8

Lesson Exemplar for Science

Quarter 4

Lesson

8

IMPLEMENTATION OF THE MATATAG K TO 10 CURRICULUM

Lesson Exemplar for Science Grade 8
Quarter 4: Lesson 8 of 8 (Week 8)
SY 2025-2026

Development Team

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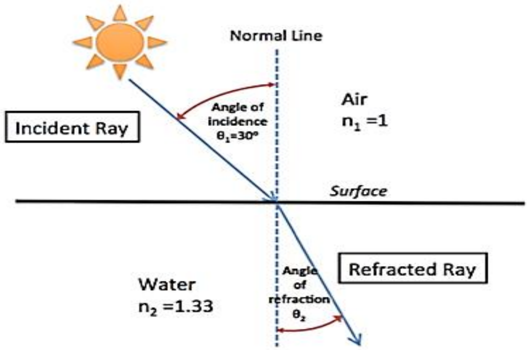
Every care has been taken to ensure the accuracy of the information provided in this material. For inquiries or feedback, please write or call the Office of the Director of the Bureau of Learning Resources via telephone numbers (02) 8634-1072 and 8631-6922 or by email at blr.od@deped.gov.ph

SCIENCE (PHYSICS)/QUARTER 4/ GRADE 8

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	*Carry out guided investigations to describe and illustrate the refraction of light using plane and curved mirrors and the refraction of light using transparent blocks, lenses, and prisms with examples from everyday applications.* *Lesson Objective 1: describe* Snell's Law (Law of Refraction) *Lesson Objective 2: determine* the characteristics of images formed by concave and convex lenses. *Lesson Objective 3: make* ray diagrams following the Law of Refraction to locate the image.
D. Content	**Refraction of Light** a. Refraction is the bending of lights as it passes obliquely from one transparent medium to another. b. Snell's Law (Law of Refraction) is the relationship between the path taken by a ray of light as it passes obliquely from one transparent medium to another.  Light bends towards the normal, if light enters from a less dense to a denser medium. Light bends away from the normal, if light enters a denser to a less dense medium.

	c. The image formed by a double convex lens varies depending on the location of the object from the lens. The image can be any of the following.: i. real, inverted and smallersmaller (if the object is located beyond **2F**) ii. real, inverted and same in size (if the object is located at **2F** iii. real, inverted and largerlarger (if the object is located between the **2F** and **F**) iv. virtual, uprightupright and largerlarger (if the object is located between the **O** and **F**) d. The image formed by a double concave lens is always uprightupright, virtual and smallersmaller.
E. Integration	Real World Applications of Refraction of Light in Transportation, Medicine, …

II. LEARNING RESOURCES
The Physics Classroom. (n.d.). Rocket Sled Interactive. Retrieved from The Physics Classroom: https://www.physicsclassroom.com/Physics-Interactives/Refraction-and-Mirrors/Optics-Bench/Optics-Bench-Interactive University of Colorado Boulder, licensed under CC-BY-4.0 (https://phet.colorado.edu). (n.d.). Simulation by PhET Interactive Simulations. https://phet.colorado.edu/sims/html/geometric-optics/latest/geometric-optics_all.html University of Colorado Boulder, licensed under CC-BY-4.0. (n.d.). Simulation by PhET Interactive Simulations. https://phet.colorado.edu https://cdn.britannica.com/64/151064-138-E52ED5A0/Explanation-refraction.jpg https://focuseyecentre.com.au/wp-content/uploads/2019/07/thumbnail_david-travis-aVvZJC0ynBQ.jpg PhD D.M. Gonong, , PhD A.J. Pelgone, Philippine Normal University https://1.bp.blogspot.com/-5_2j4aq-o9Q/UbvHVnUJgKI/AAAAAAAAPkw/0xvjIEccKRI/w1200-h630-p-k-no-nu/magnify+it.jpg

III. TEACHING AND LEARNING PROCEDURE		**NOTES TO TEACHERS**
A. Activating Prior Knowledge	**DAY 1** **Lesson Purpose** **Activity 1.** (15 minutes) *Use the learning activity sheet (page 1).* **KEY to Activity 1** **Situations:** ● Situation 1: The popsicle stick looks bent and enlarged in water.	See Learning Activity Sheet: *Activity # 1: Practical Light Refraction* The teacher should encourage the learners to observe and describe the pictures.

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- Situation 2: Clearer texts can be seen using eyeglasses.
- Situation 3: Magnifier enlarged the picture/ object.
- Situation 4: A microscope can enlarge the image of a glass slide sample.

