Part C: Project Details

1. Goals and Objectives

1.1 Short-term goals:

(i) Develop feasible and unique investigative studies that can be used in NSS physics.
(ii) Students develop problem-solving skills, communication skills, competence in using information technology, the ability to collaborate with peers, and self-directed learning skills.
(iii) Teachers gain experience in guiding students in investigative studies.
(iv) Using the finding in investigative studies to provide guided astronomical observations in astronomy outreach programmes.
(v) Students and the public are given more opportunities to gain a deeper appreciation about the wonders of the universe
(vi) Students gain knowledge and interest in astronomy.
(vii) Provide useful learning and teaching resources for all physics teachers in Hong Kong.

1.2 Long-term goals:

(i) Gain experience for further developments of innovative investigative studies.
(ii) The learning and teaching resources developed are used in various schools in Hong Kong.

2. Needs Assessment and Applicant Capability

2.1 Needs Assessment

2.1.1 Background

Munsang College (Hong Kong Island) was founded in September 1999. Our commitment is to offer to students a holistic education upon Christian principles and nurture in them a positive outlook on life, so that they can be self-motivated, resolute, devoted to making valuable contributions to the community, and prepared for the sublime state of life.

One of the main concerns in the three-year plan of the school in 2007-2009 is to prepare for the New Senior Secondary (NSS) curriculum. In the NSS physics curriculum, two important changes are the implementation of investigative studies and new elective modules. In the past two years, we have been experimenting with a few investigative studies in the core NSS physics syllabus. In the year 2008-2009, we would like to start developing observation-based learning and teaching resources for an elective module called "Astronomy and Space Science".

2.1.2 The problems and solutions in astronomical observations in schools

Most physics teachers in Hong Kong understand the importance of observations in astronomy because observations can be an inspiring experience for students to gain a deeper appreciation of the wonders of the universe. However, can observation really produce this effect? It seems that most people take this for granted, but this depends critically on *how* the observations are carried out. In fact, experience showed that most celestial objects are not worth a second look if the students have no understanding of the objects being observed.

The answer is that it is important to stimulate the minds of the students during astronomical observations. This can be done by having 'detailed guided observations', in which, for example, students are told what specific features to look for, what their natures and origins are, the dramatic events that shaped the features being observed, to look for challenging details that are on the verge of visibility, etc. The students are therefore given an opportunity to observe with understanding. This is the crucial element that will lead to a greater appreciation of the wonders of the universe.

Apart from using guided observations to stimulate the minds, the students can also be asked to make

investigative studies based on the observed views of the celestial objects. With the introduction of new equipments and software in the market recently, it is now possible for students to make scientific measurements on celestial objects and then find out important facts about the universe, rather than merely be visually amazed by the telescopic views of the celestial objects. This allows generic skills to be developed, which is a main rational for introducing investigation studies in the NSS curriculum, and can generate findings that can be used in guided observations.

A problem with star-gazing is that the need to go to remote areas at night poses safety problem, and such activity is heavily dependent on weather condition. To solve this problem, we can use the moon and the sun as targets of study so that observations can be done in the safe confines of most schools in Hong Kong. These celestial objects are also bright enough so that light pollution in urban areas and even less-than-perfect weather condition have little adverse effect on their observations.

To summarize, it is possible to use astronomical observations as an organic and integral part in the NSS physics curriculum in most schools in Hong Kong. To achieve this, physics teachers need to have related learning and teaching resources that are suitable for investigative studies on the moon and the sun. Unfortunately, there are very little relevant resources at the moment that are appropriate for the level of NSS physics curriculum in Hong Kong. In this project, we propose to experiment with 6 investigative studies using the moon and the sun as our observational targets, with the aim of developing learning and teaching resources for NSS physics curriculum in Hong Kong.

2.2 Applicant capability

The school astronomy society was founded in our school in September 2005 by the current physics panel head, Leong Dat Wing, who had obtained a Master of Science degree and a distinction in Postgraduate Certificate in Education. With over 7 years of experience in both theoretical and practical aspects of astronomy, together with an aspiration to infuse the sense of wonder of the universe in youngsters, a wide range of teaching resources had already been developed including talks, workshops on the use of astronomical instruments, basic imaging and digital processing techniques, etc. The success is reflected in the steadily growing number of members joining weekly astronomical programmes in the last three years. Details can be found in the society website http://www.imsc.edu.hk/pages/astronomy/index.htm.

