Auditory Development or "Hearing and the Brain"

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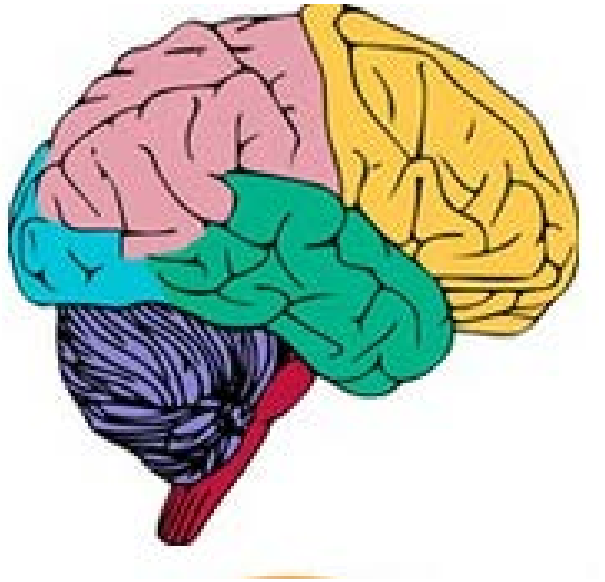
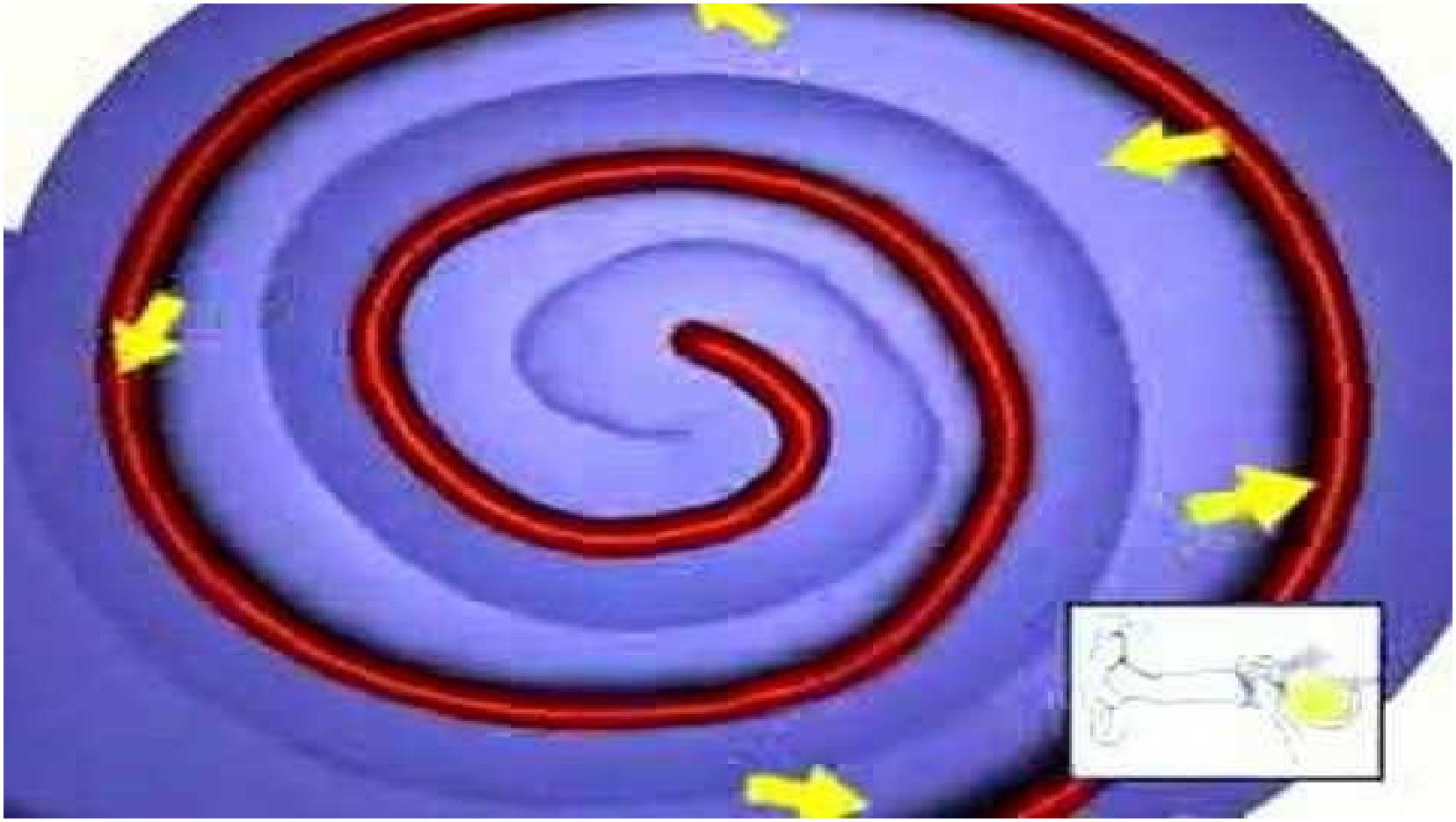
How is the Brain Involved?

