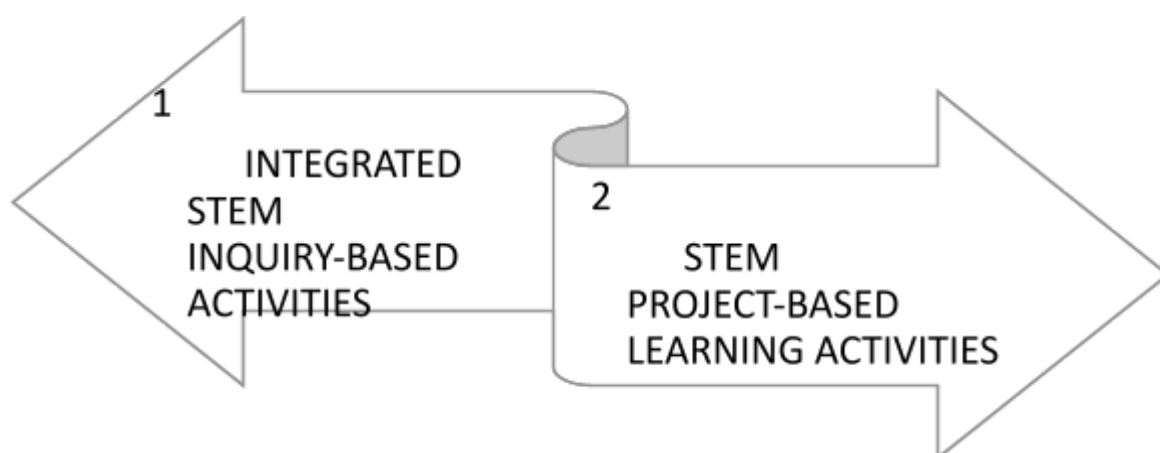


# STEM INQUIRY-BASED LEARNING MODULE OF MATRICULATION PROGRAMME MINISTRY OF EDUCATION

---

## INQUIRY-BASED SCIENCE EDUCATION (IBSE): CHEMISTRY

---



### Penulis Modul & Fasilitator

1. Dr. Nurul Fatni binti Abdussyukur (Bahagian Matrikulasi KPM - Fasilitator)
2. Pn. Siti Warda binti Selamat (Bahagian Matrikulasi KPM)
3. Pn. Chia Chew Peng (Kolej Matrikulasi Selangor)
4. Dr. Azraai bin Othman (Kolej Matrikulasi Kelantan)
5. En. Byron MC Michael Kadum (Kolej Matrikulasi Labuan)

# CHAPTER 1: INTRODUCTION

- 1.1 Background of the module
- 1.2 Aims and objectives of the module
- 1.3 Theoretical framework of the module
  - a. STEM



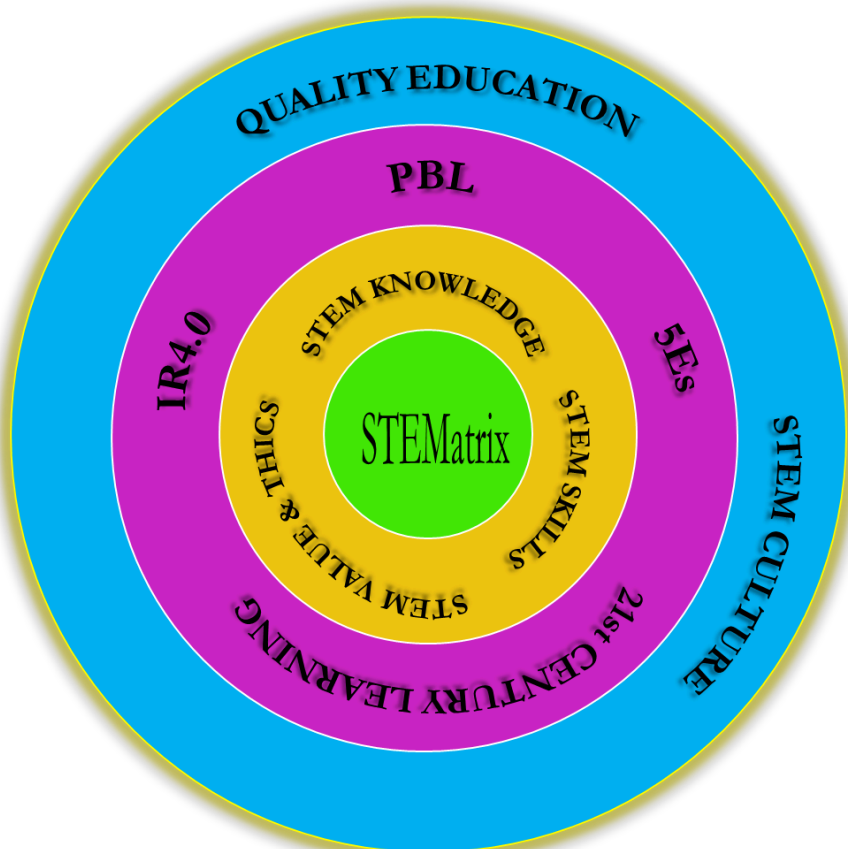
- b. Inquiry-based learning
- c. Project-Based learning

