusan, M. C. M.: Water quality index as a tool for assessing and monitoring Laguna de Bay from 2020-2021	50
Asenjo, S. B. C., Gerona, R. N., Miñoza, M. S., Jarapan, G., Flores, C. M.: Coin-operated water vending machines: bacterial contamination analysis	51
Arbas, R. S., Cayabyab, I. M., Dimalanta, A. Z., Guevarra, J. C. G., Mañalac, A. R. S., Ocampo, K. S., Vallo, J. S. & Tiongco, R. E. G.: A meta-analysis on the effect of metformin vs. pioglitazone monotherapy on plasma adiponectin levels	51
Atienza, J. J. R., Arcinue, R. J. A., Butalid, M. D. A., Maristela, M. M. B. De Grano, R. V. R. & Labrador, A. M.: Inhibitory property of triterpenoid saponins from <i>Holothuria scabra</i> (sea cucumber) against matrix metalloproteinase-1 <i>in silico</i>	52
Gaceja, K. V., Ancheta, Z. F. R., Buna, A. C. A., Clarenco, S. M. S., Garrido, M. A. R. & Ramos, J. D. A.: Association of Interleukin-13 gene single nucleotide polymorphism rs1800925 with allergic asthma in Asian population: A meta-analysis	52
Lasta, S. Lo, Tiongco, R. E. & Pineda-Cortel, M. R. B.: Oxidative stress level among Filipino women with gestational diabetes mellitus	53
Mamerto, T. P., Gaus, N. L., Suratos, T., Perez, C. M., Javier, C. J. & Pineda-Cortel, M. R. B.: Nutritional assessment of daily dietary intake during pregnancy in pre-pandemic period	53
Aguinaldo, R. A. G., Castillo, S. M. J., Emlan, J. K., Gomez, A. C. G., Crisostomo, A. B. C. & de Grano, R. V. R.: <i>In silico</i> evaluation of caffeic acid from coconut husks as an inhibitor of factor Xa	53

Pineda-Cortel, M. R. B., Bunag, J. A. A., Mamerto, T. P. & Abulencia, M. F. B.: Transcriptome analysis reveal distinct potential biomarkers for gestational diabetes mellitus	54
Valdez, N. C., Borromeo, V. L., Chong, C. C. & Mazahery, A. F.: Molecular docking analysis of flavonoids reveal eriodictyol's potential for breast cancer treatment	55
Caidic, I. M. L. & Fabonan, C. J. P.: Froguets as an Edtech tool for teaching anatomy in a grade 9 online class	55
Arangote, R. J. C., Dela Paz, T. A. M. & Vinarao, P. M. G.: Offline-online submission and assessment system (ASAS) chatbot as an e-tool on retrieval of learners' outputs in earth and life science	55
Yerro, E. B. S., Kinamot, V. B., Yerro, P. D. & Caipang, C. M. A.: Understanding mitosis through hands-on activity using onion root tip slide preparation	56
Muko, H., Kodama, A., Kitamoto, K., Ikeda, T. & Miyauchi, K.: Case study of utilization of social education facilities in biological education	56
Antalan, J. J. T. & Bautista, J. T.: Preliminary implementation and evaluation of Haynayan AR app in PSHS-CLC biology and integrated science classes	57
Torres- Reyman, C. M. A. & Palatan, J. M.: Effects of COVID-19 pandemic in choosing biology related careers among graduating STEM students	57
Sawa, T., Okumura, Y., Matsutani, H. & Nakamatsu, Y.: Practice by university students supporting observational and experimental classes using insects	58
Kaga, T.: Development of natural science books for international students from English-speaking areas and kanji (Chinese characters) using areas	58
Katayama, T., Nozaki, M., Tanaka, S. & Hino, M.: Study on observation method of cytoskeleton by microscope in high school	58
Acut, D. P., Acut, E. P., Espinosa, J. E. C., Malayao, S. O. Jr. & Magsayo, J. R.: Computer-based simulations as learning tools in biology labs during COVID-19 pandemic: Salient findings and implications	59
Funai, H., Hikita, K. & Kato, J.: Development of experimental class of TCA cycle by Thunberg tube for Japanese high school biology	59
Takeuchi, J. S., Sasaki, H. & Kado, S.: Use of polarized light microscopy to observe crystalline substances in the biomineralization processes	60
Phen, S., Mam, C. & Kato, J.: The methods of recovering and inducing vine-less phenotype by gibberellic acid treatment in common bean (<i>Phaseolus vulgaris</i> L.) used for experimental class of high school biology	60

Note: The abstracts below are reprinted from the Conference Programme and Abstracts booklet of the AABE28 and compiled as a part of this conference report. Therefore, each abstract is not treated as a published article.

<Plenary Lectures>

Haynayan AR: An Augmented Reality-Based Gamified Lesson for Cell Biology and Basic Microscopy for High School

Mr. Joel BAUTISTA

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Information Communications Technology (ICT) - infused lessons have been proven to significantly

enhance the learning achievements in various disciplines. Meanwhile, the pandemic has caused disruption in the learning of the students. Most schools have adopted blended and remote learning. In Education 4.0, schools are relying on technology and among these educational technologies are Augmented Reality, Gamification, and Mobile-first Learning. These educational technologies are gaining popularity given their accessibility and advantages. This study sought to design and develop an Augmented Reality-based and gamified learning

Tool for Cell Biology and Basic Microscopy. It aimed to assess the developed learning tool in terms of learning achievement. The project employs methods such as a technology acceptance model for our users and a pre-post testing approach to assess learning outcomes. Our findings conclude that Augmented-Reality based learning tools significantly enhance the learning achievement of students. Moreover, the study suggests that capability training for teachers on the use of such emerging technologies will be beneficial.

Keywords: augmented reality, cell biology, education, educational technology

Using Live Animals in Biology Teaching and Research: a Case Study of Two Countries and How the ‘New Normal’ might Develop Post-COVID

Prof. Robert L. WALLIS

Federation University Australia

Whilst their use in biology teaching has reduced in recent decades, live animals are still used extensively in university research and less frequently in teaching in both universities and schools. Both Australia and Japan have followed worldwide trends in ensuring animal welfare is strongly considered in both teaching and research and each jurisdiction has similar laws preventing animal cruelty and ensuring integrity in biology education. In universities, appropriate committees exist in both countries to scrutinize animal use, appropriateness of experimentation and researchers and teachers and quality of animal housing and care. However, while in Japan universities themselves regulate the care and use of animals through relevant Animal Experimentation Committees, Australian institutions, and their Animal Ethics Committees (AECs) are audited by State government agencies to ensure adherence to the prescriptions of the National Code. The membership of the committees also differs markedly between the two countries. In both countries, the 3Rs (Replacement, Reduction and Refinement) are guiding principles. In Australian schools, teachers wishing to use live animals for science practical must seek approval from the relevant State-based AEC although animals used for pets and rearing require no such approval. In Japanese primary schools there is strong interest in animal assisted education as well as in animal-

rearing – the latter emphasizing animals assisting children’s education rather than being a focus on education through assisting animals. Teachers are required to consult with veterinarians about proper care and rearing of subject animals. In senior secondary schools, Biology experiments with animals must only comply with the relevant animal welfare legislation. The COVID-19 pandemic has seen changes in the way teaching and research is carried out. There have been declines in on-campus research and teaching and in Australia, losses of key university staff. The long-term effects on how live animals are used in biology education and research could be significant.

Simulation-based Science Learning Promotes Global Competencies in Biology Education

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Under the coronavirus pandemic, education using ICT has accelerated worldwide. The keyword of the New Normal in education is the use of ICT. A simulation using ICT has the potential to strongly promote the science competencies that are fostered in the process of inquiry, since the simulation can repeat the hypothesis testing cycle in a short time. In complex systems with wide deviations, such as the relationship between the environment and organisms, simulation allows students to understand the cause-and-effect relationship as a hands-on experimental model. ICT is excellent for transmitting, collecting, and sharing information. Today, where cross-disciplinary education such as STEM and ESD is promoted, the use of ICT is effective to solve global problems from a scientific perspective. I have been conducting the SimRiver project using ICT in biological/environmental education for 21 years. The simulator allows students to manipulate various parameters in a river basin; including land use, human populations, seasons, and sewage treatment. Based on the environmental parameters selected, microbial species communities are produced by the program. Students can quantitatively and qualitatively evaluate these species communities to measure water quality. Environmental variables can then be adjusted producing a new simulated species community, allowing students to discover the resulting change in water quality. In addition, reproducing a

simulated species community similar to that of a specimen collected in the past or in another country also allows students to infer the basin environment of the river from which the specimen was collected. Global competency can also be fostered by combining the simulation with activities such as viewing photos and videos of rivers around the world, both past and present, prepared online, and students' own searches for various actions to improve water quality. Reflecting on my experience to date, I will address the problems that have arisen each time and how they could be improved.

Keywords: environmental disturbance; global competency; river pollution; science competency; simulator

Future Proofing Biology Research and Education: Lessons from the COVID-19 Pandemic

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The COVID-19 pandemic has affected our daily lives, including how we conduct our research and educational activities. However, COVID-19 may have just triggered or hastened what should have been targeted to be the thrust of many biological researches and even educational trends. The developments in information and digital technology find its way into many biological researches, foremost of which is in the field of bioinformatics. Here I share my own researches on the mining of genes involved in bioremediation as well as secondary metabolites found in some local cyanobacterial isolates, and the bioinformatics tools that can be worked on remotely. Information and communication technology also drives online learning, which has been shown to be the safest means of conducting learning activities during a pandemic. In terms of our students, we are dealing now with what we call as the Gen Z, people who have been borne with technology literally in their hands, from mobile devices, social networks and the internet, hence, a change also in the approach to teaching and learning. However, challenges in internet availability and/or stability have plagued our students and even teachers during the last two years of online learning. Now more than ever, the need for government to establish the necessary infrastructure to provide and improve internet

connectivity for every Filipino becomes more apparent and felt. With the availability of a reliable internet service, a hybrid system whereby some classes can be conducted online such as lectures and exercises can be implemented, while the needed laboratory skills especially for biology such as molecular and microbiological techniques, microscope and dissection skills, field and sampling procedures can be taught face-to-face. In this way, people can work and study anywhere and anytime while online without transportation issues and even time lost from traffic in congested areas within the country.

Borderless Classroom: A Case Study of Biology Teaching and Learning in Malaysia during Pandemic Time with Professional Learning Community (PLC)

Dr. Kwan Siew WAI

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Despite the hectic which COVID-19 created since 2020, it indeed promoted great advancement in teaching and learning. Over the years, educators were working together in making lessons interesting and achievable by learners, especially learners in rural areas. Somehow, due to many constraints like location, finance, transportation, accessibility and facilities, the effort seemed not rewarding as it was planned. In 2020 and 2021, schools were locked down, resulting in the mushrooming of virtual classes. In Malaysia, led by the Ministry of Education, followed by Local District Education Departments, schools, educators and other partners, various materials for virtual classes were enhanced and developed. This seemed to facilitate a borderless classroom, especially for biology lessons. With the high acceptance of virtual classes across the multicultural society in Malaysia, Biology teachers collaborated in conducting borderless classrooms with the Professional Learning Community (PLC) Programme. Through PLC, teachers from various locations of Malaysia collaborated in conducting biology virtual classes. Learners benefited through attending lessons guided by a few teachers which was totally different from the normal way of teaching and learning as we used to be. Teachers too, learned from each other through PLC and enhanced their content knowledge and teaching methods. On top of that, individuals or organizations also reached out to teachers through

PLC to assist in conducting virtual lessons. Joining hands of individuals and organizations from different levels, learners were scaffolded with the knowledge and skills needed for biology. The limitations in reaching to more learners seemed broken. More research is needed to develop a better model of virtual classroom and a feasible virtual assessment method. Perhaps, a hybrid form of classroom could be introduced in the near future for biology study.

Mental Health and Education during the Pandemic from #Mental Health PH

Mr. Yves Miguel ZUNIGA

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Mental Health PH, Philippines*

Mental health challenges have become inevitable in the face of this unprecedented pandemic. As a country, we have witnessed how everyone can be vulner-

able to mental ill-health with prolonged physical isolation and social distancing. This is on top of the fact that we are currently confronted with a so-called education crisis. The limited mobility and the series of longstanding lockdowns have diminished the children's learning spaces. Today's students have also been denied opportunities for social connections, among others. There is a need to hit that red button and make everyone realize the gravity of the situation – we're now headed to a double-headed crisis and we need to address this the soonest. As shapers of tomorrow's nation builders, what effective ways can we implement across different target groups? Who else needs to be in the room to reverse the course of this crisis? This plenary talk hopes to shed light on the current state of education and mental health in our country and elucidate recommendations moving forward.

<Country Reports>

The Improvisation of Hong Kong Biology Educators in Response to COVID-19: Country Report of Hong Kong SAR, China

Dr. Chi Chiu CHEANG

The Education University of Hong Kong

The COVID-19 pandemic measures substantially affected the Hong Kong education systems over two years. The learning and teaching of Biology in local secondary schools have been greatly hindered by the occasional suspension of face-to-face teaching in Hong Kong. The school-based assessment (SBA) of the major public examination, Hong Kong Diploma of Secondary Education (HKDSE), have been even canceled for the past years. To respond to the constraints imposed by COVID-19, there was an accelerated popularization of electronic learning (*e-learning*) in the educational sector. Other than conducting online real-time lectures, some new educational modules unitizing Virtual Reality (VR) have been developed by educational organizations to substitute the authentic learning in the field trip. The presentation would report a case study of such a VR-based module which has been tested in the tertiary institution for training the pre-service Biology teachers. The students agreed in the survey that the learning

experience through VR-based module is not comparable to authentic field experience, and yet it could be a contingent measure in responding to the COVID-19 situation and a potential resource for self-directed learning in the future.

Country Report from Asian Association for Biology Education, India Chapter

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AABE India Chapter: In 1988, 12th Biennial Conference of the Asian Association for Biology Education (AABE) was organized in Delhi. After 1988, we organized 26th Biennial Conference of the AABE, at Goa from September 20-23, 2016. During this conference we formed AABE's India Chapter. Under the umbrella of AABE, India Chapter, we will work more rigorously in biology education from school to college level. Our AABE India Chapter's many members are doing wonderful work in the area of biology education, on their individual level. However, I am trying my best to work together and disseminate our AABE activities among Indian students, teachers and researchers.

List of Activities: Since, March 2020 because of

COVID 19, there was a total lockdown all over the India. During this pandemic period we (Dr. Sneha Gogte, Dr. Vishvanth Gogte, Dr. Sandhya Thakur, Dr. Meena Patange and myself) conducted various life sciences related activities for school students and teachers. We also conducted teachers workshops on various biological topics, such as: model making in learning biology, online tools for biology education, virtual biology practicals, careers in life sciences, Covid awareness, etc. In collaboration with other organizations we have been working on various biology related projects, workshops and activities. Our AABE, India Chapter's EC members are also associated with our journal peer review work and other activities. As AABE country representatives, Dr. Gogte and myself are actively participating in our online discussion and trying our best to support our AABE activities and mission.

Direction and Characteristics of Biological Education in the New Curriculum of Japan

Prof. Kiyoyuki OHSHIKA

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In 2017, the new Course of Study in Japan was revised. In this revision, it was decided to develop the qualities and abilities of children and students with the aim of developing sustainable leaders. Regarding biological education, evolution was positioned at the center of the concept of life, and the curriculum was constructed with commonality and diversity as the pillars of learning. The learning content in junior high school changed from the conventional learning based on animals and plants to the classification of organisms, structure and physiology, reproduction and evolution, and grade progress. In high school curriculum, there has been a major change from traditional knowledge acquisition learning to learning to understand the concept of life through scientific inquiry through experiment and observation. The new high school curriculum will start in 2022.

