07/28/06

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Lesson Plan

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Lesson Plan

Title	Light Lessons with Professor Lighthead
Subject	Mirrors and Lenses (Reflection and Refraction)
Authors	Team I T S (Integrating Technology and Science)
Members	Debbie Harris, Carol Overton, Eva Nadeau, Holly Thorwarth, Crystal Rehm, Nancy Hutchinson
Grade Level	9th Standards (Can be adapted to lower grades.)
Time Duration	Two 50 minute class periods
Overview	An introduction to the concept of light reflecting from mirrored surfaces and passing through convex and concave lenses.
Standards	P.7. PS. 10--Differentiate among the reflected images produced by concave, convex and plane mirrors P.7. PS. 11--Differentiate between the refracted images produced by concave and convex lenses
Objectives	1. Students will be able to recognize the difference between concave and convex mirrors 2. Students will be able to explain how images form when light is reflected from a mirrored surface. 3. The student will be able to visually recognize the difference between concave and convex lenses. 4. TSSBAT explain that convex lenses cause rays of light to converge (come together) at a single point, and that concave lenses cause rays of light to diverge (spread apart). 5. TSSBAT explain how a lens is used to produce an image.
Activities and Procedures	1. Pretest of basic vocabulary and concepts 2. Exploration activity with mirrors 3. Power point presentation to introduce light reflection

4. Exploration activity with lenses

5. Continuation of Power point presentation to introduce light refraction through lenses

6. Summary of basic vocabulary through Power Point video

7. Post-Test

This site was last updated 07/28/06

Reflections In The Mirror

Objective:	To experiment with reflections of two plane mirrors placed at a 90-degree angle to see what will be reflected.

Grade Level: K-4
Subject(s): Physical Science, Space Science, Mathematics
Prep Time: < 10 minutes
Duration: One class period
Materials Category: Household

National Education Standards	
Science	3b, 3c
Mathematics	9a, 9c
Technology (ISTE)	
Technology (ITEA)	
Geography	

Materials:

- One protractor
- Two-plane mirror tiles 12 inches square (These mirrors should be backed with heavy cardboard and sealed around the edges with thick tape. The mirrors should then be taped together to form two to four hinges. You can have framed mirrors that can stand-alone.)
- Cardboard
- Tape

Related Links:

Lesson adapted from: Optics: An Educator's Guide With Activities in Science and Mathematics

http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Optics/Optics.Guide.pdf

Supporting NASAexplores Article(s):

The Shuttle-Hubble Connection

http://www.nasaexplores.com/show2_articlea.php?id=02-012

Reflections In The Mirror

Teacher Sheet(s)

Pre-lesson Instructions

- This activity can be used as a partner activity.

Background

When you look around a room, you see most objects by the light that is diffusely reflected from them. Diffuse reflections of light take place when the surface of the object is not smooth. The reflected rays from a diffusely reflecting surface leave the surface in many different directions. When the surface is smooth, such as the surface of glass or a mirror, then reflected rays always obey the Law of Reflection. The Law of Reflection states: *the angle of incidence is equal to the angle of reflection.*

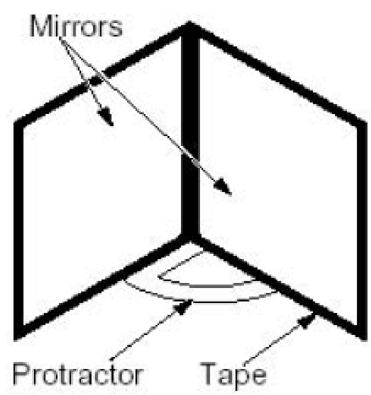
Many reflecting telescopes gather light from distant objects with a large concave mirror that directs the light toward a secondary mirror that then focuses the light onto a detector. The Hubble Space Telescope uses mirrors to send images of unprecedented light sensitivity and clarity back to Earth. When the Hubble needs maintenance or upgrades, the Space Shuttle goes on a service call. In December 1993, the Hubble had a service mission that readjusted the focus, and replaced or repaired other instruments and solar arrays.

