7

DepED
DEPARTMENT OF EDUCATION

Lesson Exemplar for Science

Quarter 3
Lesson
3

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

Development Team

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SCIENCE (PHYSICS) /QUARTER 3/ GRADE 7

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:* recall how to illustrate forces in a free-body diagram. *Lesson Objective 2:* determine the direction of the net force and state of motion of an object Identify and describe everyday situations that demonstrate*:* ● *balanced forces such as a box resting on an inclined plane, a man standing still, or an object moving with constant velocity;* ● *unbalanced forces, such as freely falling fruit or an accelerating car;* *Lesson Objective 1:* differentiate balanced from unbalanced forces through firsthand experiences. *Lesson Objective 2:* identify balanced and unbalanced forces experienced in real-life situations. Identify that when forces are not balanced, they can cause changes in the object's speed or direction of motion; *Lesson Objective 1:* demonstrate balanced and unbalanced forces through a simple investigation *Lesson Objective 2:* analyze and solve simple problems related to balanced and unbalanced forces *Lesson Objective 3:* determine the effect of balanced or unbalanced forces to the state of motion of an object.
D. Content	Balanced and Unbalanced Forces: a. Balanced forces: An object stays at rest or moves at constant speed in the same direction when the forces that act on it are of the same magnitude and in opposite directions. b. Unbalanced forces: An object changes its speed, direction, or both speed and direction when the forces that act on it may have the same or different magnitudes and directions.
E. Integration	Balanced and Unbalanced forces in Sports

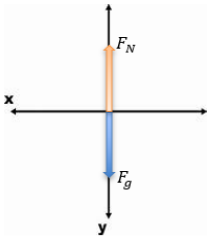
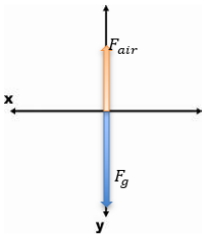
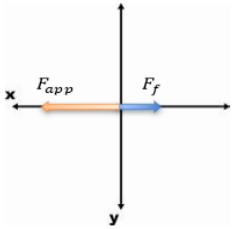
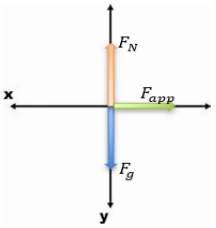
II. LEARNING RESOURCES

- DewWool. (n.d.). Retrieved from 20 Examples of balanced forces: https://dewwool.com/20-examples-of-balanced-forces/
- Phyley. (n.d.). Phyley. Retrieved from https://www.phyley.com/#force-and-motion
- The Physics Classroom. (n.d.). Rocket Sled Interactive. Retrieved from The Physics Classroom: https://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Rocket-Sledder/Rocket-Sledder-Interactive
- Thompson, D. (2023, April 21). What are Balanced and Unbalanced Forces? A Guide for Young Scientists. Retrieved from The Science Times: https://www.sciencetimes.com/articles/43390/20230421/what-are-balanced-and-unbalanced-forces-a-guide-for-young-scientists.htm
- University of Colorado Boulder, licensed under CC-BY-4.0 (https://phet.colorado.edu). (n.d.). Simulation by PhET Interactive Simulations. Retrieved from https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html
- University of Colorado Boulder, licensed under CC-BY-4.0. (n.d.). Simulation by PhET Interactive Simulations. Retrieved from https://phet.colorado.edu

Images Websites:

- https://www.physicsclassroom.com/Class/newtlaws/u2l1d.html
- https://creazilla.com/nodes/30867-end-table-with-a-pink-and-purple-lamp-clipart
- https://www.istockphoto.com/illustrations/apple-falling-from-tree
- https://cdn4.vectorstock.com/i/1000x1000/03/78/group-of-children-playing-tug-of-war-vector-21580378.jpg
- https://cdn3.vectorstock.com/i/1000x1000/01/92/boy-kicking-soccer-ball-alone-vector-18010192.jpg

