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Kulliyyah of Science,
International Islamic University Malaysia (IIUM)

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OCEANOGRAPHER

HIGHLIGHTS

Predicting Waves: How scientist work miracles

Ocean observation from the space : An Introduction

Technology for Reducing Ocean Plastic Debris

CONTENT

features

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EDITORIAL MESSAGE

"You must not lose faith in humanity. Humanity is like an ocean; if a few drops of the ocean are dirty, the ocean does not become dirty."
— Mahatma Gandhi

Dear Readers,

This is my second issue as a managing editor (*which I am truly honored*) and we hope it will continue to bring joy and information to you all.

Malaysia is a nation surrounded by ocean, more than 70 percent of her borders are surrounded by South East China Sea and Melaka Strait. Thus, it is necessary to continue monitoring changes in our ocean because it will directly impact our daily life.

The importance in understanding our ocean characteristics, behavior and its organisms lead us to developing new techniques in oceanographic studies. Which in this issue we share new methods in predicting waves.

Sea urchin is one of Malaysia natural resources in our ocean. The study of sea urchin in importance to understand the ecology and economic contribution. Thus, we are glad to share about the reproductive biology of this organisms with you.

Lastly, I would like to thanks the contributors from various institute and research centers. I hope we can truly support each other to move forward in marine science research. Thanks !

Enjoy reading!

Dr Fitri Yusof
Managing Editor
The Oceanographer

FOREWORDS

Assalamualaikum w.b.t., I am pleased to welcome the readers to Volume 8: Issue 1, 2018 of The Oceanographer. This newsletter is dedicated in highlighting the recent news, activities and findings in the field of oceanography and aquaculture conducted by INOCEM Research Station.

INOCEM is formally established to promote high quality integrated research activity related to the sustainable exploitation of natural resources in the fields of marine science and aquaculture. Since the establishment of INOCEM in 2003, our focus in promoting high quality education, research, training, and outreach in our field still continue. INOCEM researchers, assisted by Department of Marine Science researchers, are committed to achieve this vision by initiating academic and research collaborations within IIUM and other institutions.

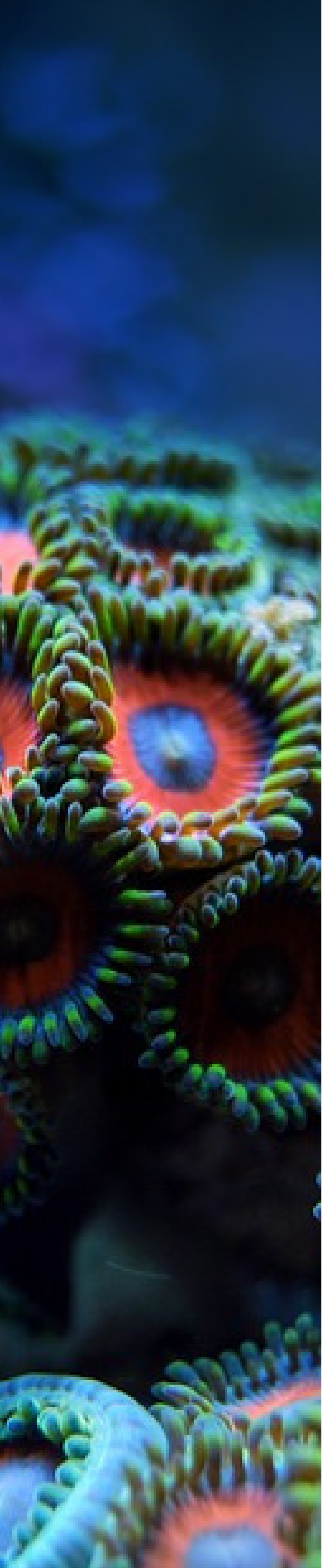
As part of IIUM Kulliyyah of Science, it is our duty to assist in teaching and learning activities. Our main services includes aquaculture hands-on, boating services, sampling, oceanography equipment handling and scuba dive expertise. Our service is not solely assisting in Marine Science field, but to other field as well, e.g. biotechnology, social science, health, plant science etc, as to promote inter-disciplinary research.

This, could lead to awareness on environmental issue through the youth group, as research and knowledge are always related and will evolve through time. Through such knowledge, one could be an environmental keeper and be part of the world in battling our ocean recent issue; climate change, marine debris, microplastic and future ocean threat. Such objective was also embedded in one of our community program with primary school children, where we nurture them with relevant knowledge that could lead them towards sustainable of our environment in the future.

I am deeply appreciated the effort by the editorial board members of The Oceanographer, lead by Asst. Prof. Dr. Fitri Yusof and the contributors from various universities. This newsletter could be considered as one of the bridge that could link INOCEM outreach and visibility purpose in academic world. I hope this annual Newsletter will continue with endless scientific exploration and circulate new research findings towards the sustainable development of marine resources in our nation and global. Thank you

Dr Mohd Fuad

Head,
INOCEM ,IIUM



DEAN`S MESSAGE

INOCEM is part of the Kulliyyah of Science to assist in teaching and learning, as well as of marine-based research activities. The station is located near at Cherok Paloh, Pekan, Pahang with easy access to ocean and river and is equipped with high-tech equipment for their scientific endeavour.

In the age of urbanisation and industrialisation, it is a great challenge to think and use the current science knowledge on marine ecosystems and the organisation of science to support an integrated approach to the management of the seas. Research on new sustainable solutions to the problems involving marine environmental and biodiversity issues should be done innovatively to protect this ecosystem for sustainability of the resources.

The INOCEM researchers are committed by initiating several activities including academic and research collaborations within IIUM and other institutions. One of our recent efforts is through becoming a member of ASEAN-FEN (ASEAN Fisheries Education Network), whereby it is hoped that the networking with 29 other institutions will be further expanded with the signing of MOU.

I would like to congratulate the editorial board members of The Oceanographer. I hope this newsletter keep highlighting scientific exploration and promoting sustainable utilisation of ocean resources.

Thank you.

