FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- What is “science”?
  - Latin *scientia* or “knowledge” - a systematic approach using observation and testable predictions to build / organize knowledge about the universe

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- “neuroscience” applies this approach to the nervous system.
  - relatively new and eclectic field of study, integrating:
    - molecular, cellular and systems biology
    - development / embryology / anatomy
    - pharmacology
    - psychology (biopsychology, psychobiology, physiological psychology, behavioral neuroscience)

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- Neuroscience is like a museum:
  - all info is freely available on the internet, but….
    - too many things to see
    - the context / importance of each piece can be difficult to conceptualize

- This class is like curated tour of the brain - my job is to act as a curator
  - “Everything should be made as simple as possible, but no simpler.”

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- Goals of class: to learn the basic structures and functions of the main regions of the nervous system, as well as basic concepts and terminology needed to discuss the nervous system

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- Nervous systems are made of nerve cells (*neurons*), which are electrically excitable cells that send signals (usually chemicals) to other cells
  - Nervous systems help an organism respond to changing stimuli in the environment

planning / control system that allows organisms to explore their surrounding world and face its challenges (escape threats, acquire positive opportunities)

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- the only multicellular animals without a nervous system are sponges
- the most basic nervous system is a *diffuse nerve net:*
  - jellyfish / anemones / hydras / corals can have “ganglia” / “central radial nerve ring” (not quite a “brain”)
    - only sensory (input) / motor (output) neurons
    - cannot localize source of stimulus (“mass action”)
    - send signals to other cells using hormones as *neurotransmitters*

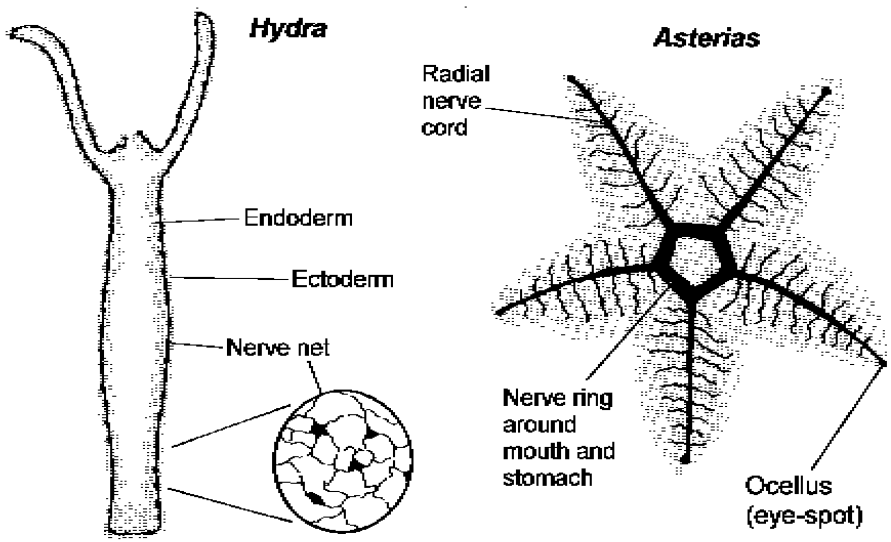
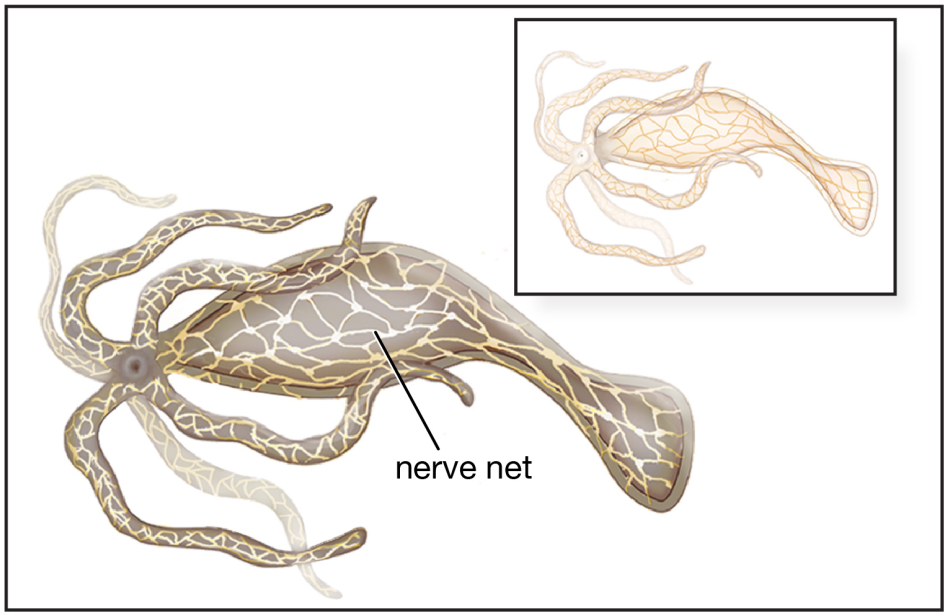


Fig. 10. Nervous systems of two radially symmetrical animals.
Left: A cnidarian, with a view of part of the nerve net as seen from the surface.
Right: An echinoderm.

