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# The Ecosystem STEM Education Learning Activity: Terrarium and Aquarium Model

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**Abstract.** In this paper will clarify STEM learning activity of the Ecosystem for the case of designing Terrarium and Aquarium model. The STEM learning activity will be developed based on Sutaphan and Yuenyong (2019) which consisted of 7 stages including (1) Identification of social issues, (2) Identification of potential solutions, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage. Through the learning activity, students could enhance their existing knowledge in designing Terrarium and Aquarium. Those pieces of knowledge may involve Science (ecosystem, photosynthesis, respiration, food chain, matters, reaction…), Technology (technical devices in tanks, using platforms to research, designing poster or report), Engineering (constructing model), Mathematics (measuring length, calculating the size, balance of $O_2$ and $CO_2$) and human (the role of human in saving ecosystem). This paper will discuss how to provide students with a chance to apply STEM knowledge through these activities.

**Keywords:** STEM Education, Aquarium, Terrarium and Ecosystem

## 1. Introduction

STEM Education is an interdisciplinary study, which involves observational technique to promotes critical thinking and practical applications that form the basis for practical use in society. Stem Education aims to make the study associated to the real life performance of the students (MoEYS, 2022). Stem education is a method of teaching focused on science, technology, engineering and mathematics that can help students to solve real social issues and be able to complete vocational in the 21st century (Cambodia. 4.0, 2022).

STEM Education Organization for Cambodia (STEMEOC) is a locally-registered NGO based in Phnom Penh. Through festivals, programs and events we build supportive STEM communities that inspire Cambodia's Youth in the study of Science, Technology, Engineering and Mathematics. We do this to increase the number of skilled men and women working in STEM-related fields so they can make an equal and vital contribution to the continued economic growth of the Kingdom and the well-being of its people, building an even brighter future for Cambodia.

Core values:

• Engaged Learning – we value independent, lifelong learning

• Environmental Awareness – we know this is the single biggest challenge of our time

• Gender Equality – we understand that including a female perspective provides a better outcome for us all.

The study of STEM is recognized globally as promoting innovation, critical thinking and developing high-level problem-solving skills. These skills are in demand worldwide and a greater contribution from a female perspective is vital. In Cambodia, STEM skills are crucial for our continued economic development and are key to tackling the greatest challenges in the world today like improving health and ensuring a sustainable environment for us all to enjoy (STEMCAMBODIA, 2023).

STEM Education is a form of teaching and learning method for Science, Technology, Engineering and mathematics subjects in which kids are taught to think critically, question about things or innovate ideas by themselves (Tinker Education, 2022). According to Margaret Choi (2023) showed that STEM (Science, Engineering, Technology, and Mathematics) is an approach to education that focuses on the hard sciences, develops critical thinking skills, and improves problem-solving abilities. The literature (Sutaphan and Yuenyong, 2023; Teerasan and Yuenyong, 2019; Villaruz et.al., 2019) suggested how to provide STEM education unit from the issues of social problems and entrepreneur problems. Some of STEM education learning (Adita and Yuenyong, 2021; Fachrunnisa et.al., 2021; Koes-H et.al., 2021) showed how to provide STEM education regarding on Sutaphan and Yuenyong (2019) teaching strategy.

An aquarium can therefore be described as a closed artificial ecosystem in which fish and plants are able to find a habitat where they can grow and develop in a healthy and balanced way. Each aquarium must be consciously designed, developed and managed to facilitate the establishment of virtuous cycles that occur spontaneously in nature and give rise to interactions (Askoll, 2018). An aquarium is a glass container that displays the aquatic organisms in a simulated natural environment by introducing aquatic plants, rocks, gravels and artificial decorative (Lucknow University, 2020). Additionally, Aquarium is a glass tank filled with water, where fishes, underwater animals and plants are kept (Collins, 2023).

Patrick Grubbs (2018) stated that a terrarium is a sealed or unsealed container that contains elements of a terrestrial ecosystem. A terrarium is a self-nourishing miniature garden enclosed in a bottle. There are 2 main types of terrariums, open and close (Ecoponics, 2023). Moreover, Terrarium is a usually transparent enclosure for keeping or raising plants or usually small animals indoors (Merriam-Webster, 2023).

An ecosystem can be defined as the biological community of living beings, communicating with their environment and other non-living components. Every living thing including man is involved in these complex networks of interdependent relationships (Vedantu,2023). Besides, an ecosystem is a community or group of living and non-living organisms that live in and interact with each other in a specific environment (youmatter, 2020).