Dr Shafida Abd Hamid
Dean
Kulliyyah of Science

RESEARCH COLUMN

How Scientist Works Miracle

Predicting Waves

Dr Zahir revealed about Weakly Compressible Smoothed Particle Hydrodynamics (WCSPH) Method to simulating 2-Dimensional Propagating Waves

Contrary to the work of craftsmen which relies on pre-scientific rules based on trial and error, the power of engineers is to provide models in order to study dimensions and then build artefacts that will be used in a certain context. Therefore, it is necessary to take into account the effects of environmental physics on the studied object. Over the years, many steps have been taken towards a deeper understanding of fluid-structure interactions and of related phenomena. Recently, the interactions of ships with very large ocean waves when underway have been the subject of interest to naval architects and have been the motivation for a number of new studies. For example, when slamming in heavy seas, the hydrodynamic impact may result in damage to a ship's structure. The tragedy of MV Estonia in the Baltic Sea on 28 September 1994, one of the deadliest marine disasters of the 20th century, resulted from the breaking of the bow door due to severe slamming. Another phenomenon that can lead to the large-scale deformation of the free surface in ocean waves is known as green water loading or shipping of water, as well as sloshing, which may cause structural damage as well.

As water-ship interactions and related phenomena problems became more serious, in the mid-1950s rapid expansion began in the application of hydrodynamic theory, the use of experimental model techniques and the collection of full-scale empirical data. These important developments led to a better understanding of the problems and ways of dealing with them. In experimental studies, most of the time, the ship model is built and tests are performed in a numerical towing tank (NWT). The aim of the tests is to measure ship responses to different wave conditions, ship speeds, relative wave headings, and sea states etc.

Although model tests are considered to be reliable tools, they are rather expensive and time-consuming, thus the test conditions need to be carefully chosen and well planned. Most of the data from these tests have been published with continuous effort spent to develop suitable tools as important assessment work of verification and validation to handle more complex relevant phenomena involved and to give valuable data. Therefore, efforts in developing numerical approaches are focused on filling the gap, in terms of the reliability, efficiency, and robustness of the solvers.

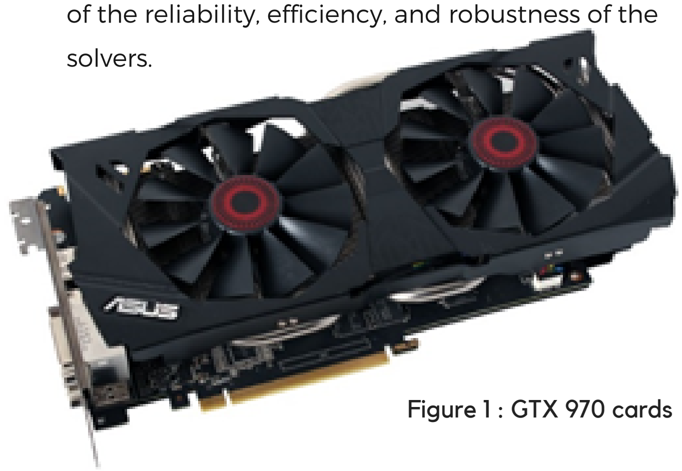


Figure 1 : GTX 970 cards

Table 1-0 Specifications of GeForce GTX 970 GPU card.

CUDA cores	1664
Base Clock (Mhz)	1050
Boost Clock (Mhz)	1178
Memory Clock	7.0 Gbps
Memory Interface	GDDR5
Memory Interface Width	256-bit
Memory Config	4 GB
Memory Bandwidth (GB/sec)	224
Bus Support	PCI Express 3.0
Max Digital Resolution	5120x3200

Smoothed Particle Hydrodynamics (SPH) which is purely Lagrangian method developed during the seventies was an attempt to model continuum physics to overcome the limitations of finite difference methods. The Lagrangian method is a meshfree method whereby the computational domain is represented by a set of interpolation points called particles rather than grid cells.

Each particle carries an individual mass, position, velocity, internal energy and any other physical quantity which evolves in time according to the governing equations. All particles have a kernel function to define their range of interaction, while the hydrodynamic variables are determined by integral approximations. These methods, where the main idea is to substitute the grid by a set of arbitrarily distributed particles, are expected to be more adaptable and versatile than the conventional grid-based methods, especially for those applications with severe discontinuities in free surface. To portray the capability of this particle method, a free surface fluid solver called DualSPHysics are employed.

DualSPHysics is a highly optimised code used for solving 2-D and 3-D Navier-Stokes equations using C++, OpenMP and CUDA for the simulation of potentially violent free-surface hydrodynamics. The code is based on WCSPH and can be modified to simulate various phenomena, including wave breaking, dam break flows, sloshing, floating objects, wave impact on a structure and multi-phase simulation.

DualSPHysics incorporates a numerical diffusive term which reduces the density fluctuations effectively. The version used in this study is 3.1. All simulations are run on graphics processing unit (GPU) that is 5 to 10 times faster than a single central processing unit (CPU) runs. GPU used in this study is GeForce GTX 970 and the specifications are provided in Table 1.0. WCSPH formulations are employed in order to simulate long non-breaking wave propagation. First, the structure and capabilities of the DualSPHysics code used are analysed. Propagating waves are absorbed by a numerical beach that is placed at the right end of the numerical tank as damping layer is not available in DualSPHysics. A wave maker is used to generate and propagate the waves. In this simulation, a sinusoidal movement is imposed on 2 layers of boundary particles which act like a piston.

The simulation is run by open source code and the results are obtained in binary files. The binary format is used to reduce the volume of the files and the time needed to generate them, allowing simulation with a high number of particles. The data from these binary files are then used as input to extract different physical quantities at a set of given points using the MeasureTool.exe.

For example, in order to determine the position of the free surface, the numerical values are computed by means of a SPH interpolation of the values of the neighboring particles around given points along the y-axis.

Table 2-0 Total runtimes of GPU performance for different cases for convergence studies

Case	Initial particle spacing, □□ (m)	No of Internal Particles	*H* (m)	Runtime, simulation (s)	Runtime, real-time (s)
1	0.030	3309	0.05	60	489.68
2	0.015	13719	0.05	60	3500.12
3	0.010	31218	0.05	60	13109.18
4	0.030	3309	0.10	60	507.87
5	0.015	13719	0.10	60	3716.93
6	0.010	31218	0.10	60	11718.22

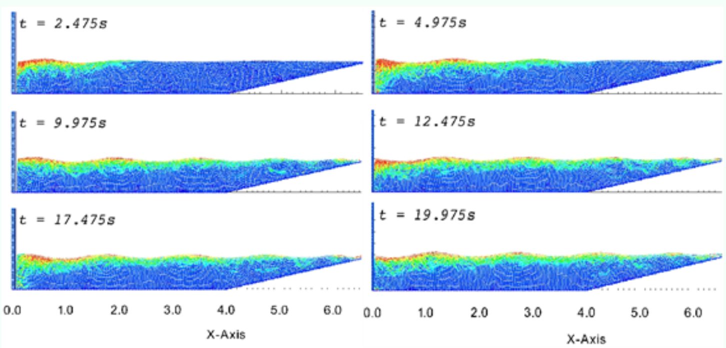


Figure 2 :Kinematic distribution of WCSPH over time. Wave height H=0.05 m; wave length λ=1.5 m; water depth d=0.6 m; tank length L=6.0 m.