Nervous system of the cnidarian *(Hydra)*



FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- Animals with “central nervous systems” are generally “bilaterally symmetrical” (rather than “radial”):
  - worms / insects / vertebrates
    - “nerve cord” w/ larger ganglion toward “head” end

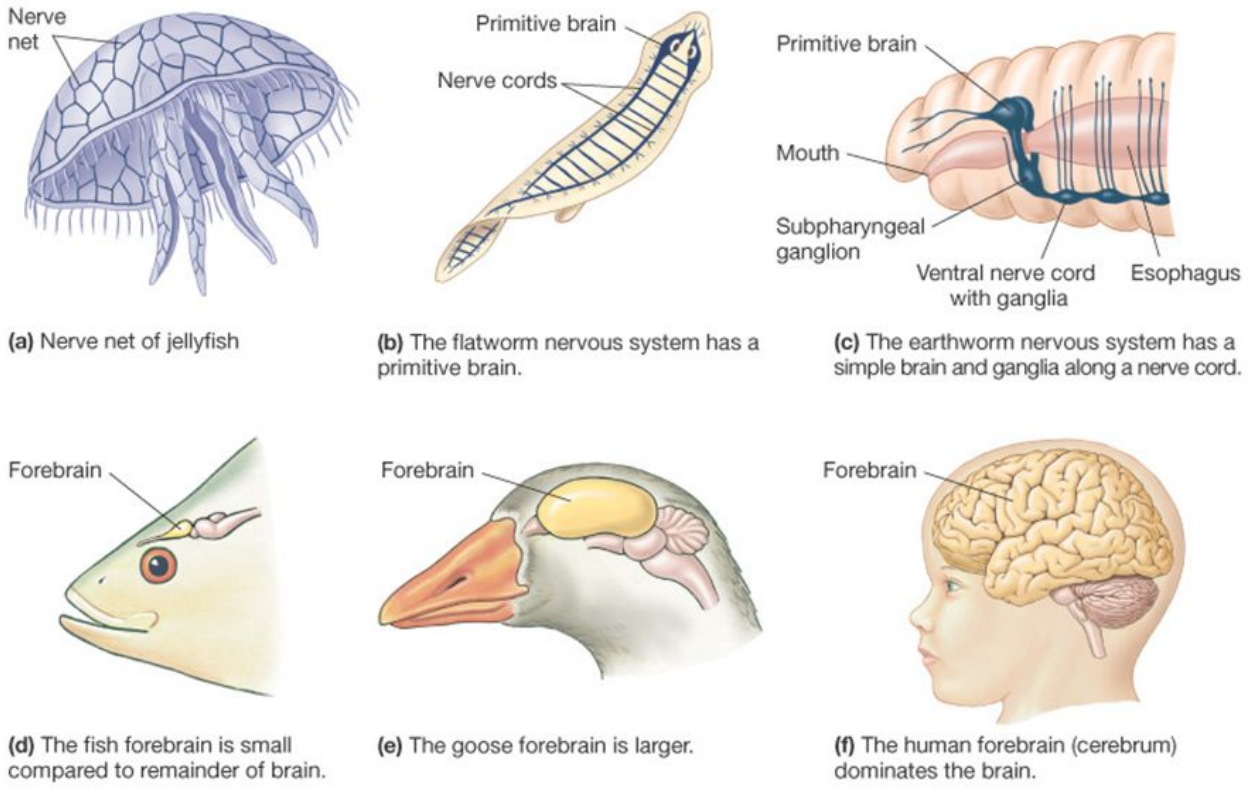
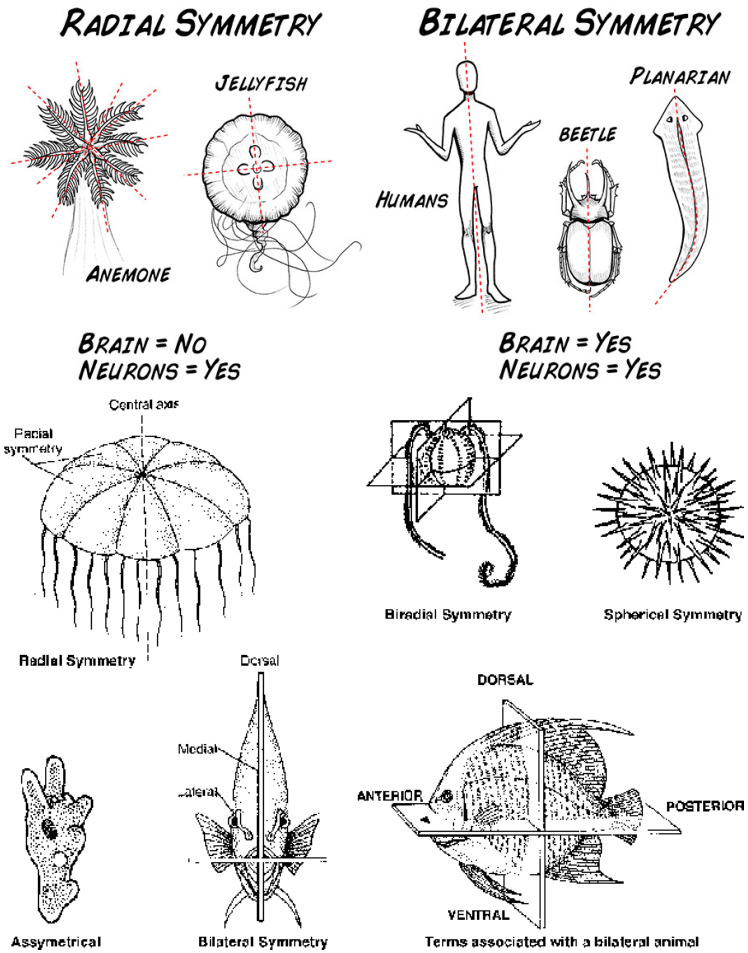