Guide Questions:

1. The popsicle looks bent as observed from outside. As the popsicle enters the air-water surface, the bending or refraction effect of light can be observed.

2. Eyeglasses can be used by individuals to see clearly. Magnifying glass or some lenses can be used to magnify things.

3. Microscopes have lenses that enable them to magnify glass slide samples.

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Ask learner volunteers to discuss and explain their observations.

Then, facilitate a class discussion to process their observations.

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B. Establishing Lesson Purpose

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Activity 2. (20 minutes)
Use the learning activity sheet (page 2).

KEY to Activity 2
Guide Questions

1. Tissue paper is a translucent material that can allow some light to pass through it.
2. Light can be transmitted using transparent materials.

Unlocking Content Area Vocabulary
Activity 3. (10 minutes)
See Learning Activity Sheet: *Activity #2 Exploring Light Transmission (page 3).*

KEY to Activity 3

1. REFRACTION
2. VIRTUAL
3. UPRIGHT
4. LARGER
5. INVERTED
6. REAL
7. SAME
8. NORMAL LINE
9. REFRACTED
10. INCIDENT

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See Learning Activity Sheet: *Activity #2 Exploring Light Transmission*

To establish the lesson purpose, learners may do Activity 2 Exploring Light Transmission. The teacher may consider other available reflecting or refracting surfaces. On the day of the activity, the teacher may divide the class into groups to perform this simple activity.

The teacher may consider conducting a simple interactive discussion to know the learners' refractions related to activity 2. The teacher can ask volunteers to share their observations and answer guide questions.

The learner should answer this unlocking activity before the interactive discussion. The teacher may explain further the meaning of the different terms/ vocabulary.

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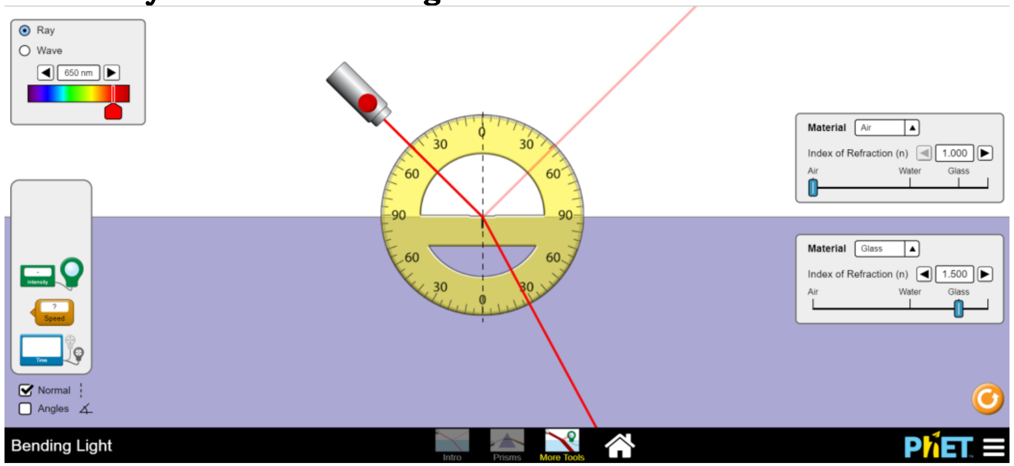
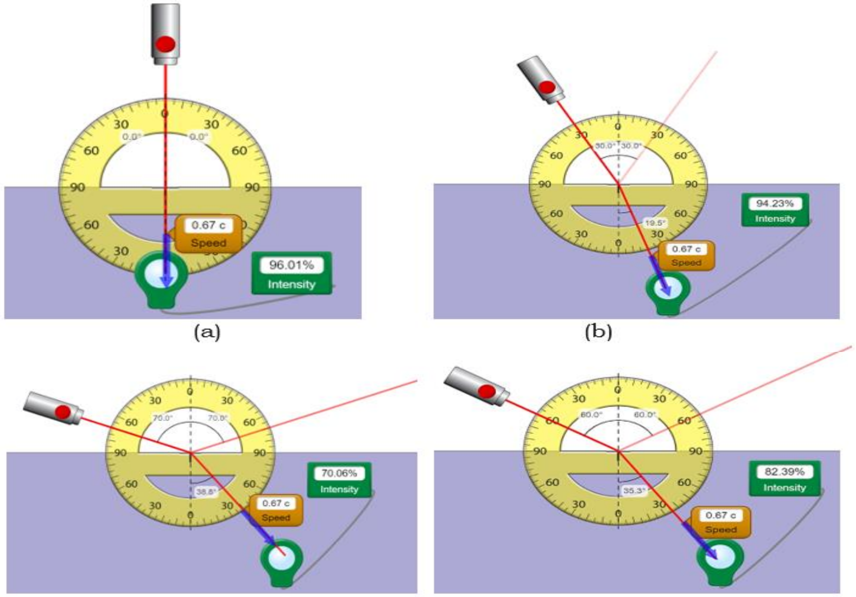
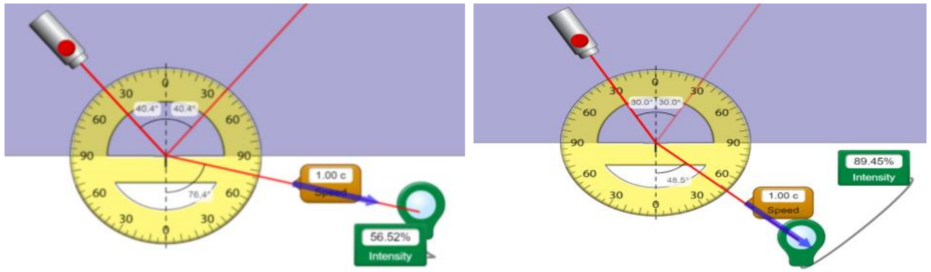
C. Developing and Deepening Understanding	**DAY 2** **SUB-TOPIC 1: Refraction of Light** **1. Explicitation** **Activity 4.** (20 minutes) *Use the learning activity sheet (pages 4-5).* **KEY to Activity 4 Guide Questions:** 1. The angle of incidence is not equal to the angle of refraction. As the angle of incidence increases, the angle of refraction also increases. 2. As light passes obliquely from air to glass, it bends towards the normal line. 3. As light passes obliquely from glass to air, it bends away from the normal line. 4. The angle of incidence and refraction is equal to zero. **2. Worked Example** **Pre-activity: Refraction of Light**  Image Source: phet.colorado.edu Refraction is the bending of light as it passes obliquely from one medium into another. There is no bending if the incident ray is along the normal line as shown in fig. (a). The intensity of light decreases when light passes from one transparent medium to another because some of it is being reflected partially. The speed of light decreases as it enters obliquely from one transparent medium to another, e.g. air to glass.	See Learning Activity Sheet: *Activity #4: Snell's Law* Note to Teacher: If possible, provide several setups for all groups. After the activity, the teacher will facilitate the discussion about the Law of Refraction. The teacher's role is to facilitate the discussion while learners actively engage / participate in doing the following tasks in the worked example:



(a) (b) (c) (d)

When light is from less dense (air) to denser medium (glass), light bends towards normal. The angle of incidence is always greater than the angle of refraction. As the incident angle increases, the angle of refraction also increases. There is also a partial reflection seen in transparent materials such as glass and water that follows the law of reflection.

On the other hand, when light is from denser (glass) to less dense (air) medium, light bends away from normal. The angle of incidence is always less than the angle of refraction.



Ask a volunteer to give the angle of incidence and angle of refraction in the figures.

Ask another volunteer to measure the angle of incidence and angle of refraction.

Based on the measured angle, ask another volunteer to describe the Law of Refraction.

Image Source: *phet.colorado.edu*

The teacher should facilitate the interactive discussion after the learners answer the activity.

3. Lesson Activity

Activity 5.: Snell's Law (Law of Refraction)

Use the learning activity sheet (pages 6-8).

KEY to Activity 5:

Bending of Light Parameters

Medium	Intensity of Light in medium (II)	Speed of light in medium (v)	Speed of light in vacuum (c)	c/v	Index of refraction (n)
Air	88.50%	1.00 c	$3x10^8$ m/s	1.00	1.000
Water	81.56%	0.75 c		1.33	1.333
Glass	96.84%	0.67 c		1.49	1.500

Bending of Light

	Index of refraction n_1	Index of refraction n_2	Angle of Incidence (θ_1)	Angle of Refraction (θ_1)	Description (Describe how light bends from the normal line)
Water to Air	1.333	1.000	40^o	60^o	away from the normal
Air to Water	1.000	1.333	40^o	29^o	towards the normal
Water to Glass	1.333	1.500	60^o	50^o	towards the normal
Glass to Water	1.500	1.333	60^o	78^o	away from the normal

Guide Questions

1. The light bends towards the normal line as it enters obliquely from air to glass.
2. The speed of light is slower in denser materials.
3. The intensity of light decreases since some of it is partially reflected.
4. There is no bending of light if the incident ray is along the normal line. Thus, the angle of incidence and refraction are both zero.