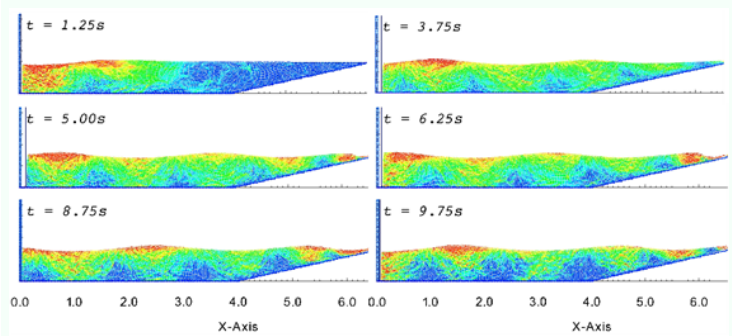


Figure 3 : Kinematic distribution of WCSPH over time. Wave height H=0.10 m; wave length λ=3.0 m; water depth d=0.6 m; tank length L=6.0 m.

At all these points a value of mass is computed and when this value of mass equals half the reference mass (0.4 in 2-D), that y position is assumed to be the free-surface position. Refinements with more points along the y-axis will result in more accurate free surface representation.

The evolution of waves can be seen in Fig. 2 and Fig. 3 for wave height, H=0.05 m and H=0.10 m. The red contour shows the higher velocity values which propagate waves along the tank. In both cases, WCSPH is able to maintain a stable propagating wave without the elevation of mean depth and numerical beach is observed to damp out all the incoming waves effectively. Overall, WCSPH agrees well with potential flow theory.

The wave profiles of WCSPH can be observed to be in symmetrical indicating small influence of nonlinear effect.

However, a slightly sharp wave peak and wave crest can be observed in the first 0.5 m and 1.0 m. This may be caused by the position of the moving piston. Horizontal movement of the piston pushes some of the particles nearby with large force at the initial stage before fluid particle redistribute themselves into a stable optimized particle distribution. Therefore, it is best to allow the fluid flow to initialise and become steady before the moving of the piston commences. In general, results from DualSPHysics WCSPH show a good agreement with potential flow theory in free surface profile and velocity distribution.

Although in both cases the pressure values are slightly higher near the wave crest, the small errors are assumed to be negligible. For convergence studies, the parameters are set and listed in Table 2.0. Smaller initial particle spacing indicates a larger number of internal particles and requires a much longer simulation run-time. dx = 0.010 m took 3 times longer to finish the simulation than dx = 0.015 m, which took only 8 minutes to complete.

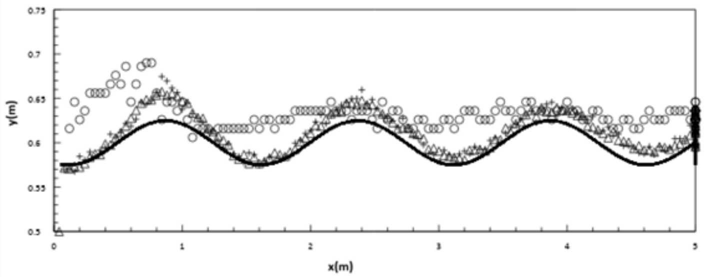


Figure 4 : Comparison of free surface predictions. Wave height H=0.05 m; wave length λ=1.5 m; water depth d=0.6 m;t=58.75 s; tank length L=6.0 m. ∘ : dx of 0.030 m; + : dx of 0.015 m; Δ : dx of 0.010 m; - : potential flow.

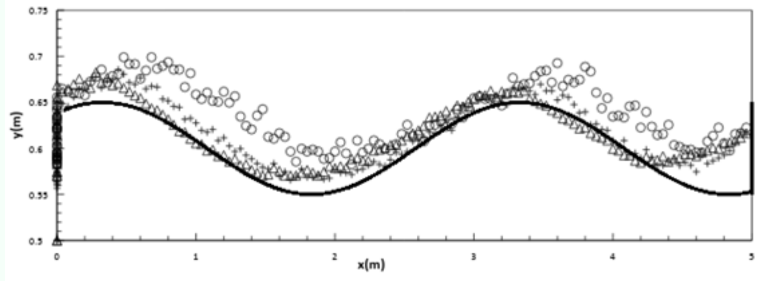


Figure 5 : Comparison of free surface predictions. Wave height H=0.10 m; wave length λ=3.0 m; water depth d=0.6 m;t=58.75 s; tank length L=6.0 m. ∘ : dx of 0.030 m; + : dx of 0.015 m; Δ : dx of 0.010 m; - : potential flow.

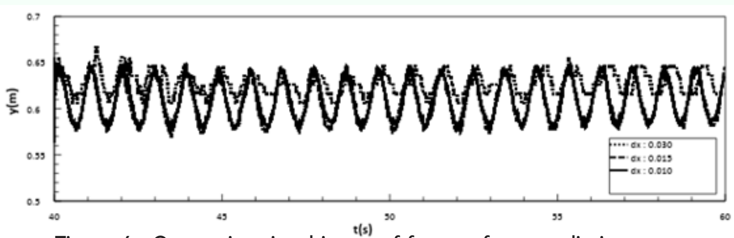


Figure 6 : Comparing time history of free surface prediction. Wave height H=0.05 m; wave length λ=1.5 m; water depth d=0.6 m; tank length L=6.0 m.

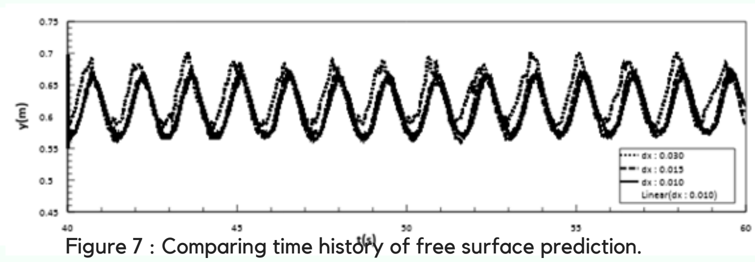


Figure 7 : Comparing time history of free surface prediction. Wave height H=0.10 m; wave length λ=3.0 m; water depth d=0.6 m; tank length L=6.0 m.