Figure 9-1: Evolution of the nervous system



FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

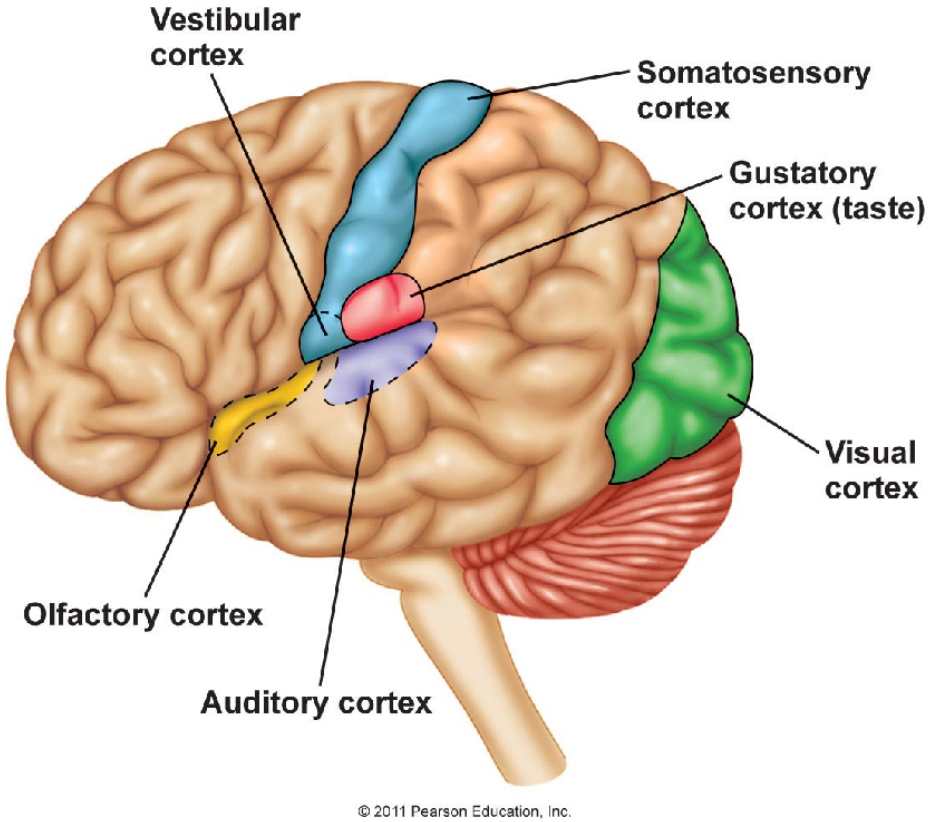
Some early major neuroscience theories

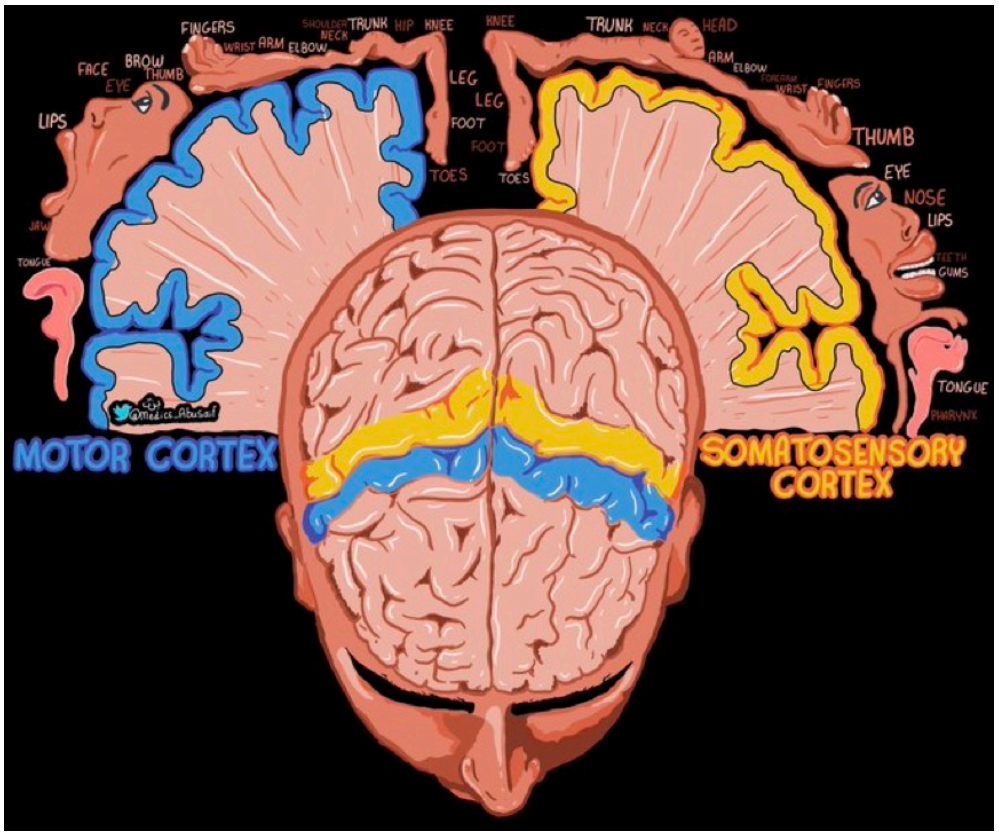
- Importance of brain was known as far back as ancient Egypt
- 1700s and earlier - brain works as a whole ("mass action")
  - then came "localization of function"
    - 1796 - Franz Gall's anatomical personology (aka "phrenology")

Phrenological Chart of the Faculties.

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- 1861 - Paul Broca: speech localized to left hemisphere
- 1868 - Hughlings Jackson: “Jacksonian march” of epileptic seizures
  - progress thru body in sequence
- 1950s - Wilder Penfield’s neurosurgery with stimulation