Challenges and Opportunities on the Practice of Biology Education and Research in the Philippines during the COVID-19 Pandemic

John Donnie A. RAMOS, Ph.D

BIOTA-Philippines Immediate Past President

The COVID-19 pandemic has disrupted almost

every aspect of human life including the educational systems. In the Philippines, varying levels and scope of national and local lockdowns resulted to partial to total closures of schools and universities across the country for more than two years now. Philippine educational institutions were forced to implement drastic teaching and learning strategies ranging from distance modular learning in a blended to fully online environment where most teachers are unfamiliar with. Teachers have to implement blended or fully online learning strategies despite the limited training, lack of resources, low internet bandwidth, and the distractions brought by the fear of uncertainties due to the pandemic. The Department of Education (DepEd) of the Philippines developed and implemented the Basic Education Learning Continuity Plan (BE-LCP) in response to the challenges of the COVID-19 pandemic. The BE-LCP key elements include the streamlining of the Kindergarten to Grade 12 Curriculum into the Most Essential Learning Competencies; implementation of multiple learning delivery modalities such as distance and blended learning strategies; development of Self-Learning Modules in print and offline/online digital formats; and the assessment of learning outcomes in the form of knowledge, skills, attitudes, and values assessed through a portfolio / e-portfolio. On the other hand, the Commission on Higher Education (CHED) issued a series of guidelines for the prevention and mitigation of the spread of COVID-19 in Higher Education Institutions (HEIs) in the Philippines. Highlights of CHED's guidelines include the practice of flexibility in the implementation of the school calendar; the deployment of available distance learning, e-learning, and other alternative modes of delivery in lieu of face-to-face learning; implementation of alternative activities to enable students to complete required practicum/internship hours; and the discretionary implementation of the National Service Training Program among others. In response to CHED's guidelines, Philippine HEIs implemented various forms of online learning (synchronous and asynchronous modalities), blended learning strategies, and limited face-to-face instruction. The Biology Teachers Association of the Philippines (BIOTA-Phils) managed to fulfill its mandate to promote biology education and research, despite the COVID-19 lockdown restrictions. BIOTA-Phils did its share in mitigating the effects of the pandemic in the education sector, through a series of webinars to ensure continuous content-knowledge and online

pedagogical skills building among its members. BIOTA conducts the Community on Quarantine (CoQ) Webinar series, the Virtual Investigatory Projects Seminars (VIPS) series, BIOTA Chapter webinars, and the BIOTA Virtual Conventions in an interactive online platform. Having a number of Philippine participants and Executive Committee members of the AABE coming from the BIOTA-Phils, it is fitting that we co-host (even if only virtually) this year's AABE 28th Biennial Conference – just like we did in 2012, 1998, 1986, 1970, and in 1966, when AABE was established by its founding director-convener, Dr. Dolores F. Hernandez.

Direction and Characteristics of Biological Education in the New Curriculum of Thailand

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Assumption University, Thailand

Since the pandemic erupted, Thailand has revised the curriculum as followed. At elementary and high school level, the teaching and learning system has been on online platform. Fundamental education has applied for Excellence in Innovation, however, it is still not officially announced. For further information, please follow <https://cbethailand.com/>.

<Seminar-Lectures>

FOOD SECURITY AND SUSTAINABILITY

Leveraging Remote Learning for Advancing Ecological Concepts for a Sustainable Food System

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A food-secure future requires sustainable food systems today. Nurturing ecological intelligence is a necessary ingredient for developing and promoting sustainable food systems that provide nutritious food and protect the environment. Interested individuals, advocates, as well as practitioners and adopters of organic, conservation, and climate-smart agriculture, need a strong background in ecology as this is foundational knowledge for the various practices that promote sustainability. A short course on the Basics of Soil Ecology was offered by the Environmental Biology Division of IBS, UPLB, in cooperation with UPLB's Professional School for Agriculture and the Environment (UP PSAE). It was attended by 19 participants from all over the Philippines. Topics included in the short course were soil properties, biodiversity, ecosystem functions and services, soil health, sustainability, permaculture, and the role of soils in climate change mitigation, sustainable development, and circular economies. The participants gave favorable feedback on their experience. They mentioned that online short courses are valuable in their particular context because it allows them to further their knowledge while staying in their professions and

managing their personal circumstances. They likewise expressed their agreement with having stackable courses that may be credited towards a Professional Master's degree. This idea exemplifies how micro-credentials can provide a flexible and targeted learning opportunity for those seeking to develop their competencies in Biology.

Quality Evaluation of Wine from Native White Pomelo (*Aurantium decumana* (L.) Mill.)

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This experimental research determined the sensory acceptability of white native pomelo wine in terms of appearance, aroma, taste, and mouth feel. The cost analysis and its physico-chemical composition, packaging and labeling of the product were determined further. This research was conducted in November 2020 at West Visayas State University – Calinog Campus. Standardized recipe in making the home-made wine was used in determining the sensory evaluation and was subjected to physicochemical analysis. The respondents of the study that were purposively selected were the 15 faculty members and 15 Food Technology students. The finished product was evaluated using a sensory evaluation score sheet based on 9-point Hedonic Scale. The sensory evaluation results showed that all wines had

like very much in terms of appearance ($m = 7.87$), aroma ($m = 7.70$), taste ($m = 7.43$) and mouth feel ($m = 7.70$). The native pomelo wine cost Php 42.50 per 33 mL bottle. This computed cost implies that was cheaper compare than that of the commercial wine in the market. Result of physicochemical analysis revealed that the total titratable acidity as citric acid (0.67% w/v), pH (3.52), ethanol content (9.95% v/v), total soluble solids (5.6 g/mL) and total insoluble solids (0.01 g/mL). Mean and percentage are the statistical tools. Based on the level of health-promoting compounds present in native pomelo, the ability to support yeast growth and the low alcoholic content of the native pomelo can be a promising raw material for production of wine. Instrumental techniques to determine the physical and chemical properties of the wine, benchmarking of quality parameters with commercially available fruit wines, evaluation of anti-oxidant and other biomolecular activity, wine nutritional value evaluation such as vitamin C and minerals and aging process of the wine are highly recommended to add value to the product and as well as to established a more rigorous and integral development of the product.

Isolation, Characterization and Molecular Identification of Lactic Acid Bacteria from Cockroaches: Implication to Poultry Industry

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Poultry production as an important economic activity faces obstacle associated with the animal diseases that significantly affect productivity. To combat this, antibiotics are used; however, a surge in the development and spread of antibiotic resistance has imposed danger to human and animal health. At present, researches are being carried out to find natural agents as growth promoters, particularly probiotics which have been used in different industry as growth promoters and antibacterial agents. Therefore, this study was carried out to evaluate the antibacterial activity of lactic acid bacteria isolated from cockroach gut and its implication to the poultry industry. Isolates from three areas (trashcans, market and households) significantly reduced the growth of *Es-*

cherichia coli and *Staphylococcus aureus* ($p < 0.00001$). Three isolates, one from each treatment, were found to have most potent antibacterial activity and were identified molecularly. Sequencing of their PCR amplicons and homology analysis using the BLAST-N application of the National Center for Biotechnology Information (NCBI) suggested that the isolates belong to the genus *Lactobacillus*. They have 99% identity scores homologous to *Lactobacillus plantarum* with query coverage of 99%. These three lactic acid bacterial isolates were utilized to test their poultry growth promoting potential in Cobb Broilers. Results suggested that combination of all three strains of *L. plantarum* as a consortium (1:1:1) significantly increased the weight gain of the treatment compared to the control groups ($p < 0.001$) and this treatment had the best feed conversion ratio. Results established that lactic acid bacteria are widely present in the gut of cockroaches; some are beneficial and must be explored further as an alternative to antibiotics usage.

<A prize winner of lecture presentation>

Growth of Selected Vegetable Crops on Mined-out Soils from Sta. Cruz, Zambales, Inoculated with *Pseudomonas putida* BIOTECH 1507

***Mary Rhovian B. BACANI¹⁾, Lemuel A. ARANGORIN²⁾ and Romar B. ALFONSO³⁾**

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The study was conducted to evaluate the growth performance of the four selected vegetable crops (*Abelmoschus esculentus* L., *Solanum lycopersicum* L., *S. melongena* L., and *Capsicum annuum* L. var. longum) on mined-out soil from Brgy. Canaynayan, Sta. Cruz, Zambales, after *P. putida* BIOTECH 1506 was inoculated. Pre-and post- reading of soil samples and dried plant tissues were analyzed by the CRL Environmental Corporation for the determination of heavy metals, Ni, Fe and Cr. Results of the study showed positive significance on the growth performance of the selected crops on inoculated mined-out soil compared to the normal field soil and uninoculated mined-out soil. The study further revealed that *C. annuum* L. var. longum performs better and is probably more compatible with the inoculant. Moreover, the mean percentages of heavy metal

reduction on the soils of each vegetable crop by *P. putida* BIOTECH 1506 were 99.5% Ni, 26.8% Fe and 50.2% Cr with metal concentrations on the plant body and fruit at notably permissible levels. Therefore, there is a probability that *P. putida* not only remediated Ni, Fe and Cr on the soil but also contributed to the growth potential of each vegetable crop. Further study is recommended to re-identify the prevailing bacteria on the planted soil, compare *P. putida* with other soil inoculants, and examine the metal concentration on the individual parts of the plant.

Carapace Length–Weight and Carapace Width–Weight Relationships of *Thalamita crenata* from Siargao Island, Philippines

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This study aimed to determine the interrelationships of morphometric characters, the carapace width–weight and carapace length–weight relationships, sex ratio and condition factors of *Thalamita crenata* from the mangrove habitat of Del Carmen, Siargao, Philippines. One hundred and three individuals, 58 females and 45 males, were utilized in the study. Results revealed that *T. crenata* has a body weight range of 12.47 to 67.74 g for females and 14.44 to 86.04 g in males. The carapace length ranges from 2.77 to 4.83 cm for females and 2.86 to 4.93 cm for males. As to carapace width, it ranges from 2.28 to 6.91 cm for females while 4.08 to 7.26 cm for males. In terms of growth pattern, it exhibited an allometric growth pattern. A positive allometric for males ($b > 3$) while negative allometric for females ($b < 3$). The values for the condition factors were higher in females (6.850 and -3.5306) than in males (-0.2684 and -0.9667). The allometric growth pattern of *T. crenata* may be attributed to the environmental conditions present in the study area. Hence, interrelationships of morphometric characters on *T. crenata* crab species may serve as baseline data for its possible aquaculture cultivation, sustainable fishery management of the resource, particularly in Caraga region, and for further comparative studies of the same species across temporal and spatial distribution in the Philippines and in other countries.

Teachers' Perceived Knowledge, Attitudes, and Behaviors on Sustainable Development: Focus on Pili (*Canarium ovatum*)

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Teachers are one of the major key players in obtaining quality education; consequently, analyzing their knowledge, attitudes, and behaviors (KAB) helps the administration and educational planners to provide better programs and resources. As part of a bigger effort to promote education for sustainable development, the researchers designed and validated a short and accessible online instrument to evaluate teachers' KAB that is contextualized on the sustainable development of Pili (*Canarium ovatum*). This 24-item questionnaire was based on the 2030 Sustainable Development Goals together with their complex systems and was disseminated online through Google Forms, specifically to science teachers ($n = 206$). Confirmatory factor analysis, Cronbach's alpha, and Fleiss' kappa estimates were used to examine the reliability and validity of this instrument. The results demonstrate that having favorable knowledge and attitudes is insufficient to induce beneficial actions. The use and adaptation of the developed instrument, as well as the investigation of various activities that would help teachers manifest positive behaviors towards sustainable development, are recommended.

PEDAGOGY

Plant Identification Mobile Apps: Reactions and Difficulties Encountered by Users

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In this study, four plant identification apps namely, Leafsnap, Plantsnap, Picturethis, and Plantnet were tried by volunteer participants who are students, teachers or simply plant enthusiasts known commonly as plantitos/plantitas. The participants were asked to take images of at least four plants and upload them to the different mobile apps for their identification. The participants were then asked about

their reactions and difficulties to the use of the four mobile apps through a questionnaire. Results showed that the participants find the use of the mobile apps interesting and enjoyable, very useful, adds to their knowledge on plants, can help them connect with nature and the world, and can provide data for research purposes. There are, however, difficulties that they encountered on the use of the mobile apps, foremost of which are the slow internet connection, inconsistency in some identification, and the need to purchase the apps after the trial period. Despite these difficulties, the satisfaction of the users supports the need to explore the use of mobile apps in teaching taxonomy or systematic biology among students or even as citizen science tools.

Gamified Approach in Teaching Life Sciences: Its Effect on Students' Engagement and Performance

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The study determined the effects of gamified approach in teaching the cell on students' individual and collaborative engagement and performance. The study used a quasi-experimental design using intact classes among 70 grade 12 senior high school students of the first semester, academic year 2019-2020, who are taking up Academic Track – Science, Technology, Engineering and Mathematics (STEM) Strand in one of the private schools in Laoag City. A pre-test and post-test were conducted to identify the academic performance of the students. Also, a pre-assessment and post-assessment of the students' individual and collaborative engagement was elicited using the Student Engagement Survey (SES). Likewise, an ICT-based game titled "Cell Voyage" was used through the gamified approach to the experimental group while the intended curriculum was used for the control group. The findings revealed that the experimental group obtained higher scores during the post-assessment of their individual and collaborative engagement and post-test, which show that the experimental group became more individually and collaboratively engaged, and performed better after having been exposed to the gamified approach. Moreover, the pre-assessment and post-assessment scores of the control group along individual and collaborative engagement has no significant difference, also with their pretest and post-test

scores, which indicate that the intended curriculum did not remarkably improve the individual and collaborative engagement and performance of the students. Further, the results proved that there is a strong correlation between students' engagement and performance, that is, if the level of engagement is higher, the students tend to have higher level of performance. Hence, the study concludes that the gamified approach is effective in enhancing the individual and collaborative engagement of students which redounds to an improved performance. It confirms the Theory of Gamified Learning of Landers & Landers (2015), which emphasizes that gamified approach can target a behavior or attitude which affects learning. Students who spend more time engaging in metacognition (thinking about how they learn) tend to have better performance. It increases metacognition, making instruction more effective.

Use of Mobile Microscopes in Cambodian High School Biology Class – Potential as Inquiring Observation Tools

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There are a few microscopes in high schools in Cambodia, and many schools do not have them. When there are a few microscopes in school, students cannot help observing by taking turns looking at the microscope or projecting a microscope image. In these methods, the lesson is inevitable to be one-sided. We thought using mobile microscopes would effectively improve biology education under these conditions. Mobile microscopes can be attached to the lens of smartphones and tablets. Mobile microscopes are much cheaper than ordinary microscopes, so students can use a microscope per several students. Using mobile microscopes will enable students to operate independently, discuss in groups, and devise observation methods. So, mobile microscopes enable learning to be inquiry and learner-centered. The presenter taught a biology class in a high school in Cambodia using mobile microscopes in February 2020. The theme of the experiment was "Observation of Cells" for 36 students of grade 10 with the cooperation of the biology teacher Sothary Kim. In the 80-minute class, students first learned how to use mobile microscopes and observed the leaves of *Egeria densa* and the cells of the human oral epithelium in the textbook. After that, various

methods of preparing slides were shown, such as making sections, peeling off the epidermis, and crushing. Students chose from foodstuffs such as bananas, onions, or asparagus, discussed and observed each groups' optimal cell observation method. In the questionnaire after the completion, all the students praised mobile microscopes. This practice confirms that we can expect mobile microscopes are practical tools for exploratory improvement of high school biology lessons. It is necessary to accumulate practice in more schools and themes as a future task. It is also an issue to disseminate it to many schools and implement teacher training.

