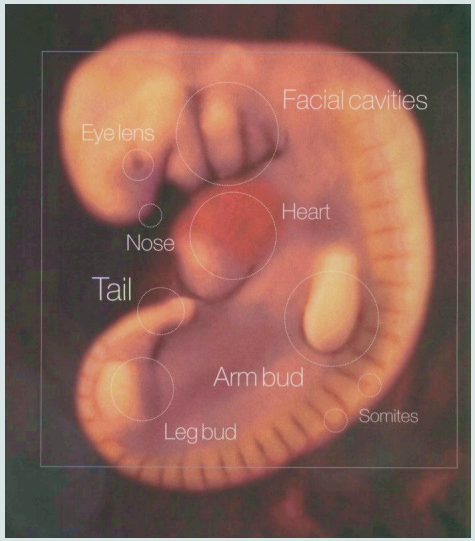
0-6 Whole Brain Development

By Drina Madden

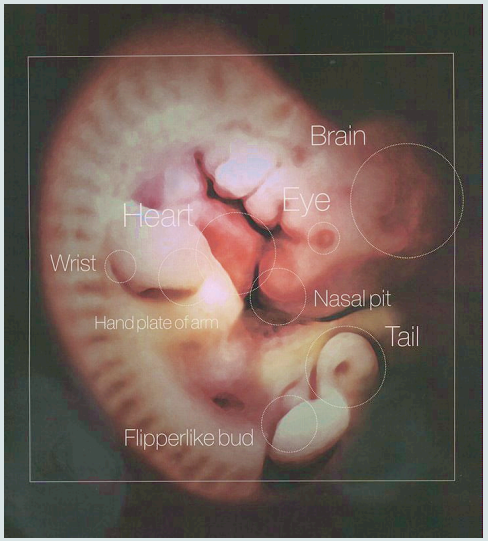
0 - 6
Lower Brain Development

THE EMBRYO

- (An embryo is less than 8 weeks in existence)



28 days (4 weeks)

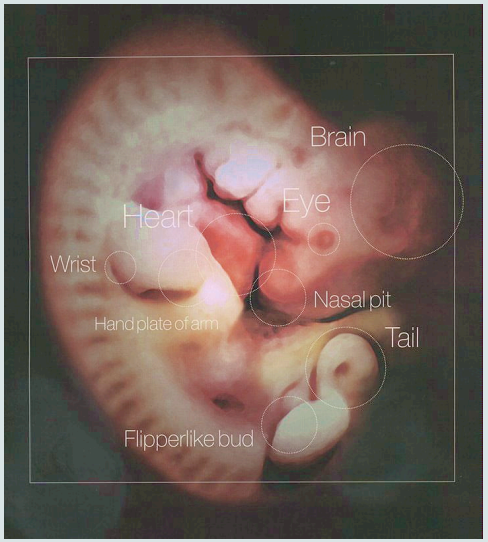


(5 weeks) 36 days

WITHDRAWAL REACTION

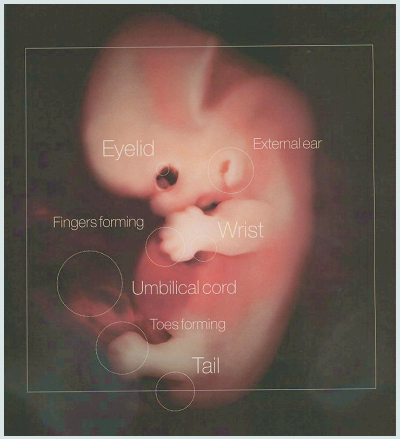
Five weeks after conception

- Embryo responds to experiences outside of itself
- Touch upper lip = withdrawal from stimulus



WITHDRAWAL REACTION

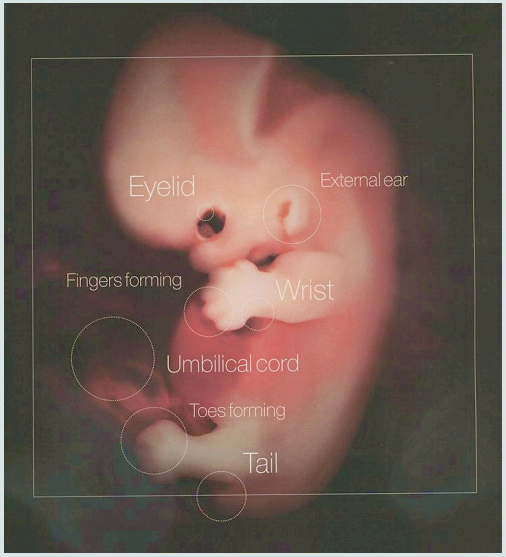
- A few days later
  - Sensitive area has spread
    - Palms of hands
    - Soles of feet



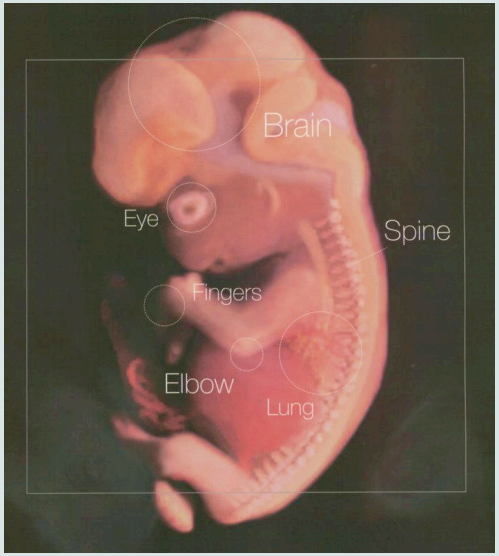
- Eventually (before 9 weeks)
  - Whole body is responsive to touch
  - Withdrawal reaction is a full body reaction

THE EMBRYO

- The period of the embryo



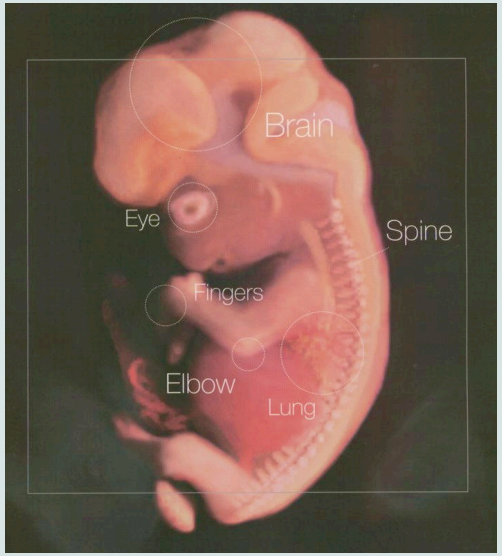
48 days (6 wks)



54 days (7 wks)

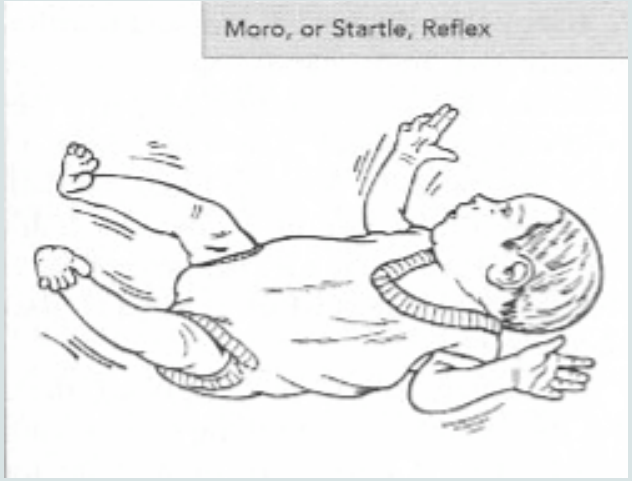
PRIMITIVE REFLEXES

- 9 weeks in utero
  - Withdrawal reactions disappear
  - PRIMITIVE REFLEXES begin to appear
  - They continue to develop through pregnancy



