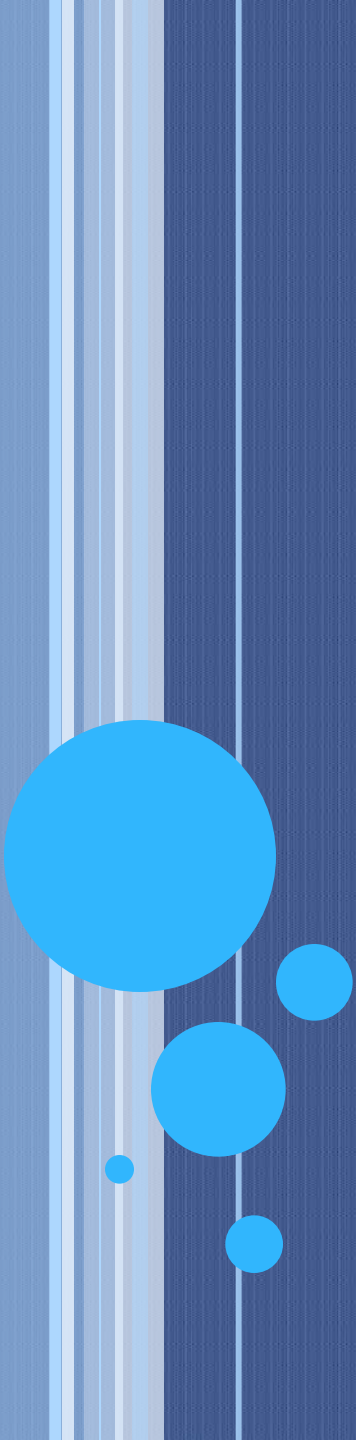




SCIENCE CURRICULUM REFORM AT THE UNIVERSITY OF HONG KONG

Sun Kwok, Dean of Science



RATIONALE FOR REFORM

- Most science curricula are designed to train students as next generation of academics. But in fact only a small fraction of our graduates go onto Ph.D.s and become professors. Most of our students become leaders in government and private sectors. Our science training should help them to fulfill these roles.
 - To train students as people of intellect, not as a trainees to a vocation
 - To lay the ground work for life long learning (encouragement of curiosity, development of rational thinking)
- 



REFORM OBJECTIVES

- To prepare students as holistic individuals who can think analytically, able to solve a diverse set of problems, and to communicate the results
- To provide opportunities for students to take advantage of our community of scholars
- To become an international institution by actively global recruitment
- To provide a broaden experience, not just in one specialized science subjects, but in all sciences





CURRICULUM REFORMS

- 2006: credit-based major/minor system, away from the highly specialized program format
- 2007: faculty common admission, students free to choose any of the 15 majors after admission
- 2007: compulsory experiential learning
- 2007: student advisory system
- 2008: academic induction
- 2010: Common Core courses
- 2012: 4-yr curriculum and Science Foundation courses

issues and events

Hong Kong's physics departments adapt to education overhaul

In September universities in the Chinese territory switched from three-year, English-style degree programs to four-year, US-style degree programs.

Less than 3% of Hong Kong's GDP comes from manufacturing. Finance, trade, and other knowledge-based service sectors make up the rest of the economy, which is among the world's wealthiest and healthiest. To keep its economy humming and its population employed, Hong Kong needs a smart, flexible workforce.

As the territory entered the 21st century, its government concluded that the education system it inherited from the British was too rigid, narrow, and elitist to produce such a workforce. After concentrating on one subject for three years, students graduated from university with a bachelor's degree but without being taught the knowledge and skills they might need to navigate the complexities of a modern, globalized society.

Starting this year, freshmen at Hong Kong's eight public universities will study a mix of majors, minors, and required courses—just like their counterparts in Australia, Canada, and the US. Mandated and funded by Hong Kong's government, the new degree structure aims to provide broader, more useful education. As the Chinese University of Hong Kong's undergraduate prospectus puts it, the new structure is “not just ‘one more year,’ but incorporates a change of emphasis, and a new way of viewing undergraduate education.”

Because Hong Kong's high schools prepared students for specialized three-year degrees, reforming tertiary education also entailed reforming secondary education. Instead of leaving high school at 16 or spending the ages 16–18 studying a handful of subjects, students now spend the final three years of high school studying a broader mix of subjects. And they graduate at 17.