Designing Citizenship Science and Project-Based Learning +1 Pedagogy Modules in Teaching Philippine Ecology and Biodiversity

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Expansive interest in preserving the world's plant and animal species has been amplified in 30 years, and almost a million of animal and plant species are at risk of extinction. This crisis was not then realized in classrooms, because of insufficiency of public education and grasp on biodiversity-related issues. Thus, this research is working towards the development of Project-Based Learning +1 Pedagogy (PBL+1P) instructional modules infused with Citizenship Science in teaching Philippine ecology and biodiversity to high school learners taking Biology courses. The researcher made use of PBL+1P, to stimulate interdisciplinary approach and to familiarize domestic ecology and biodiversity concepts. It was necessary to carry out trials on the modules in a class by administering a pre-experimental design with a one-group pretest-posttest model. Thirty-two learners under 'Engineering and Science Education Program' at Ramon Magsaysay Cubao High School were subjected to researcher-made instructional modules. The experimental set was acquainted with PBL+1P and infused with Citizenship Science projects such as Key Conservation Sites in the Philippines by Haribon, eBird, and BirdLife. The findings showed the validated and KR20-tested pretest was conducted in advance of their exposure to PBL+1P and Citizenship Science projects. Posttest was imposed after the instructional intervention. Data were examined with qualitative and quantitative procedures like the mean and dependent sample T-test. The outcomes revealed that the aggregate of learners

who had a significant gain of 5 or above was 27 (84%) while five (15%) did not have a significant score gain.

Revised Biology Textbook Features for the Latest Course of Study in Japan

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In March 2018, the revised Course of Study (CS) for upper secondary schools was released by the Ministry of Education, Culture, Sports, Science and Technology, Japan. It is scheduled to be enforced from April 2022. The new CS particularly emphasizes "independent, interactive, and deep learning". The students who are studying under the regulation of this CS will work in an unpredictable society, because of the development of globalism, AI, IoT, and other unknown factors. Therefore, student-centered learning that includes critical thinking, decision-making, discussion, and presentation, should be emphasized more than teacher-centered teaching. Thus, revised "Basic Biology" textbooks, used from the 2022 school year, include a lot of examples of methods to empower students to find questions and solve them on their own. Another feature of these textbooks is that, as part of giving priority to ICT, QR codes have been incorporated, allowing students to learn through the Internet. In addition, the new CS clearly states that the number of biological key terms used in basic biology textbooks to explain key concepts should be around 200-250. Previously there were about 450 key terms. Students were forced to memorize them in order to pass semester tests and university entrance examinations. Furthermore, because of university entrance examination pressure, teachers forced knowledge-based learning on students using teacher-centered methods. The new CS requires a shift in focus from memorization to the development of higher-level thinking skills and a reduction of the number of terms. By analyzing revised "Basic Biology" textbooks to be used in the 2022 school year, the following features are clarified: there are many exercises, that encourage students to think deeply, and key terms fewer than 250.

Educational Significance of “Fish Dissection” in Elementary School Science Education

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We have reported the "significance of animal dissection" in school science education. In the sixth grade of elementary school science in Japan, they learn about structure and functions of the human and animal body. In this paper, we analyzed the educational significance of "fish dissection" in sixth grade science. We examined science textbooks for sixth graders published from 2005 to 2020 in Japan, and we practiced fish dissection in science education class in Japanese universities. The results of the study were as follows: Japanese crucian carp (*Carassius cuvieri*) was described as a reference for observations and experiments in these two textbooks, mackerel (*Scomber japonicas*) was described in one textbook and Japanese jack mackerel (*Trachurus japonicus*) was described in one textbook published in 2015. However, Japanese crucian carp was not described in the textbook published in 2020. A questionnaire to the students after the class on fish dissection revealed the following facts: First, almost all of the students answered that it was a good experience to practice fish dissection. Secondly, they had a variety of impressions or notions on life and seemed to realize the “view of life” and “biodiversity”. The facts show the effectiveness of introducing fish dissection in elementary school science to let children realize the view of life and biodiversity. The dissection of live crucian carp seems to be resistant. On the other hand, jack mackerel and mackerel as ingredients are familiar fish that we often eat them. It is important to understand view of life and biodiversity through actual experience using jack mackerel or mackerel, and so on. We hope that the educational significance of fish dissection in elementary school science education will be understood.

A Scoping Review on the Students’ Misconceptions in Natural Selection

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The prevalence of misconceptions about natural selection among students across all levels is becoming

problematic. However, these problems imposed by misconceptions can be seen as an opportunity for teachers to execute their big role as learning facilitators. This scoping review aims to collate and examine available literature that can help teachers address the prevailing misconceptions of students in natural selection. Employing Arksey and O’Malley’s (2005) framework, inclusion criteria were formulated which left 11 records to be reviewed and analyzed. The results indicated that (1) the constructivism approach renders effective teaching about natural selection, (2) gamification or gameplay session increases engagement in learning natural selection, and (3) use of narratives in lieu of the unavailability of technology integration to the teaching of natural selection. It is recommended that curriculum planners design a coherent biology curriculum that adheres to a constructivist approach with teaching strategies incorporating the nature of science (NOS) instruction.

Exploring Students’ Creative Confidence in Disaster Readiness and Risk Reduction Using Design Thinking-Based Lessons

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Employing the descriptive research design incorporating the stages of Design-based Research (DBR) Methodology, the study explored how the lessons on Life Science topics in Disaster Readiness and Risk Reduction (DRRR) were designed especially the identification of Life Science topic and strategies to be used in writing the Design Thinking-based Lessons (DTBLs), validity of the DTBLs and the effects of DTBLs on the creative confidence of senior high school (SHS) students. Data were collected from the checklist, validation tool, and survey questionnaires responded by 15 teachers, three experts, and 28 students, respectively. Frequency count, rank and mean were used to analyze the findings. Transcriptions and remarks from the semi-structured interview and observation were also analyzed. The results of the survey showed that teachers perceived potential earthquake hazards affecting biological components as the most difficult Life Science topic to teach where this was considered in designing the six DTBLs in DRRR. Strategies used in writing the DTBLs provided students with various opportunities to use their creativity in understanding the context of the chal-

lenge, defining an actionable problem statement, idea generation, prototyping, and testing. Experts validated the DTBLs as very highly valid allowing SHS students to favorably demonstrate their creative confidence in their DRRR classes. Features of the DTBLs enabled students to show their creativity as they underwent the design challenges. After exposing the students with the design process found in the DTBLs, it resulted to the enhancement of their creative confidence where these helped them to develop trust in their creative skills and value creativity as an essential part of their lives in dealing with design challenges.

Key Concepts of the Revised Course of Study Can Change Upper Secondary Biology Classes

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The revised Course of Study (CS) for upper secondary schools that was released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan, in March 2018 is being enforced from April 2022. The new CS particularly emphasizes two key concepts, “Independent, Interactive, and Deep Learning” and “Inquiry process.” These concepts make an impact on biology classes. Teachers must redesign their classes according to the new CS. Teacher-centered teaching must be replaced with student-centered leaning. In redesigned classes, students should think about the question, express their thinking as essays, slides or anything and discussion. Also, teachers should provide those opportunities, trigger questions or foster students' curiosity. Student are asked to learn through an inquiry process in which they find issues or questions, make hypotheses, plan experiments or design investigation methods, conduct observations or experiments, analyze results and write a report or give a presentation then they find new issues or questions. Students can complete the whole inquiry process through several lessons of different topics. Teachers are asked to help students to complete this inquiry process. I have already tried to redesign and conduct some student practices: in the catalase experiment, I just involved in making a hypothesis and designing and performing the experiment; in the vegetation survey by the quadrat method, I just involved in designing the investigation, analyzing the results. Challenging to

redesign biology classes to adopt these key concepts of the revised CS allowed students to change their learning attitude. Students were encouraged to arouse their curiosity, have a positive attitude to learning, and think about familiar biological phenomena. Thus, the enforcement of the revised CS is expected to promote the changes in teaching style which foster students' curiosity, practical skills, and ability and attitude to learning.

Effect of Evaluation on Students in Inquiry Basic Biology Class in Japan

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From April 2022, the new Course of Study (CS)-based education will be implemented for high schools by the Ministry of Education, Culture, Sports, Science and Technology, Japan. The new CS-based education has some keywords, including "Inquiry" and "Evaluation". The direction these words indicate is the necessity of improving classes in Japan. Especially in science, it is important to improve students' inquiry ability by conducting observations and experiments in class. In this presentation, I will introduce Basic Biology class practice conducted in advance of the implementation of new CS-based education. I started my Basic Biology class by observing and experimenting with the creatures that my students brought. The observations and experimental results that the students had never seen and experienced made the class fully inquiry, because these observation records, experimental plans and results were not published in the textbooks. In this inquiry Basic Biology class, students were evaluated by the observation records, experimental plans, experimental results records, discussions, and reflections described in the notebook. The new CS-based education has the following three evaluation perspectives: “Fundamental knowledge and skills”, “Ability to think, to judge and to express themselves” and “Attitude of proactive learning”. Already, the evaluation method and the rubric evaluation table were taught to the students, and, at the same time, the skill of evaluating themselves was improved. Evaluation of “Attitude of proactive learning” especially promoted the reflection of the students themselves. By learning the self-evaluation method, the students' inquiry ability improved and it led to the next experimental plan.

Using a Capacities Based Approach to Teach Undergraduate Biology

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Typical curricula in the Life Sciences (and other STEM disciplines) emphasize content knowledge, especially at the higher educational levels. These curricula are based on the assumption that a majority of students in these disciplines will seek careers in areas where such content knowledge will be relevant. Based on our experience of teaching in a new undergraduate program in Biology, we found that a majority of our students migrate to careers outside the Life Sciences. Given this fact, we asked what skills and capacities could be imparted to students such that upon graduation they are well suited to undertake different career paths, whether it is post-graduate studies, industry positions, entrepreneurship or an entirely different role. This led us to develop a textbook that emphasizes a capacities-based approach to teaching Biology. This textbook, called iThinkBiology is a free online textbook that is targeted at the introductory college level (<https://ithinkbiology.in/>). The content uses case studies from India to make the content relevant to the students' lives. The textbook is augmented by teacher's guides that demonstrate how each chapter could be used in the classroom. The five capacities that we have chosen to develop are: reading and interpreting, scientific process, scientific tools, quantitative reasoning, and bridging science, society and environment. We believe these are five general capacities that will stand the student in good stead, whether she chooses Life Sciences as a career path or something entirely different. We will illustrate capacity development through specific examples taken from the textbook.

Demonstration of the Enriched Virtual Model in Teaching Respiratory System Using an Open Educational Resource-Based Mobile Learning Cloud Network

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This paper describes a demonstration and evaluation of using a classroom-based mobile cloud network for content distribution and learning management in teaching biology following the enriched virtual model. The study describes the development of an offline mobile cloud platform for content delivery and management of open educational resources in biology. This study employed both quantitative and qualitative research design to evaluate the technology-rich classroom environment and identify major themes from the performance of the simulated blended learning approach. Teachers participated in a simulated, limited face-to-face class in grade 9 Biology with the topic on the respiratory system. Initial evaluation of the mobile learning cloud network shows that the quality of the preloaded materials and the users' experience are adequate enough to be used for a blended learning implementation. Participants also reported that the physical aspects of the technology-rich class demonstration, under the proposed model, are favorable for a face-to-face deployment characterized by its perceived usefulness and efficiency. The proposed technology and learning methodology demonstrated in this study provides direction in teaching and learning biology in the post-COVID-19 era of education.

Experiential Learning - Biology Teaching at Secondary and Senior Secondary School

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Experiential learning is an engaged learning process whereby students "learn by doing" and by reflecting on the experiences gained during the learning process (Kolb, 1984). The knowledge is created by the learner through an experience that passes through 4-stage processes: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Often experiential learning has been used synonymously with active learning. Active learning is a commonly used student-centric approach not necessarily culminating in reflection and application of the activity done. The experiential learning experience provides ample opportunities to learn from natural consequences, mistakes, and successes. Experiential learning is an essential and effective pedagogical strategy in biology teaching. It is evident that experiential learning promotes learners' Higher Order Thinking Skills (HOTS) such as to

evaluate, synthesize, and analyze. A teacher of Biology is required to create experiential learning activities during an academic year aligned to the syllabus, spiraling and interconnecting topics that would allow the flow of information from simple to complex processes. The size of the class, the learning level of the students, and contextualized information are the cornerstones of the experiential learning programme. A well-designed, assessed, and reviewed experiential learning program stimulates metacognition, an inquiry approach, interdisciplinary learning, cultural awareness, leadership, and lifelong learning. The flow of the scheme needs to be discussed with the students to make them understand the core objectives of the activity. An observation sheet, designed for a particular activity with well-laid out parameters and criteria falling into the higher cognitive domain, has to be explained to the students. A careful assessment of the impact of experiential learning shall be done through a formative assessment mode and feedback gathered must be constructively used to modify the activities and align them towards the achievement of learning outcomes and goals.

The Role of Gamified E-Quizzes on Student Learning: An Interactive Gamification Solution for a Formative Assessment in Science Education

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The use of ICT in education paved the way for online teaching. Though online teaching has the challenge of engaging students, gamification strategy helps to overcome it, because everyone likes to play the games. The current study is a single group pre-post test experimental study to examine the effect of gamification in the science classes for teaching the concepts of human body system, such as digestive system, excretory system, respiratory system and male and female reproductive system, during online education. For gamifying the classroom two types of gamification applications were employed: Quizizz and Ecosystemforkids. A purposive sample of 32 VI grade students were taken, seven online sessions of one hour each as an intervention programme were conducted on Zoom platform. During the introductory session the researchers introduced

the students with game-based learning tools. From the following session, one of the researchers conducted online sessions for teaching the five human body systems. The researcher conducted a quiz during the beginning of each topic using <http://quizizz.com> as a pre-test and at the end as a post-test. The test was designed using 10 multiple choice questions with one mark for each correct answer. For assignments researchers used ecosystemforkids.com, a game-based learning tool, and shared its link daily on whatsapp group. It helped them to revise the portion conducted by the teacher during online class. The results showed that the employment of innovative gamified e-quiz applications (*i.e.*, Quizizz, and ecosystemforkids) were effective in evaluating students' learning performance, as formative assessment. Quizizz was effective to be used as a formative test tool. It shows that gamification improves the performance of students, improves their knowledge, and support fun and competition based learning.

