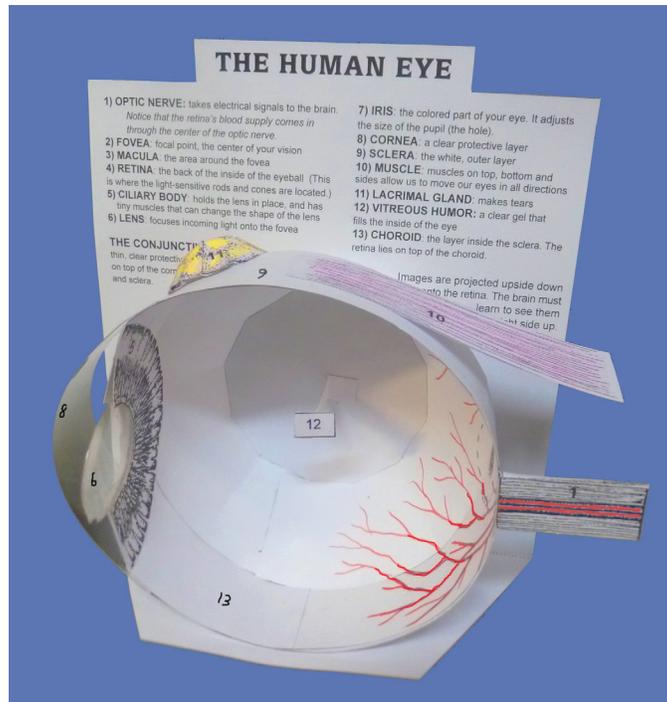


CUT-AND-ASSEMBLE PAPER EYE MODEL



Background information:

This activity assumes that you have study materials available for your students. However, if you need a quick review of how the eye works, try one of these videos on YouTube. (Just use YouTube's search feature with these key words.)

“Anatomy and Function of the Eye: posted by Raphael Fernandez (2 minutes)

“Human Eye” posted by Smart Learning for All (cartoon, 10 minutes)

“A Journey Through the Human Eye” posted by Bausch and Lomb (2.5 minutes)

“How the Eye Works” posted by AniMed (2.5 minutes)

You will need:

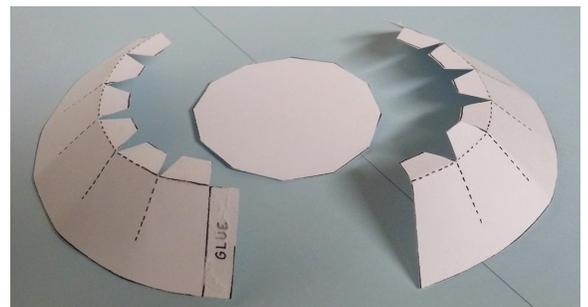
- copies of the pattern pages printed onto lightweight card stock (vellum bristol is fine, or 65 or 90 pound card stock)
- scissors
- white glue or good quality glue stick (I always advise against “school glue.”)
- clear tape (I use the shiny kind, not the “invisible” kind, as I find the shiny kind more sticky.)
- a piece of thin, clear plastic (a transparency [used in copiers] is fine, or a piece of recycled clear packaging as long as it is not too thick-- it should be fairly flimsy and bend very easily)
- colored pencils: red for blood vessels and muscle, and brown/blue/green for coloring iris (your choice) (Also, you can use a few other colors for lacrimal gland, optic nerve, if you want to.)
- thin permanent marker for a number labels on plastic parts (such as a very thin point Sharpie)

Assembly:

1) After copying pattern pages onto card stock, cut out all parts. On the background page that says THE HUMAN EYE, cut away the black rectangles and trim the triangles at the bottom, as shown in picture above.

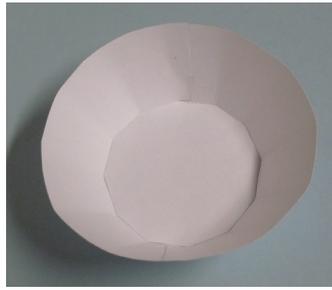
2) Use the cornea and lens patterns to cut these parts out of thin plastic. You need one cornea and two lens pieces. You can use a transparency (like you'd use in a copy machine or overhead projector) or you can use any piece of thin plastic you might have around, as long as it is thin and will bend very easily. (Plastic food wrap is too thin. The plastic that encases many products, such as batteries, is too thick.) If you have very wide clear tape, you could put two pieces with their sticky sides together.