Task: Dr. Fatni

## CHAPTER 2: TEACHING AND LEARNING ACTIVITIES

---

- 2.1 **Teaching methods and strategies:**  
IBL, Problem-based learning, Project-based learning (task Dr. Fatni)
- 2.2 **Conceptual Framework:**  
(Task: To all module writers, please generate each module's conceptual framework as below)



- 2.3 **Teaching and learning activities:** (Task: Dr. Fatni)
- Integrated STEM IBL Activities
  - STEM Project-Based Learning Activities

**2.4 Integrated STEM IBL Activities** (Task: to all module writers)

- a. Theme (4)
- b. Lesson plan (4)

**2.5 STEM Project-Based Learning Activities** (Task: to all module writers)

- a. Theme (4)
- b. Lesson plan (4)

## CHAPTER 3: AUTHENTIC ASSESSMENT

---

### 3.1 Introduction

- a. Definition of Authentic Assessment
- b. Assessment for Learning
- c. Project-based Outcomes

### 3.2 Assessment for learning: Integrated STEM IBL Activities

- a. Performance-based assessment (PBA): 100%
- b. 21st -century skills (rubric)
- c. Scientific skills (rubric)
- d. Oral presentation (rubric)

### 3.3 Project based Outcomes: STEM Project-Based Learning Activities

- a. Proposal (rubric)
- b. Product (rubric)
- c. Presentation (rubric)
- d. Report (rubric)

### 3.4 Assessment Guideline

- a. Assessment for learning: Integrated STEM IBL Activities
- b. Project based Outcomes: STEM Project-Based Learning Activities

**Note: This part will be discussed during the third and fourth series of the workshop (7-18 May 2022)**

# STEM PROJECT-BASED LEARNING

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

## 2.5 STEM PROJECT- BASED LEARNING LESSON PLAN

### a. GENERAL TEACHING INSTRUCTIONS

<b>BIG PICTURE OF THE LESSON</b>	<p>The is the project-based teaching and learning with innovative teaching approaches. This teaching technique will be slightly different with the existing teaching and learning style in the existing curriculum.</p> <ul style="list-style-type: none"><li>• The open-ended inquiry work is the main activities that should be practiced.</li><li>• Students will work in group of 4 or 5 members to complete this project task.</li><li>• Students will not be provided with any procedures to solve the problems given.</li><li>• Lecturer will play his role as the facilitator to only guiding the students by not giving any solution at all. Trials are encouraged and mistakes are not penalized.</li><li>• Students do not receive grades or exams regarding the research experience. They present their results and discuss their errors much as researchers do among themselves.</li><li>• Lecturer will begin the lesson with the problem statement given to each group. Students will not be provided with any experimental procedure, as they need to design and develop their own solution within for weeks.</li><li>• Lecturer will conduct the lesson within four weeks continuously.</li><li>• Model of 5E MODEL and PBL Model will be used throughout the project as follows: PBL Model: Follow the steps of problem-solving model in conducting this phase.<ol style="list-style-type: none"><li>I. Identify the problem (5E MODEL: Engage)</li><li>II. Represent the problem (5E MODEL: Engage)</li><li>III. Select a strategy (5E MODEL: Explore)</li><li>IV. Carry out the strategy (5E MODEL: Explain)</li><li>V. Evaluate results (5E MODEL: Elaborate dan Evaluate)</li><li>VI. Analyse the process (5E MODEL: Evaluate)</li></ol></li></ul>
----------------------------------	--

STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1

	(Adapted from Eggen & Kauchak, 1999)		
<b>LEARNING SKILL TO BE ACHIEVED IN THE STEM PBL LESSONS</b>	At the end of the lesson, students will be able to have a better insights and application of real-world STEM applications with the integration of scientific skills and 21 <sup>st</sup> -century skills.		
	<b>a) Scientific skills</b> I. Science process skills II. Manipulative skills III. Thinking skills	<b>b) 21<sup>st</sup>-Century skills</b> I. Critical thinking skills II. Creative and Innovative skills III. Communication and Collaboration Skills IV. Problem-Solving skills V. Technology literacy	<b>c) Integrated STEM</b> I. Chemistry II. Biology III. Physics IV. Mathematics
<b>TYPE OF THEMES</b>	The Lecturer can choose any topic related to your syllabus as stated below: <b>i. Theme 1: Water &amp; Pollution</b> <b>ii. Theme 2: Green Energy</b> <b>iii. Theme 3: Environment</b> <b>iv. Theme 4: Foods</b>		
	It is recommended for the lecturer to assign each projects' theme to one group of students		
<b>RELATED TOPICS</b>	<ul style="list-style-type: none"> <li>● Physical Chemistry</li> <li>● Inorganic Chemistry</li> <li>● Organic Chemistry</li> </ul>		
<b>DURATION OF THE PROJECT</b>	<b>4 weeks.</b> <i>(4 times to face lesson (2 hours in lab or outside lab) and non-face to face lesson (after class))</i> <ul style="list-style-type: none"> <li>● Week 1: Pre-practical: Task and problem will be assigned to the students and planning with the investigation will start at this phase.</li> <li>● Week 2: In-practical: Preparation of the <b>prototype</b>, level 1.</li> <li>● Week 3: In-practical: Preparation of the <b>prototype</b>, level 2.</li> <li>● Week 4: Post-Practical: Students will present the ideas and final findings.</li> </ul>		






