Quality Education Fund

Part B: Project Proposal

Project Title: Biotechnology Education Programme	**Project Number:** *(2018/1148)*

Name of School: __Po Leung Kuk Tong Nai Kan Junior Secondary College_____

Direct Beneficiaries

(a) Sector: ☐ Kindergarten ☑ Primary ☑ Secondary ☐ Special School *(Please put a tick in the appropriate box(es).)*

(b) Beneficiaries: (1) Students: 540 (S1-S3) ; (2) Teachers: 8 ;
(3) Others: Secondary and primary school students in our district and Po Leung Kuk affiliated schools

Project Period: 05/2020 to 2/2022

1. Project Needs

1.1	Project Aim(s)	The project aims at promoting biotechnology education to our students and those in the secondary and primary schools in our district. Moreover, we aim at developing our school-based junior secondary biotechnology education, arousing students' interest in learning the biotechnology topics: agriculture, environment, fuels and chemical, food and drink, gene cloning and medicine. Meanwhile, we also aim at fostering a positive moral and ethical attitude through studying the impact of biotechnology to society.
1.2	Innovative element(s)	Our school has been organizing STEM activities and gifted education programmes and training on STEM since 2015 in order to nurture the students who are interested and have good potential and performance in STEM learning activities. Our school plans to further promote biotechnology education to our students as well as to other secondary and primary students so as to catch up the rapid development of our government to promote innovation technology. Meanwhile with the revised and introduction of genetic materials, DNA and heredity curriculum in junior science curriculum and the matching of the biotechnology related courses in many universities and tertiary education, this is our important role to provide our students more opportunities for learning relevant knowledge and skills. Moreover, students will be allowed to gain more hands-on learning experience through the establishment of our biotechnology laboratory with relevant equipment. Thus, they will have more opportunities to apply what they have learnt and their learning experiences will be enriched. At the same time, our gifted students will develop research works on biotechnology and devoted in many competitions to achieve more good research and results in HK as well as in the world.
1.3	Alignment with school-based / students' needs	One of our school 3 years developments is 'promoting STEM and gifted education'. The project will provide hand-on experience and apply what they have learnt in the biotechnology so as to integrate with the other disciplines learnt in STEM education.

2. Project Feasibility

2.1	Key concept (s) / rationale(s) of the project	The rationale of this project comes from the suggestions stated in the 'Report on Promotion of STEM Education - Unleashing Potential in Innovation' (December 2016) released by the Education Bureau. The main points include: - Renewing the curricula of the Science, Technology and Mathematics Education Key Learning Areas (KLAs) - Enriching learning activities for students Meanwhile, the suggestions from 'Supplement to the Science Education Key Learning Area Curriculum Guide, Science (Secondary 1-3)' (2017) released by the Curriculum Development Council, recommended by the Education Bureau, state that the genetic

		materials DNA and heredity are introduced in the new junior science curriculum. We will review and modify the school-based junior secondary Science Education curricula. Learning and teaching activities on biotechnology will be organized for different grades of junior secondary level students, the potential and gifted students with biotechnology research, projects and competitions and other secondary and primary school students. Our school also plans to organize some training activities for teachers to enhance their professional capacity in designing and implementing biotechnology learning activities, hence enhancing the learning and teaching effectiveness.
2.2	Applicant's readiness or ability/ experience/ conditions/ facilities for project implementation	Since 2011, our school has been devoting to develop science and technology disciplines. Due to the limited funding resources, we can only equip some hardware. Meanwhile teacher professional training has also been enhancing progressively. To speed up the path, we are coping with the need of the STEM Education development comprehensively and sustainably including qualifying the Technology Maker Room, nanometer-molecular food curricula, innovation and creativity curricula and biotechnology curricula. At the same time, school has been continuously putting efforts on training the potential and gifted students on different disciplines in STEM Education so as to broaden their horizons and developing their potential as well as participating in different competitions . For our bridging courses for primary 6 to secondary 1 in our school, we introduced the technology introduction course to develop the interested and potential students on STEM. For the past two years, we organized some Joint School STEAM Competitions such as two Joint School STEAM Motorboat Competitions in Shatin and Tuen Mun districts respectively and one Joint School STEAM Motorcar Competition in Shamshuipo district with more than 12 different secondary and primary schools. This year we are also organizing another Joint School STEAM Motorboat Competitions in Kowloon City district with another 5 secondary and primary schools.
2.3	Principal's and teachers' involvement and their roles	1. Principal is responsible for planning, organizing and supervising all STEM projects and development. Meanwhile, he is responsible for communicating with all teachers, parents and students as well as leading to evaluate the running and achievements of the projects. 2. School is responsible for organizing and supervising all STEM facilities and running. 3. A coordinating committee, which comprises the panel chairpersons of STEM-related subjects, has been set up to develop, coordinate and monitor the STEM Education. 4. Science panel and teachers are responsible for the reviewing, planning, organizing and supervising the subject-based development of the biotechnology curricula into the current junior science curricula and the gifted education research team as well as the workshops with other secondary and primary school students.
2.4	Parents' involvement / participation (if applicable)	N/A
2.5	Roles of collaborator(s) (if applicable)	To promote and organize workshops on biotechnology education with other secondary school and primary schools in our district .

2.6 Implementation timeline

Implementation period *(MM/YYYY)*	Project activities
05/2020	Invite quotations / tender for the equipment and apparatus and service provider.
07-09/2020	Purchase of the equipment and apparatus and service provider.
08-09/2020	-Review the existing school-based development of the biotechnology curricula into the current junior science curricula. -Design the learning and teaching activities and lesson plans on school-based development of the biotechnology curricula into the current junior science curricula. -Set up equipment and performing testing.
10/2020-09/2021	- Conduct and review the learning and teaching activities for all junior secondary classes on the school-based biotechnology curricula in biotech laboratory and classes. - Conduct the gifted education research team training and programs. - Conduct the workshops for other secondary and primary school students. - Conduct lesson observations, and evaluate the progress of the projects as well as the learning and teaching effectiveness. The learning and teaching activities will be refined if necessary.
07-09/2021	Principal, the coordinating committee and the teachers involved will evaluate effectiveness of the project, refine the developed curriculum and learning and teaching activities. They will also discuss how to further develop the school-based biotechnology education programme and relevant learning activities in the coming school year.
11/2021-2/2022	- Organize STEM- Biotechnology Education Programme sharing session within school to showcase students' learning outcomes. - Organize sharing seminars to share the project experience and project outcomes with the secondary teachers of the district .

