DGi DENOYER-GEPPERT

Rubin’s Eye Model & Vision Lab

Table of Contents

Parts

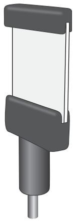
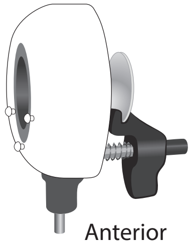
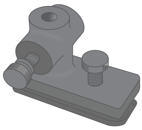


Image Slide Holder

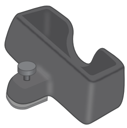


Anterior Eye Model

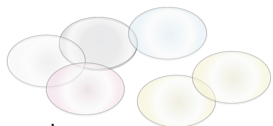
Posterior Eye Model



Accessory Holder

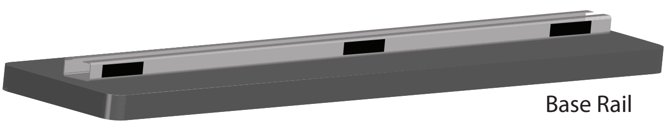


Lens Caddy



Lenses

Image Slide

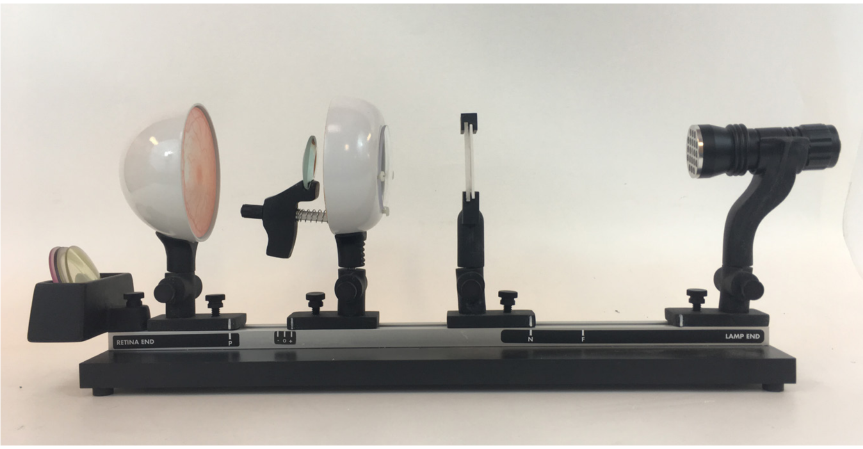


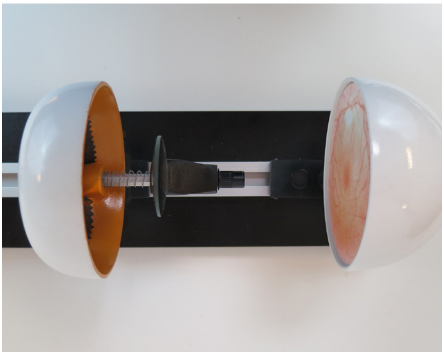
Base Rail

Assembly instructions

1. Insert two accessory holders into the channel slot from one end and two from the other end. Allow the accessory holders' lock knobs to freely slide back and forth on the channel. Do not tighten them, yet.

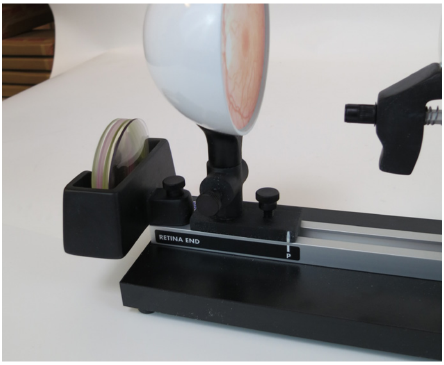
2. Beginning with the lamp end, insert the support pin of each accessory into the accessory mounting hole of each holder in the following order:
    a. Start by placing the light source
    b. Next is the image holder (light diffuser toward the light source)
    c. Then place the the anterior eye model (pupil toward the image)
    d. Finally the posterior eye model (retina toward the other accessories)





3. Use the protractor to assure that each accessory is mounted at a 90 degree angle from the base rail, the light should be parallel to the rail as you tighten each accessory mount locking knob to secure the accessories in their respective mounts.