High schools made the switch to the new system in 2009. The first cohort of students educated under the new system entered university in September. Because the last cohort of students educated under the old system had to complete an extra year of school, the two cohorts entered university at the same time.

Besides coping with super-sized freshman classes, the six Hong Kong universities that have physics departments have also had to adapt to the new, four-year curriculum. The introductory classes that physics professors teach are now larger than before and have students of more diverse educational backgrounds.

With those challenges, however, have come benefits. The required courses expose more university students to science, including physics. Physics departments have hired or are hiring more faculty members. And, attracted by the new curricula, more foreign students are applying to attend Hong Kong's universities.

Common cores

The new, four-year curricula offered by Hong Kong's public universities conform to broad guidelines established by their funding agency, the University Grants Committee (UGC). Major in applied physics at City University of

Hong Kong, for example, must accumulate at least 120 credits to graduate. Like all other CityU students, those majoring in applied physics have to complete 30 credits of what the university calls gateway education, which includes courses in the English language, Chinese civilization, arts and humanities, sociology and business, and science and technology, along with electives.

CityU physics students may choose a minor in a subject, such as electrical engineering, that complements their major. And in addition to courses in basic physics, students take electives organized in four streams: nuclear environmental physics, photonics, materials physics, and biomedical physics and engineering. First-year students are also required to work independently on a research project that could involve a local company or government agency.

The curricula at the five other physics universities follow a more or less similar template. Chinese University of Hong Kong's equivalent of CityU's gateway education, the general education foundation, includes an ambitious course called Dialogue with Humanity



The University of Hong Kong, like other universities in the territory, has embarked on ambitious building programs to accommodate the increased influx of students. The buildings in the foreground are part of the university's new Centennial Campus. (Courtesy of Sun Kwok, University of Hong Kong.)