**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

<p><b>TIME ALLOCATION</b></p>	<p><b>Week 1: Pre- practical</b></p> <ul style="list-style-type: none"> <li>● Face to face lesson (2 hours in lab or outside lab, 1 day)</li> <li>● Non-face to face lesson (after class) (6 days remain)</li> </ul> <hr/> <p><b>Week 2: In-practical</b></p> <ul style="list-style-type: none"> <li>● Face to face lesson (2 hours in lab or outside lab, 1 day)</li> <li>● Non-face to face lesson (after class) (6 days remain)</li> </ul> <hr/> <p><b>Week 3: In-practical</b></p> <ul style="list-style-type: none"> <li>● Face to face lesson (2 hours in lab or outside lab, 1 day)</li> <li>● Non-face to face lesson (after class) (6 days remain)</li> </ul> <hr/> <p><b>Week 4: Post-Practical</b></p> <ul style="list-style-type: none"> <li>● Mini exhibition: 2 hours</li> </ul>
<p><b>LECTURER'S ROLE</b> (CONSTRUCTIVIST)</p>	<p><b>Lecturer act as a Facilitator in guiding student to solve the problem given by using open-ended inquiry teaching and learning style.</b></p> <ul style="list-style-type: none"> <li>● Present tasks with real-world application so that students can contextualise their knowledge easily.</li> <li>● Give assistance so that students can consolidate their established understanding with their new learning.</li> <li>● Provide scaffolds to bridge the gap between what learners know and what they are being presented with.</li> <li>● Enable relevant experts to lead lessons when appropriate</li> <li>● Keep asking critical questions along the session as to enhance students hands-on and minds-on learning phase</li> </ul>
<p><b>STUDENT'S ROLE</b> (CONSTRUCTIVIST)</p>	<ul style="list-style-type: none"> <li>● Work in team collaboratively</li> <li>● Active learner with discussion, brainstorming and experimenting to recreate the new ideas</li> <li>● Students must learn to combine new information with their current knowledge.</li> <li>● Reflect on their own experiences and establish how they have been affected by them.</li> <li>● Learners should value the trial-and-error approach by questioning ideas and evaluating concepts through real-world activities.</li> <li>● Students must be in control of what and how they learn.</li> </ul>


**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

<p><b>EXPECTED OUTCOME</b></p>	<p><b>WEEK 1</b> 1. Draft of Project Proposal</p> <p><b>WEEK 2</b> 1. Project proposal 2. Project prototype/ model/ solution/ framework version 1 3. Data findings</p> <p><b>WEEK 3</b> 1. Project prototype/ model/ solution/ framework version 2 2. Data findings</p> <p><b>WEEK 4</b> 1. Poster 2. Power point &amp; video of the model/product 3. Final product/ prototype/model/solution/framework 4. Final Project Report</p>
<p><b>TYPE OF ASSESSMENT</b></p>	<p>Assessment for the students is based on Authentic Assessment which will emphasize on the real performance of the students in the way to completing the project given within three weeks of learning.</p> <ol style="list-style-type: none"> <li>I. PBA: Performance Based Assessment on scientific skills</li> <li>II. PBA: Performance Based Assessment on 21<sup>st</sup>-century skills i.e., critical thinking skills, creative and innovative skills, problem solving skills, communication and collaborative skills and technology literacy.</li> <li>III. Peer-Assessment</li> <li>IV. Self-Assessment</li> </ol>

**b. Theme (4 themes)**

THEME	1: Water & Pollution	2: Green Energy	3: ENVIRONMENT	4:FOOD
PROBLEMS	Single-Use Plastics	Energy Consumption	Recycling Used cooking oil	Fermentation
SCENARIOS	 <p>According to Ipsos Malaysia (2019), only 56% Malaysians are concerned about the issue of single-use plastics. Furthermore, the study revealed that 70% of Malaysians believe that it is the government's responsibility to seek ways to reduce the use of plastics.</p>  <p>Malaysia is ranked second in Asia for annual per capita plastic use and sits amongst the top ten nations globally that mismanage plastic waste (The New Straits Times, 2022). This is definitely a worrying issue and must be mitigated promptly because plastics pollution is known for its negative impacts on the environment and human well-being.</p> <p>As a responsible citizen, suggest an innovative strategy to solve this problem based on your context.</p>	<p><b>Fuel Cells—Fueling the Future!</b></p>  <p>You probably know that turning off the lights and the water, and not wasting paper are all ways to help the environment and conserve our resources. Did you know that another way is to use fuel cells? A fuel cell is a device that converts the energy in chemicals to electricity and it creates no pollution. The starting chemical does not have to be something complex — in fact you can even be water! In this science fair project try your own hand at converting water to electricity with the help of a fuel cell.</p>	  <p>In 2016, Malaysia's Klang Municipal Council spent almost RM6 million to remove clogging caused by hardened cooking oil in drains.</p> <p>The waste cooking oil (WCO) or used cooking oil (UCO) is defined</p>	<p>Microorganisms can cause massive losses annually in the food industries. On the other hand, microorganisms can be used as means of preservation to extend the shelf life of a product by altering a food taste. The method of using microorganisms to preserve food is called fermentation.</p> <p>In Malaysia, fermentation is largely employed in the food industry to minimise losses of fresh produce. During the durian season, <i>tempoyak</i> is often produced from fermentation of excessive durians to reduce loss from unconsumed fresh durian.</p> <p>Fermentation also enriches the taste of food products. <i>Tapai</i>, a popular dessert with sweet flavour, for instance, is made from fermentation of glutinous rice.</p>

