A Science Enrichment Programme for Secondary S3-4 Students

Phase 2: Intensive Training Programme (Biology/Biochemistry Programme)

Time for each session: 9:00 am – 12:45 pm (3 hours 45 minutes)

Session	Date	Topics	Teachers
1	17 Oct	**Biotechnology and Genetically Modified Food** 生物技術及轉基因食品	Dr. Cherry Chow Department of Biology
2	24 Oct	**Food and Health** 食物與健康	Profs. PCK Cheung and KH Wong, Dept. of Biology, Ms Peggy Yip, Dept. of Biochemistry
3	31 Oct	**Human Genome Project** 人類基因組計劃	Prof. Wendy Fung Faculty of Science
4	14 Nov	**Bacterial Culture and Bacterial Transformation** 細菌培養和細菌轉化作用	Dr. KC Chung Department of Biology
5	21 Nov	**Fluorescence Technology and Biomolecules Detection - I** 熒光檢測技術與生物分子檢測 - I	Prof. SK Kong Department of Biochemistry
6	28 Nov	**Fluorescence Technology and Biomolecules Detection - II** 熒光檢測技術與生物分子檢測 - II	Prof. SK Kong Department of Biochemistry

Assessments: 6 written quizzes (6 x 16.7%)
評估： 6 次筆試 (6 X 16.7%)

Session 1: Biotechnology and Genetically Modified Food
第一節：生物技術及轉基因食品

What is biotechnology? How can it change our world? In this session, we will cover the underlying principles of biotechnology and explore how it has revolutionized our life. Particularly, we will focus on the impact of GM food on our health and environment. Through rational discussion on its pros and cons, you are expected to review your standpoint toward the development of GM food.

何謂生物技術？它如何改變我們的世界？本節將介紹生物技術的基本原理和探討它如何為我們的生活帶來革命性的變化。其中我們將集中討論轉基因食品對人類健康和生態環境的影響；希望通過對其優點和缺點的理性討論，有助同學們重新思索對轉基因食品發展的個人立場。

Session 2: Food and Health
第二節：食物與健康

Nowadays, there is an increasing awareness of the effect of food on human health in our society. There are emerging scientific evidence that the pattern of our daily food consumption can be related to some common health conditions such as osteoporosis and obesity as well as some leading causes of death such as heart disease, cancer and diabetes. During this lecture period, an introduction to the chemical composition of food will be given, followed by an illustration of the food composition analysis and nutrient labeling law in Hong Kong. The relationship between diet and human health will also be discussed. Different learning activities including talks, laboratory visit and demonstration will be used.

正當社會上對食物如何影響人體健康的課題漸趨關注，科學界亦累積了不少研究數據，顯示出我們日常進食的模式與骨質疏鬆症、肥胖症、心臟病、癌症、及糖尿病等病變有密切的關係。 在本節我們將通過示範、短講、及參觀實驗室等活動去介紹食物的化學成份及其分析方法、香港營養標籤法、及膳食與健康的關係等課題。

Session 3: Human Genome Project
第三節：人類基因組計劃

The Human Genome Project (HGP) and its impact on the world of research and human ethics will be discussed. HGP is an international project aiming at investigating and sequencing the entire human genome, with enormous significance on the development of medical science and bioscience in the 21st century. The lecture included an overview of HGP, as well as the technical details to achieve the project. Its impact and contributions to ethics, medical science and biosciences were discussed. During the lecture, students were given some game relating to DNA fingerprinting and opinion questions were raised to increase interaction between students and the speaker.

本節將討論人類基因組計劃及其對科研世界和人類倫理道德的影響。 人類基因組計劃旨在研究及分析整個人類基因組及其序列，是一個對本世紀的醫學科學及生命科學的發展極為重要的國際計劃。 授課內容包括對人類基因組計劃的概覽，整個計劃的技術細節，及該計劃對倫理、醫學科學及生命科學的貢獻及影響等。 授課內容亦包括DNA指紋圖譜分析的遊戲，並輔以討論問題以促進講者與學員間的交流。

Session 4: Bacterial Culture and Bacterial Transformation
第四節：細菌培養和細菌轉化作用

We are living in a world with many microorganisms. Many of them are good for us but some of them are infectious agents that cause diseases. To study these microorganisms, we need to isolate and characterize the microorganisms. In this lecture, students will learn how different types of microorganisms are cultivated in laboratory. Also, students will learn how bacteria can be used to produce useful proteins through transformation. When bacteria take up foreign genes through transformation, they can express many new proteins for various biomedical applications.