- The ***ear*** catches and funnels sound
- The **brain** makes sense of it
  - What is this sound?
  - What does it mean to me?
  - What do I know about it?



Video: How we hear



Who are We?

What is an Audiologist?

- A health care professional trained in the evaluation and rehabilitation of hearing and balance disorders.

What Does an Audiologist Do?

Assessment

- Hearing tests
- Newborn hearing screening
- Balance assessments
- Auditory processing assessments

Treatment

- Hearing Aids
- Cochlear Implants
- Auditory rehabilitation

Different Roles of the Audiologist

Parent/Family Advocate

Clinician

Researcher

Educational Audiology

Interdisciplinary Team Member

Early Detection and Identification

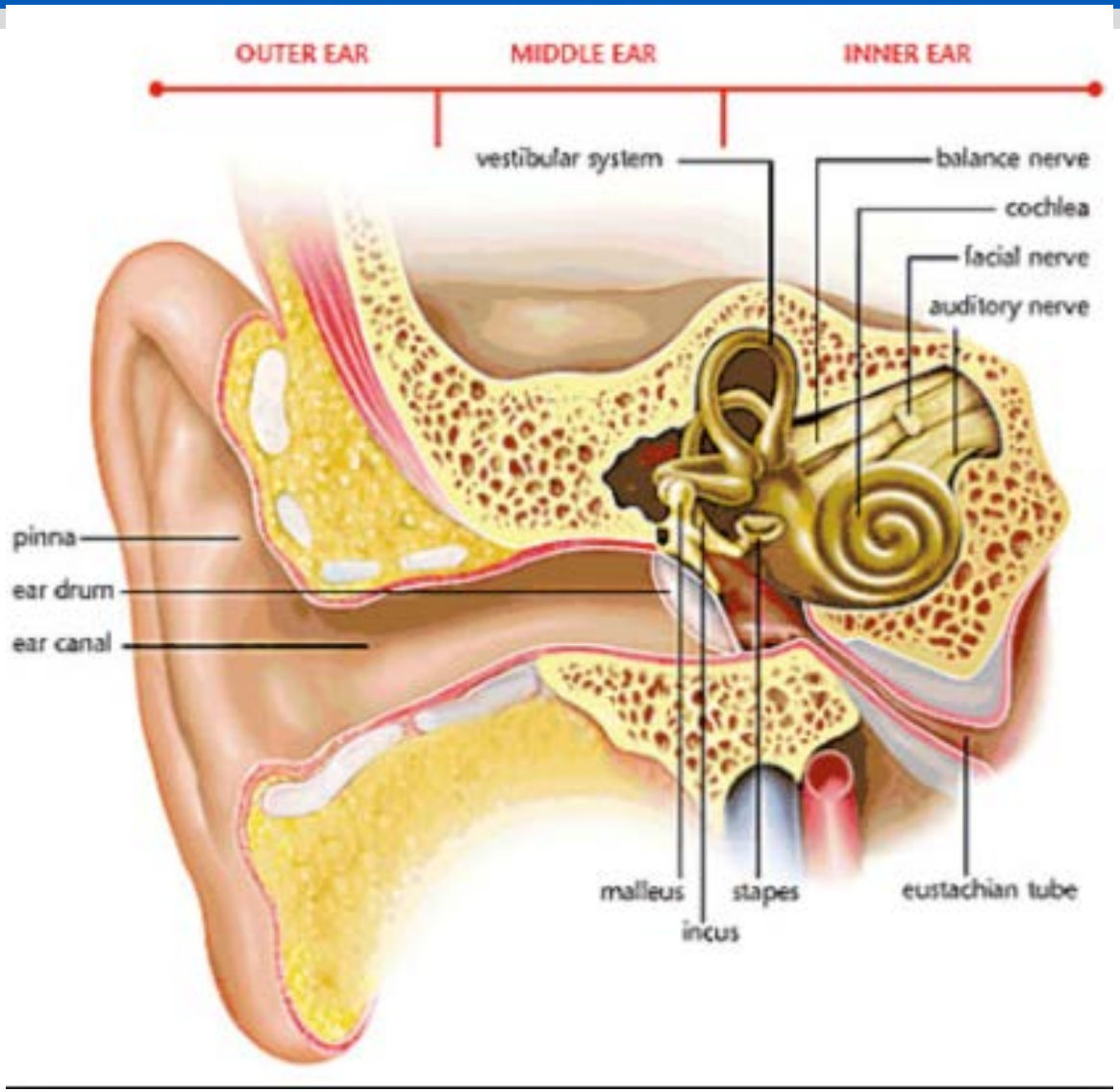