4. Insert the image slide into the slot on the image holder

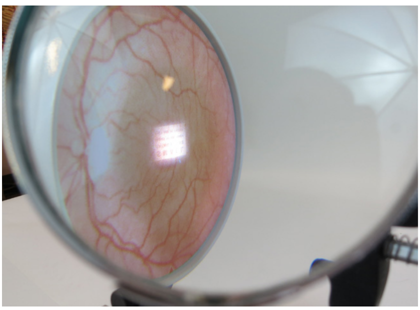


5. The lens caddy may be be inserted onto the channel to the outside of the Posterior Eye Model its position knob tightened securely, or it can be set aside.

Apparatus Use and Fine Adjustment

Correcting focus

- Place the retina on the "P" position and lock.
- Place the iris on the "O" position and lock.
- Place the image holder on the "F" position and lock.
- The outside end of the lamp support will cantilever out from the end of the channel, but the locking knob needs to stay within the channel. The indicator line will be between the words "lamp" and "end."
- Use a magnifying glass to evaluate the 3rd line of text from the projected image on the retina illustration which reads, ''easier to see when."
- Turn the adjustment knob on the hex rod of the iris clockwise or counterclockwise until the 3rd line is clear.



Note: the image is projected upside down and backwards on to the retina.

Accomodation

This physiological process can be simulated on the Rubin's Eye Model by squeezing the black trigger located below the projection lens. This changes the distance between the projection lens on the anterior eye model, the image slide, and the retina.

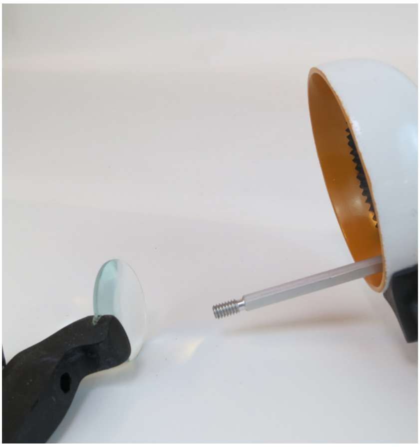
Loose Trigger

- Remove the iris from it's accessory holder.
- Locate a threaded hole with a nylon set screw inside at the bottom of the trigger
- Tighten the nylon set screw by turning clockwise with a 1/8" flat head screwdriver

Note: that on some units this threaded hole is located on the top of the trigger.)

Tight Trigger

- Try loosening the set screw in the trigger by following the process outlined above except turn the screw counter-clockwise.
- Otherwise, unscrew the adjustment knob at the end of the trigger, remove the trigger and spring from the hex rod,
- Lubricate the hex rod with a small dab of white lithium grease. Wipe off any excess, and reassemble the parts.



Projected image horizontal position

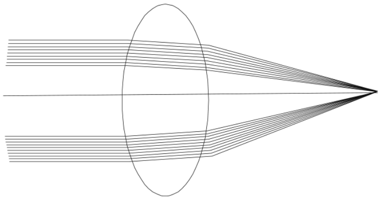
- Loosen the holder knob for the anterior eye model accessory and swivel the iris left or right approximately 5 degrees. More than 5 degrees causes an obvious image distortion.
- An alternative way to change the image position is to move the image slide, in its holder, to the left or right.