www.physicstoday.org

December 2012 Physics Today 23

Physics Today, Dec 2012

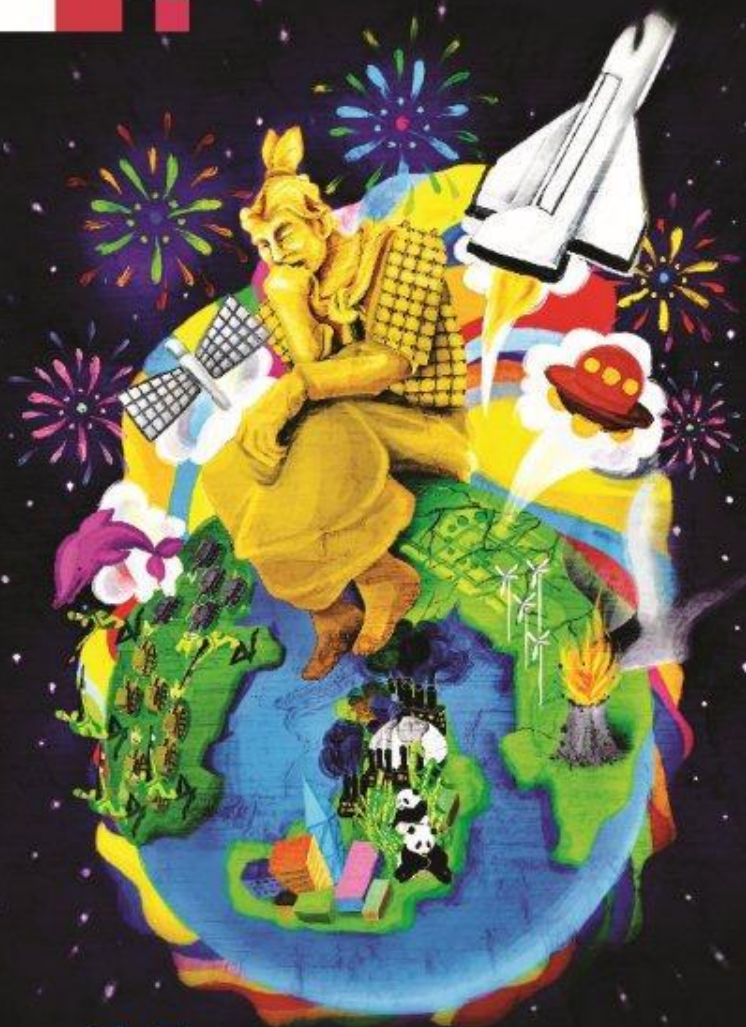


CURRICULUM REFORMS

- Common Core curriculum
 - Science and technological literacy, humanities, global issues, China: culture, state and society
- Academic advising
 - a new academic advising system to provide academic support and advice to students to face the increased choices in the new major-minor system.
- Experiential learning
 - a compulsory element in our BSc curriculum
 - A variety of learning programs such as exchange, field trips, internships, or undergraduate projects, is made available to students to help them expand their horizon, enhance their communication skills and cultural understanding.

Both now adopted by University





- Non-discipline based
- To develop broader perspectives
- Critical assessment of complex issues
- Appreciation of our own culture
- Member of global community
- *Specifically designed new courses, not introductory disciplinary courses*
- *Not “great books” model*



AN EXAMPLE OF A COMMON CORE COURSE

- Changing perceptions of our place in the universe as the result of astronomical development. Illustration of the development of the scientific method and how science has influenced the evolution of our philosophical thinking and cultural development;
- Ancient models of the universe and the early philosophical and religious interpretation of celestial objects;
- The development of concepts of time and calendars through the observation of solar, lunar, and planetary motions;
- The Copernican revolution and the change from geocentric to heliocentric cosmology and from a bounded to an infinite universe;
- The application of scientific method and a physical interpretation of the universe through the work of Kepler, Galileo and Newton;
- The expansion of the spatial scale of the universe as the result of modern astronomical observations;
- Expansion of the time domain in cosmic history through the study of the history of the Earth, biological evolution, and cosmic evolution





STUDENT COMMENTS

- the course has inspired me in my daily lives, not only in the aspect of astronomy knowledge, but also in the aspect of critical thinking and combination of science with philosophy and history.
- This course helps us to appreciate our own culture, and the interrelationship among cultures..
- As a social science student, studying the “philosophical shifts” in the course allows me to question more about how our society or social norms are created and formed to what it is today.
- This course has taught me to do something meaningful with my life.
- The course inspired me that different conclusions can be drawn from the same reality from different perspectives.

A photograph showing a group of students sitting at a table in a classroom or study hall, looking at papers and talking. The image is partially obscured by a blue gradient overlay.

NEGATIVE REACTIONS

- Many students still think that universities are there to train them for a profession or a trade and do not see the relevance of the CC.
 - Not accustomed to the methods of assessment beyond reproduction of facts
 - “All my years of schooling, I was told to memorize, now you want me to think and I can’t do it.”
 - In general, students don’t like being required to take 6 CC courses.
 - Unwillingness to read
 - Some have the preconception that CC courses should be easier than disciplinary courses
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SCIENCE FOUNDATION COURSES

- To give students a broad view of science in terms of its nature, its history, its fundamental concepts, its methodology, and its impact on civilization and society.
- Two new science foundation courses have been offered beginning in 2012 using an integrated science approach.
- compulsory for all first-year students
- A departure from their previous segregated way of learning science
- Help students to make a more intelligent decision on the selection of the major.





SCIENCE FOUNDATION 1: SCIENTIFIC METHOD AND REASONING

- The nature, history, methodology of science
- Equips students with basic skills of logical and quantitative reasoning
- Exploration of mathematics and statistics and their applications
- What is mathematics, what kinds of mathematics are there, and what can mathematics do for different disciplines of inquiry
- Emphasis on formulation of problems but not calculations