Planetary Health as a Transdisciplinary Lens for Biology Education in the New Normal

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Planetary health (PH) is a new transdisciplinary field and movement that deals with the health impacts of human-driven environmental consequences. Officially launched in 2015 by the Lancet-Rockefeller Commission on Planetary Health, PH is in its infancy stage in the Philippines. PH is very relevant to the new normal especially with the immense effect of the COVID-19 pandemic on society, its people, and their daily lives. Educational institutions adapted to the COVID-19 challenges by resorting to online/remote learning. While there are a few key players in the PH network in the country, there remains a need to institutionalize PH, especially in the academe. The academe is a promising venue to cultivate and promote PH as a field of study by creating courses that highlight its importance and applications. Scoping the Philippine landscape for higher education initiatives on PH re-

veals at least four education and curriculum design activities that aim at promoting PH in the academe in 2020-2021. These include the offering in the University of the Philippines Los Baños of BIO 191: Biological Systems and Planetary Health, the first PH-themed course in the Philippines. The elective course was divided into three major themes, namely, history of PH, biological/eco- logical research related to PH, and ways forward for PH in the Philippines. A relay mode of teaching was implemented to represent various related studies and topics. Other education projects on PH were also offered at other universities. While seminars, workshops, dialogues, and podcasts on PH have been around for a few years, with a number of Filipino advocates actively involved in the conversation, the integration of PH in the academe can be considered a significant development in PH education and provides a fresh transdisciplinary lens in life science courses in the Philippines.

<A prize winner of lecture presentation>

BIODIVERSITY AND CONSERVATION

Status of the Seagrass and Seaweed Beds in Albay Gulf, Bicol, Philippines

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A habitat assessment of seagrass and seaweed beds in randomly selected six municipalities bordering Albay Gulf was conducted to provide baseline data of its status including species composition, abundance and biomass that are essential to resource planning and management. The study noted 10 seagrass species and 36 seaweeds species. *Cymodocea rotundata*, *Cymodocea serrulata*, *Halodule pinifolia*, *Halodule uninervis* and *Syringodium isoetifolium* from Family Cymodoceaceae and *Enhalus acoroides*, *Halophila ovalis*, *Halophila minor*, *Halophila decipiens*, and *Thalassia hemprichii* under Family Hydrocharitaceae were taxonomically identified. All these species were noted in Sto. Domingo, Manito, and Prieto Diaz. Among the seaweeds, 11 genera were noted under Chlorophyceae, five from Phaeophyceae, and seven in Rhodophyceae. *Acetabularia*, *Halicoryne*, *Halimeda*, *Neomeris*, *Padina* and *Sargassum* were commonly found in most of the stations with *Padina* as the most abundant. Manito got the highest number of 17 seaweeds species recorded. *Thalassia hemprichii* was the most abundant in

Prieto Diaz. *Syringodium isoetifolium* followed being the most abundant species in Bacon District and Sto. Domingo. *Halodule uninervis* and *Cymodocea rotundata* were abundant in Rapu-Rapu and Manito, respectively. *Enhalus acoroides* has the least percentage cover although it was most abundant in Legazpi City and harbor highest biomass. *Halimeda* spp. had high biomass. Few associated macroinvertebrates were noted such as sponges, sea cucumbers, univalves, bivalves, sea urchins and starfishes. The habitat status of seagrass and seaweed beds in Sto. Domingo was excellent. Prieto Diaz was next with good bed condition, as well as Manito and Bacon District. Rapu-Rapu and Legazpi had fair habitat condition. The beds status was influenced generally by natural phenomena, like seagrass wasting decomposition; and anthropogenic activities, such as aquaculture, fishing, recreational activities and other developments. Areas near human settlement and establishments were vulnerable to physical disturbance and must be checked to protect and conserve this kind of ecosystem.

Determining the Spatial Distribution of Urban and Non-Urban Birds in NCR, Philippines, prior and during COVID-19 Lockdown Using E-bird Data

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RETONE**

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In the aftermath of the COVID-19 pandemic, there was a significant decrease in human migration, which may have had an influence on wildlife as a result of the disease. In the Philippines, we discovered that counts of 66% (80%) of focal urban and non-urban bird species changed in pandemic-affected areas, with abundances typically increasing in comparison to pre-pandemic abundances in urban habitats and in cities where lockdowns were more pronounced or occurred at the same time as peak bird migration. We based our findings on data from over 200,000 birds observed by volunteers from January 2018 to December 2020 across the country. As indicated by the spatial distribution map that we generated, our findings reveal that humans are having an impact on many of the urban and non-urban birds of the National Capital Region (NCR). Once we have recovered from the pandemic, these findings suggest that

we can make urban settings more attractive to birds by reducing traffic and lessening the disruption generated by human transit.

Assessment of Fish Diversity and Distribution and Water Quality in Lakes Caliraya and Lumot in Laguna, Philippines

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This study aims to assess the fish diversity, abundance, and distribution and characterize the water quality of the Caliraya and Lumot Lakes in Laguna. In each lake, four sampling sites (near vegetation, limnetic zone, inlet/near houses, spillway/near fish cages) were selected. Fish samples were collected using various fishing gears such as gill nets, cast net, spears, fish traps, and hook and line for two hours in each site. Captured fish were identified and counted for diversity and abundance analysis. *In situ* water quality parameters including temperature, dissolved oxygen (DO), conductivity, total dissolved solids, salinity, pH, nitrate, and chlorophyll a were determined using a multiparameter sensor. Secchi disc was used to measure water transparency. Fish and water quality data were analyzed using PAST and R software. A total of 172 fish individuals were collected from Caliraya Lake while 105 were caught from Lumot Lake. Diversity indices for fish species were 1.339 ($S = 8$) and 1.527 ($S = 9$) for Lakes Caliraya and Lumot, respectively. Most of the fish species in both lakes were located near the vegetation site. In Caliraya Lake, most abundant fish collected was *Leiopotherapon plumbeus* (54.1%) while *Sarotherodon melanotheron* was the most abundant (44.8%) in the Lumot Lake. Caliraya Lake can be classified as oligotrophic based on the chlorophyll a concentration (4.05 µg/L) while Lumot Lake has a near eutrophic condition (18.04 µg/L). The lowest DO (2.77ppm) was recorded in Lumot Lake's limnetic site. Variations in the water quality among the four sites in each lake were also observed. The results of the study can provide scientific basis on the management strategies that can be employed in the lakes to make them sustainable.

<A prize winner of lecture presentation>

Identification and Assessment of Benthic Foraminifera in Biliran Island, Philippines

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Benthic foraminifera are unicellular marine microorganism with a hard exoskeleton and commonly present in the benthic community of marine ecosystem. The study aimed to identify and determine the benthic foraminifera species present along the coastal area of Biliran Island, Philippines. The researchers conducted an *in situ* collection of the dead foraminiferal shells from intertidal areas along shallow water coastlines of the island. The collected sand grains were put in the microscope slide and observed under the microscope in the laboratory. Then, using the collected forams was compared to the world of foraminiferams database for identification. Based on the data gathered, the coastal environment of Biliran Island has the presence of benthic foraminifera. The genus of *Spirillina*, *Quinqueloculina*, *Marginopora* and *Sorites* were the forams found in the coastal area of Biliran Island. Further, these species are herbivory and bactivory and passive suspension feeders and have ecological niche in the marine ecosystem. Lastly, the Local Government Units might formulate environmental policies in regulating the disposal of waste to seawater.

Avifaunal Diversity in Selected Areas of Central Mindanao University, Musuan, Bukidnon

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This study was conducted to assess the species diversity, endemism and conservation status of birds found on three land use zones in Central Mindanao University, Musuan, Maramag, Bukidnon, Philippines, such as the forest land use zone, academic land use zone and agricultural land use zone. A line transect method was employed in the study. A total of 43 species of birds belonging to 29 families were recorded namely, Acciptridae, Apodidae, Bucerotidae, Hirundinidae Ardeidae, Columbidae, Alcedinidae, Cuculidae, Meropidae, Armatidae, Corvidae, Di-caeidae, Estrildidae, Falconidae, Laniidae, Locustellidae, Megalaimidae, Motacillidae, Muscicapidae, Passeridae, Nectariniidae, Oriolidae, Pycnonotidae,

Rallidae, Sturnidae, Timaliidae, Tytonidae, Campophagidae and Rhipiduridae. There are 28 species were listed as resident, three as migrant species, two introduced species, one resident and/or migrant species and nine species endemic to the Philippines. Site 3, or the academic land use zone, has the highest diversity ($H' = 2.66$) among the three sites while the

forest land use zone and agricultural land use zone have 2.65 and 2.25, respectively. However, there is no variation across different land use zones. Birds play a vital role in determining the quality of habitat and in maintaining balanced ecosystem, the school administration must integrate plans for biodiversity in any infrastructure development.

<E-Posters>

BIODIVERSITY AND CONSERVATION

Ethnobotanical Study and Phytochemical Screening of Selected Medicinal Plants in Agusan del Sur

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This study assessed the selected medicinal plants in selected municipalities of Agusan del Sur through ethnobotanical study and phytochemical screening. Findings revealed 71 plant species comprising of 36 families and 65 genera used in 14 different disease categories. Lamiaceae, represented with six species, had the highest Family Importance Value index. *Blumea balsamifera* was the most cited plant used to treat respiratory diseases and gastrointestinal disorders. Highest Informant Consensus Factor was for Category VIII, or diseases of the respiratory system. Leaves were the most frequently used part in this study due to the accessibility in obtaining these parts. Decoction, employed alone or in combination, was the most common method of preparation. Four plants, *Acmella grandiflora*, *Anodendron borneense*, *Hellenia speciosa* and *Homalomena philippinensis*, were used for phytochemical screening. Presence of alkaloids was detected for *A. grandiflora*. Presence of steroids was evident in *A. grandiflora*, *A. borneense* and *H. philippinensis*. Presence of flavonoids was evident in *A. borneense*. Presence of saponins was evident in *H. speciosa* and *H. philippinensis*. Presence of condensed tannins was evident in *A. grandiflora* and *H. speciosa*. This study concluded that traditional knowledge was still being practiced among Agusan Manobo tribe as indicated in the high percentage of middle and younger age group informants. Most of these plants were safe to use and readily available as they were cultivated. It is recommended to consider thorough study on the bio-

chemical activities, quantitative analyses, and methodical phytochemistry of novel medicinal plants and to intensify policies and priorities to promote conservation and protection of these plants.

Teachers' Perceived Knowledge, Attitudes, and Behaviors on Sustainable Development: Focus on Pili (*Canarium ovatum*)

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Teachers are one of the major key players in obtaining quality education; consequently, analyzing their knowledge, attitudes and behaviors (KAB) helps the administration and educational planners to provide better programs and resources. As part of a bigger effort to promote education for sustainable development, the researchers designed and validated a short and accessible online instrument to evaluate teachers' KAB that is contextualized on the sustainable development of Pili (*Canarium ovatum*). This 24-item questionnaire was based on the 2030 Sustainable Development Goals together with their complex systems and was disseminated online through Google Forms, specifically to science teachers: Biology ($n = 72$), Physics ($n = 59$), Earth Science ($n = 35$), Physical Science ($n = 15$), Chemistry ($n = 14$), and General Science ($n = 11$). Confirmatory factor analysis, Cronbach's alpha, and Fleiss' kappa estimates were used to examine the reliability and validity of this instrument. The results demonstrated that there is a significant correlation between knowledge and attitudes. By contrast, behaviors are not significantly correlated with knowledge and attitudes. Thus, having favorable knowledge and attitudes is insufficient to induce beneficial actions. The use and adaptation of the developed instrument, as well as the investigation of various activities that would help teachers manifest positive behaviors towards sustainable development,

are recommended.

Anesthetic Response of Freshwater Ornamental Fish to Sodium Bicarbonate

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The ornamental fish industry, particularly the freshwater tropical ornamental fish, is a growing industry in terms of its contribution to exports and revenues. These fish are reared in captivity before being sold; thus, they are subjected to various forms of handling- and transport-related stressors. There are a number of commercially available sedatives that are used in fish handling and routine husbandry procedures, but these products are expensive and not readily available to small-scale ornamental fish operators. The use of sodium bicarbonate or baking soda as an inexpensive alternative source of sedatives during routine husbandry activities in molly, *Poecilia* sp., a freshwater ornamental fish, was assessed in terms of its effect on the time to sedation, recovery and survival post-exposure. Juvenile molly were exposed to sodium bicarbonate at a concentration of 100 gL^{-1} and the time of sedation and time of recovery were monitored. It took longer for the fish to be fully sedated than their recovery. Survival of the fish a week post-exposure was 50%. In a simulated transport of fish for 6 hours in water containing 1 gL^{-1} of sodium bicarbonate showed survival ranging 70-100% a week after transport. These findings showed that sodium bicarbonate has the potential to be used as a low-cost sedative during handling and short-term transport of juvenile ornamental fish. Future studies shall focus on discovering the underlying physiological mechanisms in fish following sedation with sodium bicarbonate.

Utilization of Plant Wastes for Biofloc Production during the Culture of Ornamental Fish

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Biofloc technology is a minimal or zero water ex-

change technology, which exerts beneficial effects on water quality, improves feed conversion ratio by recycling microbial protein in the culture of commercially important fin-fish and shellfish. This culture technology can also be used in the rearing of ornamental fish to address limitations on land space and water use as well to minimize the impacts of wastewater discharge. Therefore, the present study evaluated the use of plant wastes in the production of biofloc for the culture of ornamental fish. A 30-day trial was conducted to evaluate the effects of using sweet potato, *Ipomoea batatas*, wastes in biofloc production for the rearing of molly, *Poecilia* sp. The effects on growth, water quality and bacterial population in the water were evaluated. Triplicate tanks of water supplemented with dried sweet potato wastes (biofloc treatment) at a carbon-nitrogen ratio (C:N) of 10 and the non-biofloc group were stocked with mixed juveniles of molly at a density of three fish per liter and reared for 30 days. Significant difference was observed in water quality parameters particularly lower concentration of ammonia and nitrate in the biofloc tanks. Growth parameters showed better growth and lower feed conversion rate in the biofloc group. Higher bacterial counts were also observed in the biofloc group than in the control. The present study proved that sweet potato wastes can be used in production of biofloc during the rearing of ornamental fish and the presence of bioflocs can improve water quality, enhance the growth of fish and increase bacterial population in the water.

Morphological and Molecular Identification of Cave Cyanobacteria

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Cyanobacteria are photosynthetic prokaryotes found in almost every plausible habitat on Earth, constituting a diverse monophyletic phylum in Domain Bacteria, and believed to be one of the oldest organisms on Earth. Their diverse morphology and abundance in nature make their classification and taxonomy hard to evaluate. Therefore, the present study investigated the cave cyanobacteria in Bulabog Putian National Park based on morphology and 16S rRNA gene. Based on morphology, fifteen genera, namely *Chroococcidiopsis*, *Aphanocapsa*, *Chroococcus*, *Gloeocapsa*, *Gloeocapsopsis*, *Dermocarapa*,

Trichocoleus, *Leptolyngbya*, *Onodrimia*, *Chroakolemma*, *Albertania*, *Calothrix*, *Fischerella*, *Toxopsis* and *Hapalosiphon* were identified. The BLASTn search results based on partial 16S rRNA gene confirmed the identification of the six morphologically identified cyanobacteria up to species level, namely *Chroococcidiopsis cubana* (99.21%), *Leptolyngbya* sp. (94.62%), *Onodrimia javanensis* (96.27%), *Chroakolemma pellucida* (94.74%), *Albertania skiophila* (98.40%) and *Calothrix* sp. (97.07%). The method used in the present study is favorable over the isolation and culturing of cyanobacteria, and at the same time, the maintenance of culture isolates is essential for future studies in the field of pharmaceutical and biotechnological phases. Thus, the findings of this study contribute to resolving the taxonomy of the cyanobacteria by adding more information as to the number of species discovered, and a starting point to the discovery of novel compounds that might be present among the cyanobacterial isolates.

