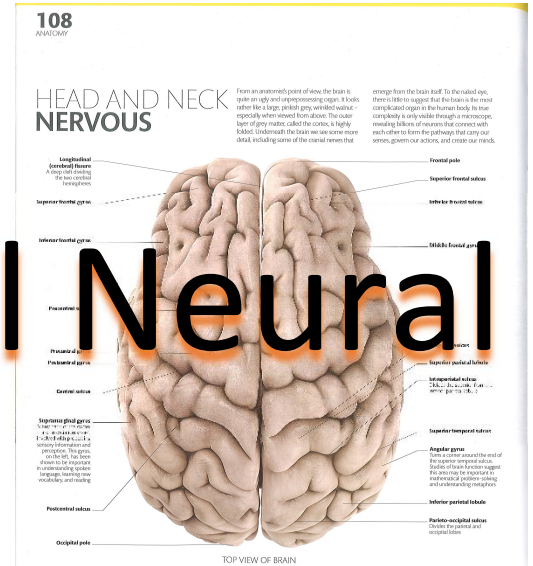
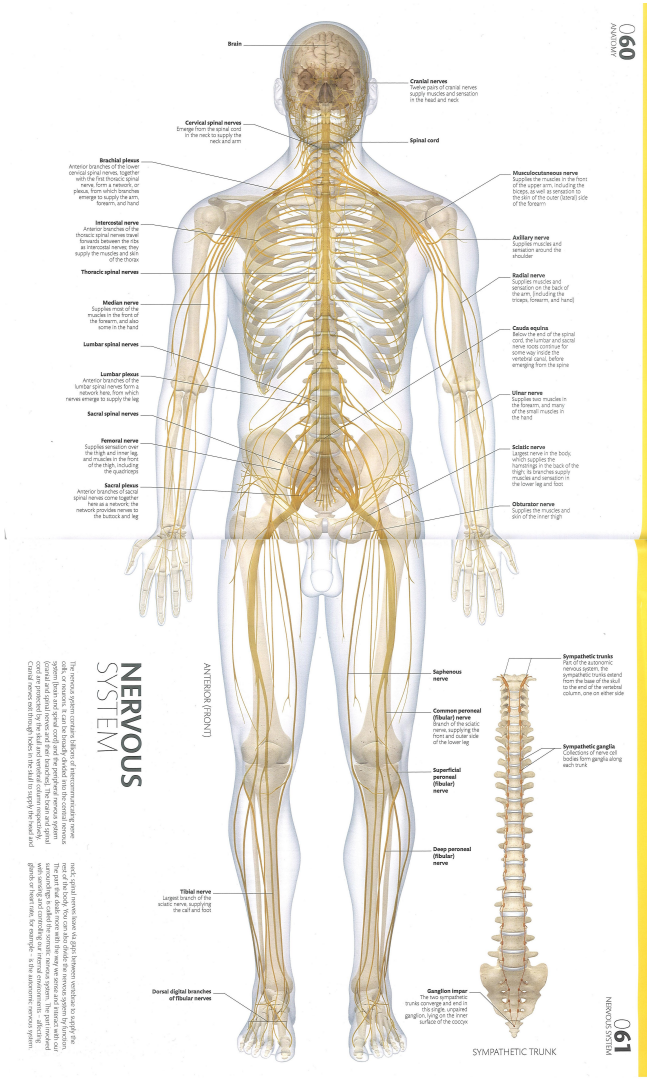


