The Brain and Cranial Nerves

*Please Do Not Remove From Class

Having explored the spinal cord in the previous exercise, it is time to move on to an exploration of the other major organ of the central nervous system: the **brain.** The brain occupies most of the cranial cavity within the skull. This rather large, complex organ has been partitioned, for convenience of study, into numerous divisions and subdivisions. Nerves that enter and exit the brain directly are called **cranial nerves.** In this exercise, you are challenged to explore the organization of the brain and the structure and function of the cranial nerves.

Before you begin

- ❑ Read the appropriate chapter in your textbook.
- ❑ Set your learning goals. When you finish this exercise, you should be able to:
  - ❑ list and describe the principal structures of the brain
  - ❑ identify structures of the human brain in a chart, model, or preserved specimen
- ❑ Prepare your materials:
  - ❑ chart, model, or preserved specimen of a human brain
  - ❑ computer setup with DISSECTIBLE HUMAN or similar human dissection program (optional)
- ❑ Read the directions and safety tips for this exercise *carefully* before starting any procedure.

HINT

Using the DISSECTIBLE HUMAN or similar computerized human dissection program, explore the human body and try to find the structures listed in this activity.

A. External aspect of the brain

Using a model or preserved specimen of the human brain, locate the structures of the brain listed in the following steps.

HINT

Your textbook has descriptions and figures that will help you identify structures of the brain. You may wish to use your textbook as a supplemental resource for this and the following activities.

❑ 1 Determine whether any of the **meninges,** or membranous coverings of the brain, are intact (Figure 24-1). If they are present, locate the following:
- ❑ **Dura mater**
- ❑ **Sagittal sinus**
- ❑ **Subdural space**
- ❑ **Arachnoid**
- ❑ **Subarachnoid space**
- ❑ **Pia mater**

❑ 2 Locate the largest part of the brain, the **cerebrum.** The cerebrum is divided into nearly symmetrical left and right **cerebral hemispheres** by a deep **longitudinal fissure.** Joining the left and right cerebral hemisphere is a band of white matter called the **corpus callosum,** which may be seen at the bottom of the longitudinal fissure. The surface of the cerebrum, or **cerebral cortex,** is characterized by large convoluted folds of gray matter called **gyri.** The grooves between the gyri are called **sulci** if they are shallow and **fissures** if they are deep. Some fissures serve as landmarks to divide the cerebrum into regions called **lobes** that correspond to the overlying skull bones:
- ❑ **Frontal lobe** (left and right)
- ❑ **Parietal lobe**
- ❑ **Occipital lobe**
- ❑ **Temporal lobe**
- ❑ **Insula** (also called the *island of Reil,* a region hidden within a fissure that separates the temporal lobe from the parietal lobe)

In addition to using lobes as a means of identifying different regions of the cerebral cortex, neurobiologists often prefer to identify **functional regions** of the cortex. Figure 24-2 is a coloring exercise that illustrates some of the major functional areas of the cerebral cortex. How many of these areas can you identify on a specimen or model of the human brain?

❑ 3 The smaller, rounded structure under the posterior portion of the cerebrum that possesses somewhat parallel gyri is the **cerebellum.**

Ma'am

❑ 4 The **diencephalon** is the brain region just under the central portion of the cerebrum, superior and somewhat anterior to the brainstem. One major region of the diencephalon, the **thalamus,** is internal and cannot be seen from the outside of the brain. From the external aspect one can see some of these features of the **hypothalamus** of the diencephalon:

- ❑ **Optic chiasma**
- ❑ **Optic tracts**
- ❑ **Mammillary bodies**
- ❑ **Infundibulum**

One can also see the **pituitary,** or *hypophysis,* which is not part of the diencephalon proper but is attached to its ventral surface by the stalklike infundibulum.