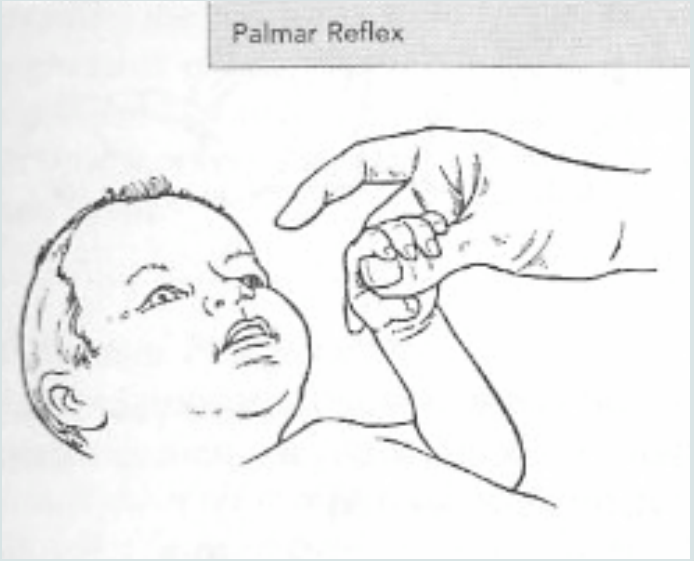
PRIMITIVE REFLEXES

- Assist in the birth process
- Insure protection for the embryo outside the womb
- Essential for survival in first 2 weeks of life
- Lay foundation for all later functioning



PRIMITIVE REFLEXES

- Are automatic responses directed from the brain stem
- Cortex does not assist



THE FETUS

- More than 8 weeks in utero
- Myelination of lower brain stem assists development of reflexes
- First reflexive breath may occur

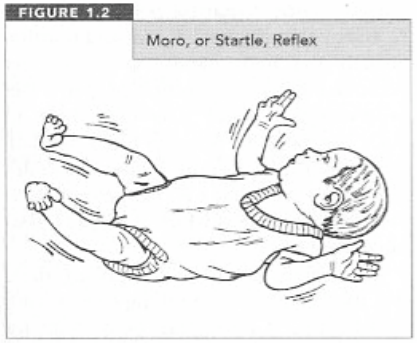
Eleventh Week

PRIMITIVE REFLEXES

Brain stem dominates

FIGURE 1.1 Rooting Reflex

FIGURE 1.2 Moro, or Startle, Reflex

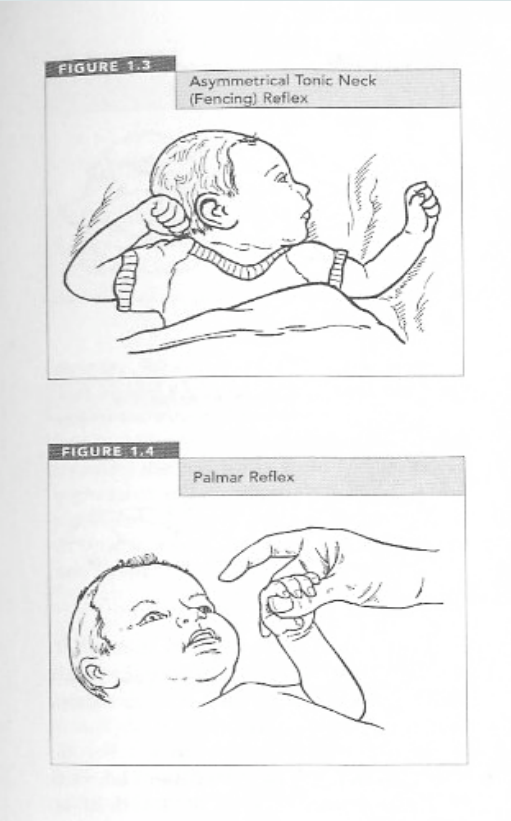


Rooting Reflex – searching
sucking and swallowing –
5mo in to 3wk out

Moro or Startle Reflex – response to outside stimuli – 9wk in to 4 mo out

PRIMITIVE REFLEXES

Brain stem dominates

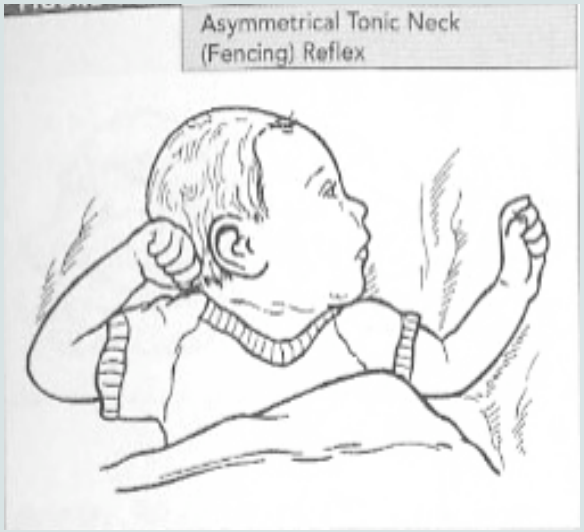


Asymmetrical Tonic – muscle tone, vestibular awareness – 18wk in to 6mo out

Palmar – grasp reflex – 11wk in to 3 mo out

PRIMITIVE REFLEXES

- Neural development determines arrival and inhibition of reflexes



- The fetus spins, stretches, kicks, punches, sucks, grasps, develops muscles ….

BOTTOM UP ATTENTION

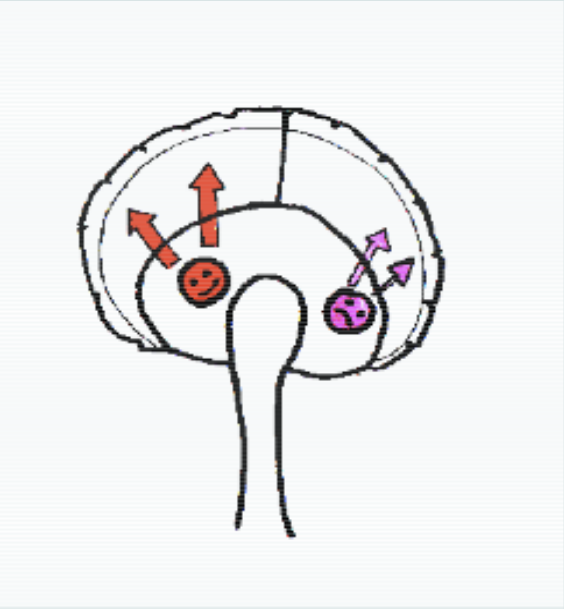
Reticular Formation of Brain Stem begins to connect

- When mature, alters the state of the entire nervous system
  - Turns on and regulates the upper cortex
  - Links to memory

MIDBRAIN

Midbrain begins to form - control over emotions

- When mature, controls gradual changes in behavior in general
  - speed of tasks
  - mood (limbic system)
  - orientation to time and place
  - memory



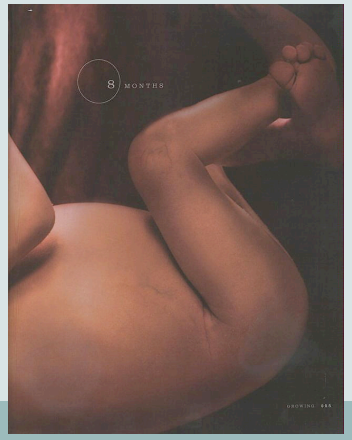
THE FETUS

- Fetus - 24 weeks (6 months)
  - Breathing movements occur 14% of the time
  - Myelination of brain stem continues

THE FETUS

8 months

- Responds to high pitched, loud external sounds
  - Can attend to and discriminate specific sounds
    - Melodies and mother's voice
- Eye movements begin - reflexes
- Reflexes are less easily "triggered" just before birth



THE FETUS

- 36 weeks
  - Billions of extra neurons have been created
  - Brainstem is capable of learning
  - Fetus probably has some level of learning-related activity
  - Some limbic/mood areas are mature shortly after birth

ATTENTION BEGINS TO DEVELOP

- Attention is essential for perception and learning
- It begins in utero as the brainstem develops
- Healthy conditions assist development

FETAL MOOD

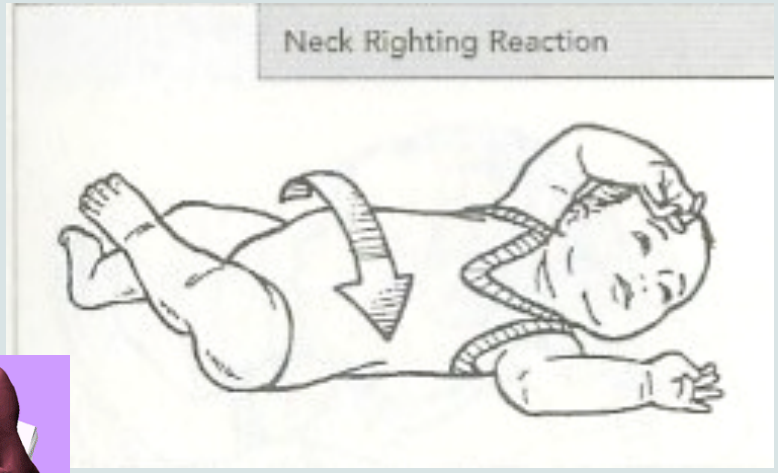
- Fetal mood is affected by external stimuli
  - Maternal stress or ease
  - Maternal exposure to toxins
  - Exposure to sound – soothing or stressful

