優質教育基金
Quality Education Fund

M:FR/E

Final Report of Project	**Project No. : EMB/QEF/2007/0351**

Part A

Project Title: The Development of Student-Oriented Teaching and Learning Resources in Science and a Science Enrichment Programme for Secondary 3-4 Students

Name of Organization/School: Faculty of Science, The Chinese University of Hong Kong

Project Period: From September 2008 *(month/year)* to August 2011 *(month/year)*

Part B

Please read the Guidelines to Completion of Final Report of Quality Education Fund Projects before completing this part of the report.

Please use separate A4-size sheets to provide an overall report with regard to the following aspects:

1. Attainment of objectives
2. Project impact on learning effectiveness, professional development and school development
3. Cost-effectiveness – a self-evaluation against clear indicators and measures
4. Deliverables and modes of dissemination; responses to dissemination
5. Activity list

**The report should be signed by the supervisor of the school/the head of the organization or the one who signed the Quality Education Fund Agreement for allocation of grant on behalf of the organization.*

1. Attainment of Objectives

Based on the success of *A Science Enrichment Programme for Secondary 3-4 Students* in 2005, this project "*The Development of Student-Oriented Teaching and Learning Resources in Science and a Science Enrichment Programme for Secondary 3-4 Students*", lasted from September 2008 to August 2011, strove to adopt various strategies to promote and contribute to gifted education in Hong Kong. Apart from the three-phase programme, the Project Team shared their experience in gifted education with the public by compiling the materials used, specially designed for this programme, into several books which were then disseminated widely in the education sector. This substantially expanded the pool of beneficiary to include the teachers and students who did not have an opportunity to participate in the programme. The long-term sustainability of the project results is guaranteed as the deliverables enable all secondary teachers and students to continue make use of the teaching and learning materials in science education.

The Project Team held regular meetings for discussing the implementation of the project plan, and at the same time evaluating the activities conducted. Project team members and teachers shared their observation and situation encountered in the activities. Feedback from participants (both teachers and students) was also analysed. Refinement of the project implementation from such thorough discussion could further enhance the quality of the whole programme.

This project was closely monitored and evaluated by the Centre for Learning Enhancement And Research (CLEAR), a unit external to the Faculty of Science and responsible for spearheading CUHK's mission on high quality teaching and learning. Adopting different evaluation strategies, a very comprehensive evaluation plan was implemented in each phase and the project as a whole reflected upon the achievement of the objectives at various stages of the project.. The strategies employed and responses collected by CLEAR are as follows:

- Evaluations from the participants in our end-of-Phase workshops and the end-of-project exhibition were collected through surveys and focus-group meetings from student and teacher participants;
- 16 student surveys and 4 student focus-group meetings were conducted to collect feedback and opinions from the student participants on their experiences;
- 10 observer surveys and 10 observer focus-group meetings were conducted to collect feedback and opinions from the teacher participants who were invited to observe the workshops and research activities of the students in the various Phases;
- Comments from helpers and teachers in the project were also gathered about their experiences at various points.

Detailed summaries of the evaluation in each of the three phases can be found in the Appendices. The feedback collected was encouraging and positive, which, from the participants' point of view, justified that the objectives of the project were achieved. It then comes to a conclusion that, in general, the project was found to be successful. The following provides a summary on the achievements that were made by the project team:

(i) Build on the success of the previously funded QEF project "A Science Enrichment Programme for Secondary 3-4 Students" to implement a 3-stage Science Enrichment Programme to a group of S3-4 students

➢ **Exploring students' unrealized academic potential - Phase 1 Scientific Workshops:**

In *Phase 1 Scientific Workshops*, we aimed to introduce students with a range of interesting science topics with which they could explore their strengths and potential in science. Based on the screening results and the application information, 311 students were selected to participate in the programme.

