Biochemistry Major Talk
2019-20

August 9, 2019

Dr KM Yao
Sch of Biomed Sc, LKS Fac of Med
The University of Hong Kong

Welcome!!!!!!!!!!!!!!!
Sch of Biomed Sc (BSc Biochemistry)

- Professors: 15 (+7 from other Div/Dept; [http://www.sbms.hku.hk/staff/academic-staff](http://www.sbms.hku.hk/staff/academic-staff)) (+Research assistant professors: 2)
- Lecturers: 4 (2 Principle Lecturers)
- Postdoctoral Fellows and Research Associates: ~35
- Research Assistants: ~20
- Research postgraduates: ~90
- Administrative staff: 5
- Technical staff: 10 technicians & 5 supportive staff
Introduction to Biochemistry

A four-minute video:

http://www.youtube.com/watch?v=tpBAmzQ_pUE&list
What is Biochemistry?

- Study of the chemistry of life processes!
- Study of the structures and functions of biomolecules e.g. proteins, carbohydrates, lipids, nucleic acids, etc…

Metabolism

- The many molecules that form the cell
- ANABOLIC PATHWAYS
- Useful forms of energy + lost heat
- The many building blocks for biosynthesis

Figure 13-19 Essential Cell Biology 3/e (© Garland Science 2010)
Cells talking and reacting...

- **GPCR**
  - Signal molecule
  - G protein
    - adenyl cyclase
      - cyclic AMP
      - calmodulin
    - IP$_3$
      - Ca$^{2+}$
        - CaM-kinase
        - PKA
  - phospholipase C
    - diacylglycerol
    - Ras-GEF (Sos)
      - Ras
        - MAP kinase kinase kinase
          - PDK1
      - PI(3,4,5)P$_3$
        - PI 3-kinase
          - MAP kinase
            - Akt kinase
            - many target proteins
          - transcription regulators
Biochemistry at Cellular Level

Regulated by Cyclin-dependent Kinases first discovered in yeasts

(Hartwell, Hunt and Nurse – Nobel laureates in 2001)
Pluripotent stem cells can differentiate into any fetal or adult cell type

(Taken from Alberts et al., Essential Cell Biology, 3rd Ed.)
Induced Pluripotent Stem Cells
(Nobel Prize in Physiology or Medicine Winner 2012)

Sir John B. Gurdon  Shinya Yamanaka

"for the discovery that mature cells can be reprogrammed to become pluripotent"

Taken from http://nobelprize.org
“Reprogramming” Cells: Achieving pluripotency using the Yamanaka factors

Reprogramming Human Skin Cells

Researchers have developed a technique for creating stem cells without the controversial use of human eggs or embryos. If the method can be perfected, it could quell the ethical debate troubling the field.

NEW METHOD
A large number of skin cells are removed.

EGG

EXISTING METHOD
A fertilized human egg is allowed to divide until it forms a blastocyst.

SKIN CELLS

GENES

Retroviruses are used to inject the skin cells with four genes. The genes somehow reprogram the cells to become stem cells.

DEVLOPING EMBRYO

BLASTOCYST

STEM CELLS

Stem cells are removed from the blastocyst, destroying the embryo.

Medical Applications of iPS Cells

1. Patient
   - Treat with therapeutic compounds
   - Transplant genetically matched healthy cells

2. Skin biopsy
   - In vitro differentiation
   - Repaired iPS cells

3. Patient-specific iPS cells
   - Repair disease-causing mutation using gene targeting

4. Affected neurons
   - In vitro differentiation

5. Disease-specific drugs
   - Screen for therapeutic compounds

6. Healthy neurons
   - In vitro differentiation
Study of tissue regeneration using Planarian (*S. mediterranea*)

Planarian stem cells are highly enriched for 37 FOX factors!!!

**FOXM1/FOXO1 orthologs?**

Required for tissue regeneration?

