Subject Description Form

Subject Code	BME2S04 / BME2S04S
Subject Title	Reducing the Scientific Divide in Primary and Secondary Students through STEM Projects
Credit Value	3
Level	2
Pre-requisite / Co-requisite / Exclusion	Nil
Objectives	The objectives of this subject are to: a. Introduce to students the concept and practice of service-learning. b. Raise students' awareness of the difficulties and challenges faced by children and teenagers studying in underprivileged schools. c. Develop students' scientific thinking and scientific literacy. d. Educate students about the impact of scientific thinking and literacy on young people and the general community. e. Enhance students' generic competencies of innovative problem solving, communication and teamwork. f. Nurture students' sense of social awareness, responsibility and engagement.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Link their service-learning activities and experience with the academic content of the subject. b. Articulate and empathize with the difficulties and challenges faced by children and teenagers studying in underprivileged schools. c. Apply basic scientific thinking principles to teach and demonstrate STEM concepts in the service setting. d. Understand the impact of scientific literacy on young people and the community. e. Work effectively in multidisciplinary teams to solve problems encountered in planning and delivering the service. f. Communicate effectively with clients and/or other stakeholders. g. Reflect on their role and responsibilities both as a professional in their chosen discipline and/or as a responsible citizen.
Subject Synopsis / Indicative Syllabus	The topics in the course syllabus cover three major areas: **<u>1. Concept and Practice of Service Learning</u>**

	- Principles, concepts and myths of service-learning. - Benefits of service-learning to students, and the community. - Ethical issues in service-learning. - Basic concepts and theories of social problems, developments and justice. - Social responsibilities of global citizens as intellectuals and professionals. - Proper attitudes and behaviors in service delivery. - Reflection as a tool for learning. **2. Discipline-Specific Concepts, Issues and Skills** - Principles and concepts of scientific literacy and thinking. - Scientific methods and inquiry; formulation, hypothesis, prediction and experiment; applications of scientific thinking to everyday experience. - Impact of scientific literacy on society; fear of science; pseudo-science versus proto-science. **3. Project-Specific Concepts, Issues and Skills** - Concepts and practices in teaching and demonstrating scientific concepts, including teaching methods; Bloom's taxonomy; classroom management; communication to large groups. - Financial, cultural and socioeconomic challenges faced by children in underprivileged schools and communities. - Moral and ethical concerns related to working with children and young people in a school setting.
Teaching / Learning Methodology	The subject can be offered as a 2-semester subject in Semester 1 + 2 and/or Semester 2 + Summer Term; or as a 1-semester subject in the Summer Term. **1. e-Learning Module (10 hours)** The e-learning module is developed and delivered by the Service-Learning and Leadership Office at PolyU, consisting of readings, exercises and assessments that are designed to introduce students to the basic concept and practice of service-learning. Students are required to successfully complete the e-learning module within the first four weeks of the semester in which they are taking the subject. **2. Discipline-Specific Lectures and Seminars (4 hours)** These lectures and seminars will be designed and conducted by the subject team. They are designed to educate students on methods of scientific thinking and inquiry and the impact of scientific literacy on society.

3. Project-Specific Lectures and seminars (4 hours)

These lectures and seminars will be designed and conducted by the subject team or other experts and speakers (e.g. Service-Learning and Leadership Office, NGOs, school teachers). They are designed to (a) develop students' understanding of the background and challenges faced by students at these underprivileged schools, (b) provide training for students in ethical knowledge and teaching/classroom management skills for planning and delivering the service project, and (c) deepen students' understanding of specific historical, cultural, and political background of offshore sites (for offshore projects).

4. Project-Specific Tutorials and/or Workshops (6 hours)

The project-specific tutorials and/or workshops on "Scientific Thinking and Experiment in a Nutshell" will be designed and conducted by the teaching team. They are designed to (a) refresh students on the various STEM methods and theories that they will encounter in the service project, and (b) give training to students in the skills and knowledge needed to create the necessary materials for the service project. Students are required to spend 20 hours in preparing proposals/plans for the service project.