❑ 5 The **brainstem** is the roughly cylindrical region of the brain that projects inferiorly from the diencephalon, anterior to the cerebellum. Locate these features if you can:

- ❑ **Midbrain** (upper portion, may not be visible in some models or specimens)
- ❑ **Pons** (bulging middle portion)
- ❑ **Medulla,** or *medulla oblongata* (cylindrical, inferior portion)

B. Cranial nerves

The cranial nerves are bundles of nerve fibers and their coverings that project from the brain, mostly from the brainstem. There are 12 pairs, each known by both name and number (usually expressed as a Roman numeral). Cranial nerves are numbered in the sequence of their origin from the ventral brain surface, from anterior to posterior. *Sensory nerves* contain only sensory (afferent) fibers. *Motor nerves* contain primarily motor (efferent fibers) but also have a few sensory fibers that carry feedback proprioceptive information. *Mixed nerves* have significant numbers of both sensory and motor fibers. Locate each of the 12 pairs of cranial nerves listed here in your model. Table 24-1 will help you identify their types and functions. Figure 24-3 will help you find them.

HINT

The first letter of each word in the following sentence, or one like it, helps in memorizing the names and numbers of the cranial nerves. It is, *"On Old Olympus' Tiny Tops, A Friendly Viking Grew Vines And Hops."* The functional type of each cranial nerve can be remembered by this sentence: *"Some Say 'Marry Money,' But My Brothers Say 'Bad Business, Marry Money."* In this sentence, *S* indicates *sensory, M* indicates *motor,* and *B* indicates *both* sensory and motor (mixed).

Table 24-1

CRANIAL NERVES

Name	Number	Type	General Function(s)
Olfactory	I	Sensory	Olfaction (sense of smell)
Optic	II	Sensory	Vision
Oculomotor	III	Motor	Controls upper eyelid muscles; controls superior rectus, medial rectus, inferior rectus, and inferior oblique muscles of the eye; controls ciliary muscle of the eye and sphincter in the iris
Trochlear	IV	Motor	Controls superior oblique muscle of the eye
Trigeminal	V	Mixed	Controls chewing movements *Ophthalmic branch:* sensation around the eye *Maxillary branch:* sensation from eye to upper jaw and throat *Mandibular branch:* sensation in mandibular region
Abducens	VI	Motor	Controls lateral rectus muscle of the eye
Facial	VII	Mixed	Controls facial muscles; controls secretion of tears and saliva; taste (anterior two thirds of tongue)
Vestibulocochlear	VIII	Sensory	*Vestibular branch:* senses of equilibrium *Cochlear branch:* hearing
Glossopharyngeal	IX	Mixed	Controls salivation; controls swallowing muscles; taste (posterior third of tongue); blood pressure sensation
Vagus	X	Mixed	Controls swallowing muscles; control and sensation in various visceral effectors
Accessory	XI	Motor	*Cranial branch:* controls some swallowing movements *Spinal branch:* controls some head movements
Hypoglossal	XII	Motor	Controls tongue muscles (swallowing and speech)

C. Internal aspect of the brain

If your brain specimen is dissectible, separate the halves of the model along the midsagittal plane to reveal the inner structures of the brain. If you are using a preserved or mounted specimen, you will need to use one that is cut in a midsagittal section to see the structures described in the following steps. Locate each structure listed (Figure 24-4).

❑ 1 The **corpus callosum** that had connected the two cerebral hemispheres can now be clearly seen in the midsagittal section. The **fornix,** part of the diencephalon, is ventral to the corpus callosum and is also composed of white fibers. You may be able to see a hollow cavity just ventral to the corpus callosum in each brain half. These cavities are the right and left lateral ventricles. In the whole brain, they are separated by a thin membrane, the **septum pellucidum.** In some models and specimens, the septum may be visible as a drumlike covering to one ventricle or may partially cover both ventricles. The **choroid plexus,** a tiny mass of capillaries within each ventricle, produces the *cerebrospinal fluid (CSF)* that fills each ventricle.