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

			<p>as the outcome of cooking oil from the action of cooking any food.</p> <p>WCO has a long term effect on the environment and human health.</p> <p>Oils that are poured down drains can clog up pipes, cause drains and sewers to stink from bacteria growth, and interrupt wastewater treatment services.</p>	 <p>During fermentation, microorganisms transform the carbohydrates in food into alcohol or carboxylic acid and carbon dioxide gas in some cases. Fermentation process must be conducted in a controlled environment to optimise the rate of microorganisms' activity and produce desirable flavour end products.</p>	
<p><b>INSTRUCTION</b></p>	<p>Develop an innovative solution that uses natural products to reduce the consumption of plastics.</p> <p>You are required to incorporate chemistry concepts and scientific skills into the innovative idea.</p> <p>You may develop ideas for a setting/situation/context of your choice.</p> <p>Discuss the impact(s).</p>	<p><a href="https://www.sciencebuddies.org/science-fair-projects/project-ideas/Energy_p002/energy-power/fuel-cells">https://www.sciencebuddies.org/science-fair-projects/project-ideas/Energy_p002/energy-power/fuel-cells</a></p> <p>Build a prototype model for</p> <ul style="list-style-type: none"> <li>- remote car</li> <li>- handphone</li> <li>- portable fan/lamp</li> </ul>	<p>Used cooking oil can be disposed of in different ways to reduce environmental problems.. Design a method to recycle the used cooking oil which will benefit the environment.</p>	<p>With the knowledge of reaction kinetics, you can design an experiment to determine the best condition for the yeast fermentation.</p> <p>You choose any food to perform fermentation using yeast.</p> <p>To determine the best conditions for fermentation, 4 sets of apparatus are required.</p> <p>i. 2 with the microorganism and store at room conditions.</p> <p>ii. 1 with the microorganism and store it in cold conditions.</p>	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

				<p>iii. 1 without the microorganism and store at room conditions.</p> <p>Record the observations for each setup for 3 consecutive days.</p> <p>Determine the best conditions for fermentation and whether yeast is needed in a fermentation process</p> <p>Discuss why the conditions are the best for the fermentation process based on the factors affecting reaction rate concept.</p>
<b>SYLLABUS LINKS</b>	Benzene & Its Derivatives Polymers	<p><b>SK025</b></p> <p>1.0 Thermochemistry</p> <p>3.1 (e) Explain hydrogen – oxygen fuel cell.</p>	<p><b>SK015</b></p> <p>4. Chemical Bonding</p> <p>4.4 Intermolecular force</p> <p>5: Matter</p> <p>5.2 liquid</p> <p>5.3 Solid</p> <p><b>SK025</b></p> <p>organic reaction hydrolysis saponification and transesterification</p>	<p><b>SK 025</b></p> <p>1.0 Reaction Kinetics</p> <p>1.3 Factors affecting reaction rate.</p>
<b>INSTRUCTIONS</b>	XXXXXX		<p>Teacher's instruction</p> <p><a href="https://docs.google.com/document/d/1Qu7VHVt7RwZ2-iAwC5d08XRI34fIBbRD/edit?usp=sharing&amp;oid=115499996489946222463&amp;rtpof=true&amp;sd=true">https://docs.google.com/document/d/1Qu7VHVt7RwZ2-iAwC5d08XRI34fIBbRD/edit?usp=sharing&amp;oid=115499996489946222463&amp;rtpof=true&amp;sd=true</a></p>	<p>Teachers' instruction</p> <p><a href="https://docs.google.com/document/d/15BvydKcm2_EO1EttJJpwxqoc8cGVjyB/edit?usp=sharing&amp;oid=114282157585157614573&amp;rtpof=true&amp;sd=true">https://docs.google.com/document/d/15BvydKcm2_EO1EttJJpwxqoc8cGVjyB/edit?usp=sharing&amp;oid=114282157585157614573&amp;rtpof=true&amp;sd=true</a></p>
<b>STEM LINKS</b>	<p><b>Science:</b> Chemistry</p> <p><b>Technology:</b> ICT &amp; multimedia</p> <p><b>Engineering:</b> Engineering Design Process</p> <p><b>Mathematics:</b> Calculation involved in proposing a solution. Data</p>	<p><b>Science:</b> Chemistry</p> <p><b>Technology:</b> Green technology</p> <p><b>Engineering:</b> Engineering Design Process</p>	<p><b>Science:</b> Chemistry</p> <p><b>Technology:</b> xxxx</p> <p><b>Engineering:</b> Engineering Design Process</p> <p><b>Mathematics:</b> amount of chemical required</p>	<p><b>Science:</b> Chemistry</p> <p><b>Technology:</b> Food Technology</p> <p><b>Engineering:</b> Engineering Design Process</p> <p><b>Mathematics:</b> Amount of carbon dioxide gas collected</p>

