7

Lesson Exemplar for Science

Quarter 3

Lesson 2

Lesson Exemplar for Science Grade 7
Quarter 3: Lesson 2 (Week 2)
SY 2024-2025

Development Team

Writer:
- Arnel Lorenzana (Bicol University)

Validator:
- Alfons Jayson Pelgone (Philippine Normal University - Manila)

Management Team
Philippine Normal University
Research Institute for Teacher Quality
SiMERR National Research Centre

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.

I. CURRICULUM CONTENT, STANDARDS, AND LESSON COMPETENCIES	
A. Content Standards	Scientists and engineers analyze forces to predict their effects on movement.
B. Performance Standards	*By the end of the Quarter*, learners employ scientific techniques, concepts, and models to investigate forces and motion and represent their understanding using scientific language, force diagrams, and distance-time graphs. They use their curiosity, knowledge and understanding, and skills to propose solutions to problems related to motion and energy. They explore how modern technologies might be used to overcome current global energy concerns.
C. Learning Competencies and Objectives	*Draw a free-body diagram to represent the relative magnitude and direction of the forces involving balanced and unbalanced forces.* *Lesson Objective 1: Define a vector as a quantity with both magnitude and direction* *Lesson Objective 2: Define force as a vector quantity* *Lesson Objective 3: Visually represent a force using a force diagram or free-body diagram* *Lesson Objective 4: Interpret force diagrams or free-body diagrams by identifying and analyzing arrows representing the magnitude and direction of the forces.*
D. Content	Balanced and unbalanced forces Force as a vector: ● A vector is a quantity with magnitude and direction. ● Force is an example of a vector quantity with magnitude and direction. ● The magnitude and direction of all the forces acting on an object can be represented using arrows. Force Diagrams or Free Body Diagrams ● Free body diagram represents the forces acting on an object. ● It helps analyze the contribution and effects of the individual forces on the state of motion of the object.
E. Integration	Forces in real life, especially in school, play, and household.

II. LEARNING RESOURCES

- GCSE Physics Revision "Resolving Forces" Retrieved from https://www.youtube.com/watch?v=8RI2_gJy0L0&list=PL9IouNCPbCxUrQkFLoPwB67nDbhw2NfAO&index=6
- The Physics Classroom. Accessed from https://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Free-Body-Diagrams/Free-Body-Diagram-Interactive
- Ling, J.S., Sanny, J., & Moebs, B. (2016). University Physics Volume 1. Retrieved from https://openstax.org/details/books/university-physics-volume-1
- Hewitt, P.G. (2014). Conceptual physics. 12th Ed. Pearson
- DepEd. (n.d). Project EASE: Integrated Science I Module 7.

III. TEACHING AND LEARNING PROCEDURE

NOTES TO TEACHERS

A. Activating Prior Knowledge

1. Short Review

The teacher will post on the board/screen the different quantities with their corresponding units. Then, the students will classify it as a vector or scalar. Students will stand and do their preferred pose if the given quantity is vector and remain sitting if not.

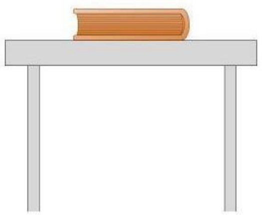
Quantity	Sample Unit
mass	kilogram (kg)
distance	meter (m)
temperature	degree Celcius (˚C)
velocity	meter per second, north (m/s, N)
acceleration	meter per square second, downward (m/s^2, d)
volume	cubic meter (m^3)
speed	meter per second (m/s)
area	square meter ($m^{2)}$
time	second (s)
electric current	Ampere (A)
force	Newton, to the right (N, R)

Notes to teachers:

The teacher should direct the students to realize there are two kinds of quantities: scalar and vector. Scalar quantities are quantities with magnitude only, while vector quantities have magnitude and direction.

Emphasize that force is a vector quantity. (The teacher should ask questions that will lead to the idea that force is a vector quantity)

The teacher should also tell their students that the focus of the week's lesson is forces.

