

VISIBLE  BODY®

Special Senses: Hearing

A nervous system lab activity using Visible Body Suite

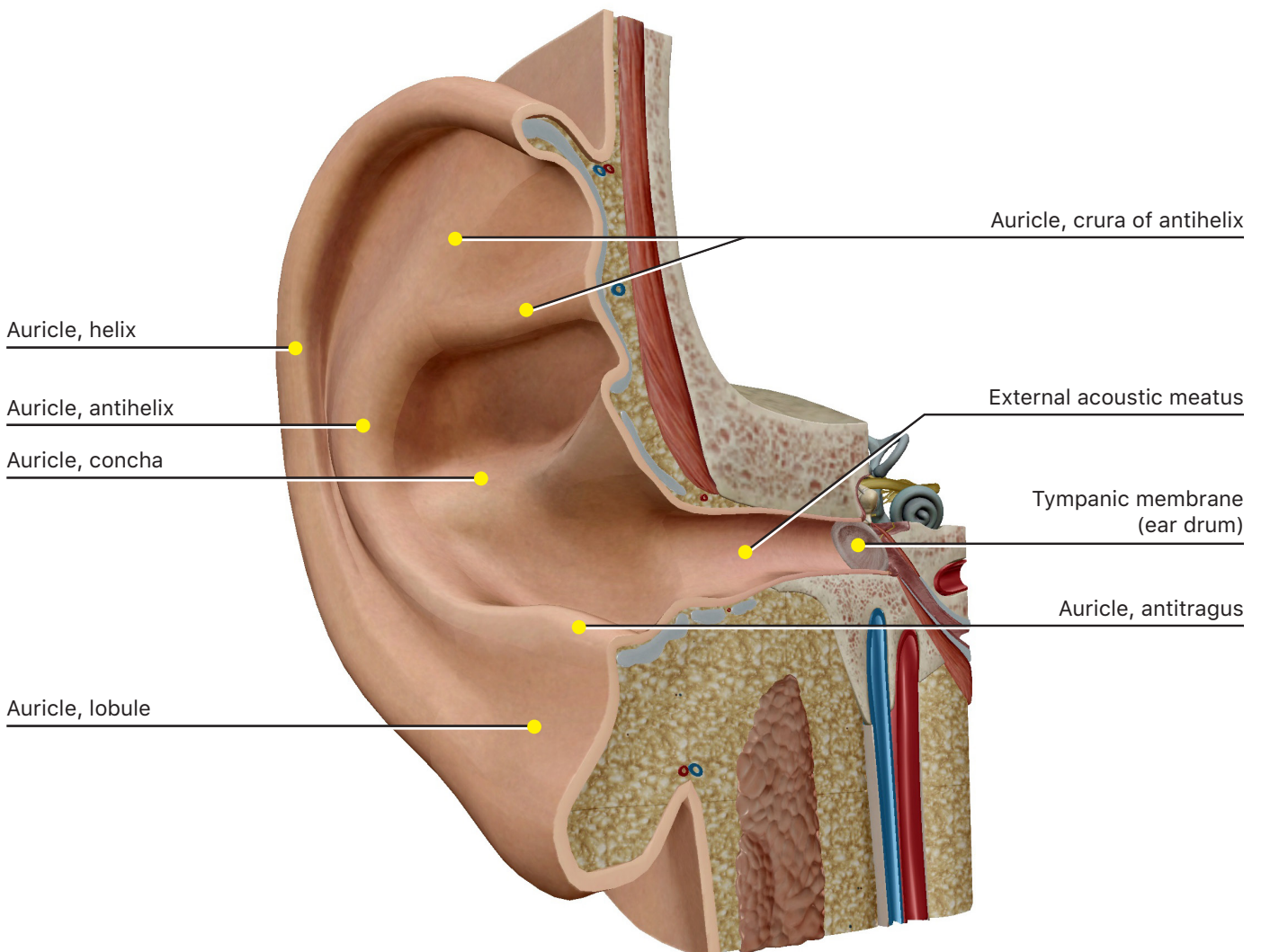
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PRE-LAB EXERCISES

What is sound? Sound is composed of waves of pressure. Through a series of events, these waves of pressure are amplified and changed into a signal, which moves ciliary hairs on receptors in the inner ear, changing the signal into a neural signal.

A. Overview of Hearing

Search for and select the Nervous System View "Ear."



1. Examine the outer ear. Note how it looks like a funnel. What do funnels do when you pour liquid into them?

2. How do you think the outer ear's funnel-like shape would influence sound movement through the ear?

3. The tympanum of the ear is colloquially called the "ear drum." What happens when you hit a drum?

4. What do you think hits the tympanum?

5. The force of something pushing on something else is related to the change in pressure divided by the resistance. This means that what it is pushing on is important. Which has more resistance (is harder to push against), air or water?

6. What would be needed to overcome increased resistance?

7. The inner ear is fluid-filled, while the external ear conducts sound through the air. What must happen to the signal as it transitions from air to fluid?