2.7 Details of project activities *(Item (a)-(f) not applicable to this application can be deleted.)*

a. Student activity, if applicable

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	Number of sessions and duration	Teachers' involvement and/or hired personnel *(Including the roles, qualifications and experiences required of the speaker(s)/ instructor(s), etc.)*	Expected learning outcomes
Activity 1: Biotechnology Lessons (S1-S3)	To arrange learning activities for all S1-S3 students by incorporating the learning elements of Science: S1: Microbiology and Antibiotics (Attachment 1,2) S2:The DNA world (DNA extraction and DNA fingerprint) (Attachment 3,4) S3: Advanced DNA world (GM food) and Catalysator in daily life (Enzymes) (Attachment 5,6) The content mainly related to the biotechnology in environment, chemical, food and drink and gene, including understanding the basic of microbiology, antibiotics, DNA and Enzymes, the laboratory skills of handling professional apparatus, e.g. micropipette, electrophoresis apparatus, spread plates etc.	12 sessions, 80 minutes for each session	To be taught by school teachers with relevant knowledge and experience	Updated Biotechnology can be promoted to our students and their interest in Biotechnology can be raised too. Students can understand about the basic knowledge of microbiology and its relationship with antibiotics, the DNA as well as enzymes. Apart from that, student can also have some acknowledge about the apparatus which is commonly

	Implementation details: An introduction of biotechnology lecture will be given to all the students, moral and ethical issue for nowadays biotechnology will be introduced. For example, the use of stem cell, animal test and cloning, the moral and ethical issue will be discussed. The development of stem cell is a good example to illustrate the moral and ethical problem. The stem cells originally are from embryonic cell. As it involved the use of embryo, it raised the ethical problem from the society about this type of research. Later people developed IPS stem cell to replace the use of embryonic stem cell, a big progress on biotechnology development (Lanza 2009). A new syllabus for biotechnology learning was designed for S.1 to S.3 students. The content of all the activities are laboratory based and a lecture will be given to the class before each experiment. The lecture is to explain the concept, background, application and importance of the experiment. For example, the first semester activity for S.1 students “Bacterial culture”, a lecture was given to the student to introduce what is microorganism and the importance of knowing them. Daily related examples of the use of culturing microorganism is related to food and water borne disease. Food and water borne pathogen can be isolated or count by the two techniques spread and streak on agar plate. A more funny experiment is also introduced to the student which is observe the bacterial culture form students thumb. Application of this technique is food and beverage microbial test. In second semester of the S.1 biotechnology learning program, the concept of antibiotics will be introduced to the students. What is antibiotics? How to discover and the application of it will be introduce and the use of antibiotics practical will be performed. The moral and ethical attitude will be introduced and discussed with the student again. This time the problem will be focused on overuse of antibiotics and the			used in Biotechnology field and they should be able to handle the apparatus properly.

	consequence (Sköld 2011). In secondary 2, students will start to learn DNA and its application through DNA extraction and DNA fingerprint experiment. The latest application of DNA technique i.e. clinical diagnosis and polymerase chain reaction (PCR) will be introduced to the students. The moral and ethical issue about the clinical data is who had the right to know or access this information. In secondary 3, genetically modified organisms were introduced to the students. The pros and cons of GMO will be discussed. This technique is not only used in food industry but also in clinical and animal toxicity test. Examples of GMO used in Hong Kong will be introduced to the student. Biotechnology company in science park is using this technology to development toxicity test to suit the EU regulation.			
Activity 2 : Extended learning activities: Apply the knowledge and apply in real-life problems (Gifted students research team)	Some elite students from S1-S3 will be selected to participate in the Science Research Team (as a little scientist to carry out simple scientific investigation and extended learning activities will be held, e.g. Daily Fermentation, environmental biotechnology, screening GM food) (Attachment 7-10) The topics for extended learning activities will be an advance of the above activities for all S1-S3 students. Biotechnology in agriculture, environment, food and drink and gene cloning will be the focuses here. The research project will be focused on basic experimental design, training their logical thinking and simple statistical analysis (i.e. mean, standard derivation and t-test). Some projects are collaborated with different university so that the students can continuous their passion on science to their tertiary education which can promote the development of biotechnology in the society. External competitions will be taken part. (Two regular competition we join are Joint School Science Exhibition and Hong Kong Youth Science and Technology Innovation Competition.)	The tasks will be completed after lessons	The theory/concept behind extended experimental activities will be taught by Biotechnology/ STEM related teachers. Teachers also serve as supervisor to coach and monitor their learning and work during the activities.	With the basic knowledge and apparatus handling skills gained from activity 1, students should be able to further apply them in activity 2. Some new biotechnology technique, e.g. Gram staining should be gained in activity 2 for advance. Other than the practical skills, some more complicated concepts about the topics in activity 1 will be elaborated and strengthened. Students thus can gain advanced knowledge in the field of microbiology and DNA, e.g. the application of microbiology in Daily Fermentation and the environment, as well as screening GM food in

	Selection Criteria A biotechnology lecture was given to the students at the beginning of the semester, students who are interested on biotechnology can join the biotechnology research team. Through the weekly based training from the research team, gifted students will be selected and individual research projects (some with collaborated with university) will be assigned to the students to conduct.			supermarket by PCR. Students can act as a little scientists to conduct their scientific investigation. They should be able to carry out analysis process and write a report of their investigation for sharing to others. This can also further cultivate their interest in Biotechnology and may encourage them to develop/devote in this field in the coming future.
Activity 3 : Provide educational service and workshops for other primary, secondary schools or other institutions	To arrange some biotechnology workshops for the district to participate so that they can have some testing in this field and gain some basic knowledge in biotechnology as well. The workshops mainly focus on the topic about food and microbiology, including DNA from fruits, Daily fermentation, e.g. microorganism in yoghurt. (Attachment 11,12)	4 times per year	Biotechnology/ STEM related teachers as a PIC for organizing the workshop Apart from that, teachers also act as a coach to coach some student helpers from the science research team so that students can also take parts in the workshop for acting as a leader in group and help for maintaining the discipline	Biotechnology Knowledge can be promoted to other people in the same district. The participants can understand basic concept in microbiology and fermentation as w ell as DNA by converting a laboratory as a kitchen. By doing so, they can also understand that there are many biotechnology applications in daily life so as to raise their awareness too. Apart from the participants, student helpers should also obtain some teaching skills while leading their groups. It will benefit their service development too.
STEM – Biotechnology Education sharing session	This sharing session will be organized for the junior secondary students at the beginning of the next school year. The sharing session will include students' sharing and booth displays which aim at summarizing the project activities,	A half-day event	STEM-related subject teachers	This event can showcase students' learning outcomes, recognize their achievements and encourage them to

	consolidating students learning experiences and showcasing their learning outcomes.			explore further.

For the safety issues and risk assessment for the microbiology and biotechnology related to the learning activities mentioned above:
We will follow nine practices for microbiology laboratory

a. Treat all microorganism as potential pathogens.
b. Sterilize equipment and materials.
c. Disinfect work areas before and after use.
d. Wash your hands.
e. Never pipette by mouth.
f. Do not eat or drink in the lab nor store food in areas where microorganisms are store.
g. Label everything clearly.
h. Autoclave or disinfect all waste material.
i. Clean up spills with care.

