

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

Project Title Integrated Learning - Aquaponics	Project Number 2016/1025 (Revised)
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Basic Information

Name of School / Organization / Individual

Beneficiaries

- (a) Sector: ☐ Kindergarten ☐ Primary ☒ Secondary ☐ Special (*Please tick*)
- (b) Students: 240 Secondary 3-5 students
- (c) Teachers: 15 (in number)*
- (d) Parents: N/A (in number)*
- (e) Participating Schools (excluding applicant school): N/A (in number and types)*
- (f) Others (please specify): N/A

Proposal

(I) Project Needs

- (a) Please state the aims of the project in clear and concise terms and elaborate how the proposed project could impact on school development.
- To inspire learning via hand-on, experimental and integrated learning activity;
 - To solidify their understanding of content learnt in the classroom such as topics involving physics, chemistry, biology, math and sustainable development & civic education;
 - To encourage accountability and teamwork;
 - To increase student engagement and interest in subject matters by bringing physical learning experience via a real reference point and seeing a greater relevance to their learning;
 - To arouse students awareness in global environmental issues such as global food security and food waste problems

(b)

- (i) What are the areas of the needs and priorities of the school?

(*Please tick the appropriate box(es).*)

- ☒ Enhance learning and teaching to facilitate students' knowledge on subjects / learning areas / generic skills development
- ☒ Promote students' social and emotional development
- ☒ Enhance school management / leadership and teachers' professional development / wellness

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

(*Please tick the appropriate box(es).*)

- ☒ School development plan:

Our missions are to inspire students to strive for excellence, and to provide an environment where each student may find his areas of happiness and has the fullest

chance to develop his own talents. By providing opportunities for students to engage on hand-on, experimental and integrated learning activities, it will help to arouse their interest and become more motivated on learning innovative science and technology fields. The proposed project is aligned with the above missions.

☒ Literature review summary:

Since 2003, aquaponics has been suggested by Cornell University as high school science project to study the nitrogen cycle (Mullen, 2003). USA National Education Association ("NEA") Foundation started building STEM competencies through aquaponics since 2009 and teachers in Canada and USA were using aquaponics as a STEM education tool in their classes. Today, aquaponics is regarded as successful STEM project by NEA Foundation with projects in Milwaukee Public schools and New York City Public Schools.

☒ Relevant experiences: Based on our experience in our outdoor garden, it was noted that students showed interest to take part in our gardening activities and they performed very well. Building on such successful experience, it is believed that aquaponics is a useful medium to enhance learning and teaching to facilitate student's knowledge subjects as well as to nurture's students' emotional development and responsibilities.

- (c) Please elaborate 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.

Introducing the future of agriculture, multi-level organic farming with latest farming technology in secondary school to enhance learning, convey new ideas to crack global food security issues and engage students to explore theories in areas of science, modern agriculture and sustainable development. This system will not be disrupted by adverse weather as opposed to conventional outdoor farming, which makes it perfectly suit for students to perform various science-related experiments regularly. Apart from that, ecological food production system which combines fishes and plants, a perfect example of utilizing waste from the nature, can also nurture students' inner self by connecting them with the beauty of nature.

Aquaponics is a technique for food production that combines aquaculture and hydroponics in a symbiotic relationship (Bernstein, 2011). It also demonstrates how plants and fish grow together in a symbiotic, sustainable environment. By measuring and observing this system, students will get hands-on experience in key scientific processes (i.e. the physics of water flow, testing and troubleshooting water chemistry and the biology of both fish and plants, etc.) and will be able to see the results of their work grow before their eyes. In this program, students will be guided by teachers and project coordinator to use and interpret scientific data. Even though teachers and project coordinator will oversee the aquaponics systems, students will be the ones in charge of monitoring and maintaining the system. Aquaponics is itself a kind of freshwater ecosystem that Biology teachers can use to illustrate abstract ecological concepts in order to let students understand them thoroughly. On top of that, a small-scale aquaponics is a miniature of the natural ecosystem which can be used for various purposes including the study of ecological relationships of different organisms and their surroundings, cycling of nutrients, food sustainability and water conservation, too. With the aquaponics system, students can visualize the abstract biological concepts and thus help them understand the concepts thoroughly.

