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理學院通訊

Newsletter



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Wishing you and
your loved ones a
happy and fruitful
Year of the Dragon.



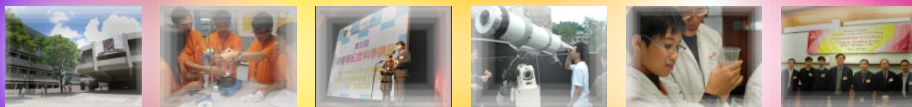
With warmest regards,
Faculty of Science

Faculty Exemplary Teaching Award *cum* Dean's Honours List 2010/11 Award Ceremony

Six faculty members, 179 students, and six International Junior Science Olympiad (IJSO) contestants were honoured for their strive for excellence at the Faculty Exemplary Teaching Award *cum* Dean's Honours List 2010/11 Award Ceremony. The ceremony took place on Saturday, 14 January 2012 in Lecture Theatre 1, Lady Shaw Building. Apart from honouring the Science Faculty's teachers and students, the opportunity was taken to celebrate the wonderful results obtained by six current secondary students at the 8th IJSO, held in Durban, South Africa in December 2011. The team's hard work earned them

one gold medal and five silver medals. Many friends and family of the award recipients were on hand to join the joyous occasion.





This year, the six outstanding faculty members to receive the Faculty Exemplary Teaching Award were as follows:

Recipient	Affiliation
Prof. FONG Wing-ping	Biochemistry
Prof. GE Wei	Biology
Prof. Dominc CHAN Tak-wah	Chemistry
Prof. Thomas AU Kwok-keung	Mathematics
Dr. TONG Shiu-sing	Physics
Prof. WONG Hoi-ying	Statistics



Winning teachers were congratulated by Prof. XIE Zuowei, Acting Dean of Science.



Upon completion of the ceremony, participants gathered for a photo at the Science Centre, home of the Faculty of Science.



Faculty Acting Dean Prof. XIE Zuowei (third from left) congratulated the 8th IJSO medalists (from left to right): Jeffrey CHAN Shi-kai; LO Kwun-yu; WONG Chun-yui; CHEUNG Ka-nam; and JUSTIN Cheng Ho-ching.





Keeping Sea Fish in Fresh Water

Amazing Marine Science Research



In Irish folklore, the salmon is the fish of wisdom. When the young warrior Fionn cooked a salmon he had caught, a drop of the fish oil fell onto his thumb and the moment he put it into his mouth, he became the wisest man in Ireland. There are many types of salmon, including a few that are born in fresh water, and migrate to the ocean to grow up, before returning to their birthplace during reproduction—legendary for being equally at home in fresh and salt water.

Prof. Norman WOO Ying-shiu of the School of Life Sciences said despite detailed research on salmon, scientists still don't have a persuasive answer to the question of why they return to reproduce in fresh water. He added, 'Some types of eel also do the same but in reverse: they live in fresh water and return to the sea to have babies.'

Salmons and eels inspired Professor Woo to wonder about the effects of seawater's salinity on fish. In other words, can sea fish be kept in fresh water? He explained that sodium constitutes about 3.5% of seawater and close to 0% of fresh water. Vertebrates have bodily fluids containing 1% sodium, which means they have a third of the salinity of seawater. When the latter's salinity rises above average levels, it triggers a mechanism in fish's bodies which enables them to get rid of the excess sodium while taking in more water. 'When the salinity level is too high, fish become dehydrated. When we preserve tangerines with salt, the tangerines lose water by the same logic. Fish living in an overly salty environment need to

replenish water just like humans in a desert.'