Deciphering the First Complete Plastid Genome of the Genus *Etilingera*: Genome Structure, Comparative and Phylogenetic Analyses within Family Zingiberaceae

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Zingiberaceae are well known for their medicinal and economic significance across the world yet remained taxonomically and phylogenetically complicated and unresolved. In addition, the paucity of complete plastid genome information severely limits our understanding of the evolution and phylogenetic relationships of Zingiberaceae species. Here, we report the first complete plastid genome of four *Etilingera* species obtained through genome skimming using next generation sequencing. All plastomes displayed a typical quadripartite structure and their size ranges from 163,615–164,641 bp which encoded 113 different genes (80 protein-coding, 30

tRNA, and four rRNA genes) with 36.1% GC content. Gene content, gene order and GC content were highly similar among these genomes. Moreover, the characteristics of simple sequence repeats (SSRs) and oligonucleotide repeats were determined. The plastomes of 39 Zingiberaceae species with *Costus viridis* as outgroup were used to construct a phylogenetic tree distinguished by Maximum Likelihood (ML) showed that *Alpinieae* was the basal group in Zingiberaceae, and *Etilingera* is monophyletic with a close relationship to *Wurfbainia*. The maximum likelihood tree of the four *Etilingera* within the family showed that plastomes can be used as a super-barcode to identify *Etilingera* spp. and provides an important reference and solid foundation in the establishment of species identification and phylogeny of Zingiberaceae.

Sustaining the Shrimp Aquaculture Industry in the Philippines through the Use of Biofloc Technology during the Nursery Production Phase in Tanks

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Nursery systems are valuable production tools in shrimp aquaculture that can support high-density culture of shrimp postlarvae (PLs), resulting in healthy and uniform-sized juveniles. The nursery production of shrimp is usually carried out in small ponds; however, the use of small and circular tanks with plastic liners is gaining popularity. From an industry standpoint, there is a need to assess how nursery systems can improve productivity of the shrimp production cycle. Hence, the use of small circular tanks coupled with the incorporation of biofloc technology was assessed in terms of its viability during the nursery production of the Pacific white-leg shrimp, *Litopenaeus vannamei*. A 450 m² plastic-lined circular tank was installed and prepared for the stocking of *L. vannamei* PLs at a density of 500 per square meter. Biofloc was produced and maintained throughout the nursery phase by adding brown sugar as carbon source at a carbon to nitrogen

ratio (C:N) of 10. Daily monitoring of the various water quality parameters was carried out, while presumptive vibrios were enumerated weekly. The shrimp juveniles were sampled for their body weight weekly until transfer to the grow-out ponds on the 30th day of culture. The different water quality parameters were within optimum levels required for shrimp growth. Presumptive vibrios were dominated by the yellow colonies. The shrimp attained 100% survival with an average body weight of 1.26 g and a feed conversion ratio (FCR) of 0.43 at the end of the nursery production phase. Our results indicate that the use of small circular tanks with biofloc during the nursery production phase of white-leg shrimp is feasible, and can be incorporated during the grow-out culture in sustaining shrimp production.

Behavioral Study on *Hirundo rustica tahitica* (Barn Swallow) in Koronadal City

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Barn swallow (*Hirundo rustica tahitica*) is one of the most globally distributed swallows, propagating successfully in human communities. In Koronadal City, flocks of barn swallows can be seen roosting in electric wires at night. Understanding their activities in the city could elucidate important questions as to why they are staying in Koronadal City. This study explores the roosting, location and behaviors of barn swallows in Koronadal City. Study shows that barn swallows roost between 5:41 P.M. to 6:16 P.M. The roosting time duration was found to decrease ($p < 0.05$) when population increases from June to October 2021. Barn swallows were identified within 60 establishments in Koronadal City with a total cumulative count of 7,860 individuals. Flight, movement, health and grooming, posture, energy conservation, nest construction, flocking, foraging and feeding young were among the nine categories of bird behaviors examined during the day. Flight, movement, posture, health and grooming, flocking, foraging and energy conservation were observed during the night. This suggests that barn swallows in Koronadal City develop adaptive behaviors, including zonation of their activities in the city.

Rapid Screening of Probiotic Candidates from Brackish Water Enriched with Organic Sources with High Carbon to Nitrogen (C:N) Content

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Most fish farmers use probiotics that are of terrestrial origins. Because of the differences in the environment of the fish and the source of the probiotics, the beneficial effects of terrestrial probiotics may be affected; thus, it is important to use host-derived probiotics or from the environment of the cultured organism to ensure the maximum effects on the host. Hence, this study aimed to isolate and characterize potential probiotics from brackish water that is used for fish or shrimp culture by enriching the water with organic source with high C:N ratio. Using a mesocosm study, brackish water was collected from the mouth of a river and placed in six 20-L containers. Water was enriched with either molasses or brown sugar to stimulate bacterial growth at a C:N ratio of 15. After twenty days, total heterotrophic bacteria were counted from the enriched water. Distinct bacterial colonies were re-streaked onto fresh nutrient agar plates with 1% sodium chloride and tested of their *in vitro* antagonistic activities against shrimp and fish bacterial pathogens. There were fifteen bacterial isolates that exhibited *in vitro* antibacterial activity. Their morphological features, biochemical profile and molecular identity will be presented. The implications of the study indicate that enrichment of brackish water with high C:N load may increase the possibility of isolating and developing potential probiotics that can be used for fish or shrimp aquaculture.

Screening of Bacteria from a Freshwater River in Iloilo City as Potential Sources of Bioplastics Production

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Bioplastics are made from renewable resources, are biodegradable and are synthesized using bio-based

polymers. These polymers can be obtained from a wide array of sources including plants, animals and microbes. There have been research initiatives on developing biodegradable alternatives to synthetic plastics, in the light of the recent problems on plastic pollution that is prevalent in both the aquatic and terrestrial environments in the Philippines. Polyhydroxyl butyrate (PHB) can be used as an effective thermoplastic, and it possesses many characteristics that are similar to standard commercial synthetic plastics. Although PHB-based plastic substitutes are less flexible than traditional synthetic plastics, the former is completely biodegradable, making it an environment-friendly alternative to traditional synthetic plastics. Microorganisms can be good sources of PHBs; thus, in the present study, PHB-producing bacteria were isolated from water samples obtained from a freshwater creek that exhibits high level of eutrophication. Serial dilutions of the water samples were prepared and plated onto EMB and MRS agar to isolate individual bacterial colonies. After incubation for 24 hours at 27°C, individual bacterial colonies were re-streaked onto fresh nutrient agar to obtain pure bacterial cultures. One hundred bacterial colonies were re-streaked and stained with 3% Sudan Black B to detect the presence of PHB granules. A total of six bacterial isolates stained deeply following addition with Sudan Black. These isolates were further characterized of their morphological, biochemical and molecular characteristics. Though the results are preliminary, the rapid screening approach that we utilized in this study enabled us to identify putative PHB-producing bacteria from a freshwater creek. This could open avenues for further research on the optimization of PHB production from these bacteria and use these microbial products as raw materials for the industrial production of bioplastics.

**Home-Based Research with Slime Molds:
Natural and Synthetic Substrates as
Spore Traps of Myxomycetes**

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Home-based experiments (HBEs) are vital to supplement educational experiences and to develop technical skills of students who are learning mainly

through online instruction. Myxomycetes are safe, non-toxic, widely distributed organisms, and therefore are ideal subject for home-based research. They can impact public health as biogenic aerosols that can trigger allergies among susceptible individuals. While the presence of myxomycete spores in air is undisputed, there are very few studies that identify substrates that can trap these airborne spores. In this home-based research, we evaluated six substrates – three natural, three synthetically-made – for their ability to trap myxomycete spores. We tested our spore baits under open-spaced, rural and enclosed or limited airflow, urban settings. Our study identified eight species of myxomycetes, namely, *Arcyria cinerea* (Bull.) Pers., *Diderma effusum* (Schwein.) Morgan, *Diderma hemisphaericum* (Bull.) Hornem., *Didymium squamulosum* (Alb. & Schwein.) Fr. & Palmquist, *Perichaena depressa* Lib., *Perichaena cf. vermicularis* (Schwein.) Rostaf., *Physarum album* (Bull.) Chevall., and *Stemonitis fusca* Roth. Among the substrata, we observed the presence of myxomycetes mainly in spore baits with leaf litter regardless of exposure time. We did not observe myxomycetes in baits with coconut coir fiber and dried sphagnum moss while the baits with synthetic substrates showed myxomycetes, albeit with very few numbers of records and species. The length of bait exposure did not impact the trapping of myxomycete spores. Our home-based research demonstrates that potentially allergenic myxomycetes can be captured by synthetic substrates in common households and as potential aero-allergens, are likely inhaled by individuals who use these materials.

**First Survey of Slime Molds in Mangrove
Forests of Negros Occidental, Philippines**

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The Philippines is one of the most mangrove-rich countries with approximately 365,000 ha of mangrove forest. However, only two surveys for myxomycetes have been conducted in such macrohabitats. This study evaluated the occurrence and diversity of myxomycetes found in Balarang Mangrove Resort (BMR) and Tomongtong Mangrove Eco-Trail (TMET) in Negros Occidental, Philippines. Four

hundred moist chambers were prepared for the collected bark and ground leaf litter substrates from the mangrove sites. Out of the 26 observed morphospecies, 23 species were identified and classified under 14 genera. The study showed that bark and ground leaf litter substrates have almost the same MC productivity of 68.5% and 67%, respectively. The taxonomic diversity index (TDI) of each mangrove forest was also assessed, wherein TMET (TDI = 1.1) was more taxonomically diverse than BMR (TDI = 1.62). Furthermore, there was a significant difference in the species diversity based on the presence and absence of myxospecies in BMR (HG = 5.14; HS = 2.83; ENS = 17) and TMET (HG = 3.17; HS = 2.29; ENS = 10), hence, the former is more diverse in terms of myxomycete species. The most abundant species recorded include *Diachea leucopodia*, *Trichia erecta*, and *Diderma effusum*, while *Diderma hemisphaericum* and *Ceratiomyxa fruticulosa* were found to be rare. Eleven myxospecies were shared by BMR and TMET, and community analysis revealed that the myxomycete assemblage of both mangrove forests were moderately similar (CC = 0.59; JS = 0.42). This study also documents the first reports of 13 species of myxomycetes from Philippine mangrove forests, thus providing baseline data of myxomycete species in the mangrove forests of the Negros Occidental province.

Media Optimization Using Synthetic Foliar Fertilizer on Tissue Culture Taro (*Colocasia esculenta* (L.) Schott)

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Taro (*Colocasia esculenta* (L.) Schott) belongs to most cultivated crop in the Philippines. It is grown using traditional techniques which often leads to high exposure in diseases such as corm rot and blight leaf disease. Together with the evolution of science, Taro has been subjected for *in vitro* propagation. To help the society and the field of biotechnology in limiting the cost production of *in vitro* propagation; the present study was directed to optimize the media using synthetic foliar fertilizer on tissue cultured taro. The aim of the study is to determine the growth rate, browning and plant survival of taro explants on the different concentration of foliar fertilizer, and compare its significant effect against the Murashige and Skoog (MS) medium. Taro plants were obtained from

the vicinity near the researchers place and their corms were cultured on the different media. The data were obtained by measuring the growth rate, browning and percent plant survival of taro explants of every medium in five replicates in the span of four to five weeks. The results showed that the medium containing ½ MS + ½ foliar fertilizer promotes the highest growth rate in taro with a 40% plant survival. However, it does not have significant difference against the MS medium. Hence, the growth rate of taro explants on the medium shows a relatively similar with those grown in MS medium making it suitable in subculturing the taro explants.

An Investigation on the Microplastic Contamination of *Oreochromis niloticus* Present in Laguna de Bay

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The prevalence of microplastics gathered a great deal of attention from the scientific community in the past decade. Microplastics have been found everywhere, from the shore to the deep sea, lakes, rivers, or even coastal sediments. These are usually small plastic pieces less than five millimeters long. Laguna de Bay, the largest lake in the Philippines, is one of the most important sources of freshwater fish, the Nile tilapia (*Oreochromis niloticus*). However, the lake has been contaminated with various pollutants like microplastics, industrial waste and untreated sewage, causing diseases and the death of many freshwater fishes. Hence, we assessed the possible occurrence and the type of microplastics present in Nile tilapia. From 50 analyzed *O. niloticus*, 23 had microplastics. Numerous organs like gills, stomach, intestines, liver, gonads and muscles were extracted and subjected to microplastic extraction by the Potassium hydroxide digestion method. Microplastics were examined and photographed under a light microscope with a magnification of 40x. Microfragments are the most dominant microplastics (68.97%) characterized by their irregular shape, whitish or yellowish color, and 0.54 - 3.48 mm size. Microfragments were also significantly higher in the intestines (48.28%) than stomach (31.03%), gills and muscles

(10.34%). Indeed, these results highlight the ingestion and accumulation of microplastics in the different organs of *O. niloticus*, causing a detrimental effect and a threat to aquatic ecosystems.

Preliminary Survey of Urban Trees along Friendship Circumferential Highway

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Due to the lack of understanding of how trees play a huge role in carbon sequestration, reduction of air temperature, removal of air pollutants and flood mitigation, benefits from trees are usually overlooked. With the faster rate of urbanization, which leads to a mass reduction of trees especially those alongside highways to accommodate the increase of buildings and roads in the city, atmospheric pollution has become one of the leading risks of death globally. With the gradual deterioration of the air quality and steady increase of the world's temperature, urban trees must be protected. Currently, 259 urban trees which are planted on Friendship Circumferential Road are threatened by the plan of widening the road. With this current situation, a preliminary survey was conducted in hope of obtaining knowledge regarding the health status, tree structure, tree species and ecological function of the trees. In conducting this study, a total of 89 trees were assessed; identification of tree species and mapping of these trees were accomplished. Air quality, air temperature, and soil temperature between sites that are shaded and unshaded by trees are compared to determine the ecological function of urban trees. The 89 assessed trees consisted of 84 *Albizia saman* or Acacia trees, three *Ficus benjamina*, or commonly known as Balete, and one *Sandoricum koetjape* (Burm.f.) Merr., or commonly known as Santol. While in the evaluation of the trees' health condition, one tree was already dead and the rest of the trees showed signs of being unhealthy based on the selected parameters. The results in shaded and unshaded sites revealed that urban trees have a huge role in the removal of air pollution and reduction of air temperature. By emphasizing the health conditions and importance of trees in urban landscape, the results from this paper will contribute in guiding the Local Government Unit of An-

geles City in the conservation and management of the surveyed trees.

Carbon Content and Capture Potential of Rain Trees along Filipino-American Friendship Highway

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The Philippines is one of the countries vulnerable to climate change. Anthropogenic activities induce emissions of greenhouse gases that elicit environmental impacts including, but not limited to, flood risk and air pollution. Highly populated areas are more prone to these effects due to the increasing demand of economic activities. The ecosystem services of trees are often neglected due to a lack of evidence in a local setting. However, urbanization ripples an impact thereby becoming a threat to urban trees and their ecosystem services. Pampanga is among the flood-prone areas in the country owing to its proximity to lakes and wetlands. Among its cities, Angeles City is one of the highly urbanized areas that participate in various economic activities. Thus, urban trees planted along one of its highways are susceptible to the road-widening projects in Angeles City. Presently, there are 259 trees planted along the roadsides of Filipino-American Friendship Highway in Angeles City that are threatened to be chopped down. Activities like this remain to compromise the carbon capture potential of the established trees. This study aims to provide further information about the roles of trees in urban landscapes, specifically in Angeles City by determining the carbon capture potential of rain trees along the Filipino-American Friendship Highway. Bark and leaf samples were collected in the field and were used to perform analysis in the laboratory. Allometric equations were used to estimate carbon content and storage potential. From the samples of 20 rain trees, more than 177 kg of carbon dioxide was sequestered. In estimation, the 259 urban trees along Filipino-American Friendship Highway have the potential to sequester up to 1,494 kg, or 1.49 tons, of carbon dioxide. Findings from the study offer relevant and science-based evidence in support to save the threatened trees.