Corrective lens handling

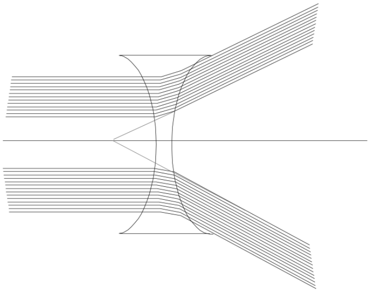
- Always handle corrective lenses by the edges
- To add a corrective lens slide it in from the top and let it rest on the three nylon mounting pins
- To remove a corrective lens, gently push up on the bottom edge of the lens until you can easily grip the top edge

Vision and Refractive Disorders

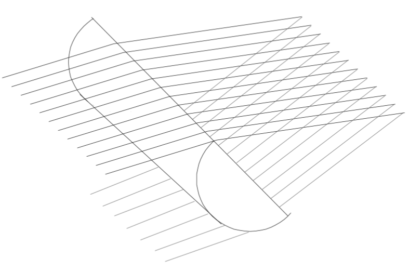
The human eye is a remarkable organ. Its structure and function allow us to see the world around us with clarity and detail. There are many optical devices that allow us to see things with even greater detail including telescopes, microscopes and binoculars. These devices and the human eye are all optical lens systems that change the properties of light. Lenses, whether in a mechanical system such as a camera or the human eye, **refract** *(or bend)* light because they are transparent and have a different density that the air through which the light rays were traveling. The curvature of the lens affects the angle at which the light is refracted, so it determines where an image wil ultimately be focused. also known as the focal length of the lens.



Concave Lenses cause light rays to converge.



Convex Lenses cause light rays to diverge.



Toric Lens

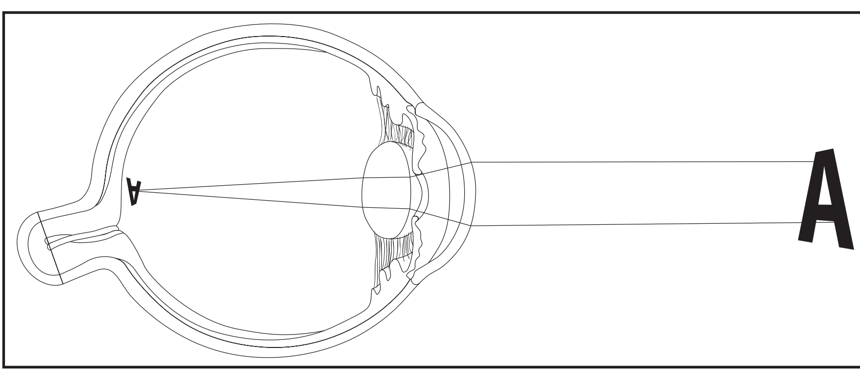
The components of the human eye lens system consist of a cornea which is the clear lens in the front of the iris, and a crystalline lens behind the pupil, which can change its curvature to help us focus clearly.

Look at your eyes in a mirror and attempt to identify your cornea. Now have your lab partner stare straight ahead while you look at their eyeball from the side. Do you see how the clear cornea bulges out at the front (anterior) of the eye. That is the cornea. Now switch and let your lab partner identify your cornea. The cornea refracts or bends light before it enters the pupil, where it is again refracted by the crystalline lens, focusing onto the retina.

Emmetropia is the state in which the optical lens system of the eye provides a sharp focus directly on the retina. The diagram below illustrates how light waves reflecting off an object travel toward the eye. As they go from the air through the cornea they are bent, or refracted. Then they pass through the pupil and encounter the crystalline lens which further refracts them sharply onto the retina.

Label the diagram below with the words listed.

Cornea
Pupil
Iris
Crystalline lens
Retina



Rubin's Functional Eye Model is an apparatus that will help you clearly and visually, learn about refractive disorders of the eye, how they affect our vision, and how we correct them.

Place the clear corneal lens (PLANO) in the holder in front of the iris. Loosen the thumbscrew on the base of the anterior eye and position it in the neutral "0" position. Tighten the thumbscrew and make sure the slide holder is in position "F" (far), and the posterior eye is in position "P". Turn on the light source.