## 2. Developing STEM Education Learning Activities

The study of ecosystem is complex. It focuses on living things and non-living things. The ecosystem Model of the Terrarium and Aquarium has too many benefits for studying and relating to real-life situation. According to Fallon et al., (2022) improving students` engagement in STEM is being promoted worldwide. STEM education is more relevant and useful for the study that answers practical problems. Moreover, STEM education is possible to forge innovative, interdisciplinary STEM learning programs. Sutaphan and Yuenyong (2019) suggested the STEM education pedagogy that was widely adopted in

Southeast Asia. The Ecosystem Model STEM education learning activity was developed based on 7 stages of Sutaphan and Yuenyong (2019) which education learning approach, included (1) Identification of social issues, (2) Identification of potential solutions, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage.

**Table 1: Lesson plan of Ecosystem Model STEM education learning activity.**

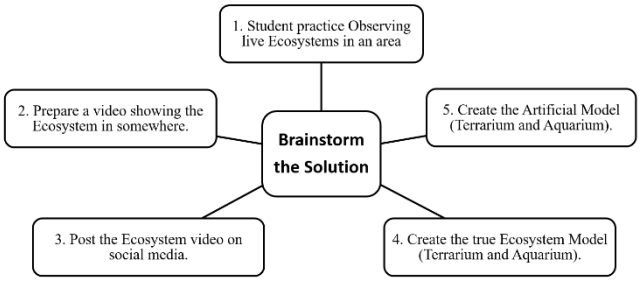
| Stage | Activity |
|---|---|
| **1.Identification of social issues** | Teacher showed the video about unsustainable ecosystem. Then students observe the video.<br>Teacher asks students, what did you see in the video? How to classified living thing such as producer, consumer and decomposer in this ecosystem? What happen if living thing in that ecosystem decrease from day to day? Is that ecosystem sustainable?<br>Key questions: How to make a sustainable ecosystem?<br>• What are the main components in ecosystem?<br>• How many kinds of living thing are in ecosystem?<br>• What are the non-living things in ecosystem?<br>• How does these living things and non-living things relevant to each other? |
| **2.Identification of potential solution** | Students brainstorm the solutions about sustainable ecosystem (Terrarium and Aquarium).<br>  <br><br>The most suitable solution is 4. Create the true Ecosystem Model (Terrarium and Aquarium).<br>Students discuss in group:<br>• Science (ecosystem, photosynthesis, respiration, food chain, matters, reaction…<br>• Technology (technical devices in tanks, using platforms to research, designing poster or report)<br>• Engineering (constructing model)<br>Mathematics (measuring length, calculating the size and balance of Oxygen and Carbon Dioxide) and human (the role of humans in saving the ecosystem |

Table 1 (Cont')

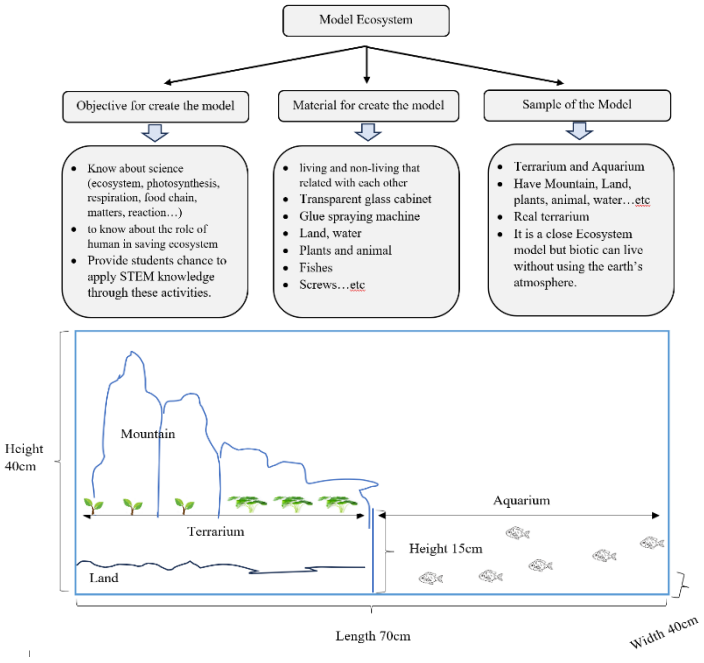
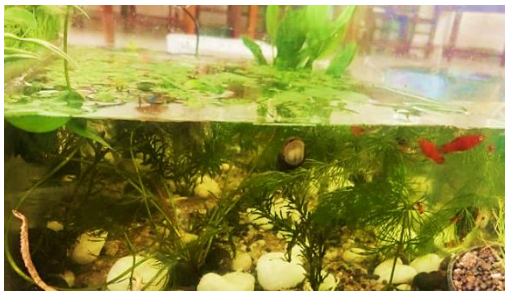
| Stage | Activity |
|---|---|
| **3. Need for knowledge** | To design the model about ecosystem (Terrarium and Aquarium) students need to study about:<br>1. The characteristics of ecosystem<br>2. The living things (producer consumer and decomposer) and non-living things (temperature light soil air water nutrients …)<br>3. Selecting living thing that appropriate with the environment of model.<br>4. The way of living and non-living related to each other (photosynthesis, food chain, food web, cellular respiration, transpiration, water cycle, oxygen cycle,)<br>5. Designing the model that can be made by material provided.<br>6. Measuring and calculating the size of the tank to store all living thing and non-living thing need.<br>7. The balance of oxygen and carbon dioxide need to supply the living thing in tank.<br>8. The human roles in saving ecosystem. |
| **4. Decision-making** | Teacher asks to construct a draft of the Ecosystem model to apply to their living situation.<br>  |
| **5. Development of the product** | The teacher provides materials to groups of students up to their need. Students work in their groups, then the teacher facilitates the students in each group.<br>The model was designed into two parts (terrarium and aquarium), including both living things and non-living things. |