Failed newborn hearing screen:

- **Permanent** hearing loss (3 out of every 1000 births)
  OR
- **Temporary:** Sound wasn't able to get into the auditory system (fluid/congestion from birth, etc.)

1-3-6 Plan

- Hearing screening by 1 month of age
- If failed: audiologic and medical evaluations to ***confirm*** hearing loss by 3 months of age
- If hearing loss: ***intervention*** by 6 months of age
  - Hearing aids, cochlear implants, etc.

Source: American Academy of Pediatrics, 1999 – Revised in 2011



Ear Infections. (2015). Retrieved November 4, 2015, from http://www.westsuburbanent.com/uploads/media/Ear.jpg

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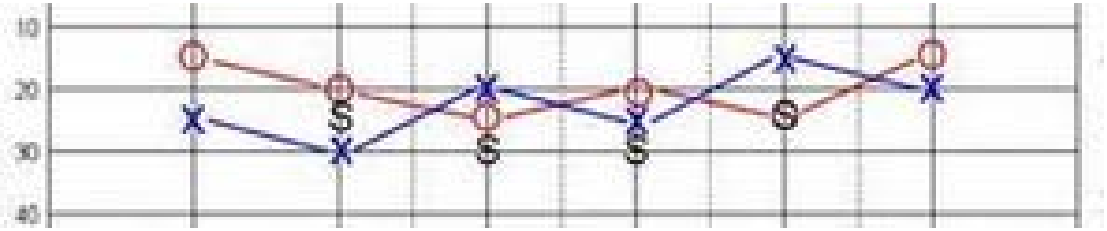
Hearing Loss Terms