In Phase 1, six scientific workshops (each of which focused on one of the following fields:

biochemistry, biology, chemistry, mathematics, physics, and statistics) were conducted every Saturday from 7 February to 28 March 2009. Around 240 students were accommodated in each workshop. Students were required to attend at least 4 of the 6 workshops to fulfil the attendance requirement. The topics of the workshops were carefully chosen by our professors as they should be challenging yet manageable to the gifted students. Different teaching and learning strategies were employed to address to the theme and learning outcomes of each workshop. Various activity modes, such as lectures, tutorials, games and laboratory experiments, were adopted to enhance students' understanding, stimulate their potential and encourage their keen participation. Assessments were also in different forms, such as group projects, mini tests, laboratory worksheets and games, to assess students in various dimensions. The assessment results were then used for selecting students into Phase 2. *For more details of Phase 1 activity schedules, please refer to Appendix 1.*

- **Enriching their deep knowledge of science and ability to use that knowledge - *Phase 2 Scientific Workshops and Intensive Courses***

Phase 2 Scientific Workshops and Intensive Courses aims at enriching students' understanding and enhancing their application of scientific knowledge. The top 120 students in Phase 1 were selected to enter Phase 2. The scientific workshops, held on 19 and 26 September 2009, aimed at training students' appreciation on various disciplines in science and other generic capabilities. They were a substituent of the planned three-day-two-night summer study camp which was cancelled due to the outbreak of human swine influenza in order to avoid the possibility of large-scale outbreaks. This decision was made after assessing the situation with all team members and consulting QEF staff (reported in 2nd Progress Report). However, despite the difference of programme mode, i.e. from study camp to workshops, the content and continuity of the teaching materials taught were the same.

The intensive courses, held in October and November 2009, strove to further enrich students' scientific knowledge and ability to internalize their knowledge. Students were required to select 1 from the 4 science streams (biological science, chemistry, mathematics and statistics, and physics) and attend all lessons of the respective intensive courses. The lessons were in the form of lectures, laboratory demonstrations, group discussions and formative assessments. The topics in each stream were more advanced and challenging than that in the workshops so as to arouse students' interest. Students also carried out scientific experiments in order to be trained for the research studies in Phase 3. *For more details of Phase 2 activity schedules, please refer to Appendix 1.*

- **Enhancing their communication skills in science - *Phase 3 Independent Research Studies and Symposium***

With training from Phase 1 (applying, analyzing and evaluating the material studied) and Phase 2 (development of their innovative skills), students are more or less well-trained and well-prepared for the more demanding tasks in Phase 3. The research projects in Phase 3 were particularly inquiry-based. Students defined the research objectives and the methodology themselves with appropriate guidance from teachers of our Faculty. Such active learning environment resulted in substantial learning benefits. 56 students with the best performance in Phase 2 were selected to participate in Phase 3.

The research studies lasted from February 2010 to May 2010. There were altogether 13 projects covering four streams (biological sciences, chemistry, mathematical sciences, and physics). Students were required to work on research projects of their choice in groups of 2 to 5 under the supervision of professors and other teaching staff of our Faculty during their regular meetings. Communication skills are of prime importance if scientifically gifted students are to excel in the

discipline because science work is often done in group settings where the ability to express concepts neatly and accurately is required. Students were required to compile a comprehensive report to conclude their research and present in the symposium organized in May 2010.

Over 200 participants attended the symposium, such as government official (representative from Innovation and Technology Commission (ITC)), representatives from Centre for Innovation and Technology, Faculty of Engineering, CUHK (CINTEC), professors, secondary school principals, teachers, S3-4 project students and their parents. Students presented their research projects and shared their efforts in developing their learning skills and enriching their learning experiences during the oral presentation. In the symposium, guests were eager to ask questions in the Question-and-Answer Session and an interactive atmosphere was attained. Posters were displayed in the venue for guests to have a deeper understanding of students' work and students were there to answer further questions.

Phase 3 further trained students to become independent and efficient learners by engaging them in research problems. They generated new ideas and evaluated the appropriateness. Through conducting research-based projects, students could know more about their own learning styles, strengths and weaknesses.

The project provided an excellent opportunity for gifted students to learn together. The intellectual exchange of students with similar abilities and interests was itself an excellent learning experience for the students. This Project maximized the peer-learning effect through a great deal of group work in all three phases. *For more details of Phase 3 project, please refers to Appendix 1.*

(ii) Organize a series of professional development workshops for teachers

Throughout the whole programme, 17 workshops were organized for secondary school teachers in parallel to students' learning activities and over 100 teachers participated. They observed the activities in the programme, including lectures, demonstrations and group discussions. After that, they shared comments on the activities or experiences on gifted education with the university professors and other teachers. They were also invited to participate in Phase 3 symposium and Teacher Development Workshop in May 2010 in which they exchanged views and insights on the research projects.