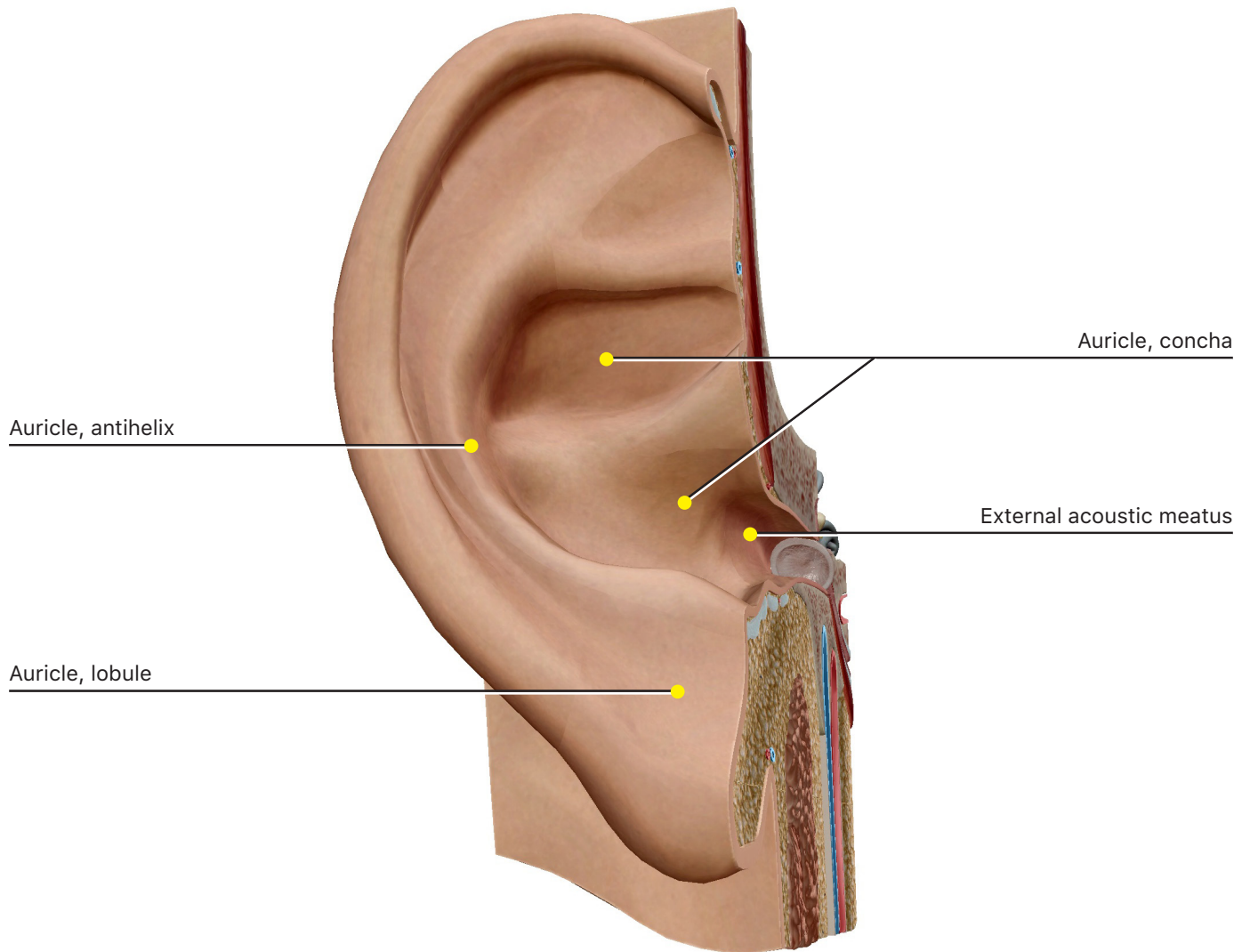
8. Briefly, what triggers a neural signal?

IN-LAB EXERCISES

A. Auricle

Open the Nervous System View "Ear."

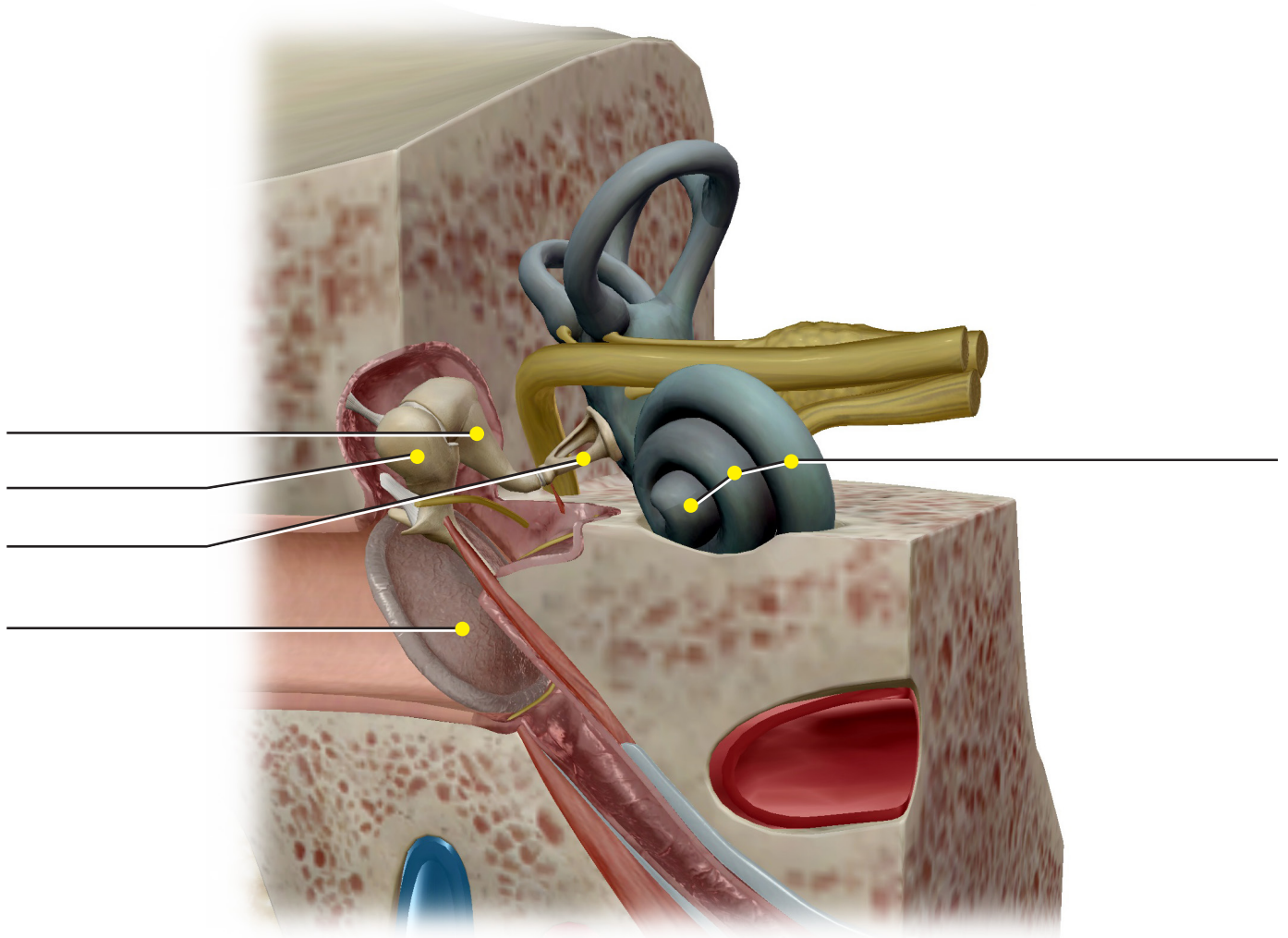
You are responsible for the identification of **all bold terms** and answers.



