Senior High School

# Lesson Exemplar in General Science

Quarter 1

Lesson Exemplar

2

**Development Team**

**Writer:** Cesar F. Navales

**Consultant:** Alfons Jayson O. Pelgone, PhD
Philippine Normal University

**Learning Area Specialists:** John Cyrus L. Doblada
Danilo G. Soriano, Jr.

Bureau of Learning Delivery
Bureau of Curriculum Development
Bureau of Learning Resources

Every care has been taken to ensure the accuracy of the information provided in this material. For inquiries or feedback, please write or call the Office of the Director of the Bureau of Learning Resources via telephone numbers (02) 8634-1072 and 8631-6922 or by email at blr.od@deped.gov.ph.

Republic of the Philippines

Department of Education

BUREAU OF LEARNING DELIVERY

| LESSON EXEMPLAR | | | |
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| **Learning Area** | General Science | **Grade Level** | 11 |
| **Semester** | 1 | **Quarter** | 1 |

| **I. OBJECTIVES *(Identifying the Goals)*** | |
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| **Content Standard** | The learners learn that understanding linear and angular quantities to describe motion helps in the design of efficient machines. |
| **Performance Standard** | By the end of the quarter, learners identify general physics principles and their applications in daily life. They use scientific principles to solve problems, make informed decisions, and illustrate the applications of physics for self, society, and the environment. They design simple and compound machines and hydraulic systems to demonstrate applications of force, torque, center of mass, and hydraulic-related principles. They evaluate energy-efficient practices in electricity supply and consumption at home and local businesses and explore the advantages and drawbacks of light and sound in medical imaging, security, communication, and entertainment. |
| **Learning Competencies** | *(Before this lesson, the learners are expected to have prior knowledge of vectors, displacement, velocity, acceleration, and the concept of rigid bodies.)*<br><br>The learners compare and contrast translational and rotational motion in terms of their respective linear and angular quantities.<br><br>The learners demonstrate through simple activities the relationship between linear and angular quantities:<br>a. human movement (e.g. exercises, dance, and gymnastics); and<br>b. ergonomic designs (e.g. buildings, vehicles, furniture, and toys). |

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| **II. REFERENCES and MATERIALS**<br><br>(*Selecting Resources and Material*) | Admin. "Angular Acceleration Formula." BYJUS, September 25, 2020. https://byjus.com/angular-acceleration-formula/.<br><br>"Angular Displacement." BYJUS, December 13, 2022. https://byjus.com/physics/angular-displacement/.<br><br>"Angular Velocity." BYJUS, August 30, 2022. https://byjus.com/physics/angular-velocity/.<br><br>Fiveable. "Linear Acceleration - (Principles of Physics I) - Vocab, Definition, Explanations \| Fiveable," n.d. https://library.fiveable.me/key-terms/principles-physics-i/linear-acceleration.<br><br>Scribe. "Linear Position and Displacement Measurement with Capacitive and Eddy-Current Sensors." Amphenol CIT, July 11, 2023. https://www.lionprecision.com/linear-position-and-displacement-measurement-with-capacitive-and-eddy-current-sensors/.<br><br>"Speed Versus Velocity," n.d. https://www.physicsclassroom.com/class/1dkin/lesson-1/speed-and-velocity.<br><br>**Note:** AI (ChatGPT) was used in the development of this Lesson Exemplar to generate ideas for activities and efficiently look for articles, videos, and other online sources used herein. The writer evaluated these suggestions and independently worked on the details. |
| **III. CONTENT**<br><br>*(Sequencing Content)* | **Applications of Translational and Rotational Motion**<br><br>● Translational Motion and Linear Quantities<br>● Rotational Motion and Angular Quantities<br>● Linear and Angular Quantities in Human Movement<br>● Linear and Angular Motion in Ergonomic Designs |
| **IV. OBJECTIVES**<br><br>*(Setting Clear Objectives and* | At the end of the lesson, the learners should be able to:<br><br>1. identify the linear and angular quantities used to describe translational and rotational motion;<br>2. compare and contrast translational and rotational motion;<br>3. demonstrate how translational and rotational motion are applied in human movement; |

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| *Analyzing the Tasks)* | 4. design and critique a simple machine or ergonomic object using the concepts of translational and rotational motion; and<br>5. reflect on the importance of understanding translational and rotational motion in real life. | |
| **IV. PROCEDURES** | | **ANNOTATION** |
| **A. Activating Prior Knowledge** | The teacher conducts routinary activities every day, such as prayer, attendance checking, unfreezing, and other classroom management activities.<br><br>1. Activating Prior Knowledge<br><br>**OPTION 1: COLLABORATIVE WORD MAP**<br><br>The class is divided into groups of at most five members. The teacher gives each group a manila paper and marker. The teacher then instructs the learners that they will be creating a word map of the words or phrases that they can associate with the central word which will be written at the middle of the manila paper. The learners do this within five minutes. They may only begin after the teacher says the central word. The central word is "motion."<br><br>After five minutes, the learners post their outputs on the board. Each group presents their word map where the members take turns in explaining the connection of each word to the central word. | *The teacher should be quick to spot misconceptions. Misconceptions may be corrected immediately, or learners may be allowed to correct themselves later in the lesson, depending on the situation.*<br><br>*The teacher can ask key questions to explicitly relate the recall to the current topic. A sample word map template can be found on this link: https://bit.ly/LEwordmap.*<br><br>*Sample Key Question for Option 1 (after all the presentations): In summary, what do you know so far about motion?* |

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| | **OPTION 2: LAVA FLOOR**<br><br>The teacher instructs the learners to move the chairs to the sides. The floor is divided into two, one for TRUE and one for FALSE. The teacher then presents statements related to motion from the previous grade levels. If the statement is true, they stand on the TRUE side. Otherwise, they stand on the FALSE side. For each statement, learners are given 30 seconds to think. Before revealing the correct answer, the teacher asks one learner from each side to defend their stand.<br><br>If the learners are mistaken, they go back to their seats. All learners can return to the lava floor when there is no learner left on the floor and still there are remaining statements.<br><br>Statements:<br><br>1. Distance is how much ground an object has covered, regardless of direction.<br>2. Displacement measures how far and in what direction an object is from its start point.<br>3. Speed is a vector because it tells you how fast and in which direction something moves.<br>4. The SI unit for both distance and displacement is the meter (m).<br>5. Average acceleration in one-dimensional motion equals total displacement divided by the elapsed time.<br>6. If the net force on an object is zero, it will either stay at rest or move at constant velocity. | *Sample Key Question for Option 2 (after the activity): Based on the statements, what do you know so far about motion?*<br><br>*Correct Answers:*<br><br>*1. True*<br>*2. True*<br>*3. False*<br>*4. True*<br>*5. False*<br>*6. True*<br>*7. False*<br>*8. True*<br>*9. True*<br>*10. False* |

7. Displacement is the rate at which an object's velocity changes over time.
8. Newton's second law can be written as F = ma, which relates net force, mass, and acceleration.
9. In uniform circular motion, although speed is constant, the velocity is changing because direction keeps changing.
10. Centripetal acceleration in circular motion points away from the center of the circle.

**OPTION 3: PAIRED K-W-L CHART**

The learners work in pairs. The teacher asks them to complete the K-W-L table on the topic of motion. The learners may remind each other of the concepts they have previously learned to be placed in the K column. Likewise, they may collaborate in filling in the W and L columns.

| K<br>What do we know about motion? | W<br>What do we want to know about motion? | L<br>How can we learn about what we want to know? |
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The teacher calls random pairs to present their outputs. The teacher facilitates the flow by asking other learners if they have the same items or if there are other items not stated by the presenters.