B. Establishing Lesson Purpose	**1. Lesson Purpose** Divide the class into small groups. Give each group a set of Post-it notes and markers. Allow them to brainstorm and write down real-world applications of forces. Encourage them to think broadly and consider everyday activities, sports, engineering, nature, technology, etc. Have each group present their examples to the class. The discussion may focus on the following questions: 1. How does understanding force help us in this situation? 2. What would happen if we did not understand the forces at play?	Examples might include driving a car (friction, engine force), construction (structural capacity), using tools (force to hammer a nail), sports like boxing (punching force), and natural disasters (typhoons, earthquakes, etc.) In the discussion, emphasize that it is important to understand force as a vector quantity.
C. Developing and Deepening Understanding	**SUB-TOPIC 1: FORCE as a VECTOR** **1. Explicitation** Stress or emphasize again that physical quantities can be classified as scalars or vectors. Scalar quantities only measure the magnitude or size of the physical quantity. On the other hand, vector quantities can describe a situation in more detail than a scalar. Vector quantities have both magnitude and direction. The teacher should highlight the difference between the two quantities. Emphasize that ***force is a vector quantity***. Ask students to identify five stationary objects. Use a pencil to sketch the stationary objects on a sheet of paper. Ask them to identify the forces acting on each object. In which direction are these forces acting? The teacher may give a sample picture showing a book on top of a table. Let the students name the forces acting in the book.  Whatever the forces acting on the object, they can be represented by vectors in a vector diagram.	 This activity can be used to connect the next topic about force as a vector quantity.

2. Worked Example

In general, a vector can be represented using arrows. Since a force is a vector, we can also represent it using arrows. The length of the arrow represents the magnitude or size of the force. The longer the arrow, the larger the force. The arrowhead points to the direction of the force.

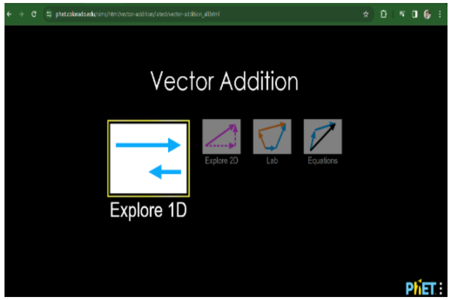
Activity 2 Vector Diagram

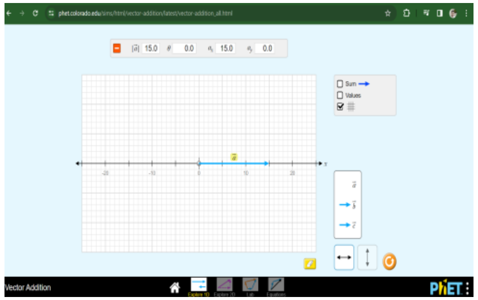
Objective: At the end of the activity, the students should be able to draw vector representations using arrows using the Vector Addition Simulation in PhET

Materials: worksheet, pen, laptop/tablet/cellphone, internet connection

Procedure:

1. Explore the Vector Addition Simulation with a laptop and internet connection.





Link: https://phet.colorado.edu/sims/html/vector-addition/latest/vector-addition_all.html

2. Draw the following vectors. Use the cardinal (geographical) direction. (By writing convention, the North is upward, the South is downward, the East is directed to the right, and the West is directed to the left.)
   a. 10 units North
   b. 5 units East
   c. 7 units West
   d. 15 units South
   e. 20 units North
3. From the vectors drawn, which is the longest? The shortest?
4. What can you say about the strength of the force the longer the arrow is?
5. Is 10 units of Force directed East the same as 10 units of Force directed West? Explain.

The teacher should make sure that the forces are named properly. For example, the forces present in the book are (1) Fg or weight W (force on the book due to Earth's gravity, and (2) Support force or Normal Force N (force on the book due to table).

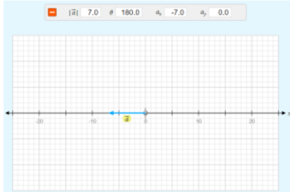
The PhET simulation works with the internet. However, the app can be purchased on Google app for 49.00 pesos only for offline use.

If there is no internet connection, ask your students to directly perform Activity 2.2. Another option is for the teacher to perform Activity 2 and present it to their class through classroom discussion.

Answers to Activity 2:

a. 

b. 

c. 

d. 

e. 

3. *The longest is 20 units North, and the shortest is 5 units East.*
4. *The longer the arrow, the stronger the force is.*
5. *Ten units of forces directed East is the same magnitude as 10 units directed West. However, their direction is not the same. Therefore, they are not the same.*

Activity 2.2 will have the same result; however, the teacher should ensure that the students are able to use proper scaling.

Note: Explain to your student that the origin of the cartesian coordinate can be made by placing the cursor on top of it and dragging it to the desired place.