Labbe et al. (2012)
Biochemistry during development
The Nobel Prize in Physiology or Medicine 2007

"for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells"

Gene targeting technology now widely used to understand the functions of genes in health and diseases

Taken from http://nobelprize.org
Mouse Models of Disorders

Skeletal

Deaf and balance

Aging
Mouse as Model System
(Transgenic core facility)

Mouse expressing a fluorescent protein
Study of Biochemistry:

• Evolving discipline - take on new meanings with time!
  E.g. Proteins (enzymes) in 60s-70s
  → Genes in 80s
  → Whole genomes in ~2000
  → System biology in ~2010 (transcriptome, proteome, metabolome)
  → Noncoding RNAs, epitranscriptome, single cell analysis, CRISPR/Cas9 genome editing more recently

• Broad
  → studied at different levels of complexity using various model systems (3D modeling, bioinformatics, cancer cells, chick neural tube, Planaria, mutant mice, etc.)

• Relevance to health and diseases
One entry in application for a choice of 14 Science majors (plus 6 intensive majors)

- Biochemistry
- Biological Sciences
- Chemistry
- Decision Analytics
- Earth System Science
- Ecology & Biodiversity
- Environmental Science
- Food & Nutritional Science
- Geology
- Mathematics
- Molecular Biology & Biotechnology
- Physics
- Risk Management
- Statistics
Major-Minor and Double-Major Options

One Science Major

Optional
Selection of 2nd Major

Optional
Selection of Minors

90 choices of minors and second majors in Science, Arts, Social Sciences, Business & Economics, Education, Computer Science, and Sports Science

(quota & timetabling restrictions may also apply)
BSc Curriculum Requirements

Curriculum requirements (240 credits)

Option A
Students taking one Science major

Option B
Students taking one Science major and one minor

Option C
Students taking double majors (one Science major and a 2nd major)

Primary Science Major: 96 credits
2 Science Foundation courses (SCNC1111 & SCNC1112, taken in Year 1),
13 Disciplinary courses
and 1 Capstone course

Common Core Courses: 36 credits #
6 courses in 4 Areas of Inquiry
(at least 1 and not more than 2 courses from each AoI)

Language Courses: 18 credits
English: 12 credits [6 credits in Core University English (CAES1000, taken in Year 1) and
6 credits in English in the Discipline (CAES9820, taken in Year 2)]
Chinese: 6 credits (CSCI9001, taken in Year 3)

Electives: 90 credits
To make up the 240 total credits

Minor*: 36 – 48 credits

2nd Major **: 72 – 96 credits

Electives: 42 – 54 credits
To make up the 240 total credits
### Example of BSc Programme Structure by Year of Study

<table>
<thead>
<tr>
<th>Yr 4</th>
<th>Cap- stone</th>
<th>Major</th>
<th>Major</th>
<th>Major</th>
<th>Major</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yr 3</td>
<td>CC</td>
<td>CS</td>
<td>Chi</td>
<td>Major</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Yr 2</td>
<td>CS</td>
<td>CS</td>
<td>Eng 2</td>
<td>Major</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Yr 1</td>
<td>CS</td>
<td>SF</td>
<td>Eng 1</td>
<td>SF1</td>
<td>SF2</td>
<td>Major</td>
</tr>
</tbody>
</table>

**CC** – Common Core Courses  
**SF** – Science Foundation Courses  
**Chi** – Chinese  
**Eng 1** – Core University English  
**Eng 2** – English in the Discipline

Note: Different distributions of courses over the years are possible. Blank boxes can be used for elective courses, or courses leading to a minor or a 2\textsuperscript{nd} major (Major 2).  
**Students are NOT allowed to take more than 72 credits in their first year. Application will not be entertained.**
Professors: 15 (+7 from other Div/Dept; http://www.sbms.hku.hk/staff/academic-staff) (+Research assistant professors: 2)

Lecturers: 4 (2 Principle Lecturers)

