Molecular Biology & Biotechnology (MB&B)

Dr. Wallace B. L. Lim
Associate Professor

School of Biological Sciences
Faculty of Science, The University of Hong Kong
School of Biological Sciences
Faculty of Science, The University of Hong Kong

Four majors:

✓ Molecular Biology & Biotechnology Major (MB&B)
Biological Sciences Major (BS)
Food & Nutritional Science Major (F&NS)
Ecology & Biodiversity Major (E&B)

All under programme 6901 Bachelor of Science
Molecular Biology & Biotechnology (MB&B)

Missions:

• To expose students to the cutting-edge biotechnologies of the 21st century
• To provide hands-on laboratory trainings and experimental based projects
• To equip students with skills in translation of basic knowledge into modern industrial and medical applications

36 graduates in June, 2017
Why did you choose Science?

Interest?

Career Goal?

No Other Choice?

Do Not Know?
I am Dr. Wallace Lim
School of Biological Sciences

I studied at
Pui Ching Primary School
Pui Ching Middle School
CUHK (BSc)
University of Oxford (D.Phil.)

At high school, I studied BIOLOGY in Chinese

ATP = 腺嘌呤核苷三磷酸

Why did I choose Biology?  Interest
Why Biotechnology is important to human welfare?

• What problems are you facing?

Food supply

Global Warming

http://www.co2.earth

9th August 2018 (410 ppm)
The removal of all the human-emitted CO₂ from the atmosphere by natural processes will take a few hundred thousand years (high confidence) (AR5 Box 6.1)

**CO₂ is forever** (David Archer 2008)

The atmospheric lifetime of CO₂ is 100,000 years

1000 years after emissions 25% of CO₂ is left in the atmosphere ...heating the earth surface and acidifying the oceans

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The percentage of emitted CO₂ remaining in the atmosphere in response to an instantaneous CO₂ pulse emitted to the atmosphere from IPCC AR5 WG1 Box 6.1, Figure 1

CO₂ absorbed by ocean causes acidification!
Use of fossil fuels increases CO₂ emission and global temperature

The global 2010 GHG emissions are 31% above the 1990 emissions (IPCC AR5 Synthesis Report, 2014, Table SPM.1)

Different scenarios of carbon emission (RCP)

Change in annual GHG emissions in 2050 (% relative to 2010 levels)

Population in 2100?

410 ppm (9th August 2018)

(IPCC AR5 Synthesis Report, 2014, Fig. SPM.10)
HKU technology speeds up photosynthesis

8 hrs light/day  
16 hrs light/day  
6 weeks old

**STUDY No. 1**

Seed Yield  
+ 38 to 40 %

**(Dr. B. L. Lim, SBS)**
AtPAP2 promote growth of Biofuel Crop (*Camelina sativa*)

Aviation Biofuel with 50% Camelina seed oils -> **New Jet Biofuel**

The technology was licensed to **Agragen LLC** (USA)

Camelina-based jet fuel reduces carbon emissions by around 80% (*US Navy*)

(Zhang et al., Biotechnology for Biofuels, 2012)
Why Biotechnology is important to human welfare?

Aging: Healthcare Biotechnology
HK & Shenzhen Healthcare biotech companies

• **BGI Genomics Raises RMB 547M in IPO** *(14 July 2017)*

Mr Alex Wong (CUHK classmate)
Executive Director BGI-Hong Kong

BGI-HK@Tai Po

• **Grail goes global, merges with Hong Kong’s Cirina** *(31 May 2017)*

Cirina, which has R&D teams in Hong Kong and San Francisco, shares Grail’s mission. The company was cofounded by Dennis Lo, the first scientist to learn of the presence of fetal DNA in a mother’s blood plasma. Lo’s research includes using liquid biopsy to detect certain cancers.

• **Diagcor** was found by Prof. Joseph Tam in 2006.

HK$214.2 million acquisition of the entire issued share capital of two companies, which together hold a 48.3 percent stake in DiagCor Technology Ltd., a holding company of a group of molecular diagnostics companies *(17 Jan, 2017)*.
Amvet Biosciences is the first biotechnology company dedicated to provide the highest quality animal genetic healthcare in Hong Kong. We focus on individualized DNA tests and precision therapeutics. Amvet Biosciences is the sole genetic service provider to the Hong Kong Kennel Club. We are the genetic consultant to the breeding program of the Hong Kong Seeing Eye Dog Services.