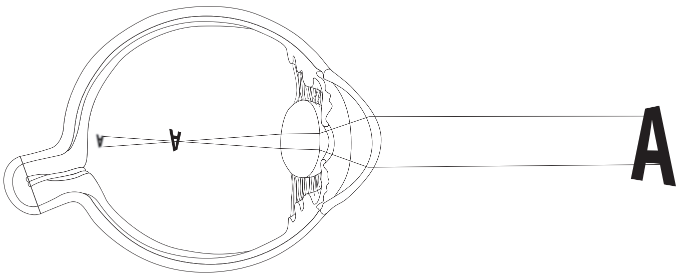
The image from the slide is now being projected upside down, backwards, and focused on the retina. This image is what an Emmetropic eye would see.

Compare the diagram you labeled with the functional eye model. Sketch the functional eye model in the space below. Then label the parts that you identified on the diagram of normal sight.

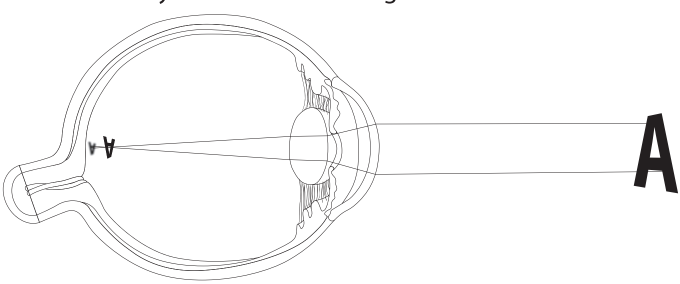
Human eyes can have refractive disorders. These refractive disorders make it difficult for the eyes to focus clearly. Some people have myopia or nearsightedness, a condition that makes it difficult to see things that are far away. Others have hyperopia or farsightedness, which makes it difficult to see close up. Another refractive disorder is astigmatism. Astigmatism causes a blurry image at any distance. When we get older, around 40 or so, we all develop a refractive disorder called presbyopia which causes reading and close work to become more difficult.

Myopia is caused when light rays converge too much, after they enter the eye, and focus before the retina. This results from having one or more of the following conditions:

1. A cornea that is too conical in shape



2. An eyeball that is too long from front to back



Consider how you could simulate myopia using the functional model. Write down your plan for the simulations before you execute them on the model. Then observe what happens to the projection on the retina.

Plan____

____

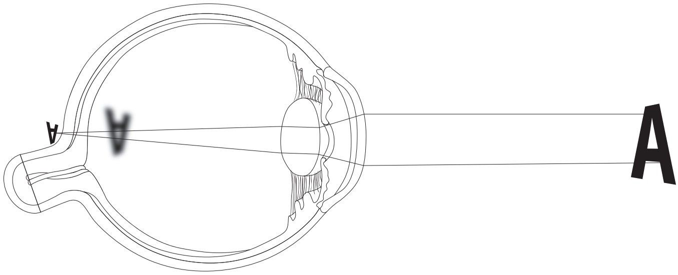
Observations____

____

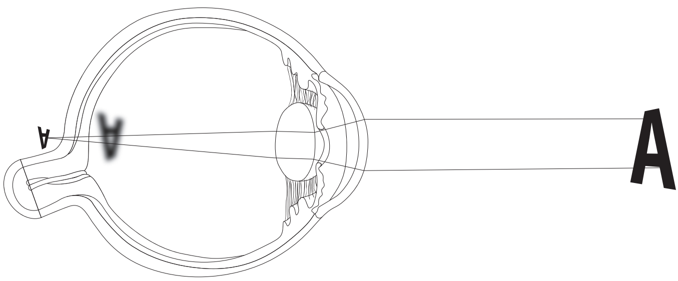
____

Hyperopia is caused when light rays don't converge enough, after they enter the eye, and focus after the retina. This results from having one or more of the following conditions:

1. A cornea that is too flat in shape



2. An eyeball that is too short from front to back



Consider how you could simulate hyperopia using the functional model. Write down your plan for the simulations before you execute them on the model. Then observe what happens to the projection on the retina.