The teacher bridges the prior knowledge with the current unit by asking the learners how they define displacement, velocity, and

*The purpose of pairing the learners is to encourage cooperative learning and shared responsibility. The learners may also discuss between themselves ideas that the other may not have thought of, thus optimizing recall and ideation.*

*Sample Key Questions for Option 3 (after the presentations): Based on the presentations, what do you know so far about motion? What do you want to know about it? How can you learn about what you want to know?*

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| | acceleration. The class should come up with an agreed and correct definition before proceeding. The teacher should use probing and leading questions to come up with a correct definition.<br><br>2. Establishing the Purpose of the Lesson<br><br>The teacher asks the learners: “Why do you think do we need to study motion? Where do you think can these be applied?”<br><br>The teacher can also allow the learners to think of their dream job or business and where motion is present or obvious in that job.<br><br>Then, the teacher presents the unit objectives for the learners to read. | *The teacher should emphasize the rationale behind informing the learners of the objectives. This encourages conscious and intentional learning which are essential to metacognition. Along the way, the teacher may mention again the specific objectives that have been achieved to give the learners a sense of accomplishment and a rewarding experience (the Endowed Progress Effect).* |
| **B. Instituting New Knowledge** | 1. Presenting Examples<br><br>The teacher explains that the previously learned concepts of displacement, velocity, and acceleration are used in this unit, and that the learners will also encounter terms that have not been tackled in the previous grade levels.<br><br>The teacher shows the concepts (linear displacement, linear velocity, linear acceleration) related to translational motion together with their definitions. The learners read them. The teacher notes that the learners will later use these concepts in the next activities. For each concept, they are given time to understand and to ask about words | *If the learners fail to give the appropriate definition of the difficult words, only then should the teacher give the correct definition.*<br><br>*Suggested definitions of the physical quantities:* |

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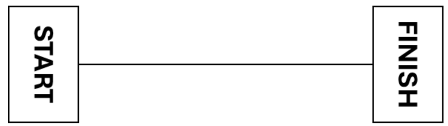
| | in the definitions that they find difficult to understand. The teacher asks other students to provide definitions of the difficult words.<br><br>The teacher asks the learners if the terms are familiar. The teacher reemphasizes that the unit is related to previous grade levels but is deeper and more expansive.<br><br>**ACTIVITY 1: MOTION COMMOTION (TRANSLATIONAL)**<br><br>1. The teacher sets up a “walking zone.” The teacher places two pieces of tape on the floor, labeled “Start” and “Finish,” about a comfortable walking distance apart.<br>2. The teacher calls a learner to perform activities while the others determine which among the three terms defined earlier is being emphasized by the action and its corresponding statement.<br>3. The teacher asks the learner to walk in a straight path from “Start” to “Finish.”<br>Statement: (Name of the learner) walked in a straight path from the starting line to the finishing line.<br>4. The teacher asks the learner to walk slower going back to the starting line in a curved path. Then, the teacher asks the learner to walk fast in a straight path toward the finishing line.<br>Statement: (Name of the learner) walked slowly toward the starting line in a curved path. Then, (name of the learner) walked fast in a straight path toward the finishing line. | *1. Linear displacement refers to the change of position of an object.*<br>*2. Linear velocity refers to the rate at which an object changes its position.*<br>*3. Linear acceleration refers to the rate at which an object's velocity changes with respect to time.*<br><br>*The “walking” zone looks like this:*<br><br>*The teacher ensures the safety of the demonstrating learner. The other learners will observe and answer.*<br><br>*The teacher may modify the statements or add more.*<br><br>*The teacher should lead the learners to the correct answer by going back to the definitions given by the teacher and the definitions previously learned by the learners, emphasizing the change of location.* |

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| | 5. The teacher asks the learner to begin at a slow pace and speed up halfway, or vice versa. Then, on a final trip, the teacher asks the learner to change direction (walk backward) halfway. Statement: (Name of the learner) changed his/her pace. Then, (name of the learner) changed his/her direction.<br>6. The teacher gives time for the learners to finalize their answers.<br>7. The teacher facilitates the processing of the activity afterwards.<br><br>Key Questions for Processing:<br><br>1. What is the difference between the previously learned concepts of displacement, velocity, and acceleration and the new concepts of linear displacement, linear velocity, and linear acceleration?<br>2. Did all the motions follow a straight line? What does this imply?<br>3. Since the motions involved straight lines and curved lines, the path is not uniform for all the examples. What is common among all the examples?<br>Leading Questions for Key Question 3:<br>a. Consider the body as made up of points. How can we compare the displacement of all the points?<br>b. How can we compare the direction travelled by all the points?<br>c. How can we compare the time taken by all the points for the duration of the travel? | *Correct Answers:*<br><br>*3. Linear displacement*<br>*4. Linear velocity*<br>*5. Linear acceleration*<br><br>*For instruction 4, the teacher should emphasize that it is the rate of motion (fast, slow) that is portrayed in the action, not the change of speed. Relate to the definitions given by the teacher and the definitions previously learned by the learners.*<br><br>*For instruction 5, the teacher should emphasize that the action portrays changing the rate of motion (from fast to slow) or a change in direction (forward to backward). Relate to the definitions given by the teacher and the definitions previously learned by the learners.*<br><br>*Expected Answers for Key Questions:*<br><br>*1. The difference is in the word "linear" which implies that the linear quantities are for a specific type of motion.*<br>*2. No. This implies that linear quantities are applicable not only for straight-path but also for curved-path motions.* |

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| | d. How can we compare the velocity of all the points? (Relate this to learners' previous knowledge of velocity, which is displacement over time, connecting the concept with the answers to Leading Questions a and c. In other words, if all points have the same displacement and the same time, their velocities are the same.)<br>e. Since the velocity is the same for all points throughout the travel, how can we compare their acceleration throughout the motion?<br><br>While the Key Question 3 is being answered by the class, the teacher writes down or shows the correct answers after processing.<br><br>4. All points on the body travel the same displacement.<br>5. All points on the body travel in the same direction.<br>6. All points on the body travel with the same duration (time).<br>7. All points on the body travel with the same velocity.<br>8. All points on the body travel with the same acceleration.<br><br>The teacher introduces these as the characteristics of TRANSLATIONAL MOTION. The teacher defines translational motion using the characteristics.<br><br>The teacher emphasizes that linear motion and translational motion are not the same in Physics as linear motion is usually used to describe a straight-path motion while translational motion is used both for straight-path and curved-path motion, just like in the activity. | *The third key question may solicit varied answers. Thus, the teacher must ask leading questions that point to the answer.*<br><br>*3. All of the examples involved movement of all points on the body with the same displacement, in the same direction, and at the same time. In other words, all points have the same velocity throughout the motion. Moreover, all points have equal acceleration at all parts of the motion.*<br><br>*The teacher may use illustrations and sketches to further guide the learners especially in answering the Leading Questions of Key Question 3.* |

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| | **ACTIVITY 2 OPTION 1: GALLERY WALK (TRANSLATIONAL)**<br><br>1. Four photos are placed on the walls of the classroom. In pairs, the learners identify whether the motion described is translational or not. Moreover, they identify the quantity being described by the descriptions placed with the photos.<br>2. A sprinter running from the starting line to the finish line (translational, linear displacement)<br>3. A dog running along a curved road at a slow pace (translational, linear velocity)<br>4. A plane flying a curved path, speeding up upon takeoff and slowing down for landing (translational, linear acceleration)<br>5. A fish swimming in a straight line from a rock to another rock (translational, linear displacement)<br>6. The learners go back to their seats. The teacher gives time for the learners to finalize their answers then processes their answers by calling on learners to justify their responses.<br><br>Key Questions for Processing:<br><br>1. Are all the motions translational? Did all the motions follow a straight line?<br>2. Since the motions involved straight lines and curved lines, the path is not uniform for all the examples. What is common among all the examples? What does this imply about translational motion?<br>3. What physical quantities were used to describe translational motion? | *Suggested Photos: a running dog, a running sprinter, a flying plane, and a swimming fish*<br><br>*Correct Answers:*<br><br>*2. Translational, linear displacement*<br>*3. Translational, linear velocity*<br>*4. Translational, linear acceleration*<br>*5. Translational, linear displacement*<br><br>*During the processing, the teacher should focus on developing the skill in identifying translational motion and the linear quantities involved.*<br><br>*Expected Answers for Key Questions:*<br><br>*1. Yes. No.* |