3) Fold tabs on the two choroid pieces, as shown in picture. Fold only on the dotted lines as far as they go. Folding it this way will put the black lines on the back of this shape so the inside is nice and white.

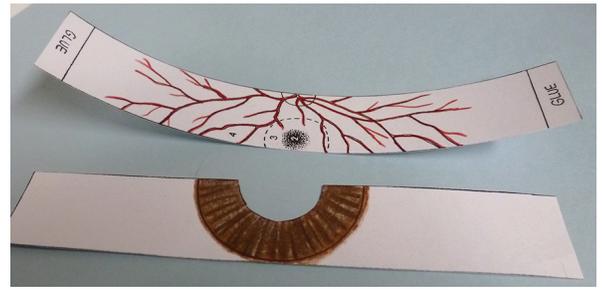


4) Glue the two choroid pieces together at glue tabs, so they make a “bottomless bowl.” Put the 12-sided shape into the bottom of the “bowl” and secure with glue. Patiently work with it a bit so that the 12-sided piece fits nicely inside, along all the tabs.

5) Color the iris brown/blue/green, and color the blood vessels at the back of the retina.



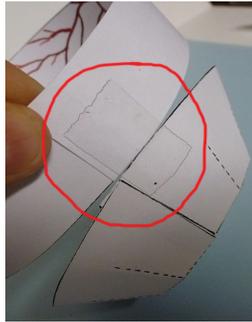
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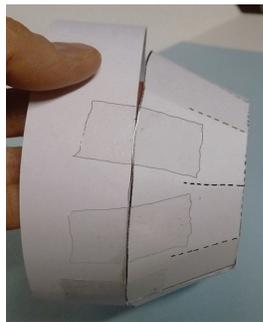
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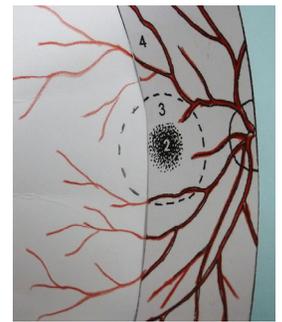
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6) Glue the two halves of the choroid ring together. NOTE: BE CAREFUL to get the opening of the iris and the optic nerve (where the vessels come out) on the same side, as shown in picture.

7) Begin taping the back of the choroid “bowl” to the choroid ring. Start with the bottom seams (although matching them is not critical and you can really start anywhere). Put one piece of tape across on section of seam. Check to see if the ring and the “bowl” are the same size and will match up. If they are far off, you might want to adjust the glued seams.

8) Gently pull the seam together at the next section and tape. Then pull the next section together and tape that. Go section by section. It’s sort of like sewing a curved seam. You just go little by little, inching your way around. You can apply tape closer than shown in photo, also. The goal is to get the ring to match up with the bowl of the choroid, all the way around. If they are just a tiny bit off you can probably just take a tiny tuck somewhere. If you are accurately following the pattern, they should line up almost perfectly. This is probably the trickiest part of the assembly. Take your time.

9) The completed choroid (The entire back of choroid is retina, not just around the number 4.)

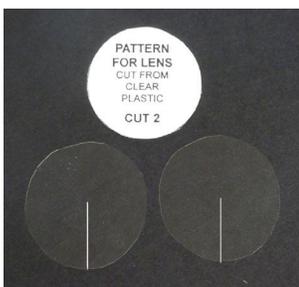
10) Use the red pencil to extend the blood vessels onto the rest of the retina, inside the bowl shape. Also, take a pencil or pen and finished the dotted circle that outlines the macula area.

11) You should have two plastic lens pieces cut from the paper pattern. Cut a slit into each one, stopping at the center. White lines have been added to the photo to show where to cut.

12) Overlap the plastic slit just a bit to make each circle into an extremely shallow cone. Then put them together as shown in picture 12 and tape with small pieces of clear tape. (If this step is too difficult, you could just use one flat piece of plastic, but making the lens as a lens shape helps in understanding how the optics of the eye work.)

