Brain Tutorial

Gross Anatomy Lab #21

Fall 2015

Modified from Dr. Len White – Brain and Behavior
Many images from Neurosciences, 5th edition.
For the Brain lab and this tutorial your main goal is to locate the basic features of the brain. This is merely an introduction to these structures and will help prepare you for Brain and Behavior (with Dr. Len White) in the spring semester ([Neuroanatomy](#)). You will have a handful of neuroanatomy labs to cover in more depth the surface of the brain, the ventricular system, the dural venous sinuses, the blood supply of the brain and spinal cord, and cross-sectional views of the brain and spinal cord. Dr. White will join us during our GA lab to help guide you through these structures.

**GOALS and OBJECTIVES:**

- Recognize the embryological derivations of the brain – find these general regions on the adult brain.
- Demonstrate the four paired lobes of the cerebral cortex and identify by name and location, the boundaries of each.
- Identify structures of the brainstem and the cranial nerves.
- Identify the major vessels supplying the lobes of the brain and the spinal cord.
- Identify the fluid filled cavities of the ventricular system.
- Identify the dural venous sinuses formed by the folding of the dura mater.
Embryological subdivisions – Pro, Mes, Rhomb

Adult - Tel, Di, Mes, Met, My

Prosencephalon (forebrain)
Mesencephalon (midbrain)
Rhombencephalon (hindbrain)
Spinal cord

**Prosencephalon:**
- Telencephalon – cerebral hemispheres, basal ganglia, hippocampus, olfactory bulb, basal forebrain
- Diencephalon – dorsal thalamus & hypothalamus

**Mesencephalon:** midbrain

**Rhombencephalon:**
- Metencephalon – pons & cerebellum
- Myelencephalon – medulla

Lateral view
Brain Tutorial

SURFACE FEATURES
Basic surface features of the brain

**Lobes:** Frontal, parietal, occipital, temporal

**Fissures:** Longitudinal fissure (superior sagittal fissure) – separates R & L hemispheres  
Lateral (Sylvian) fissure/lateral sulcus – separates frontal & parietal from temporal

**Sulci:** Central sulcus – between frontal & parietal lobes

**Gyri:** Pre-central gyrus – frontal lobe, somatic motor; Post-central gyrus – parietal lobe, somatic sensory

**Regions:** Broca’s area – production of speech  
Wernicke’s area – understanding speech  
Insula – within lateral fissure, integration of emotion & social cognition
Figure 1.5. (left) The lateral surface of the human brain. (right) Location of the insular cortex. Portions of the frontal, parietal and temporal lobes have been gently retracted apart, exposing the underlying insula that becomes covered by the expanding cortical mantle in brain development. (adapted from Figure A10 from Neuroscience, 5th Ed.)
Lateral surface features of the brain

- Primary motor cortex
- Primary somatic sensory cortex
- Broca's area
- Wernicke's area
- Primary auditory cortex
- Primary visual cortex
Medial surface features of the brain

Corpus callosum – white matter, conveys axons between hemispheres
Parieto-occipital sulcus – between parietal & occipital
Anterior commissure – small bundle of axons connecting hemispheres
Fornix – fiber bundle connecting hippocampus & hypothalamus
Septum pellucidum – separates lateral ventricles

**Diencephalon:** Pineal gland – attaches to posterior thalamus; Thalamus – relays most information to and from cortex; Hypothalamus – homeostasis & other physiological activities; Mammillary bodies – memory & limbic system; Pituitary gland – attached to hypothalamus via infundibulum
**Mesencephalon** (midbrain): Superior & inferior colliculi – oculomotor function, postural adjustment & audition
**Pons:** role in coordination of movement
**Medulla oblongata:** autonomic functions
Figure 1.7. Illustrated views of the medial surface of a hemisected human brain. (Brainstem features will be discussed in a subsequent session.) (Figure A12 from Neuroscience, 5th Ed.)
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CRANIAL NERVES
Anterior/ventral surface of the brainstem

Optic chiasm
Optic tract
Mammillary body
Cerebral peduncle
Middle cerebellar peduncle
Pons
Inferior olive
Medullary pyramid
Spinal cord

Cranial nerves

Optic nerve (II)
Oculomotor nerve (III)
Trochlear nerve (IV)
Trigeminal nerve (V)
Abducens nerve (VI)
Facial nerve (VII)
Vestibulocochlear nerve (VIII)
Glossopharyngeal nerve (IX)
Vagus nerve (X)
Accessory nerve (XI)
Hypoglossal nerve (XII)

Color key for drawing at left:
- Sensory cranial nerves
- Motor cranial nerves
- Mixed (sensory and motor) cranial nerves