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| | | *For Key Question 2, lead the learners back to the characteristics of translational motion.*<br><br>*2. All points on the body travel the same distance, in the same direction, with the same duration (time), and with the same velocity and acceleration. This implies that translational motion includes both straight-path for curved-path motions.*<br>*3. The three physical quantities used to describe translational motion are linear displacement, linear velocity, and linear acceleration.*<br><br>*Possible Learner's Question: If translational motion and linear motion are not the same, why are the physical quantities for translational motion called linear quantities?*<br><br>*Suggested Answer: Although they are not the same, the quantities related to translational motion can be described as linear quantities because its displacement, velocity, and acceleration are defined and measured based on the straight-path path from the initial position to the final position (the displacement itself) regardless of the path (straight line or curved path) taken.* |

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| | **ACTIVITY 2 OPTION 2: MATCH MADE IN MOTION (TRANSLATIONAL)**<br><br>1. Three random learners are called in front. Each learner holds a meta card containing each of the three linear quantities used to describe translational motion.<br>2. The teacher calls three other learners to draw a random paper from a box. These papers contain a photo and description which are the same as the first three in Activity 2 Option 1 (sprinter, dog, and plane). These three learners stay at a side and open their papers simultaneously. They are then given 30 seconds to choose from among the three other standing learners their correct partner (holding meta cards containing linear quantities) based on the photos and descriptions that they drew. The learners who drew papers are not yet allowed to show their drawn papers until they have found a match.<br>3. After all three learners have found their match, they reveal their papers.<br>4. The teacher processes the activity by asking the class whether they agree or disagree with the match and calling on learners to justify their responses. If a learner approaches the wrong match, the teacher asks the class for help in determining the correct one.<br><br>Key Questions for Processing:<br><br>1. Are all the motions translational? Did all the motions follow a straight line? | *Activity 2 Option 2 has a limited number of learners actively involved, so the teacher should ensure that the other learners are involved in the processing.*<br><br>*Allow the learners to make mistakes. Explain that mistakes are part of the process of learning and discovery.*<br><br>*During the processing, the teacher should focus on developing the skill in identifying* |

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| | 2. Since the motions involved straight lines and curved lines, the path is not uniform for all the examples. What is common among all the examples? What does this imply about translational motion?<br>3. What physical quantities were used to describe translational motion?<br><br>The teacher summarizes the key points: "In translational motion, all points on the body travel the same displacement, in the same direction, with the same duration (time), and with the same velocity and acceleration at any given instant. The three physical quantities used to describe translational motion are called linear quantities and these include linear displacement, linear velocity, and linear acceleration." | *translational motion and the linear quantities involved.*<br><br>*Expected Answers for Key Questions:*<br><br>*1. Yes. No.*<br><br>*For Key Question 2, lead the learners back to the characteristics of translational motion.*<br><br>*2. All points on the body travel the same distance, in the same direction, with the same duration (time), and with the same velocity and acceleration. This implies that translational motion includes both straight-path for curved-path motions.*<br>*3. The three physical quantities used to describe translational motion are linear displacement, linear velocity, and linear acceleration.* |

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| | The teacher presents another set of terms, this time the angular quantities (angular displacement, angular velocity, and angular acceleration) and their definitions. The learners read the terms and definitions. For each term, they are given time to understand and to ask about words in the definitions that they find difficult to understand. The teacher asks other students to provide definitions of the difficult words.<br><br>The teacher asks the learners if the terms are familiar to them.<br><br>Guide Questions:<br><br>1. How are these terms different from the terms previously presented?<br>2. What do you think does this imply about the type of motion that these terms describe?<br><br>The teacher explains that so far, the class has only discussed linear motion and that there is another type of motion that will be discussed in the lesson. The teacher asks the learners to guess but does not reveal the answer until later in the following activities.<br><br>**ACTIVITY 4: MOTION COMMOTION (ROTATIONAL)**<br><br>1. The teacher sets up a "spinning" zone. The teacher places a piece of tape on the floor, labeled "Reference."<br>2. The teacher calls a learner to perform activities while the others determine which among the three terms defined earlier | *If the learners fail to give the appropriate definition of the difficult words, only then should the teacher give the definition.*<br><br>*Suggested Definitions:*<br><br>*1. Angular displacement refers to the angle made by a body while moving in a circular path.*<br>*2. Angular velocity refers to how fast an object rotates or revolves relative to another point.*<br>*3. Angular acceleration refers to the rate with which angular velocity changes with time.*<br><br>*Expected Answers for Guide Questions:*<br><br>*1. The word "linear" is replaced with "angular."*<br>*2. These terms must describe another type of motion which is not translational.* |

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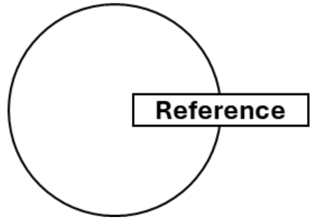
| | is being emphasized by the action and its corresponding statement.<br>3. The teacher asks the learner to spin, facing the reference line first and make one complete rotation.<br>Statement: (Name of learner) made one complete rotation, from the reference line back to the reference line. (Angular Displacement)<br>4. The teacher asks the learner in to spin slower in one complete rotation, then reverse direction faster in another complete rotation.<br>Statement: (Name of learner) made a slow rotation, then a fast rotation. (Angular Velocity)<br>5. The teacher asks the learner to spin slow halfway, then complete the rotation fast. Then, on a final spin, the teacher asks the learner to change direction (spin the other way around) halfway.<br>Statement: (Name of learner) change his/her "spin speed." Then, (name of learner) changed his/her direction of spin. (Angular Acceleration)<br>6. The learners go back to their seats. The teacher gives time for the learners to finalize their answers then processes their answers by calling on learners to justify their responses.<br>7. The teacher facilitates the processing of the activity afterwards.<br><br>Key Questions for Processing:<br><br>1. How are the previously learned concepts of linear displacement, linear velocity, and linear acceleration different | *The spinning zone looks like this:*<br><br>*The teacher may modify the statements or add more.*<br><br>*The teacher should lead the learners to the correct answer by going back to the definitions given by the teacher, emphasizing a movement from the reference point to the same reference point in a spin.*<br><br>*Correct Answers:*<br><br>*3. Angular displacement*<br>*4. Angular velocity*<br>*5. Angular acceleration*<br><br>*For instruction 4, the teacher should emphasize that it is the rate of motion (fast, slow) that is portrayed in the action, not the change of "spin speed." Relate to the definitions given by the teacher.*<br><br>*For instruction 5, the teacher should emphasize that the action portrays changing the rate of* |

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| | from the new concepts of angular displacement, angular velocity, and angular acceleration?<br>2. What is common among all the example motions portrayed?<br>Leading Questions for Key Question 2:<br>a. Consider the body as made up of many points. How can we compare the linear displacement of all the points?<br>b. How can we compare the direction at which all the points travel?<br>c. How can we compare the time taken by all the points for the travel?<br>d. How can we compare the linear velocity of all the points? (Relate this to the definition of velocity as a vector, which is displacement over time, connecting the concept with the answers to Leading Questions a and b. In other words, if the points do not have the same linear displacement and direction, their linear velocities cannot be the same.)<br>e. Since the linear velocities are not the same for all points throughout the travel, how can we compare their acceleration throughout the motion?<br><br>While the Key Questions 1 and 2 are being answered by the class, the teacher writes down or shows the correct answers after processing.<br><br>1. There is spinning, turning, or rotating.<br>2. The points on the body vary in linear displacement.<br>3. The points on the body vary in direction. | *motion (from fast to slow) or a change in direction (spinning the other way around). Relate to the definitions given by the teacher.*<br><br>*Expected Answers for Key Questions:*<br><br>*1. The difference is in the word "angular" which implies that the angular quantities are for another type of motion which is not translational.*<br><br>*The second key question may solicit varied answers. Thus, the teacher must ask leading questions that point to the answer.*<br><br>*2. All of the examples involved turning, spinning, or rotation. The linear displacement of the points varied, depending on their location from the center of the circle. The travel direction of the points also varied based on their position during the motion. The time taken by all the points to travel is the same. However, since the linear displacement and the travel direction of the points varied, their linear velocities also varied. Also, since the linear velocities varied across the motion, the acceleration also varied for all points. In circular motion, the linear acceleration is* |

