

Quality Education Fund
Application with Grant Sought Not Exceeding \$200,000
Part B: Project Proposal (Revised)

Project Title	Project Number
Education of Synthetic Biology, training students to join the iGEM competition	2018/0052

Basic Information

Name of School: United Christian College (Kowloon East)

Beneficiaries:

- (a) Secondary
- (b) Students: ~450 junior form biology students, ~100 senior form biology students and ~30 biology research team (iGEM team) members
- (c) Teachers: 3 Biology teachers

Proposal

(I) Project Needs

- (a) Please state the aims of the project in clear and concise terms and elaborate on how the proposed project could impact on school development.

The project aims to teach our students biotechnology knowledges, equipping them to join the iGEM competition. Nowadays, STEM is the main trend in education globally, however, up till today, there had been few advancements in Biology in terms of STEM education.

The International Genetically Engineered Machine competition, iGEM, is one of the most famous global synthetic biology competition held annually, with 312 teams from 42 countries participating in 2017, including MIT, Harvard etc.. By training up our students to have synthetic biology knowledge, they will be able to participate in the competition. We believe that by participating in the competition, through allowing them to carry out their own research project and getting in touch with top colleges, they will be able to develop self-driven learning, research and presentation skills, also the project will hopefully promote STEM innovation.

- (b) (i) What are the areas of the needs and priorities of the school?
 - ✓ Enhance learning and teaching to facilitate students' knowledge on subjects / learning areas / generic skills development
 - ✓ Using e-Learning (IT) for Effective Learning

- (ii) Please give background information to justify the demonstrated needs as mentioned in (b)(i).

Literature review summary: Synthetic biology-based group activities provide opportunities for integrative STEM training and literacy, while lowering barriers for high school students to become interested in science careers. (Dubé, S., Orr, D., Dempsey, B., & Wieden, H. (2017). A synthetic biology approach to integrative high school STEM training. *Nature Biotechnology*, 35(6), 591-595. doi:10.1038/nbt.3896)

Relevant experiences: We have participated in the iGEM competition for 2 years, thus we do have experience with synthetic biology. Besides, we also have little existing teaching materials.

http://2016.igem.org/Team:Hong_Kong_UCCKE

http://2017.igem.org/Team:Hong_Kong_UCCKE

- (c) Please elaborate on the innovative ideas or new practices to enhance, adapt, complement and/or supplement the existing practices that will facilitate the development of the school to address the needs specific to its own context.

This project may facilitate the development of the school in below aspects:

- This sparks student's interest in science research
- Through year-long of hands-on investigation, they may develop a comprehensive set of wet-lab and research skills, such as literature review, designing experiments, gene editing and data analysis.
- The new set of teaching resources allows student to learn synthetic biology knowledge by themselves, so that:
 - o They can develop self-learning skills
 - o Teachers can spend more time with students discussing more advanced topics
- Through arranging students to participate in different parts in the research project according to their ability, student's different needs can be taken care of and allow their talents to shine.
- Through allowing students to take a different role in the whole process, such as team leader, group leader etc., students may develop leadership skills and even communication skills as they must communicate with each other throughout the process.
- Through attending seminars or talks related to the competition, student's horizons may be broadened, so that they have more exposure to other top researchers.

(II) Project Feasibility

(a) Please describe the design of the project, including:

(i) Approach/Design/Activity

At the end of the project, two sets of teaching materials will be produced, namely set basic and set iGEM. The two sets are to be taught to two groups of students. The materials will be available through online system.

Set	Basic (0-3)	iGEM
Prerequisites	Nil	Students should have acquired basic science knowledges from set basic
Content	Scientific investigation, mathematics, chemistry, laboratory, cell biology, metabolism, genetics, microbiology, biotechnology and bioinformatics	Competition basics, case study, project design, building blocks of iGEM parts, advanced synthetic biology, wiki (project website) design
Targeted students	All students interested.	Students who want to participate in the iGEM competition



Course 0

Free

admin

ENROLL



Course 1

Free

admin

ENROLL



Course 2

Free

admin

ENROLL



Course 3



Course iGEM

Our school implements a 3-semester curriculum. We will hold a regular meeting every week for 6 weeks, giving a total of 18 sessions per school year. Below are the plans of each session:

Semester	Session	Content
1	1	Self-learning*
	2	
	3	Learn about sterile space, spreading, streaking and the use of pipette
	4	Study about PCR and gel electrophoresis
	5	Experiment: PCR and gel electrophoresis
	6	
2	1	Self-learning*
	2	
	3	
	4	Study about restriction ligation, recombination of GM plasmid
	5	Experiment: restriction ligation, recombination of GM plasmid
	6	
3	1	Self-learning*
	2	
	3	
	4	Study about transformation
	5	Experiment: agar plate and transformation
	6	

* Each student studies the course material on e-platform. They can choose their own syllabus according to their own background knowledge and learning progress. Senior student helper or teacher in charge will station at the self-learning area so that students can ask whenever they have question. They can use their e-platform account to monitor their learning progress and help them to choose their next unit.