❑ 2 The lateral ventricles can also be seen in a frontal section. If your model can be dissected along a frontal plane, do so. If you are using preserved specimens, you will need one that is cut in a frontal section. Locate the lateral ventricle(s). Just lateral to each lateral ventricle is a small circle of gray matter called the *caudate nucleus,* part of the cerebrum's basal ganglia. Separated from the caudate nucleus by a band of white matter called the *internal capsule* is another part of the basal ganglia. This portion of the basal ganglia, inferior and lateral to the caudate nucleus, is called the **lentiform nucleus.** The lentiform nucleus comprises a lateral *putamen* and a medial *globus pallidus,* both made of gray matter. Just inferior to the lateral ventricles, along the midline, is a single third ventricle. Connecting each lateral ventricle to the third ventricle is an *interventricular foramen (of Monro),* which is often not visible in any of the brain sections. The lateral walls of the third ventricle are formed by a mass of gray matter called the **thalamus,** a region of the diencephalon. The two *lateral masses* of the thalamus are joined by the *intermediate mass* that passes through the third ventricle. Note the distribution of gray and white matter in the frontal section. What do you notice about its pattern?

❑ 3 Return your attention to the midsagittal section. Identify the white matter pattern, or arbor vitae, of the cerebellum. Ventral to the cerebellum is the fourth ventricle, which is connected to the third ventricle by the cerebral aqueduct (aqueduct of Sylvius).

❑ 4 Many features of the diencephalon already seen on the external aspect or in the frontal section can be seen in the midsagittal section. Locate the **optic chiasma, mammillary bodies,** and **infundibulum.** A small, rounded body on the midline, nearest the cerebrum, is the **pineal body** (or *pineal gland*) of the diencephalon. In the midsagittal section, only the intermediate mass of the thalamus is visible. It appears as a circle of gray matter surrounded by the shallow section of the third ventricle.

❑ 5 The **corpora quadrigemina** is easily seen in the midsagittal section, along the dorsal surface of the midbrain, just posterior to the pineal body. The corpora quadrigemina comprises four rounded bumps, arranged as two pairs. The larger pair is called the **superior colliculi** and the slightly smaller pair is called the **inferior colliculi.** The white matter tracts in the ventral portion of the midbrain constitute the **cerebral peduncles.**

❑ 6 Identify the pons and medulla in the midsagittal section.

COLORING EXERCISE
Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

The Human Brain

Cerebrum - label cerebral cortex - gray
CORPUS CALLOSUM 1 white
LATERAL VENTRICLE 2 yellow

Cerebellum
GRAY MATTER 3 gray
ARBOR VITAE 4 white
FOURTH VENTRICLE 5 yellow

Diencephalon
OPTIC CHIASMA 6 red
INFUNDIBULUM 7 red
MAMMILLARY BODIES 8 red
Pituitary - red (label if)
THALAMUS green
INTERMEDIATE MASS 9 green
PINEAL BODY 10 green
FORNIX 11 green
THIRD VENTRICLE 12 yellow

Brainstem
MIDBRAIN
CEREBRAL PEDUNCLES red 13
CEREBRAL AQUEDUCT 14 yellow
CORPORA QUADRIGEMINA 15 green
PONS 16 red
MEDULLA 17 red