Beyond these school activities, astronomy outreach programmes had been undertaken in other schools and youth centre, including Hong Kong Student Aid Society Primary School, Tin Shui Wai Government Primary School, CCC Fung Yun Wah Primary School, etc. Such activities attracted the attention of Radio Television Hong Kong (RTHK) which subsequently made a related television programme. Such extensive astronomy outreach experience serves as a solid foundation to design more ambitious and unique learning experiences in this project.

2.3. The need to purchase equipments

Currently, the school uses equipments that are privately-owned by teachers and those that are borrowed from local amateur astronomers to carry out small group observations in astronomy. However, this is inadequate for NSS physics due to the following reasons:

1. The number of students involved in learning astronomy will increase dramatically when NSS physics students are included. However, detailed guided observations require each student to spend a lot of time in observing every single target. Therefore the small number of privately-owned or borrowed equipments cannot meet the need of the large number of NSS students.
2. New solar instruments in the market have opened new doors in solar observations. They allow observers to see dramatic phenomena and features on the sun, such as prominences, solar flares, super-granulation and spicules, etc. The use of such instruments during school hours will be very productive in carrying out astronomical investigations. The equipments that are currently used do not support this function.
3. Scientific measurements in astronomy require the use of special cameras and image-processing software. With the advance of new cameras and software in the market, it is now possible to do carry out astronomical measurements by students. However, the cameras currently used in school cannot

meet the need in such tasks.

4. The build-up of school astronomical resource, rather than the sole use of private equipments, is better for the long term development of the school and allows the organization of astronomical programmes to be more convenient, especially for large group observations.

Therefore, in order to achieve the goals in this project, it is necessary to build up school astronomical resources. This allows more students to be catered, more unique learning experiences to be designed, and quality astronomical measurements to be made.

3. Targets and Expected Number of Beneficiaries

Targets and Expected Number of Beneficiaries		Comments
Direct Beneficiaries	30 students participating in investigative studies	Students can learn generic skills and gain astronomical knowledge through the use of first hand data.
	3 physics teachers	The physics teachers in our school will benefit through sharing of experience in guiding students in investigative studies. This serves as a valuable continuous professional development programme for teachers.
	About 1000 students in school	Through star-gazing and solar observation activities, students in school can gain knowledge and interest about the universe in detailed guided observations organized by the students. They can also have a deeper appreciation of the wonders of the universe. After the completion of the project, the resources developed and the equipments purchased can continue to benefit many future generations of students.
Indirect Beneficiaries	Other physics teachers in Hong Kong	All physics teachers in Hong Kong can benefit because the learning and teaching materials developed in this project will be shared via the web.
	General public	The students will share their knowledge obtained in the project in star-gazing activities, commonly known as 'sidewalk astronomy'. The public can also access the learning and teaching resources developed in this project via the web.

4. Extent of Teachers' and Principals' Involvement in the Project

The physics panel head, Leong Dat Wing, will be the project leader, responsible for developing investigative studies, training of the students, assessing learning outcomes, etc. The other two members of the physics panel will participate in guiding students in investigative studies, and the principal will provide support in ensuring the smooth running of the project.

5. Implementation Plan with Time-line

5.1. Time-line

Time	Action	Comments	Aims
		Stage 1: Preliminary Stage	
9/2008 – 12/2008	Purchasing of equipments		Purchase equipments that allow the investigations to be made.
9/2008 – 12/2008	Recruitment of student	Use weekly programmes in astronomy society to recruit students participating in investigative studies (hereafter known as 'student researchers').	Recruit at least 30 student researchers.
1/2009 – 3/2009	Training of student	Weekly workshops include: • Taking astronomical pictures with	Student researchers are able to develop skills that are essential