Safety goggles and gloves will be provided to every student. Alcohol was provided to sterilize the benches and hands. For all the experiment involved microorganisms, the plate and apparatus will be autoclaved before dispose.

b. Teacher training, if applicable

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	Number of sessions and duration	Hired personnel *(Including the roles, qualifications and experiences required of the speaker(s)/ instructor(s), etc.)*	Expected learning outcomes
Activity 1 Meeting, seminar and training on Biotechnology education for teachers	- Biotechnology curricula into junior secondary science curricula review - useful topics on the Biotech research development nowadays	4	Professors from the related biotechnology stream departments of universities as our consultants	Teachers will have a better and suitable review on the design and implementation of the biotechnology curricula into junior secondary science curricula

c. Equipment (including installation of new fixtures or facilities), if applicable

	Details of equipment to be procured	Contribution to fulfilment of the project aim(s) and if applicable, the expected utilization rate (Attachment 13)
1	Basic Laboratory Apparatus	For learning & teaching activities
2	Safety Apparatus	For learning & teaching activities
3	Fluorescent Cell Imager	1 nos, For learning & teaching activities
4	Cell Counter with Printer	1 nos, For learning & teaching activities
5	Water Bath	4 nos, For learning & teaching activities
6	Microcentrifuge	1 nos, For learning & teaching activities
7		1 nos, For learning & teaching activities
8		4 nos, For learning & teaching activities
9		9 nos, For learning & teaching activities
10	Rocking Platform	4 nos, For learning & teaching activities
11		2 nos, For learning & teaching activities
12	Laboratory Refrigerators & Freezer,	1 nos, For learning & teaching activities
13	Magnetic Stirrer & Hotplate	8 nos, For learning & teaching activities
14	Microscope, Digital & Binocular	Digital x 1, Binocular x 8, For learning & teaching activities
15	Plastic Trolley	5 nos, For learning & teaching activities
16	Oven	1 nos, For learning & teaching activities
17	Ice Maker, 73kg/day	1 nos, For learning & teaching activities
18	Water System, / hour	1 nos, For learning & teaching activities

19		For learning & teaching activities. To collect, analyze and interpret the data and results simultaneously and different outputs and displays.
20	Router	1 set, For learning & teaching activities To facilitate the laboratory experiments demonstration and data analysis transmission and receive.
21		9 nos, For learning & teaching activities. To display the collected, analyzed and interpreted data and results simultaneously of the laboratory experiments. To facilitate the use of AR learning kits and assist students doing research work during lessons, research training and workshops.
22		9 nos, For learning & teaching activities
23		9 nos, For learning & teaching activities
24	Keyboard	8 nos, For learning & teaching activities
25	Keyboard	1 nos, For learning & teaching activities (Teacher's use)
26		1 nos, For learning & teaching activities (Teacher's use)
27		2 cams will be installed for providing instant video captions during experiments

d. Construction works, if applicable

	Details of the construction works proposed	Contribution to fulfilment of the project aim(s) and if applicable, the expected utilization rate
1	N/A	

(Public sector primary and secondary schools, including DSS schools, and special schools should refer to Paragraph 8.6 and other relevant paragraphs in the School Administration Guide. Kindergartens under the New Kindergarten Education Scheme should observe Paragraph 1.2(1)(g) in the Kindergarten Administration Guide.)

e. Features of the school-based curriculum to be developed, if applicable

Our school plans to develop the school-based Biotechnology Education Programme for junior secondary students as well as the other primary and secondary school students by reviewing the learning sequence and content of school-based science curricula, adding different biotechnology experiments for S1-S3 students. Extended learning activities will be arranged for potential and gifted students. They will be provided with opportunities to apply what they have learnt to solve the real-life problems. Their learning will be consolidated and will be further developed if they continue to pursuit the biotechnology-related disciplines in university study.

f. Other activities, if applicable (Please specify how they contribute to fulfilment of the project aim(s).)

N/A

2.8 Budget

Total Grant Sought: HK$__1,023,700__

Budget Categories*	**Breakdown for the budget items**		**Justifications** *(Please provide justification for each budget item, including the qualifications and experiences required of the hired personnel.)*
	Item	**Amount (HK$)**	
a. Staff	N/A	N/A	
b. Service ($180,000)	AR Design and production on Biotechnology experiments and apparatus. (including 15 3D AR of apparatus and 2 3D AR experiments will be made for a better concept teaching for experiment)	180,000	Augmented Reality (AR) learning kits will be designed and produced to facilitate the learning and teaching of the biotechnology lessons, gifted education school research team research and workshops for secondary and primary school students before, during and after they learn the biotechnology experiments and skills in the lessons. Through the AR learning kits, 3D models of demonstration of the uses of the apparatus and the experiments processes will be displayed interactively. Students can flip the lesson before lesson or learn during the lesson or even after many times so as to be familiar with the related skills and analyze more about the results deeply with discussion easily with classmates. <u>Contents</u>: Each AR needs to have full 3D animation effect. The animation will last for 90 seconds or more. We can design a apps for our bio-tech and it got two parts. ▪ Apparatus o a 3D model of demonstration will come out when the apparatus is pointed at o name should be shown o 3D model be able to turn around by swiping the finger o some description should be shown up o about 50 different apparatus should be included ▪ Experiment o a 3D model of demonstration will come out when the lab menu or worksheet is pointed at o about 20 steps for each experiment should be included o steps should be shown one by one o about 8 experiments should be included

<table>
<tr><td></td><td></td><td></td><td><u>Requirements</u>:
The AR is compatible with devices and it can be presented as a application or a 5 websites

<u>Experience</u>:
The service provider should have related experience and developments on making AR models and application. The service provider should have related qualifications (especially on some tertiary college or university will be preferable)</td></tr>
<tr><td>c. Equipment ($726,792)</td><td>Basic Laboratory Apparatus
<table><tr><th>#</th><th>Item</th><th>Unit price/ $</th><th>Unit</th><th>Total Amount</th></tr><tr><td>1</td><td>Beaker, 100mL</td><td>14.9</td><td>50</td><td>745</td></tr><tr><td>2</td><td>Beaker, 250mL</td><td>18.3</td><td>50</td><td>915</td></tr><tr><td>3</td><td>Blender</td><td>631</td><td>1</td><td>631</td></tr><tr><td>4</td><td>Reagent Bottle, Autoclave -able, 100mL</td><td>26.7</td><td>20</td><td>534</td></tr><tr><td>5</td><td>Reagent Bottle, Autoclave -able, 250mL</td><td>30.2</td><td>20</td><td>604</td></tr><tr><td>6</td><td>Reagent Bottle, Autoclave -able, 600mL</td><td>33.9</td><td>10</td><td>339</td></tr><tr><td>7</td><td>Reagent Bottle, Autoclave -able, 1000mL</td><td>47.6</td><td>10</td><td>476</td></tr><tr><td>8</td><td>Reagent Bottle, Amber, Autoclave -able, 100mL</td><td>84</td><td>10</td><td>840</td></tr><tr><td>9</td><td>Reagent Bottle, Amber, Autoclave -able, 250mL</td><td>119</td><td>10</td><td>1190</td></tr><tr><td>10</td><td>Reagent Bottle, Amber, Autoclave -able, 600mL</td><td>135.8</td><td>5</td><td>679</td></tr><tr><td>11</td><td>Reagent Bottle,</td><td>194.4</td><td>5</td><td>972</td></tr></table></td><td>40000</td><td>For learning & teaching activities</td></tr>
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		Amber, Autoclave -able, 1000mL					
	12	Screw Cap for Amber Reagent Bottle	13.4	10	134		
	13	Pouring Ring for Amber Reagent Bottle	6	10	60		
	14	Stand, Stainless Steel	160	10	1600		
	15	Boss Head, Stainless Steel	30	20	600		
	16	Clamp	40	20	800		
	17	Test Tube Stopper, 16mm	2.95	100	295		
	18	Test Tube Stopper, 24mm	4.5	100	450		
	19	Cork Borer	176	1	176		
	20	Test Tube, 16mm	3.29	400	1316		
	21	Test Tube, 24mm	5.67	200	1134		
	22	Test Tube Rack, 16mm	30	20	600		
	23	Test Tube Rack, 24mm	30	20	600		
	24	Microscope Slide, 50/pk	12	10	120		
	25	Measuring Cylinder, Removable Base, 10mL	105	20	2100		
	26	Measuring Cylinder, Removable Base, 25mL	120	20	2400		
	27	Measuring Cylinder, Removable Base, 100mL	170	20	3400		
	28	Desiccator, 300mm, vacuum	693	2	1386		
	29	Hair Drier	198	4	792		