DAY 3

SUB-TOPIC 2: Refraction of Light in Double Convex lens

1. Explicitation

Activity 6. (20 minutes)

Use the learning activity sheet (page 9).

KEY to Activity 6:

Distance of the Object	Location of the image (in front or behind the lens)	Characteristics of the image
30 cm	*Behind the lens*	*Real, inverted, smaller*

See Learning Activity Sheet: *Activity #5: Snell's Law (Law of Refraction)*

See Learning Activity Sheet: *Activity #6: Images of a Double Convex Lens*

Notes to Teacher:
If possible, provide several setups for all groups.

25 cm	*Behind the lens*	*Real, inverted, smaller*
20 cm	*Behind the lens*	*Real, inverted, same size*
15 cm	*Behind the lens*	*Real, inverted, larger*
5 cm	*Infront of the lens*	*Virtual, upright, larger*

After the activity, the teacher will facilitate the discussion about the Law of Refraction in Double convex lens

Guide Questions:

1. The image formed by a double convex lens varies depending on the location of the object from the lens. The image can be any of the following:
    a. real, inverted and smaller (if the object is located beyond 2F)
    b. real, inverted and same size (if the object is located at 2F
    c. real, inverted and larger (if the object is located between the 2F and F)
    d. virtual, upright and larger (if the object is located between the O and F)
2. If the object is located very near the double convex lens (e.g. less than 10 cm)
3. If the object is located at 20 cm in front of the double convex lens.)

2. Worked Example

Pre-activity: Image Formation by a Double convex lens

Using the PhET interactive simulation, demonstrate the Snell's Law (law of refraction) in terms of image formation by a double convex lens.

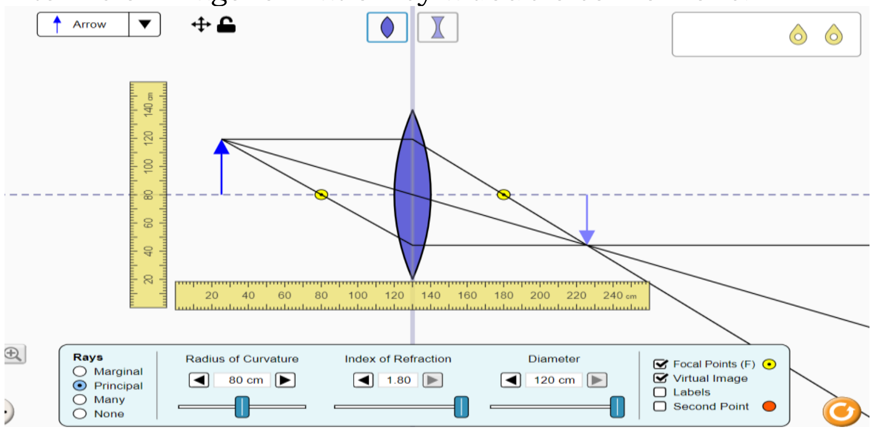
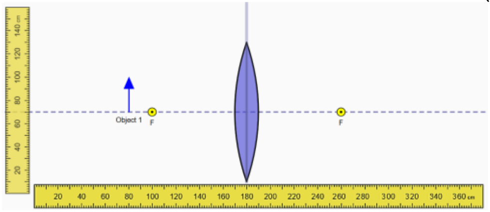


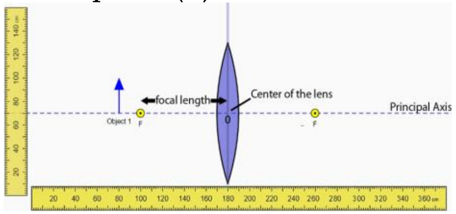
Image Source: *phet.colorado.edu*

How can we determine the location of the image formed by a double convex lens? What are the characteristics of the image formed?

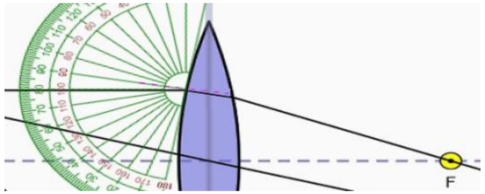
You may ask learners to reflect on the topic, if they really understood the process for the Image Formation by a double convex lens.

A 30 cm object is placed 100 cm in front of a double convex lens. The yellow circle represents the focal point (F) of the lens. The focal length (f) is the distance from the center of the lens (O) to the focal point (F).