FETAL MOOD

- Mood affects development
  - Development of attention
  - Connections to all brain areas
  - Migration to new locations
  - Myelination/insolation
  - Development of limbic system

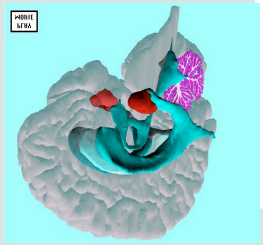
PRIMITIVE REFLEXES

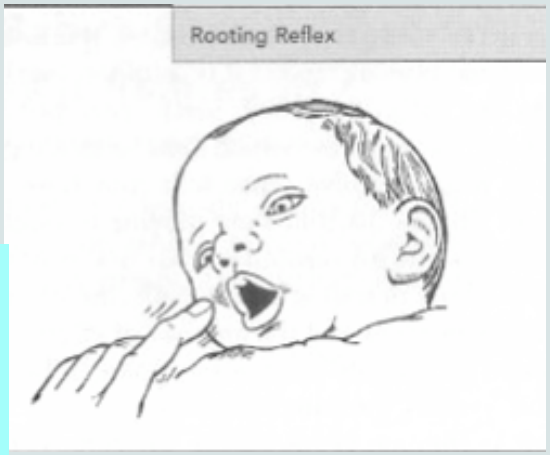
- Early weeks of life –
  - Movements are
    - Basic head lifting
    - Squirming
    - Rolling



PRIMITIVE REFLEXES

- Should only remain
  a few months

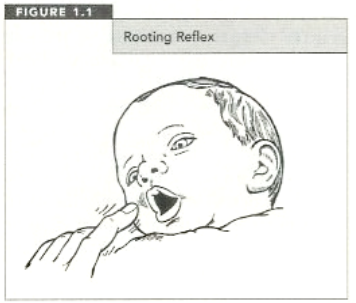


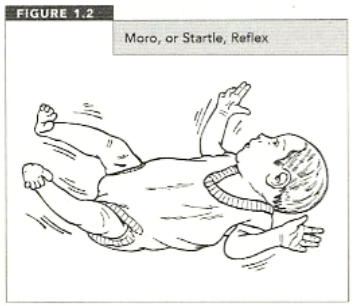


- Midbrain and cortex take over their roles as reflexes are inhibited

PRIMITIVE REFLEXES

- Primitive reflexes that remain beyond 6-12 months of life =
  - structural weakness or
  - immaturity of the central nervous system





PRIMITIVE REFLEXES

- If remain to a great degree can negatively affect
  - Motor functioning
  - Sensory perception
  - Cognition
  - Means of expression/mood

PRIMITIVE REFLEXES

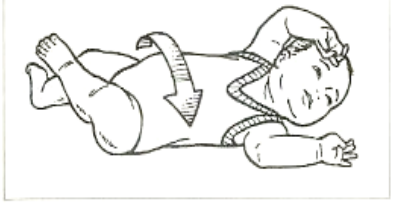
- Uninhibited/IMMATURE reflexes
  - Visual sensitivity
  - Auditory sensitivity
  - Tactile sensitivity
  - Hyperactivity
  - Hypo activity
  - Brain's further development is slowed or sidetracked

POSTURAL/CORTEX REFLEXES

Working against gravity – **Cortex begins control**

FIGURE 1.5

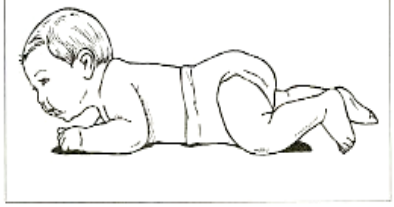
Neck Righting Reaction



Neck Righting Reaction

FIGURE 1.6

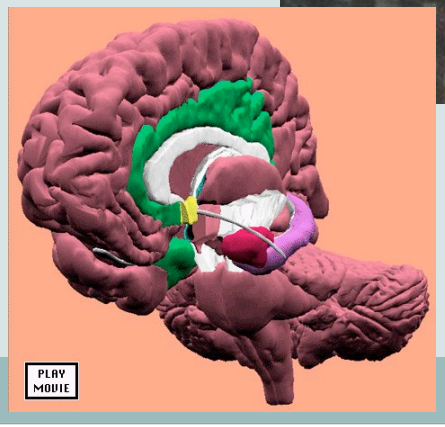
Labyrinth Righting Reaction



Labyrinth Righting Reaction

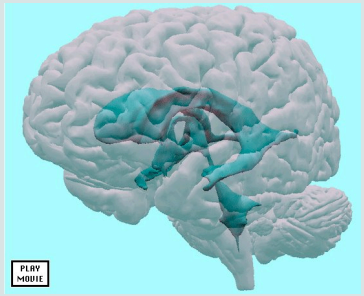
POSTURAL/CORTEX REFLEXES

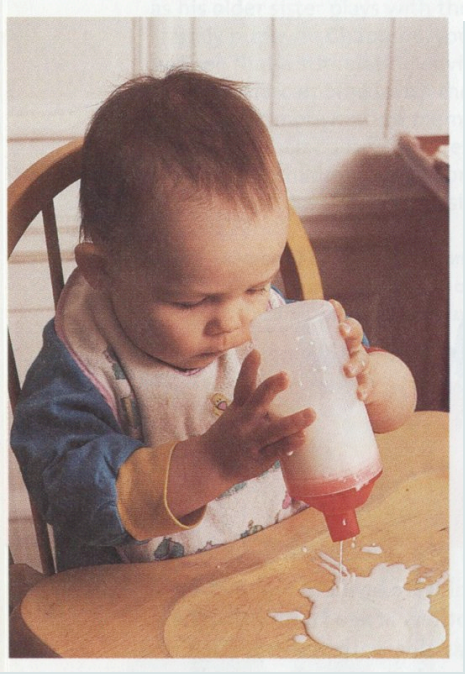
- From 6-9 months
  - CORTEX begins control
    - Purposeful rolling
    - Crawling
    - Sitting
    - Creeping
    - Standing



POSTURAL/CORTEX REFLEXES

- 6-12 months
  - **Cortex begins control**

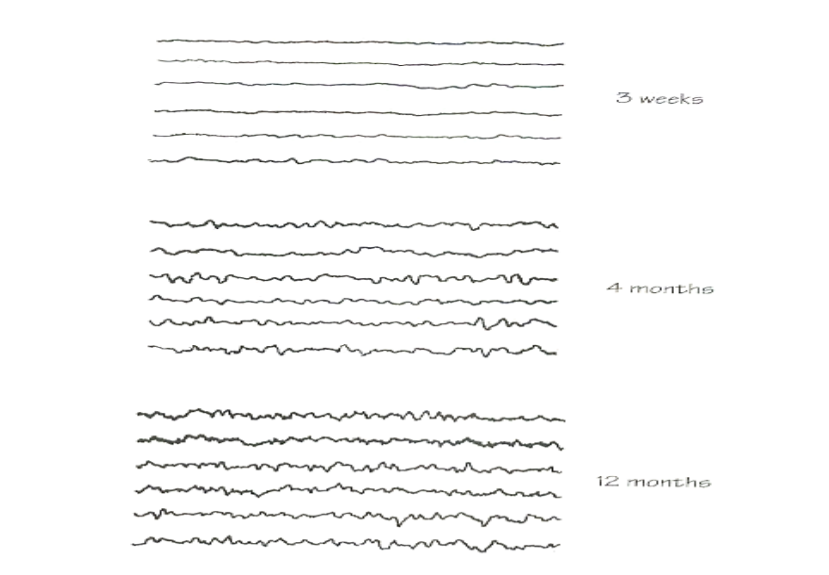




- Stand
- Move with independent use of hands
- Multisensory connections and full brain memories build
- Frontal lobe can reason and plan logically