The reason behind this is the capability of the DualSPHysics code which is designed to run in a parallel environment, using 100% of CPU or GPU capacity. Three cases of different initial particle spacing are run with two different wave heights for 60 seconds and the results are shown in Fig.4.0 to Fig.5.0. Particle spacing of dx = 0.010 m and dx = 0.015 m show almost identical behaviour in terms of wave propagation at t=58.75 s. The free-surface profiles are in good agreement with potential flow results. Particle spacing of dx = 0.030 m suffers from numerical errors in maintaining the wave height as error in the estimation of interpolation points accumulate within the time step due to an insufficient number of neighboring particles around free surface particles.

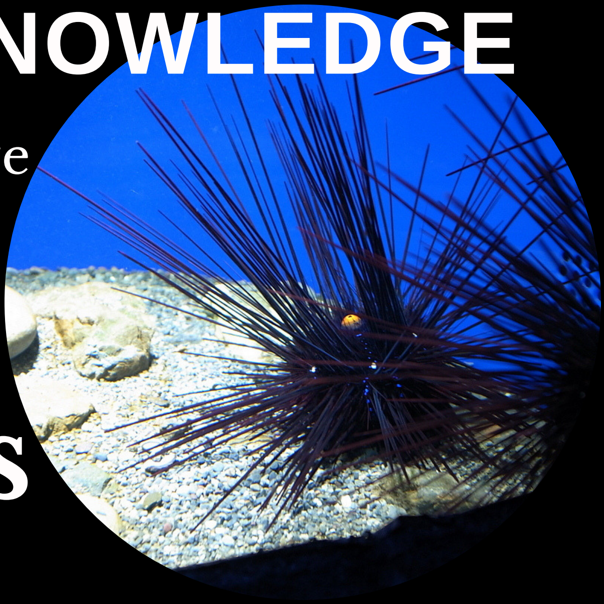
Fig.6.0 and Fig.7.0 show the comparison of the time history of free-surface at x=3 m for different initial particle spacings. Due to the insufficient free surface prediction, the wave surface of dx = 0.030 m in longer run-times becomes numerically instable and waves experience a rapid damping particularly for H=0.05 m. Particles on the free surface for H=0.10 m also suffer from noisy prediction, leading to higher wave heights along the wave tank. Both dx = 0.015 m and dx = 0.010 m share a similar tendency for wave elevation, slightly rising from mean depth level starting from t=30 s. This is probably caused by the length of the beach, which reflects back some of the incoming waves. In case with H=0.10 m, it is observed that the waves are more symmetrical for dx = 0.015 m and maintain a steady wave height. In general, smaller particle spacing does result in more accurate results compromising a higher computational cost.

Zahir Ramli, PhD
Institute of Oceanography
and Maritime Studies (INOCEM)

GALLERY OF KNOWLEDGE

A little peek on reproductive biology of

Sea Urchins



Sea urchins are typically spiny, globular animals, classed under the Phylum Echinodermata. One of the Genus under this group is Diadema,, derived from Roman word “diadem” meaning crown.   Diadema is a gonochoric animal with separate sexes (male and female), but sometimes hermaphrodites can be found in wild.

They are ecologically important and often greatly affect marine communities. Research on sea urchins has increased in recent years, encouraged first by recognition of their ecological importance and subsequently their importance in economy. Scientists around the world are actively investigating their potential for aquaculture and fisheries, and their value as model systems for investigations in developmental biology continues to increase.

Research in 1984 revealed that the blastulae in their gonads were produced from the fertilization of two individuals and they also suggested that this might be due to parthenogenesis. It is suggested that the blastulae were produced from self-fertilization caused by being hermaphrodites, which has been similarly reported in other echinoid species. Most sea urchin species exhibit sexual dimorphism, such as differences the genital papillae sizes; however, Diadema are sexually monomorphic, meaning no difference in male and female morphology.

It is expected that Diadema populations mainly have 1:1 sex ratios, but little data is available to confirm this idea. The Long Spine Black Sea Urchin (*Diadema setosum*) populations in Pulau Pangkor have 1 : 0..9 sex ratio while more males are found than females in Singapore.

Gametogenesis in all sea urchins are basically similar, including those in the Diadema genus. This consists of a regular sequence of changes in gametogenic cells and nutritive phagocytes, which differ only in the timing of the stage developments. These nutritive phagocytes appear particularly different among sea urchins.

Oogenesis also follows a regular sequence of events and is completed in one month. The vitellogenic stage varies among different species and has been estimated to be less than a month in *D. setosum* .

Echinoids produce eggs of various sizes and total energy content on the order of four magnitudes, and these parameters are correlated with each other. Nevertheless, the eggs are provisioned largely with proteins and lipids, with negligible amounts of carbohydrate. The lipid component is predominantly triglycerides, however in lecithotrophic species, their egg are predominantly wax esters.

The nutritional content of the eggs content is a source of energy to support their embryonic development as well as their pre-feeding larval stages until feeding can commence.

Scientist has revealed that egg sizes are different among individual sea urchins due to habitat differences and nutrition. Decreasing in egg size may cause a smaller early stage larva and also slower development through the early larval stages; however, it does not affect the next larval stages or the sizes and development of post-metamorphic juveniles.

Several species of sea urchin larvae have the capacity to feed facultatively, i.e. before egg reserves are depleted and exogenous food is needed for continued development and growth. The duration of this facultative feeding period is correlated with egg size. At one extreme is C. roseaceus and B latifrons that can feed on particulates, but are capable of metamorphosing without food.