	researchers	webcams • Setting up of telescopes • Learning photo-processing skills and how to extract scientific data with the use of Registax and Photoshop.	in investigations.
		Stage 2: Investigation Stage	
4/2009	Planning of investigations	• Student researchers are divided into six groups, each undertaking one project supervised by one teacher. • Details of the six investigations can be found in Section 5.2. • Briefing session for student researchers and physics teachers will be held. • Regular meetings are held between student researchers and supervising teachers, discussing their investigation plans with feedback from teachers. • Physics teachers hold a meeting to discuss the difficulties in guiding students.	Improve the teachers' skills in guiding students in investigations.
5/2009	Presentation of investigation plans	Student researchers give presentations on their methodologies, with questioning and answering session.	Develop students' communications skills.
6/2009-1/2010	Carrying out investigations	Student researchers collect data and perform data analysis. Supervising teachers have regular meetings with the students researchers to provide guidance.	1. Improve the following skills in students: (a) problem-solving skills (b) communication skills (c) data processing skills (d) use of information technology (e) the ability to collaborate effectively with peers (f) self-directed learning skills 2. Improve the teachers' skills in guiding students in investigations.
2/2010	Presentation of results	• A talk is given by each group with a selection of students and teachers in school as audience. • Student researchers hand in written reports.	1. Develop the presentation skills of student researchers. 2. Increase the knowledge and interest in astronomy of the audience.
		Stage 3: Outreach Programme Stage	
3/2010 – 8/2010	Organising outreach programmes in school	The following activities will be held so that student researchers can share their knowledge with peers: 1. At least 1 lunar observation activity 2. At least 3 solar observation activities	1. Increase the knowledge and interest in astronomy for students in school. 2. Improve the communication skills of student researchers.
3/2010 – 8/2010	Organising sidewalk	Organise sidewalk astronomy in parks or other public places, allowing the public to	1. Give the public chances to appreciate the

	astronomy	have guided views of the moon.	wonders of the universe. 2. Improve the communication skills of student researchers.
3/2010 – 8/2010	Setting up of project website	Setting up of project website.	Setting up of project website to share the project resources.

5.2 Details of investigations

Investigations	Outline of methods	Deliverables
1. Investigate the change in distance between the Earth and the moon	Photograph the moon and find the distance to the moon. Repeat this for at least a few days.	A written report and a presentation with a graph of distance against time.
2. Investigating the origin and evolution of lunar features	Photograph various regions of the lunar surface and learn the formation and evolution of the features by extensive reading.	A written report and a presentation with pictures of various parts of the moon and descriptions of their evolution.
3. Investigating the change of the moon in one night	Photograph the full moon periodically for at least half of a night, investigating the change in colour, size, shape and brightness of the moon quantitatively.	A written report describing various changes and a presentation with appropriate animations illustrating the changes.
4. Investigating the nature of solar features	Photograph pictures of special features on a solar surface and learn about their nature by extensive reading.	A written report and a presentation with pictures of solar features and descriptions of their nature.
5. Investigating sunspot development	Monitor the change in the size and shape of sunspot by photographing the sunspot for a few consecutive days.	A written report and a presentation describing the change in sunspot both quantitatively and qualitatively.
6. Investigating the rotational rate of the sun	Find the rotational rate of the sun by photographing the solar disk for a few consecutive days. Investigate the dependence of rotational rate on latitude.	A written report and a presentation describing the methodology and results.

6. Expected Deliverables and Outcomes

Deliverables:

(i) Documents describing how to carry out the investigative studies, the difficulties in guiding students and their potential solutions.
(ii) 6 written reports for the 6 investigative studies.
(iii) A website with items (i) and (ii) for sharing.

Outcomes:

(i) Student researchers develop problem-solving skills, communication skills, competence in using information technology, the ability to collaborate with peers, and self-directed learning skills.
(ii) Teachers gain experience in guiding students in investigative studies
(iii) Using the finding in investigative studies to provide guided astronomical observations in astronomy outreach programmes.
(iv) Students gain knowledge and interest in astronomy.
(v) The students and the public are given more opportunities to gain a deeper appreciation about the wonders of the universe.

