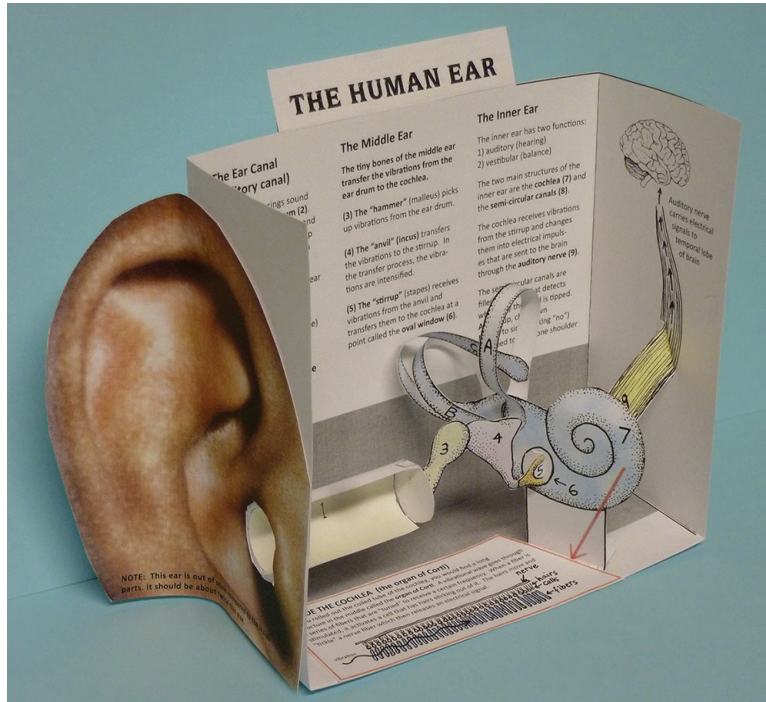


CUT-AND-ASSEMBLE PAPER EAR MODEL



Background information:

For a really good explanation of how the parts of this model work, go to YouTube and search for “Process of Hearing Animation” posted by psy113. Then watch “How the Ear Works” posted by Javitzproductions. For an excellent explanation of how the semicircular canals work, try “How the Inner Ear Balance System Works” posted by Fauquier ENT. Of course, any anatomy book will also give explanations for all these parts. The advantage of these videos is that they show 3D views and moving parts.

You will need:

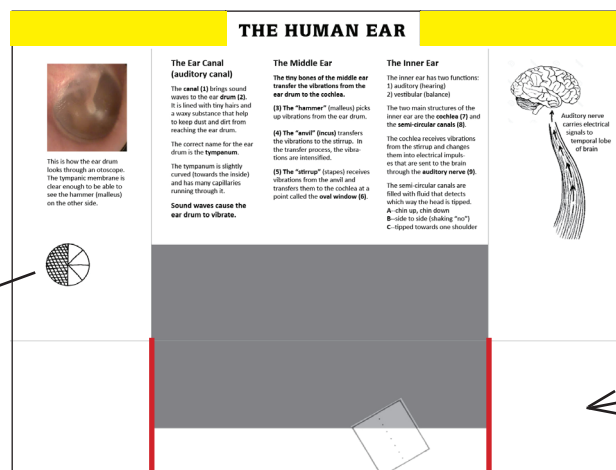
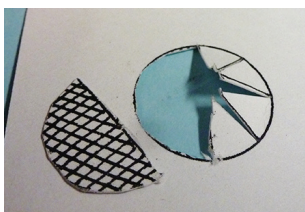
- copies of the pattern pages printed onto lightweight card stock (vellum bristol is fine, or 65 or 90 pound card stock)
- scissors and X-acto knife
- white glue or good quality glue stick (I always advise against “school glue.”)

TIP: To get these parts to stick, press and hold each tab/joint for a count of 10. Patience will pay off!

Assembly:

BOX:

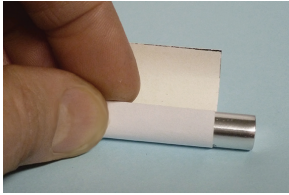
- 1) Cut along dark lines (that are shown here in red).
- 2) Cut out the yellow areas.
- 3) Cut out cross-hatched semi-circle, and cut along “wedge” lines.
- 4) Fold along light gray lines.
- 5) Fold into box shape as shown in main picture above, and glue bottom flaps underneath.
- 6) Fold title [THE HUMAN EAR] back.



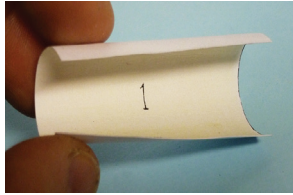
These squares will go under the gray rectangle.