Assessment of the Selected Ecological and Socio-Cultural Conservation Values of Urban Trees in Friendship Highway

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Urban trees are often undervalued and taken down for road-widening projects, especially in areas where temporary protection orders do not guarantee perpetual protection and conservation. The 164 selected trees along the Friendship Highway in Angeles City, Pampanga, were assessed in the context of ecological and socio-cultural conservation values. Soil and air temperatures, and the estimated amount of carbon sequestered by these urban trees were determined. Monitoring of soil and air temperatures was carried out in four shaded road segments and four unshaded segments at particular times (9 a.m., 12 p.m., 3 p.m., and 6 p.m.). The peak average soil temperature in unshaded segments was found to be warmer than in soil shaded by trees, with temperatures of 38°C and 32°C, respectively. The average air temperature of shaded segments (~35°C) was found to be much cooler than the unshaded segments (~38°C). Meanwhile, the estimated carbon sequestered by the 164 urban trees was estimated to be 279.04 tons/ha. The socio-cultural conservation values of the 48 respondents were included in the findings using questionnaires with a 4-point Likert scale. The perceptions of the respondents on the benefits of urban trees are stronger than perceptions of concerns. Also, the importance of these trees has mostly been perceived to be "very important," while programs for the management of urban trees are mostly perceived to be a "high priority." This study aimed to contribute to the existing knowledge about urban trees to justify their conservation and protection by highlighting their value and the services they provide in the ecosystem along the Fil-Am Friendship Highway, Angeles City, Pampanga.

Stomatal Characterization of Rain Trees (*Albizia saman* (Jacq.) Merr.) along Fil-Am Friendship Highway, Angeles City, Philippines

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Rain tree, *Albizia saman*, is a tree that is commonly planted along city streets as a natural filtration system, optimizing air quality through trapping particles on the leaf surface, primarily leaf stomata. The aim of the research was to characterize the stomata of rain tree leaves in different settings and to generate data on air quality. Leaf surface structure, stomatal density and distribution, number of open and closed stomata, and air quality were assessed. Samples were collected in Angeles City's Villa Teresa Clubhouse and on Fil-Am Friendship Highway, which was revealed to have a higher particulate matter content but a reduced air temperature. Stomata were observed employing the replica method. The results showed that there were fluctuations in the stomata characteristics of *A. saman* leaves in both locations. Closed stomata frequency and the size and density of stomata are greater on the Fil-Am Friendship Highway compared to the Villa Teresa Clubhouse. The average density of *A. saman* stomata on the Fil-Am Friendship Highway is 22635.37/mm², whereas it is 16766.94/mm² in Villa Teresa's Clubhouse. There was no variation in the distribution of stomata on rain tree leaves in both sites, all are entirely situated on the underside and are hypostomatic in origin, according to the foliar analysis.

T'S for Fears: Anti-Anxiety Activity of Philippine Tarantula Venom

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Spider venoms are reported to contain molecules which can alter its prey's neurobehavior by modulating neurotransmitters. This bioactivity provides a basis for studying the venom's potential therapeutic application against neurotransmitter-related diseases

such as pathological anxiety. In this study we investigated the anxiolytic activity of the venom extracted from a Philippine *Orphnaecus* tarantula species. Venom of tarantula collected from Lanao del Sur in Mindanao, Philippines, was extracted via electrostimulation and fractionated by reverse-phase high-performance liquid chromatography (RP-HPLC). Phosphate buffered saline-reconstituted fractions were administered intraperitoneally in adult zebrafish. Effect of venom fractions on fish neurobehavior was assessed by Novel Tank Test (NTT) and Fear Response, Social Interaction and Mirror Biting tests. Motion detection for the said tests was accomplished using idTracker, and data were analyzed using GraphPad Prism ver. 9.0. Glucose Oxidase test was performed using Sinocare-GA3 Glucometer on zebrafish blood to check for anxiolytic biochemical markers. Preliminary screening showed that fraction 4 exhibited an effect similar to diazepam, a standard anxiolytic drug, based on the recorded time spent on top by the zebrafish in the NTT. Other supporting tank tests displayed the fraction to produce similar behavioral effect on the tested zebrafish as with diazepam. Glucose oxidase test resulted in normal to lowered blood glucose level of the injected zebrafish, a characteristic of anxiolytic medication. These suggest primary evidence of the fraction's possible application in treating pathological anxiety.

<A prize winner of ePoster Session>

Effect of Phosphorus Leaching from *Fallopia japonica* Litter on Volcanic Ash Soil in Cool-Temperate Zone

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There are several volcanoes in the northern Kanto region, which belongs to the cool-temperate zone in Japan. Volcanic ash soils are difficult for plants to acquire phosphorus because of their strong adsorption properties. Phosphorus is essential for plant growth, but how plants obtain phosphorus in volcanic ash soils environment remains unclear. We hypothesized that the litter of the *Fallopia japonica*, which invades in the early stages of primary succession in cool-temperate zones in Japan, provides phosphorus to subsequent species. We began to study the effects of litter on the cool-temperate volcanic ash soil environment. The experiment was

conducted in the Nikko Botanical Garden, which belongs to the cool temperate zone. Using immature volcanic ash soil, Kanuma soil, an eruption deposit of Mt. Akagi in the northern Kanto region, and measuring plants dry weight after cultivation, we tested whether the growth of plants in primary succession was improved with or without the addition of litter leaves. The alder species found in the middle stage of the primary succession showed significantly improved growth and increased phosphorus content in the plants when litter was present. Hence, our study shows that the litter of *F. japonica* can be a source of phosphorus in the primary succession. We have now started the investigation of the speed at which phosphorus is leached out in cool-temperate environments. From autumn of 2021 to 2022, the phosphorus content of litter in *F. japonica* will be measured periodically in an attempt to get a complete picture of phosphorus leaching from litter in the cool-temperate zone. In 56th BIOTA & 28th AABE, we would like to present the results of our progress from autumn to spring.

Identification of Bacterial Community and Morphology of Skin Ulceration Disease in Sea Cucumbers (*Holothuria scabra*)

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The sea cucumbers are a diverse group of worm-like echinoderms, which can be found in almost every marine environment. They were regarded as a worthwhile candidate for sea farming, restocking, and stock enhancement. Among the different species, *Holothuria scabra* were considered the most commercially valued. Conversely, a contagious disease called Skin Ulceration Disease could develop during cultivation, in which the class of Holothuroidea is the most affected. The study investigated the bacterial community in the skin of *H. scabra* to determine the probable organisms that could trigger the disease. The *H. scabra* samples were collected from a hatchery in Masinloc, Zambales, Philippines. During the cultivation of the samples, one individual manifested the disease with a white spot near the cloaca and rapidly infected the other individuals on the following days. Their skin developed a laceration that eventually led to evisceration and the spread of ul-

ceration to the whole integument, which was ultimately followed by the death of the samples. Metagenomic analyses revealed that the predominant organisms in the skin of *H. scabra* were bacteria which comprised of 57,855 (98%) hits. While majority of the bacteria were unclassified with 13,615 (31.82%) hits, it was able to identify that there were a high proportion of bacteria in the phyla Bacteroidetes, Proteobacteria, and Firmicutes with a sequence hits and percentage of 9,300 (21.73%), 8,533 (19.24%), and 8,162 (19.07%), respectively. The genera identified were *Prevotella* and *Bacteroides* in the phylum Bacteroidetes; *Pseudoalteromonas*, *Alteromonas* and *Vibrio* in Proteobacteria; and *Clostridium*, *Ruminococcus*, *Lactobacillus* and *Bacillus* in Firmicutes. Furthermore, Hematoxylin and Eosin histological staining showed multifocal areas of necrosis affecting the epidermis, dermis, and superficial dermis of the skin of *H. scabra*. Findings indicated that bacteria impact the occurrence of the disease.

Assessment of Knowledge, Attitude and Practices on Solid Waste Management in the Province of Dinagat Islands

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The knowledge, attitudes and practices on solid waste management contribute through the proper segregation and recycling of the waste materials that starts in our household. This study aims to determine the specific variables using a survey questionnaire. It also aims to determine the significant differences between the profiles of the respondents. To assess the knowledge, attitudes and practices on solid waste management of Dinagat Municipality, Dinagat Islands, to get the desired sample size online calculator raosoft was used. This study revealed that it has a positive knowledge and attitudes in segregating recycling the waste materials properly. Also, the study revealed that sometimes they did not practice burning waste in their households that commonly they burn such as dried leaves. The effectiveness to improve the solid waste management at each household that the barangay needs to implement the amending resolutions, programs, trainings and seminar that related to solid waste management. Also, the baran-

gay should create a symposium regarding in burning of waste that can harm the human health as well as in the environment.

Water Quality Index as a Tool for Assessing and Monitoring Laguna de Bay from 2020 - 2021

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Laguna de Bay, in Southern Luzon, Philippines, is recognized as a major freshwater resource that provides multiple ecosystem services. The Laguna Lake Development Authority oversees its development, use and preservation, and is tasked with the periodic monitoring and gathering of water quality data. However, there is a disconnect between the value and interpretation of these data due to lack of a comprehensive and easily understandable metric. In this study, Water Quality Index (WQI) was used as a tool to assess the quality of the lake water based on seven parameters (fecal coliform, nitrate, inorganic phosphate, ammonia, biological oxygen demand, dissolved oxygen and pH) measured from 2020 to 2021. Quarterly data on these parameters from eight major monitoring lake stations were used to compute WQI values and to analyze temporal and spatial trends. Results showed lowest WQI values at the end of 2020, while the highest were seen towards the end of 2021. Principal Component Analysis (PCA) was employed to determine associations among water quality parameters, stations, and WQI values. Three prominent station clusters were generated: XVI of quarter 4 (Q4), 2020, V of quarter 1 (Q1), 2021 and XVIII of Q4, 2021, XV and XVII of Q4, 2020, and XVI of Q1, 2020 and XVI of Q1, 2021. Ammonia and inorganic phosphate were found to be major contributors to the similarity among WQIs of lake stations. Aquaculture activities, as well as the presence of residential, agricultural and industrial wastes may also account for the distribution of variables. Overall, there is concordance between and among the WQI values and water and land use. As WQI proves to be a useful multicomponent metric for evaluating water quality, environmental agencies should adopt its use as an indicator of water quality. We recommend the use of our approach in evaluating other body systems.

HEALTH AND WELLNESS

Inhibitory Property of Triterpenoid Saponins from *Holothuria scabra* (Sea Cucumber) against Matrix Metalloproteinase-1 *in silico*

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Common marine species such as *Holothuria scabra* (sea cucumber) that are commercially present in the Philippine archipelago, were said to be an important source of secondary bioactive compounds. In this study, the triterpenoid saponins from *H. scabra*, such as desholothurin A, holothurinoside C, and pervicoside C were assessed *in silico*, to determine its inhibitory properties against matrix metalloproteinase-1 (MMP-1). This enzyme (specifically collagenase) cleaves the collagen fibers present in the extracellular matrix that contributes to skin aging. The dermatologic activity of the triterpenoid saponins, and its binding affinities against MMP-1 were explored to determine the pharmacokinetic properties. It was found that each triterpenoid saponin represented by a Pa value of 0.408 for desholothurin A, 0.481 for holothurinoside C, and 0.297 for pervicoside C, which has a potential dermatologic activity. Molecular docking showed all triterpenoid saponins have strong (such as conventional hydrogen bonding) to weak molecular interactions (such as van der Waals forces and carbon-carbon interactions). However, holothurinoside C and pervicoside C showed unusual interactions and attractive interactions, respectively. The binding affinity of desholothurin A has the highest binding energy of -6.03 kcal/mol (37.79 $\mu\text{mol/L}$), followed by holothurinoside C with -5.46 kcal/mol (99.14 $\mu\text{mol/L}$), and pervicoside C with -3.05 kcal/mol (5480 $\mu\text{mol/L}$). Meanwhile, *in silico* pharmacokinetic studies showed poor pharmacokinetic parameters of the compound. Thus, all triterpenoid saponins represent a poor ADMET profile, but may play an inhibitory role in establishing protein ligand interactions via strong and weak molecular interactions, with holothurinoside C and pervicoside C showing unusual interaction and weak binding affinities.

Association of Interleukin-13 Gene Single Nucleotide Polymorphism rs1800925 with Allergic Asthma in Asian Population: A Meta-Analysis

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Allergic asthma is a multifactorial immune disorder characterized by elevated allergen-specific IgE production but controlled by genetic factors. The Interleukin-13 (IL-13) gene has been associated with allergic asthma pathogenesis due to genetic polymorphisms. The IL-13 Single Nucleotide Polymorphism (SNP) rs1800925 has been implicated to exacerbate allergic asthma symptoms. In this study, major databases were searched for the association of IL-13 rs1800925 to allergic asthma in various Asian populations. A total of 11 studies published between 2010 and 2021 were included in the meta-analysis. Odds ratio with 95% CI were obtained from each study, and the association was evaluated using heterozygote and homozygote comparison, dominant model, and recessive model. Subgroup analysis was also performed by ethnicity and age. A total of 2895 allergic asthma patients and 2914 non-allergic controls were included in this meta-analysis. Genotyping results showed that majority of the cases exhibited CC genotype ($n = 1897$), followed by CT genotype ($n = 852$), and TT genotype ($n = 146$). IL-13 rs1800925 was significantly associated with increased allergic asthma risk in the Asian population under the recessive model (TT vs. CT/CC: OR = 1.48, 95% CI = 1.14 - 1.93, $P = 0.37$, $I^2 = 0.08\%$). Subgroup analyses by ethnicity showed an elevated risk in West Asians (Iranian and Saudi Arabian) followed by East Asians (Chinese and Japanese). Both age groups (adult and children) exhibit an increased risk of allergic asthma. This meta-analysis provides evidence that IL-13 SNP rs1800925 is a risk factor for allergic asthma in the Asian Population. We recommended that IL-13 rs1800925 SNP analysis be conducted with a larger sample size and more diverse nationalities to obtain more comprehensive results, such as in a Filipino population to establish its role as a genetic marker for allergic asthma in the local setting.

Oxidative Stress Level among Filipino Women with Gestational Diabetes Mellitus

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Gestational diabetes mellitus (GDM) is the most common metabolic disorder complicating pregnancy with 18 million cases annually and still on the rise. Despite the recognized associated complications of GDM, its pathophysiological mechanism remains unclear. Findings have suggested that oxidative stress is significantly increased in GDM, which may have considerable clinical implications in the pathophysiology of GDM. This study aims to evaluate the maternal blood oxidative stress in GDM and non-GDM pregnant women and investigate its association on each diabetic parameter. A cross-sectional study was conducted involving Filipino pregnant women on their 2nd or 3rd trimester of gestation ($n = 60$; 30 with GDM, 30 non-GDM). Plasma protein carbonyl (PC) was measured using DNPH assay to assess protein oxidative damage. Plasma 8-hydroxy-2'-deoxyguanosine (8-OHdG) was assayed through ELISA to determine DNA oxidative damage, and total antioxidant capacity (TAC) was evaluated using a colorimetric assay to determine the antioxidative defense. Higher PC was observed in the GDM group indicating a higher protein oxidative damage than the non-GDM group ($p=0.004$). 8-OHdG and TAC levels did not differ significantly among the two groups ($p>0.05$). A significant negative correlation was noted for 8-OHdG and serum insulin levels ($p = 0.46$). Whereas, a significant positive correlation was noted for PC with FBS and 1st hr OGTT ($p=0.003$ and $p=0.008$, respectively). These findings highly suggests that oxidation status is increased in GDM, highlighting that protein oxidation increases together with hyperglycemia.