Throughout the above workshops, project members shared their ideas on how to implement our gifted education programme into secondary school environment. Draft teaching and learning materials were also distributed to the secondary school teachers for reference. It was a great chance for exchange of ideas as teachers shared their experiences and practices on gifted education and discussed their difficulties on promoting gifted education in secondary school level. Ideas on gifted education were brainstormed and consolidated during the discussions. Teachers also channeled their advices on the programme to us, and generally the responses were positive. The project team has accumulated extensive knowledge and skills on the provision of gifted education from the reflection of practice in our project design.

(iii) Design a set of instruments with a focus on exploring higher order thinking capability and creativity for the early identification of students who are exceptionally gifted in science

Academic results are not the only indicator that assists teachers to identify the gifted. Our extensive discussion with the teachers in the project confirms that many students with high potential may not excel in school examinations, particularly if the examinations test for memorization of facts and/or low-level cognition. Some factors that are considered important in identifying gifted students include cognitive abilities, motivation, creativity, and the ability to link between concepts and then apply the understanding in real settings. To share this idea with the gifted education sector, a set of identify gifted science students instrument were developed.

The set of instruments consists of 12 experiments, case studies and other student-oriented learning activities in

topics ranging from biological, physical to mathematical sciences in both Chinese and English. Teachers can make use of these instruments to assess their students in various dimensions, such as scientific knowledge, presentation skills and communication skills, with reference to the guidelines given. To further explain the use of the instruments, our professors analyse their students' performance as observed over trial runs. It is hoped that the instrument set will contribute to the gifted education and help teachers to identify gifted students in a more systematic manner.

600 copies of the set of instruments were printed and disseminated widely, including Gifted Education Section of CDI of EDB, teachers participating in the Teacher Development Workshop and participants of the 2010 Hong Kong Annual Gifted Education co-organized by The Hong Kong Academy for Gifted Education and EDB.

(iv) Develop and disseminate a set of teaching and learning resources in science that foster a cultural change towards student-oriented learning

Traditionally, teachers direct the learning process and students assume a receptive role in their education. In order to encourage students' active participation in the learning process, a new approach "student-oriented learning" is introduced. It focuses on students' need, rather than that of teachers, administrators or other educational parties. It counts on students' abilities, interests and learning styles with the teachers who act as a facilitator of learning in this learning approach in designing the curriculum, course content, and interactivity of courses. Although the education community calls for a change of pedagogy towards student-oriented and inquiry-based learning, there is a lack of relevant science teaching and learning resources. In the view of this, a set of teaching and learning resources were developed in this project.

Teaching and Learning Resources consists of 4 books, with a student edition and a teacher edition respectively in Chinese and English (published separately), together with an accompanying CD. Each book has twelve chapters covering different topics which can be broadly classified into biology, chemistry, mathematics and physics. The objective is to facilitate teaching and learning in a series of practical and interesting topics of the above fields.

Student edition is specially arranged for students to pursue self-learning. The concepts of the topic are illustrated with detailed examples in *Learning Material.* Guidelines are given in the exercises and discussion questions to guide students to learn independently. In the teacher edition, each chapter is featured with several sections which guide teachers to facilitate students' learning. *Suggested Student Work and Solutions* and *Activity Guidelines* help teachers accomplish an interactive lesson; *Assessment Guidelines* suggests parameters for designing appropriate assessments. The framework provides teachers with a clear outline of teaching a specific topic, while at the same time, leaving much room for them to explore their own teaching methods.

Sets of materials (each set comprises of four books and one CD) were delivered to all secondary schools in Hong Kong, gifted education section of CDI and teachers who participated in our programme. Copies of the student edition were sent to all students who participated in the programme. It is hoped that this material set, together with *Identifying Gifted Science Students: Practical Instruments* published in March 2010, will contribute to nurture students' interests in sciences and develop their' potential to the fullest.

2. Project Impact

(i) Learning Effectiveness

In-depth analysis and conscious planning of the learning objectives, content topics, and learning and teaching strategies were incorporated in the project so as to develop students' higher-order thinking skills, creativity and personal-social competences. The impact on students was significant. Their presentations in the project-end symposium showcased the fruits of this two-year enjoyable journey navigating through science knowledge.