Students are required to attend all of the lectures, seminars and all relevant workshops and successfully complete all of the required assignments/learning tasks prior to participation in the service-learning project.

5. Service Learning Projects

The service-learning projects will be organized in conjunction with the Service-Learning and Leadership Office. These projects may be either local or offshore. Students will work in interdisciplinary teams and be attached to resource-poor schools with large proportions of underprivileged students. For example, these schools may include large proportions of new immigrants, ethnic minorities, or at-risk youths.

The focus of the projects will be on reducing the scientific divide in primary and secondary students through teaching and learning STEM (science, technology, engineering and mathematics) concepts and theories while cultivating a spirit of scientific literacy and thinking. Example service-learning projects include designing projects to illustrate key STEM concepts to schoolchildren; designing worksheets to help the children practice STEM concepts; assisting children with STEM subjects; organizing STEM awareness workshops and activities for children, etc. The exact nature of the project will vary depending on the needs of the school that the students are serving.

	The service project will take place mainly at the collaborating schools. The exact time will vary depending on the school to which the students are attached. Some project activities may be held on weekends. For offshore projects, students will go to the service location and serve there in the Summer and/or after Semester 1 Week 13 (Dec/Jan). The offshore trip may last 10 to 14 days.
	Students are expected to spend about 20 hours in preparing the STEM worksheets. In all cases, students will be required to spend the 40 required hours of service-learning in direct interaction with the children and their teachers.
	Some projects (such as some particularly challenging or offshore projects) may necessitate specific selection requirements on participating students. The teaching team will make the final decisions on project allocation, but efforts will be made to accommodate student preferences on their choice of project. For overseas projects, students may also be asked to shoulder a portion of their incurred costs.
	6. Reflective Journals & Report and Review Sessions Students will be required to write two reflective journals during the project. The purpose of these reports are to (a) document their work, (b) reflect upon their service-learning experiences, (c) identify their learning gains and their weaknesses, and also to (d) propose areas of change for future sessions. Post-service, students will be required to write a final individual summative report and to produce a team reflective presentation video. The report and presentation will require students to demonstrate their ability to: (a) link their service-learning experiences with the academic focus/discipline-specific content of the subject, (b) reflect on their service-learning experience to identify their learning gains as well as areas for future improvements, (c) reflect on their roles and social responsibilities. To guide students in using reflection as a tool for learning, and to assess their ability in achieving the above learning objectives, reflection and review sessions will also be held both <u>during</u> and <u>after</u> the service-learning project. Experts and facilitators from outside the subject team (e.g. Service-Learning and Leadership Office, NGOs, school teachers) may be invited to contribute to some of these sessions as appropriate.
Assessment Methods in Alignment with Intended Learning Outcomes	Students' performance in this subject will be assessed using a letter-grading system in accordance with the University's convention from grade F (failure) to A+. The relative weighting of the different assessment components are as follows:

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
e-Learning Module and Project-specific seminars and workshops (individual)	Pass/Fail	√	√					√
Plans/ proposals for service (group)	25%			√		√	√	
Performance in rendering service (individual)	40%		√	√		√	√	
Reflective journals/report/ presentation (individual)	35%	√	√		√			√
Total	100%							

<u>Students must obtain a pass in all of the components in order to pass the subject.</u>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The e-Learning Module and Project-specific seminars and workshops will include <u>assignments and learning tasks</u> that are designed to assess students' ability to link service-learning with the academic content of the subject (ILO a), their understanding and empathy for the underprivileged community (ILO b) as well as their understanding of their role and responsibilities in society (ILO g).

Students will be asked to write proposals/plans for the service projects as preparation for service. These proposals and plans may include project designs, sample project deliverables, lesson plans, worksheets, model answers, etc. These will clearly require students to demonstrate their understanding of the relevant STEM concepts, as well as their ability to apply their grasp of scientific knowledge and scientific literacy (ILO c). They will be working in interdisciplinary teams and be required to demonstrate their ability to work collaboratively (ILO e) and communicate with invited speakers such as school teachers (ILO f).