(ii) Key Implementation Details

Project period: 1 April 2019 to 31 March 2020

Month / Year	Content / Activity / Event	Target Beneficiary / Participants
Apr, 2019	Brainstorm, research, literature review of the research topic, project design and ordering of substances used in the research.	iGEM team members, teacher-in-charge
May - Jul, 2019	Wet lab (Conducting experiments to prove our hypothesis and design).	iGEM team members, teacher-in-charge
Aug - Sep, 2019	Presentation training.	iGEM team members, teacher-in-charge
Jun - Jul, 2019	Design and preparation of teaching materials for future use.	All biology students, student helpers
Nov, 2019	Attend the iGEM competition Giant Jamboree in Boston, United State	~10 selected students
Dec 2019 - Mar 2020	Experience sharing by iGEM team	All students in school

(b) Please explain the extent of teachers' and/or principal's involvement and their roles in the project.

(i) Number of teachers involved and degree of input (time, types, etc.):

iGEM team teacher-in-charge, three biology teachers will guide students throughout the process of participating in the competition. Teacher-in-charge will be responsible for the development of teaching materials, and evaluation of the effectiveness of the set of teaching materials.

Three student helpers will be responsible for the creation of teaching materials, and evaluation of the effectiveness of the set of teaching materials.

Lab technician will provide suitable help to assist students.

(ii) Roles of teachers in the project:

- ✓ Leader
- ✓ Coordinator
- ✓ Supervisor of student helpers
- ✓ Design and development of teaching materials

(c) Please provide the budget of the project and justify the major items involved.

Grant Sought: HK\$ 198,100

Budget Item*	Expenditure Detail (Including the breakdown for the budget items)		Justifications
	Item	Amount (\$)	
i) Staff -3 Student helpers	Employment of 3 Student helpers to create teaching materials	\$52,800 (\$55 * 8 hours * 5 days * 8 weeks * 3 staffs)	We need to employ 3 student helpers with related professional knowledge to assist create the set of teaching materials. MPF will be included.
iii) Equipment (Detailed list is in appendix)	Education lab kits	\$12,000	These are equipment or reagents used in synthetic biology, it is for students use while doing experiments for the iGEM competition.
	Molecular biology equipment	\$51,300	
	Consumable	\$9,000	
v) General expenses	iGEM team registration fee	~\$40,000 (USD\$5,000 * 7.85 conversion rate)	The team registration and attendance expense will be covered by QEF, while the plane ticket, hotel cost etc. will be covered by students and the school. The overall expense of a US trip per student is around \$25,000. Each student will receive \$5,500 subsidy.
	iGEM Giant Jamboree attendance fee of 5 students	~\$28,000 (USD\$695 * 7.85 conversion rate)	
	Audit fee	\$5,000	
Total Grant Sought (\$):		\$198,100	

Remarks:

- 1) Requirement of student helpers:
 - a) Must have attended iGEM competition before
 - b) Have biology education in secondary school level
 - c) Tertiary level education is recommended
- 2) Requirement/selection criteria of students joining iGEM Giant Jamboree
 - a) Attain level 4 or above in biology (school examination)
 - b) Attend more than 70% of regular training in research team

c) Recommended by class teacher and biology teacher

(III) Expected Project Outcomes

- (i) Please describe how to evaluate the effectiveness of the project.
- ✓ Observation: Student's level of participation and activeness will be observed, as well as the performance and reaction of students with different abilities.
 - ✓ Focused group interview: Students will give response and feedback to the program, this includes, but isn't restricted to, the effectiveness of the program to increase their interest in synthetic biology.

The events will be recorded by photos and videos.

The feedback of participant will be collected by interview and questionnaire.

Events	Successful criteria
iGEM Jamboree	5 students can attend the event More than 70% of participant agree the event broadened their horizons in science research. More than 70% of participant agree their research skills are enhanced after the program
Biology research team training	30 students can attend the training More than 70% of participant agree the program can enhance their interest in synthetic biology More than 70% of participant agree the program can enhance their knowledge in synthetic biology
Online training program	At least 30 users. More than 70% of users agree the content in the online course can enhance their knowledge in synthetic biology More than 70% of users agree the videos in the online course can facilitate their learning of laboratory skills
Experience sharing sessions	The total number of audience should exceed 450.

(ii) Please state the project deliverables or outcomes.

- ✓ Learning and teaching materials.

The contents, the deliverables and the products developed from this project are protected by intellectual property rights. The Permanent Secretary for Education Incorporated (“PSEdI”)/QEF is the owner of the copyright and other intellectual property rights in the Products.

The contents, the deliverables and the products developed from this project can be shared to other schools for educational and non-commercial purposes.

- ✓ Research report as a website (it documents the details of our research, the result of experiments, progress of the research and the other achievements)

Proposed Report Submission Schedule

Project management		Financial management	
Type of report and covering period	Report due day	Type of report and covering period	Report due day
Final report 1/4/2019-31/3/2020	30/6/2020	Final financial report 1/4/2019-31/3/2020	30/6/2020

Appendix

Equipment list

Type	Product name	Unit Price	Amount	Total Price
Educational kit	pGLO Bacterial Transformation Kit ()	\$2000	3	\$6000
Educational kit	Crime Scene Investigator PCR Basics Kit ()	\$2000	3	\$6000
Equipment	Benchtop shaking incubator	\$28800	1	\$28800
Equipment	20ul micropipette	\$750	10	\$7500
Equipment	200ul micropipette	\$750	10	\$7500
Equipment	1000ul micropipette	\$750	10	\$7500
Consumable	TBR-14 tips, 1,000/box	\$500	5	\$2500
Consumable	TBR-35 tips, 1,000/box	\$600	5	\$3000
Consumable	TBR-40 tips, 1,000/box	\$600	5	\$3500

The End