III. TEACHING AND LEARNING PROCEDURE		NOTES TO TEACHERS
A. Activating Prior Knowledge	**Activity 3.1 (DAY 1)** **Review on FBD and Net Force** (Real World Examples) 1. Observe the situations illustrated below. Think of the forces that act on the identified object. Draw the free-body diagram and label all forces acting on the identified object in the sample situations. Remember that the length of the arrow represents the strength (or magnitude) of the force. 2. Determine the direction of the net force (right, left, up, down, or not applicable-NA) and state of motion of the object due to these forces (at rest, in motion: constant or changing speed).	In order to teach this lesson, the learners should already know the ff. concepts: *1. force as a vector quantity* *2. the net force* *3. free body diagrams (FBD)* ***Option 1:*** The learners may answer first the worksheet (3.1) provided: Review concepts of FBD and net force individually or by pair before the teacher facilitates an

	Use the worksheet for this activity (see page 1 – 2). **KEY to Activity 3.1** 1. A *lamp* on top of the table  Direction of Net force: N/A State of Motion: at rest *2. An apple* falling from a tree  Direction of Net force: down State of Motion: in motion (changing speed) 3. Kicking a soccer ball on a rough surface  Direction of Net force: right State of Motion: in motion (changing speed) 4. Pushing a box along a smooth frictionless surface  Direction of Net force: right State of Motion: in motion (changing speed)	interactive class discussion on the topic. ***Option 2:*** The teacher can use a visual presentation to show each situation, then the learners will draw on their whiteboards the FBD with labels of all forces and determine the net force and state of motion of these objects. This activity allows the learners to recall how to draw a free body diagram (FBD) and determine the direction of the net force and state of motion of objects because of these forces. **KEY to Guide Questions:** 1. Situation 1 2. Situations 2, 3, & 4 3. Situation 1 4. Situations 2, 3, & 4 5. The direction of motion is the direction of the net force.
B. Establishing Lesson Purpose	**Lesson Purpose** **Activity 3.2 Let's pull each other** The learners will be able to differentiate balanced from unbalanced force through firsthand experience and observation after participating in this activity. Please refer to the learner worksheet for the detailed instructions. *Use the worksheet for this activity (see page 3 – 4).* **KEY to Activity 3.2 Guide Questions**	To establish the lesson purpose, learners may do Activity 3.2 ***Let's pull each other*** on an open space such as the gym. The teacher should provide the preliminary orientation on the activity a day before conducting it (please see the learners' worksheet for the detailed instructions). On the day of the activity, the teacher may instruct the group leaders to inspect if their group members are wearing the proper attire (PE uniform, rubber shoes,

1. Balanced Forces – when opposing groups exert equal forces and there is no movement yet; Unbalanced force - when opposing groups exert unequal forces and there is already movement towards the center line.
2. Strategy may vary. To win the game, there must be net force.

Unlocking Content Area Vocabulary (DAY 2)

Activity 3.3 Balanced or Unbalanced Forces
Learners will now identify which real-life situations show balanced or unbalanced forces. To further understand balanced and unbalanced forces, learners need to determine the net force and state of motion of each object. Finally, they need to give a short description of the balanced and unbalanced forces in each situation.

Use the worksheet for this activity (see page 5 – 6).

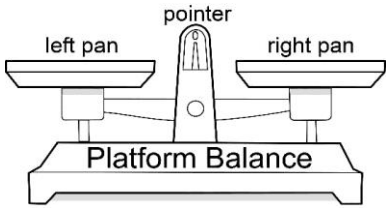
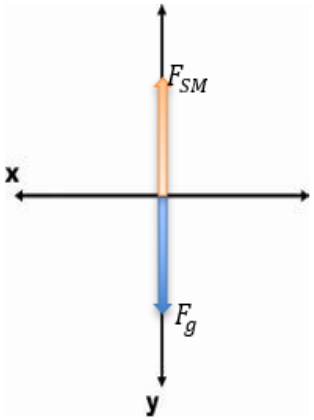
KEY to Activity 3.3