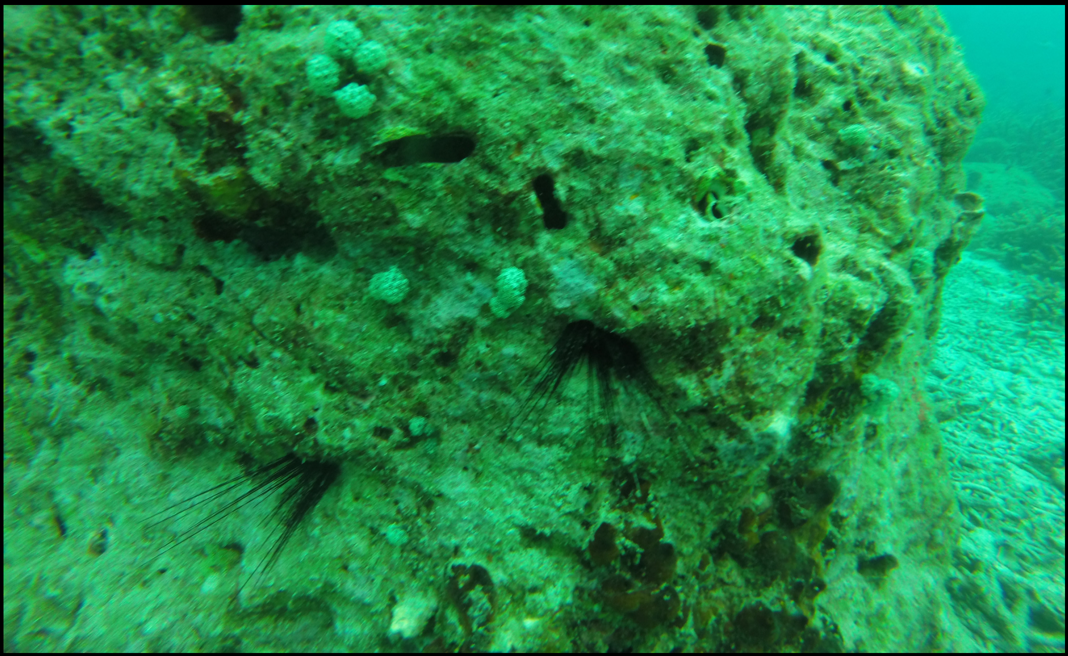
However, several species that require food to complete development, known as obligate planktothropy, also have substantial facultative feeding capability such as Notched Sand Dollar (Encope michelini) and Sea Biscuits (Clypeaster subdepressus). Surprisingly, the benefits of facultative feeding appear to be greater for species with small, poor provisioned eggs than species with large, well-provisioned eggs.

The diversity in nutritional requirements would probably have important implications for understanding the ecology and evolution of feeding larvae.

Spawning happens in reaction to pulse of phytoplankton abundance and elevated temperatures. Normally, males will spawn their sperm before the females release their eggs. However, spawning doesn't involve aggregation of adults . Because of the limited time of gamete viability after spawning, sperm dilution is a restraining aspect to fertilization success, especially in areas of turbulent flow or rapid currents. On the other hand, shear stress imposed by waves may enhance the fertilization rate in sea urchin`s eggs.

Some studies have documented that target size influences the probability of fertilization and could even be a selective factor in the egg size evolution in free-spawning organisms and suggested that sexual dimorphism in the spawning behaviors of sea urchins may be driven by fertilization ecology.

The potential for hybridization exists among co-occurring, congeneric species that free-spawn. Compared to other animals, sea urchins have simple life cycles. Reproduction is constrained to only the adult stages and usually involves the spawning sperm and eggs freely into the seawater where external fertilization takes place.

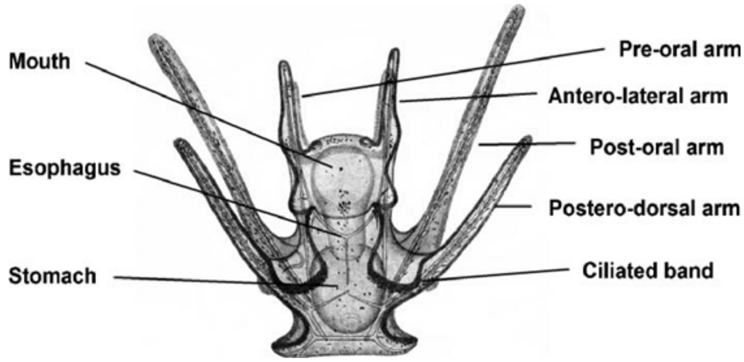


Long-Spine Sea Uchins protruding their spine in burrows of seabed rock, in Tenggol Island Terengganu. Photo credit : Dr Fitri

Compared to other animals, sea urchins have simple life cycles. Reproduction is constrained to only the adult stages and usually involves the spawning sperm and eggs freely into the seawater where external fertilization takes place. Nearly all sea urchin species, development take place in the plankton phase, however, there are exceptions for some species that brood their young and are hold in or on the adult body until reaching the juvenile stage. Developmental biologists have intensively investigated the fundamental biology of early sea urchin development through the cleavage stages, blastula formation, gastrulation and larval morphogenesis. Sea urchin development becomes fascinating once the characteristic larval shape, the pluteus, is achieved.

Larval growth involves the elaboration and growth of the body that includes the formation of rudiments of the juvenile sea urchin. Sea urchin larvae development is attained once the metamorphic competence is completed. Induction of settlement and metamorphosis happens in reaction to environmental factors that signal the availability of suitable benthic environments. Development of post-metamorphic involves growth and sexual maturation to yield a reproductive adult.

Developmental patterns in echinoderms can be described into three characteristics:
1) the mode of obtaining nutrition (lecithotrophic or planktotrophic),
2) habitat (pelagic or benthic), and
3) morphogenesis type (simple larval, complex larval or non-larval).



Dorsal view of Echinometra lucunter pluteus *larva, showing morphology characteristics like larval arms, ciliated band, and gut. Anterior is oriented towards the top of the figure. Figure were refer to Mortenson (1921)*

There are five life cycle model have been documented in the echinoderms and include obligate planktotrophy, facultative planktotrophy, nonfeeding planktotrophy, lecithotrophy and direct brooding development.

Obligate planktotrophy with pluteus larva is the most common pattern in echinoids and occurs from 114 to 175 species, based on available data. This pattern and larval type are ancestral for echinoids (Strathmann, 1978a; Wray, 1995a), and it also the most common within the class, occurring in 9 out of the 11 orders as well as 26 of the 31 families. This pattern is characterized by having a small eggs size and juveniles compared to other patterns. The duration to complete the larval stage is often 1 month, however, this varies widely among species.

The other life cycle model exhibited by some sea urchins includes facultative planktotrophy, but this has only been noted in two species: the clypeasteroid, *Clypeaster rosaceus* and the spatangoid, *Brisaster latifrons*.

Even though more cases are probably yet to be revealed, it is unlikely that this pattern is common between sea urchins. This pattern has an intermediate egg size, the juveniles are small and the time of larval development is around 1-2 weeks.

Species with feeding larvae can be found in shallow temperate and tropical waters of both hemispheres. The third life cycle model of echinoids is non-feeding lecithotrophy, which involves development via a simplified yolky larva and only can be found in 9 out of 175 species, 4 orders, and 5 families.