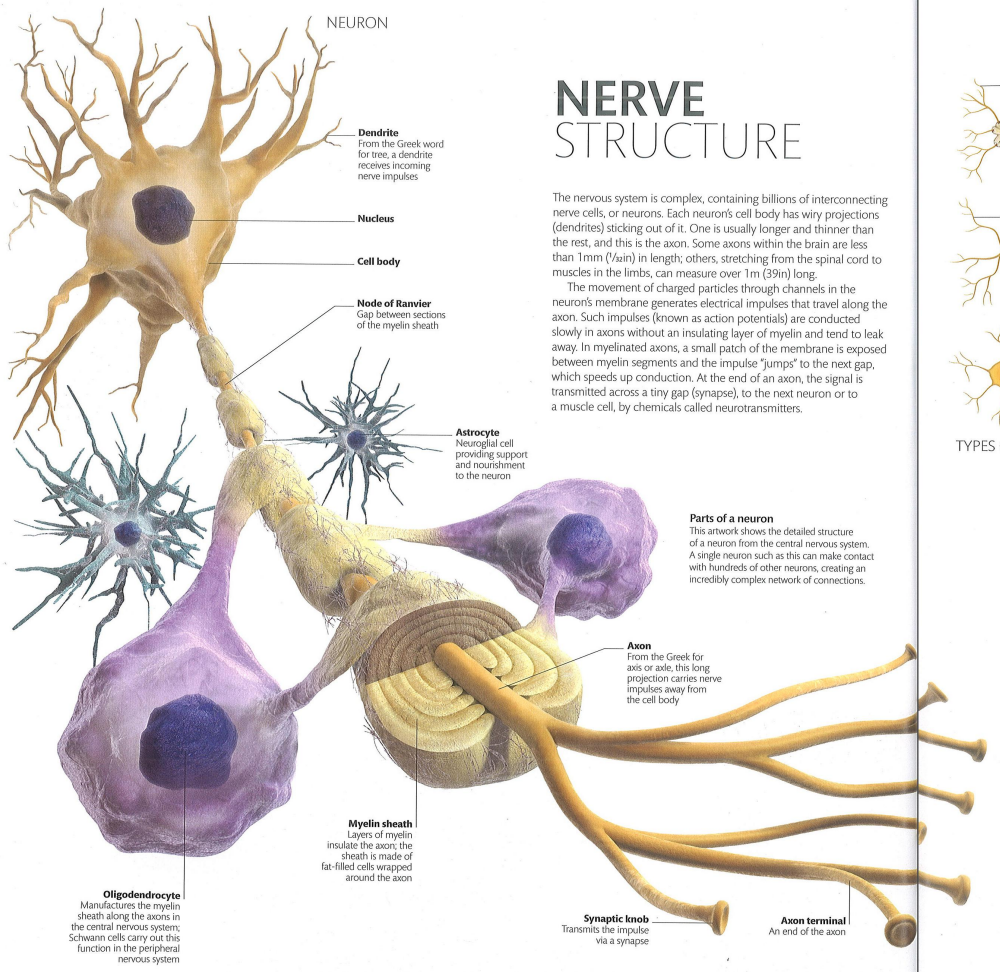
Central Neural System

Yan Zhixiong Ph.D

Central Neural System



Central Neural System

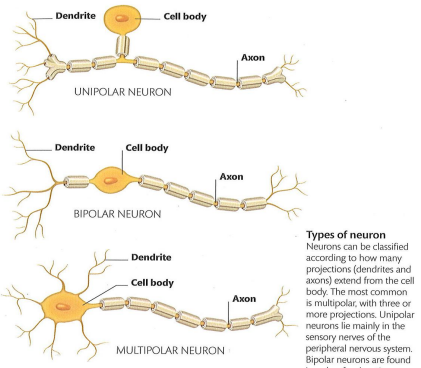


NERVE STRUCTURE

The nervous system is complex, containing billions of interconnecting nerve cells, or neurons. Each neuron's cell body has wiry projections (dendrites) sticking out of it. One is usually longer and thinner than the rest, and this is the axon. Some axons within the brain are less than 1mm (1/32in) in length; others, stretching from the spinal cord to muscles in the limbs, can measure over 1m (39in) long.