BALANCED FORCES Description: Balanced forces result to zero net force and no change in object's state of motion (at rest or moving at constant speed)	**UNBALANCED FORCES** Description: Unbalanced forces result in nonzero net force and there is a change in the object's state of motion.
1. Pushing with the same amount of force 2. Hanging Chandelier Attached to the Ceiling 3. Sports car moving at constant speed to the right 4. Same number of apples and blocks in each plate of the scale 5. Floating block of wood	1. falling stones 2. lift off of a space rocket 3. rolling a ball along the grass
Net Force: zero **State of Motion** at rest or in motion (at constant speed)	**Net Force**: nonzero **State of Motion** changing speed

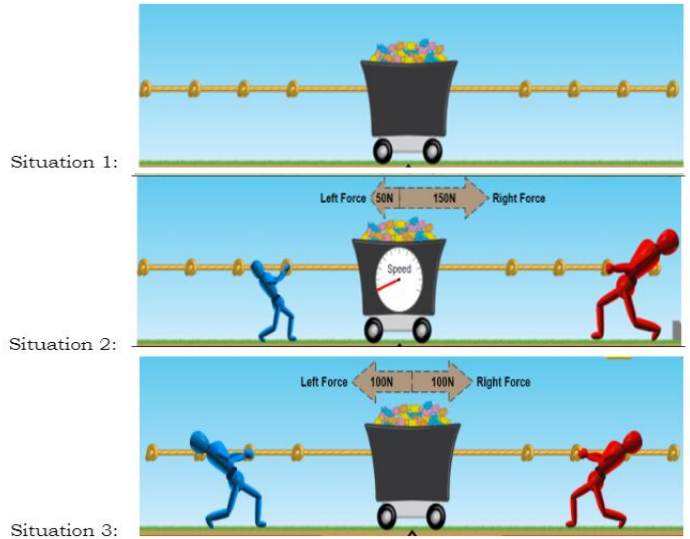
cloth gloves) for the activity. The teacher should also read the Game Proper Guidelines to inform all groups.

The teacher may consider conducting a simple interactive discussion to know the learners' reflections related to activity 3.2. The teacher can ask for student volunteers to share their answers to some of the given questions.

The teacher may ask the learners to answer first the activity before the interactive discussion.

C. Developing and Deepening Understanding	**SUB-TOPIC 1: BALANCED FORCES (DAY 2)** **1. Explicitation** **Activity 3.4 Balanced Exploration** *Use the worksheet for this activity (see page 7 – 8).*  **KEY to Activity 3.4** **Table 1:** Masses of objects will vary but the FBD will be the same for all balanced forces. *(Note: the pointer of the platform balance should be always aligned with zero mark).* **Guide Questions:** 1. No, to get an accurate mass measurement, the pointer must be always aligned with the zero mark. 2. The object was placed carefully in one plate of the platform balance and standard masses will be placed in another plate until the pointer is aligned with the zero mark. 3. The standard masses will counterbalance the force of gravity in the object. 4. The net force is zero since the downward pull of gravity was counterbalanced by the standard masses.  Net force: zero F_{SM} – *Counterbalance Force by standard mass* F_g – *Force of Gravity or Weight* **2. Worked Example** **Pre-activity 3.5 Force and Motion basics Virtual Experiment:** Using PHET, the learners should do the ff.:	To reinforce the concepts of balanced forces, the learners may do first the simple hands-on activity 3.4 with their group. The discussion about balanced and unbalanced forces can be separated to deepen learners' understanding about each topic. **Key to Guide Questions:** It is important that discussions of the activity observations be facilitated by the teacher.

1. Identify all forces acting on the crate.
2. Draw the FBD of the different situations
3. Calculate the net forces along x and y axes
4. Determine the state of motion of the crate
5. Identify if the forces are balanced or unbalanced



Assuming that the frictional force on the rolling crate is negligible and only the force of gravity, Tension and Normal Force acts on the crate, the FBD for the different situations are:

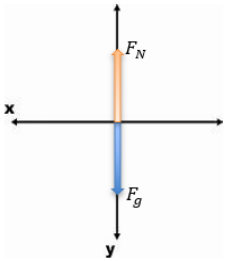


Figure 1. No exerted force from opposite ends of the rope

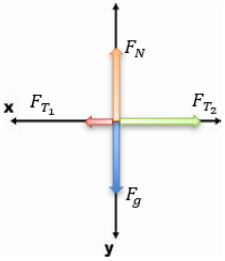


Figure 2. Greater Tension is exerted to the right

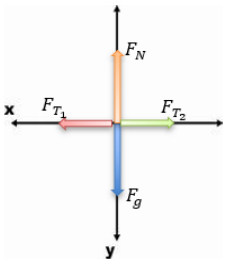


Figure 3. Same amount of force is exerted from opposite ends of the rope

A worked example should be presented before the learner performs the lesson activity independently or by pair.