我們活在滿佈微生物的世界。其中很多微生物都有益於我們，但部分卻是致病的病原體。為了研究這些微生物，我們需要分離和細查這些微生物的特性。在這個講座中，學員將會學習如何在實驗室培養不同種類的微生物。此外，學員也會學習如何利用細菌製造有用的蛋白。當細菌通過轉化作用獲取外源基因後，他們能夠製造很多新的蛋白，應用於各個生物醫學領域。

Session 5: Fluorescence Technology and Biomolecules Detection - I
第五節：熒光檢測技術與生物分子檢測－I

One of the reasons that infections are so frightening is the speed with which they can kill. To develop a fast and accurate method for disease detection therefore becomes an urgent need to improve our heath. Students in this lecture will learn the basic principles how fluorescence can be used to detect important molecules like disease markers and cancer antigens. Examples will be given to demonstrate why fluorescence is a good technology to report subtle change of biomolecules.

傳染病可怕的原因之一是病原體可以迅速殺死我們。因此，制定快速和準確檢測疾病的方法成為改善我們健康迫切的需要。學員在這個講座將會學習熒光的基本原理和如何利用熒光檢測重要的生物分子，諸如疾病標記和腫瘤抗原等。學員亦會學習一些例子為何熒光是一個很好的技術，報告生物分子輕微的變化。

Session 6: Fluorescence Technology and Biomolecules Detection – II
第六節：熒光檢測技術與生物分子檢測－II

With the background information from previous lecture, students will be guided to apply the knowledge that they had learned to produce fluorescent proteins from bacteria for various types of detection. This is an important area in biotechnology to improve the public heath through the development of better tools for disease diagnosis.

聯繫以往講座的資料，學員將嘗試應用已學習的知識，利用細菌製造熒光蛋白作不同類型疾病的檢測。這是一個重要的生物技術領域，通過發展更好的診病工具，公眾健康得以改善。

A Science Enrichment Programme for Secondary S3-4 Students

Phase 2: Intensive Training Programme (Chemistry Programme)

Time for each session: 9:00 am – 12:45 pm (3 hours 45 minutes)

Session	Date	Topics	Teachers
1	17 Oct	**Analytical Chemistry (1): Acid-base Chemistry** 分析化學（一）：酸鹼之化學	Dr. W. F. Chan
2	24 Oct	**Introduction to Organic Chemistry** 基礎有機化學	Dr. Kendrew K. W. Mak
3	31 Oct	**Quiz on Session 1-2 (30 minutes)** **Analytical Chemistry (2): Chemical Analysis in Consumer Products** 分析化學（二）：商品之化學分析	Dr. W. F. Chan
4	14 Nov	**The Chemistry of Drugs and Organic Synthesis** 藥物化學及有機合成	Dr. Kendrew K. W. Mak
5	21 Nov	**Quiz on Session 3-4 (30 minutes)** **Spectroscopic Analysis of Organic Compounds** 有機化合物之光譜分析	Dr. Kendrew K. W. Mak
6	28 Nov	**Laboratory session: Analysis of Vitamin C in Fruits** 實驗：水果中維他命 C 的測定 **Advanced Instruments in Chemical Analysis** 化學鑑定中常用之先進儀器	Dr. W. F. Chan Dr. Kendrew K. W. Mak

Assessments: 2 written quizzes (2 x 35 %)
                1 laboratory activities (lab performance and report) (1 x 30 %)
評估：   2 次筆試 (2 X 35%)
                1 次實驗活動(包括：實驗表現及報告) (1 X 30%)

Analytical Chemistry (1): Acid-base Chemistry
分析化學(一)：酸鹼之化學

In our daily life, we will encounter various acid or base substances. However, in a chemical reaction how can we classify a compound as acid or base? What is the difference between strong and concentration acid (base)? What is pH value? This session will give you the answers for the above questions and will introduce to you the use of acid-base titration in analytical chemistry.