Coin-Operated Water Vending Machines: Bacterial Contamination Analysis

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Coin-operated water vending machines (locally

known as Automatic Tubig Machines) have been an instant and cheap source of drinking water around Cebu City, Philippines. They are mostly located along the sides of roads and streets making them prone to contamination. With the high risk of contamination of these machines, this study aimed to determine the bacteriological quality of potable water from coin-operated water vending machines around Cebu Normal University. Bacteriological analysis was done on water samples collected from five of these machines around Cebu Normal University. These water samples were sent to the Water Testing Laboratory, Vicente Sotto Memorial Medical Center for analyses of various quality parameters of bacterial contamination. Various quality parameters involved were total coliform, fecal coliform and heterotrophic plate count (HPC). The results showed that 100% of the samples analyzed had high concentration of total coliform, fecal coliform and heterotrophic bacteria. The levels of total and fecal coliform contamination and heterotrophic plate count have failed to meet the standards of Philippine National Standards for Drinking Water (PNSDW) and Dialysis Water Standard (DWS). By the results of the analysis, it was concluded that ATMs cannot ensure safe water public consumption as bacteriological concentration exceeded the minimum standards set by PNSDW and DWS. It is necessary to maintain cleanliness of the machines and the surrounding environment and help secure a reliable water source. Hence, proper safety monitoring of these machines should be regulated. Furthermore, it is recommended that further analyses of these machines with increased sample size and additional parameters for testing may be considered.

A Meta-Analysis on the Effect of Metformin vs. Pioglitazone Monotherapy on Plasma Adiponectin Levels

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Metformin and pioglitazone are two drugs with insulin-sensitizing properties used to manage type-II diabetes mellitus. Their impact on the endocrine hormone adiponectin, which functions in insulin

sensitization, has been studied; however, minimal publications are available that compare their effect on plasma adiponectin levels. Hence, we performed a meta-analysis to obtain more precise estimates and increase the individual studies' power. Related literature was searched in PubMed and Google Scholar until February 2022. Four studies were selected based on the inclusion criteria set, and relevant data were extracted and tabulated. Data were then analyzed using ReviewManager 5.4.1 by computing for both the mean difference and standardized mean difference. Pooled pre- and post-intervention results showed that plasma adiponectin levels are significantly higher in the pioglitazone treatment arm after the intervention than in the metformin group. Post-intervention diabetes-related markers were also compared between the pioglitazone and metformin treatment groups. The results show that HOMA-IR or the homeostatic model assessment for insulin resistance is significantly lower in the pioglitazone treatment group than in the metformin treatment group. However, in terms of BMI, the metformin group has significantly lowered BMI after the treatment compared to those who received pioglitazone. No significant differences were noted for HbA1c. Overall, our results suggest an association between the use of pioglitazone and plasma adiponectin levels. However, further studies are still needed to verify our claims, especially in the applicability of these results in the Filipino population.

Nutritional Assessment of Daily Dietary Intake during Pregnancy in Pre-Pandemic Period

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A woman's health and wellness status changes during pregnancy. These changes are essential for the growth and development of the baby; these include but not limited to the increase of daily macro- and micronutrients intake of pregnant women. A healthy pregnancy, supports a healthy mother to fetus nutritional transmission. However, there are complications in pregnancy such as gestational diabetes mellitus (GDM) that requires nutritional and dietary modifications. We aim to determine and evaluate the daily dietary intake of pregnant women during the pre-pandemic period. We gathered 248 informed and

consented pregnant women to participate in the study. After following the set of inclusion and exclusion criteria, there were 145 accepted pregnant women, 68 were diagnosed with GDM and 77 have normal glycemic control based on 75-g oral glucose tolerance test. To evaluate their daily dietary intake a validated questionnaire was used and administered via interview. Data analysis and calculations were performed in GraphPad Prism 9. The pre-pregnancy BMI of GDM women are significantly higher than non-GDM women, (25 ± 0.56 vs. 24 ± 0.63 $p < 0.05$). The percentages of women with GDM and without GDM who follows the recommended dietary intake were 100% and 43%, respectively. The nutritional plan for women with GDM includes, low carbohydrate intake (65%), reduced sugar intake (35%), and carbohydrate counting with food pyramid guidelines (18%). This study shows that for both pregnancy conditions the following were the topmost food choices: breakfast (rice, bread, egg, milk); lunch (rice, fish and vegetables); snacks (bread); and dinner (rice, fish and vegetables). This emphasizes that most pregnant women consider rice, fish and vegetable as the staple food for daily intake. Dietary intake of pregnant women during the pre-pandemic situation comprised mostly of carbohydrates, fiber, and proteins. The next direction of the study would be a comparison with pandemic and post-pandemic dietary plan.

***In silico* Evaluation of Caffeic Acid from Coconut Husks as an Inhibitor of Factor Xa**

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Selectively inhibiting the activated coagulation factor X (FXa) effectively blocks coagulation due to its position at the start of the common pathway of the coagulation cascade and is thus considered to have a broad therapeutic window as an anticoagulant target. Hence, many researchers have been studying the development of safer and more potent anticoagulants from natural products that target FXa. Coconut and its wastes, such as husks and shells, are found to be good sources of bioactive natural polyphenolic substances, such as caffeic acid. However, the anticoagulant activity of caffeic acid from coconut husks has not been studied yet. In this study, the inhibiting

capabilities of caffeic acid present in coconut (*C. nucifera* L.) husks on the FXa were investigated using a bioinformatic molecular docking method. The caffeic acid structure was obtained from the PubChem database while the structure of FXa was retrieved from the RCSB Protein Data Bank. Using the software, AutoDock MGL Tools, AutoDock Vina, and PyMol, the binding geometries of caffeic acid and FXa were visualized, the stability of the interactions of the ligand with the binding site of the protein was evaluated based on its binding affinity, and the potency of caffeic acid to inhibit the coagulation cascade was determined. Results of the molecular docking showed that caffeic acid bound to the S1, S2, and S4 pockets of the active center of FXa block the access of its native substrates. Hence, the results indicate that caffeic acid exhibits putative anticoagulant activity and can be used as a structural basis in developing selective FXa inhibitors.

Transcriptome Analysis Reveal Distinct Potential Biomarkers for Gestational Diabetes Mellitus

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The use of transcriptome analysis has been a useful tool in differentiating disease from non-disease states. In this study, transcriptome analysis was used to determine potential biomarkers for gestational diabetes mellitus (GDM). GDM is a common complication during pregnancy and is considered as a harbinger of the vicious cycle of diabetes as it affects the mother, the baby and health of the next generation. This emphasizes the need to improve GDM diagnosis to prevent the vicious cycle of diabetes. A cross-sectional study was conducted among 80 pregnant women. Blood samples were collected every trimester, and total RNA was isolated. After quality control and library preparation, next-generation sequencing was performed. Differential expression analysis was done. Enriched Gene Ontology: Biological Processes (GO: BP) terms and Kyoto Encyclopedia of Genes and Genomes (KEGG) pathways were identified. Gene co-expression networks were constructed. Protein-protein Interaction (PPI) networks were then built from modules significantly correlated with Hemoglobin A1c. Genes with the highest degree of interaction were

identified as hub genes. IGKV2D-28 and PTPRG were consistently differentially expressed among the three comparisons. Top enriched GO: BP terms and KEGG pathways are linked to immune responses. Orange ($r=0.59$, $p=0.02$) and purple modules ($r=0.41$, $p=0.02$) of the GDM cohorts in the first and second trimesters, respectively, significantly correlated with Hemoglobin A1c. HDAC8 of the orange module and MPO and CRISP3 of the purple module were identified as hub genes. In this study, potential biomarkers of GDM were identified, namely, IGKV2D-28, PTPRG, HDAC8, MPO, and CRISP3. Validation of these genes as biomarkers of GDM will improve early diagnosis of GDM.

<A prize winner of ePoster Session>

Molecular Docking Analysis of Flavonoids Reveal Eriodictyol'S Potential for Breast Cancer Treatment

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Breast cancer is the most prevalent cancer worldwide. Over 70% of breast cancer cases are estrogen-receptor positive and involve two receptor proteins. The binding of estrogen to estrogen-receptor alpha (ER α) promotes breast cancer growth while its binding to estrogen-receptor beta (ER β) inhibits tumor growth. While natural products have been a promising source of chemotherapeutic agents, the challenge remains in finding a bioactive compound that specifically targets cancer cells, minimizing side effects on normal cells. Flavonoids are natural products which act as phytoestrogens and induce the same response as estrogen. This study aimed to determine which particular flavonoids can specifically recognize ER β and potentially be used for breast cancer treatment. This was done through molecular docking of 206 flavonoids to ER β and ER α in Autodock Vina. Genistein is known as a flavonoid that exhibits anticancer effects by binding to ER β so its binding affinity was used as a baseline. Eriodictyol and 4'',6''-Di-O-Galloylprunin both exceeded genistein's binding affinity for ER β and was lower than its binding affinity for ER α . Of the two, eriodictyol was pursued due to previous reports of anticancer properties in other cancers. Protein pathway and gene analysis using ChEMBL and PANTHER showed that eriodictyol may induce anticancer effects through the ROS1,

CA7, KMO, and KDM1A genes which are involved in cell proliferation in other cancers. The high binding affinity of eriodictyol to ER β as well as its potential affected genes makes it a candidate for developing new breast cancer treatment. Verification through *in vitro* study is recommended.

PEDAGOGY AND BIOLOGY EDUCATION

Offline-Online Submission and Assessment System (OSAS) Chatbot as an e-Tool on Retrieval of Learners' Outputs in Earth and Life Science

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The COVID-19 had markedly impacted education that moved to distance learning. With this, the Basic Education Learning Continuity Plan (BE-LCP) emphasized the fairness of learners' access to technology, gadgets, and household assistance. Moreover, low-tech and no-tech approaches should consider (UN, 2020 & UNICEF, 2020). In response, the researcher created Offline-Online Submission and Assessment System (OSAS) chatbot employed in the Messenger app with features on submission and assessment strategy used in Earth and Life Science core subject where both offline and online can access. The 170 participants were among the selected grade 11 senior high school learners exposed to OSAS chatbot for 6-week. The 15-item OSAS Usability Scale was assessed, while the 3-item open-ended questions to analyze the learners' personal experiences made the study a mixed-method. The result of OSAS 15-item Usability Scale in terms of convenience, applicability, accessibility, organization and satisfaction were with all high-level interpretations. Besides, the 3-item open-ended questions focused on learners' experience revealed the OSAS advantages, such as accessibility even with a low internet connection, ease of assessment, convenience of submission, ability to track and monitor progress, user-friendly, no stress to use, and lower cost. On the other hand two drawbacks reported poor network signals and the pressing buttons. Overall, all learners recommended OSAS due to its convenience, ability to access even offline, less hassle on internet cost, effective aid in the teaching-learning process, and ability to track their progress personally.

Froguts as an Edtech Tool for Teaching Anatomy in a Grade 9 Online Class

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It has been challenging for online educators to utilize technology in teaching science that allows experimentation to better grasp practical applications. In maintaining a learner-centered environment, teaching strategies should employ lesson delivery that provides engaging activities to facilitate knowledge acquisition. It's important for learners to remember terminologies and recall pertinent details. It has been found that interactive simulations can be helpful in providing hands-on experiences. Several studies have compared learners' test scores after receiving traditional teaching methods versus undertaking virtual simulation. It has been observed that virtual simulations improve knowledge acquisition. The multi-sensorial stimulation from simulations motivates learners to actively engage, explore, and discover through manipulating an imitation of real objects and scenarios. This aspect of interactivity has been found effective in teaching anatomy in the medical field. Froguts virtual dissection has been considered as an alternative to actual dissection, and perceived to be an effective learning tool because of its visual appeal. This posttest only quasi-experimental study aims to investigate the effectiveness of Froguts as an Edtech tool in a Grade 9 online class for knowledge acquisition. Twenty-four students were employed in this study, with the control group receiving a traditional lecture on anatomy while the experimental group explored the same lesson by navigating Froguts virtual dissection. *t*-Test revealed no significant difference in the learning acquisition between the use of Froguts virtual software and a traditional online lecture. It could be inferred that learning acquisition of basic anatomical structures of the frog can be learned easily by attending a traditional lecture with a slideshow setup in an online environment. It is recommended to conduct a similar study on assessing a higher level of learning in the Bloom's taxonomy, employing more participants, and applying a time series design.

Case Study of Utilization of Social Education Facilities in Biological Education

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There are the special science courses for elementary and junior high school students in Ehime University. One of them is Ehime University Junior Doctor Training course. This course is aimed at 5th and 6th grade elementary school students and 1st, 2nd and 3rd grade junior high school students, and aims to provide special science classes for children who are highly interested in science and to improve their scientific inquiry skills. This course has about 20 science classes, some of which are in charge of social education facilities. In this presentation, I will report on the class I was in charge of at the Archaeological Museum at Matsuyama City and the Tobe Zoological Park of Ehime Pref. The archaeological museum's class was conducted in collaboration with curators and science education researchers under the theme of "Science of Ancient Fire." Furthermore, this course was developed and held at the museum as a special exhibition. In the zoological park's class, Students observed zoo exhibits and enrichment tools under the theme of animal welfare. We also provide career education on the work of veterinarians. About 10 students will be instructed by one university faculty member to work on the subject research. One of them studied the welfare of zoo animals. The student performed a behavioral analysis of the hamadryas baboon (*Papio hamadryas*). As a result, it became clear that the behavior of the hamadryas baboon changes depending on the use of enrichment tools and the season. The utilization of social education facilities has increased the attractiveness and educational effectiveness of special science courses.

Understanding Mitosis through Hands-on Activity Using Onion Root Tip Slide Preparation

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Mitosis is a cell-cycle stage during which condensed chromosomes migrate to the middle of the cell and segregate into two daughter nuclei before cytokinesis (cell division) with the aid of a dynamic mitotic spindle. Teaching this fundamental biological concept to high school and undergraduate levels requires hands-on activities using onion, *Allium cepa*, to demonstrate the process among the students. However, different processes yield variable results, which may not provide a clear resolution of the slides to examine the different mitotic stages. In this study, we developed rapid processing techniques for the onion to give a good resolution of the different mitotic stages using a combination of various established procedures. Results showed that root tips cut between 10:00 A.M. to 1:00 P.M. and pretreated with 0.02% Colchicine showed more visible chromosomes in metaphase and anaphase stages. Furthermore, root tip cells exposed longer to 0.02% Colchicine and Conroy's fluid than the standard resulted in bands in the chromosomes which were more enlarged and lightly stained. On the other hand, root tips that were directly hydrolyzed using 1N HCl without Colchicine pretreatment and fixation using Conroy's fluid resulted in the clearest appearance of chromosomes, and the bands are more visible in the chromosomes. Still, it could be observed that the size of the chromosomes does not vary so much. The modified protocols resulted in more visible chromosomes of *A. cepa*, specifically that of anaphase and metaphase stages. Our results demonstrate that the different stages of mitosis can be visualized using a combination of established procedures. These steps that we developed could be integrated with the hands-on activities in the teaching of mitosis to high school and undergraduate biology.