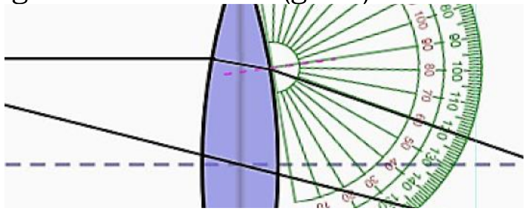




Based on the figure, the angle of incidence (5 degrees) is greater than the angle of refraction (around 3 degrees) since light is from less dense (air) to denser (glass) medium.



On the other hand, the angle of incidence (20^0) is less than the angle of refraction (30^0) since light is from denser (glass) to less dense (air) medium.

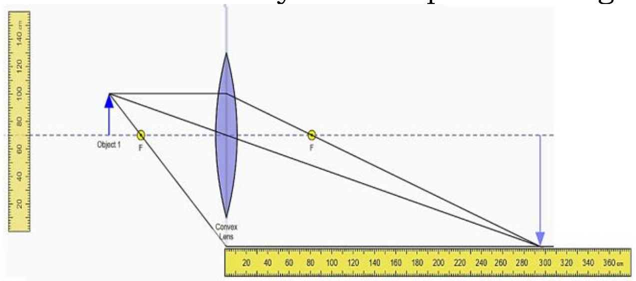


Using Snell's Law (Law of Refraction), you can determine the location of the image formed. The bending of light varies from air to glass (bends towards the normal) and glass to air (bends away from normal).

For easier ray diagramming, the following rules may be followed:

1. If the incident ray is parallel to the principal axis, the refracted ray passes the focal point (F).

2. If the incident ray passes the focal point, the refracted ray is parallel to the principal axis.
3. If the incident ray is along the center of the lens (O), the refracted ray is still along the center of the lens (O).
4. The intersection of the refracted rays is the tip of the image.



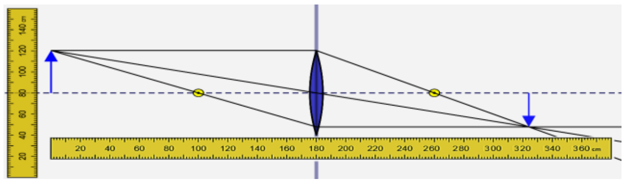
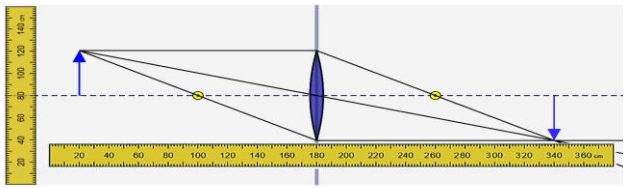
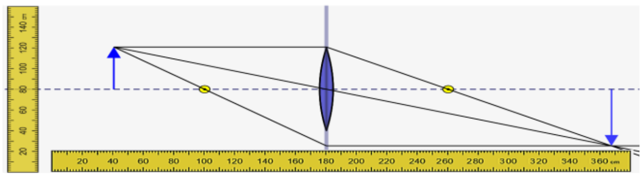
3. Lesson Activity

Activity 7. (30 minutes)

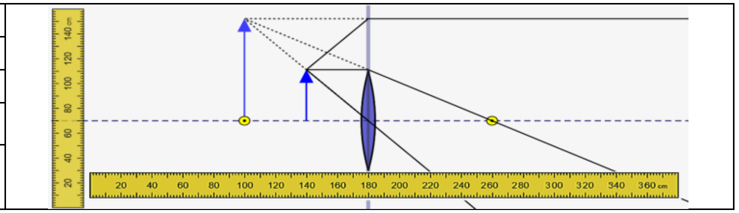
Use the learning activity sheet (pages 10 -12).

See Learning Activity Sheet: *Activity #7: Image Formation by a Double Convex Lens*

KEY to Activity 7 (Ray Diagrams)

f = 80 cm	
d_o = 180 cm	
d_i =144 cm	
s_o = 40 cm	
s_i = -32 cm	
Real, inverted & smaller	
f = 80 cm	
d_o = 160 cm	
d_i =160cm	
s_o = 40 cm	
s_i = 40 cm	
Real, inverted & same size	
f = 80 cm	
d_o = 140 cm	
d_i =187cm	
s_o = 40 cm	
s_i = -54 cm	
Real, inverted & larger	
f = 80 cm	

Learners will first answer the provided worksheet before the short interactive discussion facilitated by the teacher to

d_o = 40 cm	
d_i =- 160 cm	
s_o = 40 cm	
s_i = 82 cm	
Virtual, upright & larger	

Guide Questions:

1. To locate the image formed by a double convex lens, there must be at least two intersecting refracted rays. The intersection of these refracted rays indicates the tip of the image. If the refracted rays do not intersect behind the double convex lens, it can be extended in front of the lens.
2. The image formed by a double convex lens varies depending on the location of the object from the lens. The image can be any of the ff.:
   a. real, inverted and smaller (if the object is located beyond 2F)
   b. real, inverted and same size (if the object is located at 2F
   c. real, inverted and larger (if the object is located between the 2F and F)
   d. virtual, erect and larger (if the object is located between the O and F)

DAY 4
SUB-TOPIC 3: Refraction of Light in Double Concave Lens
1. Explicitation
Activity 8. (20 minutes)
Use the learning activity sheet (page 13).

KEY to Activity 8:

Images of a double concave lens

Distance of the Object	Location of the image	Characteristics of the image
30 cm	Infront of the lens	Virtual, upright, smaller
25 cm	Infront of the lens	Virtual, upright, smaller
20 cm	Infront of the lens	Virtual, upright, smaller
15 cm	Infront of the lens	Virtual, upright, smaller
10 cm	Infront of the lens	Virtual, upright, smaller

assess their understanding about the topic.

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

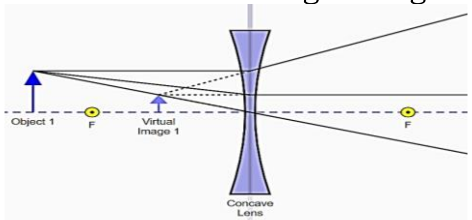
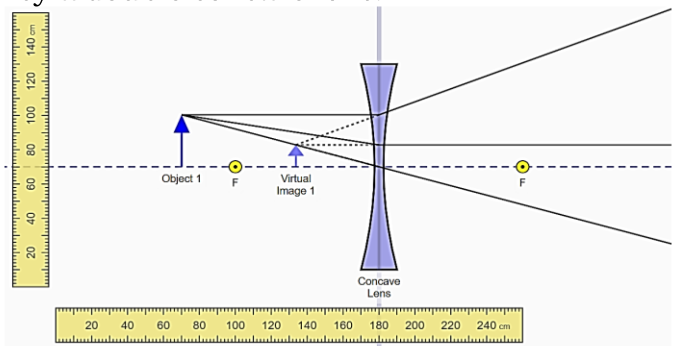
The teacher may emphasize the tasks of the learners in this virtual activity such as determining the following:

1. Use the Law of Refraction to make incidents and refracted rays
2. Locate the image formed by a double convex lens.
3. Measure the focal length, distance and size of the object and image formed (in cm).
4. Describe the characteristics of an image formed as real or virtual, inverted or upright, smaller, larger or same size.

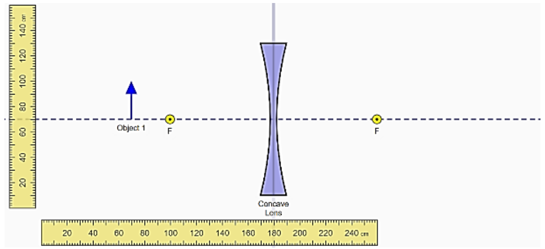
See Learning Activity Sheet: *Activity #8: Images of a Double Concave Lens*

If possible, provide several setups for all groups.

After the activity, the teacher will facilitate the discussion about the Law of Refraction in Double Concave lens

	Guide Questions 1. The image formed by a double concave lens is always virtual, upright and smaller. 2. You cannot form larger image than the object. 3.  **2. Worked Example** **Pre-activity: Image Formation by a Double concave lens** Using the PhET interactive simulation, demonstrate the law of refraction in terms of image formation by a double concave lens.  *Link:* [*phet.colorado.edu*](phet.colorado.edu) *How can we determine the location of the image formed by a double concave lens? What are the characteristics of the image formed?*	Learners will first answer the provided worksheet before the short interactive discussion facilitated by the teacher to assess their understanding about the topic. This should be done by a group. The teacher should encourage the learners to think how they can make ray diagrams using the Law of Refraction to determine the location of the image formed in front of a double concave lens. The teacher's role is to facilitate the discussion while learners actively engage / participate in doing the following tasks in the worked example: 1. Use the Law of Refraction to make incidents and refracted rays 2. Locate the image formed by a double convex lens. 3. Measure the distance and size of the object and image formed (in cm). 4. Describe the characteristics of an image formed as real or virtual, inverted or upright, smaller, larger or same size.