In the project-end evaluation, focus was drawn to the learning outcomes, activity content and process in all three phases. Students feedback was very positive: they agreed that: the workshop series in Phase 1 broadened their horizons (scored 4.4 in a 5-point scale); Phase 2 enhanced their knowledge on science and its application on solve real-life problems (3.8); the learning activities in Phase 3 enhanced their creative thinking (3.9), and were useful for their learning of science (4.5).

The representative from ITC was highly impressed by some of the student projects, such as *Effect of polyphyllin D on the induction of cell death in human red blood cells, Marine Micro Algae as Bioreactor for Fatty Acid Production, How are the Active Ingredients in Chinese Herbal Medicine Affected by Different Preparation Methods,* and *Calculating the orbits of the moon, planets and spacecrafts*. Students from these groups were invited to take part in *Inno Carnival 2010* (創新科技嘉年華) in November 2010 in which posters and display panels were made to present their ideas. These students also participated in the innovative science and technology activities in the festival.

(ii) Professional Development

In parallel to students' learning activities, a series of teacher development workshops and observation sessions were organized in all three phases to enhance secondary school teachers' sense of achievement and offer more professional training opportunities to them. The observation sessions triggered their thoughts about students' needs and gifted education which was shown in the enthusiastic discussions afterwards. For details of the teacher development workshops, please refer to Section 1 (ii).

To raise teachers' professionalism, the teaching materials used in the project were consolidated and published in two sets of deliverables. The first set *Identifying Gifted Science Students: Practical Instruments* was published in March 2010 and the second set "*A Science Enrichment Programme for S3-4 Students: Teaching and Learning Resources*" in August 2011.

(iii) School Development

The project aimed at setting up a quality-assured model for developing gifted education. The 3-phase programme curriculum was carefully developed for gifted education and can be readily adopted by secondary school teachers to organize similar programmes or activities. Details such as content, teaching materials, expected learning outcomes, learning activities, assessment schemes and operation remarks were fully developed. They are also of value to all secondary school teachers in the formulation of new teaching strategies in the NSS. Teaching materials in the programme were shared with the participating teachers in the teacher development workshops. The set of *Teaching and Learning Resources* were also distributed to all secondary schools in Hong Kong. The project has stimulated changes in many Hong Kong schools in terms of their awareness to develop gifted education and the pedagogies of teaching science.

Students in the project came from 121 schools. The teacher observers and the teacher participants who attended different development workshops came from over 40 different schools. The project Team has established connection with these students and teachers throughout the programme and hopefully this connection can last after the programme ended.

3. **Cost-effectiveness**

Budget Items *(Based on Schedule II of Agreement)*	**Approved Budget (a)**	**Actual Expense (b)**	**Change [(b)-(a)]/(a) +/- %**
Staff Cost	$586,000	$585,439.22	-0.1%
General Expenses	$113,000	$85,786.92	-24.08%
Equipment	$40,000	$10,011.5	-74.97%
Service	$2,761,000	$3,107,059.07	+1.88%
- Other Income	$288,857.49		

** The application on budget re-allocation is under review by QEF*

S3-4 Programme had organized a series of workshops and activities in science (please refer to Part 5 for the detailed list of activities) for over 300 selected gifted students, all science teachers in secondary schools and educators who were interested in gifted education development, e.g. EDB and QEF officials. Students were given opportunities to try new things in a well-equipped environment and to interact with senior academicians through this programme. This experience, for the students, is invaluable.

The project Team had published a set of instruments for identifying gifted science students with Chinese and English for assessing students' capabilities in various dimensions, which is called *Identifying Gifted Students: Practical Instruments.* And to accommodate the growing need of teaching and learning materials for gifted science education, the project Team developed *Teaching and Learning Resources.* The set has both teacher and student editions in Chinese and English to share good practices with secondary school teachers and students who pursue self-learning of students. An electronic version in CD is also available for quick and easy reference.

The project not only benefited the programme participants, students and teachers in other schools will also benefit from the widely available and the easily accessible deliverables produced by the project Team, especially when schools organise similar programmes or activities.

It would be difficult to evaluate the success and the effectiveness of this project solely by the unit cost for beneficiaries since it, as a whole and in a broad sense, aimed to provide a feasible framework for further development of gifted science education, and to produce deliverables that can be used in the whole secondary sector for promoting the use of student-centred approach in science teaching and learning.