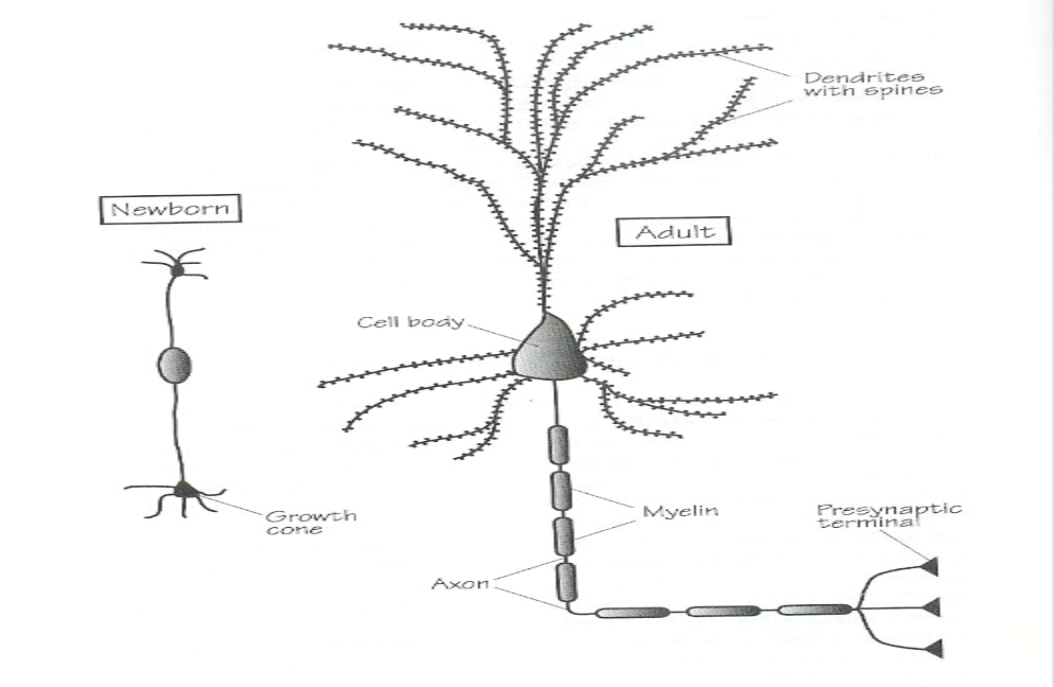
ELECTRICAL CONNECTIONS

- Electrical activity increases with brain growth gained through experience



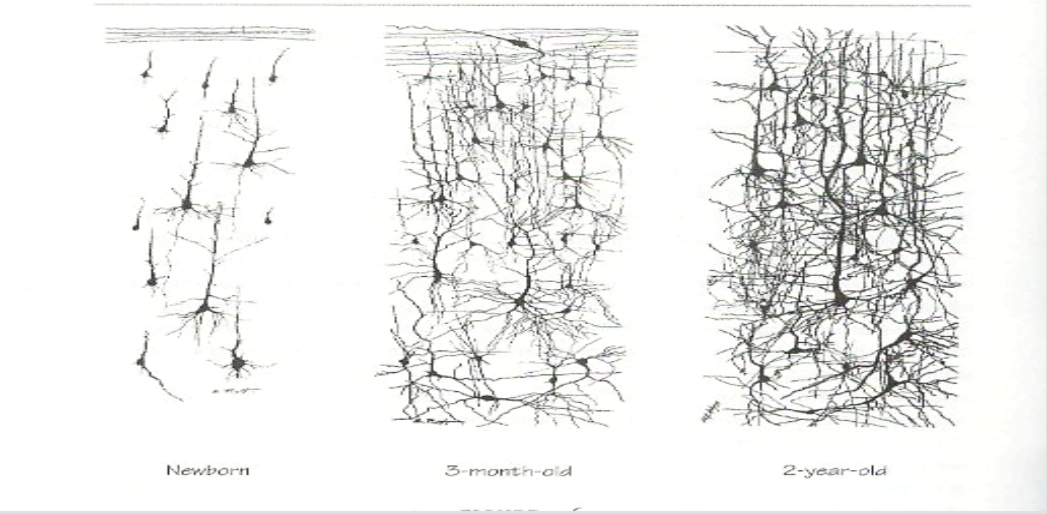
ELECTRICAL CONNECTIONS

- Connections grow through nature and nurture



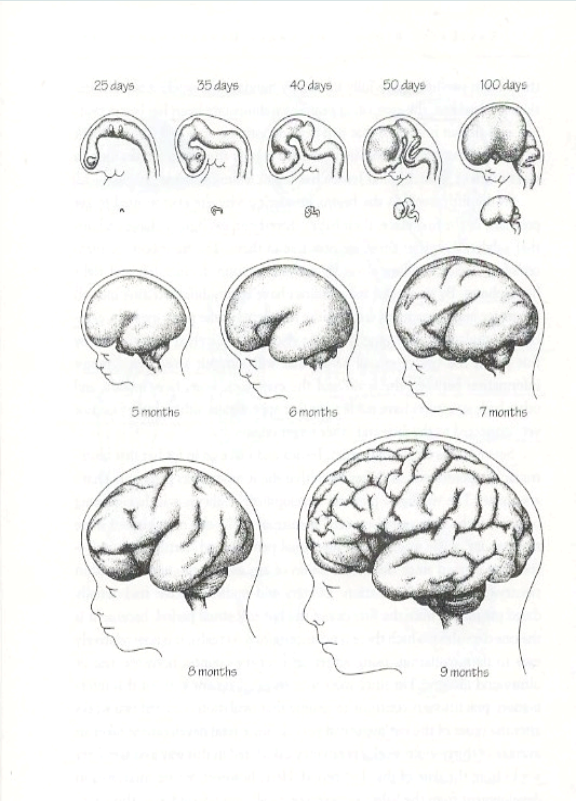
ELECTRICAL CONNECTIONS

- Heredity and experiences increase connections



BRAIN SIZE AND COMPLEXITY

- As the body grows – the brain grows

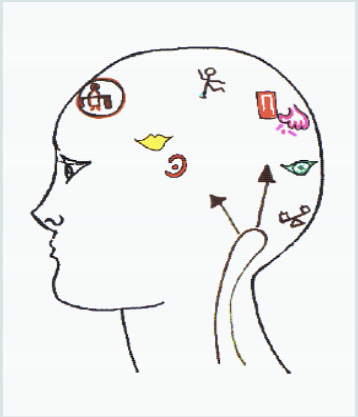


0 – 6 Multisensory Upper Brain Development

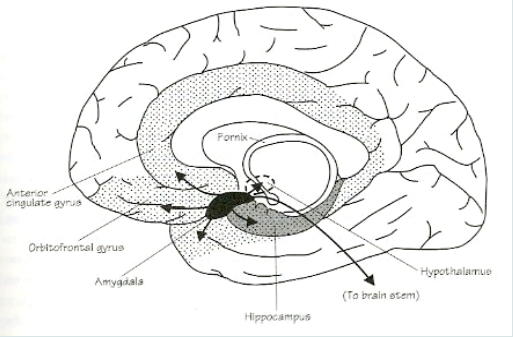
THE SENSES

- Separate organs for reception
- Experiences are stored in sensory specific parts of the brain

DEPEND ON EACH OTHER FOR MUCH OF THEIR FUNCTIONING



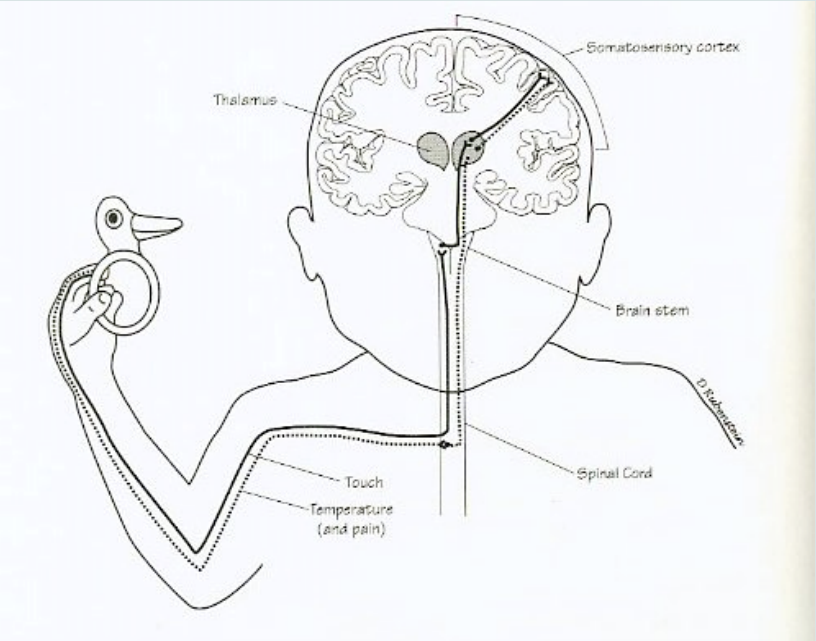
THE SENSES



- Thalamus
  - "the sensory gate"
  - Controls synchrony of all sensations
  - Readies the child to receive through all senses