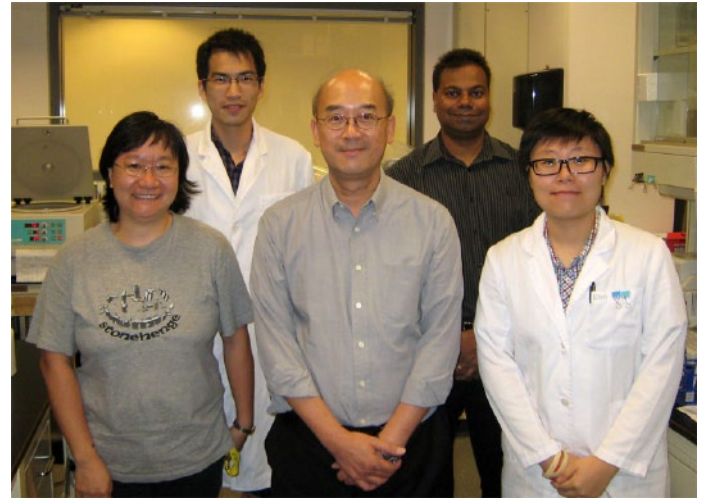
On the other hand, salt water fish living in low-salinity water will compensate for the loss of sodium while getting rid of excess water. And it is chemicals which trigger this mechanism. When the fish feel the change in salinity, their gills, kidneys and some other organs will make osmotic adjustments. These chemicals behave like hormones in humans. Generally speaking, fish use a third of their total energy to work this mechanism, so theoretically they survive best in brackish water, because it does away with the need to remove or replenish sodium. They can then channel the energy into other uses, most significantly turning food into protein, which results in faster growth and a stronger immune system.

Professor Woo observes that all seawater fish have both of these osmotic adjustment functions though one is almost never used. Take coral fish for instance. Spending all their lives in high-salinity environments renders their sodium-replenish function idle, and by the theory of evolution, degenerate and disappear. According to Professor Woo's deductions, the most plausible explanation is that osmotic specialization began in the Devonian Period some 300 million years ago. Seawater then was a lot less salty than it is now, so fish were able to adjust to living in fresh water. Through the ages, as the oceans' salinity rose, sea fish developed another function which allows them to get rid of excess sodium, alongside the function they inherited from their ancestors.





Professor Woo has awakened this function in sea fish that had been latent for tens of millions of years. He used sea bream in his study because it is available in large numbers locally and it's hardy. He has completely mastered the technology of keeping salt water fish in fresh water. Does it have great potential for development and what is its commercial value? 'I never thought of that. Commercial fish farming is a totally different matter. Salt water fish raised in fresh water tend to have a milder flavour, which may not appeal as much to Hong Kongers as real sea fish. But our aim is scientific research. We use different ways to think and observe, and uncover the mysteries of evolution. That is a biologist's greatest pleasure.'

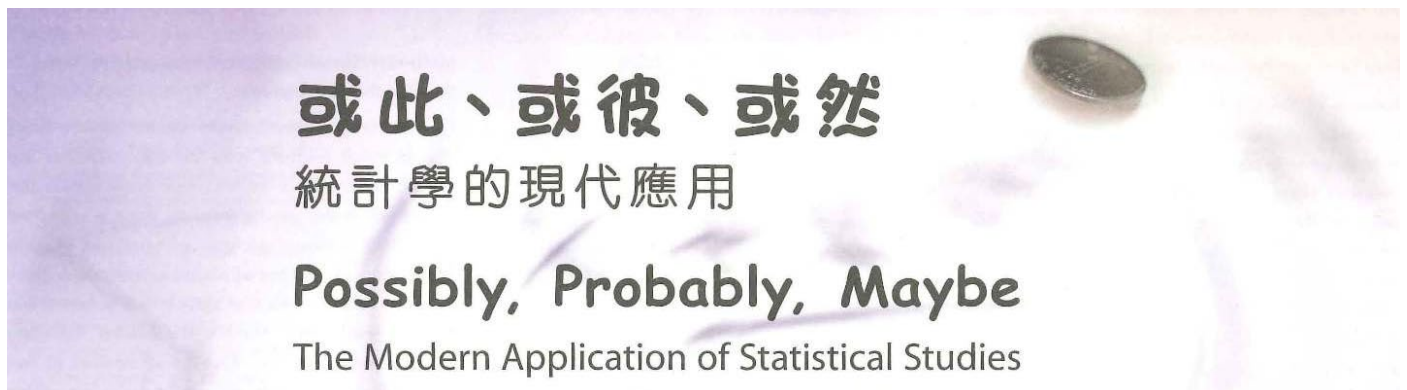


Professor Woo and his research team

Credit: **CUHK Newsletter Issue no. 386**, 04.11.2011.

