



Science Objectives

- Students will explore the direction of light rays through concave and convex lenses.
- Students will determine the affect the focal points have on light rays leaving a lens.
- Students will explore the images that are produced from concave and convex lenses.

Vocabulary

- concave
- converging
- convex
- diverging
- focus, foci, focal length
- real image
- virtual image

About the Lesson

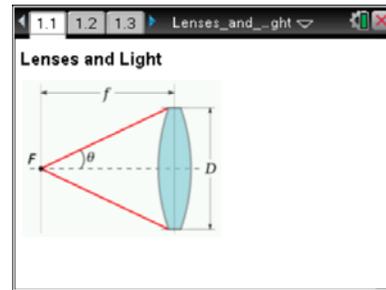
- In this lesson, students will explore the characteristics of lenses.
- As a result, students will:
 - Develop an understanding of the affect different types of light have on light rays.
 - Relate the effect of a light ray to the focal point of a lens.
 - Explore the relationship of objects to the images that are produced when light passes through a lens.

TI-Nspire™ Navigator™

- Send out the *Lenses_and_Light.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.
- Collect the student .tns file and evaluate the student understanding.

Activity Materials

- *Lenses_and_Light.tns* document
- TI-Nspire™ Technology



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Use a minimized slider
- Construct a Locus

Tech Tips:

Make sure that students understand how to create a Locus by pressing **Menu > Construction > Locus**.

Lesson Materials:

Student Activity

- *Lenses_and_Light_Student.doc*
- *Lenses_and_Light_Student.pdf*

TI-Nspire document

- *Lenses_and_Light.tns*

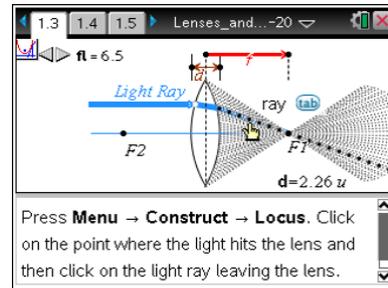


Discussion Points and Possible Answers

Move to pages 1.2 and 1.3.

Convex Lenses

The students press **Menu > Construction > Locus**. At that point they should place the cursor over the point where the light ray touches the lens and click. They then place the cursor on the ray exiting the lens. This shows how light rays at different positions on the lens will exit the lens.



Move to pages 1.4–1.6.

Have students answer the questions on either the handheld, on the activity sheet, or both.

Q1. As light passes through a convex lens, light rays _____.

Answer: C. converge

Q2. The point where light comes together is known as the _____.

Answer: A. focal point

Q3. The thicker the lens, the _____.

Answer: A. shorter the focal length

Tech Tip: When students use the Locus tool, have them click on the point where the ray meets the lens and then click on the ray that is leaving the lens to produce all the paths that would be produced by the light leaving the lens.

TI-Nspire Navigator Opportunities

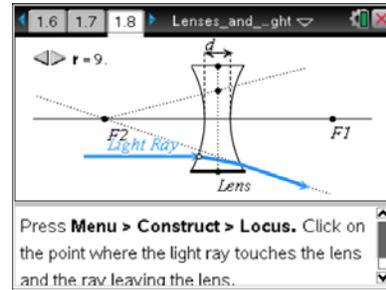
Use Live Presenter to have one student demonstrate the locus to the class and open a discussion about the point at which all of the light converges.



Move to pages 1.7 and 1.8.

Concave Lenses

2. On Page 1.8 there is a concave lens. Grab the point where the Light Ray touches the lens and drag it up and down the lens. Observe the effect on the Light Ray leaving the lens.
3. The students press **Menu > Construction > Locus**. At that point they should place the cursor over the point where the Light Ray touches the lens and click. They then place the cursor on the ray exiting the lens. This shows how light rays at different positions on the lens will exit the lens. The slider allows students to look at different curvatures of lens to see that effect also.



Move to pages 1.9 and 1.10.