**Founder & Scientific Director**

Mario P S Chin, PhD

Dr. Chin is a bioentrepreneur and an expert in molecular genetics and systems virology. He is a Professor and Associate Director in the Institute of Genomics at Huaqiao University. Before founding Amvet Biosciences, he was an Assistant Professor at Temple University School of Medicine in the U.S. Prior to that, he was a Scholar at the Aaron Diamond AIDS Research Center of the Rockefeller University in New York City. He also received several awards from the National Institutes of Health, the Comprehensive NeuroAIDS Center and the International AIDS Society for his innovations in science. He served on the scientific review committees of the American Association for the Advancement of Science, the National Institutes of Health, the American Cancer Society and the University of Wisconsin, and on the mentoring committee of the International AIDS Society. He also serves on the editorial and review boards of several international journals.

Dr. Chin received his **PhD in molecular genetics** from the University of Hong Kong Faculty of Medicine, where he was a Swire Scholar, and graduated with a **BSc (Hons) in zoology** from the University of Hong Kong.
# MBB Curriculum (Major)

## Year 1/2

### Required courses (96 credits)

1. **Introductory level courses (42 credits)**
   - **Disciplinary Core Courses: Science Foundation Courses (12 credits)**
     - SCNC1111: Scientific method and reasoning (6)
     - SCNC1112: Fundamentals of modern science (6)
   - **Disciplinary Core Courses (24 credits)**
     - BIOL1110: From molecules to cells (6)
     - BIOL2102: Biostatistics (6)
     - BIOL2103: Biological sciences laboratory course (6)
     - BIOL2220: Principles of biochemistry (6)

     OR

     - BIOC2600: Basic biochemistry (6)

### Disciplinary Electives (6 credits)

- BIOL1309: Evolutionary diversity (6)

     OR

- BIOL2306: Ecology and evolution (6)
# MBB Curriculum

## Year 2/3/4

### 2. Advanced level courses (48 credits)

**Disciplinary Core Courses (24 credits)**
- BIOL3401 Molecular biology (6)
- BIOL3402 Cell biology and cell technology (6)
- BIOL4411 Plant and food biotechnology (6)
- BIOL4415 Healthcare biotechnology (6)

**Disciplinary Electives (24 credits)**

*At least 24 credits selected from the following courses:*
- BIOL3403 Immunology (6)
- BIOL3404 Protein structure and function (6)
- BIOL3406 Reproduction and reproductive biotechnology (6)
- BIOL3408 Genetics (6)
- BIOL3508 Microbial physiology and biotechnology (6)
- BIOL4401 Medical microbiology and applied immunology (6)
- BIOL4409 General virology (6)
- BIOL4416 Stem cells and regenerative biology (6)
- BIOL4417 'Omics' and systems biology (6)
- ENV5410 Environmental remediation (6)

### 3. Capstone requirement (6 credits)

*At least 6 credits selected from the following courses:*
- BIOL3993 Directed studies in Molecular biology & biotechnology (6)
- BIOL4963 Molecular biology & biotechnology internship (6)
- BIOL4993 Molecular biology & biotechnology project (12)
Graduates from accredited programmes will receive one year of guest membership of the Royal Society of Biology at *Associate level*.

May progress to Chartered Biologist (CBiol) in UK
# MBB Curriculum (Intensive Major)

## Year 1/2

(96→ 144 credits)

<table>
<thead>
<tr>
<th>Introductory level courses (66 credits)</th>
<th>(42 for ordinary major)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disciplinary Core Courses: Science Foundation Courses (12 credits)</td>
<td></td>
</tr>
<tr>
<td>SCNC1111</td>
<td>Scientific method and reasoning (6)</td>
</tr>
<tr>
<td>SCNC1112</td>
<td>Fundamentals of modern science (6)</td>
</tr>
</tbody>
</table>