Table 1 (Cont')

| Stage | Activity |
|---|---|
| | In terrarium part, students contextualized by animals, fungi and plants habitation Within this, soil and water were used as the main non-living things in terrarium. Additionally, students developed aquarium ecosystem using animals and plants, which live under water. For non-living things, water sand and rock were used in the aquarium. This model is a close Ecosystem model but biotic can live without using the earth's atmosphere. Because it has plants to photosynthesis produce Oxygen and catch Carbon Dioxide. Audiences may be interested in this model and relax through seeing the habitation of living things in both terrarium and aquarium.<br>  <br>  |
| **6. Test and evaluation of the solution** | To develop or to have reliability students will be asked<br>To develop or to have reliability students will be asked<br>• How much O2 is in the Ecosystem model? Does it supply enough for all living things in there? How do they live?<br>• Can living things adopt to new environment?<br>• Can decoration attract the audients?<br>• Do this model reflex to reality ecosystem? |
| **7. Socialization and completion decision stage** | • Each group does the presentation to the audients and judger.<br>• Each group explains about self-model<br>• Let audients accession their project to give some commendations<br>• Teacher will assess based on comments from audients, judgers and teachers. |

## 3. Conclusion

As the results of research and practice showed that the Ecosystem Model (Terrarium and Aquarium) has too many benefits for studying and relating to real-life situation. Catherine (2023) indicated that an environment is made up of both living and nonliving things. Biotic such as plants, animals and bacteria, while Abiotic are non-living components; such as water, soil and atmosphere. The way these components interact is critical in an ecosystem. All of Biotic needed food for living that call a food chain refers to the order of events in an ecosystem, where one living organism eats another organism, and later that organism is consumed by another larger organism (BYJU'S, 2023). In this case, before getting the energy from one organism to another once, need to have a power transfer that comes from producers (plants doing photosynthesis and cellular respiration) to consumers (people, animal doing cellular respiration) and the last is decomposers that when plants and animals die, they become food for decomposers like bacteria, fungi and earthworms. Decomposers or saprotrophs recycle dead plants and animals into chemical nutrients like carbon and nitrogen that are released back into the soil, air and water (Durham, 2023). Based on Sutaphan and Yuenyong (2019) the context-based STEM education learning approach through 7 stages of teaching will engage students to practice their knowledge.

After studying this ecosystem students can use their skill or knowledge to apply their livelihood by observing some activities of everything around them such as the food chain that biotic organism eats in the order that they can eat. In addition, students can develop their soft skills through making Terrarium and Aquarium Model like cooperation, leadership, working hard, research skill, know the way how the living things and non-living things interact with each other in the world or in their area. Moreover, they can understand about natural resource management, environmental health, agriculture, and wildlife conservation (Dale, 2003).

When students have learned about Ecosystem, they will use their knowledge product with what they think it's better for the environment and for the living things (Biotic). They might be nature lovers, care too much about the ecosystem, and advertise the advantages of nature to others as they can do. The last message is "*Eventually, we'll realize that if we destroy the ecosystem, we destroy ourselves*" (Jonas Salk, 1984).

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