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| | 4. The points on the body travel with the same duration (time).<br>5. The points on the body vary in linear velocity.<br>6. The points on the body vary in linear acceleration.<br><br>The teacher introduces these as the characteristics of ROTATIONAL MOTION. The teacher defines rotational motion using the characteristics.<br><br>The teacher emphasizes that the key characteristic of rotational motion is in the word itself: rotation. The teacher also explains that the uniform time component is true for a rigid body, but it may not be applicable to fluids. Let the learners think of examples. Examples: whirlpool, water in a washing machine, tornado. The teacher may need to explain rigid bodies as compared to fluids.<br><br>**ACTIVITY 5 OPTION 1: GALLERY WALK (ROTATIONAL)**<br><br>1. Four photos are placed on the walls of the classroom. In pairs, the learners identify whether the motion described is translational or rotational. Moreover, they identify the quantity being described by the descriptions placed with the photos. | *directed towards the center (centripetal acceleration), so this direction is different at different points along the circle.*<br><br>*Recall with the learners that velocity and acceleration are vector quantities and are thus dependent on direction.*<br><br>*Learners may think that linear acceleration "directed toward the center" means the same direction (toward the center). The teacher may illustrate points along the circle at 90, 180 and 270 degrees to illustrate that acceleration "directed toward the center" means different directions at different points.*<br><br>*The teacher may use illustrations and sketches to further guide the learners especially in demonstrating why the points varied in linear displacement and direction. Recall that the objects moving in circular motion follow the direction of the line tangent to the circle at every point of motion.*<br><br>*Suggested Photos: Door, electric fan, merry-go-round, rolling stone* |

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| | 2. A door being opened completing a 45-degree angle (rotational, angular displacement)<br>3. An electric fan spinning very fast (rotational, angular velocity)<br>4. A merry-go-round going from rest, to a slow spin, to a faster spin (rotational, angular acceleration)<br>5. A rock rolling downhill slowly at first then faster due to gravity (rotational, angular acceleration)<br>6. The learners go back to their seats. The teacher gives time for the learners to finalize their answers then processes their answers by calling on learners to justify their responses.<br><br>Key Questions for Processing:<br><br>1. Are they all rotational? What is common among them?<br>2. What physical quantities were used to describe rotational motion?<br>3. Why do you think are the rotational motion quantities called "angular quantities"? | *Correct Answers:*<br><br>*2. Rotational, angular displacement*<br>*3. Rotational, angular velocity*<br>*4. Rotational, angular acceleration*<br>*5. Rotational, angular acceleration*<br><br>*During the processing, the teacher should focus on developing the skill in identifying rotational motion and the angular quantities involved.*<br><br>*For Key Question 1, lead the learners back to the characteristics of rotational motion.*<br><br>*Expected Answers for Key Questions*<br><br>*1. Yes. All of the examples involved turning, spinning, or rotation. The linear displacement of the points varied, depending on their location from the center of the circle. The travel direction of the points also varied based on their position during the motion. The time taken by all the points to travel is the* |

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| | | *same, but the linear velocities of the points varied.*<br>2. *The three physical quantities that were used to describe rotational motion are angular displacement, angular velocity, and angular acceleration.*<br>3. *All the angular quantities can be described in relation to angles because the motion is circular in shape.* |
| | **ACTIVITY 5 OPTION 2: MATCH MADE IN MOTION (ROTATIONAL)**<br>1. Three random learners are called in front. Each learner holds a meta card containing each of the three angular quantities used to describe rotational motion.<br>2. The teacher calls three other learners to draw a random paper from a box. These papers contain a photo and description which are the same as the first three in Activity 5 Option 1 (door, electric fan, and merry-go-round). These three learners stay at a side and open their papers simultaneously. They are then given 30 seconds to choose from among the three other standing learners their correct partner (holding meta cards containing angular quantities) based on the photos and descriptions that they drew. The learners who drew papers are not yet allowed to show their drawn papers until they have found a match. | *Activity 5 Option 2 has a limited number of learners actively involved, so ensure that the other learners are involved in the processing.*<br>*Allow the learners to make mistakes. Explain that mistakes are part of the process of learning and discovery.* |

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| | 3. After all three learners have found their match, they reveal their papers.<br>4. The teacher processes the activity by asking the class whether they agree or disagree with the match and calling on learners to justify their responses. If a learner approached the wrong match, ask the class for help in determining the correct one.<br><br>Key Questions for Processing:<br><br>1. Are they all rotational? What is common among them?<br>2. What physical quantities were used to describe rotational motion?<br>3. Why do you think are the rotational motion quantities called "angular quantities"? | *During the processing, the teacher should focus on developing the skill in identifying rotational motion and the angular quantities involved.*<br><br>*For Key Question 1, lead the learners back to the characteristics of rotational motion.*<br><br>*Expected Answers for Key Questions*<br><br>*1. Yes. All of the examples involved turning, spinning, or rotation. The linear displacement of the points varied, depending on their location from the center of the circle. The travel direction of the points also varied based on their position during the motion. The time taken by all the points to travel is the same, but the linear velocities of the points varied.*<br>*2. The three physical quantities that were used to describe rotational motion are angular displacement, angular velocity, and angular acceleration.*<br>*3. All the angular quantities can be described in relation to angles because the motion is circular in shape.* |

Checkpoint: The teacher asks the learners what new terms and concepts they have learned so far based on the activities.

Then, the teacher says that this time, the two types of motion will be presented side by side for clearer comparison.

2. Discussing New Concept

1. The teacher posts a chart on the board. The chart contains two columns: Translational Motion and Rotational Motion.
2. The teacher pulls out meta cards with terms related to translational motion and rotational motion. Learners are called to paste the meta cards in the appropriate column.

| Translational Motion | Rotational Motion |
|---|---|
| Points have equal linear displacement | Points have varying linear displacements |
| Points travel in the same direction | Points travel in varying directions |
| Points travel with the same linear velocity | Points travel with different linear velocities |
| Points travel with the same linear acceleration | Points travel with varying linear accelerations |
| Linear displacement | Angular displacement |
| Linear velocity | Angular velocity |
| Linear acceleration | Angular acceleration |

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| | 3. The teacher asks a learner to explain each type of motion based on the data in the chart.<br>4. If the learners' explanations are insufficient, the teacher provides additional explanation.<br><br>The teacher asks learners to raise their confusions and have other learners clarify, unless the teacher's expertise is needed. This process is repeated until all confusions so far will have been clarified.<br><br>The teacher explains that the two types of motion are not mutually exclusive (they can exist together at the same time in the same object and in the same movement of an object). The teacher introduces the following activity as an example, highlighting that they are not mutually exclusive and emphasizing how the concepts they are learning are used even by the National Aeronautics and Space Administration (NASA) and other space agencies around the world, apart from other applications in various fields. | *Possible Learner's Question: Why are the terms "linear displacement" and "linear velocity" used under "rotational motion?"*<br><br>*Suggested Answer: While angular displacement, angular velocity, and angular acceleration are used to describe the rotational motion of a rotating body, we can also use linear displacement, linear velocity, and linear acceleration if we spread out the circular path into a straight line. In this lesson, the linear quantities are used only to provide a clear difference between translational motion and rotational motion. There is a deeper discussion for this but it is beyond the scope of this unit or lesson.* |