Plan____

____

Observations____________________________________

____

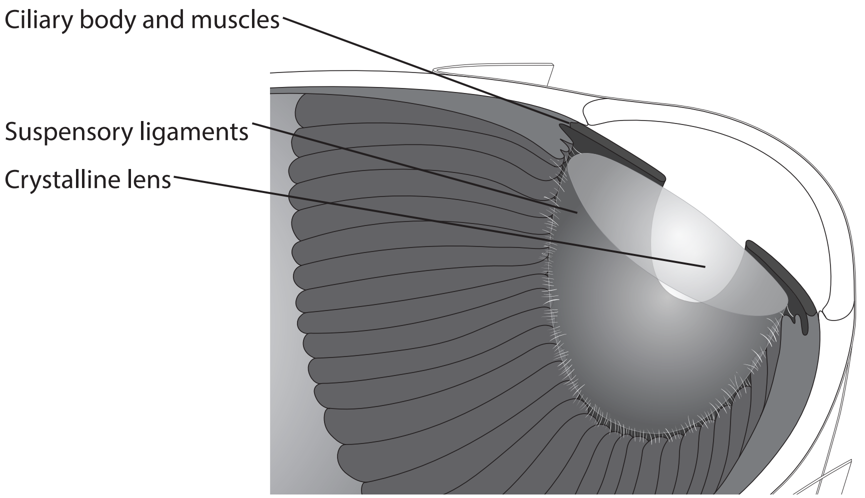
____

Presbyopia develops as the crystalline lens becoming less flexible. In younger people, the crystalline lens is very supple. This pliability allows the ciliary body to alter the shape of the lens thereby allowing us to focus on objects at different distances. When presbyopia begins, usually around age 40, the lens becomes less flexible, which makes focusing via accommodation more difficult.

To practice accomodating with your own eyes, close one eye and hold your thumb a few inches in front of your open eye. When you focus on your thumb, everything in the background will be out of focus. Now look at the background and you will see your thumb is out of focus. Your crystalline lens is accommodating.

We cannot identify the crystalline lens from the outside of the eye. However, if your lab has a human eye model, you can identify the crystalline lens part; note the shape and position with relation to the iris and ciliary body. Also, in the diagram on the next page you can see zonular fibers running between the ciliary body and the crystalline lens. As the ciliary muscle contracts and relaxes the fibers alter the shape (curvature) of the lens thereby changing the focal length of the lens and focusing the light rays directly on the retina. This focusing process is called accommodation.

We can also observe accomdation via the funcional model. Earlier in the exploration you located the crystalline lens on the model. You may have noticed tht it is mounted on a rod and it has a black trigger underneath. To "accomodate" the crystalline lens on the model you simply squeeze the trigger so that the lens moves toward the anterior portion of the eye.



Use the space below to describe what you see happening when you accomodate the crystalline lens on the model.

How is the crystalline lens on the model similar to the crystalline lens in your eye?

In what ways is the lens different?

Vision Correction Explorations

When we can't focus clearly we go to professionals who specialize in the eyes. Optometrists are doctors that specialize in diagnosing and correcting vision problems usually with eyeglasses or contact lenses. Ophthalmologists are medical doctors who also diagnose and correct vision problems. Ophthalmologists can treat patients with medications and surgery. Opticians are not doctors, they are the people who make and dispense the eyeglasses that are prescribed by Optometrists and Ophthalmologists.

To correct refractive disorders, doctors prescribe eyeglasses or contact lenses. As we discussed earlier, lenses bend light rays to correct the way light is projected on the retina.

Recaling the vision disorders that we learned about previously in the exploration we can imagine the conditions that we will need to design a correction for.

In the spaces below, sketch the conditions that can lead to hyperopia that we discovered in the first section.

Hyperopic *(farsighted)* people have eyes whose focal lengths are too long. So in order to correct the vision we must [ ] the focal length.