1. Locate the **auricle**. What are the divisions of the auricle?
2. Note the funnel-like shape of the auricle; it funnels sound into the middle ear.
3. Locate the **external acoustic meatus**. What is its function?

B. Middle Ear

Open the Nervous System View "Middle Ear."

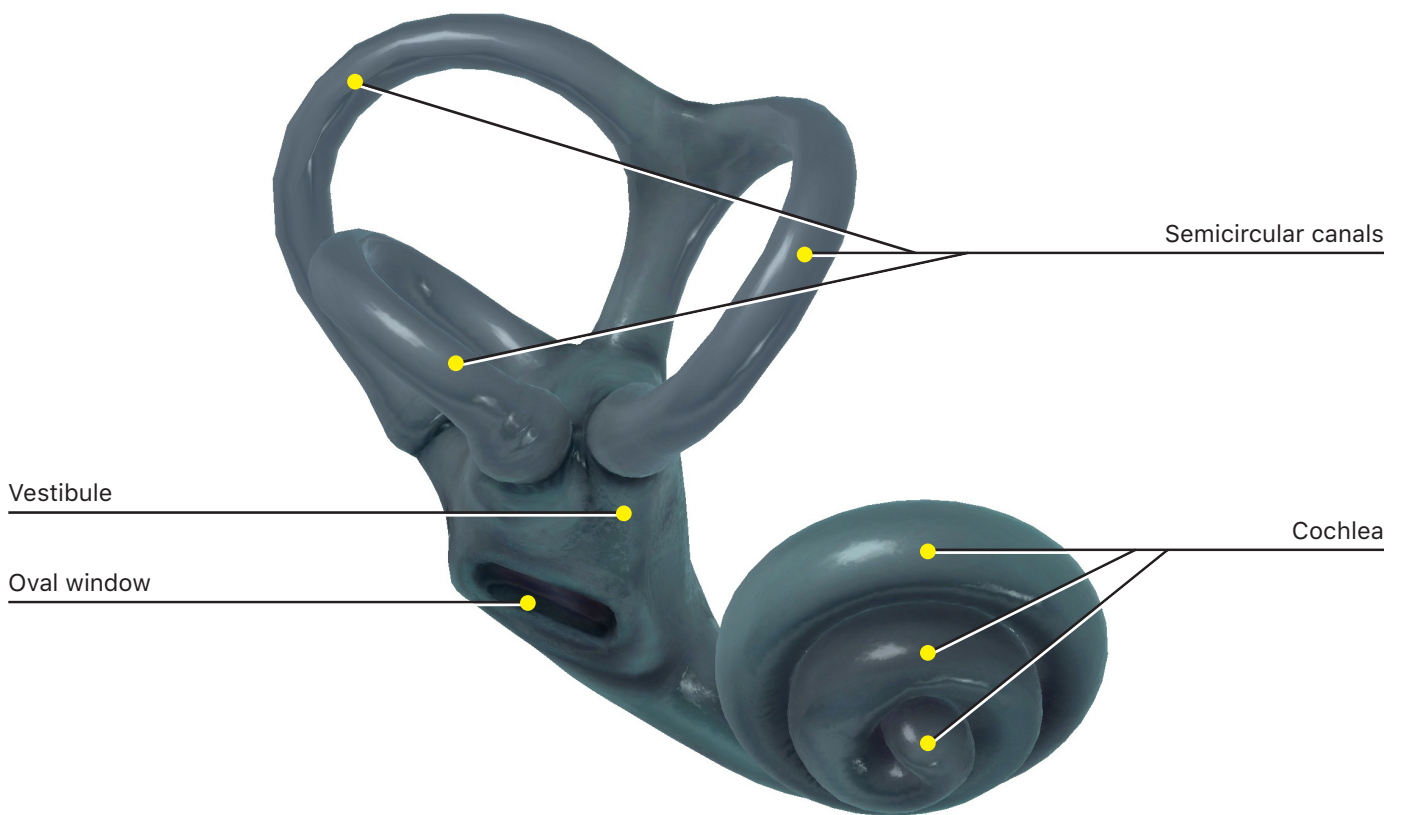


1. Locate the following structures and label them in the diagram above:

- a. **Tympanum**
- b. **Cochlea**
- c. **Incus**
- d. **Stapes**
- e. **Malleus**

2. For the structures listed above, list them in order, from outermost to innermost.

3. For the structures listed a–d above, list the role each of them has in hearing.



4. The stapes connects to the **oval window**, which is a membrane that allows the movement of the stapes to create waves in the fluid inside the **cochlea** of the inner ear.

Label the following structures in the image below.