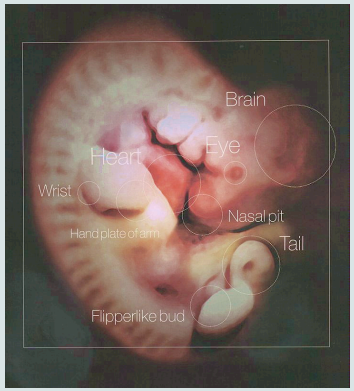
THE SENSES

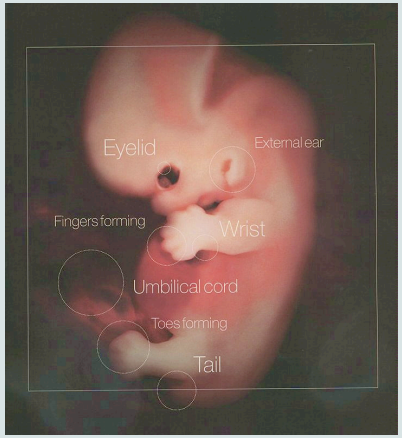
Touch/tactile begins in utero - Our first source of contact with the world



THE SENSES

- Touch/Tactile
  - 5 weeks after conception
    - Withdrawal reaction
    - Defensive response

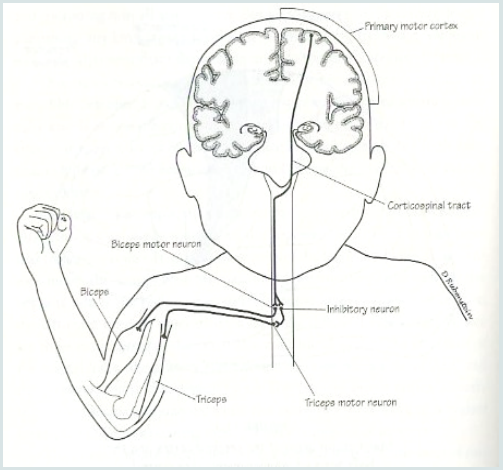




  - 4 weeks later
    - Whole region of face, palms, soles, then whole body

THE SENSES

- Touch/Tactile
  - Precedes hearing and vision as primary learning channels
  - Registers
    - Heat
    - Cold
    - Pain
    - Body position

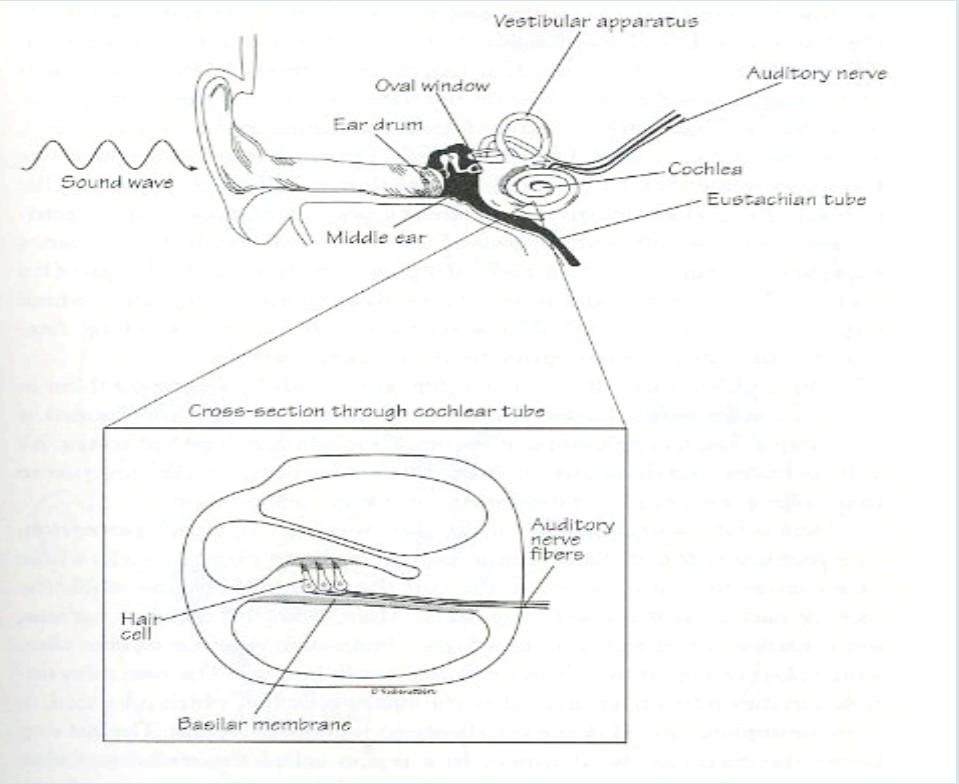


THE SENSES

- Touch/Tactile
  - Good development
    - Better immune system
    - Better infant weight gain
  - Poor development
    - Much self stimulation/rocking

THE SENSES

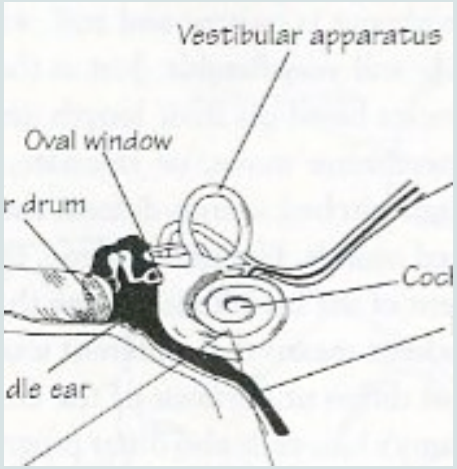
- Vestibular - inner ear
  - Balance and awareness in space
  - Allows a sense of direction
  - Helps cope with gravity



THE SENSES

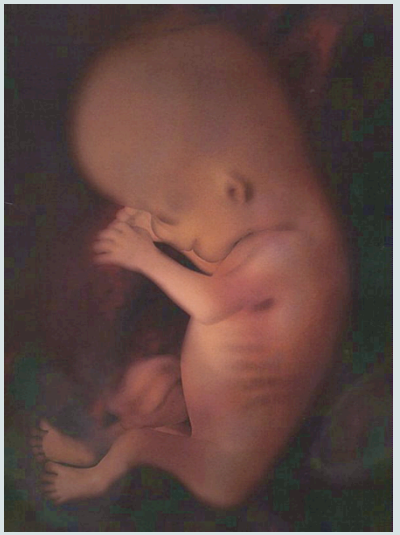
- Balance/Vestibular
  - Brain areas
    - Inner ear – Semicircular Canals and Cochlea
      - Fluid and hairs provide info re:
        - Direction
        - Angle
        - Extent of movement
    - Passed to brain stem level

      for transmission to cerebellum



THE SENSES

- Balance/vestibular
  - Balance is the core of sensory functioning
  - First system fully developed
    - Begins 16th week in utero
    - Myelinated at birth



THE SENSES

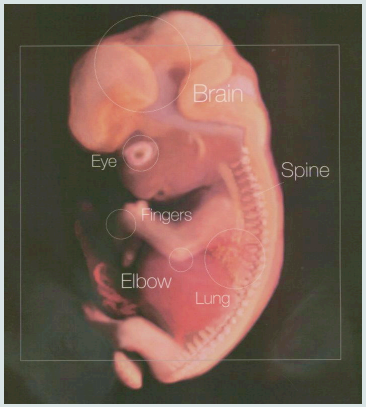
- Balance/Vestibular
  - Vestibular affects Hearing
  - Hearing affects Vestibular
  - Vestibular and reflex system are bound to visual system
    - Eye motor
    - Visual perception
    - Balance
    - Eye tracking
    - Motor planning

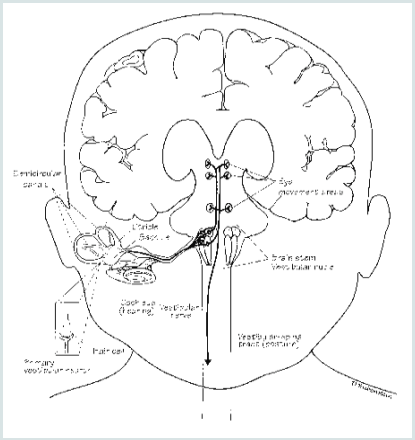
THE SENSES

- Proprioception
  - Know where body parts are at any given moment
  - Receptors are in joints, tendons, and muscles