	30	Filter Paper, 125mm, 100/pk	133	5	665		
	31	Funnel, 75mm	16	20	320		
	32	Conical Flask, 250mL	21.3	40	852		
	33	Volumetric Flask, 10mL	36	10	360		
	34	Volumetric Flask, 100mL	30	10	300		
	35	Volumetric Flask, 1000mL	73	10	730		
	36	Forceps, Fine, 130mm	16	20	320		
	37	Glass Rod, 250mm	5.5	20	110		
	38	Table Lamp	120	9	1080		
	39	Stirrer Bar, 35mm	24.5	30	735		
	40	Mortar & Pestle	24	12	288		
	41	Petri Dish, Plastic, 60mm	1.6	1000	1600		
	42	Scalpel Holder	17	10	170		
	43	Scalpel Blade, 100/pk	165	10	1650		
	44	Scalpel Blade Remover, 50/pk	60	20	1200		
	45	Scissors, Fine	22	10	220		
	46	Sealing Film	220	5	1100		
	47	Spatula, 145mm	10	20	200		
	48	Spillage Control Kit	540	1	540		
	49	Test Tube Brush	4.5	30	135		
	50	Thermometer, Digital	80	10	800		
	51	Thermometer, -10-260	48.7	10	487		
	52	Test Tube Holder	25	10	250		

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<tr><td></td><td>Safety Apparatus<table><tr><th>#</th><th>Item</th><th>Unit price/ $</th><th>Unit</th><th>Total Amount</th></tr><tr><td>1</td><td>Safety spectacles storage cabinet</td><td>2000</td><td>1</td><td>2000</td></tr><tr><td>2</td><td>Safety spectacle</td><td>42</td><td>40</td><td>1680</td></tr><tr><td>3</td><td>Glove, Latex, 100/box</td><td>65</td><td>10</td><td>650</td></tr><tr><td>4</td><td>Glove, Nitrile, 100/box</td><td>90</td><td>35</td><td>3150</td></tr><tr><td>5</td><td>Laboratory Coat</td><td>80</td><td>40</td><td>3200</td></tr><tr><td>6</td><td>Laboratory Coat Hanger</td><td>51</td><td>4</td><td>204</td></tr><tr><td>7</td><td>Face Shield</td><td>366</td><td>1</td><td>366</td></tr><tr><td>8</td><td>Safety Screen</td><td>500</td><td>2</td><td>1000</td></tr><tr><td>9</td><td>Autoclave Bag, 122*94cm, 100/pk</td><td>4150</td><td>3</td><td>12450</td></tr><tr><td>10</td><td>First Aid Box</td><td>300</td><td>1</td><td>300</td></tr></table></td><td>25000</td><td>For learning & teaching activities</td></tr>
<tr><td></td><td>Fluorescent Cell Imager (1unit)</td><td>83000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Printer (1 unit)</td><td>52000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Water Bath (4 units)
$12000 X 4</td><td>48000</td><td>4 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Microcentrifuge, 16K, 220V (1 unit)</td><td>22000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>SmartSpec Plus Spectrophototmeter (1 unit)</td><td>42000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Cuvettes, 50/pk (4 units)
$675 X 4</td><td>2700</td><td>4 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Vortexer (9 units)
$3000 X 9</td><td>27000</td><td>9 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Rocking Platform (4 units)
$12500 X 4</td><td>50000</td><td>4 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Electronic Balance, 1500g, 0.01g (2 units)
$2250 X 2</td><td>4500</td><td>2 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Laboratory Refrigerators & Freezer, 361L (1 unit)</td><td>16000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Magnetic Stirrer & Hotplate (8 units)
$2250 X 8</td><td>18000</td><td>8 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Microscope, Digital (1 unit)
$30,000 X 1
& Binocular (8 units)
$1000 X 8</td><td>38000</td><td>Digital x 1, Binocular x 8, For learning & teaching activities</td></tr>
<tr><td></td><td>Plastic Trolley (5 units)
$2000 X 5</td><td>10000</td><td>5 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Oven (1 unit)</td><td>15000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Ice Maker, 73kg/day (1 unit)</td><td>35000</td><td>1 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Water System /</td><td>60000</td><td>1 nos, For learning & teaching activities</td></tr>
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<tr><td></td><td>hour (1 unit)</td><td></td><td></td></tr>
<tr><td></td><td>Data Loggers & Sensors
<table><tr><th>#</th><th>Item</th><th>Unit price/ $</th><th>Unit</th><th>Total Amount</th></tr><tr><td>1</td><td>Charge Station</td><td>853</td><td>8</td><td>6824</td></tr><tr><td>2</td><td>Conductivity Probe x 8</td><td>1123</td><td>8</td><td>8984</td></tr><tr><td>3</td><td>Gas Pressure Sensor x 8</td><td>1006</td><td>8</td><td>8048</td></tr><tr><td>4</td><td>Temperature Probe</td><td>780</td><td>8</td><td>6240</td></tr><tr><td>5</td><td>Tris-Compatible Flat pH Sensor</td><td>1232</td><td>8</td><td>9856</td></tr><tr><td>6</td><td>Optical Dissolved Oxygen Probe</td><td>3260</td><td>8</td><td>26080</td></tr><tr><td>7</td><td>CO_2 Gas Sensor</td><td>2246</td><td>8</td><td>17968</td></tr></table></td><td>84000</td><td>For learning & teaching activities.
To collect, analyze and interpret the data and results simultaneously and different outputs and displays.</td></tr>
<tr><td></td><td>Router (1 set)</td><td>3000</td><td>1 set, For learning & teaching activities
To facilitate the laboratory experiments demonstration and data analysis transmission and receive.</td></tr>
<tr><td></td><td>Wifi, 256GB (9 units)
$3500 X 9</td><td>31500</td><td>9 nos, For learning & teaching activities.
To display the collected, analyzed and interpreted data and results simultaneously of the laboratory experiments.
To facilitate the use of AR learning kits and assist students doing research work during lessons, research training and workshops.</td></tr>
<tr><td></td><td>$788 x 9</td><td>7092</td><td>9 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Keyboard (8 units)
$750 x 8</td><td>6000</td><td>8 nos, For learning & teaching activities</td></tr>
<tr><td></td><td>Keyboard (1 unit)</td><td>1300</td><td>1 nos, For learning & teaching activities (Teacher’s use)</td></tr>
<tr><td></td><td></td><td>5700</td><td>1 nos, For learning & teaching activities (Teacher’s use)</td></tr>
</table>

d. Works ($22,000)	Cam Installation	5000	2 cams will be installed
	Ice Maker Installation	2000	Install the Ice Maker
	Stand Installation	15000	will be installed for providing a better environment to students
e. General expenses ($65,094)	Consuming materials for biotechnology	50094	For conducting learning and teaching activity
	Audit Fee	15000	
f. Contingency ($29,814)	Contingency fee	29814	[(b+c+e)x3%]
Total Grant Sought (HK$):		**1,023,700**	

*

(i) Applicants should refer to the QEF Pricing Standards in completing the above table. All staff recruitment and procurement of goods and services should be carried out on an open, fair and competitive basis. Budget categories not applicable to this application can be deleted.

(ii) For applications involving school improvement works, a contingency provision of not more than 10% for carrying out works is considered acceptable.