- Cochlea
- Vestibule
- Semicircular canals
- Oval window

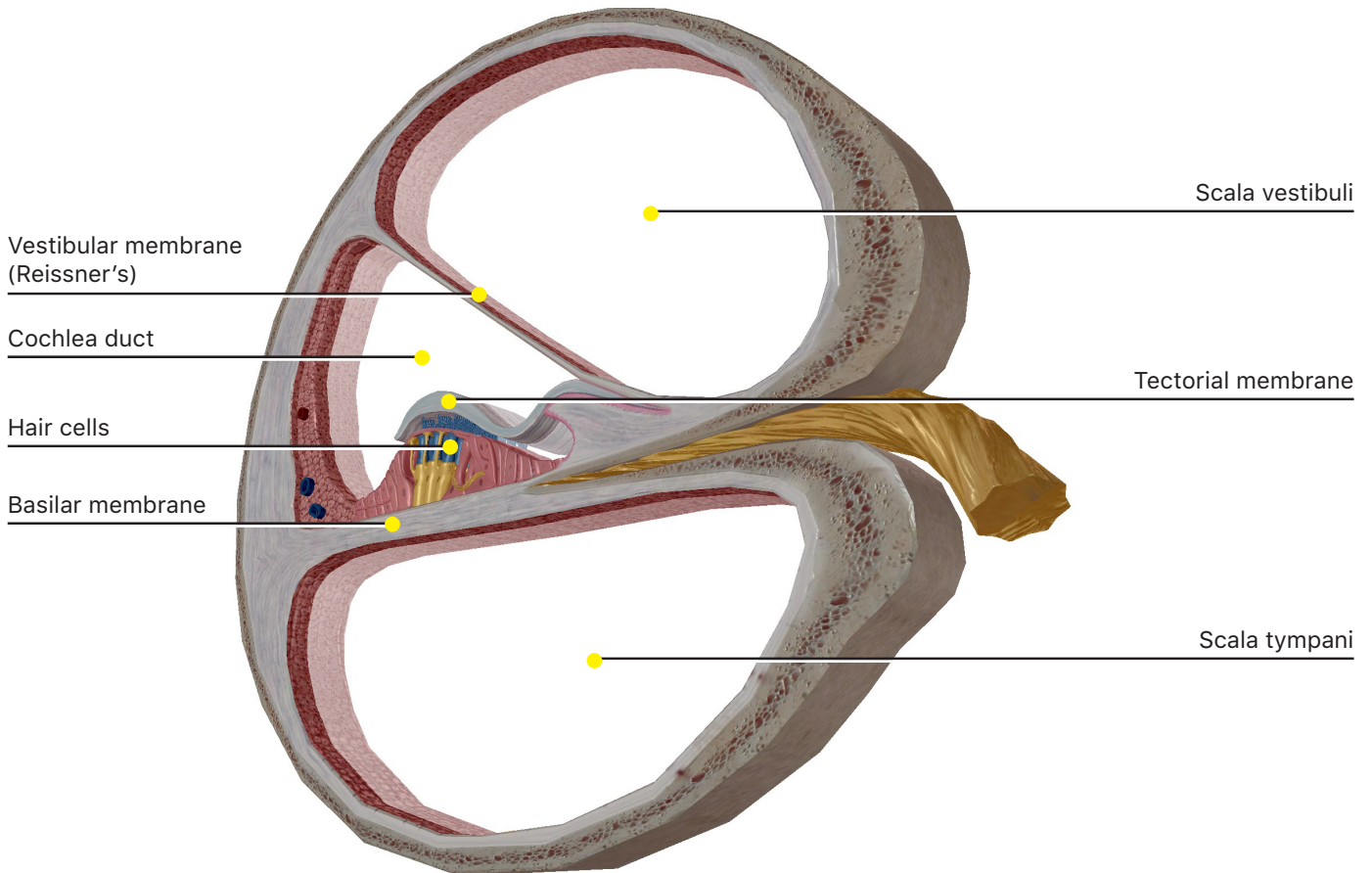
5. What part(s) of the inner ear do the nerves connect to?

6. Where do these nerves project in the brain? (For each structure you choose, be sure to select the book icon for more information.)

7. Locate the **round window**. What is its function in hearing?

C. Cochlea

Open the Nervous System View "Cochlea."



1. Locate the following structures:

- a. **Scala tympani**
- b. **Scala vestibuli**
- c. **Cochlear duct**
- d. **Tectorial membrane**
- e. **Reissner's membrane (vestibular)**
- f. **Basilar membrane**
- g. **Hair cells**

2. Examine the hair cells. What do they look like?

3. Which membranes are the hair cells in contact with? (Include the part of the cell in contact with each membrane).

4. Which nerves are the hair cells in contact with?

5. When the stapes vibrates against the oval window, it causes the basilar membrane to vibrate up and down. What would this do to the hair cells?

6. The basilar membrane starts wide, and as it travels through the cochlea, it gets narrower. The base of this membrane is sensitive to very high-pitched noises, because it is very rigid. As you move toward the tip, it becomes more flexible and thus more sensitive to low-pitched noises.

a. Where do high-pitched sounds contact the membrane?

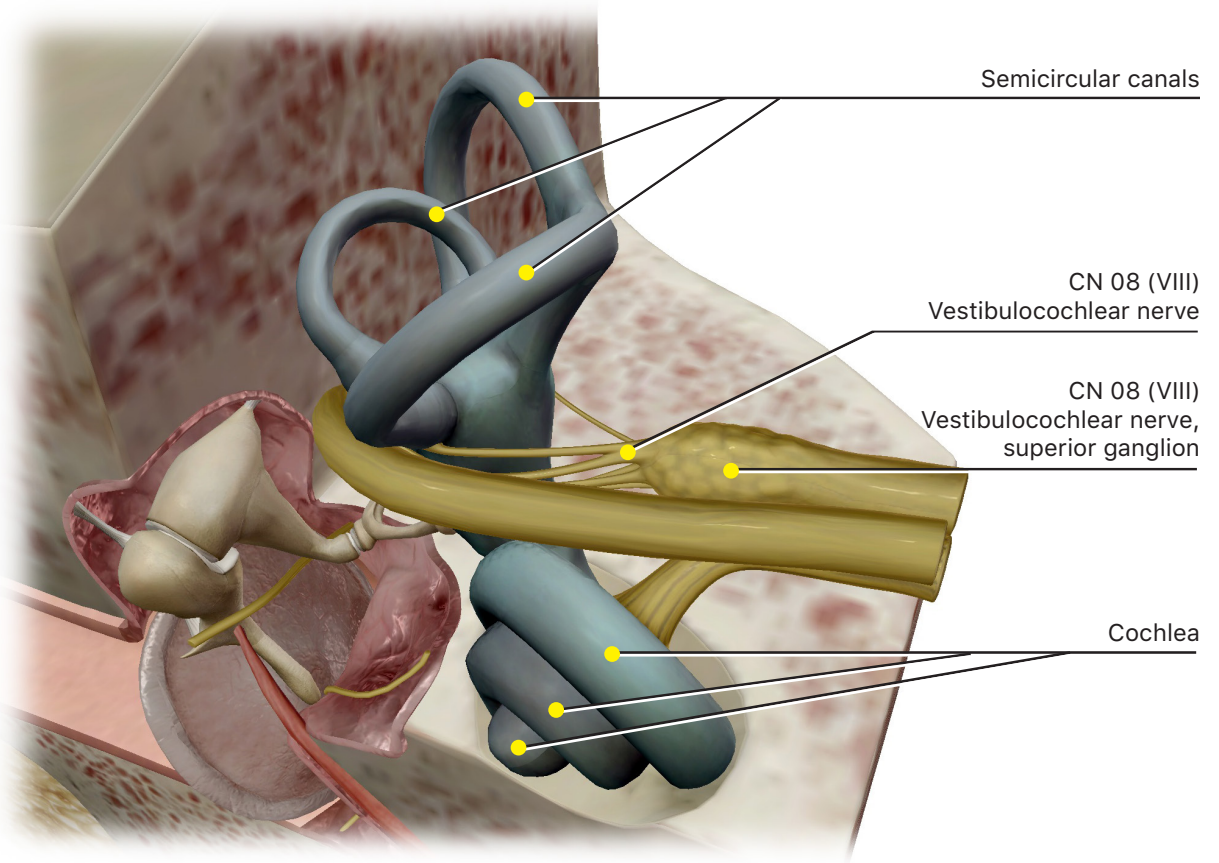
b. Where do low-pitched sounds contact the membrane?

c. Where would medium-pitched sounds contact the membrane?