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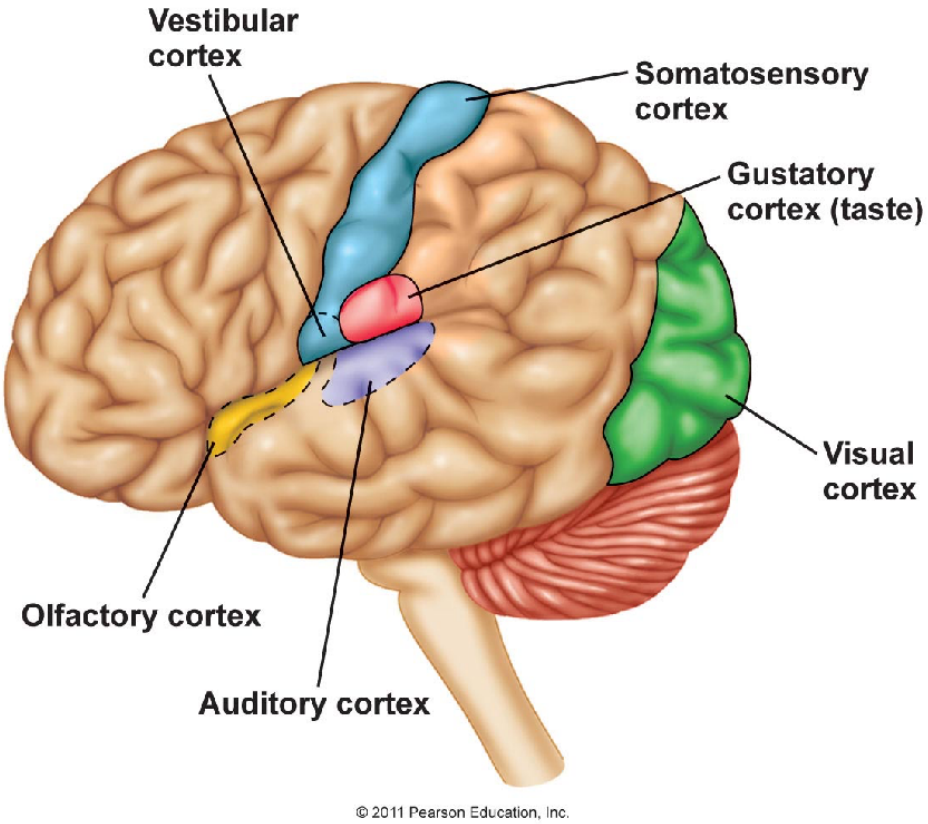
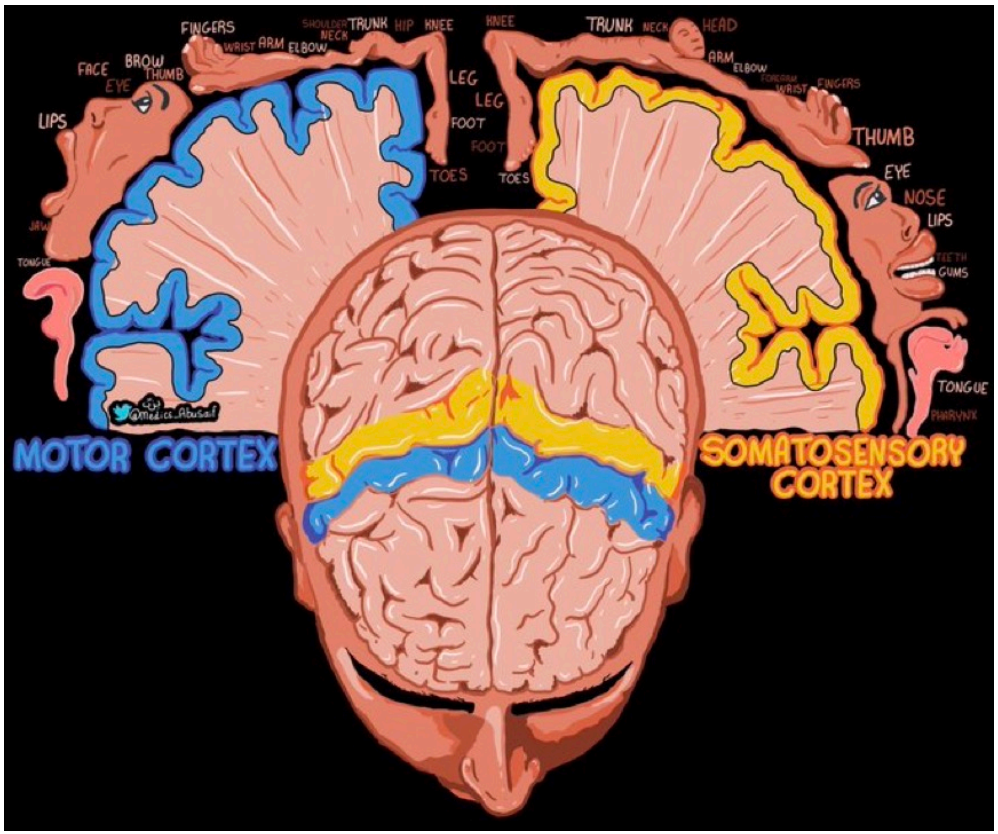
- currently, **cellular connectionism** - localization, but only elementary functions (vision, motor, etc) - not specific faculties of the mind (hope, love, etc)