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

	management & representation (i.e., graphs and tables).	<b>Mathematics:</b> Amount of voltage produce, Energy release		
<b>BLOOM'S TAXONOMY</b>	Level: C4 (Analysis), C5 (Evaluation), and C6 (Create).	Analysing	Level: C4 (Analysis), C5 (Evaluation), and C6 (Create).	Level: C4 (Analysis), C5 (Evaluation), and C6 (Create)
<b>EXPECTED FINDINGS</b>	Students are expected to propose a solution such as: <ul style="list-style-type: none"> <li>• Making edible plastics from household materials.</li> <li>• Making biodegradable plastics from natural products.</li> </ul>	Students are expected to propose a prototype model on hydrogen - oxygen fuel cell based.	Students are expected to propose the solution to manage waste cooking oil <ul style="list-style-type: none"> <li>• produced soap/candle</li> <li>• produced biodiesel fuel</li> </ul>	Students are expected to propose <ul style="list-style-type: none"> <li>• a food to produce from ferme using yeast.</li> <li>• the best conditions for the yeast fermentation process.</li> </ul>

**WEEK 1: PRE- PRACTICAL**

**5E MODEL: ENGAGE**

**LEARNING OUTCOMES:**

1. Students will have a comprehensive discussion in solving the problems given.
2. Students will be able to explore and access the information as many as they can to come out with their own tentative proposal.

NO.	STEP AND DURATION	TASK	TEACHER'S ROLE	STUDENTS' ROLE	TEACHING AIDS/ MEDIA/ SOURCES	QUESTIONS BY TEACHERS	LEARNING SKILLS	AFL
1.	<b>Introduction</b>	<ol style="list-style-type: none"> <li>1. Explain the process of chemistry project-based learning and its concepts, advantages, learning process and asses</li> <li>2. Explain the continuation and progression from the IBL to PBL.</li> </ol>	Explaining the tasks	Taking note	Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom	N/A	N/A	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

2.	<b>Assigning group project.</b>	<ol style="list-style-type: none"> <li>Split students into four (4) smaller groups.</li> <li>Split students into smaller groups of mixed abilities. <i>*Preferably assign groups before the PBL commences.</i></li> </ol>	Splitting the students into groups	Getting into the assigned groups	Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom	N/A	N/A	
3.	<b>Assigning problem and task</b>	<ol style="list-style-type: none"> <li>Briefly explain the themes, problems, and scenarios.</li> <li>Explain the expected outcomes from the PBL.</li> <li>Assign each group with a PBL theme (as listed in this module).</li> <li>Explain to each group that they may select an appropriate context for their PBL.</li> </ol>	Explaining the tasks	Taking note	Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom	What can you describe about the problem that is being assigned to your group?	Reflecting Analysing	
4.	<b>Discussion &amp; Group Brainstorming session</b>	<ol style="list-style-type: none"> <li>Explain the process of brainstorming session.</li> <li>Initiate group discussions.</li> </ol>	Facilitating brainstorming session	Working collaboratively  Following closely the rules of brainstorming	<b>For Task 1:</b> <a href="#">7 Simple Rules of Brainstorming</a>	<p>What context do you think is the most suitable for your group to choose for your PBL?</p> <p>Why do you think the context is suitable?</p> <p>What are the raw materials you must have to build the prototype?</p>	Analysing Collaborating Brainstorming Creative thinking Innovative thinking	
5.	<b>Proposal presentation by Each Project Group</b>	<ol style="list-style-type: none"> <li>Each group presents their PBL proposal for the assigned problem.</li> <li>Initiate peer-assessment and feedback after each presentation.</li> <li>Provide lecturer's feedback on each groups' PBL proposal.</li> </ol>	Observing Reflecting Analysing Giving feedback	Presenting Observing Analysing Giving feedback Reflecting	Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom	<p>What feedback can you give to the group that just presented?</p> <p>How are you going to execute the PBL with limited resources?</p> <p>How are you going to delegate the tasks in completing the PBL?</p>	Analysing Reflecting	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

6.	<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Debrief the Week 1 PBL session.</li> <li>2. Explain the objectives and tasks for Week 2 PBL session.</li> </ol>	<p>Explaining</p> <p>Clarifying</p>	Taking note	Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom	N/A	N/A	
----	----------------	---	-------------------------------------	-------------	---	-----	-----	--

**WEEK 2: IN-PRACTICAL PREPARATION OF THE PROTOTYPE, LEVEL 1.**

**5E MODEL: EXPLORE**

**LEARNING OBJECTIVES:**

**At the end of the lesson students will be able to**

1. To present the solution on the problems given by proposing ideas and solution with full proposing the procedure of the experiment.
2. To equip with argumentation session among them to explicitly discuss about the problem-solving strategies.
3. To conduct open-ended experiments based on the improvised project proposal.
4. To have comprehensive understanding about the connection between theory and real-life practices