7. Examine the semicircular canals in the image below. Each of these canals is filled with fluid, and much like in the cochlea, movement of this fluid stimulates hair cells, causing an action potential. Note that each of these canals is oriented in a different direction. In this way, these canals work like levels (as in the tools, also known as spirit levels or bubble levels) for your body. In the image below, draw an arrow representing the plane of movement that would activate each of the canals.

D. Inner Ear

Open the Nervous System View "Inner Ear."



1. What is the name of the nerve that connects to the semicircular canals?
2. Where does that nerve project to in the brain?

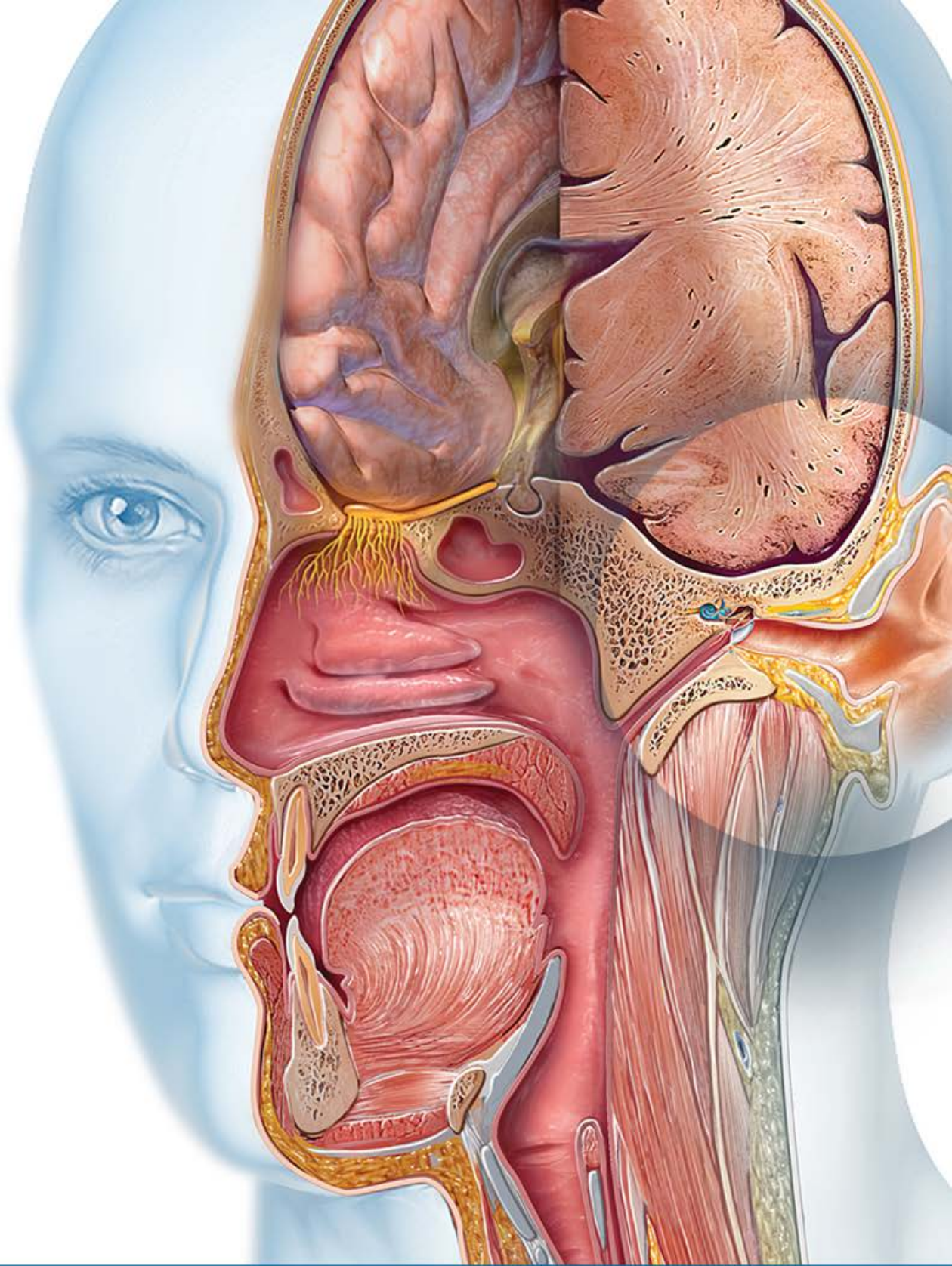
PUTTING IT ALL TOGETHER

1. When a sound enters the ear, what are the structures it passes through on its way to become a fully processed neural signal within the brain? Fill in the blanks below.

Sound enters through the _____ of the ear, which funnels it into the _____. At the end of this structure is the _____, which vibrates because of the pressure waves created by the sound. This vibration causes movement in a series of bones: first, a small bone called the _____; second, a small bone called the _____; and third, a bone called the _____, which is connected to the _____ of the inner ear. The movement of these bones causes fluid within the cochlea to move, resulting in movement of the _____ membrane. The movement of this membrane causes the _____ to move against the _____ membrane, resulting in the creation of a neural signal. This signal travels through the _____ nerve, which is transferred to the _____ nucleus of the _____ in the brainstem. From there, information is relayed through multiple regions in the brain, eventually reaching the _____ of the cerebral cortex.

2. When the head is tilted, what are the structures the signal passes through on its way to becoming a fully processed neural signal within the brain? Fill in the blanks below.

When the head is tilted, the fluid within the _____ of the inner ear moves. The exact location of stimulated cells depends on the plane of movement—with each plane being represented by a different part of that structure. The movement of fluid stimulates _____, which transduce the signal into an electrical signal. This signal travels through the _____ nerve to the _____ nucleus of the _____. From there, the information is sent to the _____ for subconscious action and to the _____ for conscious sensation.