THE SENSES

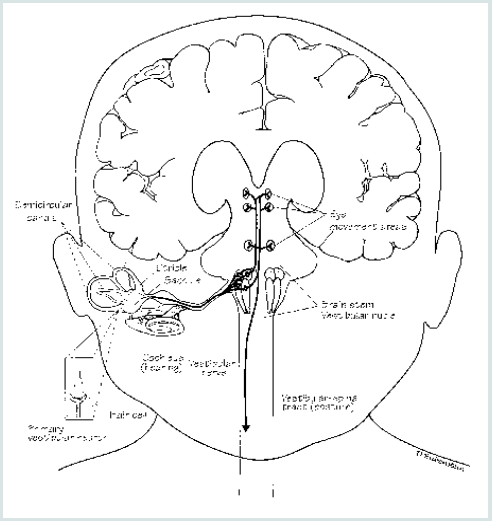
- Auditory
  - Formation
    - 2nd ½ of mid embryonic life (4 – 8 weeks)
    - Myelination occurs 24th – 28 weeks
    - Able to hear internal and external sound





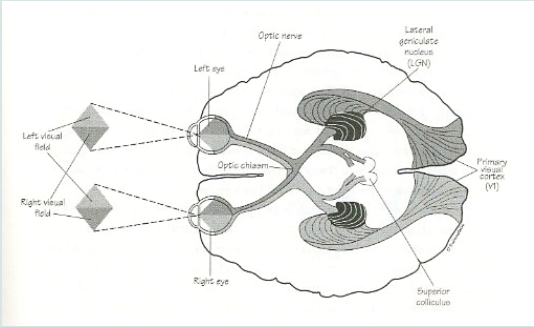
THE SENSES

- Auditory
  - First three years
    - Picks up the sound of own language
    - After 3 – more difficult to learn a new language



THE SENSES

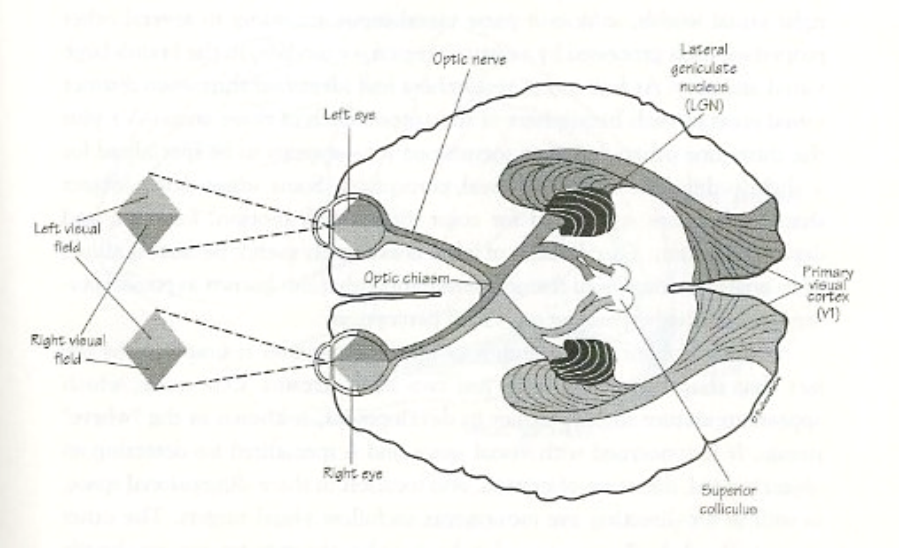
- Visual
  - Eyes must work together
  - Focal distance must be adjusted



  - Scanning/tracking must be smooth and even
  - Good directional awareness needs vestibular connection

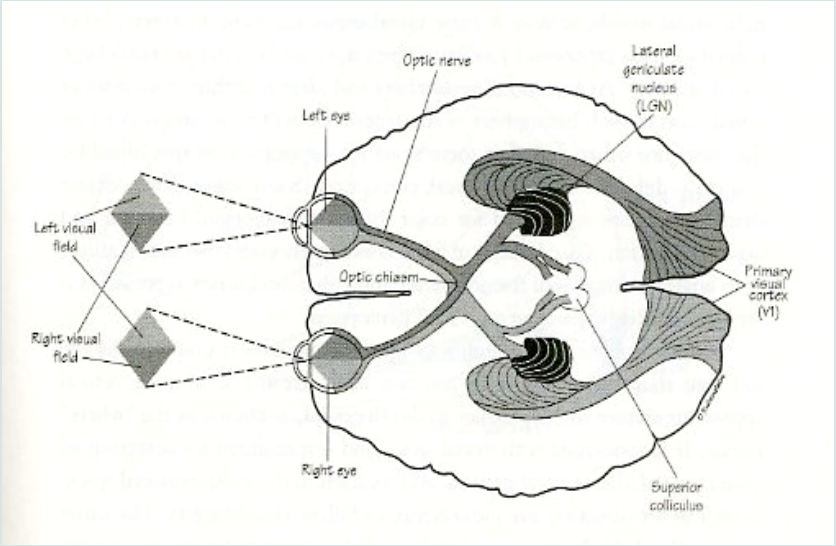
THE SENSES

- Visual
  - Perception is decreased if reflexes not inhibited
  - During first year of life – eye/brain/body connect



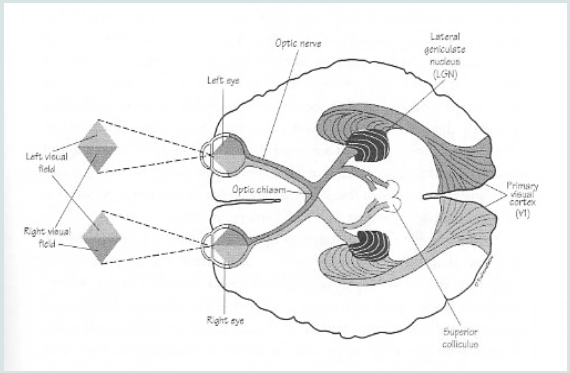
THE SENSES

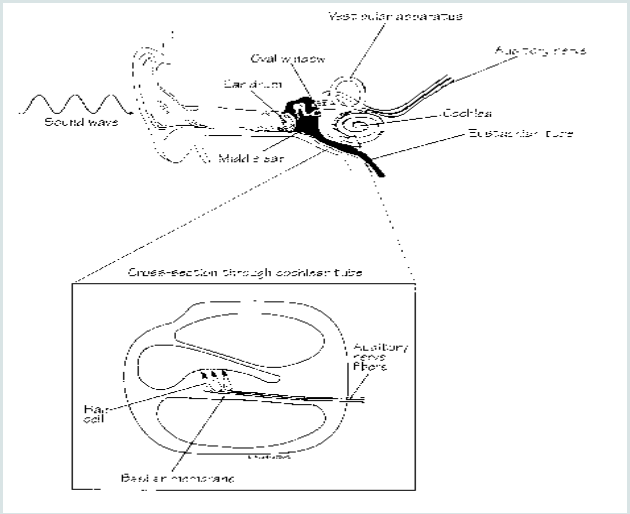
- Vision is the last sense to complete its journey
- In time, sharing occurs



THE SENSES

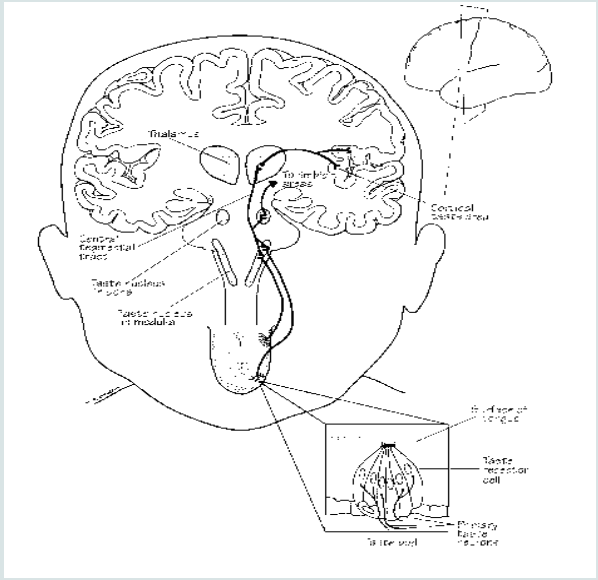
- Vision and hearing both depend on inner ear (vestibular system)
  - Awareness of body in space
  - Location of sights/sounds