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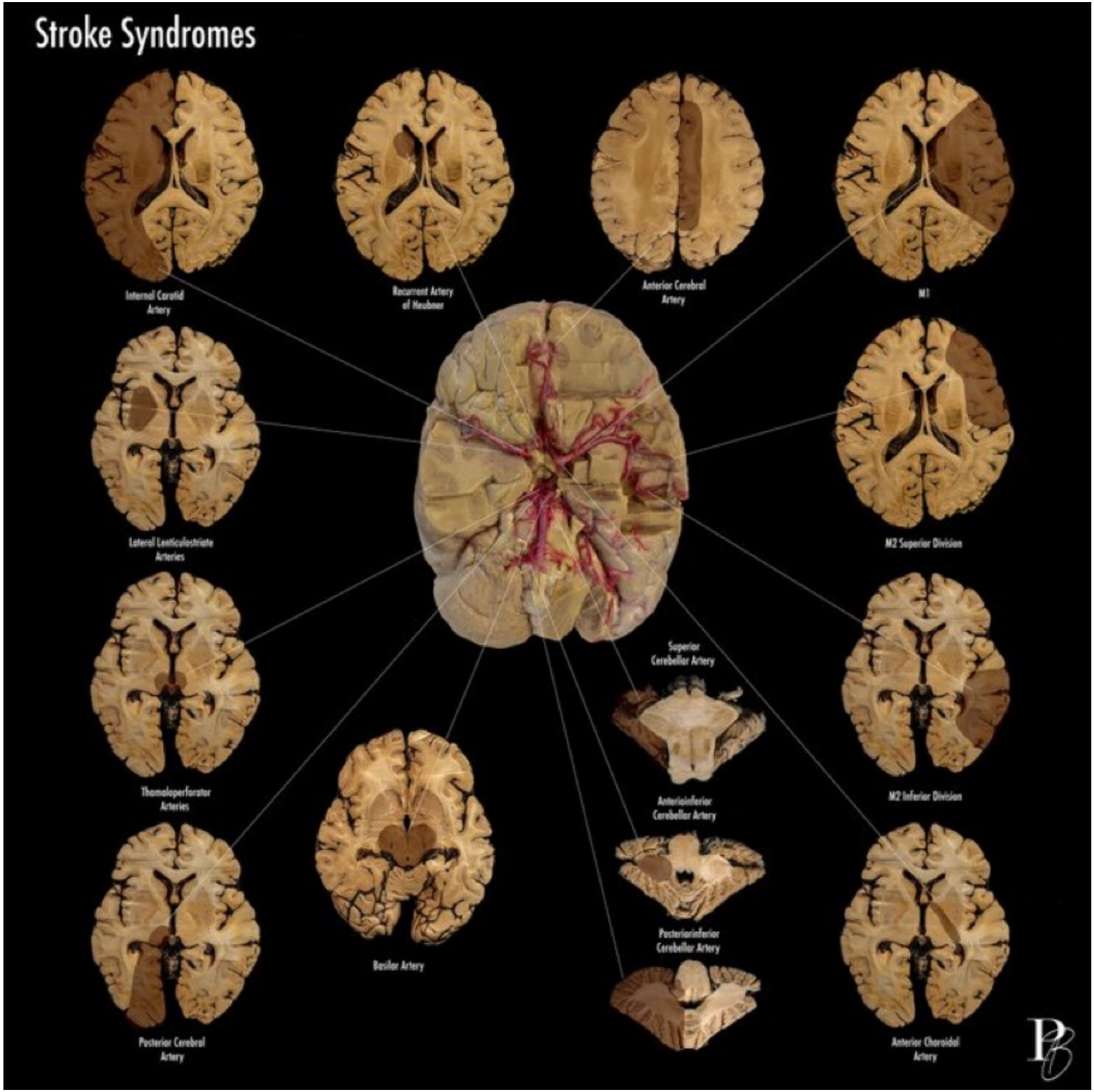
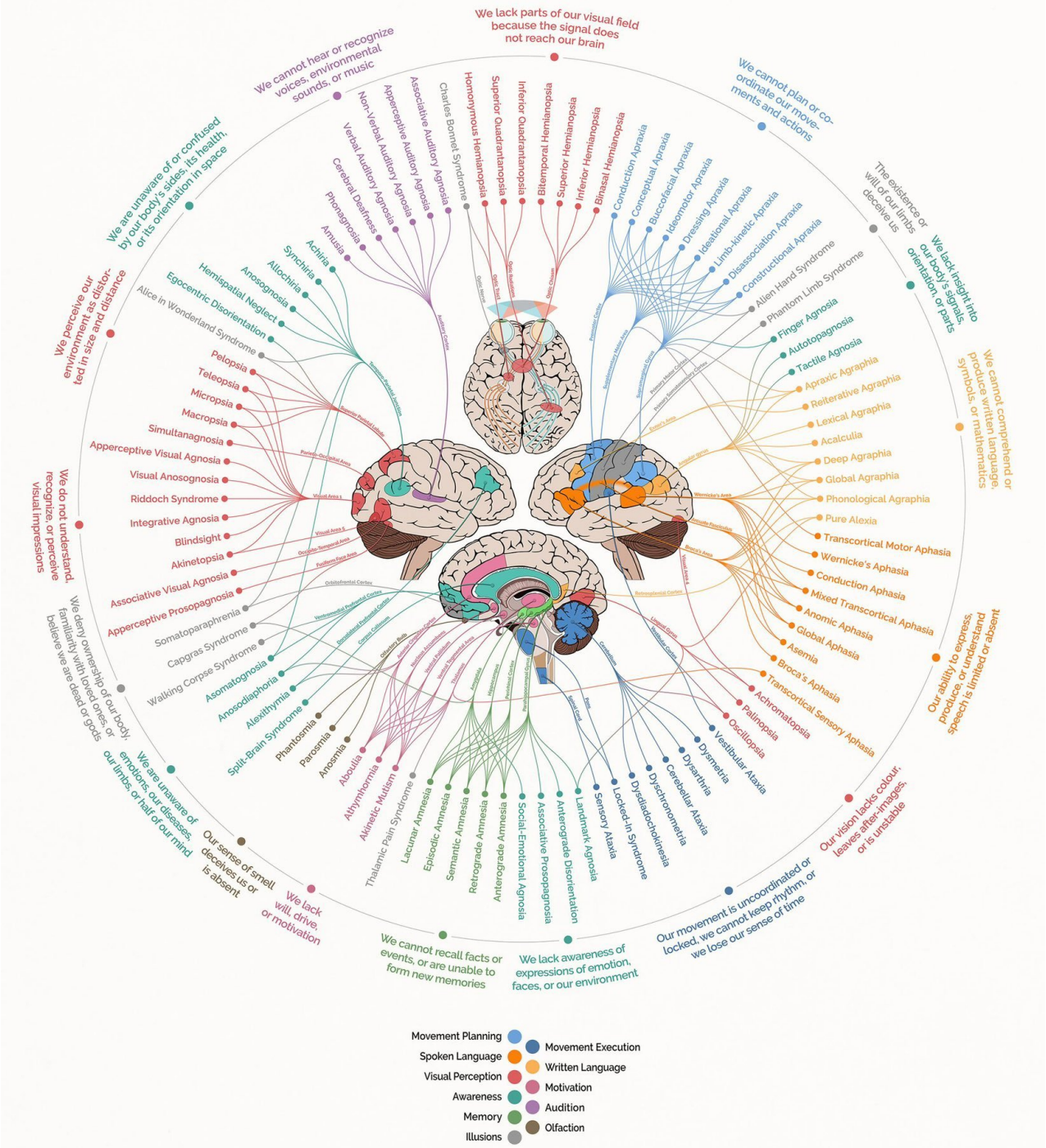
- *behavioral neuroscience* is *reductionistic*
  - major goal is to determine “structure - function relations (i.e., brain - behavior relations)