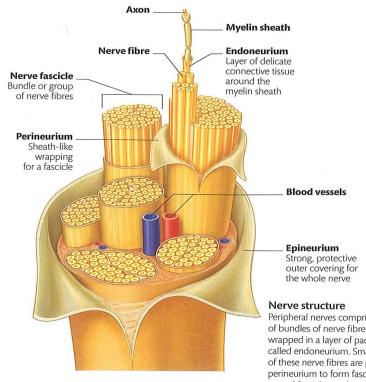
The movement of charged particles through channels in the neuron's membrane generates electrical impulses that travel along the axon. Such impulses (known as action potentials) are conducted slowly in axons without an insulating layer of myelin and tend to leak away. In myelinated axons, a small patch of the membrane is exposed between myelin segments and the impulse "jumps" to the next gap, which speeds up conduction. At the end of an axon, the signal is transmitted across a tiny gap (synapse), to the next neuron or to a muscle cell, by chemicals called neurotransmitters.

Parts of a neuron
This artwork shows the detailed structure of a neuron from the central nervous system. A single neuron such as this can make contact with hundreds of other neurons, creating an incredibly complex network of connections.



TYPES OF NEURON

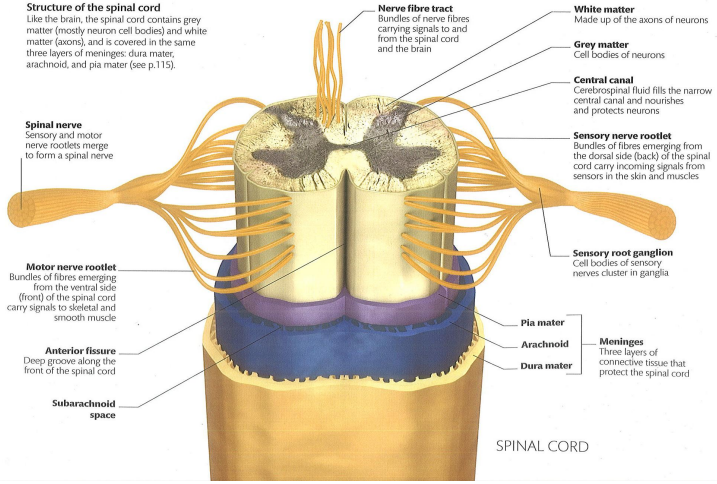
Types of neuron
Neurons can be classified according to how many projections (dendrites and axons) extend from the cell body. The most common is multipolar, with three or more projections. Unipolar neurons lie mainly in the sensory nerves of the peripheral nervous system. Bipolar neurons are found in only a few locations, such as the eye's retina.



PERIPHERAL NERVE

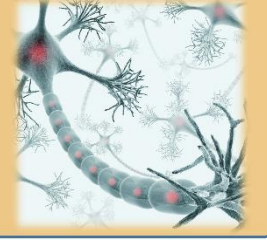
Nerve structure
Peripheral nerves comprise bundles of bundles of nerve fibres. Axons are wrapped in a layer of packing tissue called endoneurium. Small bundles of these nerve fibres are packaged in perineurium to form fascicles, and several fascicles are bundled within epineurium to form the nerve.

Structure of the spinal cord
Like the brain, the spinal cord contains grey matter (mostly neuron cell bodies) and white matter (axons), and is covered in the same three layers of meninges: dura mater, arachnoid, and pia mater (see p.115).



SPINAL CORD

Central Neural System



Body of corpus callosum
The largest commissure (or bundle of connecting nerve fibres) between the two hemispheres, this forms the roofs of the lateral ventricles

Septum pellucidum
This "translucent partition" is a thin dividing wall between the two lateral ventricles

Superior frontal gyrus

Cingulate gyrus
"Cingulum" is the Latin for girdle and this gyrus wraps closely around the corpus callosum; it is part of the limbic system, which is involved with emotional responses and behaviours

Genu of corpus callosum
The anterior (front) end of the corpus callosum is bent over – "genu" means knee in Latin