Preliminary Implementation and Evaluation of Haynayan AR App in PSHS-CLC Biology and Integrated Science Classes

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In pursuit of continually providing innovations and approaches in teaching and learning as further advancements of the Digital Era, the Haynayan AR app is among the first Filipino-developed augmented

reality (AR)-based mobile application dedicated to understand several topics in biology. It can be downloaded for free and it offers access to interesting topics such as Cell Theory, Cell Structure, Prokaryotes vs. Eukaryotes, Cell Cycle, Cell Modification, Transport Mechanics and Microscope. The Haynayan AR app has the primary target of improving student's learning experience through its modern and exploratory features. In order to test for its effectiveness and usability, the Haynayan AR app has been implemented and integrated in Biology and Integrated Science classes of Grades 8, 9 and 10 students of the Philippine Science High School- Central Luzon Campus (PSHS-CLC). PSHS-CLC Biology and Integrated Science subject teachers incorporated the use of the Haynayan AR app in the lessons to assess the student's comprehension of the concepts tackled in class. Through its gamified augmented-reality based features, students were able to enhance their mastery and understanding of biology lessons. Results also showed that there was a statistically significant improvement of student scores in the pre-test and post-test with the utilization of the Haynayan AR app, having a p -value of 0.001. In addition, based on the usability evaluation of the Haynayan AR app, it was found out to be user-friendly, reflected good system management arrangement and was useful both in teaching and learning of various biology topics. Lastly, it is noteworthy to mention that the Haynayan AR app offers students and teachers an opportunity to explore and further understand biology concepts through its unique design and helpful features. It is further recommended to include more topics in the mobile application for a wider scope of interactive learning and cognizance of learning biology.

Effects of COVID-19 Pandemic in Choosing Biology Related Careers among Graduating Stem Students

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The extent of the COVID-19 outbreak is undeniably vast. It has affected science and medicine, economics, education and even on the aspect of a person – physical, social, spiritual, emotion and most of all mental. The modality of schools was swiftly changed and as result many struggles and challenges

occurred. Many students gave up along the way because they could not get along with the new learning modality and or was included among those who experienced the “digital division”. In addition, even the professional careers were challenged. Many new career opportunities blossomed but other careers were found to be drifting and obsolete to meet the demands of the pandemic and the 4th industrial revolution. In this qualitative study, the researcher aimed to answer – how does the COVID-19 pandemic affected the decision making or career choice of graduating STEM students in opting biological science related careers in college? Using purposive sampling, 20 graduating students participated in a focus group discussion. It was found out that majority of the participants shared that their decisions were influenced by the pandemic. In both ways, it encouraged them to pursue careers in biological sciences, but others opt to take non biological science courses because of fear, and they found that most medical frontliners are not properly compensated in the country. It was recommended to expand the research to other strands and tracks in of SHS.

Development of Natural Science Books for International Students from English-Speaking Areas and Kanji (Chinese Characters)-Using Areas

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Students who want to study the natural sciences using Japanese in Japan are restricted from traveling due to the COVID-19. The purpose of this study is to develop a bilingual version of the book materials so that students can study the natural sciences using English and Japanese. As the first step, we are working on a bilingual book of Professor Emeritus Osamu Mitamura "If you look at the lakes of the world, you will understand the way to live - Recommendations for comparative limnology". This book is a record of Prof. Mitamura studying lakes around the world with local researchers. The description of the specialized field of comparative limnology should be as simple as possible, and the content should be rewritten by Prof. Mitamura so that international students can get to know the lakes of the world and be interested in environmental conservation. It was a Japanese-English book, and many pho-

tos were inserted. This time, we added ruby text to Japanese text and developed a book in a format that alternately shows English text every few lines. Japanese-English bilingual books will be distributed free of charge on condition that they cooperate with the questionnaire and will be used as a reference for future teaching material development.

Practice by University Students Supporting Observational and Experimental Classes Using Insects

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Observations and experiments are described as an important means for pupils to act with their own prospects, as well as to develop their problem-solving abilities in the Science section of the Japanese Elementary School Courses of Study. A Grade 3 science textbook describes the observation of insect metamorphosis using the cabbage butterfly *Pieris rapae*. However, when *P. rapae* are collected from outdoors and reared indoors, they sometimes die because they fail to develop into pupae or adults. The cause of this phenomenon, which is puzzling to the pupils, is due to Parasitoid wasps named *Cotesia glomerata* that parasitized the *P. rapae* larvae. This concept of parasitism is not originally taught in the Grade 3 elementary school science, but will eventually be taught in Grade 6, making it a valuable teaching tool for observations and experiments. We rear armyworm *Mythimna separata* in our laboratory, a complete metamorphic insect belongs to Lepidoptera, the same order as *P. rapae*, and *C. kariyai*, a parasitoid wasp that parasitizes the armyworm *M. separata* larvae. Therefore, using *M. separata* and *C. kariyai*, we developed teaching materials for observations and experiments that include the concepts of parasitism as well as body structure and metamorphosis of insects described in textbooks. Class support was provided by university students, who were divided into three roles: lead instructor, assistant for observations and experiments, and coordinator. The results of a questionnaire survey of the pupils showed that their motivation for the subject of science and experiments was significantly higher than before the class was implemented. In addition, the university students in each group carefully and kindly assisted

and explained the experiments in detail, which immediately resolved any questions that the pupils had, and this is thought to have contributed to the good survey results.

Computer-Based Simulations as Learning Tools in Biology Labs during COVID-19 Pandemic: Salient Findings and Implications

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How do computer-based simulations (CBS) substitute in-school biology lab experiments? As the COVID-19 pandemic continues to affect the education sector, teachers and educational practitioners developed hybrid learning modalities to address students' needs and continue the delivery of quality instructions. This study employed inquiry-based lesson (IBL) design following the 7E instructional model, with the use of CBS to teach cell division (mitosis), anatomy and physiology (tissues), and some 21st biological tools and techniques - spectrophotometry, lyophilization, and microscopy. Furthermore, a modified Computer Class Environment Inventory (CCEI) was utilized to assess students' perceptions of a learning environment that involve both IBL approach and the use of CBS. Respondents' cognitive outcomes were evaluated using the cognitive achievement test questionnaire. Results revealed that students find the intervention to be highly investigative (4.10±0.38), open-ended (3.80±0.47), organized (4.00±0.41), user-friendly (4.09±0.48) and sufficient (4.10±0.46). In addition, students' cognitive skills (remembering, understanding, applying, analyzing, evaluating, and creating) are all proficient in the three biological concepts after engaging in the CBS learning environment. Lastly, statistical tests demonstrated that there is a positive relationship and significant correlation between the cognitive skills of the students and how they perceived the computer simulations that were implemented with p -value of 0.411, 0.277, 0.322, 0.336 and 0.297, respectively. Meaning to say, when the simulations are investigative, open-ended, organized, user-friendly, and sufficient in nature, it results in

a high level of cognitive skills. Implications in these results include the credible explanation of the build-up of psychomotor learning due to high engagement of cognitive processes facilitated by inquiry-based computer simulations. With the ongoing pandemic restrictions, this study supports the use of CBS as an effective and alternative learning tool in laboratory subjects.

Development of Experimental Class of TCA Cycle by Thunberg Tube for Japanese High School Biology

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In high school biology, observations and experiments are more effective than classroom lecture understanding each chapter for students. However, most of experiment class are only picked up a limited part of content and are not covered whole one. The experimental class using Thunberg Tube is described at TCA Cycle of Catabolism chapter in Japanese high school Biology textbook. Since the description of experiment using Thunberg Tube in Japanese high school textbook was specialized for only succinate dehydrogenase by methylene blue decolorization, it may be difficult for students to extend their understanding of the entire TCA cycle from this experiment. Therefore, a better understanding of whole TCA cycle for students also needed more experiments with other substrates in the TCA cycle. Because coenzyme FAD was only required for succinate dehydrogenase reaction in TCA cycle, succinate dehydrogenase reaction using Thunberg Tube by methylene blue decoloring might be located as detecting reaction of other TCA cycle substrates. In this study, several substrates of TCA cycle, succinate, citrate, oxaloacetate, malate, fumarate, were tested to detect reaction by the Thunberg Tube method using yeast. The reaction time measurements of methylene blue decoloring showed that all substrates, except for succinate, required longer decolorization times in order of the TCA cycle. These results suggested that experiments of TCA substrates using yeast by the Thunberg Tube method might be effective to recognize whole TCA cycle for students in biology experimental class, and corresponding relationship between substrate orders and reaction times could

become inquiry educational materials in high school biology. Investigation into the relationship between reaction time and more other substrates is now in progress.

The Methods of Recovering and Inducing Vine-Less Phenotype by Gibberellic Acid Treatment in Common Bean (*Phaseolus vulgaris* L.) Used for Experimental Class of High School Biology

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Gibberellic acid (GA) is one of the plant hormones to regulate plant height, seed germination, and so on, which is learned at high school biology in Japan. In Cambodian textbook, because description of plant hormones was only theoretical, an experimental class on GA would be needed. To introduce the content of plant hormones of Japanese biology textbook, including GA, into Cambodian biology textbook, development of the visible biology materials and experimental materials will be effective for students to learn about them. To watch GA's effect, recovering plant height from dwarf by exogenous GA treatment or inhibiting plant height to dwarf by GA inhibitor treatment may be easy and understandable for students. Common bean is one of the vegetables cultivated worldwide. While the normal phenotype is vine type, the dwarf phenotype shows vine-less. Recovering experiment from vine-less phenotype to vine phenotype by GA treatment, vine-less type of cultivar 'Morocco' was used in this study. The experiments were designed as two models, A and B. Model A: a plant was sprayed the GA solution once a week, and model B: a plant was sprayed GA solution twice a week. Four kinds of concentrations of GA solutions were treated in these two experimental models. The results showed that recovering of stem and internode elongation from vine-less phenotype depended on not only GA concentrations but also model. Because model B, twice treatment in a week, showed more vine recovering than model A, once treatment in a week, these results suggested that the effect of exogenous GA treatment for elongation could not continue for a week. So, twice treatment of GA in one week was recommended for student ex-

perimental class.

Use of Polarized Light Microscopy to Observe Crystalline Substances in the Biomineralization Processes

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A simple and rapid polarized light microscopy without any staining procedures has been introduced here at the secondary education level as a series of students' practical project-based learning (PBL) studies, thereby monitoring the biomineralization processes of freshwater sponges' recolonization and dental plaque biofilms formation. Both specimens have crystalline aggregates inside or outside the organic cellular substances. Under the crossed nicol condition consisting of a polarizer and analyzer pair integrated to a phase contrast microscope (Wraymer, Osaka) the crystalline particles indicate bright spots in the dark background. This enables us to trace the targeted fragments back possibly gathering together, settling down or dispersing alongside the lifecycle of each organism having any molecular repeating structure. In the case of freshwater sponges, the original structure of parental biomass and the relevant skeletons of biogenic silica can be observed by this technique, though the spicules are usually observed by the SEM. Dental plaque portions could be cultivated on a standard plate count agar (Nissui, Tokyo) supplemented with urea, showing blue opaque colonies because of the urea hydrolysis. Most of the blue colonies produced the crystalline aggregates of calcium apatite crystals, eventually leading to the tartar deposits on human teeth. Interestingly, the similar blue colonies having crystalline particles were also isolated from the biofilms of submerged rock surfaces in the shallow pools, the Shirokita Wand, of slow watercourse down the Yodo River, Osaka, Japan. The current methodology proposed herewith would be particularly suitable for high school students to carry out self-motivated research works with

a minimum investment requirement. The current method could be widely applicable for many other biogenic substances such as cellulose of waterweeds, cuticle layers of nematodes, and reserved polymer granules of bacteria.

Study on Observation Method of Cytoskeleton by Microscope in High School

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The pictures of cytoskeletons first appeared in all Japanese high school Advanced Biology textbooks in 2013 because of the directive "to deal with the structure and function of cytoskeletons" mandated in the 2009 Course of Study. The Courses of Study were revised in 2018 and the directive "to deal with cytoskeletons" remains. The fluorescence microscopic images of the cytoskeleton are also included in Advanced Biology textbooks approved this year. These images were taken with fluorescence microscopes or confocal laser microscopes using fluorescent antibody techniques, which are unavailable in high schools, so students cannot observe real cytoskeletons. Therefore, in 2018, we proposed that microtubules and actin filaments could be observed with a student optical microscope by the immunoenzyme technique using tubulin antibody and biotinylated phalloidin, respectively. We also reported the practice of using this technique in an actual high school class. We used the cultured cells, such as Hela cells, which are not readily available in high school biology labs. In this paper, we report on the method for observing the cytoskeleton using silkworm hematopoietic cells, which can be obtained easily in Japan. We will also introduce the cells, which can be easily cultured by high school students. [This work was supported by JSPS KAKENHI Grant Number JP25350209 and JP17K01042.]

<A prize winner of ePoster Session>

From the Editor-in-Chief

The COVID19 pandemic, which started in early 2020, still continues in 2022. The AABE Biennial Conference, one of the major AABE activities had to be postponed due to the pandemic. Fortunately, in April 2022, with the Biology Teachers Association (BIOTA) Philippines, AABE could hold its Biennial Conference (AABE28) as a joint online event, the BIOTA 56th National Convention and Scientific Sessions and AABE28.

Under such severe circumstances, we have been publishing the *Asian Journal of Biology Education* (AJBE) every year since 2018. In the present issue of the journal, AJBE vol. 14, there are one practical note, two country reports, and the AABE28 conference report.

During last two years, the manuscripts contributed to AJBE have been peer-reviewed by the following persons as well as the Editorial Board members: Professor Hiroaki Asaga (Meiji University, Japan), Dr. Nobuaki Asakura (Kanagawa University, Japan), Dr. Cheung Ming Cherry Chow (The Chinese University of Hong Kong, HKSAR), Dr. Go Katayama (Takasaki University of Health and Welfare, Japan), Professor Robert Wallis (Federation University, Australia) and Ms Kwan Mei YAM (The Chinese University of Hong Kong, HKSAR). I am very thankful to them for their efforts to review manuscripts critically.

By the way, for twenty years, since 2002, I have been serving as the AJBE Editor-in-Chief. During the period, the AABE has been able to publish fourteen issues of AJBE. I am grateful to all contributors, AABE members and AJBE readers for their continuous support to publish AJBE. I am proud of maintaining the high quality of the AJBE as an academic journal. Now, I will leave this work. I have asked Dr. Shigeki Mayama to take my place. Since 2012, Dr. Mayama has been working on publishing the AJBE as an AJBE editorial board member. He also managed to register AJBE for J-stage, an online system of searching for research papers, to make AJBE a well-known journal worldwide. From now on, AJBE will be on a par with preceding journals on biology education, such as *Journal of Biological Education* and *American Biology Teachers*. I have no doubt Dr. Mayama will conduct the editorial work of AJBE much better than I have done. I keenly hope AJBE will include many good quality articles and be published continuously. From January 2023, please send your manuscripts to Dr. Mayama (mayama@u-gakugei.ac.jp).

Thank you all very much for your cooperation.

Dr. Nobuyasu Katayama