Have students answer the questions on either the handheld, on the activity sheet, or both.

- Q4. What occurs when the light passes through a concave lens?

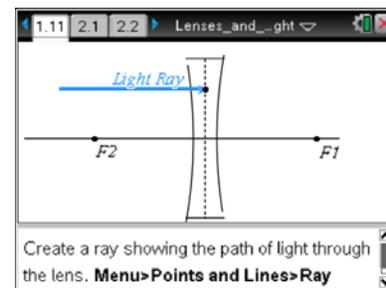
Answer: The light rays diverge.

- Q5. How can the path of light leaving the lens be predicted?

Answer: By drawing a ray from the focal point through the lens.

Move to page 1.11.

4. Students will draw a ray from the focal point (F2) through the end point of the light ray by pressing **Menu > Points and Lines > Ray**. They then click on the focal point (F2) to set the first point and click on the end point of the ray to set the second point.



TI-Nspire Navigator Opportunities

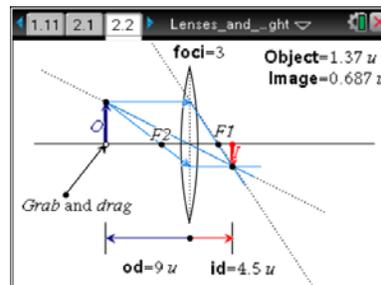
Make a student Live Presenter and have them demonstrate how to create the ray that passes from the focal point to the endpoint of the ray. This should open discussion on how light rays pass through the two different types of lenses.



Move to pages 2.1 and 2.2.

Images and Convex Lenses

5. Students will grab the point indicated on the object and move it back and forth observing the light rays and the image that is produced. They need to make sure they drag the object inside of the focal point to observe the affect on the image. A virtual image will form behind the object once inside the focal point.



Move to pages 2.3–2.8.

Have students answer the questions on either the handheld, on the activity sheet, or both.

- Q6. The image is the same size as the object when _____.

Answer: C. the object is at 2 times the focal point

- Q7. As the object moves away from the focal point and the lens, the image gets _____.

Answer: A. smaller

- Q8. When the object is at the focal point, _____.

Answer: A. there is no image

- Q9. When the object is between the lens and the focal point, the image appears _____.

Answer: C. larger and on the same side of the lens as the object

- Q10. When the image appears on the opposite side of the lens from the object, the image is

Answer: D. always upside down

- Q11. When the virtual image is on the same side of the lens as the object, the image is

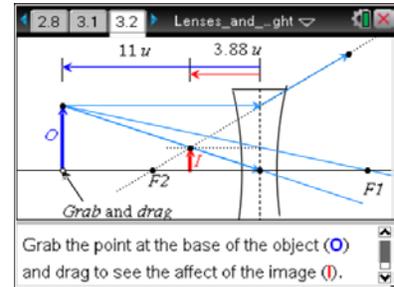
Answer: A and C. always larger and always same side up



Move to pages 3.1 and 3.2.

Concave Lenses and Images

5. Students will grab the point at the base of the object (O) and move it toward and away from the lens, observing the image (I) that is produced.



Move to pages 3.3–3.8.

Have students answer the questions on either the handheld, on the activity sheet, or both.

- Q12. The light rays passing through a concave lens _____.

Answer: A. always diverge

- Q13. The image that is created on the same side of the lens is real. True or False?

Answer: False

- Q14. As the object moves away from the focal point and the lens, the image _____.

Answer: D. gets smaller and moves toward the focal point

- Q15. To create a larger image, the object needs to _____.

Answer: B. always move toward the lens

- Q16. If the object gets close enough to the lens, the image will appear on the opposite side of the lens right side up. True or False?

Answer: False

- Q17. The image is always right side up when using a concave lens. True or False?

Answer: True



Q18. The image is always virtual when using a concave lens. True or False?

Answer: True

Wrap Up

When students are finished with the activity, collect the .tns files using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.