Non-feeding lecithotrophs have much larger eggs as well as juveniles, but the larval duration is between 1-2 weeks. Direct development has only been found in only species on echinoid species, the Antarctic spatangoid, A. cordatus.

In addition to having large eggs and juveniles, morphogenesis is highly modified and the duration of each development stage is extremely long. In several orders, developmental patterns have been particularly well studied like Echinoida and Clypeasteroida, however other taxa are poorly known, such as Holectypoida and Holasteroida.

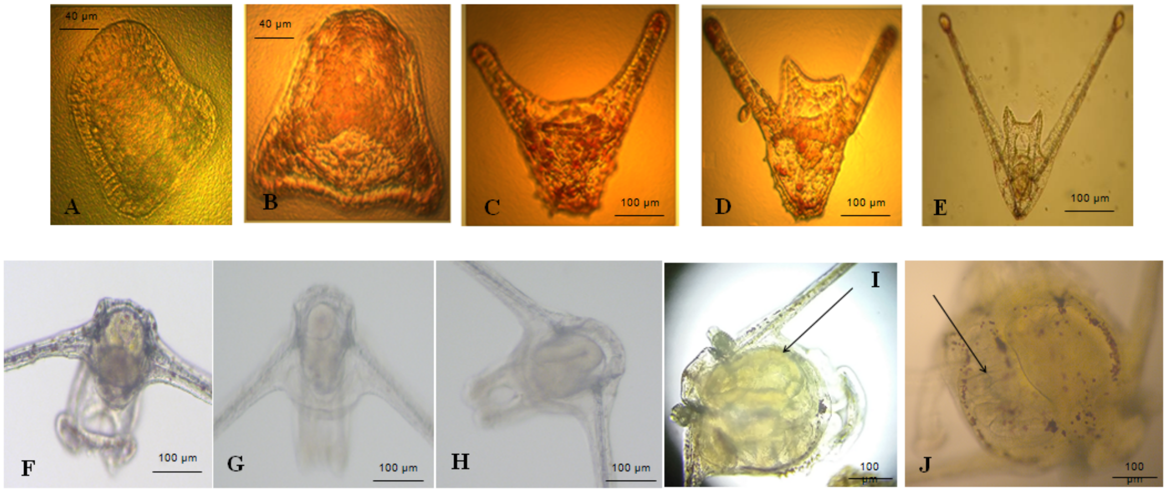


Figure above show the cell with skeleton developmental stages of Diadema setosum under a compound microscope. A. Gastrula, B. Prism, C. 2-arm pluteus, D. 4-arm pluteus, E. Late-4 arm pluteus, F. POA stage-1, G. POA stage-2 (Early), H. POA stage-2 (Late), I. Pre-competent larva with growing rudiment, J. Competent larva with complete rudiment growth.

Mohammad Sarifudin, PhD
Institute of Bioscience
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Ocean Observation From The Space

Dr Cheah explained how satellite in the space help identifying phytoplankton in the ocean.

This year marked the 61th anniversary of the launching of Sputnik I, the first artificial satellite with a size of beach ball (~58 cm in diameter) by the Soviet Union on 4th October 1957. Although the original idea of an orbiting satellite program was to measure Earth's surface at the high point of solar activity during the International Geophysical Year from 1st July 1957 to 31st December 1958, the launching of Sputnik I sparked the space race between the Soviet Union and the United State of America, which directly led to the creation of National Aeronautics and Space Administration (NASA).

Since then, a whopping 8000 plus satellites have been launched by more than 40 countries of which closed to 2000 are still operational. We are now in an exciting time of satellite observation as in 2017 alone, about 450 satellites have been launched with Earth Observation (EO) satellite contributed a signification proportion. With the increased in the number of EO satellites and technology, we are now in an exciting time for Earth Observation especially for the observation of the ocean, which covers over 70% of the Earth's surface and contains about 97% of the Earth's surface water.

Although most of us are aware how important is the ocean to us, it is ironic that we probably know more about the space than the ocean. Since 1969, twelve people have been to the moon (~384,400 km away from Earth) but only three have descended to the deepest part of the ocean in the Mariana Trench (~10.9 km deep).

The stark contrast is due partly to our urge to explore things further away from us (probably something to do with the "the grass is always greener on the other side" syndrome) or probably due to our fear of an alien invasion. Conventional measurements of the ocean through manual sampling are costly and labour-intensive, which are also prone to human error.

Although the invention of oceanic sensors attached to ships, buoys or drifters managed to solve this issue, the measurement coverage is still limited to a relatively small area and often challenged by rough weather or human intervention. Hence, data from ships, buoys, and drifters are not sufficient to characterise the conditions of the spatially diverse of the ocean.

Fig. 1. Some of NASA's Earth Observation satellites. Credit: NASA

The advent of ocean-observing satellites has launched a new era of marine discovery. Satellite remote sensing technique provides valuable dataset of a suite of parameters (Fig. 1) such as sea surface temperature, sea surface height, currents, waves, winds, sea-ice coverage, rainfall, amount of sunlight reaching the surface of the ocean and phytoplankton biomass at high spatial (global coverage) and temporal (hourly) resolutions. Therefore, with satellite observation we can now study the seasonal, interannual and even the decadal patterns of these parameters at a global scale for the first time.

Among the parameters measured by satellite sensors, the ability to detect phytoplankton from space greatly improved our understanding on global climate cycle as phytoplankton is responsible for nearly half of the global primary production, despite only amounts to less than 1% of total plant biomass on Earth. This is because phytoplankton although tiny has high turnover rates (1-3 weeks vs. 9-20 years for terrestrial plants). Any changes in phytoplankton biomass will alter the carbon cycles. In addition, phytoplankton are also an important source of cloud-droplet-forming aerosols, which can influence cloud albedo and global climate.

Detecting phytoplankton from satellite can be done by measuring the portions of the visible spectrum reflected from the ocean surface (Fig. 2). This is what gives the waters its colour, like the reason a leaf is green is due to the reflection of the green portion of the visible light during photosynthesis. Likewise, the colour of the ocean or a particular water is due to the amount of a type of light being reflected e.g. crystal clear water in Pulau Tioman is due to the reflectance of blue light compared to greenish/yellowish water near the coast of Kuantan as a result of high concentrations of phytoplankton or suspended particles reflecting green or yellow light.

One of the most striking ocean colour images captured by satellite is the impact of El Niño on the phytoplankton in the Equatorial Pacific.