The teacher can reinforce learners' experience and observation regarding the Activity 3.2 Let's pull each other using the Force and Motion basics virtual experiment.

The teacher may have interactive discussions while demonstrating this interactive simulation.

The teacher's role is to facilitate the discussion while learners actively engage / participate in doing the following tasks in the worked example:

1. Identify all forces acting on the crate.
2. Draw the FBD of the different situations
3. Calculate the net forces along x and y axes
4. Determine the state of motion of the crate.
5. Identify if the forces are balanced or unbalanced?

	$F_{net_x} = NA$ $F_{net_y} = F_N - F_g$ Solution: $F_{net_y} = 0$; *since* $F_N = F_g$ Forces are balanced since there's no movement of the crate along the y-axis.	$F_{net_x} = F_{T_2} - F_{T_1}$ $F_{net_y} = F_N - F_g$ Solution: $F_{net_x} = 150\ N - 50\ N$ $F_{net_x} = 100$ Forces are unbalanced along the x-axis since the crate moves to the right. $F_{net_y} = 0$; *since* $F_N = F_g$ Forces are balanced since there's no movement of the crate along the y-axis.	$F_{net_x} = F_{T_2} - F_{T_1}$ $F_{net_y} = F_N - F_g$ Solution: $F_{net_x} = 100\ N - 100\ N$ $F_{net_x} = 0$ Forces are balanced since there's no movement of the crate along the x-axis. $F_{net_y} = 0$; *since* $F_N = F_g$ Forces are balanced since there's no movement of the crate along the y-axis.

3. Lesson Activity (Day 3)

Learners will first answer the provided worksheet before the short interactive discussion facilitated by the teacher in order to assess their understanding about the topic.

Activity 3.5 Force and Motion Basics Virtual Experiment (25 minutes)

To reinforce the experience and observation of the learners regarding the previous 'Let's pull each other' activity, they will do the Force and Motion basics Virtual Experiment. In this activity, learners will be able to analyze the effects of balanced and unbalanced forces in a virtual experiment related to their firsthand experience.

This can be done individually, by pair, or by group.

Use the worksheet for this activity (see page 9 – 10).

The teacher may emphasize the tasks of the learners in this virtual activity such as determine the ff.:
1. net force
2. description of motion
3. identify if balanced or unbalanced forces.

KEY to Activity 3.5

Simulation

1. 0 N, at rest, balanced
2. 0 N, at rest, balanced
3. 100 N, moving, unbalanced
4. - 50 N, moving, unbalanced
5. 0 N, at rest, balanced

Guide Questions

1. The object will move depending on the direction of the net force.
2. The direction of motion depends on the team which exerted the greater force.
3. No

To reinforce the concepts of unbalanced forces, the learners

4. When the forces exerted by the opposing team are equal.

SUB-TOPIC 2: UNBALANCED FORCES

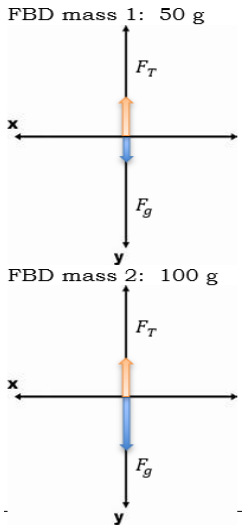
1. Explicitation

Activity 3.6 Unbalanced Exploration

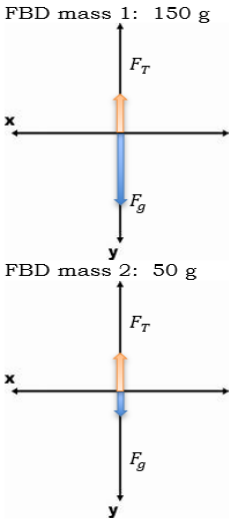
Use the worksheet for this activity (see pages 11 – 12).