(iii) For projects lasting for more than one year, a contingency provision of not more than 3% of the total budget exclusive of staff cost and works expenditure (including the related contingency provision), if any, is considered acceptable.

3. Expected Project Outcomes

3.1	Deliverables / outcomes	☑ Learning and teaching materials ☑ Resource package ☐ e-deliverables**(please specify)* _____ ☑ Others *(please specify)* _____ - Learning and teaching resources, including lesson plans, lesson worksheets, lab manuals, lesson plans and the AR learning kits for both junior secondary classes, gifted classes and the classes for primary schools of the districts. - students research works and workshops lesson works. **For e-deliverables to be hosted on HKEdCity, please liaise with HKEdCity at 2624 1000.*
3.2	Positive impact on quality education/ the school's development	The project will help the school plan and develop Biotechnology Education as well as STEM Education systematically and nurture students to be good self-learners in the coming century in HK through the advanced and interactive establishment of the Biotechnology Education Program, curriculum development and teachers' development programmes.

The school confirms that the copyrights of the deliverables/materials developed should be vested with the QEF. Any reproduction, adaption, distribution, dissemination or making available of the deliverables to the public for commercial purposes by the service provider is strictly prohibited.

3.3 Evaluation

Please state the methodologies of evaluating project effectiveness and provide the success criteria.

(Examples: lesson observation, questionnaire survey, focus group interview, pre-test/post-test)

The project will be evaluated through observation, questionnaire surveys, group interviews and students' performance. The evaluation items are listed below.

1. The effectiveness of the school-based biotechnology education programme for junior secondary students. (success criteria: 80% of the teachers and students agree that the project helps the school promote Biotechnology education)
2. To arouse students' learning interest. (success criteria: 80% of the teachers and students agree that the project helps arouse students' learning interest in STEM-related subjects)
3. To arouse students' creativity, collaboration and problem-solving skills. (success criteria: 80% of the teachers and students agree that the project helps enhance students' creativity, collaboration and problem-solving skills)
4. To enhance teachers' professional capacity. (success criteria: 80% of the teachers agree that the project helps enhance their confidence in implementing Biotechnology education)

****

For applications with grant sought exceeding $200,000, please complete Parts 3.4 and 3.5.

3.4 Sustainability of the project

- By the end of the project, an evaluation meeting will be held for Principal, the committee members and the teachers involved. They will discuss how to further develop the school-based Biotechnology education and refine the learning and teaching activities of biotechnology for all S1-S3 students, potential and gifted students and the other secondary and primary school students.
- The maintenance fee and purchase of new equipment of the Biotechnology laboratory in future will be responsible by school. The school will continue to make good use of the facilities and equipment to conduct learning and teaching activities in order to enrich students' learning experience on Biotechnology as well as STEM-related education after the completion of the project.

3.5 Dissemination

Please provide a dissemination plan for sharing the good value of the project with the school sector.

(Examples: dissemination seminar, learning circle)

- The school plans to organize a sharing seminar for the teachers of the district by the end of the project period so as to showcase students' learning outcomes, share the project experience and essential notes for implementing Biotechnology learning activities.
- The deliverables will be uploaded to the school webpage for teachers' reference.

4. Asset Usage Plan

Item/Description	No of Units	Total Cost	Proposed plan for deployment
Fluorescent Cell Imager	1 unit	$83000	The equipment will continue to be used by the school to conduct learning and teaching activities after the completion of the project.
Printer	1 unit	$52000	
Water Bath	4 units	$48000	
Microcentrifuge, 16K, 220V	1 unit	$22000	
Spectrophototmeter	1 unit	$42000	
Vortexer	9 units	$27000	
Rocking Platform	4 units	$50000	
Electronic Balance, 1500g, 0.01g	2 units	$4500	
Laboratory Refrigerators & Freezer, 361L	1 unit	$16000	
Magnetic Stirrer & Hotplate	8 units	$18000	
Plastic Trolley	5 units	$10000	
Oven	1 unit	$15000	
Ice Maker, 73kg/day	1 unit	$35000	
Water System, with UV, 6L / hour	1 unit	$60000	
Router	1 set	$3000	
	9 units	$31500	
Keyboard	1 unit	$1300	
	1 unit	$5700	
Safety spectacles storage cabinet	1 unit	$ 2000	
Autoclave Bag, 122*94cm, 100/pk	3 units	$12450	
Microscope, Digital	1 unit	$30000	
Microscope, Binocular	8 units	$8000	
Conductivity Probe	8units	$8984	
Gas Pressure Sensor	8 units	$8048	
Tris-Compatible Flat pH Sensor	8 units	$9856	
Optical Dissolved Oxygen Probe	8 units	$26080	
CO2 Gas Sensor	8 units	$17968	

5. Report Submission Schedule

Project Management		Financial Management	
Type of Report (covering period)	Report due day	Type of Report (covering period)	Report due day
Progress Report 1/5/2020 – 31/10/2020	30/11/2020	Interim Financial Report 1/5/2020 – 31/10/2020	30/11/2020
Progress Report 1/11/2020 – 30/4/2021	31/5/2021	Interim Financial Report 1/11/2020 – 30/4/2021	31/5/2021
Progress Report 1/5/2021 – 31/10/2021	30/11/2021	Interim Financial Report 1/5/2021 – 31/10/2021	30/11/2021
Final Report 1/5/2020 – 28/2/2022	31/5/2022	Final Financial Report 1/11/2021– 28/2/2022	31/5/2022

Attachment 1
Activity 1 - S1 Bio-Tech Experiment Manual: Microbiology

Date:
Topic: Growing Bacteria

Material and apparatus:

Petri Dish with Nutrient agar	5 nos	Inoculating loop	1 nos
Bunsen Burner	1 nos	Alcohol Lamp	1 nos
Gloves	1 pair	Cotton Swab	2 nos
Beaker (10mL)	4 nos	strip	Enough
IPA	Enough	Autoclave	1 nos
water	Enough	Incubator	1 nos
Oven	1 nos	Gloves	1 pair

Procedure:
1. Sterilize the all the table and your both hand
2. Put on your gloves and sterilize it
3. Turn on the Bunsen Burner and Alcohol Lamp in different location
4. Take out all the apparatus from the oven and put it under the sterile space of alcohol lamp
5. Label the Petri Dish
6. Use cotton swab to collect sample from the following location,
   i. Dirty Hand
   ii. Dirty Table
   iii. Sterilized Hand
   iv. Sterilized Table
7. Put the sample into the beaker with 5mL water
8. Sterilize the inoculating loop with Bunsen Burner
9. Put the inoculating loop into the Dirty hand solution prepare in step 7
10. Do the streak plate on the Agar labelled DH
11. Seal the Petri Dish with parafilm strip
12. Repeat the step 8-11 with DT, SH, ST
13. Keep the Petri Dish in the incubator for 12 hours with 38ºC
14. Observe the dishes and compare the amount of colonies they have

Attachment 2
Activity 1 – S1 Bio-Tech Experiment Manual: effects of Antibiotics on bacteria