在日常生活中，我們會接觸到一些屬於酸或鹼性的東西。但是在化學反應中，我們又怎樣去定義化學品是酸或鹼？強酸(鹼)和濃酸(鹼)有什麼不同？什麼是 pH 值？在這節課中，你會得到以上問題的答案，課堂中還有會介紹利用酸鹼滴定法去做一些化學分析。

Introduction of Organic Chemistry
基礎有機化學

Organic chemistry is about the chemistry of carbon, hydrogen and oxygen. All life forms start from organic chemistry. This session will cover the fundamental concepts in structure, chemical bonding, stereochemistry and physical properties of some organic compounds.

有機化學是關於碳、氫、氧之化學，所有生命均始於有機化學。本節將討論有關有機化合物之結構、化學鍵、立體化學與物理性質等基本概念。

Analytical Chemistry (2): Chemical Analysis in Consumer Products
分析化學(二)：商品之化學分析

Consumer products are being used in all kinds of daily activities. Therefore, all consumer products must be thoroughly tested to ensure their safety when being used under normal circumstances. This session will cover the potential risks associated with different kinds of consumer products, and the kinds of tests that have to be carried out to ensure the products are free from the risks.

日常一切活動均涉及商品之應用，因此所有商品必須經過嚴格的測試以保證在正常使用下是安全的。此部分將討論不同類型商品可能存有的潛在危險、及相關科學測試方法以保證這些商品可安全使用。

The Chemistry of Drug and Organic Synthesis
藥物化學

Drug development and our health are inseparable. The development, synthesis and analysis of drugs rely heavily on modern chemical technologies. This session will cover the historical development of some common drugs, the chemical technologies involved in the synthesis and quality monitoring of drugs, and the principles of some examples of drug actions.

藥物發展與健康息息相關，藥物之研究發展、合成及成分測定均非常依賴現代之化學技術。本節將討論一些常見藥物之開發過程，在藥品合成及品質鑑定中所涉及之化學技術，及一些有關藥物功效之基本原理。

Spectroscopic Analysis of Organic Compounds

有機化合物之光譜分析

There are millions of organic compounds known today, ranging from very simple to very complex ones. Chemists need to know the compounds' exact chemical structures to make feasible plans for studying their properties and synthesizing them. Elucidating a compound's chemical structure is not a trivial task, and nowadays chemists use a wide variety of advanced spectroscopic instruments to solve these problems. This session will introduce the principles and applications of modern spectroscopic instruments for structural elucidation.

現今已知的有機化合物數以百萬計，當中有些是簡單的，亦有些的化學結構是非常複雜的。化學家必須準確地認識這些化合物的化學結構，才能設計出可行的計劃以研究它們的特性及合成它們。要破解一個有機化合物的化學結構絕非易事，今天化學家用上多種先進光譜學儀器來完成這件艱鉅的工作。在本節中會介紹多種應用於化合物結構鑑定的先進光譜學儀器及解說其原理。

Laboratory session: Analysis of Vitamin C in Fruits

實驗：水果中維他命 C 的測定

This is another laboratory class. Students in this session will determine the amount of vitamin C in fruits using titrimetric method.

此節為一實驗課。在本節中學員會利用滴定法去測定水果中維他命 C 的含量。

Advanced Instruments in Chemical Analysis

化學鑑定中常用之先進儀器

Nowadays most delicate and accurate chemical analysis relies heavily on the applications of advanced instruments. There are a wide variety of different advanced spectroscopic and chromatographic systems developed to meet different needs. In this session we will go into an advanced instrument laboratory and explain the principles and applications of these instruments one by one.