**Disciplinary Core Courses (42 credits)** (24 for ordinary major) + 3 courses

| BIOL1110 | From molecules to cells (6) |
| BIOL2102 | Biostatistics (6) |
| BIOL2103 | Biological sciences laboratory course (6) |
| BIOL2409 | Biotechnology Industry and Entrepreneurship (6) |
| BIOL2220 | Principles of biochemistry (6) |
| or | |
| BIOC2600 | Basic biochemistry (6) |
| CHEM1042 | General chemistry I (6) |
| CHEM1043 | General chemistry II (6) |
| BIOL1309 | Evolutionary diversity (6) |
| COMP1117 | Computer programming (6) |
| MATH1011 | University mathematics I (6) |
| MATH1013 | University mathematics II (6) |

**Disciplinary Electives (12 credits)** (6 for ordinary major) + 1 course

| BIOL 2408 | Green earth-plants and mankind (6) |
| BIOL2306 | Ecology and evolution (6) |
| BIOL1309 | Evolutionary diversity (6) |
| COMP1117 | Computer programming (6) |
| MATH1011 | University mathematics I (6) |
| MATH1013 | University mathematics II (6) |

Quota 50, students major in MBB has priority

Take either BIOL2220 or BIOC2600, but not both.

Take either BIOL2220 or BIOC2600, but not both.

May take either BIOL1309 or BIOL2306, but not both.

May take either BIOL1309 or BIOL2306, but not both.
# MBB Curriculum (Intensive Major)

## Year 3/4

<table>
<thead>
<tr>
<th>2</th>
<th>Advance level courses (66 credits)</th>
<th>Disciplinary Core Courses (30 credits)</th>
<th>Disciplinary elective (36 credits)</th>
<th>Capstone requirement (12 credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advance level courses (66 credits)</td>
<td>Disciplinary Core Courses (30 credits)</td>
<td>Disciplinary elective (36 credits)</td>
<td>Capstone requirement (12 credits)</td>
</tr>
<tr>
<td></td>
<td>(48 for ordinary major)</td>
<td>(24 for ordinary major)</td>
<td>(24 for ordinary major)</td>
<td>FYP</td>
</tr>
<tr>
<td>2</td>
<td>Advance level courses (66 credits)</td>
<td>Disciplinary Core Courses (30 credits)</td>
<td>Disciplinary elective (36 credits)</td>
<td>Capstone requirement (12 credits)</td>
</tr>
<tr>
<td></td>
<td>(48 for ordinary major)</td>
<td>(24 for ordinary major)</td>
<td>(24 for ordinary major)</td>
<td>FYP</td>
</tr>
<tr>
<td></td>
<td>+ 1 course</td>
<td>+ 2 courses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disciplinary Core Courses (30 credits)**

- BIOL3401 Molecular biology (6)
- BIOL3402 Cell biology and cell technology (6)
- BIOL4411 Plant and food biotechnology (6)
- BIOL4415 Healthcare biotechnology (6)
- BIOL4417 "Omics" and system biology (6)

**Disciplinary elective (36 credits)**

- BIOL3107 Plant physiology (6)
- BIOL3205 Human physiology (6)
- BIOL3403 Immunology (6)
- BIOL3404 Protein structure and function (6)
- BIOL3406 Reproduction & reproductive biotechnology (6)
- BIOL3408 Genetics (6)
- BIOL3508 Microbial physiology and biotechnology (6)
- BIOL4401 Medical microbiology and applied immunology (6)
- BIOL4409 General virology (6)
- BIOL4416 Stem cells and regenerative biology (6)
- ENVS4110 Environmental remediation (6)

**Capstone requirement (12 credits)**

- BIOL4993 Molecular biology & biotechnology project (12) Need GPA > or = 3.0
Final Year Project
(12 credits) (cGPA 3.0 or above)

Intensive write-up of a topic based on laboratory research

Need a supervisor and required to work in his/her lab

Come up with conclusions based on lab work and other published results

Assessments

FYP:
1. Written report 9000-12000 words (by April)

2. Oral presentation 15-20 min (in early May)

3. Attending 2 postgrad or guest seminars at SBS (during the semesters)

News about SBS seminars:
SBS web → News & Events
### Overview of the biotech industry, case studies and start-up