NO.	STEP AND DURATION	TASK	TEACHER'S ROLE	STUDENTS' ROLE	TEACHING AIDS/ MEDIA/ SOURCES	QUESTIONS BY TEACHERS	LEARNING SKILLS	AFL
7.	<p>INTRODUCTION:</p> <p>Proposal presentation by each group</p> <p>30 minutes</p>	<ol style="list-style-type: none"> <li>1. Briefly explain the objectives of the session.</li> <li>2. Set the order of group presentations by drawing lots.</li> <li>3. Each group is given three (3) minutes to present their proposal ideas. <i>*Each member of the groups are encouraged to partake in the presentations.</i></li> <li>4. Initiate a feedback session after each presentation. Peers and lecturer provide feedback and the session lasts for a maximum of two (2) minutes.</li> </ol>	<p>Explaining the tasks</p> <p>Facilitating the lots drawing for determining presentation order</p> <p>Facilitating the group presentations</p>	<p>Taking notes of the tasks</p> <p>Setting up a strategy for an effective presentation</p> <p>Assigning roles to each group member for the presentation</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet</p>	<p><b>For Task 4:</b> What is/are the strength(s) of the idea you have just heard?</p> <p>What is/are the area that can be developed more of the idea you have just heard?</p>	<p>Communicating ideas</p> <p>Analysing</p> <p>Critical thinking</p> <p>Reflecting</p> <p>Collaborating</p>	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

			and feedback sessions  Taking notes of students' ideas  Giving feedback	Paying attention on other groups' presentation to provide compre  Giving feedback  Reflecting on feedback	<b>For Task 2:</b> <a href="https://onlinetoolz.net/draw-lots">https://onlinetoolz.net/draw-lots</a>			
8.	<b>HANDS-ON SESSION</b>  Teaching Method: PBL by using Problem Based Model: Step 4 'Carry Out Strategy'  5. At the end of this stage, students will be able. i. To accomplish their own designated experiments ii. To generalize the findings with hypothesis iii. To relate the theory, experiments, and real-world practices.	<ol style="list-style-type: none"> <li>1. Explain how to develop a hypothesis for a project.</li> <li>2. Instruct each group to develop a hypothesis or a set of hypotheses for their projects.</li> <li>3. Explain how to develop a set of procedural steps to test a hypothesis.</li> <li>4. Instruct each group to develop a set of procedural steps to test their PBL's hypothesis (or hypotheses).</li> <li>5. Instruct the groups to test the procedural steps and encourage them to actively review those steps.</li> <li>6. Encourage the groups to generalise their initial findings with the hypothesis (or hypotheses).</li> </ol> <p><i>*Encourage groups to use Google to research for the prototype development.</i></p> <p><i>*Encourage groups to use the SMART analysis tool in the prototype development</i></p>	<p>Explaining about hypothesis generation in general</p> <p>Facilitating hypothesis generation task</p> <p>Explaining about setting up procedural steps</p> <p>Facilitating procedural steps generation</p> <p>Facilitating hypothesis testing</p> <p>Encouraging active research via Google</p>	<p>Working collaboratively</p> <p>Generating hypothesis</p> <p>Setting up procedural steps</p> <p>Testing procedural steps</p> <p>Testing hypothesis</p> <p>Researching actively using Google</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p> <p>Google / Google Scholar / Bing</p> <p><a href="#">What are SMART objectives?</a></p> <p><b>For Task 1:</b> <a href="#">6 Steps to Formulate a STRONG Hypothesis   Scribbr</a></p> <p><b>For Task 2:</b> <a href="#">Experimental Procedure</a></p>	<p>Have you considered the SMART analysis tool in developing your hypothesis/hypot heses and procedural steps?</p> <p>What is/are the challenge(s) in developing the solution/prototyp e for the assigned problem?</p> <p>Can your group overcome the challenge/challe nges?</p> <p>How do you overcome the challenge/challe nges?</p> <p>What is/are the link(s) between theory/theories and real-world situation(s) that you can establish via your PBL?</p>	<p>Communicatin g ideas</p> <p>Negotiating ideas</p> <p>Critical thinking</p> <p>Creative thinking</p> <p>Analysing</p> <p>Persuading others</p> <p>Collaborating</p>	
9.	<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Instruct all groups to share their prototype drafts via class's Telegram/WhatsApp/Teams.</li> </ol>	Explaining the tasks	Sharing drafts	Smartboard / Online board (e.g., Jamboard) /	What is/are the strength(s) of the prototype drafts?	Analysing  Reflecting	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

		<ol style="list-style-type: none"> <li>Provide an overall lecturer's feedback for the shared drafts.</li> <li>Encourage students to give comment(s) on the shared drafts (this can be done after the session ends).</li> <li>Debrief the session and provide a brief explanation of next session's objectives.</li> </ol>	<p>Facilitating the sharing of drafts</p> <p>Providing feedback</p> <p>Encouraging peer-evaluation</p>	<p>Providing feedback</p> <p>Taking notes of feedback</p> <p>Reflecting on the feedback</p>	<p>Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p>	<p>What is/are the area that can be developed more of the prototype drafts?</p>	<p>Critical thinking</p> <p>Creative thinking</p>	
--	--	---	--	---	---	---	---	--

**WEEK 3: IN-PRACTICAL: PREPARATION OF PROTOTYPE LEVEL 2**

**5E MODEL: EXPLAIN**

**LEARNING OBJECTIVES:**

**At the end of the lesson students will be able to**

- To present the solution on the problems given by proposing ideas and solution with full proposing the procedure of the experiment.
- To equip with argumentation session among them to explicitly discuss about the problem-solving strategies.
- To conduct open-ended experiments based on the improvised project proposal.
- To have comprehensive understanding about the connection between theory and real-life practices.