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| | **ACTIVITY 6: PAPER MARS HELICOPTER (TRANSLATIONAL AND ROTATIONAL)**<br><br>1. The teacher makes introductory statements on NASA's Perseverance Mars rover. The teacher can refer to the link for help.<br>2. The teacher asks the learners to form pairs.<br>3. The teacher provides the materials and the instructions. The teacher allows the learners to independently perform the activity.<br>4. After the activity, the teacher facilitates the class in processing the activity. The teacher may use the actual questions in the materials for processing. The following questions should be added to relate the activity to the competency:<br>    a. How does the paper Mars helicopter exhibit translational motion? Describe the linear quantities exhibited by the helicopter.<br>    b. How does the paper Mars helicopter exhibit rotational motion? Describe the angular quantities exhibited by the helicopter.<br>    c. How important is understanding translational and rotational motion in designing NASA's Perseverance Mars rover (both the paper and the actual)?<br><br>The teacher emphasizes again that translational and rotational motion are not mutually exclusive, meaning a body may have both types of motion at the same time. Let the learners think of examples. | *The material can be downloaded from this link: https://tinyurl.com/NASAMarsChopper. The link also contains instructions, introductions, and video tutorials on creating a paper helicopter rotor, including the template for paper cutting.*<br><br>*The full activity is quite long because of additional activities. The teacher has the prerogative to ask the learners to stop at a certain point.*<br><br>*Expected Answers:*<br><br>*a. The paper Mars helicopter exhibited translational motion as the entire helicopter moved from one place to another. We can define the motion of its translational motion in terms of a single uniform displacement to represent all the points, moving toward the same direction, and with the same linear velocity as the helicopter moved in the air. The linear quantities exhibited by its motion are linear displacement, linear velocity, and linear acceleration.*<br>*b. The paper Mars helicopter exhibited rotational motion as it spun or rotated. We can define the motion of spinning in* |

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| | Examples: a ball spinning while "flying" through the air, a stone rolling downhill, the wheels of a moving vehicle.<br><br>Now, the learners are expected to have learned the concepts. The teacher now states that the learners will engage in more activities to develop their mastery. | *terms of differing linear displacement of the individual points, with differing direction, and differing linear velocity as it spun.*<br>*c. Answers for c may vary.* |
| | 3. Developing Mastery<br><br>**ACTIVITY 7 OPTION 1: AHA SLIDES**<br>1. The teacher groups the learners into groups with a maximum of five members.<br>2. The teacher prepares the Aha Slides platform, including the QR code or link.<br>3. The teacher facilitates the interactive game.<br>4. Scores are automatically revealed at the end of the game.<br>5. The teacher appreciates the groups with perfect scores and asks the groups with errors which part confused them. Those with perfect scores will clarify confusions unless the teacher's expertise is needed.<br><br>**ACTIVITY 7 OPTION 2: WALK AND SPIN PART 2**<br>1. The teacher asks the learners to work in pairs.<br>2. The teacher gives each learner a piece of paper labelled A and B. | *For Developing Mastery, more than one option may be performed by the class until mastery is achieved. The options are arranged as follows: a group activity, a paired activity, and an individual activity.*<br><br>*If Aha Slides is to be used, ensure that the internet connection of both the teacher and the learners is stable. It should also be ensured that each group uses only one device. The teacher must create a new quiz with "Categorise." Set the two categories as "Translational Motion" and "Rotational Motion." Use the following phrases for the options:*<br>*1. Linear displacement (Translational)*<br>*2. Linear velocity (Translational)*<br>*3. Linear acceleration (Translational)*<br>*4. The entire body always changes location (Translational)*<br>*5. An accelerating dog (Translational)*<br>*6. Angular displacement (Rotational)* |

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| | 3. Nine phrases are listed each in Paper A and Paper B. These phrases are taken from the phrases used in Option 1. The teacher may add to, omit from, or replace the options.<br>4. The learners simultaneously take turns in reading the items in the list simultaneously in the class. Thus, they take turns in being the “reader” and the “doer.” If the item read by the “reader” pertains to translational motion, the “doer” takes three steps forward. If the item read by the “reader” pertains to rotational motion, the “doer” spins once.<br>5. The learners will record in the paper whether their partner is correct or wrong.<br>6. The teacher observes the learners and clarifies confusions evidenced by a wrong action of the “doer.”<br><br>**ACTIVITY 7 OPTION 3: VENN DIAGRAM**<br><br>1. The teacher instructs the learners to get a piece of paper or their notebook.<br>2. The teacher asks the learners to create a Venn diagram showing the similarities and differences between translational motion and rotational motion. The 18 statements given may be used for the differences, but the similarities must be identified by the learners.<br>3. The learners submit their outputs. | *7. Angular velocity (Rotational)*<br>*8. Angular acceleration (Rotational)*<br>*9. Spinning washing machine (Rotational)*<br>*10. The Earth spinning about its axis (Rotational)*<br>*11. All points have the same displacement. (Translational)*<br>*12. All points travel in the same direction. (Translational)*<br>*13. All points travel with the same velocity. (Translational)*<br>*14. All points travel with the same acceleration. (Translational)*<br>*15. The points have varying linear displacement. (Rotational)*<br>*16. The points travel with varying direction. (Rotational)*<br>*17. The points travel with varying linear velocity. (Rotational)*<br>*18. The points travel with varying acceleration. (Rotational)*<br><br>*The teacher can set the time limit and whether time consumed is a factor in scoring.*<br><br>*The Venn diagram may be given as a last activity to give time for the teacher to check the outputs individually after class.* |

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| **C. Demonstrating Knowledge and Skills** | The teacher explains that the ultimate purpose of the lesson is for the learners to be able to apply the concepts in daily life and in their senior high school exit pathways, like in future careers and businesses. Thus, the following additional activities will expose them to some real-world applications of the topic.<br><br>1. Finding Practical Applications<br><br>**ACTIVITY 8 OPTION 1: HUMAN MOTION VIDEO ANALYSIS AND DEMONSTRATION**<br><br>1. Assignment: The teacher gives a link to a video that the learners need to watch before the next meeting: bit.ly/TransRotMove. This video titled "Movement Sciences Explained: Kinetics and Kinematics" shows various body movements while explaining some kinetics and kinematics principles involved. Alternate videos may be used, but those that show many examples of human motion, exemplifying both translational and rotational motions.<br>2. Task: Create two columns in your paper/notebook. Label the first column "Translational Motion" and the other column "Rotational Motion." Fill out the table with the human motions or actions found in the video that exhibit translational or rotational motion. Moreover, describe the actions in terms of the physical quantities. All the six physical quantities discussed should be mentioned in the table. Finally, answer the question: How important is | *This highlights the relevance of the curriculum in developing learners' preparedness for the senior high school exit pathways.*<br><br>*To save time and allow the learners to watch the video over and over, the teacher must give the video-watching activity as a take-home task. However, the video may be shown once or twice in class before checking the assignment to allow those without internet connection or those with power interruption to comply. This is feasible as the video is relatively short (only three minutes).* |