Stroke Syndromes
Internal Carotid Artery
Recurrent Artery of Heubner
Anterior Cerebral Artery
M1
Lateral Lenticulostriate Arteries
M2 Superior Division
Thalamoperforator Arteries
Superior Cerebellar Artery
M2 Inferior Division
Anteriorinferior Cerebellar Artery
Basilar Artery
Posteriorinferior Cerebellar Artery
Posterior Cerebral Artery
Anterior Choroidal Artery



COGNITIVE DISORDER ATLAS

Research & Layout: Lasse Damgaard | **Algorithmic Design:** Lasse Hansen | **Posters:** lassedamgaard.redbubble.com

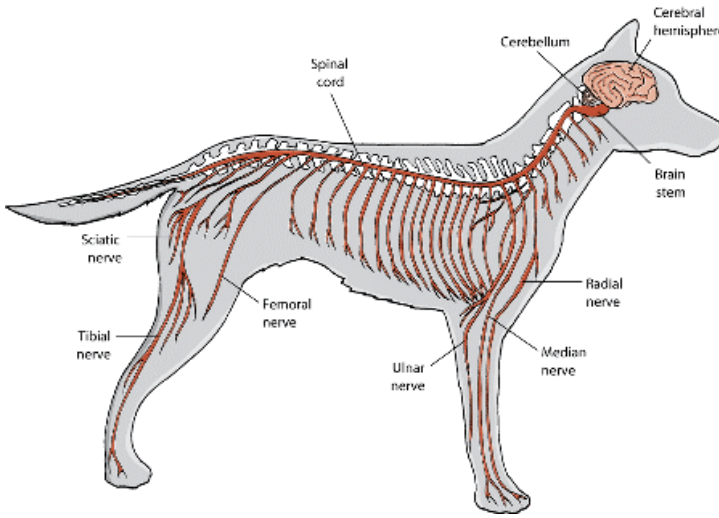
FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

- the major “philosophy” of behavioral neuroscience is *Psychophysical monism*
  - *the mind and the brain are one*
    - the “mind” is a byproduct of what the brain does
      - all thoughts / behaviors / memories result from biochemical interactions between ~100 billion neurons w/ ~500 trillion synaptic connections

FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

Navigation - 3D Orientation / Direction

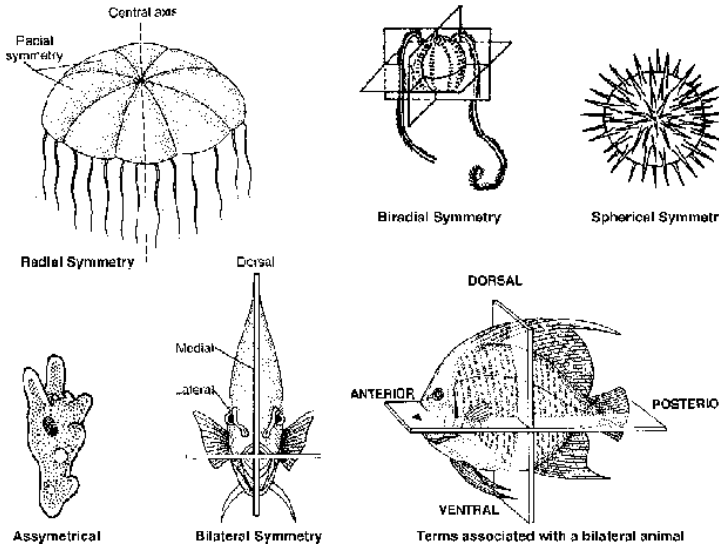
- *dorsal* “back” <> *ventral* “belly”
- *caudal* “tail” <> *rostral* “beak”



- But human nervous system curves, so these terms can mean different things in different areas,
  - e.g., rostal / caudal = face / back of head, so…
    - *superior* “above” <> *inferior* “below”
    - *posterior* “rear” <> *anterior* “front”

- *medial / lateral* - toward / away from midline
- *ipsilateral / contralateral* - same / opposite side