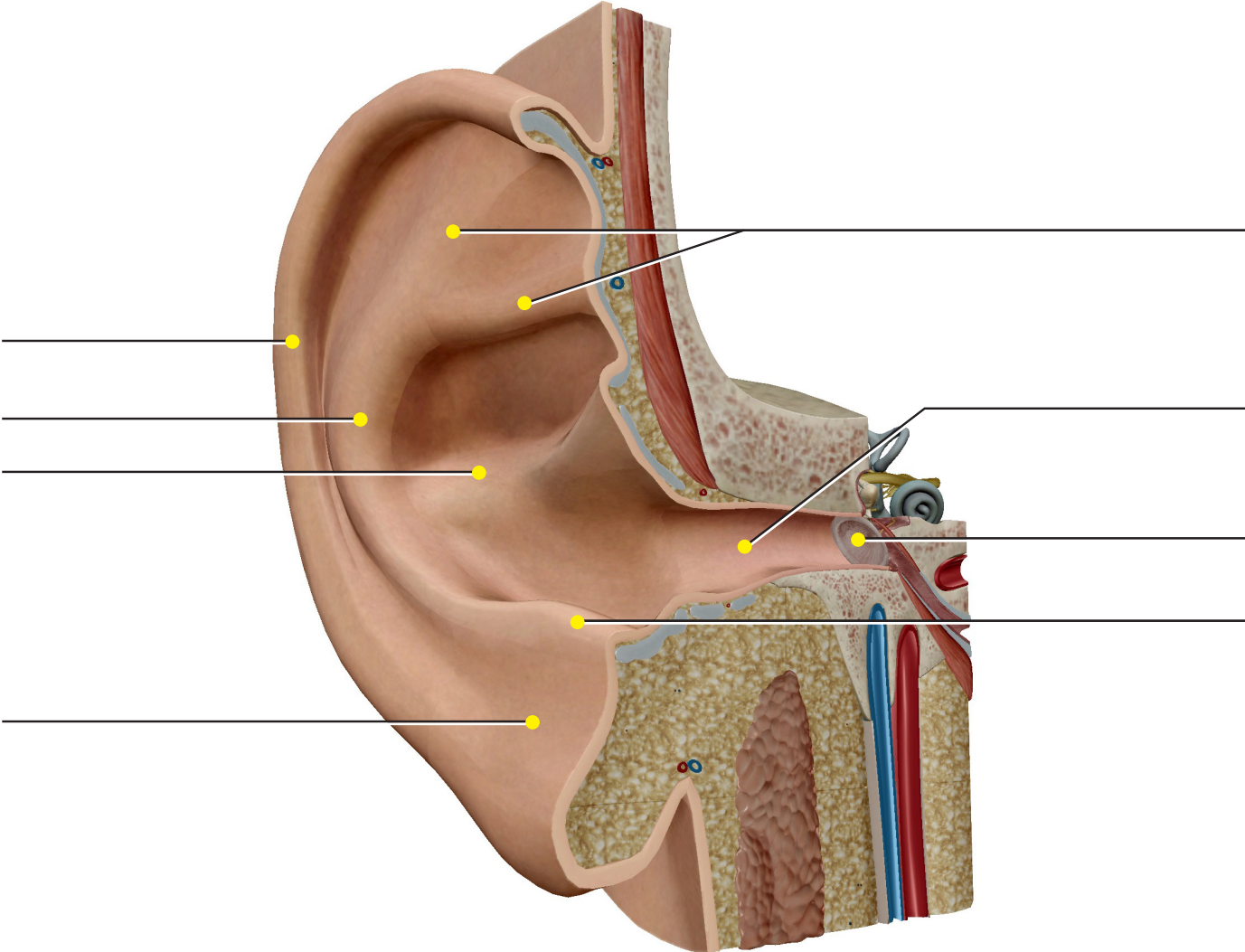


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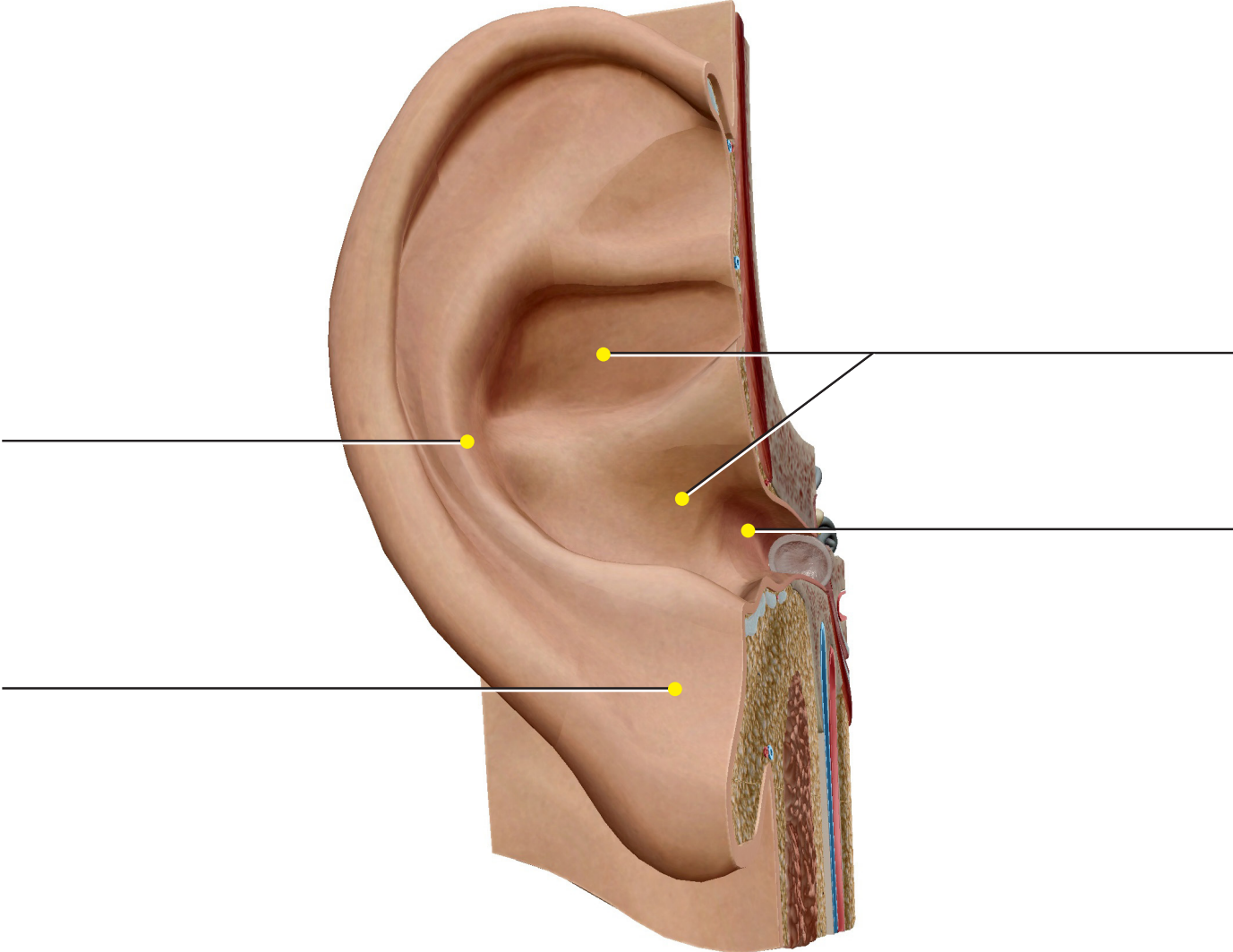
Student Practice