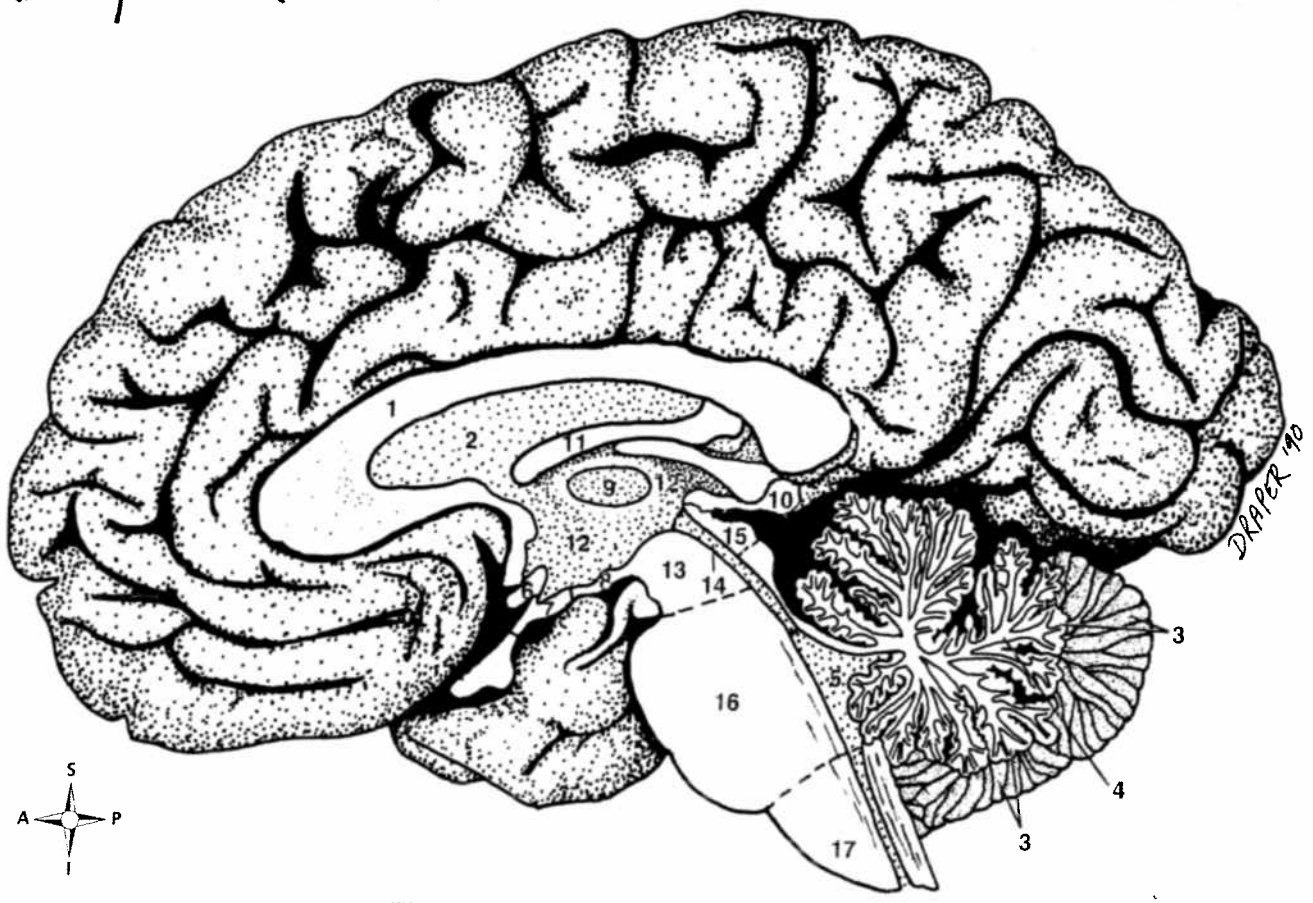

Figure 24-5 Anatomy of the human brain.

COLORING EXERCISE Color!

Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

Cerebral Cortex

Lobes

FRONTAL LOBE **1**
PARIETAL LOBE **2**
OCCIPITAL LOBE **3**
TEMPORAL LOBE **4**
INSULA **5**

Functional Areas

PREFRONTAL AREA **6**
PREMOTOR AREA **7**
MOTOR SPEECH AREA **8**
PRIMARY SOMATIC MOTOR AREA **9**
PRIMARY SOMATIC SENSORY AREA **10**
PRIMARY TASTE AREA **11**
SOMATIC SENSORY ASSOCIATION AREA **12**
SENSORY SPEECH AREA **13**
VISUAL ASSOCIATION AREA **14**
VISUAL CORTEX **15**
PRIMARY AUDITORY AREA **16**
AUDITORY ASSOCIATION AREA **17**