KEY to Activity 3.6

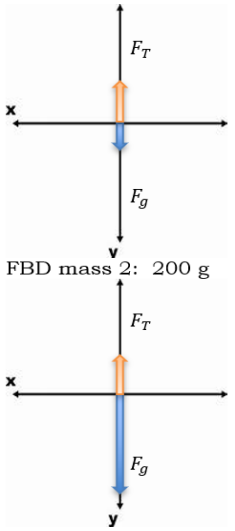
Situation 1:50 g and 100 g *(both masses experienced unbalanced forces since they both move; massive downward, less massive upward)*



Situation 2:150 g and 50 g *(both masses experienced unbalanced forces since they both move; massive downward, less massive upward*



Situation 3:50 g and 200 g *(both masses experienced unbalanced forces since they both move; massive downward, less massive upward*



2. Worked Example (DAY 4)

Activity 3.7 Rocket Sledder Interactive (Working Example)

Use the worksheet for this activity (see pages 13 – 15).

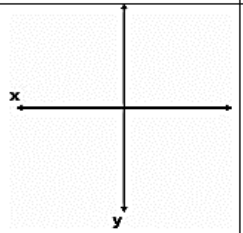
may do first the simple hands-on activity 3.6 with their group.

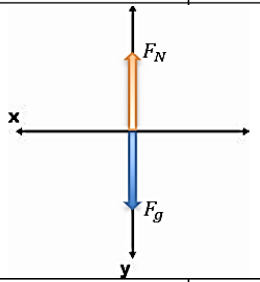
Legend:

F_T – *Tension Force*

F_g – *Force of Gravity or Weight*

The teacher may facilitate interactive discussions while demonstrating this virtual simulation. Learners can volunteer to answer the given situations.

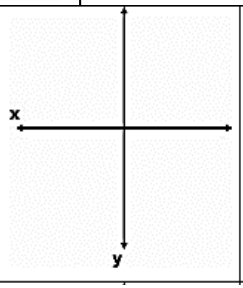
Given	Rocket Sledder FBD	Net Force (x-axis)	Net Force (y-axis)	Motion description
Normal Force 700 N Applied Force: 0 N Friction Force: 0 N Air Drag: 0 N Force of Gravity: 700 N				

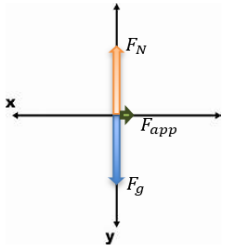


$F_{net_x} = NA$ $F_{net_y} = F_N - F_g$

Solution:
The rocket sledder remains at rest since no other forces acting on it along the x-axis.

$F_{net_y} = F_N - F_g = 700N - 700N$
$F_{net_y} = 0\ ;\ since\ F_N = F_g$
Forces acting are balanced since the rocket sledder did not move along the y-axis.

Normal Force 700 N Applied Force: 20 N Friction Force: 0 N Air Drag: 0 N Force of Gravity: 700 N				



$F_{net_x} = F_{app}$
$F_{net_y} = F_N - F_g$

Solution:

$F_{net_x} = F_{app} = 20\ N$

Forces acting are unbalanced since the rocket sledder moves to the right.

$F_{net_y} = F_N - F_g = 700N - 700N$
$F_{net_y} = 0\ ;\ since\ F_N = F_g$
Forces acting are balanced since the rocket sledder did not move along the y-axis.

A worked example should be done before the learner does the lesson activity independently or by pair.

The teacher may facilitate interactive discussions while demonstrating this interactive simulation.

The teacher's role is to facilitate the discussion while learners actively engage / participate in doing the ff. tasks in the worked example:

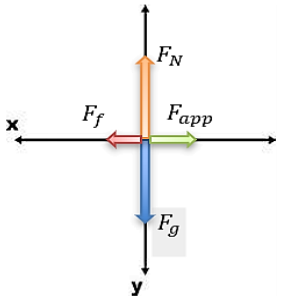
1. Draw the FBD of the different situations
2. Calculate the net forces along x and y axes
3. Describe the motion
4. Determine if balanced or unbalanced forces acting on the rocket sledder.