In this lesson, the students will experiment with reflections of two-plane mirrors placed at different angles. When you place two-plane mirrors at a 90-degree angle, the image of the first mirror is reflected in the second mirror so that the reversed mirror image is reversed again, and you can see a *true image*. The placement of images in the mirror will vary with the distance of the person or object in front of the mirror.

Guidelines

1. Use the Background Information, and discuss how a reflecting telescope works. Explain that the Hubble Space Telescope is an automated reflecting telescope, which orbits the Earth. The Hubble Space Telescope uses mirrors to send images of unprecedented light sensitivity and clarity back to Earth. When the Hubble needs maintenance or upgrades, the Space Shuttle goes on a service call. In December 1993, the Hubble had a service mission that readjusted the focus, and replaced or repaired other instruments and solar arrays.
2. Tell the class they are going to experiment with reflection by using a plane mirror.

3. For older students, hand out the Student Sheets for each pair of students to read and to follow the directions on their own. For younger students, read over the directions below orally, and model each step.
4. Place the mirrors at a 90-degree angle. See the diagram below.



5. Place yourself in front of the mirrors.
6. Look into the mirror, and follow the instructions. All instructions should be followed while looking in the mirror, not at your body.
    - Raise the right hand that you see in the mirror.
    - Turn your head to the left.
    - Touch your right ear with your left hand.
    - Look into the mirror, and wink your left eye.
    - Raise both hands with your palms facing the mirror.
    - Touch one little finger to the thumb on the other hand.
    - Bring both hands together until your fingers touch.
    - Raise the left hand with the palm facing the mirror and the right hand with the palm turned away from the mirror.
    - Touch your right shoulder with your left hand.

Discussion / Wrap-up

- What did you observe during this activity? *When the mirrors are placed at a 90-degree angle, the image is not reversed, and this is called a true image.*
- What information did your eyes give you? *The eyes see a true image, or they see the student as other people see the student.*
- Why was this activity difficult? *Over the years, the student has adjusted to a reversed image in the mirror. Also, the activities ask the student to use the hand to cross midline of the body. The right side of the brain controls the left side of the body, and the left side of the brain controls the right side of the*

body. Discuss how this adds another variable, which the student must consider.

- What characteristic of light did this activity use or demonstrate? *Reflection*
- Explain the Law of Reflection. (See the Background Information.)

Extensions

- Have students make a model of the Hubble Telescope.

Where is the penny?

Working in pairs, each student should obtain:

1. an opaque saucer/bowl,
2. a penny and a
3. a glass of water

With the bowl on the table, place the penny in the center of the bowl, and then have one of the students back away from the bowl until the penny is no longer visible at the bottom. The second student pours water into the bowl (it may be necessary to tape the penny to the bottom of the bowl) until it is visible again. Students should then discuss what they think may have caused it to again be visible.

LESSON PLAN

REFRACTION OF LENS

BY :

ICHY LUCYA RESTA

12744/2009

PHYSICS DEPARTMENT

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

STATE UNIVERSITY OF PADANG

2012

LESSON PLAN

A. Identities

School	:	SMP N XXX
Grade/Semester	:	VIII/ 2
Subject	:	Physics
Academic Year	:	2012/ 2013
Standard Competence	:	6. Understanding the concept and application of vibrations, waves and optics of technology products in daily life
Basic Competence	:	6.1. To Investigate the properties of light and its relationship to various forms of mirrors and lenses
Indikator (Indicators)		1. To explain refraction of lens 2. To make image formed by a lens

B. Objectivies of Learning

After following the questioning and presentation, the students are able to:

1. Differentiate Refraction of convex and concave lens
2. Draw image formed by convex and concave lens and state the characteristics of the image.
3. Use lens equation to solve problem.

C. Learning materials

Refraction of Lens

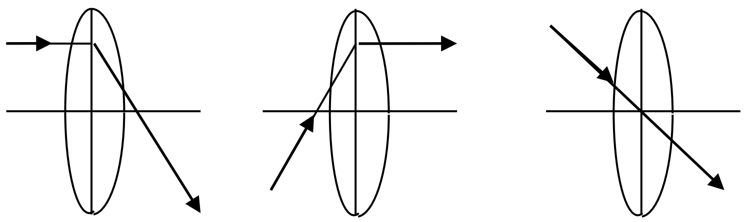
Lens is a transparent object which is bounded by two optical planes so that the thickness of its middle and edge part is different. It is different from a mirror which only has one surface. Lens consist of two kinds, namely convex lens and concave lens.