Anterior commissure
A bundle of nerve fibres connecting parts of the two cerebral hemispheres

Optic chiasma
The crossover point where the two optic nerves meet and swap fibres, then part company as the optic tracts, which continue on each side of the brain towards the thalamus

Hypothalamus
Plays an important role in regulating the internal environment of the body, by keeping a check on body temperature, blood pressure, and blood sugar level, for instance

Pituitary gland
Produces many hormones and forms a link between the brain and endocrine system

Mammillary body
Part of the limbic system of the brain

Interthalamic adhesion
Connection between the thalami on each side of the brain

Cerebrum
The largest part of the brain, consisting of the two cerebral hemispheres

Thalamus
Processes and relays sensory and motor information to higher brain centres

Splenium of corpus callosum
The posterior end of the corpus callosum

Choroid plexus of the third ventricle
A choroid plexus is formed where the inner and outer membranes of the brain come together; it is full of capillaries and produces cerebrospinal fluid, which flows into the ventricle

Pineal gland
Produces the hormone melatonin and is involved in the regulation of sleep–wake cycles

Superior colliculus
Involved in visual reflex pathways, including the pupillary light reflex, which makes the pupils constrict when bright light hits the retina

Tectum of the midbrain
The roof of the midbrain

Cerebral aqueduct
A narrow channel connecting the third and fourth ventricles

Inferior colliculus
Involved with auditory pathways, including reflex responses to loud noises

Tegmentum of midbrain

Fourth ventricle

Pons

Median aperture of the fourth ventricle
Cerebrospinal fluid escapes from the fourth ventricle via this opening in the midline, as well as through an opening on each side, into the subarachnoid space around the brain and spinal cord