Activity 2.2. Vector Diagram using Graphing Paper

Objective: At the end of the activity, the students should be able to draw vector representations manually using arrows.

Materials: worksheet, pen, ruler

Procedures:

1. Draw the vectors given in Activity 2.1 on graphing paper using a pencil and ruler. Use the scale 1 unit = 1 cm (two boxes).
2. Answer the questions in numbers 3 to 5 in the previous activity.

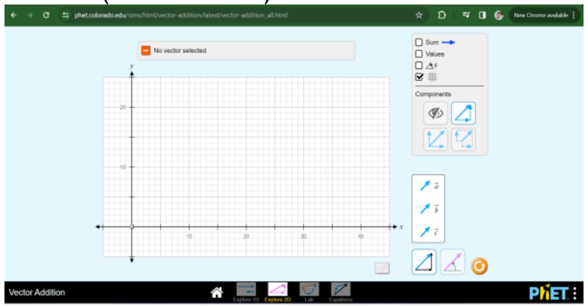
Activity 3. Resolving Force Vectors

Objective: At the end of the activity, the students should be able to resolve force vector using the Vector Addition: Explore 2D Simulation

Materials: worksheet, pen, laptop/tablet/cellphone, internet connection

Procedures:

1. Explore the Vector Addition: Explore Simulation if you have a laptop and internet connection.
2. Make sure to press the buttons for Components (upper right) and the arrows colored blue (bottom left).



https://phet.colorado.edu/sims/html/vector-addition/latest/vector-addition_all.html

3. Draw the following vectors by dragging the vectors to the coordinate and identify their x and y components. (The x-component is along the East-West direction, and the y-component is along the North-South direction.)
   a. Vector A = 5 units, 53.1˚ North of East
   b. Vector B = 13 units, 67.4˚ North of East
   c. Vector C = 10 units, 53.1˚ South of East
   d. Vector D = 25 units, 36.9˚ West of North
4. What are the vector components of the vectors in item 1.? How are they related to the original vector?
5. How do you resolve or determine the horizontal and vertical components of a vector?
6. Can you think of a real-world example where resolving a vector into its components is applicable?

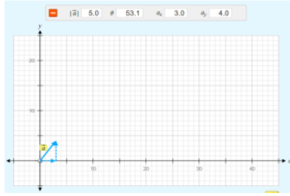
Activity 4. Resolving Force Vectors Graphically

Objective: At the end of the activity, the students should be able to resolve the force vector graphically.

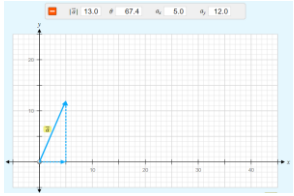
Materials: worksheet, pen, drawing materials

Answer to Activity 3 and 4

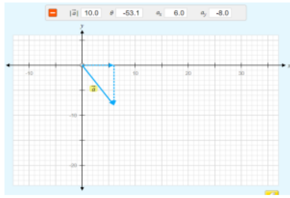
a.



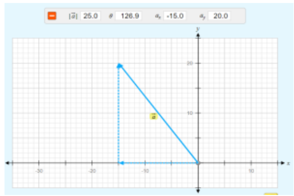
b.



c.



d.



2. The vector components are the x- and y- dimensions of the vector. The horizontal component is the projection of the vector onto the horizontal

Procedures:

1. In a graphing paper, draw the x-y coordinate system.
2. Draw the following vectors using a ruler and protractor. (The x-component is along the East-West direction, and the y-component is along the North-South direction.)
    a. Vector A = 5 units, 53.1˚ North of East
    b. Vector B = 13 units, 67.4˚ North of East
    c. Vector C = 10 units, 53.1˚ South of East
    d. Vector D = 25 units, 36.9˚ West of North
3. What are vector components? How are they related to the original vector?
4. How do you resolve or determine the horizontal and vertical components of a vector?
5. Can you think of a real-world example where vector resolution is applied?

axis or the x-axis, and the vertical component is the projection onto the vertical axis or the y-axis. In the case of the letter a vector, the components are 3 units along the x-axis and 4 units along the y-axis.

3. Create a right triangle, where the triangle's base and height correspond to the x- and y-components.

4. An example is determining the safe angle or slope of a road. This accounts for the friction between the tire and the road so that any vehicle will not skid downward.