Taste

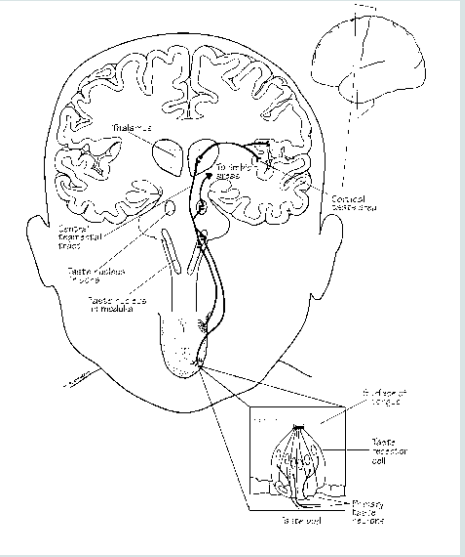
- Begins to connect at birth
- Sweet, sour, salty, bitter



THE SENSES

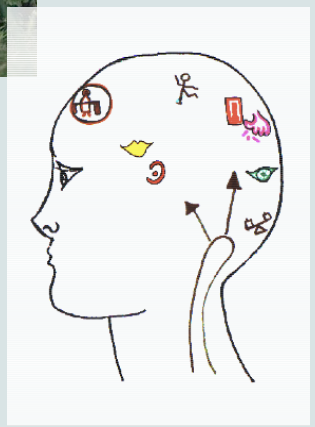
Smell

- Goes directly to olfactory bulb for storage
- Direct mood connections
- Source of flavors



MULTISENSORY CONNECTIONS

- Touch and sight often share the same moments
- Hearing joins in
- When we see –
  - We often smell and/or taste
- We must smell to experience flavor



MULTISENSORY CONNECTIONS

- Attention and mood govern development
- Each of the brain lobes grows separately.
- Connections begin to reach to other lobes
- Left and Right connect
- Lower and Upper brain connect

MULTISENSORY/UPPER BRAIN CONNECTIONS

- By school age
  - Lower and Midbrain are more developed
  - UPPER BRAIN IS FREE TO CONNECT
  - Child can

    - Receive information through word and action
    - Process information through word and action
    - Respond to information through word and action

CONNECTION

- RELAXED ALERTNESS
  - Attention and mood regulation

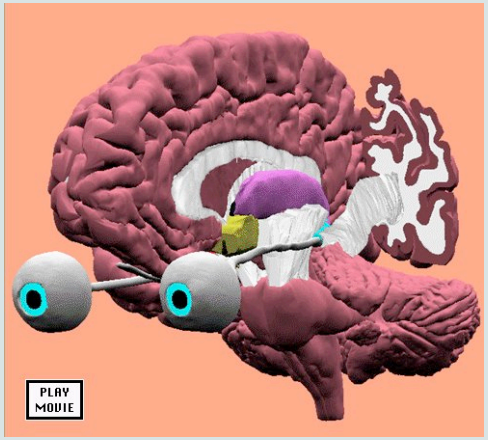
- Reflexes free to connect and mature
- Senses able to receive and send

oops 0 – 6

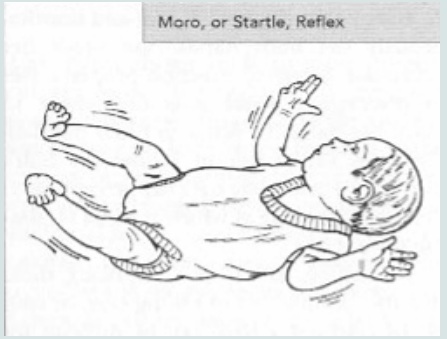
MULTISENSORY misCONNECTIONS

- Problem with one sense organ =
  major impact on
  reception of other sensory experience

- Overloading one system can cause another to shut down



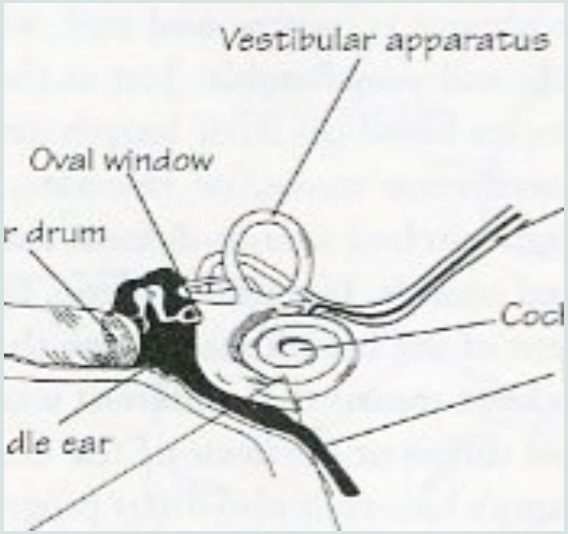
misCONNECTION



- Senses not developing correctly
- Primitive reflexes not inhibited/mature
- Attention difficulties

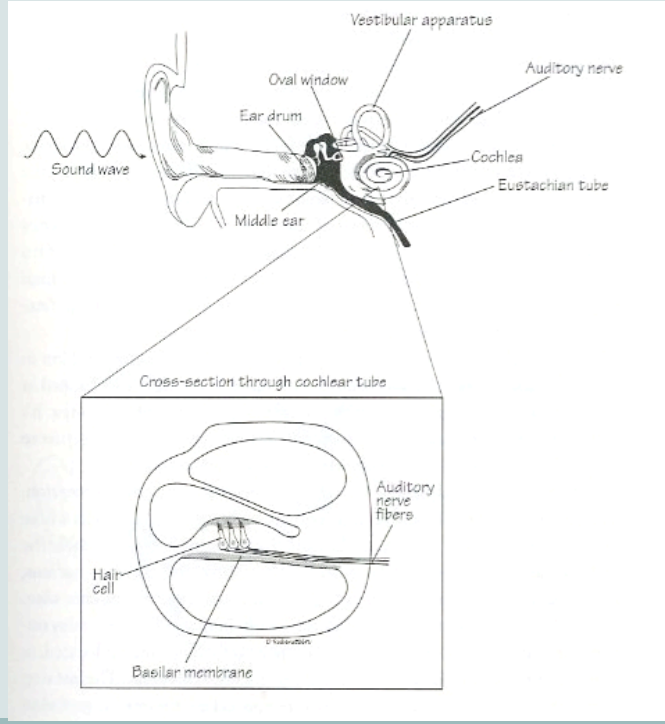
misCONNECTION

- Balance and vestibular
  - Inappropriate vestibular signals causes REFLEX reactions to occur



misCONNECTION

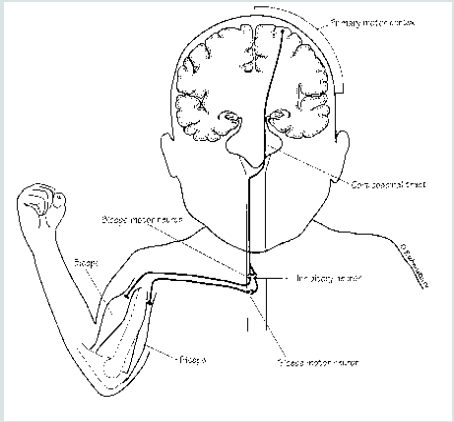
- Balance and Vestibular
  - Uninhibited reflex activity will slow down vestibular function
    - Balance problems
    - Motion sickness
    - Dislike of heights, swings, carousels
    - Disorientation
    - Difficulty sitting still
    - Eye-motor dysfunction
    - Visual perception difficulties
    - Directional awareness problems
    - Spatial perception difficulties
    - Organizational problems



misCONNECTION

Tactile/Kinesthetic

- Over-active protective subsystem
  - Touch is not comforting
  - Touch cannot send information
  - Withdrawal results
    - Certain clothes
    - Contact sports
    - Poor body image
    - Sense of self in space
  - Extreme withdrawal = anorexia (poor body image)



misCONNECTION

Tactile/Kinesthetic

- Uninhibited
  - Hypersensitive
    - Not like being touched
    - Allergic skin reactions
    - Poor temperature control
    - Low external pain threshhold
    - Anorexia
    - Dislike of sports

misCONNECTION

Tactile/Kinesthetic

- Uninhibited
  - Hyposensitive
    - High pain threshhold
    - Crave contact sports
    - Provoke rough and tumble play
    - Compulsive need to touch
    - “Bull in China Shop”

misCONNECTION

Tactile/Kinesthetic

- Uninhibited
  - Lack of discriminative system
    - Dare devil
    - Not sense danger
    - Oblivious to injury
    - Cannot read body language

