Gifted Education in Science

Po Leung Kuk Laws Foundation College
Our Vision and Mission in Science Education and Biotechnology Education

Our Vision
• Science education for meeting personal needs;
• Science education for nurturing scientific mind, creativity and curiosity;
• Science education for resolving current societal issues;
• Science education for preparing for further studies;
• Science education for educating the future citizens;
• Science education for offering a means of creating new knowledge;

• Biotechnology education for strengthening and enriching science education.

Our Mission
• To nurture students’ scientific literacy, creativity and curiosity;
• To breed informed and accountable citizens to deal responsibly with science-related societal issues;
• To prepare students for applying science to improve their lives;
• To equip students who are likely to pursue science academically and professionally with a good knowledge foundation;
• To provide learning opportunities and facilities for students to create knowledge;
• To maximize students’ potentials.

In summary,
1. To educate future citizens
2. To nurture future scientists

We promise to try our best to nurture every student to respect every life, appreciate the nature and make good use of their knowledge for helping people and protecting the environment.
Science education in Hong Kong

Science Education is one of the eight key learning areas.

There are 6 strands in Science Education in Hong Kong:
- Scientific Investigation
- Life and Living (Looking at living things, Cells and human reproduction, Living things and air, Sensing the environment and A healthy body)
- The Material World
- Energy and Change
- The Earth and Beyond
- Science, Technology and Society

Biotechnology is absent in the syllabus.

References:
Science Curriculum in LFC

• Biotechnology

- School-based Curriculum
Our School-based Biotechnology Curriculum
(10-year development)

<table>
<thead>
<tr>
<th>S.1</th>
<th>S.2</th>
<th>S.3</th>
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<tbody>
<tr>
<td>Classification of living things</td>
<td>Basic Chemistry: concepts of chemical formula and concentrations</td>
<td>DNA, RNA and Proteins</td>
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<td>Microbiology: <strong>Culture of bacteria</strong> and <strong>Culture of fungi</strong></td>
<td>• Plant tissue culture</td>
<td>• <strong>DNA fingerprinting</strong></td>
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<td>• Animal cell culture</td>
<td>• <em>Transformation of E. coli with GFP gene (started in 14/15)</em></td>
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<td>• <em>Research Projects</em> (4-month)</td>
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<td>(started in 12/13) – Like Bachelor students in the final year, our S.3 students conduct a group research project.</td>
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~90-hour lessons in S.1-3
Science Curriculum in LFC

DiagCor
Biotechnology Laboratory
Equipment in our DiagCor Biotechnology Laboratory to support the curriculum

- **1st phase development in 2004:** ~HK$ 200,000
- **2nd phase development in 2012:** ~HK$ 950,000
- Lists of equipment and their role in the biotechnology curriculum

<table>
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<tr>
<th>(University-Level) Equipment</th>
<th>Biotechnology curriculum</th>
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<tr>
<td>Microbiological incubator</td>
<td>Bacterial and fungal culture in S.1</td>
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<tr>
<td>Class II biological safety cabinets</td>
<td>Plant tissue culture and animal cell culture in S.2</td>
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<tr>
<td>( \text{CO}_2 ) incubator for cell culture</td>
<td>Animal cell culture in S.2</td>
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<td>Plant growth chamber</td>
<td>Plant tissue culture in S.2</td>
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<td>Live-cell imaging system</td>
<td>Animal cell culture in S.2 ; Fluorescent microscopy for studying cells in culture in S.2</td>
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<td>Inverted microscopes</td>
<td>Animal cell culture in S.2</td>
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<tr>
<td>High-speed centrifuge</td>
<td>Extraction and purification of DNA, RNA and Proteins in S.3; Separation of organelles in S.3</td>
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<tr>
<td>Real-time PCR machine</td>
<td>PCR and DNA fingerprinting in S.3; Analysis of gene expression in S.3</td>
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<tr>
<td>Spectrophotometer</td>
<td>Quantitation of DNA and RNA concentration in S.3</td>
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<tr>
<td>-150°C ultra deep freezer</td>
<td>Storage of cells, DNA, RNA and proteins in S.2 and S.3</td>
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<tr>
<td>96-well plate reader</td>
<td>Quantitation of protein concentration in S.3; Bio-assays for studying cellular signaling mechanisms</td>
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<tr>
<td>Gel documentation system</td>
<td>Analysis of DNA, RNA and Protein gels in S.3</td>
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**Our Science Curricula for gifted students**

- Three-tier gifted education framework in our school:

<table>
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<tr>
<th>Whole-class</th>
<th>Pull-out</th>
<th>Off-site</th>
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<tr>
<td><strong>S.1 – 3 Biotechnology Lessons</strong> (as enrichment of Integrated Science curriculum)</td>
<td>“Budding Scientists” for S.1-2 students</td>
<td>International Junior Science Olympiad</td>
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<td></td>
<td>“Neuroscience Club” for S.3-6 students</td>
<td>Hong Kong Biology Olympiad for Secondary Schools</td>
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<td>“Chemistry Club” for S.3-6 students</td>
<td>Hong Kong Chemistry Olympiad for Secondary Schools</td>
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<td></td>
<td>“Physics Club” for S.3-6 students</td>
<td>Hong Kong Physics Olympiad</td>
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<td>Courses offered by The Hong Kong Academy for Gifted Education</td>
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<td>Summer and Winter programs offered by universities</td>
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Bridging Course (Pre-S.1)

Po Leung Kuk Laws Foundation College

§.1 Bridging Course

Science of Candies!

Your Experience...

M&Ms claims that the beans only dissolve in your mouth but not on your hands. Is it really true? Do you have any experiences that M&Ms beans dissolve on your hands?

I think that...
1.
2.

Your Missions...

Today, you are going to be a little scientist. You are going to carry out an experiment to study the differences between different colours of M&Ms by placing in a plate of water. Before carrying out the experiment, let’s learn how scientists’ think and work for a scientific investigation.
Bridging Course (Pre-S.1)

Prediction

Observation

Explanation
Budding Scientist Program
A Gifted Education Program for S.1 and S.2 students
**Neuroscience Club**

Neuroscience Club is a pull-out programme for scientifically gifted students

- **Targets of students:** Scientifically gifted students who are interested in biological science
- **Mode of learning:** Research-based learning (like a M.Phil./Ph.D. student)
- **Lesson time:** Lunch time and after-school periods
- **Teacher’s research publications** about the development of Neuroscience Club as a gifted education programme:
“Secondary School Students can be a scientist.”
(supported by the advanced equipment in the DiagCor Biotechnology Laboratory)

Students planned their experiments.

Students calculated how to prepare different concentrations of TCM.

They are SH-SYSY cells stained with DAPI.

The 96-well plate cover shows the concentrations of chemicals used.

Students drew the protocol of the experiment.

Students were going cell culture experiments.

Abbass Gary gave presentation about neuroscience.

Parents were listening to the presentation given by their children.

Chung Ho-lim was giving a presentation about cell death.
Our students attended international scientific conferences and presented their research findings like other scientists.
Neuroscience Conference
(The Annual Meeting of the Society for Neuroscience (SfN))
(SfN: The Society for Neuroscience is the world’s largest organization of scientists and physicians devoted to understanding the brain and nervous system.)

• 2006: In Atlanta, CA, USA
  Doing physical exercise has no indication on learning and memory enhancement in children aged 13-15.
  Increment of sleeping time does not implicate enhancement on memory and learning in adolescents.

• 2008: In Washington, DC, USA
  Immediate night-time sleep helps memory consolidation in adolescents aged 13-14.

• 2010: In San Diego, CA, USA
  Elicitation of a pungent sensation does not implicate memory modulation in adolescents aged 14-16.

• 2013: In San Diego, CA, USA
  Dendrobium huoshanense can reduce hydrogen peroxide-induced toxicity in SH-SY5Y cells.

• 2015: In Chicago, IL, USA
  Differential effects of seed extracts of citrus fruits against hydrogen peroxide-induced toxicity in SH-SY5Y cells.
Science Competitions

The Space Science Experiment Design Competition for Hong Kong Secondary School Students
(香港中學生太空搭載實驗方案設計比賽)

微重力狀態下雙擺運動的混沌性質
Science Competitions

The 30th China Adolescents Science and Technology Innovation Contest (第三十届全国青少年科技創新大賽)

周柏臻和洪英展的參賽題目為「金桔核提取物的腦神經保護作用」
• 「十佳科技創意之星」
• 「青少年科技創意作品一等獎」
• 「香港賽馬會創新科技獎嘉許獎」

馬皓謙和鍾灝廉的參賽題目為「霍山石斛對抗腦退化症的研究」
• 「青少年科技創意作品三等獎」
To nurture future scientists

Wong Chun Hei, Victor
PLKLFC Alumnus (Class of 2011)
Bachelor of Science, 1st Class Honours, HKU
Doctor of Philosophy, HKU (In progress)