7. Budget

Items (Equipments)	Comments	Cost per Unit	Quantity	Expense
1. Lunt Solar LS100T/Ha hydrogen-alpha single pass telescope system with B1200 blocking filter	A telescope that allows safe observation of various phenomena on the sun, such as prominences and spicules.	$37000	1	$37000
2. Lunt Solar 100mm hydrogen-alpha filter with B1200 blocking filter	A solar filter to be used in conjunction with item 1 to produce higher resolution images, or used with another telescope to cater for a larger audience.	$45000	1	$45000
3. 12 inch Dobsonian telescope	A telescope with high-resolution for detailed lunar study.	$9000	1	$9000
4. The Imaging Source DMK 21AF04.AS camera	An astronomical webcam for taking picture through telescopes, allowing for scientific measurements to be made.	$3400	1	$3400
Total				$94,400

8. Evaluation Parameters and Method

Time	Action	Aims	Evaluation Methods	Success Criteria
Stage 1: Preliminary Stage				
1/2009 – 3/2009	Training of student researchers	Student researchers are able to develop skills that are essential in investigations.	Use tests to check student researchers' performance in each skill.	All student researchers should be able to pass all tests.
Stage 2: Investigation Stage				
4/2009	Planning of investigations	Improve the teachers' skills in guiding investigations.	Physics teachers hold at least one evaluation meeting to discuss the difficulties in guiding students and the potential solutions.	The evaluation meeting is carried out with a minute recording the main conclusions.
5/2009	Presentation of investigation plans	Develop student researchers' communications skills.	Physics teachers hold interviews to ask each student researcher to reflect on how to improve their communication skills.	Each student research is able to reflect on how to improve their communication skills.
6/2009 – 1/2010	Carrying out investigations	Improve student researchers' skills in the following areas: (a) problem-solving skills (b) communication skills (c) data processing skills (d) use of information technology (e) the ability to collaborate effectively with peers	Use questionnaires to ask the student researchers whether they have improved in each area.	Over 80% of student researchers agree that they have improved various skills.

		(f) self-directed learning skills		
		Improve the teachers' skills in guiding students in investigations.	Physics teachers hold at least one evaluation meeting to discuss the difficulties in guiding students and the potential solutions.	The evaluation meeting is carried out with a minute recording the main conclusions.
2/2010	Presentation of Results	Develop the presentation skills of student researchers.	Distribute questionnaires to the audience to rate the presentation skills of the student researchers.	Over 80% of the audience rate the presentation skills of the student researchers as good.
		Increase the knowledge and interest in astronomy of the audience.	Distribute questionnaires to the audience to see if they have gained knowledge and interest in astronomy.	Over 80% of the audience agree that they have gained knowledge and interest in astronomy.
Stage 3: Outreach Programme Stage				
3/2010 – 8/2010	Organizing outreach programmes in school	Student researchers are given chances to provide guided observations for their peers.	The number of lunar and solar observation activities organized by the student researchers.	At least 1 lunar observation activity and at least 3 solar observation activities are held in school.
		Increase the knowledge and interest in astronomy for students in school.	Distribute questionnaires to the students joining the activities to see if the guided observations have deepened their appreciation of the views in telescopes.	80% of the students joining the activities agree that the guided observations have deepened their appreciation of the views in telescopes.
		Improve the communication skills of student researchers.	Use questionnaires to ask the student researchers whether they have improved their communication skills.	80% of the student researchers agree that sidewalk astronomy have improved their communication skills.
3/2010 – 8/2010	Organising sidewalk astronomy	Give the public chances to appreciate the wonders of the universe	The number of sidewalk astronomy organized.	At least 2 sidewalk astronomy sessions are organized.
		Improve the communication skills of student researchers.	Use questionnaires to ask the student researchers whether they have improved their communication skills.	80% of the student researchers agree that sidewalk astronomy have improved their communication skills.
3/2010 – 8/2010	Setting up of project website	Setting up of project website to share the project materials.	The time when the website is set up.	Website is set up by 8/2010.

9. Sustainability of the Outcomes of the Project

- All equipments purchased are non-consumables. Therefore, the project can be continued indefinitely without further funding.
- Telescopes are designed to provide lifetime enjoyment with little maintenance problems. So the equipments purchased in this project can be used to benefit many generations of students in the future.
- Investigative studies developed in the project will be run in the future in NSS physics curriculum.

10. Dissemination / Promotion

- A project website that is open to the public will be set up to share the learning and teaching resources that are developed in this project.
- If the project is successful, local educational organizations will be contacted (such as Educational Bureau and Hong Kong Association for Science and Mathematics Education, etc.) to look into the possibility of project resource sharing in seminars or websites.