1. Convex lense

   A convex lens as if made of two convex mirrors opposite to each other, with a coincide central axis. It is a lens that possesses at least one surface that curves outwards. It causes light to deviate inward, bringing the rays of light to a focus.

Refraction rules for a converging lens:

a. Any incident ray traveling parallel to the principal axis of a converging lens will refract through the lens and travel through the focal point on the opposite side of the lens.
b. Any incident ray traveling through the focal point on the way to the lens will refract through the lens and travel parallel to the principal axis.
c. An incident ray that passes through the center of the lens will in affect continue in the same direction that it had when it entered the lens.

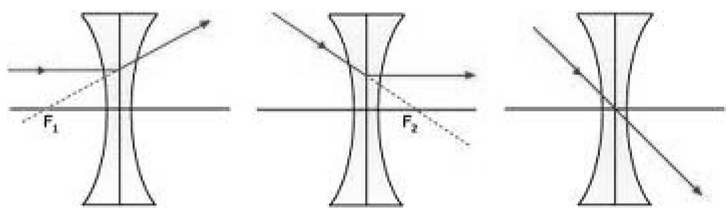


2. Concave lens

Concave lens is a lens such that a parallel beam of light passing through it is caused to diverge or spread out.

Refraction rules for a diverging lens:

a. Any incident ray traveling parallel to the principal axis of a diverging lens will refract through the lens and travel in line with the focal point (i.e., in a direction such that its extension will pass through the focal point).
b. Any incident ray traveling towards the focal point on the way to the lens will refract through the lens and travel parallel to the principal axis.
c. An incident ray that passes through the center of the lens will in affect continue in the same direction that it had when it entered the lens.



D. Model and Method of Learning

Learning Model : Direct Instruction

Learning Methods : Lecture, persentation, questioning, observation

E. **Learning Activities**

1st meeting (1 x 15')

Number	Stage of learning	Times
Introduction Activities		
1	✓ Teacher says greeted opening ✓ Teacher prepares students to start study with praying and checking student prior knowledge ✓ Teacher reviews the last lesson with questioning ✓ Teacher explains the learning objective ✓ Teacher delivers the scope of learning	4'
Whilst Activities		
2	Exploration ✓ Teacher ask student to observe at persentation ✓ The teacher explains about Refraction of Lens ✓ The teacher asks students to explain the using of that lenses in daily life. ✓ The teacher explain how to draw refraction for a convex and concave lens Elaboration ✓ Student do exercise about how to draw refraction for a convex and concave lens ✓ The teacher guide student to do exercise ✓ The teacher goes around to control and be ready to help the students if needed ✓ The teacher asks one of student to explain their answer in front of the class Confirmation ✓ Teacher gives correction about the result of student's working and gives addition information	8'
Closure Activities		
	✓ The teacher asks a student to conclude the lesson. ✓ Teacher give oral test to check understanding of student	3'

	✓ Teacher give appreciate for best individual student ✓ Teacher gives homework to improve the students understanding ✓ Teacher asks students to read about surface tension for material in the next meeting	

F. Learning Sources

a. Text book : - Kanginan, Marthen. 2009. *Physics For Junior High School second semester grade VIII, English Edition*. Jakarta: Erlangga.