NO.	STEP AND DURATION	TASK	TEACHER'S ROLE	STUDENTS' ROLE	TEACHING AIDS/ MEDIA/ SOURCES	QUESTIONS BY TEACHERS	LEARNING SKILLS	AFL
1.	<b>DATA FINDINGS &amp; TABULATION SESSION</b>	<ol style="list-style-type: none"> <li>Explain the objectives of the session.</li> <li>Each group presents their prototype draft and procedural steps to test the prototype's hypothesis/hypotheses. Each group is given a maximum of three (3) minutes to present.</li> <li>Set the order of group presentations by drawing lots.</li> </ol>	<p>Explaining the tasks</p> <p>Facilitating group presentations</p>	<p>Taking notes of feedback</p> <p>Working collaboratively</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p>	<p>Are your procedural steps effective in testing the hypothesis/hypotheses?</p>	<p>Communicating ideas</p> <p>Negotiating ideas</p>	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

	<p>Teaching Method: PBL by using Problem Based Model: Step 5: Evaluate Results Step 6: Analyse the process.</p>	<ol style="list-style-type: none"> <li>4. Instruct students to provide feedback for the group presentations via Telegram/WhatsApp/Teams/Padlet/Jamboard.</li> <li>5. Instruct each group to test their prototype based on the set procedural steps.</li> <li>6. Instruct each group to tabulate their data and evaluate their finding(s).</li> <li>7. Encourage the groups to revise their prototype drafts accordingly.</li> </ol> <p><i>*Encourage groups to use Google to research for the prototype development.</i></p> <p><i>*Encourage groups to use the SMART analysis tool in the prototype development</i></p>	<p>Facilitating peer-evaluation</p> <p>Providing feedback</p> <p>Facilitating prototype testing</p> <p>Encouraging active research</p>	<p>Devising an effective presentation strategy</p> <p>Providing feedback</p> <p>Testing prototype</p> <p>Recording data</p> <p>Observing</p> <p>Tabulating data</p> <p>Analysing data</p> <p>Interpreting data</p> <p>Revising prototype and/or procedural steps</p>	<p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p> <p>Google / Google Scholar / Bing</p> <p><b>For Task 3:</b> <a href="https://onlinetoolz.net/draw-lots">https://onlinetoolz.net/draw-lots</a></p>	<p>What is/are the thing(s) you must alter to improve the prototype and/or procedural steps?</p> <p>What is/are the best method(s) to interpret your data?</p> <p>How do you use your data interpretation in revising the prototype and/or procedural steps?</p> <p>Based on the data analysis, does the prototype provide the solution for the assigned problem in the context that you chose?</p>	<p>Persuading others</p> <p>Collaborating</p> <p>Critical thinking</p> <p>Intepreting data</p> <p>Analysing</p> <p>Reflecting</p> <p>Creative thinking Innovative thinking</p>	
2.	<b>CLOSURE</b>	<ol style="list-style-type: none"> <li>1. Instruct all groups to share their revised prototype drafts via class's Telegram/WhatsApp/Teams.</li> <li>2. Provide an overall lecturer's feedback for the revised drafts.</li> <li>3. Encourage students to give comment(s) on the revised drafts (this can be done after the session ends).</li> <li>4. Debrief the session and provide a brief explanation of next session's objectives.</li> </ol>	<p>Explaining the tasks</p> <p>Facilitating the sharing of drafts</p> <p>Providing feedback</p> <p>Encouraging peer-evaluation</p>	<p>Sharing drafts</p> <p>Providing feedback</p> <p>Taking notes of feedback</p> <p>Reflecting on the feedback</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p>	<p>What is/are the strength(s) of the revised prototype drafts?</p> <p>What is/are the area that can be developed more of the revised prototype drafts?</p>	<p>Analysing</p> <p>Reflecting</p> <p>Critical thinking</p> <p>Creative thinking</p>	

## WEEK 4: POST- PRACTICAL: MINI EXHIBITION

### 5E MODEL: ELABORATE & EVALUATE

#### LEARNING OBJECTIVES:

At the end of the lesson students will be able to

1. To present the final findings on the problem given collaboratively in a team.
2. To defend their claims and findings through argumentative learning.
3. To integrate the presentation session with technology literacy and 21st-century skills i.e., communication skill, critical thinking skill and collaborative skill.
4. To evaluate the improvement of students' learning skills retrospectively with lecturers.