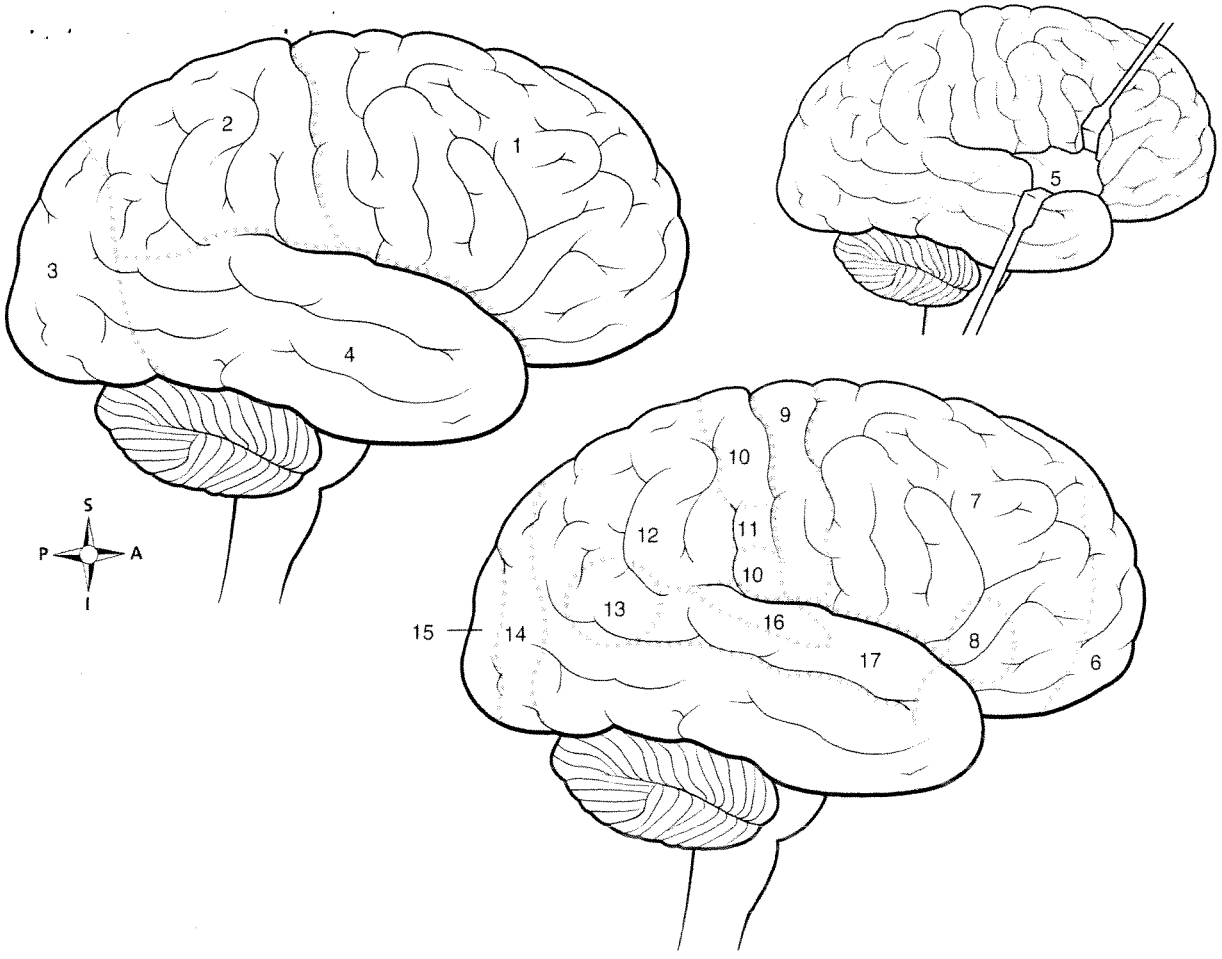

Figure 24-2 Lobes and functional areas of the human brain.