現今，精細及準確的化學分析工作大都依賴各類不同的先進儀器。為配合各類化學分析上的需要，已發展出多種不同的先進光譜學及色層分析儀器。本節將會帶大家同學一同到一間設置各類先進儀器的實驗室，向同學們逐一介紹這些儀器之原理、結構及其主要的應用範圍。

A Science Enrichment Programme for Secondary 3-4 Students

Phase 2: Intensive Training Programme (Mathematics/Statistics Stream)

Time for each session:　9:00 am – 12:45 pm (3 hours 45 minutes)

Session	Date	Topics	Teachers
1	17 Oct	**Introduction to MATLAB, Vectors and Matrices** **MATLAB, 向量及矩陣簡介**	Prof. Raymond H. F. Chan Dr. Jeff Wong Department of mathematics
		Assessment (30 minutes) **評估 (30 分鐘)**	
2	24 Oct	**Linear Programming** **線性規劃**	Prof. Raymond H. F. Chan Dr. Jeff Wong Department of Mathematics
		Assessment (30 minutes) **評估 (30 分鐘)**	
3	31 Oct	**Dynamic Programming** **動態規劃**	Prof. Raymond H. F. Chan Dr. Jeff Wong Department of Mathematics
		Assessment (45 to 60 minutes) **評估 (45 至 60 分鐘)**	
4	14 Nov	**Measure of Association** **相關性的量度**	Prof. S.H. Cheung Prof. W.Y. Poon Department of Statistics
		Assessment (30 minutes) **評估 (30 分鐘)**	
5	21 Nov	**Introduction to Linear Regression** **綫性迴歸分析簡述**	Prof. S.H. Cheung Prof. W.Y. Poon Department of Statistics
		Assessment (30 minutes) **評估 (30 分鐘)**	
6	28 Nov	**Applications of Linear Regression** **綫性迴歸分析的應用**	Prof. S.H. Cheung Prof. W.Y. Poon Department of Statistics

Assessments: The assessment portfolio will consist of individual and group works, and written tests, oral presentations and computer exercises.

評估: 評估組合內包括個人及小組習作，亦包括筆試、口試及電腦作業。

Introduction to MATLAB, Vectors and Matrices
MATLAB, 向量及矩陣簡介

The symbolic computation package MATLAB can be very useful, particularly in solving matrix computations and linear programs. In this lecture, MATLAB is briefly introduced. Examples of its use are presented here along with the basic commands used in the program. The techniques of linear algebra are introduced, followed by a key concept of how to convert a linear equation into a matrix equation. The solution of a system of linear equations and programming skills are also discussed.

MATLAB 是一套用于數學符號計算的強大工具，被廣泛應用于矩陣計算、線性規劃等領域。第一堂會先從整體的角度介紹 MATLAB，包括對基本指令的介紹及實例示範。接著介紹線性代數技術，當中著重介紹線性方程的矩陣表達，以及如何使用 MATLAB 編程技術求解線性方程系統。

Linear Programming
線性規劃

The central topic in this lecture is linear programming. The simplex algorithm is reviewed. The formulation of problems is discussed. The applications of the simplex algorithm to problems with nonstandard constraints are presented. The solutions of minimization problems or maximization problems are discussed. Some advantages of linear programming as a managerial tool are provided.

本堂重點介紹何為線性規劃。在回顧求解線性規劃的單純形法之後，這節會介紹該類問題的界定，並著重討論線性規劃在實際問題中的運用，以及介紹單純形法在非標準約束問題中的應用。此外，本堂也會介紹如何求解最大、最小化問題，加深學生理解線性規劃在實際中的靈活運用。

Dynamic Programming
動態規劃

Certain problems to which a solution can be defined through a succession of steps are approachable by dynamic programming (DP). DP relies heavily on recursion, so it is necessary to introduce some of the key concepts associated with recursive functions. A few recursive examples are discussed; the Towers of Hanoi, Fibonacci numbers, and the binomial expansion. Based on the concept of DP, both the longest path problem and the traveling salesman problem are discussed, and some of the computational challenges of such problems are highlighted.

本堂使用分步法來介紹何為動態規劃。由於動態規劃與回歸方程式有著密切的聯系，因此本堂在介紹動態規劃之前，首先會介紹回歸方程。對 Hanoi 塔問題、Fibonacci 數列問題、二項展開式等回歸方程中的經典問題作逐一介紹。本堂的第二部分介紹動態規劃在實際問題中的運用，包括如何求解最長路徑問題，旅行商問題等，並指出動態規劃中的計算難點、要點以及其發展中的新挑戰。

Measure of Association

相關性的量度

Measure of association is related to the evaluation of the strength of relationship between two variables.   The choice of an appropriate measure depends on the level of scales of the variables (Nominal, ordinal, interval, or ratio).   Statistical methods to measure association, ranging from graphical descriptions, numerical statistics to the use of contingency tables, will be examined.