EXAMPLES OF COURSE CONTENT

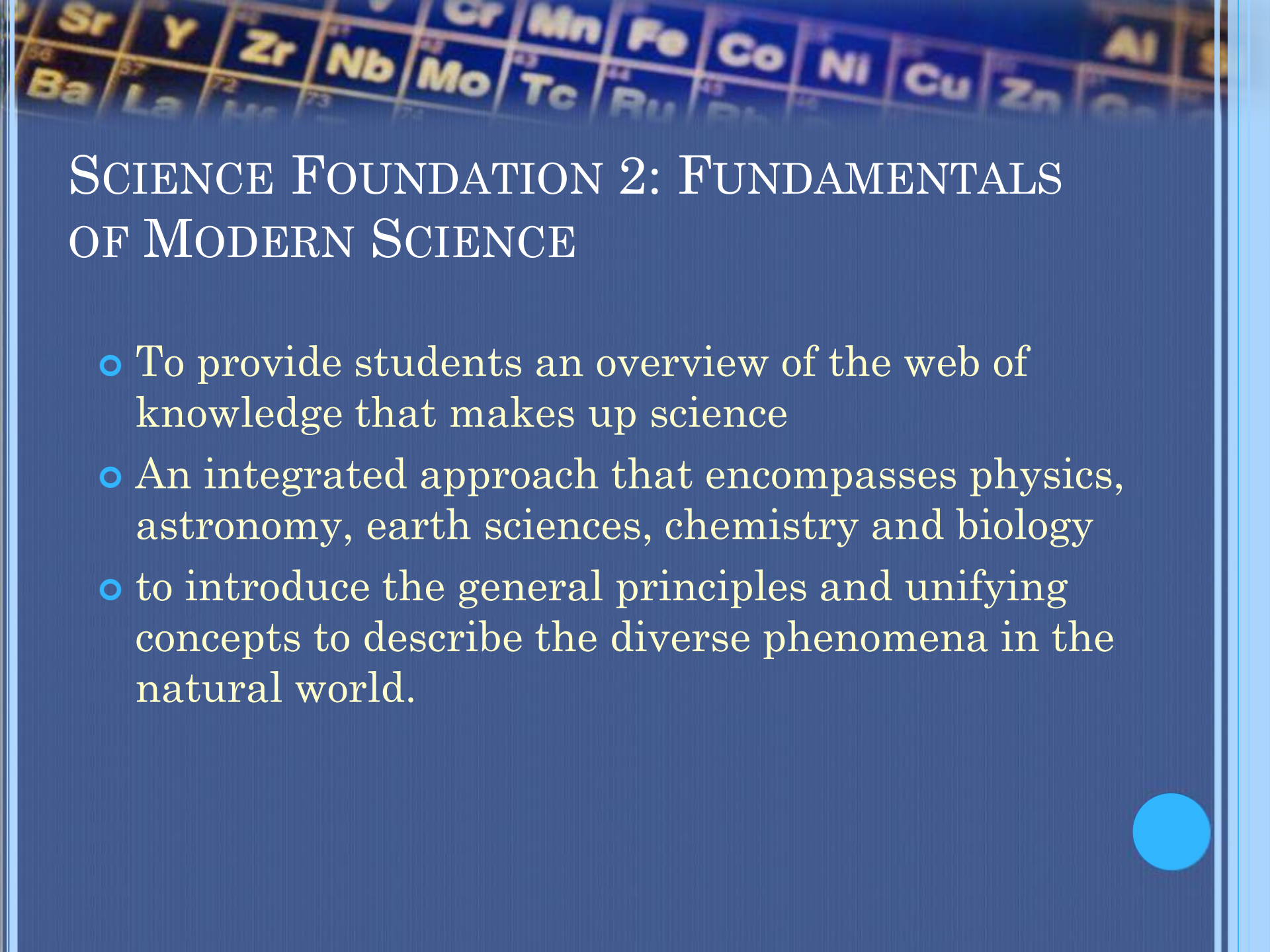
- The scientific method: hypotheses and logical deduction, observation and experiments, inductive and deductive reasoning, criteria on “good” scientific theories
 - Guesstimation
 - Mathematical modelling
 - Difference equations, matrices, differential equations, fractals and chaos
 - Hypothesis testing and decision making using statistics, correlation and causation
 - Regression, predictions
- 



STUDENT REACTIONS

- "Many practical examples are used to illustrate the key concepts. The contents of teaching are well organized."
- "Different interesting mathematical topics are introduced to students."
- "Basic histories and developments of science including the methodology and different mathematical/statistical topics are introduced in the course that can give students a brief idea of the respective applications in their own science subjects."
- "Cover topics that are useful to my future studies."
- "Good examples to illustrate theories and applications."





SCIENCE FOUNDATION 2: FUNDAMENTALS OF MODERN SCIENCE

- To provide students an overview of the web of knowledge that makes up science
- An integrated approach that encompasses physics, astronomy, earth sciences, chemistry and biology
- to introduce the general principles and unifying concepts to describe the diverse phenomena in the natural world.