Label the structures in the following figures.

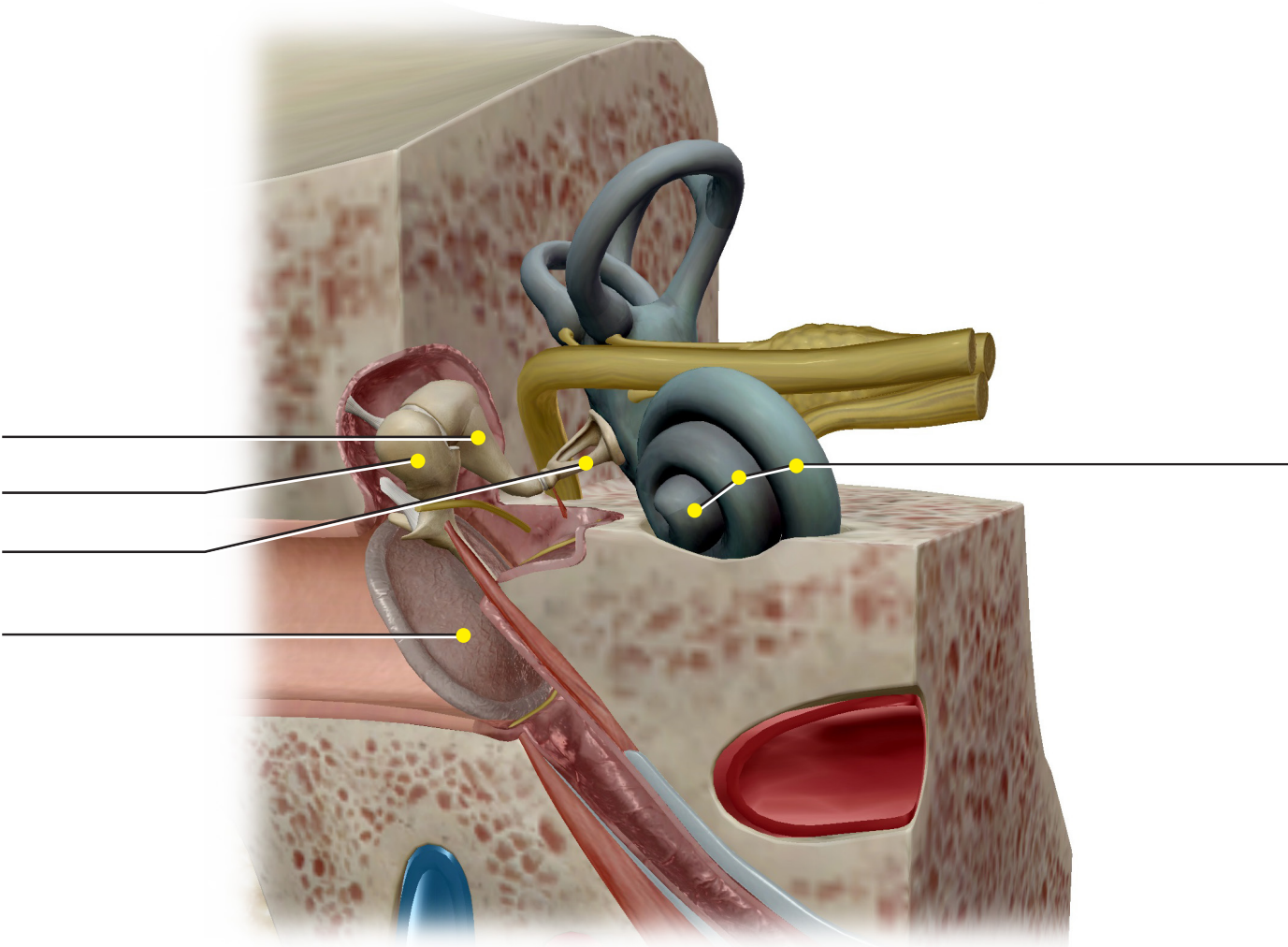
Source: Nervous System View "Ear"