Postdoctoral Fellows and Research Associates: ~35

Research Assistants: ~20

Research postgraduates: ~90

Administrative staff: 5

Technical staff: 10 technicians & 5 supportive staff
Sch of Biomed Sc
1/F, 3/F & 4/F, Lab Block, LKS Fac of Med, 21 Sassoon Rd

Lab Tour on 16/8 (Fri, 3:00 to 4:30pm, L3-38)
organized by Biochemistry Society, SS, HKUSU!
BIOCHEMISTRY MAJOR (2012 onwards)

Objectives:
The Major in Biochemistry aims to provide students with both basic and advanced knowledge in contemporary biochemistry and molecular biology. Core courses in the curriculum emphasize equipping students with a general understanding of the fundamental ideas, principles and theories of biochemistry with particular focus on the relevance of biochemistry, molecular biology and genomics to biology, human health and disease. Elective courses extend this core knowledge to provide students with specialized insight into both basic and applied scientific endeavour in biochemistry, bioinformatics, molecular biology and molecular genetics. Throughout the curriculum there is an emphasis on experiential learning through laboratory practicals, problem-solving exercises, group-based learning, industrial experience, overseas exchange and research-based projects. These experiences are designed to develop students' ability to read and interpret scientific data, to integrate knowledge with wider scientific theory, and to improve logical thinking and communication skills. The ultimate goal is to provide a comprehensive degree-level biochemistry education that equips students with the critical thinking, communication and analytical skills essential for them to play a leading role in society in the future.

Learning Outcomes:
By the end of this programme, students should be able to:
(1) describe the principles of biomolecular structure, metabolism, molecular interactions, molecular processes and their regulation, genetics and systems biology critical to contemporary biochemistry and molecular biology (by means of coursework and experiential learning)
(2) apply biochemical, bioinformatics and molecular genetics technologies for new observations, measurements and analyses; and to design experiments that bring discovery and insight into the unknown (by means of laboratory-based and research project-based learning)
(3) interpret and communicate scientific data and literature using appropriate scientific language (by means of literature-based coursework and debate)
(4) work effectively as a team and synergize with their colleagues in a supportive manner (by means of group-based learning and by group-based problem solving)
(5) recognize the interconnections of biochemistry with other disciplines in science, medicine and engineering, humanities and ethics, which are relevant for diverse working environment in the society (by means of multidisciplinary-based research projects, internship and debate)
## Required courses (96 credits) (16 courses)

### 1. Introductory level courses (42 credits) (7 courses)

<table>
<thead>
<tr>
<th>Disciplinary Core Courses: Science Foundation Courses (12 credits)</th>
<th>(semester)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCNC1111 Scientific method and reasoning (6)</td>
<td>(1,2)</td>
</tr>
<tr>
<td>SCNC1112 Fundamentals of modern science (6)</td>
<td>(1,2)</td>
</tr>
</tbody>
</table>

### Disciplinary Core Courses (30 credits)

<table>
<thead>
<tr>
<th>Disciplinary Core Courses (30 credits)</th>
<th>(semester)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM1042 General chemistry I (6)</td>
<td>(1,2)</td>
</tr>
<tr>
<td>CHEM1043 General chemistry II (6)</td>
<td>(2)</td>
</tr>
<tr>
<td>BIOC2600 (or BIOL2220) Basic biochemistry (6) [or Principles of biochemistry (6)]</td>
<td>(1)</td>
</tr>
<tr>
<td>CHEM2441 Organic chemistry I (6)</td>
<td>(1,2)</td>
</tr>
</tbody>
</table>

### Disciplinary Electives (6 credits)

<table>
<thead>
<tr>
<th>Disciplinary Electives (6 credits)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC1600 Perspectives in biochemistry (6)</td>
<td>Take either BIOC1600 or BIOL1110, but not both. (1)</td>
</tr>
<tr>
<td>BIOL1110 From molecules to cells (6)</td>
<td>Take either BIOC1600 or BIOL1110, but not both. (1,2)</td>
</tr>
</tbody>
</table>
2. Advanced level courses (48 credits) *(8 courses)*