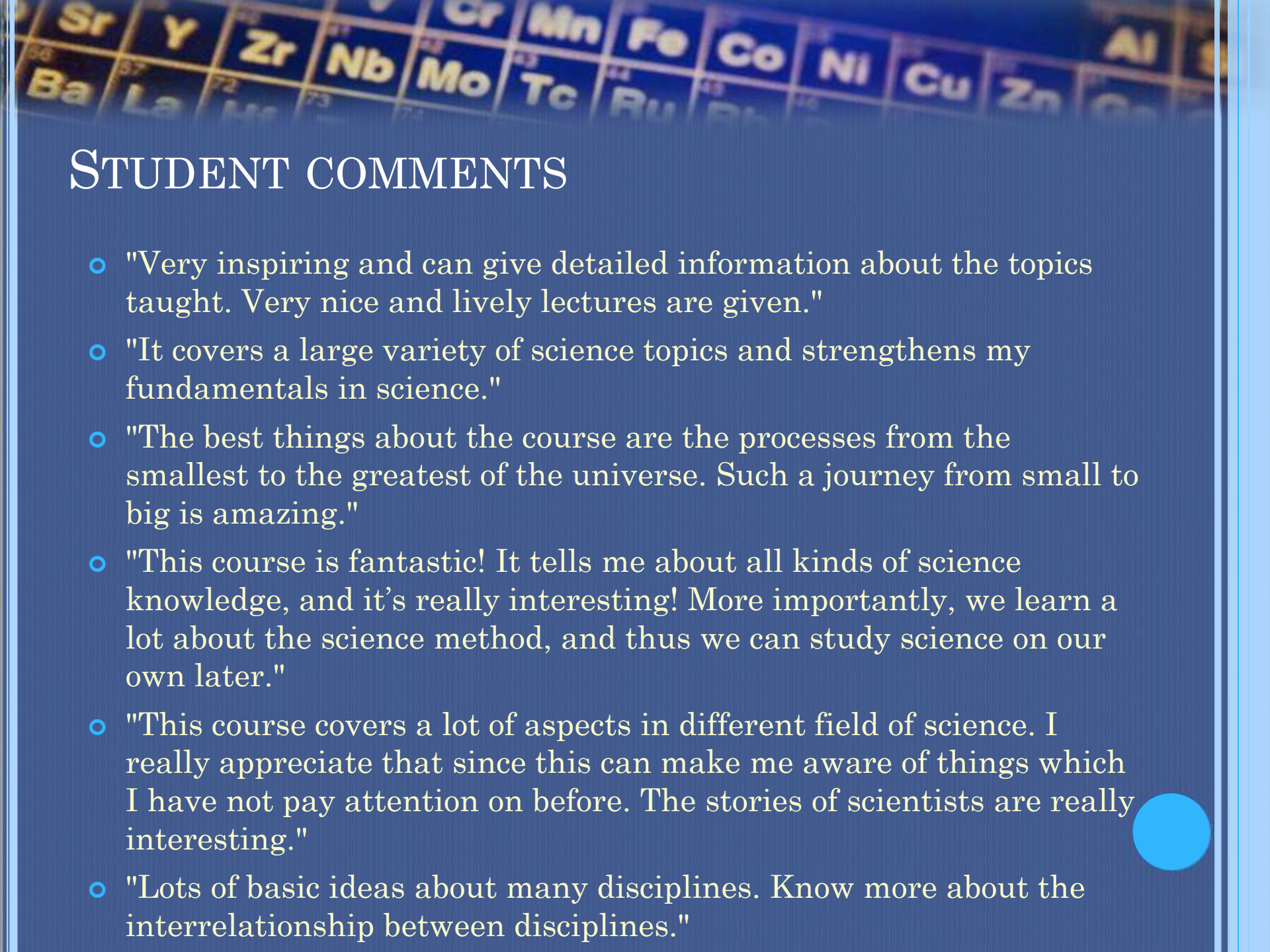




TEACHING AND ASSESSMENT TECHNIQUES

- History of the subject
- Start with real life problems, not abstract concepts
- In exam, students are not asked to repeat tasks done in lectures but given new situations that they need to have mastered the taught materials to solve