- Setiawan, Tedy and Tata Santana. 2006. *Fisika Bilingual untuk SMP Kelas VIII*. Bandung: Yrama Widya
- Jewett.J.W and Serway. 2004. *Physics for Scientists and Engineers 6th Edition.* Brooks/Cole Thomson. Pdf Ebook.
- Halliday, D. & Resnick, R. (1986). *Fundamentals of Physcs*. New York: John Wiley & Sons.

b. Media : Microsoft Power Point Persentation

G. Assessment

a. Technique : Written Test

b. Instrument Form : Essay test

c. Test Example

Table of Test Example

No	Test Indicators	Essay Test	Items numb er	Scor e	Keys of Test
1	To explain refraction of lens	Mention Refraction rules for a converging lens!	1	5	a. Any incident ray traveling parallel to the principal axis of a converging lens will refract through the lens and travel through the focal point on the opposite side of the

					lens. b. Any incident ray traveling through the focal point on the way to the lens will refract through the lens and travel parallel to the principal axis. c. An incident ray that passes through the center of the lens will in affect continue in the same direction that it had when it entered the lens.
2	To Explain image formed by a lens	Refraction happens for a convex lens with focal length 10 cm. An object with hight 1 cm is put at 15 cm from the lens. Where will the image be formed? What is magnification and height of image? Write down the characteristic of image formed!	2	5	Given : f = 10 cm h = 1 cm s =15 cm Ask : s' = ... ? M = ... ? h' = ... ? Characteristic of image? Answer : $\frac{1}{s}+\frac{1}{s'}=\frac{1}{f}$ $\frac{1}{15}+\frac{1}{s'}=\frac{1}{10}$ $\frac{1}{10}-\frac{1}{15}=\frac{1}{s'}$ $s' = 30\ cm$ $M=\frac{s'}{s}=\frac{h'}{h}$ $M=\frac{30}{15}=2\ X$ $M=\frac{h'}{h}$

					$2\,X = \frac{h'}{1}$ $h' = 2\ cm$ Characteristic of image are real, inverted, magnified

Knowledged by,
Head master of SMA XXX

Padang, April 2012
Physics Teacher

Ichy Lucya Resta

NIP:

NIP:

Galileoscope Assembly Instructions

To begin, open the exterior box flaps to reveal the interior box. Under one flap, but not the other, you'll find two holes, as shown at right. Place a finger and thumb in the holes and pull out the interior box.

Parts are stacked in several layers. First you'll see a sheet with assembly instructions and a little plastic bag containing a paper sticker, a metal nut, and four rubber rings. Remove these and place them on a work table. Then lift out the top layer of cardboard and set it aside. The box now looks like this:

Note that the tube in the middle has a plastic bag tucked inside, containing multiple layers of white foam. Pull out the bag and remove the foam. You'll see that it separates into two blocks, one thick and heavy, the other thin and light. The thick, heavy block contains a large round lens wrapped in tissue paper. The thin, light block is secured by two pieces of transparent tape. Carefully cut or remove one piece of tape so that one layer of foam unfolds from the others, revealing six small lenses nested inside under a sheet of tissue paper. Set both foam blocks containing the lenses next to the other small parts on the table.

Next, lift out the middle layer of cardboard and the parts attached to it — *but do not remove the parts from the cardboard yet.* Place the cardboard with the parts still attached on the table.

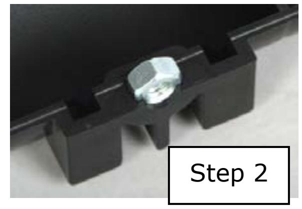
At the bottom of the box you'll now see a large sheet of tissue paper. Remove it to reveal the last two parts — the long plastic tubes labeled A in the following photo. Remove these from the box and set them on the table next to the other parts. You should now have an arrangement similar to this:

Parts List (in order of assembly)

A – telescope main tube halves (2)
B – V-block bases/stands (2)
C – 50-mm glass objective lens
D – ¼-20 tripod nut
E – focuser tube halves (2)
F – small main-tube clamp ring
G – small rubber O-rings (2)
H – Sun-warning sticker
I – large lens shade/dew cap
J – large rubber O-rings (2)
K – main eyepiece barrel halves (2)
L – auxiliary eyepiece barrel halves (2)
M – small main eyepiece lenses (4)
N – tiny, thin eyepiece ring/field stop
O – large main eyepiece clamp ring
P – small eyepiece clamp rings (2)
Q – tiny auxiliary eyepiece lenses (2)
R – Barlow lens tube
S – auxiliary eyepiece cap

Step 1. Lay one of the telescope main tube halves (**A**) on a table or on the two V-block bases/stands (**B**). Examine the 50-mm (2-inch) diameter objective lens (**C**); handle the lens only by the edges, preferably while using a piece of the tissue paper

it was wrapped in. Note that the objective is actually two lenses cemented together. One lens is thinner, and the other is thicker. Insert the objective lens into the groove at the front (wide) end of the telescope main tube half so that the thinner lens points forward, out of the telescope, as shown at left.