Possible, Probably, Maybe

The Modern Application of Statistical Studies



French mathematician and astronomer Pierre Simon de Laplace (1749–1827) said, 'The most important questions of life are indeed, for the most part, really only problems of probability.' De Laplace was an expert on probability. In *Théorie Analytique des Probabilités* (1812), he wrote, 'The theory of probabilities is at bottom nothing but common sense reduced to calculus.'

The basic principle of probability states the likelihood that some random event will or will not happen; the more likely the higher the probability. When you toss a coin, there's a 50% chance that it'll land heads up and another 50% tails, so the probability of each is half. Probability is a branch of mathematics that studies the pattern in probability from a quantitative angle. Originating in 17th century calculations of risks involved in gambling and seafaring, as well

as errors in measurement, it developed rapidly with advancements in scientific technology, and inspired and was inspired by other disciplines. It has wide application in modern technology, industrial production, finance and insurance, and forms the basis of quantitative statistics.

Probability theory is about 'applying common sense to inference', de Laplace said simply. The story of 'The Boy Who Cried Wolf' is a case in point, as quoted by **Prof. CHAN Ping-shing** of the Department of Statistics at the CUHK Orientation Camp, to explain to students about statistics. When the sheep herder cried wolf the first time, the villagers thought it was true as it usually was. When he did it again, they still believed him. Every time he cried wolf, the probability of it being a lie is the villagers' statistical reference. Once they have enough data, there would be a





switch in their decision and they would stop believing his cries for help. Professor Chan remarked, 'This fable shows a classical application of statistical data.'

The area of statistics that Professor Chan is most interested in is censored data, in other words, unidentified data that falls outside the net in statistical analyses. 'For example, we want to measure the heights of a class of Primary 6 students, but because the ruler is only 150 cm long, only 25 students of a class of 30 can have their heights measured. For the remaining five, we only know that they are taller than 1.5 m. The heights of these five are the censored data.'

Censored data are a problem in all statistical analyses. The more serious becomes missing data, which happens when, say, only eight out of 10 questions in a questionnaire are answered or when a question that should have been posed was not due to oversight. Statisticians do not ignore censored or missing data. Using different mathematical models, they take such unapparent data together with all data collected into their calculations in order to arrive at more comprehensive and accurate statistical information. 'The most commonly used method is conditional probability which infers censored or missing data and inputs it for calculation. The results are then compared to those obtained without that data. If the discrepancy is small, the data deduced are considered effective.'

Censored data are used in gauging the reliability and durability of industrial products, from furniture and electrical appliances to cars, airplanes, and even nuclear plants. Censored data are used to calculate

their lifetime distribution, which is their performance under different circumstances and how long they'll last. This is also Professor Chan's present research focus. He explained that it is not easy to gather data to assess a product's life-span under normal circumstances. At present, industry uses the accelerated life test which applies severe environmental stress to the product to induce rapid deterioration, and use the data inferred to calculate its life-span. The ones that survive the test are known as 'censored observations'.

Professor Chan's research involves making maximum likelihood statistical inferences from data obtained from these tests, and thereby identifying the most effective accelerated life test for different products to help industry design tests that are efficient, accurate and cost-effective. 'This shortens the time taken for products to reach the market,' he says. 'But the question of how to design a product so that it's considered reliable and durable is at times a commercial decision. We only provide scientific data for reference.'



Prof. CHAN Ping-shing (centre) and his team

Credit: **CUHK Newsletter Issue no. 389**, 19.12.2011.

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地址：香港新界沙田香港中文大學科學館高錕樓G43室
Address: Room G43, Charles Kao Building, Science Centre, CUHK, Shatin, N.T.

電話 / Tel: 3943 6327 傳真 / Fax: 2603 5156

電郵 / Email: sfo@cuhk.edu.hk

網址 / Website: <http://www.cuhk.edu.hk/sci/>