STUDENT COMMENTS

- "Very inspiring and can give detailed information about the topics taught. Very nice and lively lectures are given."
- "It covers a large variety of science topics and strengthens my fundamentals in science."
- "The best things about the course are the processes from the smallest to the greatest of the universe. Such a journey from small to big is amazing."
- "This course is fantastic! It tells me about all kinds of science knowledge, and it's really interesting! More importantly, we learn a lot about the science method, and thus we can study science on our own later."
- "This course covers a lot of aspects in different field of science. I really appreciate that since this can make me aware of things which I have not pay attention on before. The stories of scientists are really interesting."
- "Lots of basic ideas about many disciplines. Know more about the interrelationship between disciplines."

A photograph of several students sitting at a table in a classroom or study hall, looking at papers and talking. The image is partially obscured by a blue gradient overlay.

NEGATIVE REACTIONS

- I am a biologist, I don't want to learn mathematics/I am a mathematician, I don't want to learn biology
 - I want to take more courses in my major biochemistry, everything else is a waste of time
 - I am at a disadvantage because others have taken more math/physics/chemistry/biology than me.
 - The stuff is too easy (students confuse having seen the technical term to understanding the concept. In school, they were given very hard problems, but did they learn anything?)
 - Too much reading
 - I don't want to learn about evolution
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SKEPTICS

- Hong Kong is already doing very well in PISA (programme for international student assessment) results (math #3, science #2, reading #2, in the world, 2012 results). Why change?

MY RESPONSE

- Students may do well in exams, but they don't know science and mathematics are relevant to their lives.
 - Students lack common sense, most don't know why it is hot in the summer and many think the Earth is only a few thousands years old
- 

BIG HISTORY (SCIENCE ELECTIVE)

- Based on the course by David Christian and supported by Bill Gates



Students using handheld spectrometers (top), and testing the inverse-square law (bottom)



SCNC1113
The Big History of Our Planet
A Scientific Perspective on Everything that Has Ever Happened

Teaching team:
Dr. Chi-wang Chan, Dr. William M.Y. Cheung,
Dr. Benny C.H. Ng & Professor Quentin A. Parker

Offering semester:
1st semester in 2015/2016

Time:
Mon & Thurs 13:30 - 15:20

Venue:
MB 151

Pre-requisite:
Students with Level 3 or above in at least one science subject at the pre-university level (HKDSE Physics, Chemistry, Biology, Combined/Integrated Science or equivalent); Not open to students in BSCE6011 or BEd&BSCE1131 programmes.

The 1st Big History course offered in any university in HK
The Big History Project is supported by the Gates Foundation
A great chance for our non-science major students to go beyond world history and explore our universe

- How did our universe begin and how might it end?
- How did our world evolve from different states in the past?
- How and where do humans fit in?

"How did we get here? Where are we going?"
— Prof. David Christian, Pioneer of the Big History Project

"I just love it! My favorite course of all time"
— Bill Gates

"An important intellectual movement"
— Prof. Sam Wineburg, Stanford University



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<http://www.sfnr.hku.hk/~scnc1113/>
Feel free to contact Dr. William M.Y. Cheung at williamc@hku.hk for enquiries.
Endorsed by the Big History Institute at Macquarie University





CURRICULUM REFORMS

- Promotion of interdisciplinary studies
 - The new initiatives include inter-departmental teaching, research collaboration and joint appointments.
 - The curricula and courses in biological science are being significantly revised after the integration of the 3 separate departments into a single School.
 - A new major of environmental science was offered in 2008. This is a truly interdisciplinary major with courses jointly taught by members of 6 departments.
 - Academic induction
 - introduced in the academic year 2008-2009
- 



UNDERGRADUATE RESEARCH

- Undergraduate research symposium, summer research fellowship, overseas research fellowship



Swire Institute of Marine Science



HONOURS SEMINAR

- Lectures by “star professors” to describe the frontiers of science being carried out at the University
- To encourage students to engage in undergraduate research

SCNC3111
Frontier of Science Honours Seminar

Offering semester: 2nd semester in 2015/2016
Time: Mon & Thurs 12:30–14:20
Venue: MW 325
Pre-requisites and Co-requisites: Pass in SCNC1111, SCNC1112, and a level 2 science course.
Students who participate in ORF/SRF starting in 2015–16 will need to take this course.