Cerebellum

Medulla oblongata

Spinal cord

SAGITTAL SECTION THROUGH BRAIN

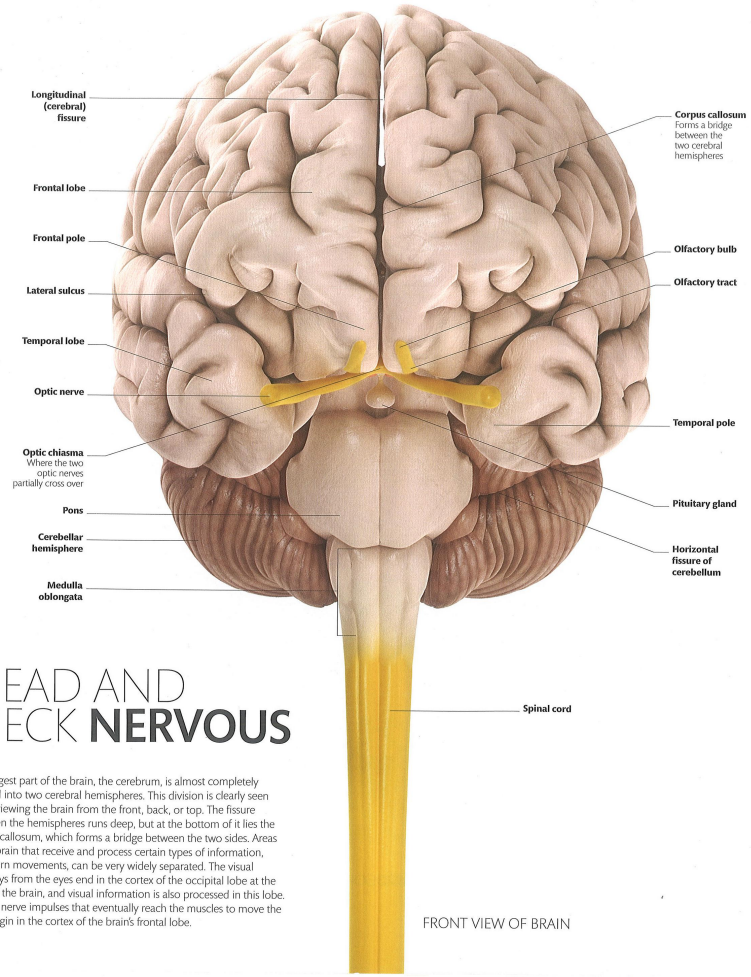
HEAD AND NECK
NERVOUS

This median sagittal section – a vertical slice right through the middle of the brain – shows clearly the corpus callosum, which links the two hemispheres. We also see that the brain is not solid: there are cavities within it. Two spaces (or ventricles) lie inside each hemisphere, while the third and fourth ventricles are located on the midline. These spaces are full of cerebrospinal fluid. Beneath and behind the cerebrum sits the cerebellum. The grey cortex of the cerebellum is more finely folded than that of the cerebrum, with fissures separating its leaves (or folia). Sliced through like this, the inside of the cerebellum reveals a beautiful, tree-like pattern. In this section, we can also see clearly all the parts of the brainstem – the midbrain, pons, and medulla.

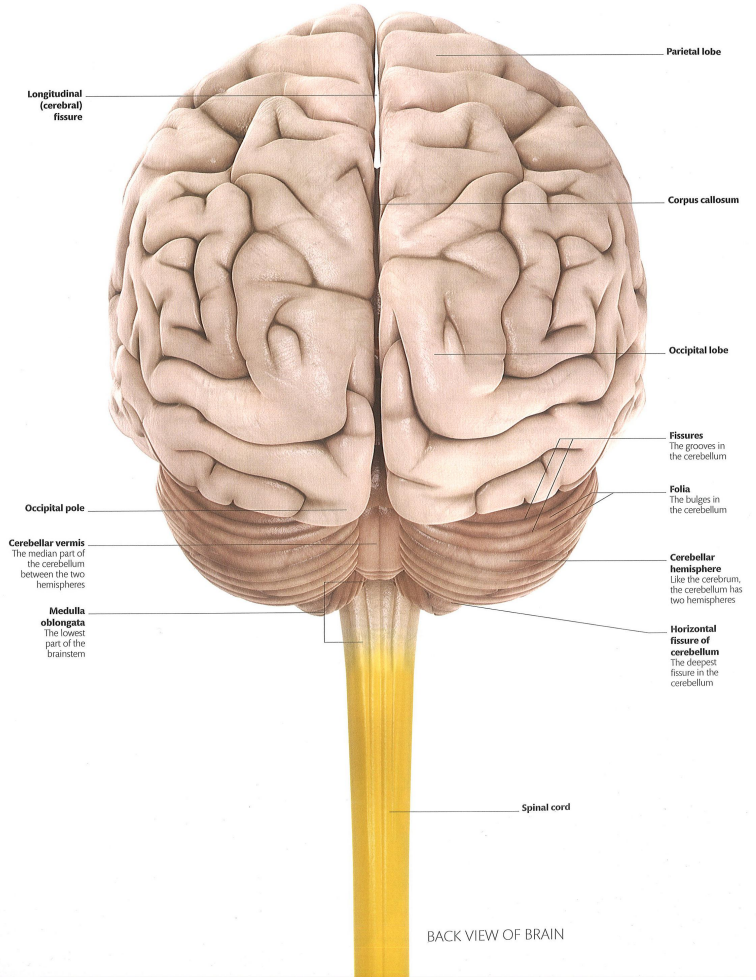
Central Neural System

HEAD AND NECK **NERVOUS**

The largest part of the brain, the cerebrum, is almost completely divided into two cerebral hemispheres. This division is clearly seen when viewing the brain from the front, back, or top. The fissure between the hemispheres runs deep, but at the bottom of it lies the corpus callosum, which forms a bridge between the two sides. Areas of the brain that receive and process certain types of information, or govern movements, can be very widely separated. The visual pathways from the eyes end in the cortex of the occipital lobe at the back of the brain, and visual information is also processed in this lobe. But the nerve impulses that eventually reach the muscles to move the eyes begin in the cortex of the brain's frontal lobe.