**Disciplinary Core Courses (30 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC3601</td>
<td>Basic Metabolism (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>BIOC3604</td>
<td>Essential techniques in biochemistry and molecular biology (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOL3401</td>
<td>Molecular biology (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>BIOC4610</td>
<td>Advanced biochemistry (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>BIOC4613</td>
<td>Advanced techniques in biochemistry &amp; molecular biology (6)</td>
<td></td>
<td>(1)</td>
</tr>
</tbody>
</table>

**Disciplinary Electives (18 credits)**

Plus at least 18 credits selected from the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC3605</td>
<td>Sequence bioinformatics (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOC3606</td>
<td>Molecular medicine (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOL3202</td>
<td>Nutritional biochemistry (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>BIOL3402</td>
<td>Cell biology and cell technology (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>BIOL3403</td>
<td>Immunology (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOL3404</td>
<td>Protein structure and function (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOL3408</td>
<td>Genetics (6)</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>CHEM3441</td>
<td>Organic chemistry II (6)</td>
<td></td>
<td>(1,2)</td>
</tr>
<tr>
<td>BIOC4612</td>
<td>Molecular biology of the gene (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>BIOL4417</td>
<td>'Omics' and systems biology (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>CHEM4145</td>
<td>Medicinal chemistry (6)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>CHEM4444</td>
<td>Chemical biology (6)</td>
<td></td>
<td>(2)</td>
</tr>
</tbody>
</table>

3. Capstone requirement (6 credits) *(1 course)*

At least 6 credits selected from the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC3999</td>
<td>Directed studies in biochemistry (6)</td>
<td></td>
<td>(1,2,summer)</td>
</tr>
<tr>
<td>BIOC4966</td>
<td>Biochemistry internship (6)</td>
<td></td>
<td>(1,2,summer)</td>
</tr>
<tr>
<td>BIOC4999</td>
<td>Biochemistry project (12)</td>
<td></td>
<td>(1+2)</td>
</tr>
<tr>
<td>Year</td>
<td>Science Foundation and Chemistry</td>
<td>Fundamental Biochemistry/ Molecular Biology</td>
<td>Advanced and Integrative Biochemistry/ Molecular Biology</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------</td>
<td>------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Year 1</td>
<td>SCNC 1111 Scientific method and reasoning (6)  SCNC1112 Fundamentals of modern science (6)  CHEM1042 General Chemistry I  CHEM1043 General Chemistry II</td>
<td>BIOC1600 Perspectives in biochemistry (6) or BIOL1110 From molecules to cells (6)</td>
<td>BIOC3605 Sequence bioinformatics (6)  BIOC3606 Molecular medicine (6)  BIOL3404 Protein structure and function (6)</td>
</tr>
<tr>
<td>Year 2</td>
<td>CHEM2441 Organic Chemistry I (6)</td>
<td>BIOC2600 Basic Biochemistry (6)</td>
<td>BIOC3601 Basic Metabolism (6)  BIOL3401 Molecular Biology (6)</td>
</tr>
<tr>
<td>Year 3</td>
<td>CHEM3441 Organic Chemistry II (6)</td>
<td>BIOC3601 Basic Metabolism (6)  BIOL3401 Molecular Biology (6)</td>
<td>BIOL3202 Nutritional biochem (6)  BIOL3402 Cell biol &amp; cell tech (6)  BIOL3403 Immunology (6)  BIOL3408 Genetics (6)</td>
</tr>
<tr>
<td>Year 4</td>
<td>CHEM4145 Medicinal chem (6)</td>
<td>BIOC4610 Advanced Biochemistry (6)  BIOC4612 Molecular biology of the gene (6)  BIOL4417 “Omics” and systems boil (6)  CHEM4444 Chemical biology (6)</td>
<td></td>
</tr>
</tbody>
</table>
## Suggested Electives at the Advanced Level