- **Conductive:** Hearing nerve is functioning normally, but something is blocking the path
  - **Sometimes reversible or clears up with time**
  - Fluid, wax, foreign objects
- **Sensorineural:** Hearing loss in hearing nerve
  - **Permanent**
  - Family history/genetics, environmental exposure, noise damage, sometimes cause is not known
- **Mixed:** Nerves showing hearing loss, and also something blocking the path
  - Nerve hearing is permanent, but blockage may be reversible



How we test hearing

- Birth to 6 months
  - **Auditory Brainstem Response (ABR)** electrical impulses sent from the inner ear to the brain
  - **Otoacoustic Emissions (OAE's)** sounds created by the vibrations of hair cells in cochlea

How we test hearing

- 6 months to 2 ½ years
  - **Visual Reinforcement Audiometry:** Child's responses to sound are reinforced with a visual event

How we test hearing

- 2 ½ years to 6 years
  - **Conditioned Play Audiometry:** Children are trained to perform a play activity in response to sounds

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Normal Development

AGE	Hearing Milestones
Birth to 3 months	Startles to loud sounds
	Smiles when spoken to
	Recognizes voices
4 to 6 months	Moves eyes in direction of sound
	Notices toys that make sound
	Pays attention to music
7 to 12 months	Turns head in direction of sound
	Enjoys peek-a-boo
	Listens when spoken to
	Recognizes common words like “cup”
12 to 24 months	Can point to body part Follows simple commands Understands simple questions Listens to simple stories and songs

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Normal Development

AGE	Hearing Milestones
2 to 2 ½ years	Answers questions from a story
	Starts to understand meaning (go vs stop)
	Follows 2 step requests
2 ½ to 3 years	Can describe an event or vacation
	Answers simple questions about familiar topic
3 to 4 years	Can retell stories
	Can repeat sentences
	Identifies object when described
	Hears when called from another room
4 to 5 years	Can recall simple facts from a story
	Understands rhyming
5 to 6 years	Learning letter-sound associations

What To Watch For – Red Flags

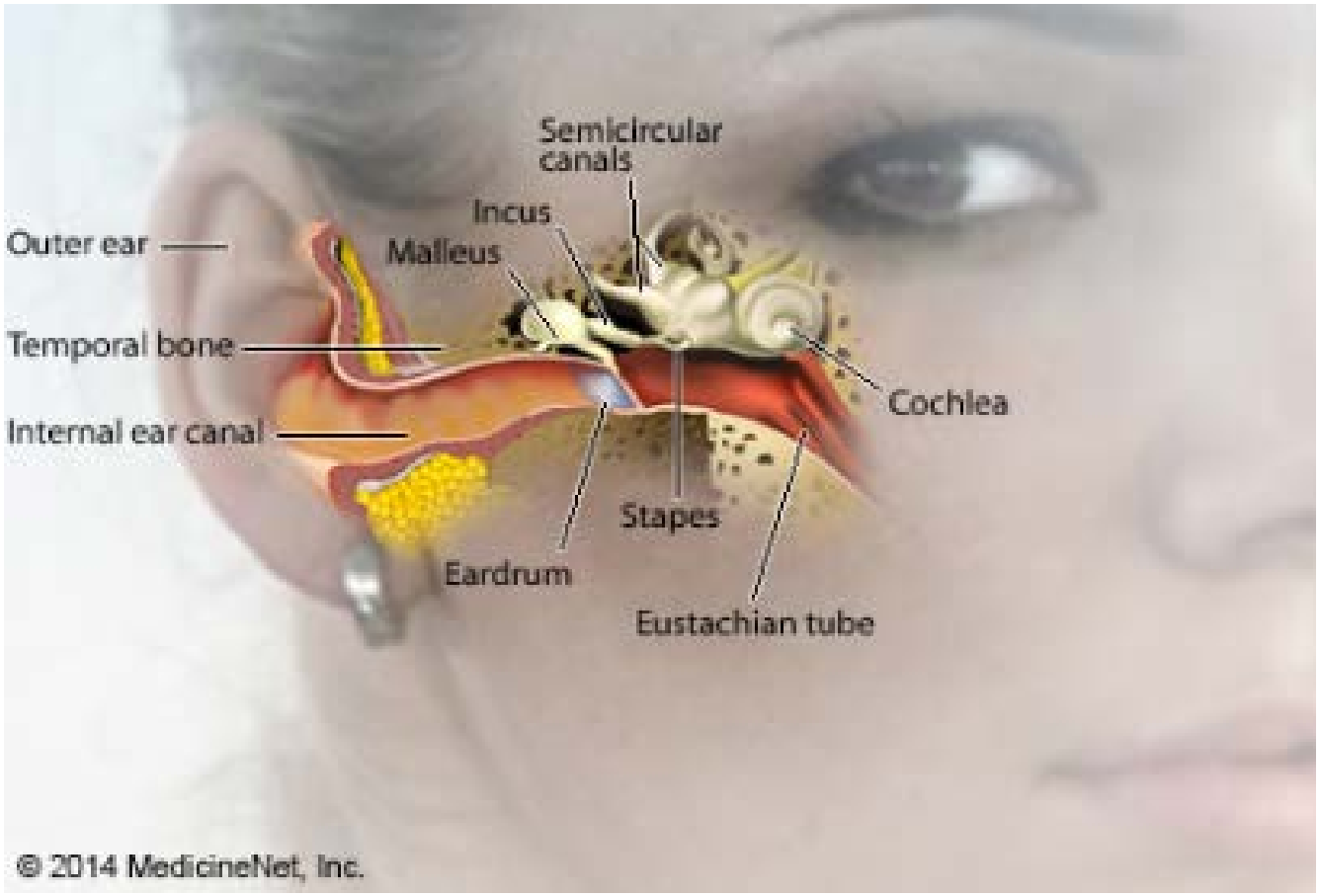
- Delay in speech/language development
- Having trouble understanding requests
- Pulling or complaining about ears