Along with science activities, we believe this system can improve students' ability to communicate with others and service learning requirements. According to the case study conducted by NEA Foundation, students who involved will often become ambassadors, explaining the system to their peers, parents and community members – fulfilling both requirements in an effective and

personally rewarding way. Moreover, by giving students hands-on experience with the aquaponics system, students can really apply the knowledge that they learnt in classroom to solve real-life problems. By showing students that the skills they learn can help them come up with practical solutions in the aquaponics systems, students will be more interested in acquiring scientific knowledge and thus develop self-directed learning skills that can help them become lifelong learners. . Moreover, students will learn some techniques in sustainable agriculture while receiving cross-disciplinary training of STEM.

(II) Project Feasibility

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

(i) Approach/Design/ Activity

Five topics (i.e. physics, chemistry, biology, math, sustainable development & civic education) will be introduced to enhance students' scientific and technological knowledge, such as:

- Physics – wavelength (i.e. LED, UV), water flow dynamics, etc.;
- Chemistry –reduction/oxidation (redox) reaction, acid/alkalinity, nitrogen fixation, etc;
- Biology – ecosystem, ecological process, plant biology, bacteria, chlorophyll, etc;
- Math – mathematical analysis of water chemistry, yield and economic modeling
- Sustainable development & civic education – food security, total carbon footprint, how climate change affects global food supply, food waste & health

Students will be introduced to the topics via performing various experiments and recording and maintaining the system. Students' understanding of each topic will be deepened by performing various activities throughout the plant growth. Besides, they will also learn some basic techniques for maintaining and taking care of plants and fishes.

Apart from above, this project can also nurture students' inner self by connecting them with the beauty of nature. Through growing the plants and fish all by themselves, students can have hands-on experience in what life is and therefore can nourish their dedication and gratitude to life. Spending more time in aquaponics can also inspire students to appreciate and respect nature, and hopefully by connecting the students with nature and healthy food that they grow, they can rediscover the peace and love within their inner selves. Enhancing students' plant-human relationship can as well bring relaxation and stress relieve, as long as improving their self-esteem and confidence. All in all, aquaponics not only brings scientific techniques to students but also supports their personal growth.

Design:

Custom build and design of the Aquaponics System

We are planning to install the system under an opened but covered area, where the system will mitigate the effects from heavy wind or rain. LED growing light will also be installed and used during rainy and gloomy days for optimal light absorption of the plants. This multi-layer aquaponics system will capable of growing different kinds of plant species without the vagaries of the sun and rain. Since prefabricated aquaponics system does not fit into what we are aiming for, we will collaborate with professionals to design and build a customized system to suit the project's practicality, efficiency and effectiveness.

Learning contents & learning and teaching strategies

Our learning contents will integrate into our existing school planning at the initial stage in which both the learning contents and the activities will build upon the existing knowledge, ideas and experiences of the students. In order to enhance learning effectiveness, we will guide our students via practical work and scientific investigation approach where students can associate the findings with the theories they have learnt. After students performing the learning activities, contextual approach will also be adopted by teachers in which students will be able to acquire the relevant concepts, skills, attitudes and moral values in a systematic manner.

Activities:

Students will be assigned into groups to perform routine activities as categorized below: (a) Water monitoring; (b) Plant management; and (c) Fish management & System maintenance. With the life cycle of crops growing period (i.e. growing, maintaining and harvesting crop species) will be approximate 4 to 6 weeks, routine activities will rotate once in two weeks to allow students to have opportunities experiencing all three categories above during the crops growing period. Some of routine activities are, including but not limited to:

- Collect water samples to perform water quality tests including pH, ammonia, nitrite and nitrate;
- Check and analyze the plant if there are any deficiencies;
- Monitor the plant growth situation;
- Check the behavior and appearance of the fish;
- Remove any solids from the clarifier and rinse any filters, etc.

Crops will be harvested by students with a concept of bringing fresh, healthy green crops back home to share with their parents. In addition, students will have opportunity to create different experimental scenarios via growing other kinds of crop species including herbs and melon.

Reflection

After each crops growing period, students will be required to fill in a questionnaire as well as write down their reflections in 1-2 sentences regarding on their learning experience. Students are encouraged to make reference to any photos and records made throughout the crops growing period.