**NEUROSCIENCE 5e, Figure A7**
Posterior/dorsal surface of the brainstem

Thalamus

Midbrain

Pons

Medulla

Spinal cord
Cranial nerves: superior view into cranial cavity

- Olfactory nerves (I)
- Olfactory bulb and tract
- Optic nerve (II)
- Oculomotor nerve (III)
- Trochlear nerve (IV)
- Trigeminal nerve (V)
- Facial nerve (VII)
- Vestibulocochlear nerve (VIII)
- Spinal accessory nerve (XI)
- Hypoglossal nerve (XII)
- Abducent (abducens) nerve (VI)
- Glossopharyngeal nerve (IX)
- Vagus nerve (X)
<table>
<thead>
<tr>
<th>Cranial nerve</th>
<th>Name</th>
<th>Sensory and/or motor</th>
<th>Major function</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Olfactory nerve</td>
<td>Sensory</td>
<td>Sense of smell</td>
</tr>
<tr>
<td>II</td>
<td>Optic nerve</td>
<td>Sensory</td>
<td>Vision</td>
</tr>
<tr>
<td>III</td>
<td>Oculomotor nerve</td>
<td>Motor</td>
<td>Eye movements; <strong>pupillary constriction and accommodation</strong>; muscles of eyelid</td>
</tr>
<tr>
<td>IV</td>
<td>Trochlear nerve</td>
<td>Motor</td>
<td>Eye movements</td>
</tr>
<tr>
<td>V</td>
<td>Trigeminal nerve</td>
<td>Sensory and motor</td>
<td>Somatic sensation from face, mouth, cornea; muscles of mastication</td>
</tr>
<tr>
<td>VI</td>
<td>Abducens nerve</td>
<td>Motor</td>
<td>Eye movements</td>
</tr>
<tr>
<td>VII</td>
<td>Facial nerve</td>
<td>Sensory and motor</td>
<td>Controls the muscles of facial expression; taste from anterior tongue; lacrimal and salivary glands</td>
</tr>
<tr>
<td>VIII</td>
<td>Vestibulocochlear (auditory) nerve</td>
<td>Sensory</td>
<td>Hearing; sense of balance</td>
</tr>
<tr>
<td>IX</td>
<td>Glossopharyngeal nerve</td>
<td>Sensory and motor</td>
<td>Sensation from pharynx; taste from posterior tongue; carotid baroreceptors</td>
</tr>
<tr>
<td>X</td>
<td>Vagus nerve</td>
<td>Sensory and motor</td>
<td>Autonomic functions of gut; sensation from pharynx; muscles of vocal cords; swallowing</td>
</tr>
<tr>
<td>XI</td>
<td>Spinal accessory nerve</td>
<td>Motor</td>
<td>Shoulder and neck muscles</td>
</tr>
<tr>
<td>XII</td>
<td>Hypoglossal nerve</td>
<td>Motor</td>
<td>Movements of tongue</td>
</tr>
</tbody>
</table>
Arteries of the brain – inferior/ventral surface

Light blue = #1-5 (supplied by internal carotid and part of the anterior circulation)

Yellow/tan = #5-8 (supplied by vertebral/basilar and part of the posterior circulation)

Figure 2.1. Major arteries at the base of the brain. The top four arteries listed in the chart (previous page) arise from the carotid artery and supply most of the forebrain (match numbers in Figure to numbers in chart). The bottom four arteries arise from the vertebral and basilar arteries and supply the posterior forebrain, the brainstem and upper levels of the spinal cord. (Figure 10.3 from H. Blumenfeld, Neuroanatomy Through Clinical Cases 2nd Ed., Sinauer Assoc., Inc., 2010)
Arterial supply of the cerebrum

(A) Right lateral view of right hemisphere

(B) Medial view of left hemisphere

(C) Inferior view

Frontal pole of cerebrum
Temporal pole of cerebrum
Occipital pole of cerebrum

Anterior communicating
Anterior cerebral
Ophthalmic
Middle cerebral
Internal carotid
Posterior communicating
Posterior cerebral
Cerebral arterial circle
Superior cerebellar
Basilar
Anterior inferior cerebellar
Posterior inferior cerebellar
Vertebral
Anterior spinal
Arteries of the brain review – inferior view

- Anterior cerebral artery (ACA)
- Ophthalmic artery
- Internal carotid artery (ICA)
- Middle cerebral artery (MCA)
- Posterior communicating artery (PCOM)
- Posterior cerebral artery (PCA)
- Superior cerebellar artery (SCA)
- Labyrinthine artery
- Anterior inferior cerebellar artery (AICA)
- Posterior inferior cerebellar artery (PICA)
- Basilar artery
- Pontine arteries
- Vertebral artery
- Anterior spinal artery
- Posterior spinal arteries
- Anterior communicating artery (ACOM)
- Anterior choroidal artery
VENTRICLES AND DURAL VENOUS SINUSES
Ventricular system of the brain

Cerebral spinal fluid (CSF) flows within the ventricular system – produced in choroid plexuses

**Lateral ventricles** – inside cerebral hemispheres (septum pellucidum separates)

**Third ventricle** – continuous with lateral ventricles, runs in midline of diencephalon

**Cerebral (Mesencephalic) aqueduct** – continuous with 3rd ventricle, runs through midbrain

**Fourth ventricle** – aqueduct connects with, space in dorsal pons & medulla

**Central canal** – continuous with 4th ventricle, runs within spinal cord
*The sigmoid sinus drains into internal jugular vein.*
Dural venous sinuses

Dura mater:
- Periosteal layer
- Meningeal layer

Arachnoid mater

Subarachnoid space and arachnoid trabeculae

Pia mater

Layers of the scalp:
- Skin
- Connective tissue
- Aponeurosis
- Loose connective tissue
- Periosteum

Diploic vein

Superior sagittal sinus

Arachnoid granulation

Cerebral hemisphere

Corpus callosum

Septum pellucidum

Falx cerebri

Lateral ventricle

Inferior sagittal sinus

Cerebral artery

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7-49 Dural Venous Sinuses, B. Coronal Section