Red Flags

- Risk Factors
  - Family history of hearing loss
  - Newborn hearing screening, pass? Pass, at risk?
  - Prematurity and/or NICU stay
  - Pathology of body systems (Cardiac, Musculoskeletal, Neurologic, Skin, Endocrine-metabolic, Visual-eye, Kidney disorders)
  - Persistent ear infections
  - Persistent middle ear fluid without infection

Red Flags

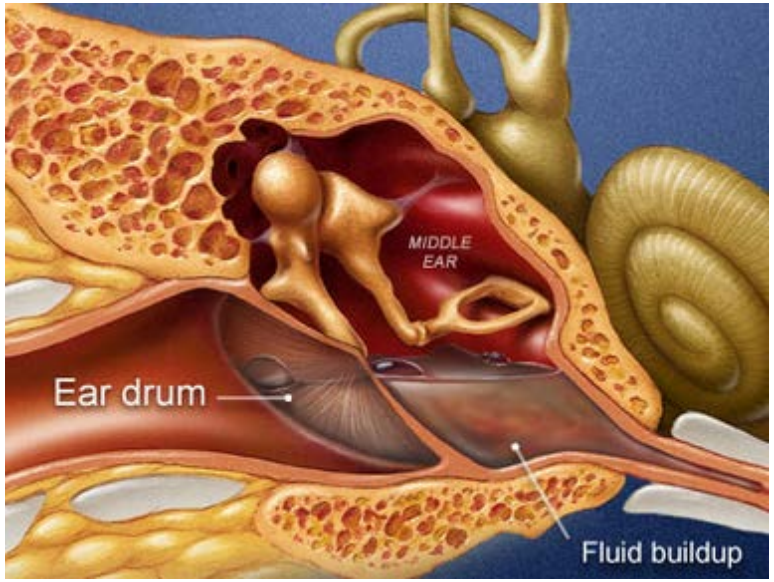
- Otitis Media with Effusion (OME)
  - Build up of fluid without the onset of symptoms like fever and pain
- Acute Otitis Media (AOM)
  - Onset of infection and symptoms including swelling and pain



Ear Picture Image on MedicineNet.com. (n.d.). Retrieved November 5, 2015.