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| | understanding translational and rotational motion in human movement?<br>3. On the next meeting, the answers are checked. The teacher may opt to use a physical or online word map or word cloud for the learners to write or encode their answers (action with description).<br>4. The teacher asks a learner to read the answers for “Translational Motion” while the whole class demonstrates the action.<br>5. The teacher asks a learner to discuss the answers for “Rotational Motion” while the whole class demonstrates the action.<br>6. The teacher asks two or three learners to discuss how important it is to understand translational and rotational motion in human movement.<br>7. The teacher summarizes the discussion, focusing on the application of translational and rotational motion in human movement.<br><br>**ACTIVITY 8 OPTION 2: DANCE/EXERCISE ROUTINE**<br><br>1. Assignment: The teacher groups the learners into groups with a maximum of five members. The teacher instructs the learners to design a two- to three-minute dance or exercise routine exemplifying translational and rotational motion through body movement. The routine may or may not have musical accompaniment. For every movement, the performers will state whether the action demonstrates translational | *In the demonstration of action, the teacher should remind the learners of their safety. If the actions are too complicated, a simpler version may be performed.*<br><br>*If time permits, more than one option for Activity 1 may be done to deepen the learners’ appreciation of the importance of understanding translational and rotational motion and their physical quantities in human movement.*<br><br>*The optional musical accompaniment allows for learners with religious reservations to still participate in the activity.*<br><br>*The class and the teacher should agree on the rubrics to be used for the performance. These are the suggested criteria to be used in the rubric: conceptual accuracy (25%), creativity and originality (20%), execution and* |

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| | motion or rotational motion by saying "translational" or "rotational."<br>2. The routine will be presented on the next meeting.<br>3. After all groups have presented, the teacher asks the question: How important is understanding translational and rotational motion in human movement?<br>4. The teacher summarizes the discussion, focusing on the application of translational and rotational motion in human movement.<br><br>**ACTIVITY 9 OPTION 1: READING AND REFLECTION**<br><br>1. The teacher gives a link to a scientific article related to brain injuries caused by translational and rotational motion: bit.ly/TransRotInjury. The article is to be read before the next meeting. This article titled "Why most traumatic brain injuries are not caused by linear acceleration, but skull fractures are" explains head injuries caused by translational and rotational kinematics. Alternate articles may be used, but those that show injuries in the human body caused by translational and rotational motion.<br>2. Task: Read the article. Take note of the importance and application of understanding translational and rotational motion. Answer the following questions.<br>a. What is the article about?<br>b. What concepts of translational and rotational motion are used in the article and how are they used?<br>c. What new thing did you learn from the article? | *coordination (20%), scientific integration and explanation (15%), and presentation and engagement (10%).*<br><br>*To save time and allow the learners to read the article over and over, the teacher may give the reading activity as a take-home task. The teacher may opt to provide learners with no device a hard copy of the article.* |

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| | d. What is the importance of understanding translational and rotational motion in human movement based on the article?<br>e. After reading the article, what new questions do you have?<br>3. After the answers are checked, the teacher calls learners to discuss their answers to the questions.<br>4. The teacher facilitates the summary for the discussion, focusing on the application of translational and rotational motion in human movement and the importance of understanding it in the context of safety.<br><br>**ACTIVITY 9 OPTION 2: SPORTS AND MOTION**<br><br>1. The teacher divides the class into two groups. The first group observes a game being played. The learners note the translational motion, rotational motion, and the physical quantities they observe in the game.<br>2. For the second group, the teacher facilitates a mini press conference with a sports coach. The coach discusses the importance of understanding the capabilities and limits of human movement to optimize performance and enhance safety. The learners ask questions later.<br>3. After the activities, the learners are tasked to pair with someone from another group. They discuss their learnings.<br>4. The teacher calls volunteers or random pairs to share their insights. | *This activity can be performed during the available time of the coach, athletes, and the class. However, if there is no such time, the teacher should coordinate with the coach and the athletes involved. Coordination with the school head is also necessary to ensure that the coach's class is not left unattended, and the athletes are given due consideration to comply with their class activities.*<br><br>*The discussion may be done on the next meeting.* |

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| | **ACTIVITY 10: INTRODUCTION TO ERGONOMICS**<br><br>1. The teacher shows a video on ergonomics. The video can be found on the link: bit.ly/ErgoIntro. This video titled “Why Ergonomics? \| Importance & Benefits of Ergonomic Workplace [LUMI]” explains the importance and advantages of using ergonomics in workplaces. Alternate videos may be used, but those that may serve as an introduction to ergonomics, highlighting its importance in modern society.<br>2. The learners are tasked to define ergonomics in their own words. The definition is discussed in class.<br>3. The teacher shows learners statistics on Global Economic Products Market Size and Forecast. The data can be found on this link: bit.ly/ErgoProds, showing global trends in ergonomic products across various applications. The data is discussed in class with the following key questions:<br>a. Why do you think is there an increasing global demand for ergonomic products, and what does this suggest about the role of ergonomics in daily life and work?<br>b. How do ergonomic products help reduce health issues such as musculoskeletal disorders, and why is this important in both workplace and home settings?<br>c. What industries or sectors appear to prioritize ergonomics based on the infographic, and why might ergonomics be especially critical in those areas? | *The video can be played more than once, depending on the learners’ request and as time permits.*<br><br>*For the parts of the lesson related to ergonomics, the teacher should ensure that the class does not stray away from translational and rotational motion. All discussions on ergonomic design should be anchored on the importance of understanding translational and rotational motion through their linear and angular quantities.* |

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| | d. How can understanding ergonomics help individuals make better choices when selecting tools, furniture, or devices for their personal or professional use?<br>e. How can the concepts of physical quantities and translational and rotational motion relate to ergonomic design?<br><br>**ACTIVITY 11 OPTION 1: VIDEO ANALYSIS ON AN ERGONOMIC DESK SETUP**<br><br>1. The teacher shows to the class a three-minute video found on this link: bit.ly/ErgoDesk1. This video titled "Ergonomics Expert Explains How to Set Up Your Desk \| WSJ Pro Tip" explains the how to set up desks ergonomically. Alternate videos may be used, but those that explain the mechanism of an ergonomic product or setup. The video may be played repeatedly. Before the video is played, the learners are advised to note how ergonomic designs and tools relate to translational and rotational motion and the linear and rotational quantities. The following guide questions are given before watching:<br>a. How does the ergonomic setup provide ease and comfort to the user?<br>b. How are the concepts of the linear and angular quantities of translational and rotational motion applied in designing the setup? | *Learners' answers to this question may yet be vague. This is expected as the explicit relationship between ergonomics and mechanics has not yet been discussed. This question only serves to initially bridge the two and go back to the main idea of the unit.* |

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| | c. What further improvements can you suggest to the setup?<br>2. The learners are given time to answer the questions.<br>3. The learners look for a partner to discuss their answers with.<br>4. The teacher facilitates the processing of the questions by encouraging discussion in the class.<br><br>**ACTIVITY 11 OPTION 2: PERSONAL READINGS**<br><br>1. Look for an ergonomic object or tool on the internet. The object or tool must clearly address a perceived challenge or problem. Print out a photo of the object or tool or bring a physical material if available and read about its design. Answer the following questions:<br>a. What is the rationale/reason for its design?<br>b. What makes it different from other designs?<br>c. Defend the design by using the concepts of the linear and angular quantities of translational and rotational motion.<br>d. What further improvements can you suggest to the ergonomic object or tool?<br>2. On the next meeting, the learners look for a partner to discuss their answer with.<br>3. The teacher facilitates the processing of the questions by encouraging discussion in the class.<br><br>The teacher explains that it is now time for the learners to generalize the lesson. | *The searching and reading part may be assigned in advance.*<br><br>*In this part, the teacher should be quick to note and rectify misconceptions.* |

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| | 2. Making Generalization<br><br>**ACTIVITY 12 OPTION 1: COMEDIC SKITS**<br><br>1. The class is divided into groups of a maximum of six members.<br>2. The learners develop role play skits portraying common scenarios but the key concepts they learned throughout the unit are mentioned instead of normal conversational words.<br>3. It must be noted that the presentations must present all the six physical quantities, three each under translational and rotational motion.<br>4. After sufficient preparation time, the learners present their skits.<br><br>**ACTIVITY 12 OPTION 2: CONCEPT MAP**<br><br>1. Important words and phrases used in the lesson are randomly placed in a chart.<br>2. The teacher asks learners to trace lines to related words or phrases. They justify their lines by explaining the relationships among the concepts.<br><br>The teacher gives a summary of the entire unit by stating the following:<br><br>1. The definition and characteristics of translational motion.<br>2. The definition and characteristics of rotational motion.<br>3. The quantities under translational motion. | *The comedic part here is that they will use scientific terms in common scenarios instead of normal conversational words. For example, bumping into a person while running, the learner says, “Ouch! Didn’t you see me making translational motion through linear displacement from one place to another?” To make it more naturally comedic, the learners can speak in mixed languages.*<br><br>*There are no right or wrong answers in the Concept Map. What matters is that the learners correctly justify their answers by stating the relationships among the words or phrases. The teacher should be quick to detect and rectify misconceptions.* |