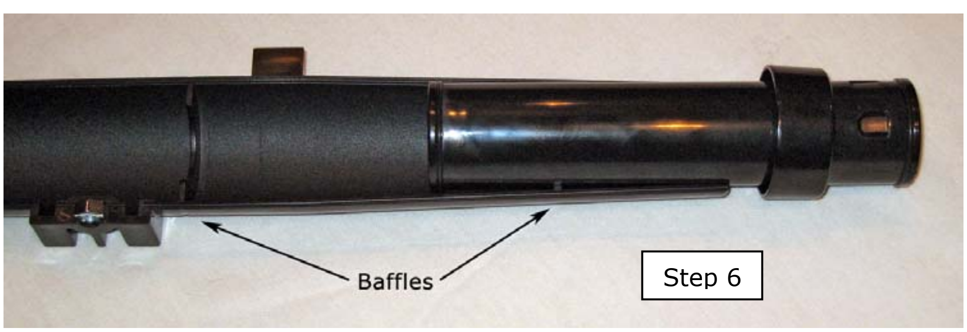
Step 2. Insert the ¼-20 tripod nut (**D**) into the slot in the middle of the telescope main tube half. To seat the nut securely, make sure it is oriented as shown at right, with one of its "points" (not one of its flat sides) facing up.

Step 3. Lay the two focuser tube halves (**E**) on the table, oriented with their interiors facing up. Note that one end of each tube is rough on the inside, and the other end is smooth. (On one tube half, the smooth end has two U-shaped cutouts; they're at bottom left in the adjacent photo.) Orient the tube halves so that the two smooth ends match and the two rough ends match, as shown at left.

Step 4. Join the two focuser tube halves and hold them together. Slide the small main-tube clamp ring (**F**) onto the focuser tube, with the wider end of the ring facing away from the end of the tube with the two U-shaped cutouts.

Step 5. Secure the two ends of the focuser tube with the two small rubber O-rings (**G**), which fit in grooves around each end of the tube.

Step 6. Lay the completed focuser tube assembly into the back (narrow) end of the telescope main tube that's resting on the table or in the V-block bases/stands. As shown in the photo below, make sure that the end of the focuser tube with the two U-shaped cutouts is protruding out the back (narrow) end of the telescope main tube, along with the main-tube clamp ring, and that the other end of the focuser tube lies between the two baffles closest to the narrow end of the main telescope tube.

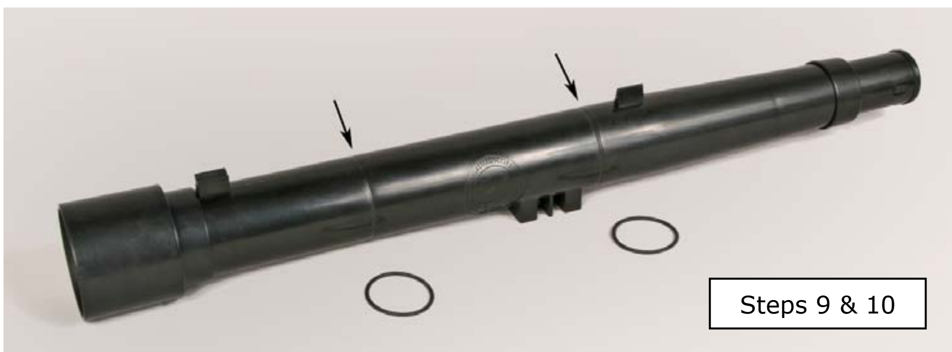


Step 7. Peel the backing off the Sun-warning sticker (**H**) and affix the sticker to the second half of the telescope main tube (**A**), about 25 mm (1 inch) from the narrow end, as shown in the next photo.

Step 8. Place the second half of the main tube over the first half (the one already on the table or in the V-blocks/stands). Make sure the objective lens and ¼-20 tripod nut fit securely into their slots in the top half of the tube.