<table>
<thead>
<tr>
<th>Track</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premed/Graduate school track</td>
<td>BIOC3605 Sequence bioinformatics (6)</td>
</tr>
<tr>
<td></td>
<td>BIOC3606 Molecular medicine (6)</td>
</tr>
<tr>
<td></td>
<td>BIOL3403 Immunology (6)</td>
</tr>
<tr>
<td></td>
<td>BIOL3404 Protein structure and function (6)</td>
</tr>
<tr>
<td></td>
<td>BIOL3408 Genetics (6)</td>
</tr>
<tr>
<td></td>
<td>BIOC4612 Molecular Biology of the gene (6)</td>
</tr>
<tr>
<td>Biotech/Pre-business track</td>
<td>BIOC3606 Molecular medicine (6)</td>
</tr>
<tr>
<td></td>
<td>BIOL3402 Cell biol &amp; cell tech (6)</td>
</tr>
<tr>
<td></td>
<td>CHEM3441 Organic Chemistry II (6)</td>
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<tr>
<td></td>
<td>BIOL4417 “Oomics” and systems boil (6)</td>
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<tr>
<td></td>
<td>CHEM4145 Medicinal chem (6)</td>
</tr>
<tr>
<td></td>
<td>CHEM4444 Chemical biology (6)</td>
</tr>
<tr>
<td>Teaching track</td>
<td>BIOC3606 Molecular medicine</td>
</tr>
<tr>
<td></td>
<td>BIOL3402 Cell biol &amp; cell tech</td>
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<td>BIOL3404 Protein structure and function</td>
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<td>CHEM3441 Organic Chemistry II</td>
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<tr>
<td></td>
<td>BIOC4612 Molecular Biology of the gene</td>
</tr>
</tbody>
</table>

Talk to your Academic Advisor!!!!!!!!!
Three common core courses offered!

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCST9060</td>
<td>Exploring Human Longevity</td>
</tr>
<tr>
<td>CCST9006</td>
<td>Chasing Biomedical Miracles: Promises and Perils</td>
</tr>
<tr>
<td>CCST9009</td>
<td>Living with Stem Cells</td>
</tr>
</tbody>
</table>

CCST9006 course video at CCC website:

https://youtu.be/ZjWQa-or_k0
Student Peer Advisers in 2019-20

• General roles
  • to **offer advice** in relation to academic studies to freshmen; and
  • to **facilitate** freshmen’s **smooth transition** from secondary to university education

• Matching between **Student Peer Advisers (SPAs)** and freshmen starting from 2019-20

• You are highly encouraged to contact the following SPAs if you have any questions about your study (their contacts can be found at the Faculty’s website)
  • Mr CHAN Alistair Kai Chak (BSc Year 3)
  • Mr KWOK Yi Hin (Edwin) (BSc Year 2)
  • Mr SZETO Dei Men (John) (BSc Year 3)
  • Miss TANG Tsz So Acacia (BSc Year 4)
  • Mr YAU Yig Jun Jon (BSc Year 3)
  • Mr YIK Kai Hei (Andrew) (BSc Year 4)
  • Miss ZHANG Xiaotian (Louise) (Bsc Year 3)
Student Peer Advisers (SPAs)

Specific roles:

• to offer assistance during the add/drop period for freshmen: by performing shift duty in the ‘Student Peer Advising Corner’ counter in the Faculty to assist in checking course selection documents submitted by freshmen and answering their enquiries; and

• to serve as a contact point for freshmen regarding academic enquiries: contact details of Student Peer Advisers will be available at the Faculty website to facilitate freshmen to enquire on academic related matters.
Welcome Party for BSc freshmen

Date: September 9, 2019 (Monday)

Time: 6:00 pm - 8:00 pm

Venue: Convocation Room, 2/F., Main Building

Come to meet School staff members, fellow students and recently graduated alumni!!!!!

Jot this down in your diary!!!