相關性的量度可反映兩個變量間的關係，而我們需利用變量的量表程度 (類別、序級、等距、等比) 來選擇適當的相關性量度。本節會討論各種量度相關性的統計方法，包括圖像描述、數字性統計值及列聯表的應用。

Introduction to Linear Regression

綫性迴歸分析簡述

Linear regression analysis is a powerful statistical technique that could be used to capture the linear relationship between variables.   In this session, the basic concepts of linear regression will be outlined.

綫性迴歸分析在統計學中扮演一個非常重要的角色，它可利用來描繪兩個變量間的綫性關係。本節會介紹綫性迴歸的基本概念。

Applications of Linear Regression

綫性迴歸分析的應用

Interesting examples will be used to illustrate the applications of regression.   Part of the lecture will be devoted to hands-on computer practice.   Students will have the chance to utilize popular statistical software and gain knowledge of writing programs to generate meaningful statistical findings.

本節會利用有趣的例子來說明綫性迴歸的應用。課堂上亦會有電腦習作，讓學生學習常用的統計軟件，並編寫程式以得出有意義的統計結果。

A Science Enrichment Programme for Secondary 3-4 Students
Phase 2: Intensive Courses (Physics)

Name of Course:

Perspectives in the theory of relativity 透視相對論

Time for each session: 9:30am - 12:30pm (3 hours)

Session	Date	Topics	Teachers
1	24 Oct	**Preparation for special relativity and its historical background** 狹義相對論的歷史背景和相關資料	Dr. PANG Kam-moon
2	31 Oct	**Novel concepts of space and time I** 時間和空間觀的革命 I	Dr. PANG Kam-moon
3	7 Nov	**Novel concepts of space and time II** 時間和空間觀的革命 II	Dr. PANG Kam-moon
4	14 Nov	**Mathematical derivations** 數學推導	Dr. PANG Kam-moon
5	21 Nov	**Novel concepts of mass and energy** 質量和能量觀念的革命	Dr. PANG Kam-moon
6	28 Nov	**General relativity and its applications** 廣義相對論及其應用	Dr. PANG Kam-moon

Assessments: Quiz (70%)

Performances in task learning and group discussion sessions (30%)

Session 1：Preparation for special relativity and its historical background

第一節：狹義相對論的歷史背景和相關資料

(a) Properties of waves, (b) Michelson-Morley experiment, and (c) Role of ether.

(a) 波動的性質，(b) Michelson-Morley 實驗，和 (c)「以太」(ether)的角色。

Session 2：Novel concepts of space and time I

第二節：時間和空間觀的革命 I

(a) Fundamental postulates of special relativity, (b) Simultaneity, (c) Time dilation, and (d) Lorentz contraction.

(a) 狹義相對論的基本設定，(b) 同時性，(c) 時間延滯，和 (d) 洛倫茲收縮。

Session 3：Novel concepts of space and time II

第三節：時間和空間觀的革命 II

(a) Unification of space and time, and (b) Paradox in relativity.

(a) 時間、空間的統一，和 (b) 相對論中的佯謬。

Session 4：Mathematical derivations

第四節：數學推導

(a) Lorentz transformation equations and its consequences, and (b) Concepts of proper time and proper length

(a) 洛倫茲變換公式的及其重要性，和 (b)「原時」(proper time)和「靜長度」(proper length)的物理觀念。

Session 5：Novel concepts of mass and energy

第五節：質量和能量觀念的革命

(a) Momentum, mass and energy in classical physics, (b) Mass and energy in relativity, and (c) Mass-energy relation.

(a) 經典力學中的動量、質量和能量，(b) 相對論的中質量和能量，和(c)質量 —— 能量關係。

Session 6：General relativity and its applications

第六節：廣義相對論及其應用

(a) The principle of Equivalence, (b) Gravitational red shift and time dilation, (c) Detection of gravitational waves, and (d) Global Positioning System.

(a) 等效原理，(b) 重力紅移和時間延滯，(c)偵測重力波，和(d) 「全球衛星定位系統」(Global Positioning System)。