13) Tape the lens to the back of the ciliary body piece (5).

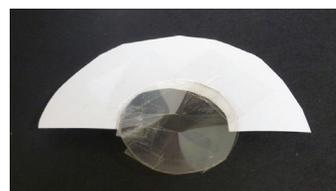
14) Tape or glue the ciliary body to the back of the iris. The ciliary body is the part that changes the shape of the lens. Tiny nerves not shown in this model connect this part to the brain and the retina so that if the image is not in focus, signals are automatically send to the muscles in the ciliary body to either make the lens more round or more flat. There are two sets of muscles, one that pulls it flat and one that pulls it round.



11



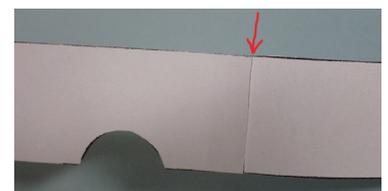
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13

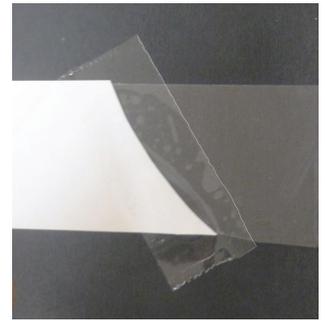
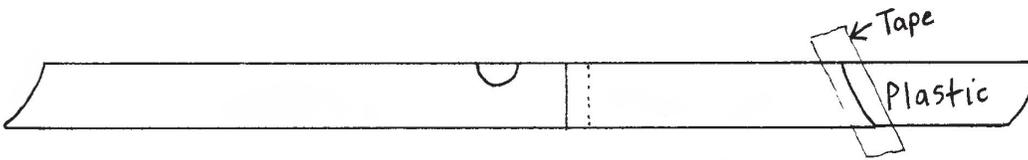


14



15) Glue the two sclera pieces together at the glue tab.

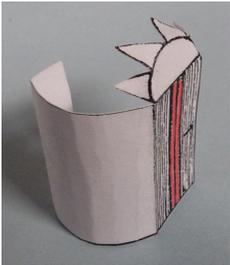
16) You should have a piece of plastic cut from the paper cornea template. Put this plastic piece flush with the paper strip, as shown in diagram. The paper and plastic should not overlap. Tape over the seam.



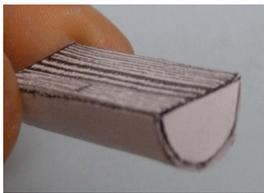
Fold the ends of the tape over. Sketch and photo show placement of tape before the ends are folded over. Obviously, you don't want sticky tape hanging off.

17) Bend the strip around to make a complete loop. The plastic cornea shape should match the end of the paper. Again, put them flush (end to end) and secure with tape. The reason you don't want to overlap is that we are showing here that the cornea is "continuous" with the white sclera. The cornea and sclera are all one piece. It's like the whole "ball" is the sclera, but the sclera is clear in this place in the front and we call it the cornea. The proteins that the cornea is made of are very similar to the sclera proteins, except that they are transparent. Now you should have a ring of sclera. Of course, the sclera is actually a ball, not a ring. We are only using a strip of the sclera in this model in order to make the model easier to build. Otherwise we would have to make another bowl shape.

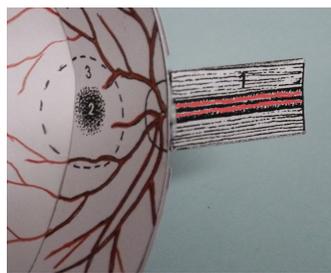
18) Glue the sclera ring around the outside of the choroid ring so that the notch matches up with the optic nerve (which you will attach in just a minute). The cornea should bulge out. The space between the iris and the cornea is filled with a special fluid. (Too much fluid can cause glaucoma.)