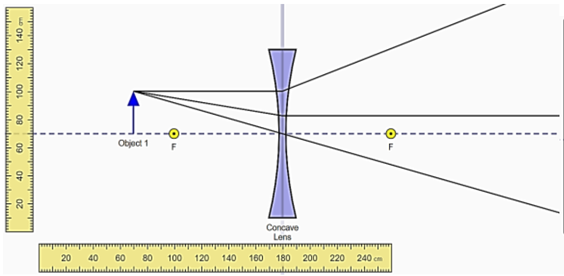
A 30 cm object is placed 185 cm in front of a double concave lens. The focal length, which is half of the radius of curvature, is 75 cm.

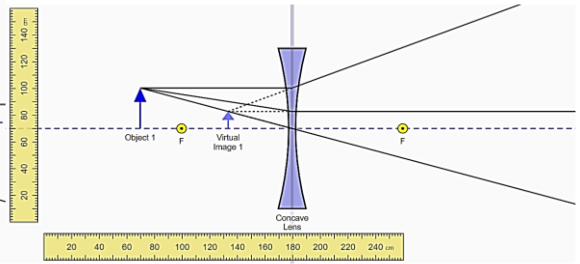


Using Snell's Law (Law of Refraction), you can determine the location of the image formed. The bending of light varies from air to glass (bends towards the normal) and glass to air (bends away from normal).

For easier **ray diagramming**, the following rules should be followed:

1. If the incident ray is parallel to the principal axis, the refracted ray passes the focal point (F).
2. If the incident ray passes the focal point, the refracted ray is parallel to the principal axis.
3. If the incident ray is along the center of the lens, the refracted ray is still along the center of the lens (O).
4. The intersection of the refracted rays is the tip of the image.





3. Lesson Activity

Activity 9. (30 minutes)

(Please see worksheet for the complete details)

Ask a volunteer to make a normal line and use a protractor to measure the angle of incidence and angle of refraction to verify the law of refraction. (Similar to double convex lens).

Ask another volunteer to use a ruler to measure the ff:

a. focal length of the lens

b. size of the object

c. distance of the object

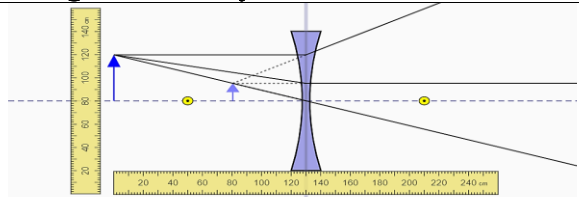
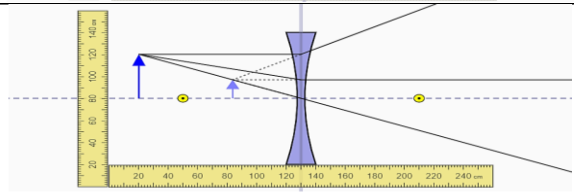
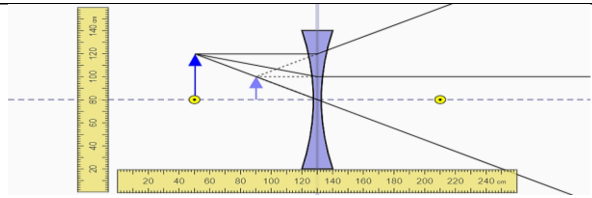
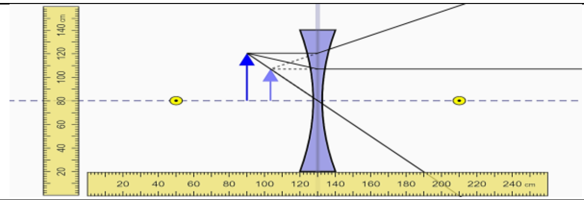
d. size of the image

e. distance of the image

The teacher may emphasize the tasks of the learners in this virtual activity such as determining the following:

1. Use the Law of Refraction to make incidents and refracted rays or the ways to do ray diagrams.
2. Locate the image formed by a double concave lens.
3. Measure the focal length, distance and size of the object and image formed (in cm).
4. Describe the characteristics of an image formed as <u>real or virtual</u>, <u>inverted or upright</u>, <u>smaller, larger or same in size</u>.