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| | 4. The quantities under rotational motion.<br>5. The comparison and contrast between translational and rotational motion.<br>6. Some examples of how linear and angular quantities are applied to human movement.<br>7. Some examples of how linear and angular quantities are applied to ergonomic design.<br><br>The teacher states that it is now time to assess the learners individually, compared to the previous group or class activities.<br><br>3. Evaluating Learning<br><br>**ACTIVITY 13: SHORT RESPONSE**<br><br>1. The learners are asked to answer the following questions in a paper or notebook. They may answer in words, phrases, or sentences.<br>a. What are the characteristics of translational motion?<br>b. What are the characteristics of rotational motion?<br>c. How do translational and rotational motion differ?<br>d. What three quantities discussed belong to translational motion?<br>e. What three quantities discussed belong to rotational motion?<br>f. Give at least one way linear and angular quantities are applied to human movement as observed in daily life and explain how. | *This individual activity should not be given as an assignment to ensure raw assessment, not allowing any opportunity for web searching or asking classmates. Their answers can be written as words, phrases, or sentences in order to focus more on the concept instead of sentence construction.*<br><br>*Expected Answers:*<br><br>*a. In translational motion, all points on the body travel with the same displacement, direction, velocity, and acceleration.*<br>*b. In rotational motion, there is turning or spinning and the points on the body* |

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| | g. Give at least one way linear and angular quantities are applied to ergonomic designs as observed in daily life and explain how.<br><br>The following activity is optional. This may be done if there is an extra time beyond the teacher's allocated budget for this unit or lesson. Moreover, this activity may be given as a performance task. | *travel with varying displacement, direction, velocity, and acceleration.*<br>c. *Translational and rotational motion differ in terms of the behavior of the physical quantities of the individual points on the body.*<br>d. *The three discussed quantities that belong to translational motion are linear displacement, linear velocity, linear acceleration*<br>e. *The three discussed quantities that belong to rotational motion are angular displacement, angular velocity, angular acceleration.*<br>f. *The translational quantities are linear while the rotational quantities are angular.*<br>g. *Answers may vary.*<br>h. *Answers may vary.* |

<table>
<tr><td></td><td>4. Additional Activities<br><br>ACTIVITY 14 OPTIONAL: MOTION AT WORK AND IN BUSINESS<br><br>1. The teacher distributes a bond paper to each learner.<br>2. The teacher instructs the learners to think of their dream job or business. After doing so, the learners explain in at least three sentences a certain scenario or object in that dream job or business that exhibits both translation and rotation motion, either individually or together.<br>3. The teacher also instructs the learners to sketch such scenario or object.<br>4. The class agrees on the rubric to be used, considering the following suggested criteria: clarity of explanation and quality of sketch.<br>5. After doing the activity, the learners share their outputs to a partner. After doing so, random learners are called to present their output to the class.</td><td>This activity further highlights the connection between what learners learn inside the classroom with actual events, objects, or scenarios. This bridges theory to practice and makes the lesson more relevant to their lives, especially the senior high school exit pathways, in coherence with the curriculum’s goals.</td></tr>
<tr><td>V. ASSESSMENT<br><br>(Assessing Learnings)</td><td colspan="2">Two options are given in this part: a performance-based assessment and a paper-and-pen assessment. The teacher may opt to implement both at his/her discretion and based on availability of time and the needs of the learners.<br><br>ASSESSMENT OPTION 1: COLLABORATIVE PERFORMANCE-BASED ASSESSMENT (DESIGN PITCHING AND CRITIQUING CHALLENGE)<br><br>The teacher announces the following activity as the assessment for this unit or lesson. This summative assessment is a performance task and will be scored and recorded as a performance task.<br><br>This activity can be announced in advance to give learners ample time to prepare.</td></tr>
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The learners work in groups. The teacher instructs the groups to design a simple machine or ergonomic object using the concepts of translational and rotational motion. The following must be observed.

1. The design should be sketched in one or more bond papers (the class should determine the size). Learners are free to sketch manually or use design software.
2. The design should be made incorporating the concepts of translational and rotational motion.
3. The design should be made with the purpose in mind, which is to provide ease and comfort to living organisms, including humans, in their community. In other words, the design must solve a problem in the community.

The learners fill in Annex A (Design Thinking Process) to create a successful design.

When the designs are done at the set schedule, the learners exchange their designs with other groups designated by drawing lots or using a computer-based randomizer. The learners then critique and note each other's designs and suggest improvements for 15 minutes using the concepts of translational and rotational motion.

After the critiquing activity, the groups present their designs for one to three minutes. After each presentation, the group that critiqued the design gives feedback and suggestions for improvement. This activity is open to interactions, such as the presenter defending the design. The feedback and defense last for five minutes only. The teacher assigns a learner to serve as timekeeper who will raise a flag when there is only 30 seconds remaining for both presentation and feedback/defense.

The teacher may use and modify the following rubric after presenting it to the class.

**Part 1: Design Presentation (20 points)**

| Criteria | Excellent (5 pts) | Proficient (4 pts) | Developing (3 pts) | Beginning (1-2 pts) |
|---|---|---|---|---|
| Application of Translational and Rotational Motion Concepts | Accurately and clearly applies relevant concepts to explain the | Applies concepts with minor errors or partial clarity | Shows limited understanding or only vaguely relates concepts | Concepts are missing, inaccurate, or poorly explained |

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| | function and design of the object | | | |
| Ergonomic Relevance and Purpose | The design is highly purposeful and clearly enhances comfort/ease for living organisms | The design has a clear purpose and moderate ergonomic consideration | Purpose is somewhat evident, but ergonomic benefit is minimal | Purpose is unclear or unrelated to ergonomic benefit |
| Clarity and Quality of Visual Design | Sketch is neat, detailed, visually clear, and effectively supports explanation | Sketch is mostly neat and understandable, with minor issues | Sketch is basic or unclear in parts | Sketch is messy or lacks important details |
| Presentation and Communication Skills | Presents with confidence and clarity and ideas are well-organized and engaging | Presents clearly but may lack some organization or confidence | Presentation is hesitant or disorganized | Presentation is unclear, very short, or difficult to follow |

**Part 2: Critique of Peer's Design (20 points)**

| Criteria | Excellent (5 pts) | Proficient (4 pts) | Developing (3 pts) | Beginning (1-2 pts) |
|---|---|---|---|---|
| Use of Scientific Concepts | Critique insightfully uses concepts of | Uses relevant concepts, though | Concepts used are general or not well | Scientific basis is weak or absent |

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| | translational and rotational motion to analyze design | with slight inaccuracies | connected to critique | |
| Constructiveness of Feedback | Feedback is specific, respectful, and suggests practical improvements | Feedback is mostly helpful and respectful with some useful suggestions | Feedback is vague or only partially constructive | Feedback is minimal, irrelevant, or overly critical |
| Clarity and Structure of Critique | Ideas are clearly and logically expressed with strong justification | Mostly clear and logical, with minor gaps in explanation | Somewhat disorganized or unclear | Lacks structure and ideas are poorly communicated |
| Engagement in Dialogue | Actively engages in open discussion and responds thoughtfully to defense or questions | Participates in discussion and responds adequately | Limited engagement or passive interaction | Avoids or minimally engages in discussion |

**ASSESSMENT OPTION 2: MULTIPLE CHOICE**

The teacher gives instructions on where and how to write the answers. Rationalization of the answers is provided as Annex B.