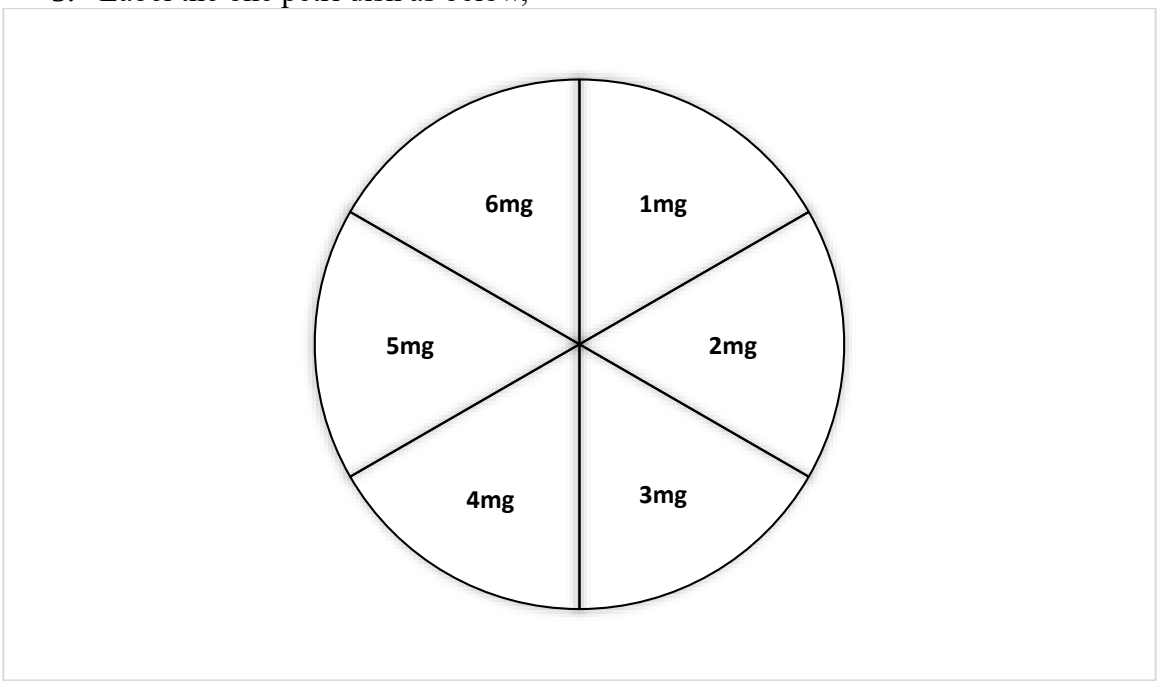
Date:
Topic: Antibiotic

Material and apparatus:

Petri Dish with Nutrient agar	2 nos	L-shape Glass Spreader	1 nos
Bunsen Burner	1 nos	Alcohol Lamp	1 nos
Gloves	1 pair	E Coli Bacterium Culture	5 mL
Ampicillin Solution (1-6mg)	10mL / per	Beaker (100mL)	6 nos
6mm Filter Paper Discs	6 nos	Parafilm strip	Enough
water	Enough	Oven	1 nos
IPA	Enough	Incubator	1 nos
Autoclave	1 nos		

Procedure:

1. Sterilize the all the table and your both hand with IPA
2. Put on your gloves and sterilize it with IPA
3. Turn on the Bunsen Burner and Alcohol Lamp in different location
4. Take out all the apparatus from the oven and put it under the sterile space of alcohol lamp
5. Label the one petri dish as below,



6. Label the other one petri dish with “control”
7. Put the filter paper disc into the Ampicillin Solution respectively
8. Do the Spread Plate by using L-shape Glass Spreader on both petri dishes with 1mL E Coli Bacterium Culture
9. Take out the filter paper disc with a forceps and put it on the agar of the dish prepared at step 5
10. Seal both petri dish with parafilm strip
11. Keep the petri dish in the incubator for 12 hours with 38ºC
12. Observe and compare the result

Attachment 3
Activity 1 - S2 Bio-Tech Experiment Manual: DNA world (extraction DNA from fruit)

Date:
Topic: DNA Extraction

Material and apparatus:

Cold Isopropyl Alcohol	10 mL	Dish Soap	10 mL
Strawberry	1 nos	Mortar and pestle	1 nos
Gauze	1 nos	Beaker 100mL	2 nos
Forceps	1 nos	Sodium chloride	2g
Gloves	1 pair	Milli-Q water	90mL

Procedure:

1. Measuring 90mL Milli-Q water
2. Add 10mL Dish Soap and 2g Sodium Chloride and mix it well
3. Labelled the solution prepared in step 2 as “Extract”
4. Put a strawberry in the mortar and pestle and pour the extract in
5. Use your finger to smash the strawberry as much as possible
6. Pour the strawberry mixture into a gauze and squeeze the juice as much as you can in to a 100mL Beaker
7. Add 10mL of cold Isopropyl Alcohol in the beaker in step 6
8. Use a forceps to gently take out the DNA from the solution
9. Store the DNA in a glass bottle containing alcohol

Attachment 4
Activity 1 - S2 Bio-Tech Experiment Manual (DNA world: DNA fingerprint)

Date:
Topic: DNA fingerprint

Material and apparatus:

Treated Crime scene DNA sample (CS)	25µl		120ml
Treated Suspect 1 DNA sample (S1)	25µl	Agarose gel (Agarose powder dissolved in TAE buffer)	1 nos
Treated Suspect 2 DNA sample (S2)	25µl	Micro test tube holder	1 nos
Treated Suspect 3 DNA sample (S3)	25µl	Micro test tube	Enough
Treated Suspect 4 DNA sample (S4)	25µl	Ice maker	1 nos
Treated Suspect 5DNA sample (S5)	25µl	Ice bucket	1 nos
DNA ladder	25µl	Electrophoresis Apparatus	1 nos
Gel tray	1 nos	Timer	1 nos
Gel staining tray	1 nos	water	Enough
Micropipette (2-20ul, 20ul-200ul,100-1000ul)	1 nos	Microwave	1 nos
Pipette tips	Enough	Microcentrifuge	1 nos
Rocking Platform	1 nos	Laboratory Refrigerators & Freezer, 361L	1 nos
Gloves	1 pair		

Procedure:
Gel Electrophoresis

1. Ice bucket with ice (generating by the ice marker) will be prepared for you
2. Take out the samples and DNA ladder from the Laboratory Refrigerators and put them on ice.
3. Spin the tubes with microcentrifuge and Add **10µl DNA ladder and each DNA samples** into the wells with **fresh tips** as the following:

Lane (From left to right)	DNA ladder/sample	Load volume
1	DNA ladder	10µl
2	Tube CS	10µl
3	Tube S1	10µl
4	Tube S2	10µl
5	Tube S3	10µl
6	Tube S4	10µl
7	Tube S5	10µl

4. Run the gel at 120 V for around 30mins

Staining and Visualization

5. Get out the gel from the chamber carefully and place it in the container gently
6. Pour about 120ml 100x into the gel staining tray
7. Stain the gel for 2 mins
8. Wash the gel with water for 5 mins by shaking it with rocking platform.
9. Repeat the previous step until clear result can be obtained
10. Make a conclusion based on the result

Attachment 5
Activity 1 - S3 Bio-Tech Experiment: Advanced DNA world (GM Food)

Date:
Topic: GMO Investigator

Material and apparatus:

GMO Food	2g	Non-GMO food	2g
Mortar & Pestle	2 nos		500ul
Screwcap tube	2 nos	PCR Tube	4 nos
Plant Primers	40ul	GMO Primers	40ul
dye	40ul	Electrophoresis Apparatus	1 nos
UV Light	1 nos	Water bath	1 nos
Thermocycler	1 nos	microcentrifuge	1 nos
Micropipette (2-20ul,20-200ul,100-1000ul)	1 nos	Pipet tips	Enough
Ice bath	1 nos	Ice marker	1 nos
Electronic balance,1500g, 0.01g	1 nos	water	Enough
Gloves	1 pair		