See Learning Activity Sheet: *Activity #9: Image Formation by a Double Concave Lens*

Situations	Image Formed by a Double concave lens
f = 40 cm	
d_o = 130 cm	
$d_i = -50\ cm$	
$s_o = 40\ cm$	
$s_i = 16\ cm$	
virtual, smaller, upright	
f = 40 cm	
d_o = 110 cm	
d_i =-46 cm	
s_o = 40 cm	
s_i = 17 cm	
virtual, smaller, upright	
f = 40 cm	
d_o = 80 cm	
d_i =-40 cm	
s_o = 40 cm	
s_i = 20 cm	
virtual, smaller, upright	
f = 40 cm	
d_o = 50 cm	
d_i = - 30 cm	
s_o = 40 cm	
s_i = 24 cm	
virtual, smaller, upright	

Guide Questions:

1. To locate the image formed by a double concave lens, there must be at least two intersecting refracted rays. The intersection of these refracted rays indicates the tip of the image. If the refracted rays do not intersect behind a double concave lens, it can be extended in front of the lens.
2. The image formed by a double concave lens is always virtual, erect and diminished.

D. Making Generalizations	**1. Learners' Takeaways**	To make generalization of the lessons learned, the teacher may call volunteers to

Complete the table for the characteristics of images formed by concave and convex lens.

Type of Mirror	Size of the image	Location of the image	Characteristics of the image
Double Convex	Larger	behind the mirror	Virtual, upright & Larger ($d_o < f$)
	-	at infinity	Real, Inverted & Same size ($d_o = f$)
	Same size	in front of the mirror	Real, Inverted & Same size ($d_o = 2f$)
	Larger	in front of the mirror	Real, Inverted Larger ($2f > d_o > f$)
	Smaller	in front of the mirror	Real, Inverted & smaller ($d_o > 2f$)
		in front of the mirror	Real, Inverted & smaller (d_o $at\ infinity$)
Double Concave	smaller	In front of the lens	Virtual, upright and smaller

complete the table about the different images formed by a double convex and double concave lens.

2. Refraction on Learning
One-Page Refraction
Compose a one-page refraction discussing the real-life applications of concave and convex lenses. Explain how these applications deepen your understanding of physics.

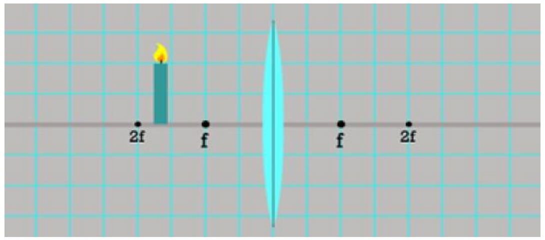
Answers may vary for the One-page refraction.

IV. EVALUATING LEARNING: FORMATIVE ASSESSMENT AND TEACHER'S REFRACTION

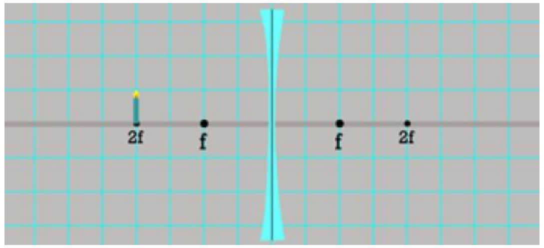
NOTES TO TEACHERS

A. Evaluating Learning

1. Formative Assessment
This assessment evaluates learners' understanding of the topics discussed.
1. Make ray diagrams and draw the image formed by a double convex lens. Describe the image formed.



The teacher may ask learner volunteers to share and discuss their answers to the assignment. The sharing process can enhance the overall learning experience of the learners.

<table>
<tr><td></td><td colspan="3">2. Make ray diagrams and draw the image formed by a double concave lens.
Describe the image formed.


2. Homework (Optional)
Make a poster of the different applications of convex and concave lenses related to Navigation, Health Services, or Research. Then, describe how lenses or refracting materials were used in the chosen application.</td><td></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">This lesson design component prompts the teacher to record relevant observations and/or critical teaching events that he/she can reflect on to assess the achievement of objectives. The documenting of experiences is guided by possible areas for observation including teaching strategies employed, instructional materials used, learners’ engagement in the tasks, and other notable instructional areas.

Notes here can also be on tasks that will be continued the next day or additional activities needed.</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>
</table>

C. Teacher's Reflection	*Reflection guide or prompt can be on:* ▪ *principles behind the teaching* *What principles and beliefs informed my lesson?* *Why did I teach the lesson the way I did?* ▪ *learners* *What roles did my learners play in my lesson?* *What did my learners learn? How did they learn?* ▪ *ways forward* *What could I have done differently?* *What can I explore in the next lesson?*	This lesson design component guides the teacher in reflecting on and for practice. Entries on this component will serve as inputs for the LAC sessions, which can center on sharing the best practices discussing problems encountered and actions to be taken; and identifying anticipated challenges and intended solutions. Guide questions or prompts may be provided here.