What this can mean

- Influence of effusion (fluid) over time
  - Mild to moderate hearing loss
    - Temporary
    - May take weeks or months to clear
  - Auditory deprivation
  - Delayed language development
  - Greater risk for delayed reading and educational concerns



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How is hearing related to reading?

- Hearing is __*IMPORTANT*__?

First Order Event

It is the foundation for all spoken language

Building Blocks

- **Sounds** (**Phonemes**) – Identify what sounds ***mean***
- **Vocabulary** – All of the words we ***know***.
  - Learning ***new*** words is based on experience
- **Semantics** – ***meaning***
  - D-O-G = what we know as a dog
- **Morpheme** – parts of words with meaning
  - eg. -ing endings are morphemes. Go + ing = going (2 morphemes)
- **Syntax** – structure and putting things in the right order
- All of these things build from the **bottom up**!
  - First we must hear ***sounds***, we put them together to make words, we put words together to make ***sentences*** and we associate sentences with ***information***

How is hearing related to reading?

- Spoken language builds reading skills
- Listening experience in infancy is critical for adequate language and literacy development.
- Vocabulary is one of the biggest predictors of kindergarten success
  - How many words you know and ***use***

Acquiring Vocabulary

Age	Number of Words
2	300
2.5	500
3	900
4	1,500
5	2,500
6	13,000
7	20,000

Reading

- Understanding of sounds building words
- Poor hearing during infant and toddler years affect understanding of words and sounds
  - Two issues
    - 1 – less benefit from treatment (i.e. speech/language therapies)
    - 2 – missed opportunities to hear spoken language, conversation, overhearing…

Source: Moeller, M. P., Tomblin, J. B., Yoshinaga-Itano, C., Connor, C. M., & Jerger, S. (2007)

How to grow Auditory Brain Centers

- ***Read, read, read*** aloud every day.
- Name ***objects*** in the environment as you encounter them in daily routines
- Talk about and ***describe*** how things sound, look, feel
- ***Compare*** how objects or actions are similar and different in size, shape, smell, color, or texture.

How to grow Auditory Brain Centers

- Talk about ***where*** objects are located
  - Prepositions: such as in, on, under, behind, beside, next to, between.
  - Prepositions are the bridge between concrete and abstract thinking
- Describe ***sequences***: Talk about the steps involved in activities as you are doing the activity. Sequencing is necessary for organization.

Ideas for increasing auditory/language experiences

- Talk with your child all the time about what they are thinking and doing (conversations)
- Create experiences and talk about them
- Draw pictures and tell stories with them
- Use complex language, explain, and link it to the experiences
- Read aloud with your child using challenging books

Tips for Reading Aloud

- Read aloud to your child. It's never too early to begin and never too late to start
- Read more challenging material as your child learns to read along
- Establish a regular time to read

Tips for Reading Aloud

- Show enthusiasm about what you are reading
- Choose a story, poem, news story to grab the child's interest
- Cut the session short if interest lags

- Link the story to life and other books
- Ask the child to predict the outcome through the reading of the story

Tips for Reading Aloud

- Start with picture books, build to storybooks and novels
- Vary the length and subject matter of your readings
- Go on a "book walk" prior to starting the book
  - Point out the title, author, illustrator
  - Discuss illustration on cover
  - Predict what the story will be about based on the title and illustration on cover

Takeaway

- Having access to sounds is ***critical*** for **brain development**.
- **Listening, speech/language development and reading skills depend on auditory *exposure and experience*!**
- If hearing loss is detected and treated early in life, it is often possible for children to progress with other kids their age.

Source: Kiese-Himmel, 2008

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Thank You

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