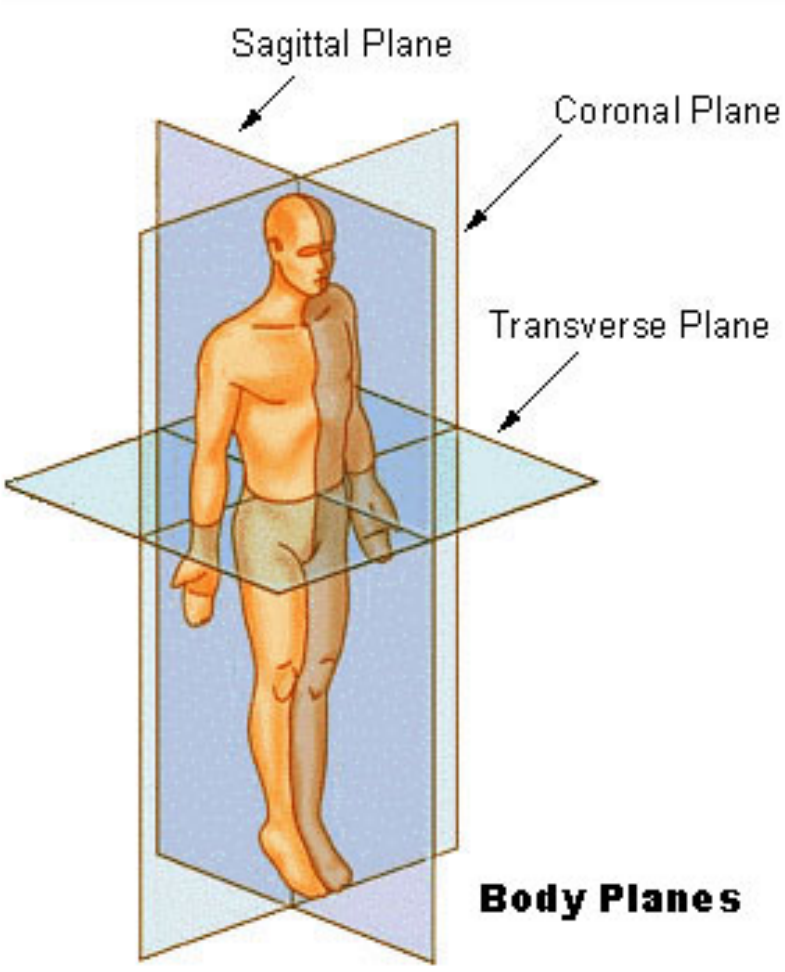
- *proximal / distal* - toward / away from reference (root / extremity)



FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

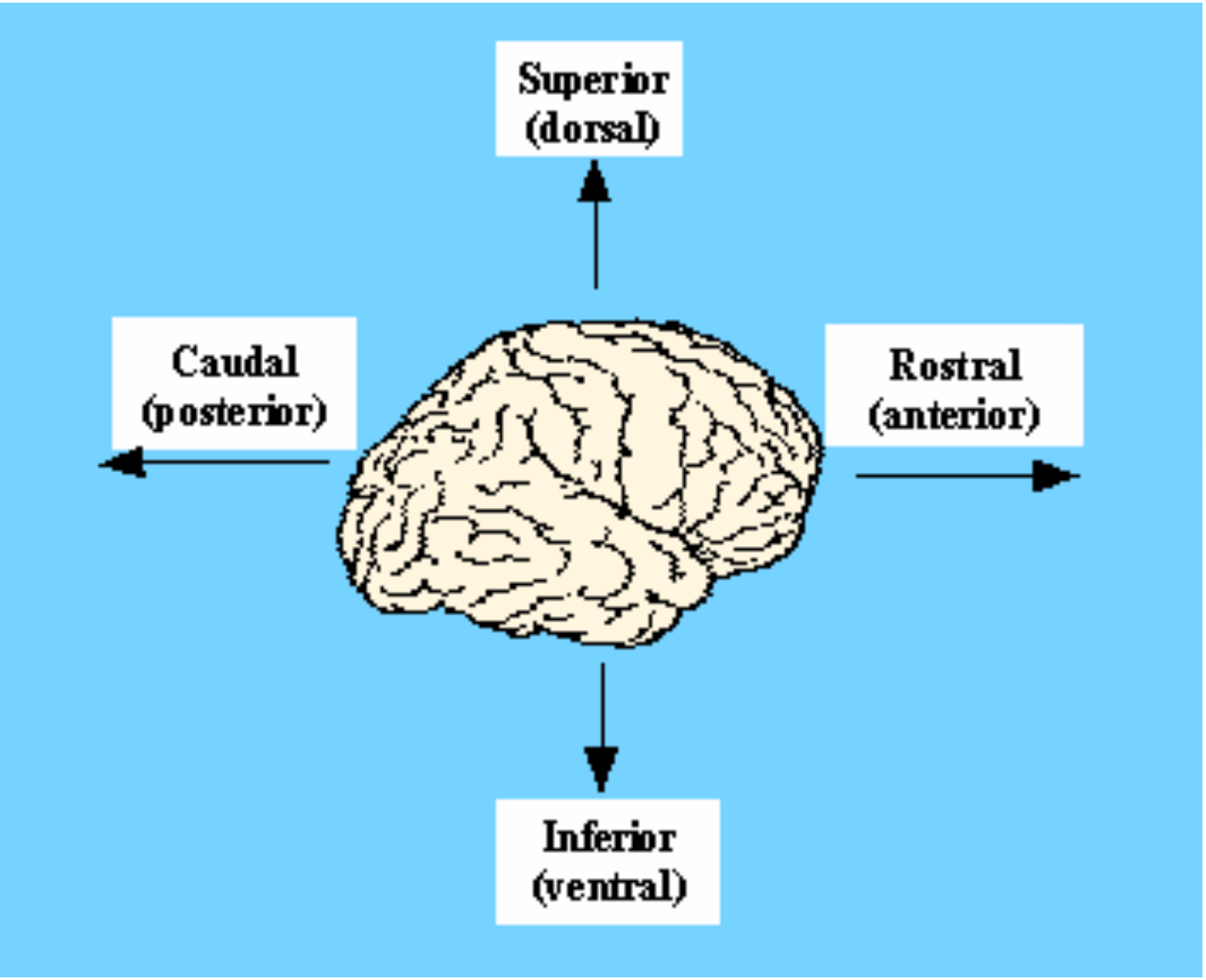
Navigation

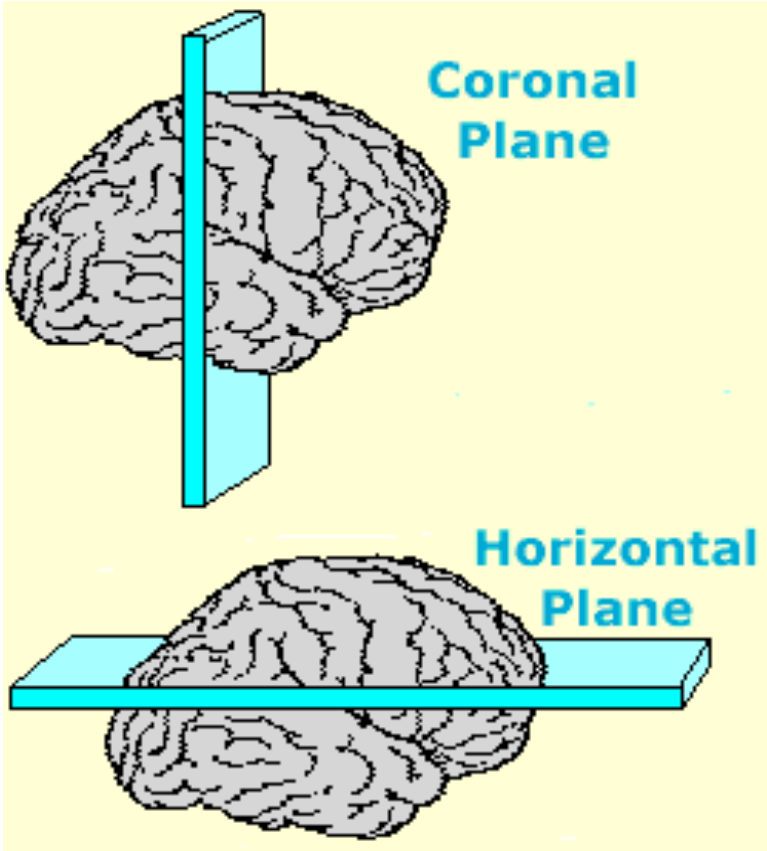
- Planes
  - horizontal / transverse / axial
    - “horizon”
  - coronal / frontal
    - “crown”
  - sagital (parasagital) / lateral
    - “arrow”

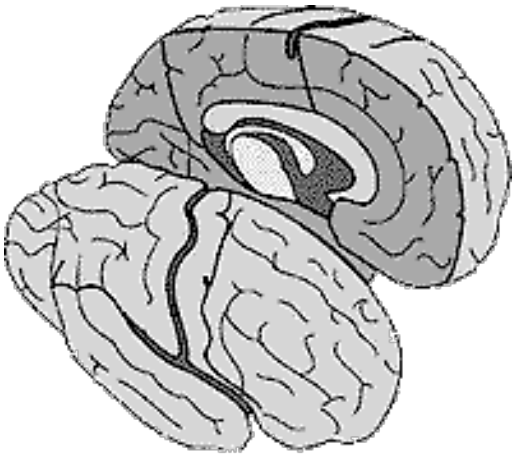


FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

Navigation



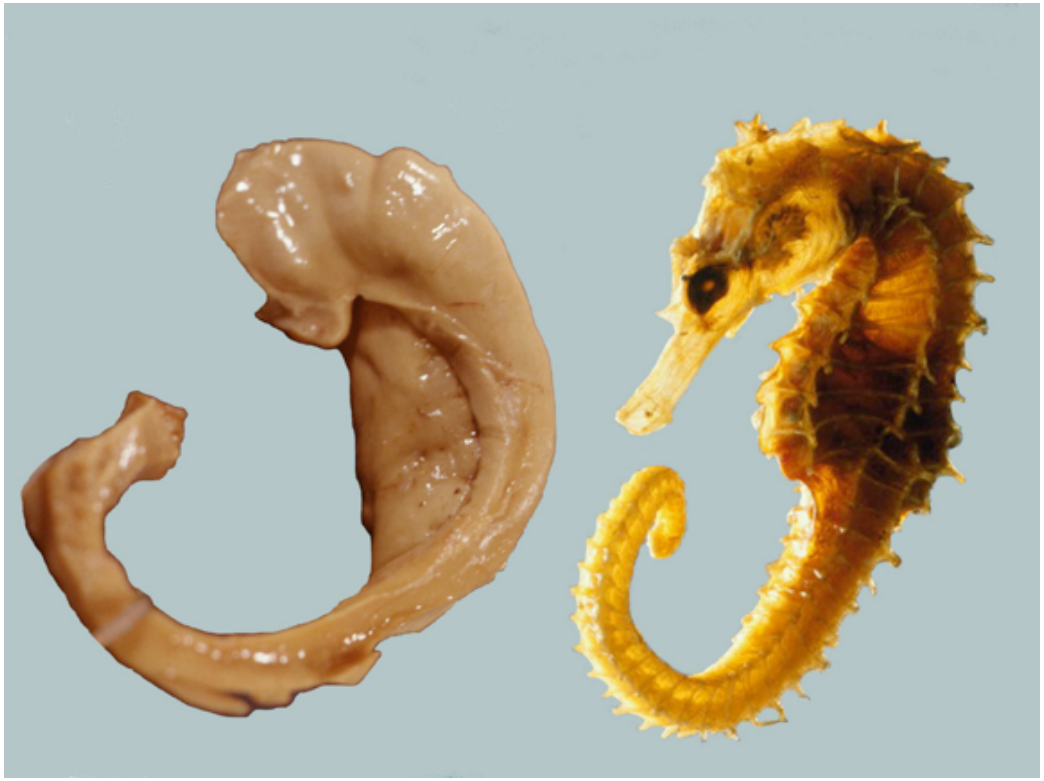




FOUNDATIONS OF BEHAVIORAL NEUROSCIENCE

Ways of naming nervous system structures:

- looks like something
  - hippocampus (“sea horse”), amygdala (“almond”)
- location - dorsomedial thalamic nucleus
  - upper / lower motor neurons
- function - primary visual cortex
- discoverer - fields of Forel / Broca’s area



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