19

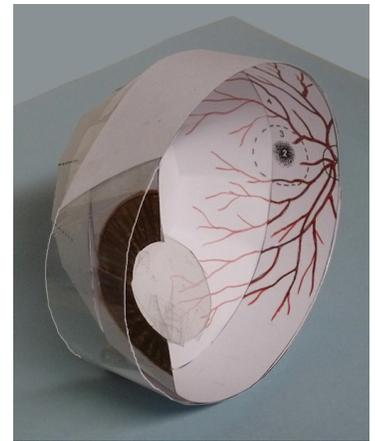


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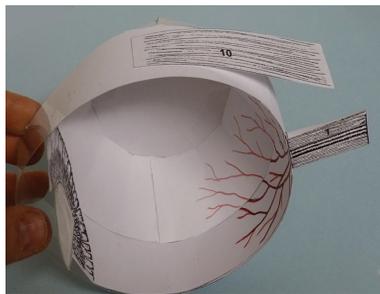
19) Fold the tabs on the optic nerve piece. Use a pencil to roll it into a half-cylinder. Color the central vessels red.

20) Glue tabs. 21) Glue optic nerve to back of sclera.

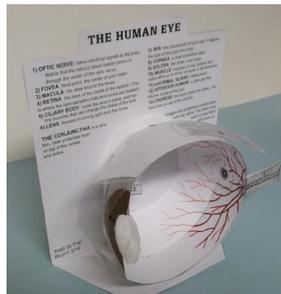
22) Glue muscle to top of sclera. You can color the muscle pinkish-red if you want to, but leave the ends white.

23) Glue eyeball to background piece. NOTE: Look at it from the side, making sure that the background piece is making a nice, square, 90 degree "corner."

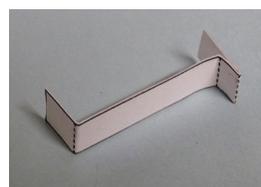
24) Fold tab with number 12 on it, and glue it into the middle so that the number 12 is "floating" in the middle of the eye.



22

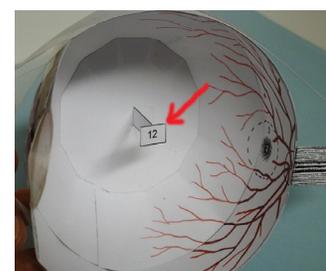


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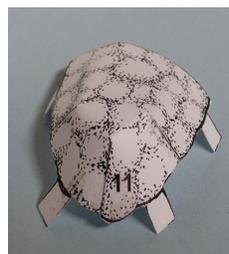
Shown from the back.



24

25) Color the lacrimal gland light yellow if you want to. Cut the lines (solid, not dotted) on the lacrimal gland, and pull tabs over to dotted line so that the shape looks like the picture. Fold small tabs under and use them to glue lacrimal gland in place, above and to the left of cornea, as shown in picture on page 1. (It will almost touch the back.)

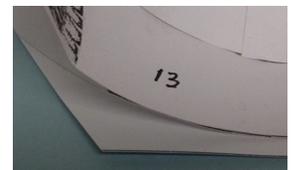
26) Use waterproof marker to label cornea as 8, and lens as 6. Also label choroid as 13, and the sclera as 9. (I labeled my sclera on top.)