COLORING EXERCISE
Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

Coverings of the Brain

SKULL **1**
SUPERIOR SAGITTAL SINUS **2**
PERIOSTEUM **3**
DURA MATER **4**
SUBDURAL SPACE **5**
ARACHNOID **6**
SUBARACHNOID SPACE **7**
PIA MATER **8**
BRAIN **9**

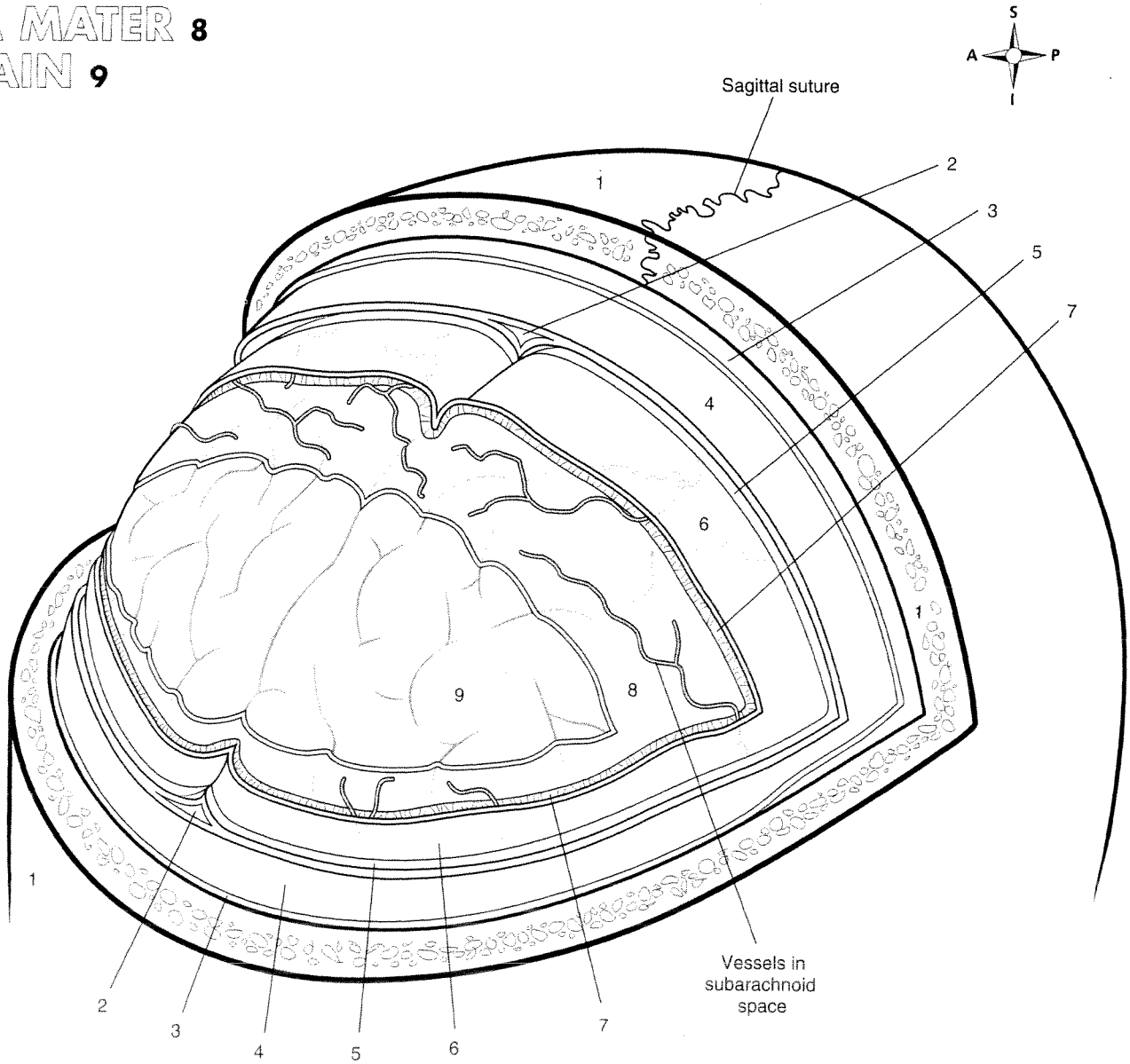

Figure 24-1 External aspect of the human brain and its coverings.