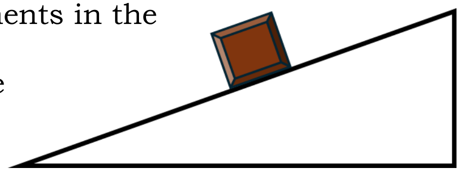
Activity 5. Components of Force Vectors-Application

Objective: At the end of the activity, the students should be able to identify the components of vectors in actual scenarios.

Materials: Worksheet, Pen, drawing materials

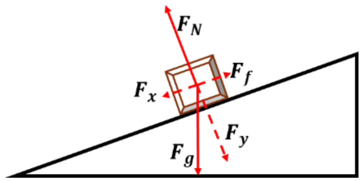
Procedures:

1. Identify the forces and their components in the following scenarios.
    a. A box at rest on an inclined plane

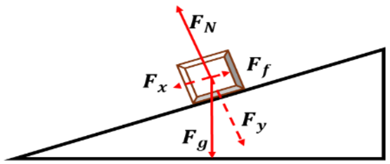


Answers to Activity 5

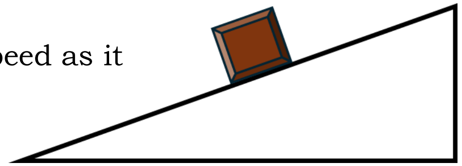
a.



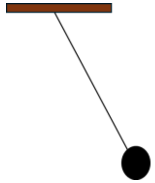
b.



b. A box is sliding and increasing speed as it moves along an inclined plane.



c. A swinging pendulum



d. A soccer ball that is kicked at a 45° angle

How did you resolve the components of the forces in the given scenarios?

3. Lesson Activity

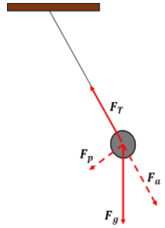
Activity 6 Balanced Forces

Objective: At the end of the activity, the students should be able to identify and draw balanced force vectors in each scenario.

Materials: worksheet, pen

Procedure:

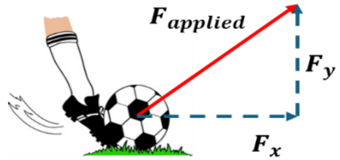
1. Identify and draw the force vector in the following scenarios.
   a. A book on top of a table
   b. A fruit on a tree
   c. A picture frame on the wall
   d. A grocery cart moving at a constant speed
   e. A jeepney moving at a constant speed
   f. An airplane flying at a constant velocity at a constant altitude
   g. A man standing still



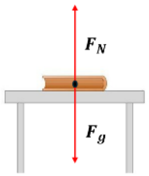
c.

F_g = gravitational force
F_a = force of gravity along arm of the pendulum
F_p = force of gravity perpendicular to the arm of the pendulum
F_T = tension

d.



Answers for selected items in Activity 6



a.

b.

h. A man walking at a constant speed
i. A box resting on an inclined plane

2. Which of the situations involves an object which is at rest?
3. Which of the situations involves an object which is in motion?
4. How did you determine the direction of the forces?

Discuss balanced and unbalanced forces.

Activity 7. Unbalanced Forces

Objective: At the end of the activity, the students should be able to identify and draw unbalanced force vectors in each scenario

Materials: Worksheet, Pen

Procedures:

1. Identify and draw the force vector in the following scenarios.
   a. A falling fruit
   b. An accelerating car to the right
   c. A helium-filled balloon recently released
   d. A man inside an elevator accelerating upward
   e. An airplane taking off
2. Which of the situations indicate balanced forces?
3. Which of the situations indicate unbalanced forces?
4. What is the direction of the unbalanced or net forces in the given scenarios?

SUB-TOPIC 2: FREE BODY DIAGRAMS

1. Explicitation

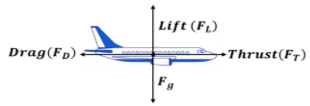
Activity 8. Free-body diagram-balanced forces

Objective: At the end of the activity, the students should be able to accurately identify and represent all relevant forces acting on an object in each scenario using a free-body diagram.

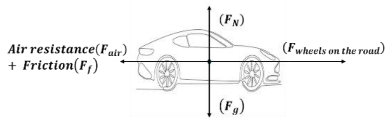
Materials: worksheet, pen, drawing materials

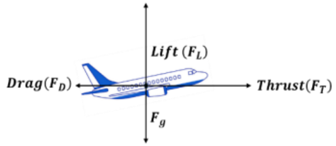
Procedures:

1. Follow the steps in drawing a free-body diagram (Ling et al., 2016)
   a. Treat the object as a particle and represent the object as a point.
   b. Place this point at the origin of the xy-coordinate system.

f. 