4. Deliverables and Modes of Dissemination

No.	Item description	Purpose	Evaluation of the quality and dissemination value of the item	Dissemination activities conducted	The value and feasibility for the items to be widely disseminated by the QEF and its suggested modes of dissemination
1.	A set of promotion items including programme logo, poster and press releases	To enhance public understanding of the programme and promote the programme	Satisfactory	Promotion through public media and secondary schools	/
2.	Two versions of programme website (Chinese and English)	To release latest information and share resources with participants and the public	Effective	Widespread of information through public media and secondary schools	Online resources on the website could be used as reference for organising gifted science programme
3.	Three phases of programme activities	To enhance students' knowledge in science and nurture their multiple intelligence	Satisfactory and significant	Workshops, lectures, research and symposium *(for more details, please refer to Section 5)*	/
4.	Teacher Development Workshops	To maintain close relationship with secondary school teachers and to share with them the good practices for gifted education	Interactive and constructive	1. 17 class observations and focus group discussions during student workshops and lectures 2. In-depth Teaching Development Workshop on 29 May 2010	The teaching materials could be shared with other secondary schools or education institutes.
5.	Two versions of identification instruments	To provide teachers with guidelines for assessing	Informative	Disseminated to the secondary school teachers	The identification instruments could be

	(Chinese and English) *(for more details, please refer to Part iii in Section 1)*	students in various dimensions in science		and education institutes who participated in teacher development workshops, project-end symposium, or 2010 HK Annual Gifted Education Conference.	disseminated through QEF official book fair.
6.	Two sets of teaching and learning resources for teachers with accompanying CD (Chinese and English) *(for more details, please refer to Part iv in Section 1)*	To share with secondary school teachers the good practices in teaching science students	Informative and significant	Disseminated to all secondary schools in Hong Kong , teachers who participated in our programme and other education institutes	100 sets of teaching and learning resources were reserved for QEF and they could be disseminated through QEF official book fair.
7.	Two sets of teaching and learning resources for students with accompanying CD (Chinese and English) *(for more details, please refer to Part iv in Section 1)*	To encourage students' self-learning	Informative and significant	Disseminated to all secondary school in Hong Kong , students and teachers who participated in our programme and other education institutes	
8.	"Teachers' Professional Experience Sharing Month 2009" organized by QEF	To share with teachers our experience on gifted education and disseminate project results based on our experience on organizing S3-4 project		The project leader and three project members delivered a talk on gifted education on 14 March 2009 with secondary school teachers as target group.	/
9.	Participation in *Inno Carnival 2010* organised by Innovation and Technology Commission	To share project ideas of *Phase 3 Independent Research Studies* and enrich students' learning experiences		18 students from S-34 *Phase 3* presented their projects with posters and display panel	/

10.	*International Workshop on Innovative Practices for Science and Nanotechnology Education* co-organized by Faculty of Science, The Chinese University of Hong Kong, Hong Kong, Nanotechnology Human Resource Development Program Office, National Science Council, Taiwan and Hong Kong Association for Science and Mathematics Education, Hong Kong	To provide a valuable platform for teachers to share ideas about how nanotechnology could be introduced into the secondary school classrooms, and introduce the teaching resources that are currently available		The project leader shared with teachers from Hong Kong and Taiwan their experiences on gifted education and introduced recent initiatives developed by CUHK for promoting science education on 22 Jan 2011	/
11.	Visit to the *Nanotechnology Human Resource Development Program* launched by the National Science Council of Taiwan	To promote and share innovative ideas for teaching science and nanotechnology		One of the project members promoted the programme activities to Taiwan educators from 14 to 16 April 2011	/