Procedure:

1. Measure 2g of the non-GMO food in mortar with the electronic balance
2. Add 10mL water
3. Gently crash the food with mortar & pestle
4. Add 500ul InstaGene and 50ul crashed extract into a screwcap tube
5. Labelled the tube as “non-GMO”
6. Repeat step 1-5 with GMO food and label the tube as “GMO”
7. Shake the both tubes well
8. Place them into 95°C water bath for 5 mins
9. Place them into microcentrifuge for 5 mins at maximum speed
10. Label the tube with 1-4 as below
11. Place the tube into ice bath
12. Add the master mix to each tube according to the table

Tube number	Master Mix	DNA
1	20ul Plant MM	20ul Non-GMO
2	20ul GMO MM	20ul Non-GMO
3	20ul Plant MM	20ul GMO
4	20ul GMO MM	20ul GMO

13. Mix the mixture with pipette up and down technique
14. Place the tube 1-4 in PCR for thermal cycle
15. Place the tube 1-4 in centrifuged for a pulse-spin
16. Add 10ul dye into tube 1-4
17. Add 20ul of each sample into the electrophoresis apparatus as below

Lane	Sample	Load Volume
2	Tube 1	20ul
3	Tube 2	20ul
4	Tube 3	20ul
5	Tube 4	20ul
7	PCR molecular weight ruler	20ul

18. Run the electrophoresis with 100V for 30 mins
19. Observe the gel under a UV light

Attachment 6

Activity 1 - S3 Bio-Tech Experiment Manual: Catalyzers in daily life (Enzymes)

Date:
Topic: Enzyme

Material and apparatus:

Fresh Pineapple	50g	Canned Pineapple	50g
Jelly Powder	132g	Beaker 250mL	2 nos
Cling Film	Enough	Laboratory Refrigerators & Freezer	1 nos
Gloves	1 pair		

Procedure:

1. Prepare the fresh pineapple and canned pineapple independently
2. Cut the pineapple into $1cm^3$ size
3. Add 132g jelly powder in 225mL hot water
4. Stir it well
5. Add 225mL cold water into the mixture from step 2
6. Pour 150mL of the mixture of step 5 into a beaker
7. Put fresh pineapple into the beaker
8. Repeat the step 6-7 with canned pineapple
9. Seal the two beakers with cling film
10. Put them into refrigerator for 30 mins
11. Observe and compare the result

Attachment 7
Activity 2 - Extended Bio-Tech Experiment Manual: Microbiology

Topic: Culturing Bacteria from different locations

Material and apparatus:

Perti Dish with Nutrient agar	5 nos	Inoculating loop	1 nos
Bunsen Burner	1 nos	Alcohol Lamp	1 nos
Gloves	1 pair	Cotton Swab	2 nos
Beaker (10mL)	4 nos	Parafilm strip	Enough
	Enough	water	
Oven	1 nos	Autoclave	
Incubator	1 nos		

Procedure:

1. Sterilize the all the table and your both hand
2. Put on your gloves and sterilize it
3. Turn on the Bunsen Burner and Alcohol Lamp in different location
4. Take out all the apparatus from the oven and put it under the sterile space of alcohol lamp
5. Label the 4 Petri Dishes with the 4 locations obtained bacteria (locations will be decided by the students) and 1 for control
6. Use cotton swab to collect sample from the decided locations
   i. (door)
   ii (floor)
   iii (window)
   iv (bench)
7. Put the sample into the beaker with 5mL water
8. Sterilize the inoculating loop with Bunsen Burner
9. Put the inoculating loop into “Door solution” prepare in step 7
10. Do the streak plate on the Agar labelled “Door”
11. Seal the Petri Dish with parafilm strip
12. Repeat the step 8-11 with the other 3 locations sample
13. Keep the Petri Dish in the incubator for 12 hours with 38^{o}C
14. Observe the dishes and compare the number of colonies from different position the students chose. Try to make a conclusion of the result and explain it.

Attachment 8

Activity 2 – Extended Bio-Tech Experiment Manual (Dairy Fermentation: making Yoghurt)

Material and apparatus:

Beaker, 500ml	2 nos	Inoculating loop	1 nos
Bunsen Burner	1 nos	thermometer	1 nos
Gloves	1 pair	Water bath	2 nos
Hot plate	1 nos	Non-fat milk	500ml
Incubator	1 nos	Glass rod	1 nos
Starter culture or plain yogurt from local stores	enough	pH paper	1 nos
spoon	1 nos	wrap	enough
Microscope	1 nos	Slides	enough
crystal violet	enough	DI water	enough
Gram's iodine solution	enough	Safranin	enough
Alcohol	enough	Test tube holder	1 nos

The making of yoghurt is the application of microorganism. The second part of this experiment is to observe the microorganism to make yoghurt by gram staining. The yoghurt bacteria are gram positive bacterial culture, this is a golden opportunity to introduce to the student about gram positive and negative bacteria and their cell membrane differences.

Procedure

Part A: making yoghurt

1. Heat 500mL of milk in a beaker slowly to 85 ºC with hot plate
2. Cool milk in a cold water bath to 42-44 ºC. The cooling process should take about 15 minutes.
3. Pour the heated milk into two beakers evenly
4. Add 1 spoon of starter culture (plain yogurt) to one of the beakers and mix it with the cooled milk with a glass rod, label it as "ASC"
5. Nothing will be added to the other beaker, label it as "NSC"
6. Cover the beakers and Incubate them at 45ºC in incubator for 24 hours.
7. When the yoghurt milk has solidified, the incubation should be stopped.
8. Observe the product and record the colour, smell, texture and pH by pH paper next day and mark them down.
9. Compare the differences of the two beaker and have discussion from the result and try to discuss and explain it.

Part B: Gram staining

1. Prepare a smear with inoculation loop on slides and fix it with Bunsen burner
2. Stain the smear with crystal violet for 20s
3. Wash carefully with DI water
4. Stain the smear with Gram's iodine solution for 1 min
5. Wash it with DI water again
6. Decolorize the smear with alcohol
7. Stain the smear with safranin for 20s
8. Wash it with DI water again
9. Air dry the smear
10. Observe the smear under microscope

Attachment 9
Activity 2 - Extended Bio-Tech Experiment Manual (DNA world: DNA fingerprint)

Topic: DNA fingerprint

Material and apparatus:

Treated Crime scene DNA sample (CS)	25µl	DNA stain, 100x	120ml
Treated Suspect 1 DNA sample (S1)	25µl	Micro test tube holder	1 nos
Treated Suspect 2 DNA sample (S2)	25µl	Micro test tube	Enough
Treated Suspect 3 DNA sample (S3)	25µl	Ice maker	1 nos
Treated Suspect 4 DNA sample (S4)	25µl	Ice bucket	1 nos
Treated Suspect 5DNA sample (S5)	25µl	Electrophoresis Apparatus	1 nos
DNA ladder	25µl	Timer	1 nos
Microwave	1 nos	Agarose gel powder	0.2g
Scissor	1 nos	buffer	20ml
Microcentrifuge	1 nos	Gel tray	1 nos
Pipet tips	Enough	water	Enough
Rocking Platform	1 nos	Micropipette (2-20ul, 20ul-200ul,100-1000ul)	1 nos
Laboratory Refrigerators & Freezer, 361L	1 nos	Gel staining Tray	1 nos
Gloves	1 pair		