Answers for selected items in Activity 7

b. 

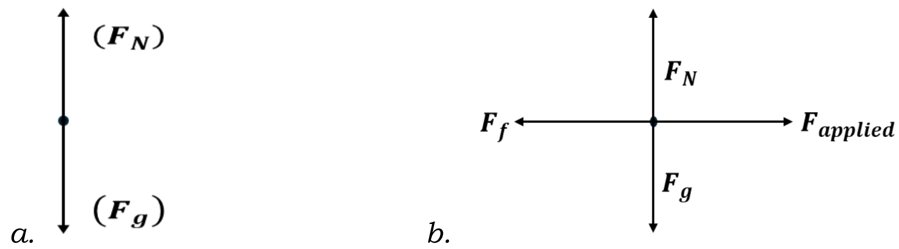
e. 

The teacher may give a prior discussion on the Free-body Diagram.

Content: A free-body diagram is a sketch showing all external forces acting on an object or system. The object is presented by a single point (that is why it is called free-body), and only

c. Include all forces that act on the object, representing these forces as vectors.
2. Draw a free-body diagram on the following scenarios.
    a. A book on top of a table
    b. A box pushed in a constant motion
3. What can you say about the forces on objects that are at rest or in constant motion?

Answers to Activity 8



2. Worked Example

Activity 9. Free-body diagram-unbalanced forces

Objective: At the end of the activity, the students should be able to accurately identify and represent all relevant forces acting on an object in each scenario using a free-body diagram.

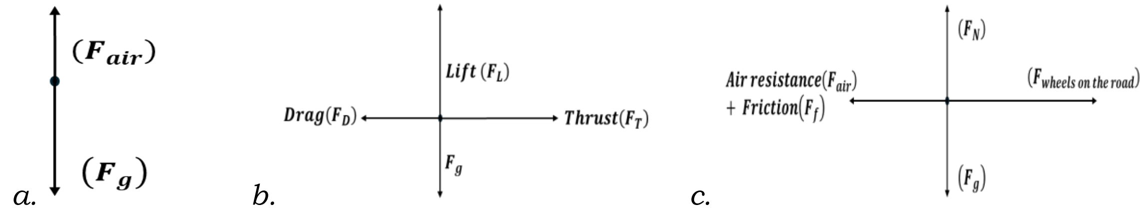
Materials: worksheet, pen, drawing materials

Procedures:

1. Follow the steps in drawing a free-body diagram (Ling et al., 2016)
    a. Treat the object as a particle and represent the object as a point.
    b. Place this point at the origin of the xy-coordinate system.
    c. Include all forces that act on the object, representing these forces as vectors.
2. Draw a free-body diagram on the following scenarios.
    a. A falling fruit from a tree
    b. An airplane taking off
    c. A car speeding up
3. What can you say about the forces on objects that are changing speed? changing direction? changing speed and direction?

those forces acting on it that originate outside the object or system are shown.

Answers to Activity 9



3. Lesson Activity

Activity 10. Using the interactive Free-body diagram

Objective: At the end of the activity, the students should be able to accurately identify and represent all relevant forces acting on an object in each scenario using a free-body diagram with the aid of an interactive free-body diagram

Materials: worksheet, pen, laptop/tablet/cellphone, internet connection

Procedures:

1. Access the physics classroom free-body diagram interactive: https://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Free-Body-Diagrams/Free-Body-Diagram-Interactive
2. Identify the type of forces and their relative magnitude. Tap a direction and identify the type of force. Tap an arrow on the diagram to change the size of the force. Tap Check Answer when ready.
3. The screen will show the word “Dataway!” if you get the answer correctly.
4. What can you say about the forces on objects that are at rest or in constant motion?
5. What can you say about the forces on objects that are changing speed? changing direction? changing speed and direction?

If the school does not have a strong internet connection, the teacher can give the scenarios to students and answer by manually drawing the free-body diagram.

The answers are given in a free-body diagram interactive activity found in the physics classroom.