Under normal conditions, easterly winds gather warm water toward the Western Pacific Ocean and triggered upwelling in the equatorial Pacific. During El Niño periods, easterly winds is weakened and warm waters from the Western Pacific Ocean spread out over eastward weakening the upwelling. When the upwelling is weakened, there are less nutrient for phytoplankton and resulted in low chlorophyll (chl-a, a proxy of phytoplankton biomass) concentration (top panel in Fig. 3). During La Niña conditions, the opposite effect occurs as the easterly winds pickup and upwelling intensifies bringing a lot of nutrients to the surface waters, which increases phytoplankton growth (bottom panel in Fig. 3). For the first time, we are able to monitor environmental change on a true global perspective.

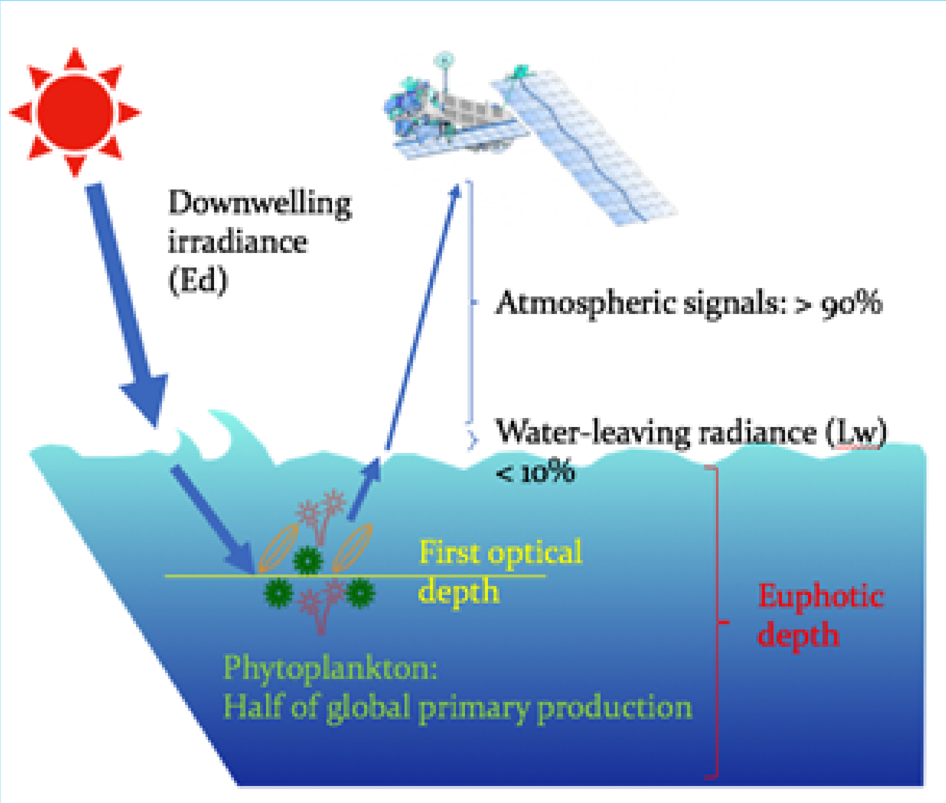

Fig. 2 Basic principles of detecting phytoplankton from space

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Technology for Reducing Ocean Plastic Debris

Being a "universal solvent", the decomposition rates of common marine debris ranging from 1 year to 600 years - Dr Azri Hizami Rasid

As a substance that is essential to all forms of life, water covers 71% of Earth's surface. Up to date, it is believed that there are 1.4 billion cubic kilometres of it available on Earth which appears mostly in the oceans (saltwater) and polar ice caps.

Being a "universal solvent", the decomposition rates of common marine debris ranging from 1 year to 600 years that are found in the ocean make it vulnerable to pollution. Plastics, polystyrene and surprisingly cigarettes are making huge damage to the ocean. The horrifying effects of microplastics on food safety and health are being observed. The issue has gone unattended for far too long, and if left uncheck further, no walk of life will be spared of its demise.

Alarmed by this growing concerns, various independent efforts were made by individuals, companies and states institutions trying to curb the problems. The range of creativity and technologies deployed are large. In this article, we are going to go through several solutions that has been implimented for different types of locations using different technological strategies.

The Ocean Cleanup Projects

The most famous of them all is clearly The Ocean Cleanup Projects. The non-profit organization aims to develop advanced technologies to rid the world's oceans of plastic. Ocean currents concentrate plastic in five areas in the world: the subtropical gyres, also known as the world's "ocean garbage patches".

Using that knowledge to select a suitable location, the cleanup system is deployed in one of these ocean garbage patches which also the largest one, the Great Pacific Garbage Patch, that is located between Hawaii and California. The principle of the project is simply creating a coastline in the middle of the ocean, concentrate the plastics and remove it. The system consist of a 600-meter-long floater and a tapered 3-meter-deep skirt attached below. Marine life are also not harmed as the impenetrable skirt creates a downward flow for them to pass beneath it safely.

The concept behind this system is utilization of the natural oceanic forces. As both the plastic and system are being carried by the current, the floater are propelled by the wind and waves in comparison to the plastics that are primarily just beneath it.

The Ocean Cleanup (TheOceanCleanup, 2013)
Source: https://www.theoceancleanup.com/technology/

This phenomenon causes the system to move faster than the plastic, hence capturing them. Once it is concentrated with plastic, a support vessel then comes to remove the garbages and transport it to land and recycled.

The Seabin Project

This project is founded by Andrew Turton and Pete Ceglinski, who decided to quit their jobs to create a "Seabin" that would collect trash, oil, fuel and detergents. The Seabin is a floating rubbish bin that is located in the water at marinas, docks, yacht clubs and commecial ports. It is installed in a specific "Debris problem area", with calm environment near the marina on a floating dock.

Basically, water is sucked in from the surface and passes through a catch bag inside the Seabin by using a submersible water pump. The water will then be pumped back into the marina leaving the litter and debris trapped in the catch bag. Once the catch bag is saturated with debris (20kg), it needs to be emptied manually.

The Seabin Project
Source: https://www.seabinproject.com

The Trash Wheel Project

This is an invention from Clearwater Mills, LLC. Installed in Baltimore's Inner Harbor for cleaning trash pollution in waterways. Known as the Inner Harbor Water Wheel, or "Mr. Trash Wheel" by locals, it is a combination of old and new technology to harness the power of water and sunlight to collect litter and debris flowing down Jones Falls River.