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Topics</th>
<th>Basic concepts</th>
<th>Companies</th>
</tr>
</thead>
</table>
| Lecture 1 | How to initiate a Start-up company?  
IP rights – Major assets | Business model  
IP rights  
Patents | Assignment 1 |
| Lecture 2 (24 Jan) | Licensing  
Technology Transfer Office  
How to raise fund? | Licensing  
Business plan | Assignment 2 |
| Lecture 3 (7 Feb) | Agrobiotechnology  
Green Technologies | Plant Biotech  
Biofuels | Monsanto  
Syngenta |
| Lecture 4 (14 Feb) | Biotech company analysis | 4P, Pipeline, PB  
PB, PEG, SWOT | |
| Lecture 5 | Biotechnology Industry | | |
| Lecture 6 | Diagnostics business | Molecular diagnostics | FCL Biotech  
Quest Diagnostics |
| Lecture 7 Dr. Ng | Pharmaceutical Industry  
Drug Development | Clinical trials | GILEAD Sciences |
| Lecture 8 Dr. Ng | Clinical Research Organization | | Wuxi PharmaTech |
| Lecture 9 KYY | Stem Cell Biotechnology | Stem Cell | |
| Lecture 10 BLL | Company Visit to Science Park | Stem Cell  
Molecular diagnostics | Science Park |
| Lecture 11 BLL | Company Visit to Diagcor | Molecular diagnostics | Diagcor/BGI |
**Experiential Learning**

- **Exchange study programmes** in overseas universities in the UK, USA, Canada, Australia and Europe

- **Internship** (Biological Sciences Internship)
  1. Local and foreign universities
  2. Departments and statutory bodies of the HKSAR
  3. Local biotechnology companies

- **Research projects**
  1. Final Year Project (FYP) : Publications
  2. Directed Studies in Biological Sciences
  3. Summer Research Fellowship (SRF)
  4. Overseas Research Fellowship (ORF)
Nationality of MBB graduates

2016
Total = 31
Local = 65%

2017
Total = 36
Local = 75%
There are plenty of positions available in the job market, and they are not restricted to biotechnology companies, but also many other types of organizations, both in the public and private sector.

**HKSAR Government**

1. The Agriculture, Fisheries and Conservation Department
2. Environmental Protection Department
3. Food and Environmental Hygiene Department
4. Department of Health
5. Hospital Authority
6. Secondary and tertiary educational institutions
• **Commerce, industry and community/personal/social services**
  1. Biotechnology companies (e.g. CK Life Science International Inc.)
  2. Health products companies (e.g. Vita Green Health Products Company Ltd.)
  3. Pharmaceutical industries (e.g. Novartis Pharmaceuticals Ltd.)
  4. Private medical laboratories (e.g. PathLab Medical Laboratories Ltd.)
  5. Research institutes (e.g. Genome Centre, HKU)

**Positions include:**
• Health product consultants
• Laboratory technicians
• Medical sales representatives
• Quality control officers
• Research scientists
• Sales and marketing executives
• Secondary school teachers
• Teaching/research assistants
2015 MBB Graduates

11 Commerce
3 Education

<table>
<thead>
<tr>
<th>No. of respondents</th>
<th>2015</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Employed</td>
<td>14</td>
<td>78%</td>
</tr>
<tr>
<td>Unemployed seeking F/T job</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Further Studies</td>
<td>3</td>
<td>17%</td>
</tr>
<tr>
<td>Emigrated/Returned to home country</td>
<td>1</td>
<td>5.6%</td>
</tr>
<tr>
<td>Not seeking F/T job</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

^ Not all MBB graduate responded to survey

<table>
<thead>
<tr>
<th>Commerce and Industry -</th>
</tr>
</thead>
<tbody>
<tr>
<td>* - ACGP</td>
</tr>
<tr>
<td>* - AIA Group Limited</td>
</tr>
<tr>
<td>* - Buying Hong Kong Limited</td>
</tr>
<tr>
<td>* - CJ CheilJedang</td>
</tr>
<tr>
<td>* - Edelman</td>
</tr>
<tr>
<td>* - HealthCare Diagnostics Limited</td>
</tr>
<tr>
<td>* - LF Asia</td>
</tr>
<tr>
<td>* - Optimal Medical Laboratory Limited</td>
</tr>
<tr>
<td>* - Pfizer Corporation Hong Kong Limited</td>
</tr>
<tr>
<td>* - St. Jude Medical, Inc.</td>
</tr>
<tr>
<td>- Organization's name not reported</td>
</tr>
</tbody>
</table>