5. Activity List

No.	Types of activities	Brief description	No. of participants				*Feedback from participants
			Schools	Teachers	Students	Others	
1.	Launch of programme website	Release of the programme information to the public for promotion					484 applications were received.
2.	Screening test	An assessment to recruit programme students was held in CUHK campus at 9:30 am to 11:30 am on Saturday, 21 December 2008			446		/
3.	*Phase 1 Scientific Workshops*	6 workshops in statistics, mathematics, chemistry, physics, biochemistry and biology were held on 7, 14, 28 Feb and 7, 14, 21 March 2009 accordingly in CUHK Campus			311		1360 student questionnaires and 41 observer questionnaires were received.
4.	*Phase 1* class observations and teaching sharing session	Secondary school teachers were invited to give comments and exchange views on gifted education in class observations and sharing session which were organized in parallel to the student activities in Item 3		45			
5.	*Phase 2 Scientific Workshops*	A 2-day scientific workshop were held on 19 and 26 September 2009			112		188 student questionnaires and 18 observer questionnaires were received. 13 observers attended focus groups.
6.	*Phase 2 Intensive Courses*	8 three-hour lessons about biological sciences, chemistry, physics and mathematical sciences were held on Saturdays from October to November 2009			112		
7.	*Phase 2* class observations and teaching sharing session	Secondary school teachers were invited to give comments and exchange views on gifted education in class observations and sharing session which were organized in parallel to student activities in Item 5 and 6		32			

8.	*Phase 3 Independent Research Studies*	Students carried out researches under the supervision of project team members and acquired fundamental research skills and concepts. There were altogether 13 projects and the research studies were held from February to May 2010 in CUHK campus			56		28 student questionnaires and 2 observer questionnaires were received. 2 student interviews and 2 observer interviews were conducted.
9.	*Phase 3* class observations and teaching sharing session	Secondary school teachers were invited to give comments and exchange views on gifted education in class observations and sharing session which were organized in parallel to the student activities in Item 5 and 6		6		1 QEF officer	
10.	Project Symposium	A symposium in which Phase 3 students presented and exhibited their research projects was held on 29 May 2010		49	67	1 ITC member, 3 CINTEC members and 79 parents	13 observer questionnaires were received and 11 observer interviews were conducted.
11.	Teacher Development Workshop	Project team members shared experience and resources on promoting gifted science education for secondary school students		18			
12.	Nomination of students participating *Inno Carnival 2010*	Some groups of *Phase 3 Independent Research Studies* were invited to join the *Inno Carnival 2010* to share the findings of their projects in November 2010			18		Encouraging

* Please refer to the evaluation report attached in 2nd, 3rd and 4th progress report.

6. Difficulties Encountered and Solutions Adopted

As stated in the 2nd progress report, due to the sudden outbreak of human swine influenza, the planned summer camp in Phase 2 was cancelled to avoid the possibility of large-scale outbreaks after assessing the situation with all team members and consulting QEF staff. Many additional logistic arrangements were needed in order to switch the activity mode from a 3-day and 2-night Summer Study Camp to a 2-day scientific workshop series without changing the content or affecting the continuity of the materials to be taught. This sudden change and difficulty was unpredictable and unavoidable.

In *Phase 3 Independent Research Studies*, students were required to work on research projects of their choice in groups of 2 to 5 under the supervision of professors and other teaching staff of our Faculty during their regular meetings. Some of the students had difficulty in attending the regular meetings due to their tight schedule. To solve this problem, students were given the materials for adequate preparation at home to enhance the efficiency in the meetings, as meeting in CUHK campus should focus on group discussion and laboratory work with guidance from teachers of our Faculty.

Two series of teaching and learning materials were planned to be published in the project time. The production of the materials, such as collecting data, planning lessons, designing learning activities and materials, etc., involved much time and coordination between colleagues. While our teachers were highly engaged in the preparation of the new 4-year curriculum to be implemented in 2012, they were also eager to enhance the quality of the material. We hence requested QEF to grant an extension of the project period on 26 January 2011, which was then approved on 1 February 2011. Therefore, the project end date was revised from 28 February 2011 to 31 August 2011.

Appendix 1 - Activity Schedules

Table 1 Schedule of Phase 1 Scientific Workshops

Date (on Saturdays)	Workshop	Brief Description
7/2/2009	Statistics: Applications of Statistics	Basic descriptive statistics, principles in questionnaire design and graphical presentation skills will be studied
14/2/2009	Mathematics: Game Theory – The Mathematics of Strategy	To introduce Game Theory and several deep Mathematical concepts related through talks and various interesting games
28/2/2009	Chemistry: Modern Chemical Analysis	Several modern scientific techniques of chemical analysis will be introduced
7/3/2009	Physics: A virtual tour of the cosmos	Students can have visualizations of planets, asteroids, sun, stars, nebulae, black holes and galaxies with animated motions and flythrough
14/3/2009	Biochemistry: Chasing 'Microbial Pathogens'	To learn the war between human and pathogens and the use of antibody in medicine
21/3/2009	Biology: A Journey to The Nature Wonderland	To introduce the different levels (Populational, Organismal, and Cellular/Molecular levels) of BioScience