3. Lesson Activity
Activity 3.7 Rocket Sledder Interactive Simulation

Use the worksheet for this activity (see pages 13 – 15).

KEY to Activity 3.6

Situation 1:

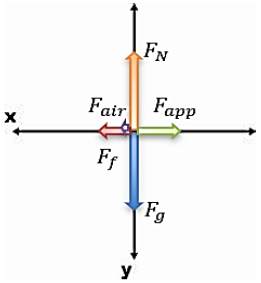


$F_{net_x} = F_{app} - F_f$
$F_{net_y} = F_N - F_g$

Solution:
$F_{net_x} = 70\ N - 50\ N$
$F_{net_x} = 20\ N$
Forces acting are unbalanced since the rocket sledder moves to the right.

$F_{net_y} = F_N - F_g = 700N - 700N$
$F_{net_y} = 0\ ;\ since\ F_N = F_g$
Forces acting are balanced since the rocket sledder did not move along the y-axis.

Situation 2:

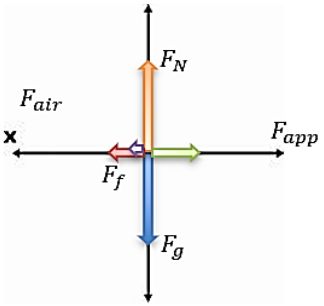


$F_{net_x} = F_{app} - F_f$
$F_{net_y} = F_N - F_g$

Solution:
$F_{net_x} = 70\ N - 50\ N$
$F_{net_x} = 20\ N$
Forces acting are unbalanced since the rocket sledder moves to the right.

$F_{net_y} = F_N - F_g = 700N - 700N$
$F_{net_y} = 0\ ;\ since\ F_N = F_g$
Forces acting are balanced since the rocket sledder did not move along the y-axis.

Situation 3:



$F_{net_x} = F_{app} - F_f - F_{air}$
$F_{net_y} = F_N - F_g$

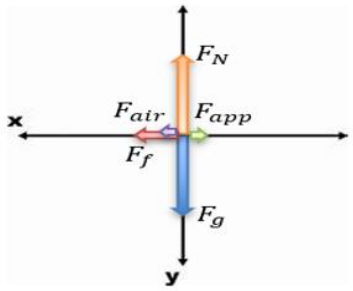
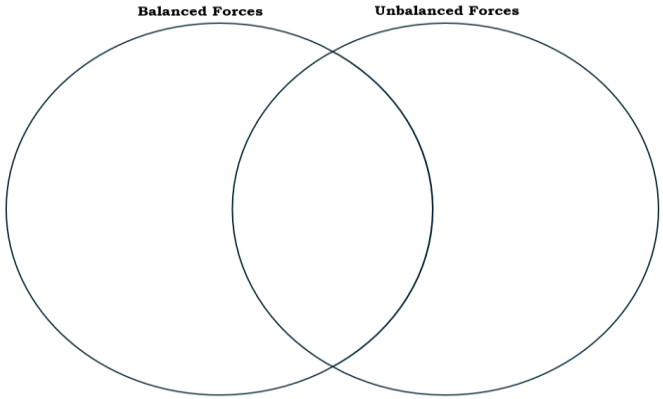
Solution:
$F_{net_x} = 70\ N - 50\ N - 20\ N$
$F_{net_x} = 0\ N$
Forces acting are balanced, the rocket moves at constant speed.

$F_{net_y} = F_N - F_g = 700N - 700N$
$F_{net_y} = 0\ ;\ since\ F_N = F_g$
Forces acting are balanced since the rocket sledder did not move along the y-axis.

Learners will answer first the provided worksheet before the short interactive discussion facilitated by the teacher to assess their understanding about the topic.
This can be done individually, by pair or by group.

The teacher may emphasize the tasks of the learners in this virtual activity such as:
1. draw the FBD
2. calculate the net forces along and y -axes
3. description of motion
4. determine if balanced or unbalanced forces are acting on it.