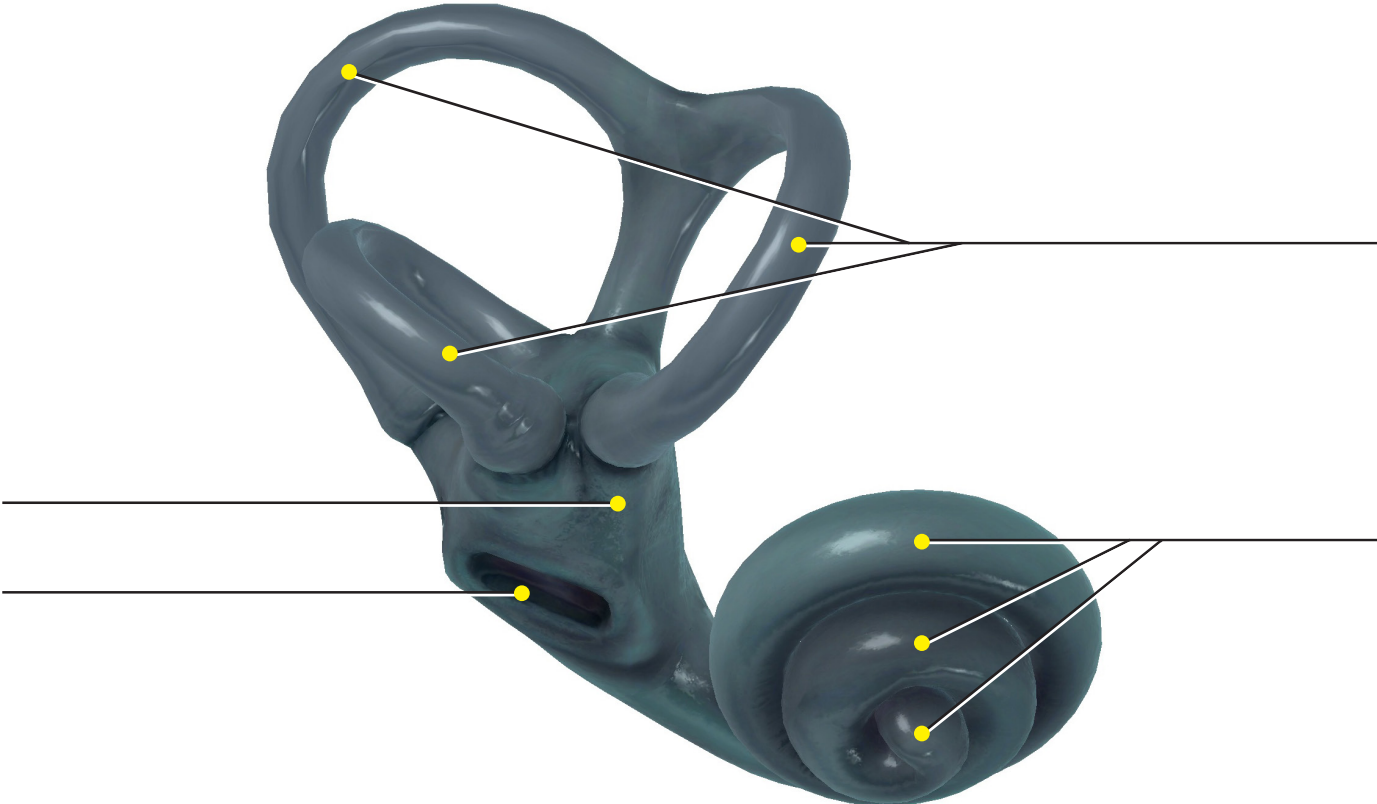
Source: Nervous System View "Ear"



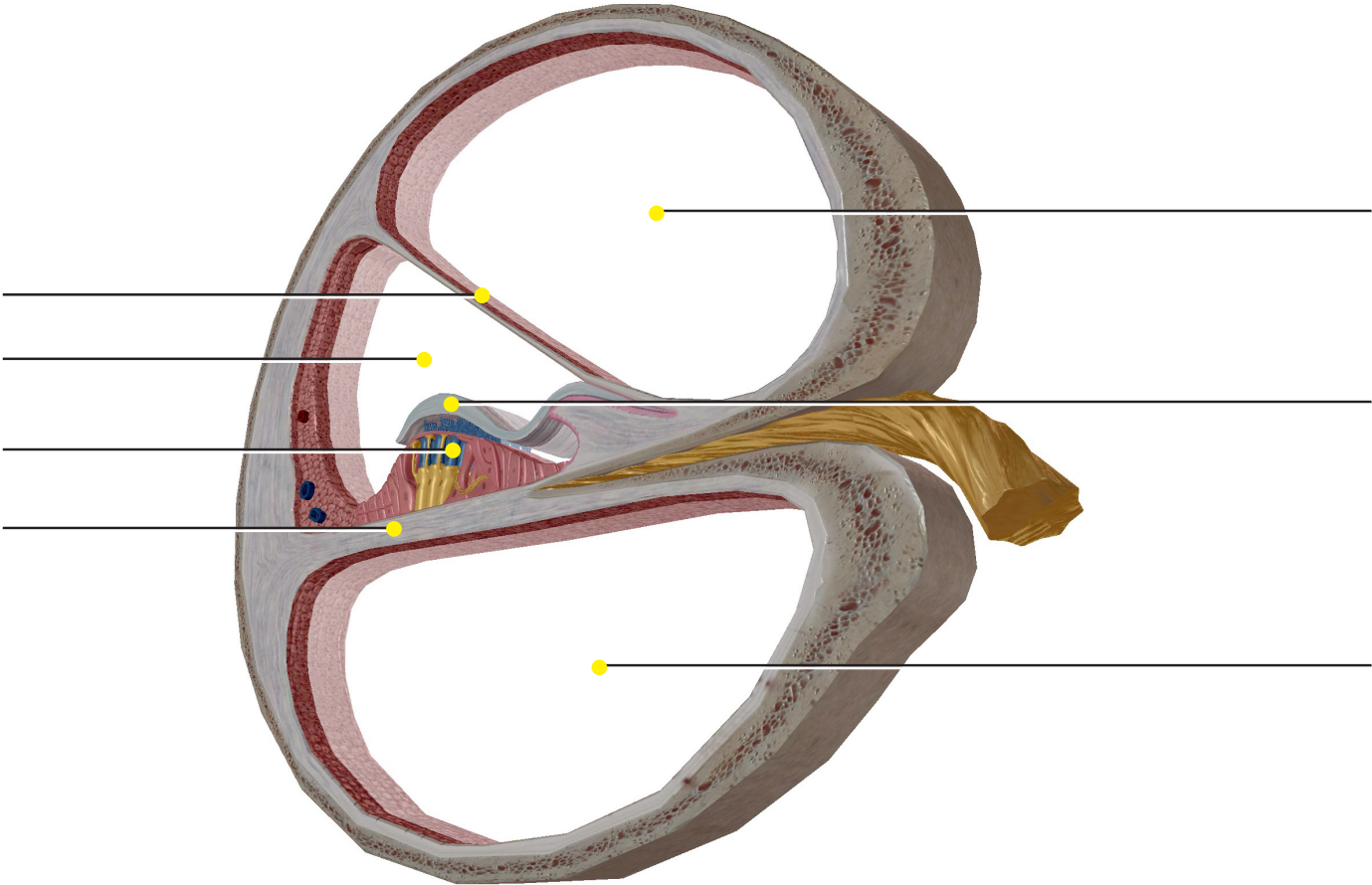
Source: Nervous System View "Middle Ear"



Source: Nervous System View "Middle Ear"



Source: Nervous System View "Cochlea"



Source: Nervous System View "Inner Ear"