1. Which of the following best describes translational motion?
    a. All points accelerate differently.

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| | b. All points rotate around a center.<br>c. All points change shape while moving.<br>d. All points move the same distance in the same direction.<br>2. Which of the following is a linear quantity?<br>a. Angular velocity<br>b. Angular momentum<br>c. Linear acceleration<br>d. Angular displacement<br>3. Which of the following exhibits rotational motion?<br>a. A spinning ceiling fan<br>b. A man walking down a street<br>c. A fish swimming in a straight line<br>d. A car going forward on a straight road<br>4. In rotational motion, which quantity refers to how fast an object rotates?<br>a. Linear velocity<br>b. Centripetal force<br>c. Angular velocity<br>d. Angular displacement<br>5. What is common to all points in a rigid body undergoing translational motion?<br>a. No motion<br>b. Same velocity<br>c. Different direction<br>d. Different acceleration<br>6. Which of the following motions is best described using linear acceleration?<br>a. A door swinging open<br>b. A rotating merry-go-round<br>c. A car increasing speed on a curved road<br>d. A coin rolling down a road as it spins continuously<br>7. What characteristic differentiates rotational motion from translational motion?<br>a. Motion in a straight path |

b. Equal velocity for all points
c. Same direction of movement
d. Points have different displacements

8. A dancer spins in place and gradually increases her spin speed. What physical quantity is most directly observed?
   a. Linear velocity
   b. Linear acceleration
   c. Angular displacement
   d. Angular acceleration
9. What describes the motion of a rolling stone down a hill?
   a. No motion
   b. Pure rotational
   c. Pure translational
   d. Both translational and rotational
10. Which device demonstrates rotational motion in an ergonomic design?
    a. Swivel chair
    b. Foldable table
    c. Standing desk
    d. Adjustable chair that moves up and down
11. Why do all points in a spinning CD have different linear velocities but the same angular velocity?
    a. The CD is accelerating.
    b. The CD is not rotating uniformly.
    c. They have the same displacement.
    d. Points farther from the center travel a greater distance at the same time.
12. Which physical quantity is shared between rotational and translational motion of a rolling wheel?
    a. Time
    b. Direction
    c. Acceleration
    d. Displacement
13. Why is it incorrect to assume that rotational motion always results in linear acceleration?

<table>
<tr><td></td><td>
a. Rotational motion is not real.<br>
b. Linear acceleration does not depend on rotation.<br>
c. Only solids can rotate due to their physical properties.<br>
d. Rotational motion primarily involves angular, not linear quantities.<br>
14. A machine part is moving forward while spinning. What kind of motion is it undergoing?<br>
a. Pure rotational<br>
b. Pure translational<br>
c. Neither rotational nor translational<br>
d. Combined translational and rotational<br>
15. Which of the following best supports the design of ergonomic tools using rotational motion principles?<br>
a. Constant force across all angles<br>
b. Equal displacement of all points<br>
c. Variable movement of parts to reduce strain<br>
d. Uniform speed of an object in all directions always
</td></tr>
<tr><td>VI. REFLECTION<br><br>(Feedback and Continuous Improvement)</td><td>
Learners' Reflection:<br><br>
Ask the learners to complete the following sentences in a piece of paper. They may write as many points as possible.<br><br>
1. In this unit, the most significant lesson I learned is ________________________________________.<br>
2. I will apply what I learned by ________________________________________.<br>
3. I am still confused about ________________________________________.<br>
4. My learning experience could have been better if ________________________________________.<br><br>
Teacher's Reflection:<br><br>
1. Were the objectives achieved? What evidence do I have that learning took place?<br><br><br>
2. What went well in this unit or lesson? What contributed to it?
</td></tr>
</table>

| | |
|---|---|
| | 3. *What challenges did I encounter? How did I handle them?*<br><br>4. *How can I improve my teaching practice to better support learners' understanding?* |

Prepared by:

**CESAR F. NAVALES**

Reviewed by:

**ALFONS JAYSON O. PELGONE, PhD**
Philippine Normal University, Manila

Approved by:

**JOHN CYRUS L. DOBLADA**
General Science Specialist
BLD-TLD

Annex A. **DESIGN THINKING PROCESS**

| | |
|---|---|
| **Project Title** | |
| **Project Proponents** | |
| **Project Duration** | |

What knowledge, skills, and attitudes (KSAs) are needed in this project?

| Knowledge | Skills | Attitudes |
|---|---|---|
| | | |

| | |
|---|---|
| **EMPATHIZE**<br>Understand the context and the need. What glaring need or problem have you observed? Why is this a problem? | |
| | |
| **DEFINE**<br>Define the scope of your problem. What problem do you commit to address? | |
| | |
| **IDEATE**<br>Think of potential solutions. What are your ideas on how the problem will be solved? | Will these ideas work? How? |
| **Idea 1** | |

| | |
|---|---|
| **Idea 2** | |
| **Idea 3** | |

| |
|---|
| **PROTOTYPE/PRODUCE**<br>Create your solution. How would you translate your idea into a product, process, or output? |
| |
| **TEST AND IMPLEMENT**<br>Implement your solution. How would you test if your idea is working? How would you roll out the solution? |
| |
| **LEARN**<br>Evaluate your learning experience. What were your essential learning in the process of designing? Answer by highlighting the KSAs. How would this project impact you and the community if implemented? How can the project be improved? |
| |

Annex B. **RATIONALIZATION OF THE MULTIPLE CHOICE ASSESSMENT**

| Item No. | Correct Answer | Rationalization |
|---|---|---|
| 1 | D | Translational motion means every point in a body moves the same distance in the same direction. This is in contrast to rotational motion, where different points move differently. |
| 2 | C | Linear acceleration is used to describe changes in speed in straight-line or translational motion. Angular quantities apply to spinning or circular motion. |
| 3 | A | A spinning fan rotates around its central axis, showing rotational motion. Walking or swimming in a straight or curved path is translational. |
| 4 | C | Angular velocity measures the rate of change of angular displacement with respect to time. It tells how fast something spins or rotates. |
| 5 | B | In translational motion, all points in the object move uniformly—same displacement, velocity, and acceleration. This uniformity distinguishes it from rotational motion. |
| 6 | C | A car accelerating along a curved road experiences translational motion and is best described using linear acceleration. The path may be curved, but the motion of all points is uniform. |
| 7 | D | In rotational motion, different points travel different paths, so their displacements vary. This variation is not present in translational motion. |
| 8 | D | Angular acceleration is the rate of change in spin speed or angular velocity. The dancer is spinning faster over time, which is a textbook example of angular acceleration. |
| 9 | D | A rolling stone both rotates and translates—it spins while also moving forward. This is an example of combined motion. |
| 10 | A | A swivel chair allows rotation around a vertical axis, making it a practical ergonomic tool that uses rotational motion. This motion provides ease of movement without changing location. |
| 11 | D | In a spinning CD, outer points travel more distance in the same time than inner points, so their linear velocities differ. However, all points rotate through the same angle in the same time, hence same angular velocity. |
| 12 | A | In both types of motion, duration or time is constant for all points in a rigid body. This is a shared trait, even when displacements and velocities differ. |

| | | |
|---|---|---|
| 13 | D | Rotational motion is defined by angular, not linear, quantities. Therefore, rotational motion alone doesn’t guarantee linear acceleration unless there’s also translation. |
| 14 | D | When an object moves and spins at the same time, it exhibits both translational and rotational motion. Many real-world machines and tools show this combination. |
| 15 | C | Ergonomic designs often incorporate rotational motion to reduce user strain by allowing natural pivoting or swiveling. This improves comfort and efficiency by aligning with human joint movements. |