During the execution of the project, students will be working in teams at underprivileged schools. This will expose them to the issues and challenges faced by teachers and students at these schools (ILO b). They

will have to be able to communicate effectively with the students and the teachers (ILO f) and to empathize with their situation (ILO b). Since students will be working in teams to demonstrate STEM concepts (ILO c), this will also require them to demonstrate their ability to work collaboratively to apply their knowledge and skills to deal with real problems in the service setting (ILO e).

Students will be supervised throughout the service component either by members of the teaching team, or by staff of the Service-Learning and Leadership Office. They will be assessed by their <u>attitude</u> and <u>performance</u> in the rendering of service, their degree of <u>engagement</u> with the primary and/or secondary students and their teachers, their <u>collaboration</u> with other fellow students, and <u>interactions</u> with the service recipients and the collaborating school.

Students' reflective journals and report, and their presentations and discussions during the reflection and review sessions and tutorials, will testify to the students' <u>reflection</u> on their learning experience, and the breadth and depth of their learning. This assesses their ability to link service-learning and the academic content of the subject (ILO a), their ability to reflect upon the impact of scientific literacy on the community (ILO d), their understanding of and empathy for the challenges faced by the children that they serve (ILO b), and their ability to reflect on their role and responsibilities in the society (ILO g).

Student Study Effort Expected	**e-Learning Module**	10 Hrs.
	Class Contact:	
	▪ Discipline-related Lectures, Tutorials and Seminars	4 Hrs.
	▪ Project-Specific Seminars, Tutorials and/or Workshops	10 Hrs.
	Other Student Study Effort:	
	▪ Readings, self-study, and planning and preparation for the service project	40 Hrs.
	▪ Direct rendering of service, including meeting with school teachers	40 Hrs.
	▪ Reflection and review	31 Hrs.
	Total student study effort	135 Hrs.

Reading List and References	■ Wozniak, J.R., Bellah, J., & Riley, M. (2016). Building a community garden: A collaborative cross-disciplinary academic community engagement project. Journal of Business Strategies,33(2), 95–115. ■ Wang, L., & Calvano, L. (2018). Understanding how service-learning pedagogy impacts student learning objectives. Journal of Education for Business, 95(5), 204–212.https://doi.org/10.1080/08832323.2018.1444574 ■ Anderson, S.,Hsu, Y., & Kinney,J. (2016). Using importance-performance analysis to guide instructional design of experiential learning activities. Online Learning,20(4). ■ Bhattacharya, M., & Scheraga, C. (2015). Introducing global cultural diversityawareness through service-learningin human resource management. BusinessEducationInnovationJournal,7(2), 51–58. ■ Chan,S.C.F., Ngai, G., & Kwan, K.(2019). Mandatory service-learning at university: Do less-inclined students learn from it. Active Learning in Higher Education,20(3),189–202. ■ Gallagher, M.J., & McGorry, S. Y. (2015). Service-learning and the capstone experience. International Advance Economic Resource, 21, 467–476. ■ Megley, M. (2020). Service-learning in an interdisciplinary capstone: Engaging students in community. AURCO Journal, 26, 56–70. ■ Sabat, I. E., Morgan, W.B., Perry, S.J., & Wang, Y.C. (2015). Developing students' twenty-first century skills through a service-learning project. Journal of Learning in Higher Education, 11(2), 23–32. ■ Ashley Amanda J., and Vos Jaap. 2015. "The Department as a Third Sector Planner: Implementing Civic Capacity through the Planning Core Curriculum." Journal of Planning Education and Research 35 (4): 501–14. ■ Cress, C.M., Collier, P.J. & Reitenauer, V.L. (2005). Learning Through Serving: A Student Guidebook for Service-Learning Across the Disciplines. Stylus Publishing ■ Hazen, R., Trefil, J. Science Matters: Achieving Scientific Literacy. (2009) Anchor ■ Adams, M., Blumenfeld, W., Castañeda, C.R., Hackman, H.W., Peters, M.L., Zúñiga, X. (Ed.) (2010). Readings for Diversity and Social Justice. Routledge ■ Johnson, A. (2005). Privilege, Power, and Difference. McGraw-Hill ■ Selected readings on STEM literacy ■ Primary and Secondary School STEM textbooks