EAR PARTS:

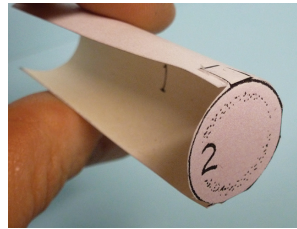
- 1) Cut out all parts. Use X-acto knife to cut out striped area of outer ear ("hole" in ear).
- 2) Roll the ear canal (1) around a pencil to make it curved into a half tube.
- 3) Glue the ear drum (2) to the end of the ear canal using the tabs. (Press and hold each tab for a count of 10.)
- 4) Glue the ear canal to the wedge-shaped tabs. In the picture, the box is tipped on its side.



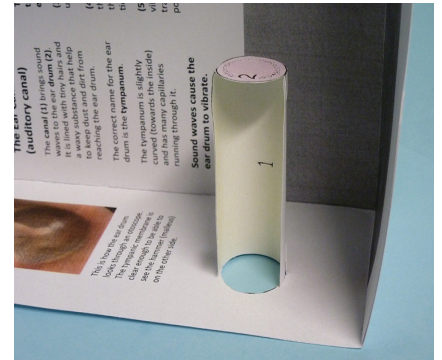
(2)



(2)

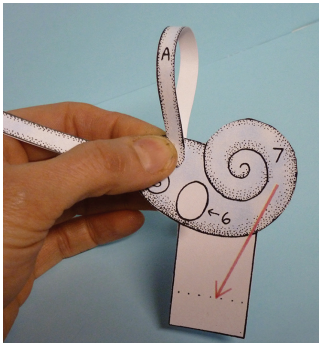


(3)

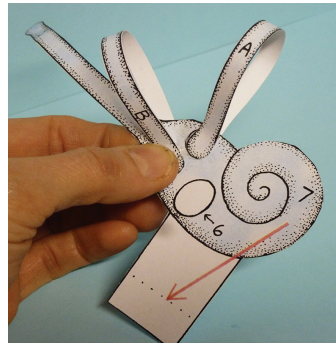


(4)

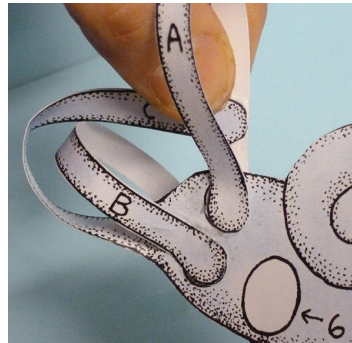
- 5) Take the semicircular canal tab marked A, and glue it as shown in picture, matching end of tab to circle marked A. (Don't forget to press and hold for at least 10 seconds before letting go.)
- 6) Take the semicircular canal tab marked B and glue it as shown, making sure to match end of tab to circle marked B.
- 7) For semicircular canal C, you will have to gently stroke and twist the long tab a bit, coaxing it into position. Manipulate the paper so that the front (blue) side of the tab comes over and glues to the back rear A strip, as shown in picture.



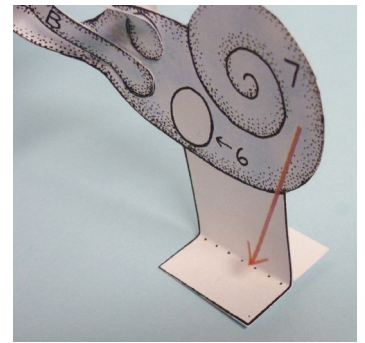
(5)



(6)

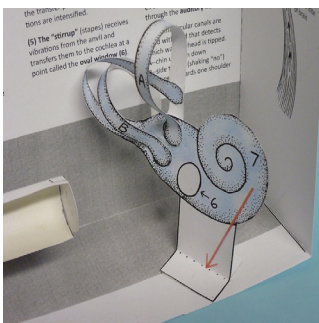


(7)

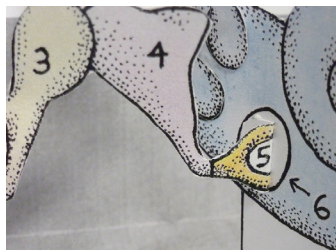


(8)

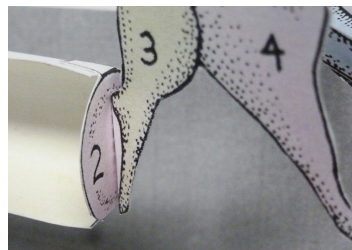
- 8) Fold the square piece in half along dotted line and glue to back of cochlea, making it a "foot" to stand on.
- 9) Glue cochlea into box on top of indicated square.
- 10) Fold back tab on stirrup along dotted line and glue tab to oval window, marked 6, on cochlea.
- 11) Fold back tab on hammer (3) and glue to eardrum.
- 12) Fold the glue tab on the auditory nerve (9) and glue to back of cochlea. Make an appropriate fold at the other end and glue to bottom of picture of nerve going to brain. (A glue tab was not provided so that you can custom design your auditory nerve to fit into the space between the cochlea and the end of the box.)