Table 2 Schedule of Phase 2 Scientific Workshops

Date (on Saturdays)	Workshop	Brief Description
19/9/2009	Statistics: Financial Tsunami, Investment Strategy	To provide students with opportunities to experience a simplified version of financial market
	Chemistry: Plastic is Born!	To introduce the basic chemistry principles of polymers
	Biochemistry: Expression of Jellyfish's Green Fluorescent Protein (GFP) in E.coil	To experience the applications and processes in genetic engineering and biotechnology
26/9/2009	Mathematics: Application of simplex method in linear programming	To discuss some important issues of the simple method and demonstrate it using EXCEL
	Biology: Exploring experimental Biology	To experience two common methodologies in biological research
	Physics: The Galileoscope	To introduce the use of Galilean configuration and Keplerian configuration Galileoscope

Table 3 Schedule of Phase 2 Intensive Course --- Biological Sciences

Session	Date	Topics
1	17/10/2009	Biotechnology and Genetically Modified Food
2	24/10/2009	Food and Health
3	31/10/2009	Human Genome Project
4	14/11/2009	Bacterial Culture and Bacterial Transformation
5	21/11/2009	Fluorescence Technology and Biomolecules Detection - I
6	28/11/2009	Fluorescence Technology and Biomolecules Detection - II

Table 4 Schedule of Phase 2 Intensive Course --- Chemistry

Session	Date	Topics
1	17/10/2009	Analytical Chemistry I: Acid-base Chemistry
2	24/10/2009	Introduction to Organic Chemistry
3	31/10/2009	Quiz on Session 1-2 (30 minutes)
		Analytical Chemistry II: Chemical Analysis in Consumer Products
4	14/11/2009	The Chemistry of Drugs and Organic Synthesis
5	21/11/2009	Quiz on Session 3-4 (30 minutes)
		Spectroscopic Analysis of Organic Compounds
6	28/11/2009	Laboratory session: Analysis of Vitamin C in Fruits
		Advanced Instruments in Chemical Analysis

Table 5 Schedule of Phase 2 Intensive Course --- Mathematical Sciences

Session	Date	Topics
1	17/10/2009	Introduction to MATLAB, Vectors and Matrices
		Assessment (30 minutes)
2	24/10/2009	Linear Programming
		Assessment (30 minutes)
3	31/10/2009	Dynamic Programming
		Assessment (45 to 60 minutes)
4	14/11/2009	Measure of Association
		Assessment (30 minutes)
5	21/11/2009	Introduction to Linear Regression
		Assessment (30 minutes)
6	28/11/2009	Applications of Linear Regression

Table 6 Schedule of Phase 2 Intensive Course --- Physics

Session	Date	Topics
1	24/10/2009	Preparation for special relativity and its historical background
2	31/10/2009	Novel concepts of space and time I
3	7/11/2009	Novel concepts of space and time II
4	14/11/2009	Mathematical derivations
5	21/11/2009	Novel concepts of mass and energy
6	28/11/2009	General relativity and its applications

Table 7 Project Titles of Phase 3 Independent Research Studies

Science Stream	Project Titles	
Biological Sciences	Effect of polyphyllin D on the induction of cell death in human red blood cells	
	Expansion of Plant RabA1 subclass: Innovation, Specialization or Redundancy?	
	Marine Micro Algae as Bioreactor for Fatty Acid Production	
	Phylogenetic relationship among pomacanthid species	
Chemistry	Analysis of Volatile Compounds in Herbs using Headspace Single-Drop Microextraction and Gas Chromatography	
	Stereochemistry of the Wittig Reaction	
	How are the Active Ingredients in Chinese Herbal Medicine Affected by Different Preparation Methods	
Mathematical Sciences	Mathematics	Aligning DNA Sequences Using Dynamic Programming
		The Application of Linear Programming in solving Game Theory Problems
	Statistics	Multiple Regression and its applications
Physics	Calculating the orbits of the moon, planets and spacecrafts	
	"Seeing" our microscopic world	
	The Rise of Quantum Physics	