FACULTY OF SCIENCE
THE UNIVERSITY OF HONG KONG

1st Honours Seminar Course offered

- Features 6 award-winning professors who will share about their exciting research projects
- Learn how professors from different fields tackle their research problems
- Broaden your scientific horizons
- Practice your scientific writing and presentation skills

Professor Vivian Yan

- Photophysics and photochemistry
- Inorganic and organometallic chemistry
- Supramolecular chemistry
- Transition metal complexes
- Sensing
- Luminescence
- Molecular functional materials
- Solar energy conversion
- Optoelectronic materials

Professor Yvonne Sadoy

- Marine biology
- Sustainable fisheries management
- Marine conservation
- Reproductive biology of fishes

Professor Sun Kwok

- Astrochemistry
- Planetary nebulae
- Understanding of the death of sun-like stars
- Spreading organic compounds
- Throughout the milky way galaxy
- The origin of life on earth

Professor Wing Sum Cheung

- Calculus of variations
- Exterior differential systems
- Differential equations
- Analytic inequalities

Dr. Ka Chun Cheung

- Actuarial science
- Dependence structures
- Stochastic orders
- Optimal insurance

Dr. Jason Ali

- Earth sciences and biology
- Oceanic islands
- Continental islands
- Manufacturing biology
- Why are animals where they are?



http://www.scnc.hku.hk/department/bsc/particulate/scnc3111
Feel free to contact Dr. Benny CH. Ng at ngbeny@hku.hk for enquiries.



EXPERIENTIAL LEARNING

- Student field trips to Australia, British Columbia, Brazil, Cyprus, India, Kenya, Thailand, Okinawa, Tibet, and U.S.





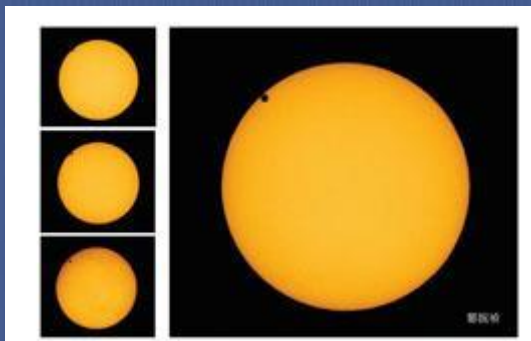
KNOWLEDGE EXCHANGE AND COMMUNITY ENGAGEMENT

- The Faculty of Science maintains strong liaisons with secondary schools, our alumni, the science museums, and the general community. We regard our mandate on education goes beyond the university campus.
- Junior Science Institute
 - with hands on workshops and laboratory exercises for secondary school students
- *Science Corner on Astrobiology* in the Science Museum, which attracted 1.4 million visitors



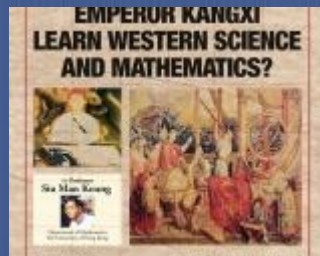
KNOWLEDGE EXCHANGE

- A Night at the Museum
 - 600 students from 60 schools
- Public viewing of the Venus transit
 - June 5, 2012
 - Over 10,000 members of the general public
- Earth Hour 2013
 - Thousands participated in real-time measurements of night sky brightness



PROMOTION OF SCIENCE LITERACY

- Faculty Public Lecture series to introduce areas at the frontier of science in a format that is understandable by the general public
- This series is now in its 7th year and has been extremely popular among our undergraduate students, general public, as well as secondary school students.



STUDENT EXCHANGE

- 118 (2012-2013), 129 (2013-2014), and 169 (2014-2015) out of ~1500 eligible undergraduates went out on international exchange for 1 semester or more
- Summer courses at UBC (Bamfield marine station and experimental farm)



A close-up photograph of a person's hands, wearing a white lab coat, holding a small, light-colored starfish. The starfish has five arms and a textured surface. The background is slightly blurred, showing what appears to be a laboratory or classroom setting.

SUMMARY

- The Faculty has taken a number of new initiatives in curriculum structure and reform
- Some of these have been taken up by the University, and some by other institutions
- A diverse, international teaching staff
- Continued improvement in research level and standards

