1) Both the **brain** and the **spine** functionally divide *sensory input* (in the posterior) from *motor output* (in the anterior). The posterior of the spine is easy to find – there are always bulges, called *ganglia*, found there! Please label the **bold faced** parts on this picture:

- **Gray matter** – moves APs at 1m/s
- **White matter** – moves APs at 100m/s
- **Posterior root** – contains sensory neurons
- **Posterior ganglion** – bulge that protects sensory neuron cell bodies
- **Anterior root** – contains motor neurons
- **Dura mater** – “tough mother” that protects CNS & forms blood-brain barrier
- **Pia mater** – “weak mother” that is permeable to CSF and holds brain shape
- **Arachnoid membrane** – binds pia to dura mater and allows CSF flow in CNS
- **Spinal nerve** – contains both sensory and motor neurons, connects CNS to the body

2) Neurons are bundled into nerves using *sheets of collagen* in much the same manner as muscle fibers in muscles. They even use the same prefixes for their layers! Please label the parts of this **dissected nerve**:

- **Fascicle** – a bundle of neurons
- **Blood vessels** – supply nutrients to the neuronal fascicles
- **Axon** – transmits APs to and from the body and organs
- **Schwann cells** – create a myelin sheath to create 100m/s speeds
- **Nodes of Ranvier** – allow saltatory conduction of APs, Na⁺ ions enter here
- **Epineurium** – sheet of collagen protecting an entire nerve
- **Perineurium** – sheet of collagen binding together a bundle of neurons
- **Endoneurium** – sheet of collagen protecting an individual neuron
3) **Spinal nerves** exit the spine through openings between vertebrae and provide both *sensory input* and *motor output* for areas of the body at the level of that nerve set. There is some **terminology** associated with those nerves, however. Please define these terms so I understand their *function*:

a. intervertebral foramina –

b. cervical plexus –

c. brachial plexus –

d. lumbosacral plexus –

e. dermatome –

f. peripheral neuropathy –

g. shingles –

h. sciatic nerve –

4) **Reflex arcs** are formed in order for the CNS to *perceive changes* in the environment and then *respond correctly* to those stimuli. They are often described using **five main steps**. Please *concisely* summarize the correct steps directly on *the diagram* provided.
5) **Embryonic brains** form in the first few weeks of development, and already exhibit the three main regions that our adult brains have (the *fore*, *mid*, & *hind brain*). As they enlarge, they then develop a complex system for cerebrospinal fluid (CSF) flow. Label the diagram using these terms: *third ventricle, subarachnoid space, lateral ventricle, fourth ventricle, choroid plexus* (used twice!), *cerebral aqueduct, arachnoid villi, & central canal*. Now, correctly number the steps 1-8 so they start with the creation of CSF at #1.

6) The dura mater contains pockets of blood called **dural sinuses**, and this is where we reabsorb Cerebrospinal Fluid (CSF) to remove toxins and wastes from the CNS. Because *blood* is on one side of the dura, and *CSF* is on the other side, this region is referred to as the **blood-brain barrier**.

**Why do we need** a blood-brain barrier (BBB)?

Where are the **four weak spots** in the BBB (where the CNS is directly linked to the blood)?

For each of the following items, tell me whether they **pass through** the BBB, or are **blocked**!

a. small ions (K⁺, Na⁺, Ca²⁺, Cl⁻, etc.)
b. ethanol
c. serotonin
d. carbon dioxide
e. teracycline
f. sulfadiazine
7) Please label the brain regions indicated on this midsagittal section with a letter and then write a concise function next to each part listed below:

a. medulla oblongata
b. pineal gland
c. corpus callosum
d. cerebellum
e. pituitary gland
f. thalamus
g. pons
h. hypothalamus

<table>
<thead>
<tr>
<th>Lobe/Area</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRONTAL LOBE</td>
<td></td>
</tr>
<tr>
<td>Primary motor cortex</td>
<td>Voluntary control of skeletal muscles</td>
</tr>
<tr>
<td>PARietal LOBE</td>
<td></td>
</tr>
<tr>
<td>Primary somatosensory cortex</td>
<td>Conscious perception of touch, pressure, pain,</td>
</tr>
<tr>
<td></td>
<td>vibration, taste, and temperature</td>
</tr>
<tr>
<td>OCCipital LOBE</td>
<td></td>
</tr>
<tr>
<td>Visual cortex</td>
<td>Conscious perception of visual stimuli</td>
</tr>
<tr>
<td>TEMPORAL LOBE</td>
<td></td>
</tr>
<tr>
<td>Auditory cortex and olfactory</td>
<td>Conscious perception of auditory (hearing) and</td>
</tr>
<tr>
<td>cortex</td>
<td>olfactory (smell) stimuli</td>
</tr>
</tbody>
</table>

8) Please label the cerebral cortex regions indicated on this picture with a letter, and then write a concise function next to each part listed below:

a. premotor cortex
b. visual cortex
c. Broca’s area
d. auditory cortex
e. primary somatosensory (postcentral gyrus)
f. Wernicke’s area
g. primary motor (precentral gyrus)

h. somatosensory association cortex

9) Please describe the **function** of the:

a. superior and inferior colliculi

b. decussation of the pyramids

c. reticular activating system (RAS)

d. limbic system

Information in the brain moves quickly between regions through the use of myelinated fibers in pathways called “**tracts**”. Since there are **three** possible directions for information flow (up/down, left/right, front/back), there are also **three** type of fibers. Please describe **how we use** our:

a. associational fibers

b. commissural fibers

c. pyramidal fibers

Now, based on what you wrote, tell me **which fibers** connect up/down, left/right, and front/back?

10) The human cerebrum consists of **two hemispheres**, but they do not always process the **same kinds** of information!

a. What is meant by the term “**lateralization**” of the two cerebral hemispheres?

b. What **kinds of functions** are lateraled in human brains to the **left** side? How about the **right**?

c. Which one of the two cerebral hemispheres is the **dominant** side for **speech** in humans?

d. Which one of the two cerebral hemispheres is the **dominant** side for **decision making**?