Steps 7 & 8

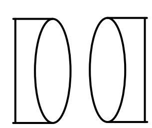
Step 9. Secure the two halves of the body together by sliding the small main-tube clamp ring (**F**) onto the back and the large lens shade/dew cap (**I**) onto the front. Your Galileoscope should now look like this:


Steps 9 & 10

Step 10 (optional): Place the two large O-rings (**J**) around the telescope main tube, in the channels provided for this purpose (indicated by arrows in the photo above). These will hold your Galileoscope together more securely. If you decide to do this, remove the lens shade/dew cap first, then replace it, and be careful not to tear the O-rings when stretching them over the two sighting posts on the top of the tube.

There are two pairs of eyepiece barrel halves. The wider pair (**K**), with the larger central opening, is for the main eyepiece, which gives a magnification of 25x. The narrower pair (**L**), with the smaller central opening, is for the auxiliary eyepiece, which serves two different purposes about which we'll say more below.

Step 11. Examine the four main eyepiece lenses (**M**), which are about 14 mm (a little over a half inch) in diameter. As before, it is best to handle the lenses with the supplied tissue paper, touching only their edges, to avoid fingerprints. Two of the lenses are flat on one side and concave — curved inward — on the other side. The other two lenses are convex — curved outward — on both sides. Take one of each type of lens and place them together as shown at right. Repeat with the other two main eyepiece lenses.


Step 11

Step 12. Take one half of the main eyepiece barrel (**K**). Insert the two eyepiece lens pairs into the appropriately sized slots of the barrel. Be sure the flat sides of the lens pairs point away from each other (that is, toward the ends of the eyepiece barrel).


Steps 12 & 13

Step 13. Insert the tiny, thin eyepiece ring/field stop (**N**) into the thin slot in the main eyepiece barrel half.* You should now have something that looks like the photo at right.


Step 14

Step 14. Join the second half of the main eyepiece barrel (**K**) with the first half (the one you just assembled), taking care that the lenses and field-stop ring fit into the appropriate slots on the second half as you bring the halves together. Secure the two halves with the large main eyepiece clamp ring (**O**), which goes on the end closest to the lenses, and one of the small ones (**P**), which goes on the other end. All the parts of the main eyepiece described in steps 11 to 14 are shown at left.

Step 15. Insert the eyepiece fully into the end of the focuser tube, as shown in the following sequence of photos:

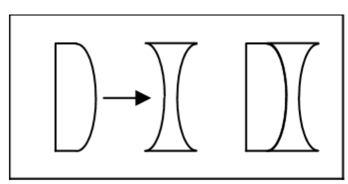

Step 15

*You may omit the tiny, thin eyepiece ring/field stop in Step 13. Omitting the field stop will produce a slightly wider field of view. But the edge will be "ragged," and the outer parts of the image may not be in sharp focus when the rest of the image is.

ASSEMBLING THE BARLOW LENS & GALILEAN EYEPIECE

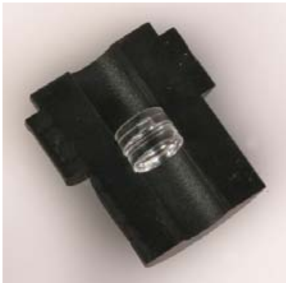
Your Galileoscope can be used in multiple configurations. With the main eyepiece, it yields a magnification of 25x and a true field of about 1½°, the width of three full Moons. With the auxiliary eyepiece parts, you can assemble a 2x Barlow lens, which will double the magnification to 50x but show a smaller amount of the sky in your field of view. Or you can make a 17x Galilean eyepiece. While the main eyepiece (with or without the Barlow lens) gives an upside-down image, the Galilean eyepiece produces a right-side-up image but a very narrow field of view. You may find it difficult to observe with the Galilean eyepiece, but it will let you appreciate what Galileo himself saw through his telescopes 400 years ago!

The Barlow Lens



Step 16. Find the two smallest lenses (**Q**), with diameters of about 10 mm (about ⅜ inch). One is thin in the middle — both sides are concave, or curved inward. The other

lens has one flat side and one convex (curved outward) side. Place them together as shown in the preceding illustration.