(ii) Key Implementation Details

Project period: March 2018 to Feb 2019

Month / Year	Content / Activity / Event	Target Beneficiary/ Participants
Mar 2018 – Apr 2018	Design and build the multi-layered aquaponics system	Teachers in collaboration with professionals*
Apr 2018	Organization of a talk on introducing aquaponics as well as three workshops on basic knowledge, training & service of the system (An hour each)	15 Teachers
Apr 2018– May 2018	Development of learning contents for five topics (i.e. physics, chemistry, biology, math, sustainable development & civic education).	Teachers in collaboration with the Instructor

Jul 2018 – Jan 2018	<p>Implementation of learning activities:</p> <p>An hour for each topic, 5 hours in total for each group of students (approx. 30 students for each group)</p> <p>Student will participate in at least 15 minutes learning activities each day</p> <p>The learning and teaching contents will be adapted and designed with different levels of difficulties to cater for the diverse learning abilities and needs of students</p>	240 Secondary 3 to 5 students
Jan 2018 – Feb 2018	Project Evaluation	Students, teachers, the school head

*We propose to collaborate with professional aquaponics service provider such as the one listed by Vegetable Marketing Organization ("VMO") to design and build the aquaponics system.

(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.):

15 teachers will participate in the project by designing the system, attending the workshops, assist in adapting, designing as well as conducting the learning activities.

(ii) Roles of teachers in the project: (Please tick the appropriate box(es).)

- ☐ Leader
 ☒ Co-ordinator
☒ Developer
 ☒ Service recipient
☐ Others (please specify) _____

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

Grant Sought: HK\$91,900

Budget Item	Expenditure Detail		Justifications
	Item	Amount (\$)	
i) -Service	Training (\$820 x 4 hrs)	\$3,280	An instructor with expertise and experience in multi-level aquaponics farming will be hired for training.
- Design & Build	Build multi-layered Aquaponics System including: - Biofilter and its growing medium; - LED grow lights; - Fish tank; - Water pumps &	\$60,000	To create and perform different experimental scenarios

	plumbing materials		
ii) General expenses	Water Monitoring Test Kit, Analytical Tool Kit, Timers	\$8,800	Including consumables such as test strips to perform data collection and record observations
	Organic Fish Food & Bio-bacteria	\$4,500	Including adding bio-bacteria after cleaning-up
	Germinated Seeds, Fishes	\$6,500	Including adding new fishes during the project period)
	Electricity wiring and water pipes	\$4,820	
	Miscellanies		
	-Planting cups, sponge cubs	\$2,000	
	-Containers and other cleaning/maintenance gear	\$2,000	
Total Grant Sought (\$):		91,900	

(III) Expected Project Outcomes

(i) Please describe how to evaluate the effectiveness of the project;

(Please tick the appropriate box(es).)

- ☒ Focused group interviews: To learn more about connection with student's own learning, student focus groups will be performed as a way of collecting information in which areas of improvements we should make in order to develop a better learning experience (including enjoyment or enthusiasm) throughout the project.
- ☒ Pre-and post-activity surveys: Questionnaire are incorporated into the end of activity and participated students will be required to fill in the questionnaire to evaluate the following goals:
 - More than 80% of participated students agree that the activity improve their relevancy, understanding and knowledge of the theories discussed;
 - More than 80% of participated students agree that the activity arouses their appreciation of food and environmental aspects;
 - More than 75% of participated students agree that the activity increases the awareness of any discussed issues such as food security problems;
 - More than 75% of participated students agree that this kind of hand-on, experimental and integrated learning activity will help them to inspire learning;

☒ Performance change of students in assessment:

Teachers will observe if there are any performance change of students including any increased participation in its relevant subjects and changes in students' social and emotional development throughout and after the activity

(ii) Please state the project deliverables or outcomes.

(Please tick the appropriate box(es).)

- ☒ Learning and teaching materials
- ☒ Others (please specify): Photos of the grown plants, recorded data

Assets Usage Plan

Category (in alphabetical order)	Item Description /	No. of Units	Total Cost	Proposed Plan for Deployment (Note)
audio and video equipment				
book & VCD				
computer hardware				
computer software				
musical instrument				
office equipment				
office furniture				
sports equipment				
Others	Water Monitoring Test Kit, Analytical Tool Kit, Timers	2	\$8,800	Leave in campus, for students to perform water quality tests in the future

Note: for use by school / ~~organization~~ / in other projects (please provide details of the department / centre to which the asset will be deployed and the planned usage of the asset in activities upon project completion).

Report Submission Schedule

I/ My school / My organization commit(s) to submit proper reports in strict accordance with the following schedule :

Project Management		Financial Management	
Type of Report and covering period	Report due day	Type of Report and covering period	Report due day
Progress Report 1/3/2018 - 31/8/2018	30/9/2018	Interim Financial Report 1/3/2018 - 31/8/2018	30/9/2018
Final Report 1/3/2018 - 28/2/2019	31/5/2019	Final Financial Report 1/9/2018 - 28/2/2019	31/5/2019