Looking back to how the different types of lenses refract light which one do you think would be the best choice to correct hyperopia.

____

____

____

____

Now test your hypothesis by first setting up the model in the hyperopic state.

- Move the anterior eye into the [-] position
- Place the plano (clear) lens in the front of the eye.

Next do the corrective procedure that you hypothesized above.

Describe what happened below.

____

____

____

____

Convex lenses converge light rays to a focal point, so convex lenses help to shorten the focal length of the eye and correct hyperopia (or farsightedness). A magnifying glass is an example of a convex lens.

In the spaces below, sketch the conditions that can lead to myopia that we discovered in the first section.

Myopic *(nearsighted)* people have eyes whose focal lengths are too short. So in order to correct the vision we must [ ] the focal length.

Looking back to how the different types of lenses refract light which one do you think would be the best choice to correct myopia.

____

____

____

____

Now test your hypothesis by first setting up the model in the hyperopic state.

- Move the anterior eye into the [+] position
- Place the plano (clear) lens in the front of the eye.

Next do the corrective procedure that you hypothesized above.

Describe what happened below.

____

____

____

____

Lenses that lengthen the focal length of the eye are called concave. Concave lenses diverge light rays from a focal point, and make things look smaller when you look through them.

More fun with optics.

With the posterior eye at "P", and the slide holder at "F", move the anterior eye closer to the slide. When the cornea gets close to the slide, the image will appear on the retina. Why is the image larger? Move the anterior eye back to "O" . Use a ruler to measure the size of the image on the retina. Now move the slide holder to "N" and move the anterior eye to "-". Now measure the image again. Why is it larger? How does the size of the projected image compare with the original image on the slide? Try to make the image on the retina the same size as the image on the slide. Do this by moving the slide toward the anterior eye and/or the anterior eye toward the slide in small increments. What do you observe about the distance between the lens and the projected image? How does it compare with the distance between the original image and the lens? How does this relationship affect image size?

Hold the pink minus lens in front of the pencil as shown in figure B. The image is smaller behind the lens. What happens to the image of the pencil when the lens is rotated? Because it is a spherical lens, the image appears the same regardless of its rotation. Try moving the lens up and down (same direction as arrows in figure B). As you move the lens up and down the image of the pencil moves in the same direction that the lens is moving. Follow the same procedure with the gray plus lens. When you move the lens up and down, the image of the pencil moves the opposite direction that the lens is moving. What happens when you stack the concave and convex lenses together? When you look through the two lenses together they no longer magnify or minify. Because they are equal but opposite powered lenses, together they neutralize each other. Next, stack the two astigmatic lenses one on top of the other. If you rotate one lens, you will find a direction that makes the two lenses neutralize each other.

Astigmatism affects both near and far vision. To demonstrate this place the anterior eye at "0", and the slide holder at "F". Place the yellow astigmatic (toric) lens in the corneal lens holder. The image on the retina is blurry. Try making the eye more nearsighted or more farsighted by moving the anterior eye. The image will always be blurry to some degree. Move the anterior eye back to "0". Take the other astigmatic lens (yellow) and hold it in front of the cornea. If the image is blurry, rotate the lens in front of the cornea until it becomes clear. By placing the astigmatic lenses perpendicular to one another, astigmatism can be neutralized.

Lay a pencil on a desk or a table about two feet from your eyes. Look through the astigmatic lens with one eye while holding it about a foot from the pencil (See figure A). Now rotate the lens and observe what happens to the image of the pencil as the lens rotates. Notice that the pencil continues through the lens in a straight line every quarter turn, and in between the pencil rotates back and forth. You may also notice that when the pencil is straight with the lens in one position, the image is slightly smaller. In the other position that keeps the pencil straight, the image is slightly larger. This lens is actually concave and convex as well as cylindrical. Many people have astigmatism and sometimes it is combined with myopia or hyperopia. Eyeglasses or toric contact lenses can be worn to correct this vision disorder.