Activity 11. Free-body diagram

Objective: At the end of the activity, the students should be able to accurately identify and represent all relevant forces acting on an object in each scenario using a free-body diagram

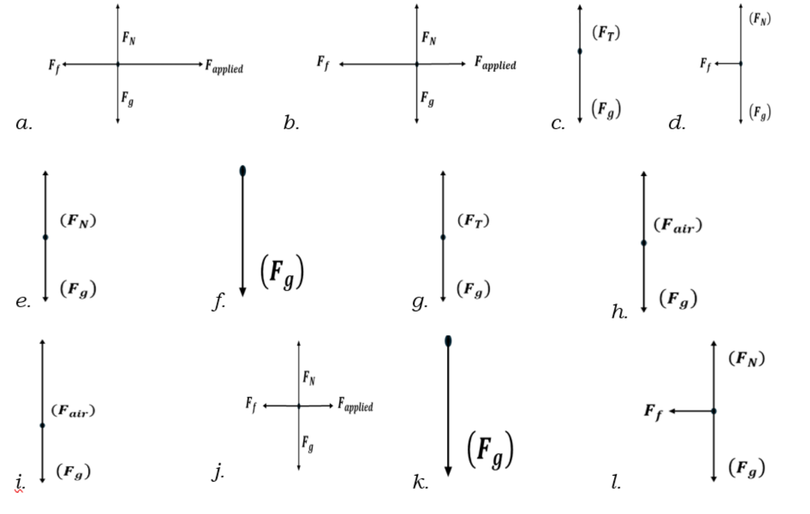
Materials: worksheet, pen, drawing materials

Procedure:

1. Identify the type of forces and their magnitude.

This is the activity if the internet is unavailable. However, students can do this with an

	2. Draw the force vectors on the following scenarios (scenarios are similar to the interactive activity found in activity 1,4,1). Make sure to draw the correct relative magnitude and direction. a. A rightward force is applied to a dresser to accelerate it to the right across the bedroom floor. Ignore air resistance. b. A rightward moving car is skidding to a stop across a level roadway with locked wheels. Ignore air resistance. c. The cabin of a small freight elevator is secured to a motor by a cable and is moving upward while slowing down. There is no contact between the cabin and the elevator shaft. Ignore air resistance. d. A softball player does a head-first dive while sliding to the right across the infield dirt. Ignore air resistance. e. A hockey puck glides to the right across the ice at a constant speed. Ignore air resistance. f. A football kicked initially at a 40-degree angle to the horizontal is at the peak of its trajectory. Ignore air resistance. g. The cabin of a small freight elevator is secured to a motor by a cable and is moving upward at a constant speed. There is no contact between the cabin and the elevator shaft. Ignore air resistance. h. A downward-moving skydiver is falling at a constant speed. i. A downward-moving skydiver who has just opened the parachute is slowing down. (Diagram the forces on the skydiver/parachute system. j. A rightward force is applied to a crate to push it across the floor at a constant speed. Ignore air resistance. k. A football is moving upward and rightward toward the peak of its trajectory. Ignore air resistance. l. A sledder has reached the bottom of a hill and is coasting to the right while slowing down along the loosely packed snow. Ignore air resistance. 3. What can you say about the forces on objects that are at rest or in constant motion? 4. What can you say about the forces on objects that are changing speed? changing direction? changing speed and direction?	internet connection to practice further.

	Answers to Activity 11 	
D. Making Generalizations	**1. Learners' Takeaways** Discuss the advantages of knowing how to draw and apply a free-body diagram. **2. Reflection on Learning** Compose a one-page reflection discussing what you learned, what you do not understand, and what you want to learn further.	

IV. EVALUATING LEARNING: FORMATIVE ASSESSMENT AND TEACHER'S REFLECTION				**NOTES TO TEACHERS**
A. Evaluating Learning	**Formative Assessment** Click on the link https://www.physicsclassroom.com/Class/newtlaws/U2L2c.cfm#1 and answer the practice exercises.			If the school cannot access the internet, the teacher can prepare the assessment task in a PowerPoint presentation.
B. Teacher's Remarks	*Note observations on any of the following areas:*	**Effective Practices**	**Problems Encountered**	

	strategies explored			
	materials used			
	learner engagement/ interaction			
	Others			
C. Teacher's Reflection	*Reflection guide or prompt can be on:* ▪ *<u>principles behind the teaching</u>* *What principles and beliefs informed my lesson?* *Why did I teach the lesson the way I did?* ▪ *<u>students</u>* *What roles did my students play in my lesson?* *What did my students learn? How did they learn?* ▪ *<u>ways forward</u>* *What could I have done differently?* *What can I explore in the next lesson?*			