Cranial Nerves

OLFACTORY NERVE (I) **1**
OPTIC NERVE (II) **2**
OCULOMOTOR (III) **3**
TROCHLEAR NERVE (IV) **4**
TRIGEMINAL NERVE (V) **5**
ABDUCENS NERVE (VI) **6**
FACIAL NERVE (VII) **7**
VESTIBULOCOCHLEAR NERVE (VIII) **8**
GLOSSOPHARYNGEAL NERVE (IX) **9**
VAGUS NERVE (X) **10**
ACCESSORY NERVE (XI) **11**
HYPOGLOSSAL NERVE (XII) **12**

COLORING EXERCISE
Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

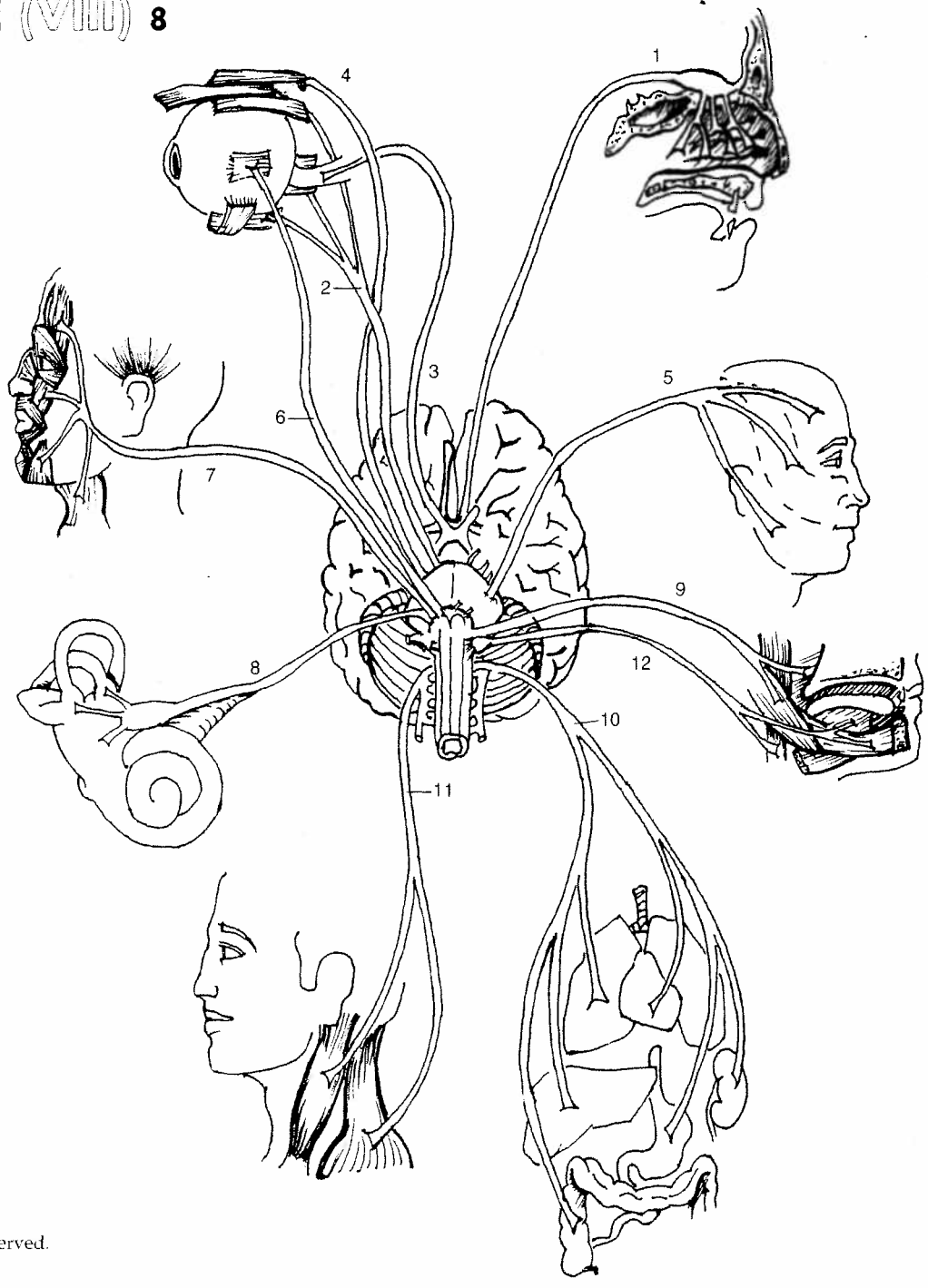

Figure 24-3 Ventral surface of the brain showing attachment of the cranial nerves.

Name:_____ Date:_____ Section:_____

LAB REPORT 25

Dissection: The Brain

Use this table as a checklist to keep track of your study of the mammalian brain specimen.

Brain Region	Structure	Specimen	Notes
Meninges	Dura mater	❑	
	Arachnoid	❑	
	Pia mater	❑	
Cerebrum	Hemispheres	❑	
	Longitudinal fissure	❑	
	Corpus callosum	❑	
	Frontal lobe	❑	
	Parietal lobe	❑	
	Occipital lobe	❑	
	Temporal lobe	❑	
	Insula	❑	
	Lateral ventricle	❑	
	Septum pellucidum	❑	
	Caudate nucleus	❑	
Cerebellum	Gray matter	❑	
	Arbor vitae	❑	
	Fourth ventricle	❑	
Diencephalon	Optic chiasma	❑	
	Infundibulum	❑	
	Mammillary bodies	❑	
	Thalamus	❑	
	Pineal body	❑	
	Fornix	❑	
	Third ventricle	❑	
Midbrain	Cerebral peduncles	❑	
	Cerebral aqueduct	❑	
	Corpora quadrigemina	❑	
Pons	Pons	❑	
Medulla	Medulla	❑	

Name:_____ Date:_____ Section:_____

LAB REPORT 24

The Brain and Cranial Nerves

Identify

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____

Put in Order

1. _____
2. _____
3. _____
4. _____
5. _____

Identify (write the names of the structures described as follows)

1. A mass of white fibers connecting the left and right cerebral hemispheres
2. A cerebral lobe not visible in an ordinary external inspection
3. A fold of cortical gray matter on the surface of the cerebrum
4. A deep sulcus
5. A vein in the dura mater roughly parallel to the longitudinal fissure
6. A rounded structure dorsal to the brainstem
7. A distinct, branched pattern of white matter in the cerebellum
8. The middle of three divisions of the brainstem
9. A vascular structure that produces CSF and is present in all the fluid ventricle
10. The fluid ventricle associated with the cerebellum
11. The membrane that separates the left and right lateral ventricles
12. The portion of the thalamus that passes through the third ventricle
13. This structure is composed of four colliculi
14. The gland is not technically a part of the brain but is attached to the brain via the infundibulum
15. The gray matter on the surface of the cerebrum
16. The white matter tracts in the ventral portion of the midbrain
17. The most caudal structure of the brain

Put in Order (arrange these in the order in which CSF passes through them, beginning with the place in which CSF could first be formed)

cerebral aqueduct
interventricular foramen (of Monro)
fourth ventricle
lateral ventricle
third ventricle