The working mechanism of this device is through the movement from the river into the dumpster barge inside the body of the Trash Wheel through a conveyor belt by taking advantage of the river current. The river's current provides power to the turn wheel which lifts the trash and debris from the water and deposits it to the barge. However, if the water current happen to be slow and is not sufficient to rotate the turn wheel, a solar panel array provides additional power to keep the machine running. Upon reaching maximum capacity, the dumpster is towed away by a boat and replace by a new one.

The Surf Rake

The first model of Surf Rake Model 500, the beach cleaning machine is built by Harold S. Barber, which founded the H. Barber & Sons, Inc., a family owned and operated corporation. Now they offer 3 models of Surf Rake beach cleaners, the working principle similar, but comes in different sizes. Unlike the other models above, this device specialise in cleaning debris that are washed up to the beach or littering by the beach user.

Surf rake beach cleaners are separated into 2 components, the tractor and the rake. The rake on the other hand may also be divided into sub-parts of moldboard, stainless steel tines, deflector plate, conveyor and hopper. The moldboard functions to level uneven areas in the sand to ensure even surface for cleaning and guides the machine over large submerged objects to protect the conveyor system. The tines are in charged of raking the debris towards the deflector plate. This will result in the debris to bounce of the deflector plate and deposit on the conveyor. Through the conveyor the trashes are transported to the hopper. Once the hopper is full, it can be hydraulically raised to dispose its contents into a truck.

Mr. Trash Wheel
Source:
http://baltimorewaterfront.com/healthy-harbor/water-wheel/

All these technological solutions are part of what we call cleanup process. Debates are common in this area, and many scientists agree that the most effective strategy would be focusing in source reduction, namely waste management. However, both goes hand in hand.

Simply imagine if a pipe in your house suddenly broke and causing a flood. A wise way to solve the problem would of course be turning of the main pipe and mop up the flood. The technological improvement in cleaning up the ocean is certainly great but, let's not forget to instill awareness among the population to simply not litter.

The Surf Rake Source: http://www.hbarber.com/Cleaners/SurfRake/HowItWorks.html

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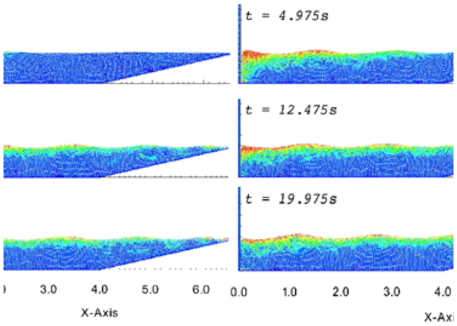
OUR RESEARCHS

Fish Breeding

Fishfarmers often facing slow growth of *Pangasius* catfish in cages. Thus, a study on how to produce triploid catfish is perform. The growth performance of triploid catfish will be compare to normal diploid catfish.



Coastal Engineering

Development and applications of computational methods for fluid-structure interactions in physical oceanography and coastal engineering.

Chemistry Oceanography

Research on understanding the fate of chemical proxies; metals, rare earth elements and nutrients, in the marine environment. The assessment includes inter-relations study of biotic and abiotic factor; e.g. water, sediment, particulate matter, biota. The extent of the study relates with the human health interaction as well.

Horseshoe crab

Whole genome sequencing of Asian horseshoe crabs to understand the population trend in Asia.

OUR ACTIVITIES

MARCH RECREATIONAL SCUBA TALK

INOCEM has invited Tuan Syed from SCUBAKIDS to brief about wold of SCUBA dive with IIUM communities. This was to enlightened IIUM community about the SCUBA activities.

MAY DISCOVERY SCUBA

We have conducted two session, one session for male and another session for ladies. The participants were IIUM staffs and students. In this training, we introduce the basic of SCUBA, its equipment and its basic skills such as mask clearing, regulator recovery and hand signals. We hope the participants can join in SCUBA Open Water License in future.

AUG "ENGLISH IS FUN" CAMP

The English program was targeting secondary school students as participants. The objectives was to help the kids in community gain confidence speaking English and benefit for their English examination.

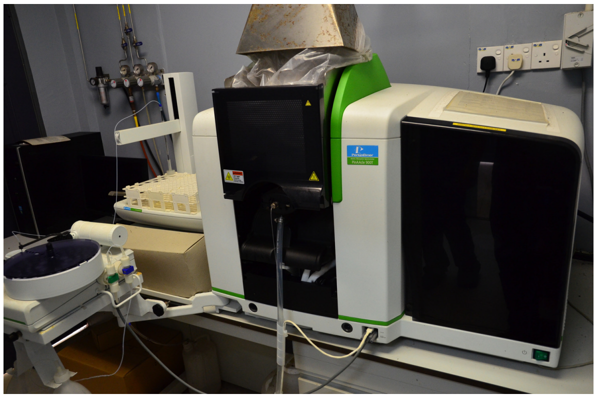
NOV ASIAN-FEN COMMITTEE MEETING

ASIAN-Fisheries Education Network committee board meeting was held in Prince of Songkla University, Hatyai this year. It was conducted after International Fisheries Symposium (IFS 2018). The meeting was mainly discussed about to new application from INOCEM and Marine Science Department IIUM as ASEAN-FEN associate members.

NOV SEA SURVIVAL TRAINING

Sea Survival Training is part of subject for Marine Science students in IIUM. INOCEM has supported this class in collaboration with Malaysian Maritime Enforcement Agency to provide students enough experience and knowledge about survival in sea.

OUR SERVICES



RESEARCH ANALYSIS

INOCEM provide research analysis services for any researchers who keen to use our equipment.

The equipment included HPLC, AAS, water parameter analsis and beach morphology survey.

FISHING BOAT

Our boat equipped with two 225 HP engines, to facilitate marine surveys and leisure activities.

Since 2018, it has been rented for sport fishing activities, scuba diving for research and marine survey.

SCUBA EQUIPMENT

We have 25 scuba equipment for teaching, research and sport activities. This equipment can be rented for research or fun dive.

In future we plan to organised SCUBA licensed program for IIUM staffs and students.

AERIAL PHOTO

DJI 2 Inspire drone was used for aerial surveillance on coastal environment. It help to monitor beach, corals and island where men are unable to explore.

I READ, I RESEARCH, I BECOME.

We are glad to receive any articles related to marine environment for publication in our upcoming newsletter. Please submit your contribution to the address below :-

Phyllidiella pustulosa

Known as Pimpled Phyllidiella, this nudibranch can be found at water depth 3- 40 meters.
They are mainly distributed in South East Asia, Australia, Hawai and North of Red Sea.

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