Step 17. Place the lens pair into the slot in one half of the auxiliary eyepiece barrel (**L**), which is narrower and has a smaller central opening than the main eyepiece barrel. Be sure the lens that is thin in the middle faces the narrow/bottom of the barrel, as shown at left.

Step 18. Join the second half of the auxiliary eyepiece barrel to the first half, taking care that the lenses fit into the slot on the second half as you bring the two halves together.

Step 19. Secure the wide/top end of the barrel with the second small eyepiece clamp ring (**P**); you used the first such ring in Step 14 above.

Step 20. Insert the narrow/bottom end of the barrel all the way into the narrow end of the Barlow tube (**R**). You'll have an assembly that looks like the one at left in the next photo.

Step 21. Insert the main eyepiece (at right in the adjacent photo) as far into the wide end of the Barlow tube as it will go. You'll now have an assembly that looks like the one shown at right.

Step 22. Insert the Barlow-lens-and-main-eyepiece assembly into the focuser of your Galileoscope to enjoy a view with a magnification of 50x, enough power to show the rings of Saturn clearly!

The Galilean Eyepiece

Step 23. Remove the auxiliary eyepiece barrel from the narrow end of the Barlow tube and set the Barlow tube aside.

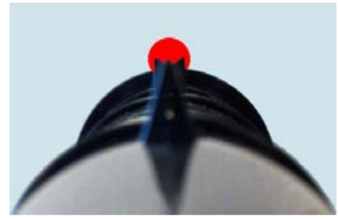
Step 24. Place the auxiliary eyepiece cap (**S**), shown on the right in the photo at left, over the narrow end of the auxiliary eyepiece barrel. You'll now have a Galilean eyepiece, as shown at right.

Step 25. Insert the Galilean eyepiece into the focuser tube of the telescope.

Focusing the Galileoscope

To focus the Galileoscope, slide the focuser tube forward or back while looking into the eyepiece. Fine focus adjustments are easier to make if you twist the focuser tube slightly as you slide it in or out.

Aiming the Galileoscope



Sight along the top of the tube. Your observing target should line up with the tip of the rear (single) post and the tips of the front (V-notched, double) post, as indicated at right, where the target is simulated by a red dot.

Using the Galileoscope on a Tripod

Because a telescope gives a highly magnified view, the tiniest vibration looks like a major earthquake in the eyepiece. Even at 25x, and especially at 50x, the Galileoscope needs to be firmly attached to something stable.

Because the instrument is so lightweight, an inexpensive photo tripod — the type you'll find at most discount stores — should be sufficient. The tripod should have a pan head that moves smoothly in altitude (up-down) and azimuth (left-right), so that you can aim the telescope anywhere in the sky and make small adjustments without jerking it around.

The included ¼-20 mounting nut on the bottom of the Galileoscope will fit any standard photo tripod. If you plan to use the Galileoscope while standing up — sitting in a chair is more comfortable! — we recommend attaching it to a tripod that extends to a height of at least 150 cm (60 inches). Otherwise, you'll find it difficult to get your head under the eyepiece when the telescope is pointed high in the sky.

Additional Eyepieces

Because the Galileoscope has a 1¼-inch-diameter focuser tube, it can accept any commercial eyepiece with a 1¼-inch barrel — the most common type. But because the focuser is held in place by friction, rather than by gears or other mechanisms, only relatively small, lightweight eyepieces are suitable for use with the Galileoscope. Many such eyepieces are available in the amateur-astronomy marketplace, affording you the option of many different combinations of magnification and field of view.

Star Diagonals

The Galileoscope is designed for straight-through viewing. There is not enough "in focus" to permit the use of a star diagonal, a common accessory that goes between the telescope and eyepiece and enables you to avoid having to crane your neck when observing celestial objects high overhead. As noted above, we recommend sitting in a chair with the telescope on a tripod that can be extended to a good height. That way, observing objects high in the sky will be comfortable without a star diagonal.

More Information

Visit www.galileoscope.org for the latest information and to download free observing guides and educational activities.