NO.	STEP AND DURATION	TASK	TEACHER'S ROLE	STUDENTS' ROLE	TEACHING AIDS/ MEDIA/ SOURCES	QUESTIONS BY TEACHERS	LEARNING SKILLS	AFL
1.	<b>Group Presentation Preparation</b>	<ol style="list-style-type: none"> <li>1. Explain the objectives of the session.</li> <li>2. Explain to the groups that each member must contribute and take part in the presentation. <i>*Each member must be assigned as "an expert" for a different segment of the group's PBL.</i></li> <li>3. Instruct all groups to prepare with their presentation materials.</li> <li>4. Set the order of group presentations by drawing lots.</li> </ol>	<p>Explaining the tasks</p> <p>Explaining the presentation's system</p> <p>Facilitating the setting up of presentation order</p>	<p>Taking notes</p> <p>Assigning segments to group members</p> <p>Setting up effective presentation strategy</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p>	<p>How do you strategise to present your project effectively?</p>	<p>Collaborating</p> <p>Persuading others</p> <p>Delegating tasks</p>	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

					<b>For Task 4:</b> <a href="https://onlinetoolz.net/draw-lots">https://onlinetoolz.net/draw-lots</a>			
2.	<p><b>Group Presentation</b></p> <p>Teaching Method: 1. PBL by Using Problem Based Model:</p> <p>Step 5: Evaluate Results Step 6: Analyse the Process</p> <p>Teaching Approach: Revolving Ambassador</p>	<ol style="list-style-type: none"> <li>1. Provide each group with a maximum of ten (10) minutes presentation time.</li> <li>2. Instruct all groups to utilise thoughtfully technology/technologies to aid their presentations.</li> <li>3. Encourage students to take notes of the presentations.</li> <li>4. Instruct each group to prepare question(s) for the other groups' PBL based on their presentations.</li> </ol>	Facilitating group presentations	<p>Presenting the prototype</p> <p>Presenting findings</p> <p>Taking notes</p> <p>Preparing questions</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p>	<p>What is/are question(s) you would like to ask about the PBL of other groups?</p>	<p>Communicating ideas</p> <p>Collaborating</p> <p>Persuading others</p> <p>Reflecting</p> <p>Providing feedback</p> <p>Analysing</p> <p>Critical thinking</p>	
3.	<p><b>Question And Answer Session Continues</b> along the <b>Revolving Ambassador Technique</b></p>	<ol style="list-style-type: none"> <li>1. Instruct each group to assign a member who stays as a "host" to entertain the "guests" from other groups.</li> <li>2. Instruct the groups to assign each member as a guest to a different group. <i>*Each group must send at least one (1) guest to every group.</i></li> <li>3. Instruct all guests to present their question(s) to the host of the visited group.</li> <li>4. Instruct all hosts to take note of the questions and provide answers accordingly.</li> <li>5. After the Q&amp;A session ends, instruct all guests to return to their respective groups.</li> <li>6. Instruct hosts to explain what they have gathered from the Q&amp;A session.</li> </ol>	<p>Facilitating the Q&amp;A session</p> <p>Encouraging students to ask questions</p>	<p>Asking questions</p> <p>Providing answers</p> <p>Taking notes</p>	N/A	N/A	<p>Critical thinking</p> <p>Inquiring</p> <p>Analysing</p> <p>Communicating ideas</p> <p>Reflecting</p>	
4.	<p><b>Discussion Session</b></p>	<ol style="list-style-type: none"> <li>1. Instruct all groups to discuss the information gathered through the Q&amp;A session.</li> <li>2. Initiate a whole class discussion.</li> <li>3. Provide an overall lecturer's feedback.</li> </ol>	<p>Facilitating discussions</p> <p>Providing feedback</p>	<p>Discussing</p> <p>Reviewing ideas</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p>	<p>What is/are the most striking question(s)?</p> <p>How does/do the question(s) improve the way(s) you</p>	<p>Communicating ideas</p> <p>Negotiating ideas</p> <p>Reviewing ideas</p>	

**STEMATRICULATION INQUIRY-BASED LEARNING  
MODULE (STEMATRIC-IBL MODULE) \_DRAFT V.1**

					Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote	perceive your PBL?	Collaborating	
5.	<b>Peer and Self-Assessment</b>	<ol style="list-style-type: none"> <li>Instruct all groups to share their PBL materials on Telegram/WhatsApp/Padlet.</li> <li>Instruct students to provide feedback.</li> <li>Encourage students to engage in self-evaluation.</li> </ol>	<p>Facilitating peer and self-assessment</p> <p>Encouraging students to be self-critical</p> <p>Encouraging students to provide constructive criticism</p>	<p>Providing constructive criticism</p> <p>Reflecting on the PBL</p> <p>Reflecting on self-growth via the PBL</p>	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p>	<p>What is/are the strength(s) of the solutions to the problems?</p> <p>What is/are the area(s) that can be developed more for the materialised solutions?</p> <p>What have you learned from the PBL?</p> <p>Have you experienced self-growth via the PBL?</p> <p>What are the skills that you have developed throughout the whole PBL process?</p>	<p>Critical thinking</p> <p>Reflecting</p> <p>Criticising constructively</p>	
6.	<b>Closure</b>	<ol style="list-style-type: none"> <li>Debrief the session.</li> <li>Draw a link between the curriculum specifications with the PBL projects.</li> </ol>	<p>Making conclusions</p> <p>Drawing links</p>	Taking notes	<p>Smartboard / Online board (e.g., Jamboard) / Whiteboard / Telegram / Google Meet / Microsoft Teams / Zoom</p> <p>Microsoft PowerPoint / Microsoft Words / Microsoft Excel / Canva / Kami / Padlet / OneNote</p>	N/A	N/A	