Procedure:

Part A:
Agarose Gel preparation

1. Dissolve 0.2g agarose in 20 ml buffer
2. Microwave until boil and gel powder completely dissolve
3. Put the comb on gel tray
4. Pour the dissolved gel on the tray
5. Wait for the gel to set

Gel Electrophoresis

6. Ice bucket with ice (generating by the ice marker) will be prepared for you
7. Take out the samples and DNA ladder from the Laboratory Refrigerators and put them on ice.
8. Spin the tubes with microcentrifuge and Add **10µl DNA ladder and each DNA samples** into the wells with **fresh tips** as the following:

Lane (From left to right)	DNA ladder/sample	Load volume
1	DNA ladder	10µl
2	Tube CS	10µl
3	Tube S1	10µl
4	Tube S2	10µl
5	Tube S3	10µl
6	Tube S4	10µl
7	Tube S5	10µl

9. Run the gel at 120 V for around 30mins

Staining and Visualization

10. Get out the gel from the chamber carefully and place it in the container gently
11. Pour about 120ml 100x DNA stain into the gel stain tray
12. Stain the gel for 2 mins
13. Wash the gel with Milli-Q water for 5 mins by shaking it with rocking platform

14. Repeat the previous step until clear result can be obtained
15. Interpret the result

Part B

Paper work of restriction digestion during the waiting time of the experiments

DNA paper model will be distributed to the Students need to use the scissors (restriction enzymes) to cut at the specific sites (restriction site) which mimic the restriction digestion

Attachment 10

Activity 2 - Extended Bio-Tech Experiment: Screening GM Food

Topic: Screening GMO food brought from supermarket

Material and apparatus:

Test Food (GMO/non-GMO)	2g	Verified Non-GMO food	2g
Verified GMO food	2g		1500ul
Mortar & Pestle	2 nos	Tube	6 nos
Screwcap tube	2 nos	GMO Primers	60ul
Plant Primers	60ul	Electrophoresis Apparatus	1 nos
Loading dye	60ul	UV light	1 nos
molecular weight ruler	20ul	Water bath	1 nos
Thermocycler	1 nos	microcentrifuge	1 nos
Micropipette (2-20ul,20-200ul,100-1000ul)	1 nos	Pipet tips	Enough
Ice bath	1 nos	Ice marker	1 nos
Electronic balance,1500g, 0.01g	1 nos	water	Enough
Gloves	1 pair		

Procedure:

1. Measure 2g of the verified non-GMO food in mortar with electronic balance
2. Add 10mL of Milli-Q water
3. Gently crash the food with mortar & pestle
4. Add 500ul and 50ul crashed extract into a screwcap tube
5. Label the tube as “non-GMO”
6. Repeat step 1-4 with the verified GMO food and test food and label the tube as “GMO” and “Test” respectively.
7. Shake the both tubes well
8. Place them into 95°C water bath for 5 mins
9. Place them into microcentrifuge for 5 mins at maximum speed
10. Label the tube with 1-6 as below
11. Place the tube into ice bath
12. Add the master mix to each tube according to the table

Tube number	Master Mix	DNA
1	20ul Plant MM	20ul verified Non-GMO DNA
2	20ul GMO MM	20ul verified Non-GMO DNA
3	20ul Plant MM	20ul verified GMO DNA
4	20ul GMO MM	20ul verified GMO DNA
5	20ul Plant MM	20ul Test food DNA
6	20ul GMO MM	20ul Test food DNA

13. Mix the mixture with pipette up and down technique
14. Place the tube 1-6 in PCR for thermal cycle
15. Place the tube 1-6 in centrifuged for a pulse-spin
16. Add 10ul dye into tube 1-6
17. Add 20ul of each sample into the electrophoresis apparatus as below

Lane	Sample	Load Volume
2	Tube 1	20ul
3	Tube 2	20ul
4	Tube 3	20ul
5	Tube 4	20ul
6	Tube 5	20ul
7	Tube 6	20ul
8	PCR molecular weight ruler	20ul

18. Run the electrophoresis with 120V for 30 mins

19. Observe the gel under a UV light
20. Determine and discuss whether the test food is GM food or not by interpreting the result bands. (remark: some food declared as non-GM food in supermarket may be GM food actually.)

Attachment 11
Activity 3 – DNA Extraction workshop

Introduction
DNA is present inside the nucleus of every cell in all living organisms. It contains all information needed to control the activities within our cells and thus, the functions of our bodies. It also determines the traits we inherit from our parents, e.g. brown eyes, black hair etc. In this workshop, we will try to extract DNA from fruits.

Material and apparatus:

Cold Isopropyl Alcohol	10 mL	Dish Soap	10 mL
Strawberry	1 nos	Mortar and pestle	1 nos
Gauze	1 nos	Beaker 100mL	2 nos
Forceps	1 nos	Sodium Chloride	2 g
Gloves	1 pair		90mL

Procedure:

1. Measuring 90mL water
2. Add 10mL Dish Soap and 2g Sodium Chloride and mix it well
3. Labelled the solution prepared in step 2 as "Extract"
4. Put a strawberry in the mortar and pestle and pour the extract in
5. Use your finger to smash the strawberry as much as possible
6. Pour the strawberry mixture into a gauze and squeeze the juice as much as you can in to a 100mL Beaker
7. Add 10mL of cold Isopropyl Alcohol in the the beaker in step 6
8. Use a forceps to gently pick up the DNA from the solution and store them into a little jar containing alcohol

Attachment 12
Activity 3 – Making yoghurt workshop

Introduction
In Our daily life, industrial companies commonly utilize microorganisms in food processing so as to produce yummy foods or drinks, e.g. beer, red wine, cheese, yoghurt, etc. In this workshop, we will use yogurt as an example to demonstrate the use of microorganism in food processing.

For the formation of yogurt, two strains of bacteria called L. bulgaricus and S. thermophilus play an important role on it. They digest the sugar from the milk and generate acidic products. These acidic products provide an acidic environment for making yummy yoghurt and it also explains the sour taste of the yoghurt. Apart from making the yoghurt, we will have a chance to look at the features of the microorganisms containing in the commercial yoghurt under the microscope.

Material and apparatus:

Beaker, 500ml	2 nos	Inoculating loop	1 nos
Gloves	1 pair	Water bath	2 nos
Hot plate	1 nos	Non-fat milk	500ml
Incubator	1 nos	Glass rod	1 nos
Non-fat milk	1 L	Starter culture or plain yogurt from local stores	enough
wrap	enough	pH paper	1 nos
spoon	1 nos	thermometer	1 nos
Microscope	1 nos	Slides	enough

Procedure

1. Heat 1 L (approximately 1 quart) of milk in a beaker slowly to 85 ºC with hot plate
2. Cool milk in a cold water bath to 42-44 ºC. The cooling process should take about 15 minutes.
3. Add 1-2 spoon of starter culture to the cooled milk and mix with a glass rod.
4. Cover the beaker and incubate it at 45ºC for around 3 hours.
5. Observe the prepared slides of the stained microorganisms from the commercial yoghurt under microscope
6. When the yoghurt milk has solidified, the incubation should be stopped.
7. Observe the product and record the colour, smell, texture and pH by pH paper.