* Related to Biotechnology/Biosciences

(CEDARS Report, 2016)
## 2016 MBB Graduates (Employment)

<table>
<thead>
<tr>
<th>Employers</th>
<th>Job Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Educational Institutions</strong> -</td>
<td>* Related to Biotechnology/Biosciences</td>
</tr>
<tr>
<td>- The Chinese University of Hong Kong</td>
<td>* - Research Assistant</td>
</tr>
<tr>
<td><strong>Community, Social and Personal Services</strong> -</td>
<td></td>
</tr>
<tr>
<td>- BGI Hong Kong</td>
<td>* - Lab Technician</td>
</tr>
<tr>
<td>- Tech Dragon Limited</td>
<td>* - Laboratory Technician</td>
</tr>
<tr>
<td>- Organization's name not reported</td>
<td>* - Teacher</td>
</tr>
<tr>
<td><strong>Commerce and Industry</strong> -</td>
<td></td>
</tr>
<tr>
<td>- Action X-Ray &amp; Medical Diagnostinc Centre</td>
<td>* - Medical Laboratory Assistant</td>
</tr>
<tr>
<td>- GlaxoSmithKline Limited</td>
<td>* - Medical Service Associate</td>
</tr>
<tr>
<td>- Jean Marie Pharmacal Company Limited</td>
<td>* - QA Officer</td>
</tr>
<tr>
<td>- John Swire &amp; Sons (H.K.) Ltd</td>
<td>* - Sales Operations Assistant</td>
</tr>
<tr>
<td>- Johnson &amp; Johnson (Hong Kong) Ltd</td>
<td></td>
</tr>
<tr>
<td>- St Jude Medical (HK) Ltd</td>
<td>* - Clinical Assistant</td>
</tr>
<tr>
<td>- Tricor Services Limited</td>
<td>* - Occupation's name not reported</td>
</tr>
<tr>
<td></td>
<td>* - Corporate Service Associate</td>
</tr>
</tbody>
</table>
Career development of science students

Undergraduates

Postgraduate Diploma in Education (1 yr PGDE)

High School Teacher in Sciences

(M.Phil.)

PhD.

Postdoc

Professor (University) & Scientist (Industry)

Technicians Sales

Other Alternatives?
Alternatives for MBB Graduates

Undergraduates/Postgraduates

- Trainees at Investment Bank Management Consultant
- MBA/CFA
- Seniors/CEO/Financial Analyst

- CPE (HK SPACE or UK) 2 year part time
- Conversion Course (1 yr)
- PCLL (1 yr) (300 spaces/1000 applicants)
- Lawyers (Hong Kong)
- IP lawyers (Patents)

Conversion Course
(1 year part time, 4 months full time)

- HKI CPA Qualifying exam
- Accountants

Lawyers (Hong Kong)
IP lawyers (Patents)
Major & Minor options

- Major/Double Major in MBB
- Minor in MBB
- Minor in other science subject
- Minor in other Faculties (Business, Social Sciences, Arts, Engineering, etc).
Non-academic skills

• Good Language ability (Oral, Listening)
• Common sense (Know this world!)
• Communication skills (Do not be shy!)
• Mature/Easy characters
• Academic Exchange/Leadership in ECA
• Independent thinking
• Self-motivated learning

I wish you enjoy your study at HKU!!
Your future....

June 1990, CUHK, Biochemistry

Executive Director
BGI-Hong Kong

Civil Servant

Finance

PhD (Cambridge)
Professor, CUHK

Vice President of a Biotech Co.
Stock no: 1298

May, 2017
MBB Student Peer Advisers (SPAs)

General roles of SPAs:
• to offer advice in relation to academic studies to freshmen
• to facilitate freshmen’s smooth transition from secondary to university education.

Specific roles of SPAs:
• 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

Ms. POON Hoikiu, Year 2
Email: kphoikiu@hku.hk

Ms. Miss LIM Hui Yuan, Year 2
Email: huiyuan@hku.hk