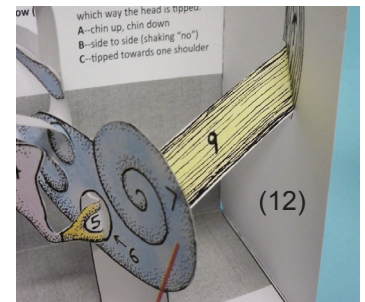
(9)



(10)



(11)



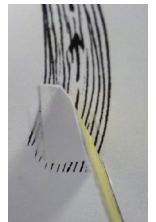
(12)

- 13) Glue the outer ear to the left side of the box, matching the holes. Before you apply glue, notice that the outer ear is larger than the box. You won't want glue on the part that goes beyond the box.



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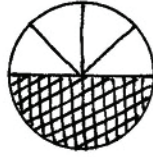
(12)



THE HUMAN EAR



This is how the ear drum looks through an otoscope. The tympanic membrane is clear enough to be able to see the hammer (malleus) on the other side.



The Ear Canal (auditory canal)

The **canal (1)** brings sound waves to the **ear drum (2)**. It is lined with tiny hairs and a waxy substance that help to keep dust and dirt from reaching the ear drum.

The correct name for the ear drum is the **tympanum**.

The tympanum is slightly curved (towards the inside) and has many capillaries running through it.

Sound waves cause the ear drum to vibrate.

The Middle Ear

The tiny bones of the middle ear transfer the vibrations from the ear drum to the cochlea.

(3) The "hammer" (malleus) picks up vibrations from the ear drum.

(4) The "anvil" (incus) transfers the vibrations to the stirrup. In the transfer process, the vibrations are intensified.

(5) The "stirrup" (stapes) receives vibrations from the anvil and transfers them to the cochlea at a point called the **oval window (6)**.

The Inner Ear

The inner ear has two functions:

- 1) auditory (hearing)
- 2) vestibular (balance)

The two main structures of the inner ear are the **cochlea (7)** and the **semi-circular canals (8)**.

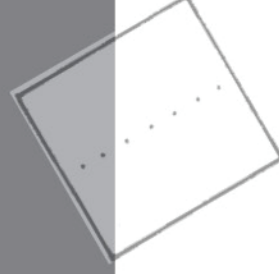
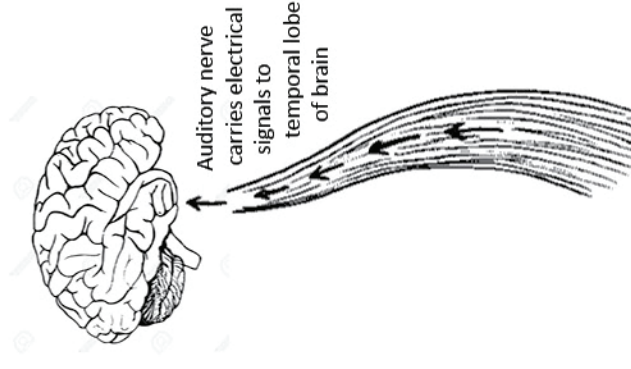
The cochlea receives vibrations from the stirrup and changes them into electrical impulses that are sent to the brain through the **auditory nerve (9)**.

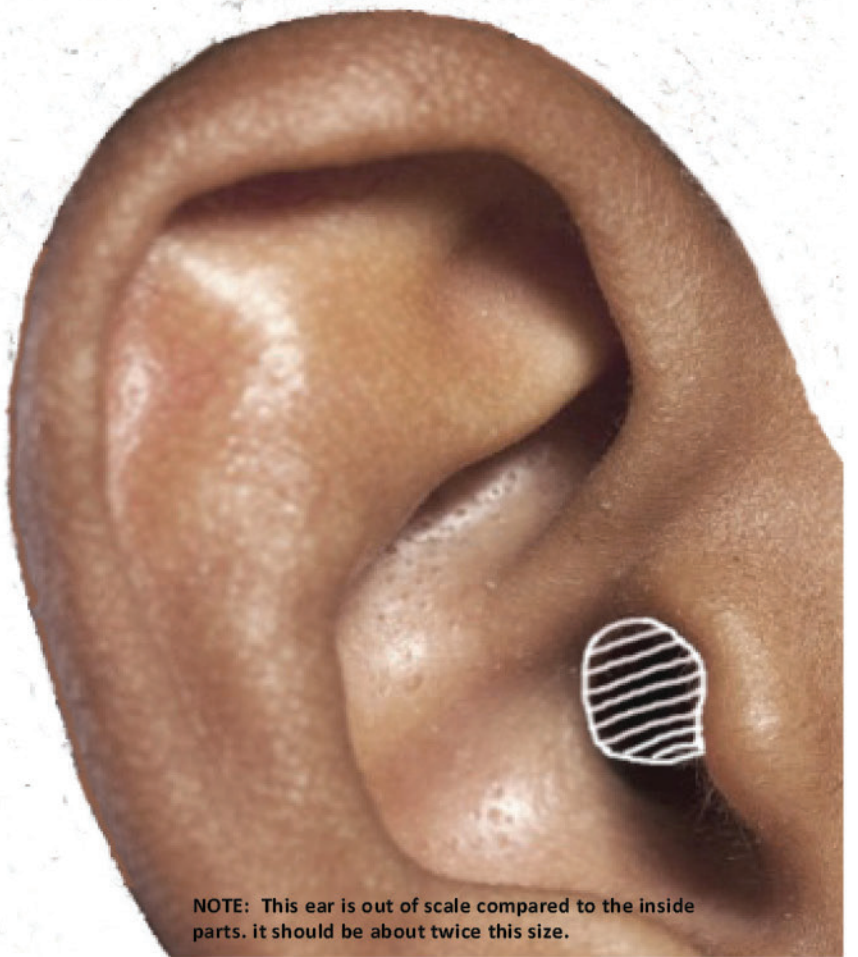
The semi-circular canals are filled with fluid that detects which way the head is tipped.