KEY to the Guide Questions
1. The rocket sledder moves at constant speed since the net force is zero.
2. The rocket sledder slows down.
3. The rocket sledder speeds up.
4. The rocket sledder moves at constant speed since the net force is zero.
5. The forces along the y -axis, force of gravity and normal force.

	Situation 4:  $F_{net_x} = F_{app} - F_f - F_{air}$ $F_{net_y} = F_N - F_g$ Solution: $F_{net_x} = 100\ N - 50\ N - 20\ N$ $F_{net_x} = 30\ N$ Forces acting are unbalanced since the rocket sledder moves to the right. $F_{net_y} = F_N - F_g = 700N - 700N$ $F_{net_y} = 0\ ;\ since\ F_N = F_g$ Forces acting are balanced since the rocket sledder did not move along the y-axis.	
D. Making Generalizations	**1. Learners' Takeaways (DAY 4)** Using the Venn Diagram, the learner will differentiate balanced from unbalanced Forces.  • Balanced Forces: ✓ Zero net force ✓ Objects can be at rest or moving at constant speed ✓ Do not cause any change in motion ✓ May have equal magnitude forces in the opposite direction • Unbalanced Forces: ✓ Nonzero net force ✓ Objects moving at changing speed ✓ Cause a change in motion ✓ May have unequal magnitude forces in the opposite direction • BOTH ✓ Involves force/s acting on the object	To make generalization of the lessons learned, the teacher may call volunteers to write their answers on the Venn Diagram regarding the similarities and differences of balanced and unbalanced forces.

	2. Reflection on Learning **One-Page Reflection** Compose a one-page reflection discussing the real-life applications of balanced and unbalanced forces. Explain how these applications deepen your understanding of physics.	Answers may vary for the One-page reflection.

IV. EVALUATING LEARNING: FORMATIVE ASSESSMENT AND TEACHER'S REFLECTION		**NOTES TO TEACHERS**
A. Evaluating Learning	**1. Formative Assessment (DAY 4)** **Activity 3.8 Simple Problem-Solving Activity** *Use the worksheet for this activity (see pages 16 – 17).* **2. Homework (Optional)** Make an infographic about how scientists/ engineers use the concepts of balanced and unbalanced forces in their tasks.	**KEY to Assessment** 1. Situation 1: oven on tabletop Net Force (x-axis): NA Net Force (y-axis): 0 State of Motion: at rest Direction of motion: NA 2. Situation 2: falling skydiver Net Force (x-axis): NA Net Force (y-axis): -392 N State of Motion: moving Direction of motion: downward 3. Situation 3: pulling a cart on a smooth surface Net Force (x-axis): NA Net Force (y-axis): 15 N State of Motion moving Direction of motion: right 4. Situation 4: moving car at constant speed Net Force (x-axis): 0 N Net Force (y-axis): 0 N State of Motion: at rest

<table>
<tr><td></td><td colspan="3"></td><td>Direction of motion: NA

The teacher may ask student volunteers to share and discuss their answers to the assignment to enhance the overall learning experience of the learners.</td></tr>
<tr><td rowspan="5">B. Teacher's Remarks</td><td>Note observations on any of the following areas:</td><td>Effective Practices</td><td>Problems Encountered</td><td rowspan="5">The teacher may take note of some observations related to the effective practices and problems encountered after utilizing the different strategies, materials used, learner engagement and other related stuff. They may also suggest ways to improve the different activities explored/ lesson exemplar.</td></tr>
<tr><td>strategies explored</td><td></td><td></td></tr>
<tr><td>materials used</td><td></td><td></td></tr>
<tr><td>learner engagement/ interaction</td><td></td><td></td></tr>
<tr><td>others</td><td></td><td></td></tr>
<tr><td>C. Teacher's Reflection</td><td colspan="3">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>learners</u>
What roles did my learners play in my lesson?
What did my learners learn? How did they learn?
▪ <u>ways forward</u>
What could I have done differently?
What can I explore in the next lesson?</td><td>Teacher's reflection in every lesson conducted/ facilitated is essential and necessary to improve practice. You may also consider this as an input for the LAC sessions.</td></tr>
</table>