misCONNECTION

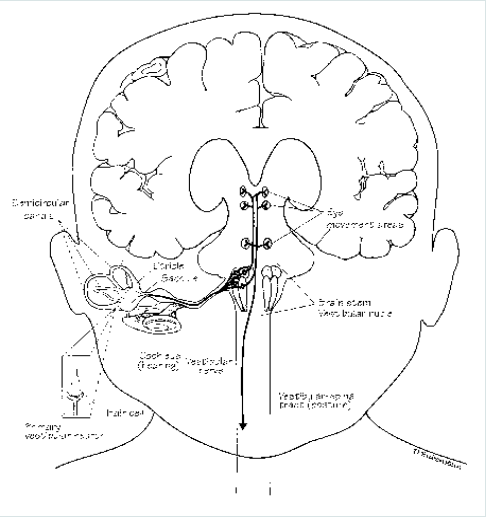
Proprioception – self in space

- Difficulties with reflex inhibition
  - Need to move constantly to get spatial feedback
  - Inconsistent performance
  - Poor posture
  - Fidget
  - Excessive desire to be held
  - Provoke fights
  - Visual problems

misCONNECTION

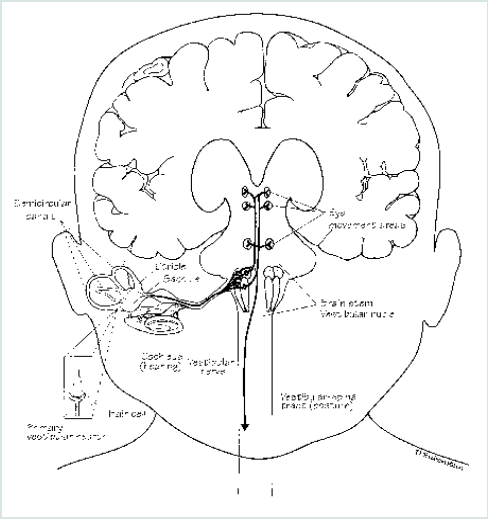
Auditory

- Hearing loss can cause
  - Hearing discrimination difficulties
    - /ch/ and /sh/
    - /th/ and /f/
    - /p/ and /b/
- Poor filter
  - Poor listening skills
  - Communication difficulties
  - Behavior problems



misCONNECTION

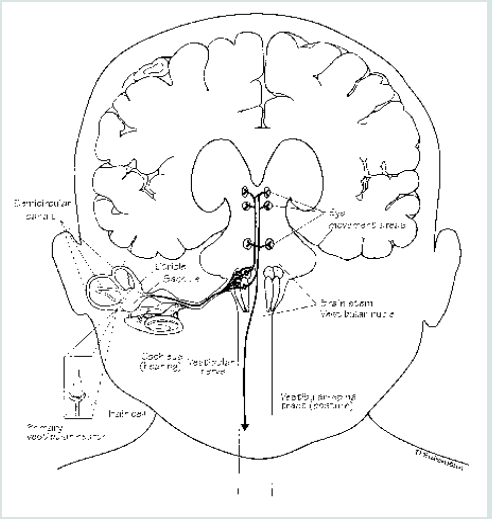
Auditory



- Poor filter
  - Hyperacuity
    - Hear too much
    - Affects concentration
    - Causes speech difficulties
    - Problems with socialization
    - Hyperactivity when hypersensitive to HIGH, energetic sounds

misCONNECTION

Auditory

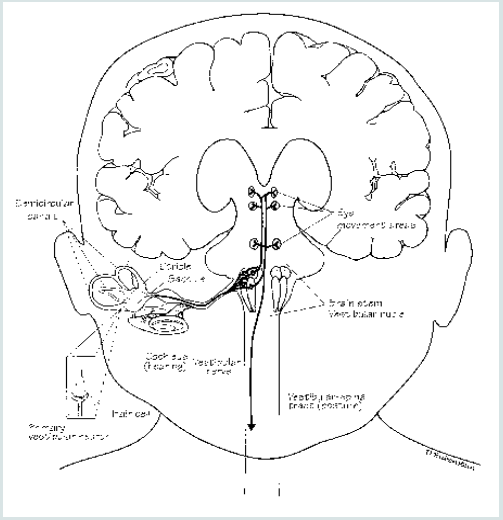


- Poor filter
  - Short attention
  - Distractibility
  - Hypersensitivity to sound
  - Misinterpretation of directions
  - Confusion of similar sounding words
  - Hesitant speech

misCONNECTION

Auditory

- Poor filter
  - Weak vocabulary
  - Poor sentence structure
  - Can't sing in tune
  - Confusion or reversal of letters
  - Reading comprehension



misCONNECTION

Visual

- Problems with reflex inhibition
  - Poor posture
  - Clumsy
  - Difficulty playing ball games
  - Fatigue when using eyes
  - Concentration is down
  - Work close to work surface

misCONNECTION

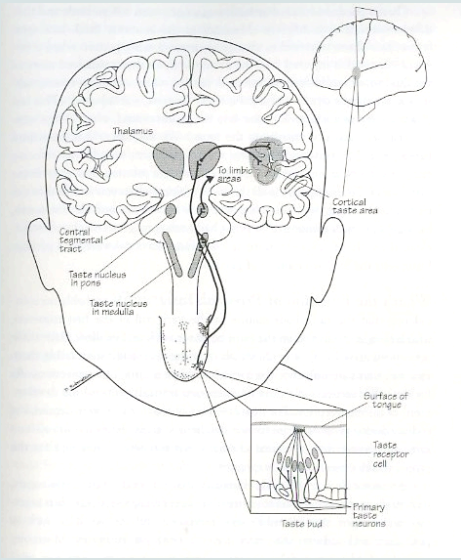
Visual

- Problems with reflex inhibition
  - Poor spacing
  - Crooked handwriting
  - Misread words
  - Miss or repeat words while reading
  - Slow reading
  - Use finger when reading
  - Can't remember what they read

misCONNECTION

Taste/smell

- Hypersensitivity
  - Avoid bathrooms due to smell
  - Avoid other children due to smells
  - Misbehave after some smell exposure
  - Avoid cafeteria and strong food smells
  - Not want to be near others
- Hyposensitivity – eat indiscriminately



ALLOW THE BRAIN TO CONNECT

Tactile/Kinesthetic

- RELAXED ALERTNESS
  - Massage
  - Feldenkrais
  - Sensory Integration activities
  - Calming music
  - Simple tactile activities with words and/or exploration

ALLOW THE BRAIN TO CONNECT

Proprioception

- RELAXED ALERTNESS
- Vestibular activities
  - Slow introduction
  - Sliding, climbing, spinning,
  - swinging, crawling

ALLOW THE BRAIN TO CONNECT

Auditory

RELAXED ALERTNESS – Massage, Feldenkrais, rocking

- Music
  - sharpens auditory discrimination
  - and sequence memories/connections
    - Encourage singing of nursery rhymes and sequences (days of the week, alphabet, etc.).
    - Encourage tapping of the rhythm using various sound making techniques.

ALLOW THE BRAIN TO CONNECT

Auditory

RELAXED ALERTNESS – massage, Feldenkrais, rocking

- Listening exercises that cause the child to discriminate between which note is the higher of two notes.
  - Encourage the child to sing each note.
  - Record the child's voice on a tape recorder and then have him modify his singing after listening to the sound.

ALLOW THE BRAIN TO CONNECT

Visual

RELAXED ALERTNESS – massage, Feldenkrais, rocking

- Activities that emphasize:
  - **Eye movement**
  - Attention to visual detail from concrete to abstract
  - Visual/motor activities of a basic nature to enhance multisensory brain connections

ALLOW THE BRAIN TO CONNECT

Visual

RELAXED ALERTNESS

- Seeing and saying in response to visual, auditory, kinesthetic and combined sensory activities

- Pediatric ophthalmologist to determine the health of the eye
- Pediatric optometrist to evaluate eye movements and focusing

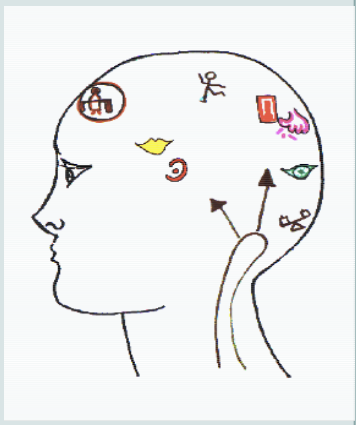
ALLOW THE BRAIN TO CONNECT

Taste/Smell

- RELAXED ALERTNESS – massage, music, rocking
- Slow exposure to different tastes and smells when relaxed

ALLOW THE BRAIN TO CONNECT

- RELAXED ALERTNESS
  - Attention and mood regulation
- Reflexes free to connect and mature
- Senses able to receive and send
-
- Language: external speech to internal speech



ALLOW THE BRAIN TO CONNECT

- Use Repetition, Recollection and Reflection
- Leads to self-direction executive function (development of self and relationship with others)