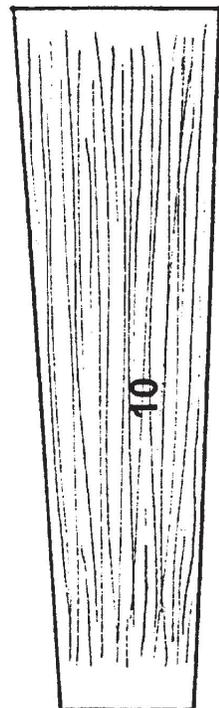
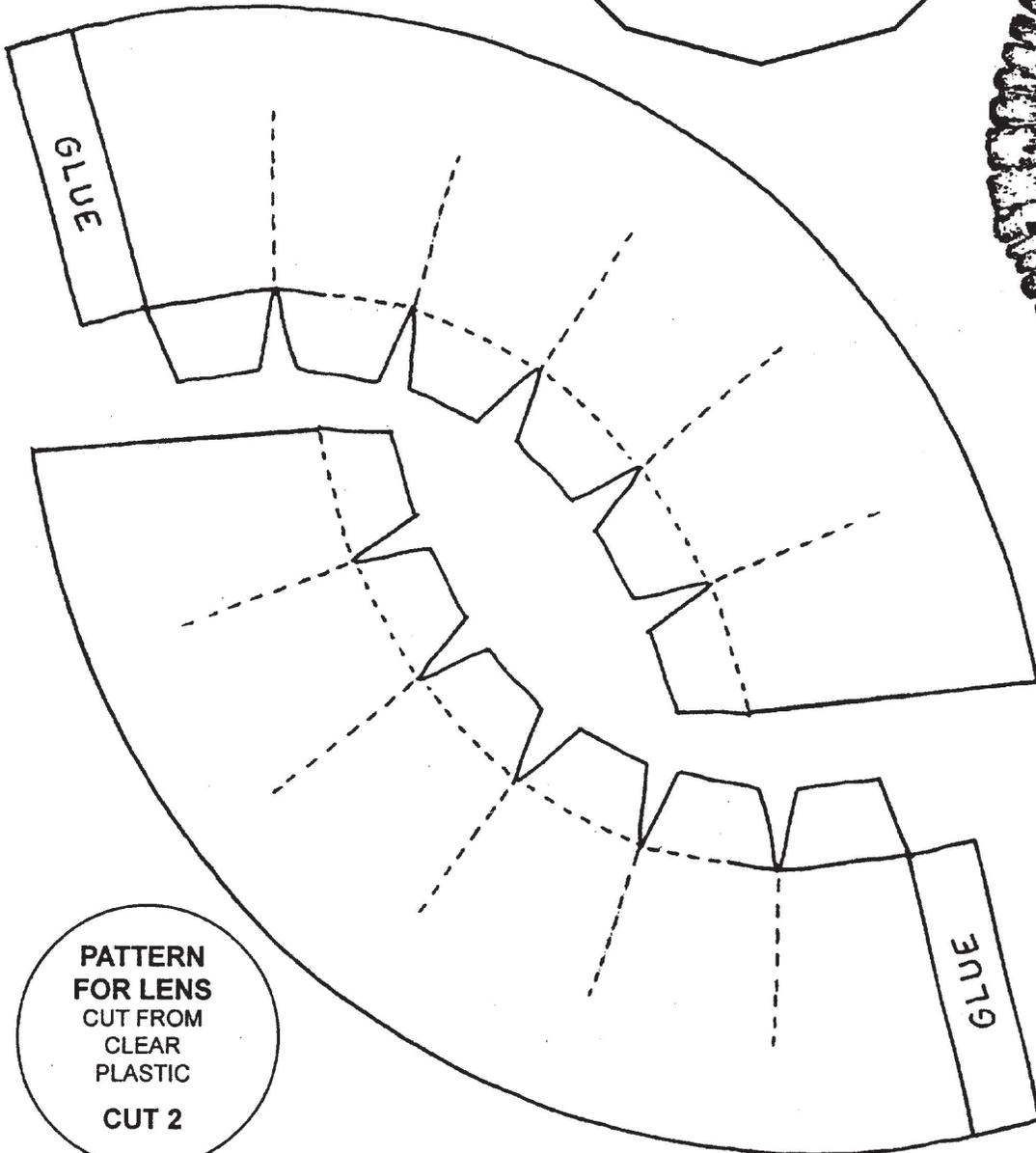
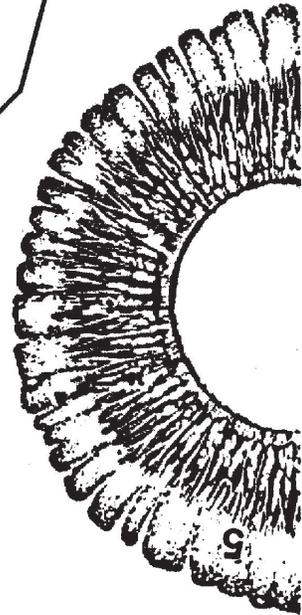
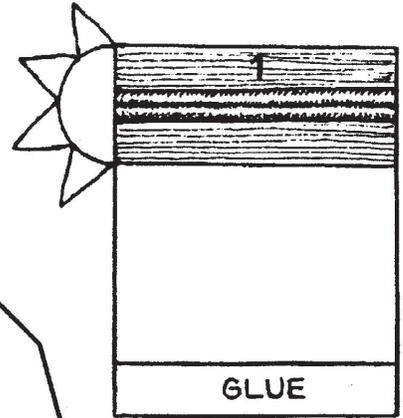
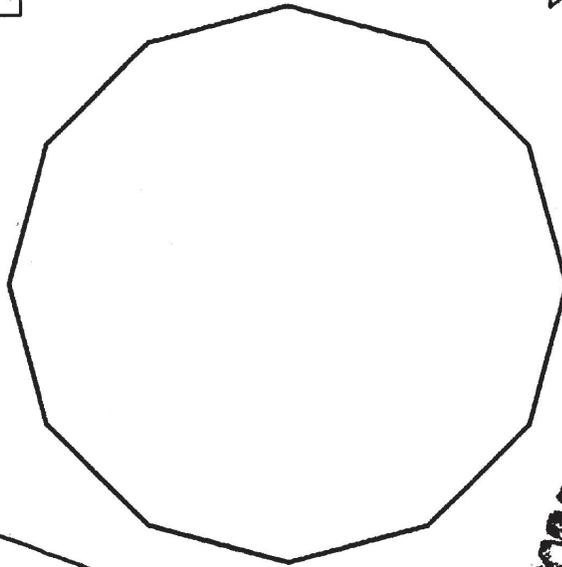
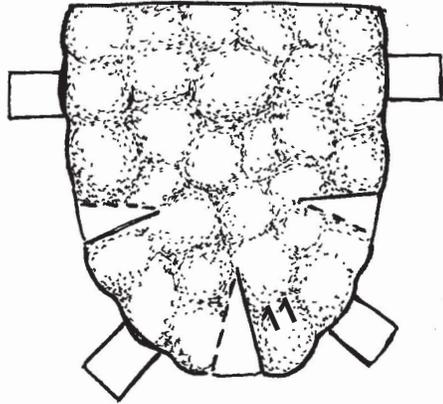
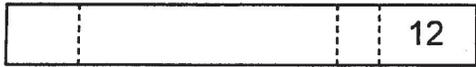
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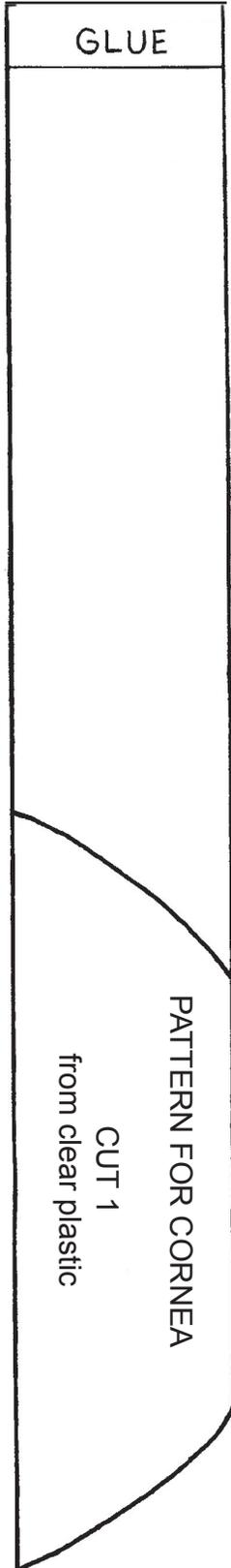
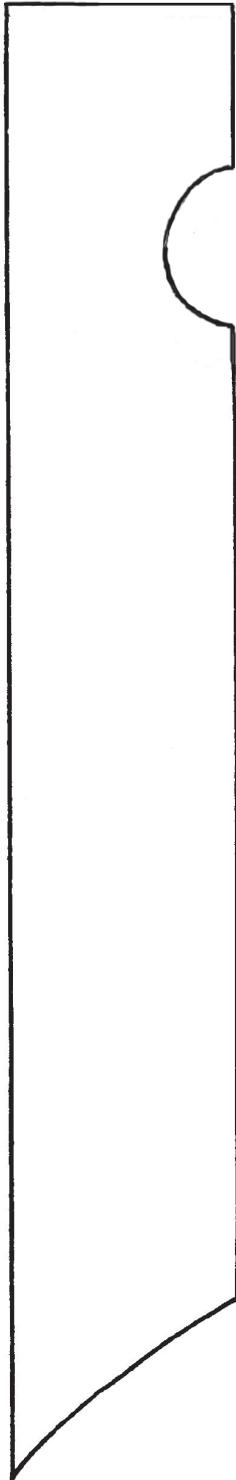
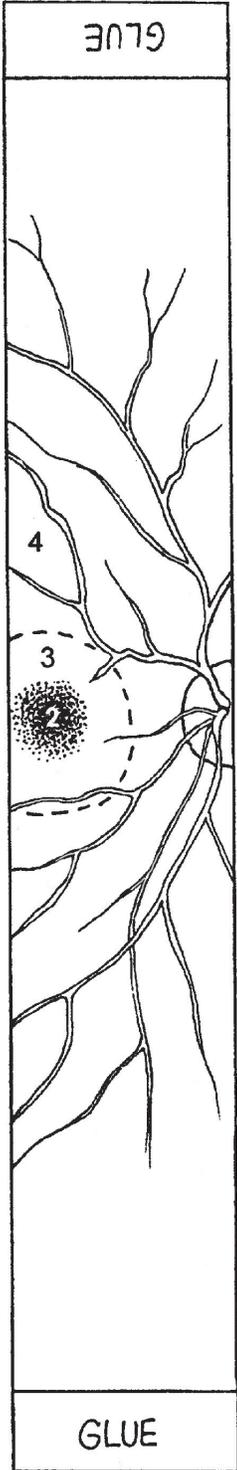
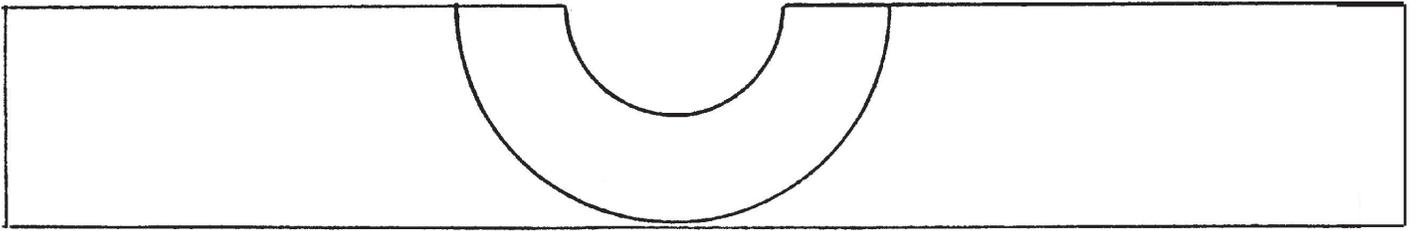
26



26



**PATTERN
FOR LENS
CUT FROM
CLEAR
PLASTIC
CUT 2**



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THE HUMAN EYE

1) OPTIC NERVE: takes electrical signals to the brain.

Notice that the retina's blood supply comes in through the center of the optic nerve.

2) FOVEA: focal point, the center of your vision

3) MACULA: the area around the fovea

4) RETINA: the back of the inside of the eyeball (This is where the light-sensitive rods and cones are located.)

5) CILIARY BODY: holds the lens in place, and has tiny muscles that can change the shape of the lens

6) LENS: focuses incoming light onto the fovea

THE CONJUNCTIVA is a very thin, clear protective layer on top of the cornea and sclera.

7) IRIS: the colored part of your eye. It adjusts the size of the pupil (the hole).

8) CORNEA: a clear protective layer

9) SCLERA: the white, outer layer

10) MUSCLE: muscles on top, bottom and sides allow us to move our eyes in all directions

11) LACRIMAL GLAND: makes tears

12) VITREOUS HUMOR: a clear gel that fills the inside of the eye

13) CHOROID: the layer inside the sclera. The retina lies on top of the choroid.

Images are projected upside down onto the retina. The brain must learn to see them right side up.

THIS IS THE
RIGHT EYE

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