A--chin up, chin down

B--side to side (shaking "no")

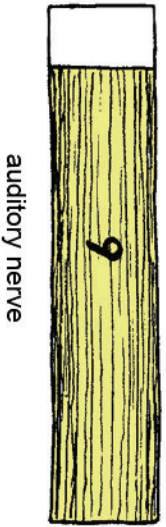
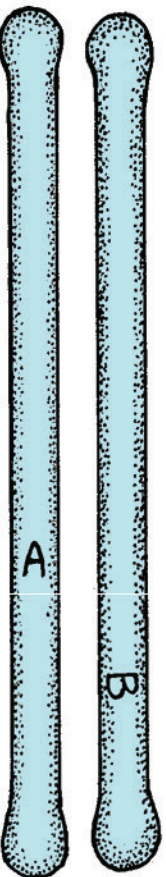
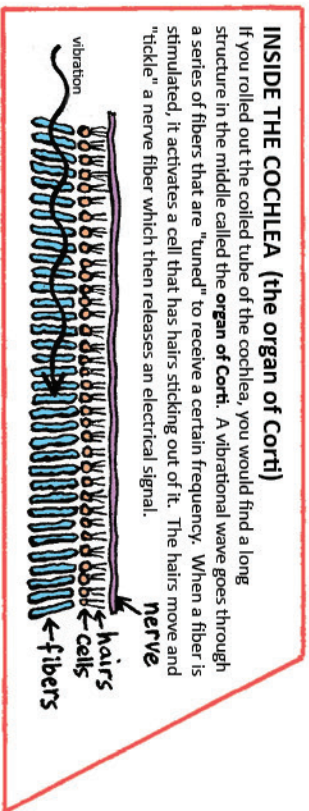
C--tipped towards one shoulder



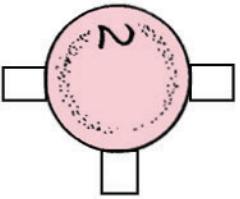


NOTE: This ear is out of scale compared to the inside parts. it should be about twice this size.

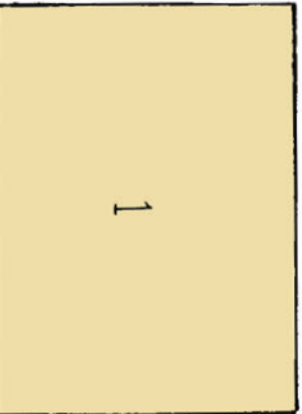
Cut out the striped area inside the ear.
TIP: A sharp craft knife like an X-acto knife works better than scissors.



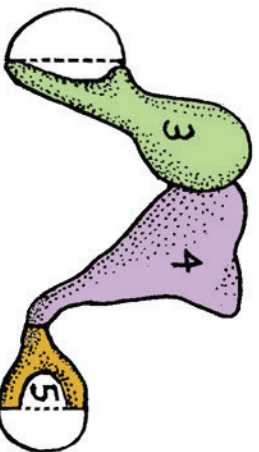
auditory nerve



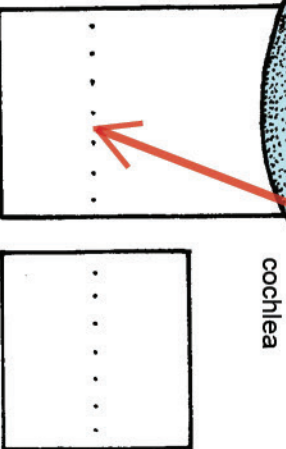
eardrum



ear canal



hammer, anvil, stirrup



cochlea