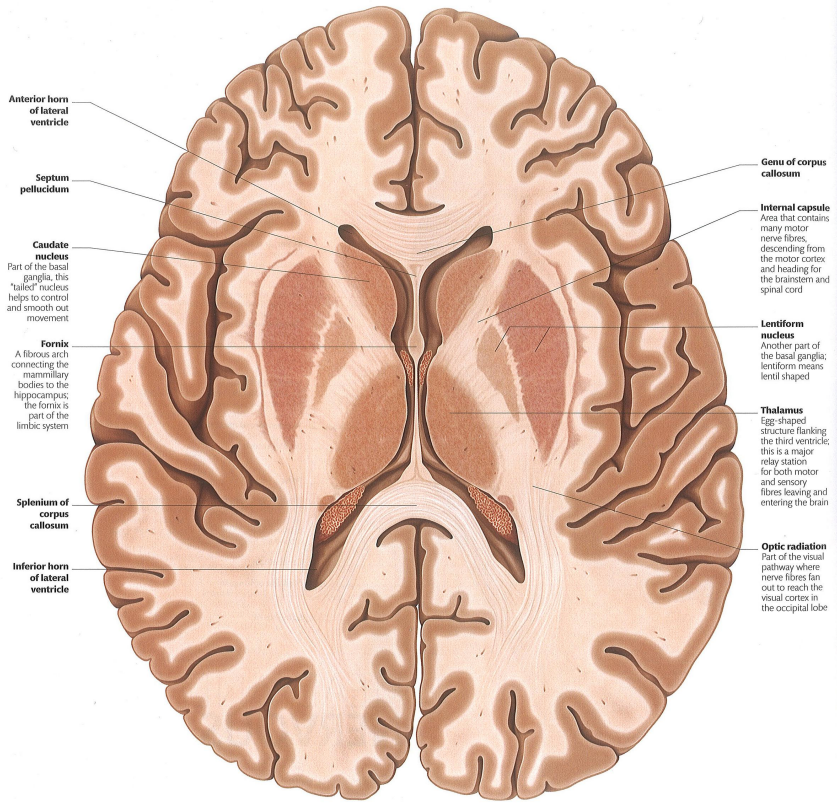


FRONT VIEW OF BRAIN

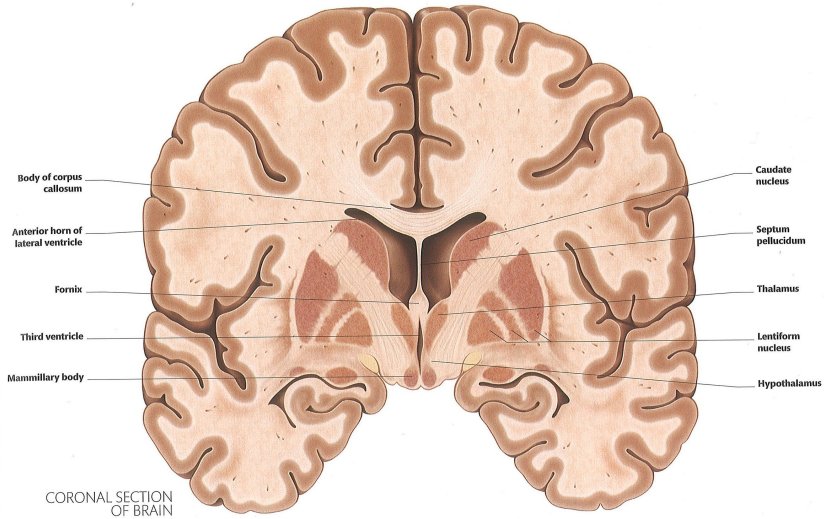


BACK VIEW OF BRAIN

Central Neural System



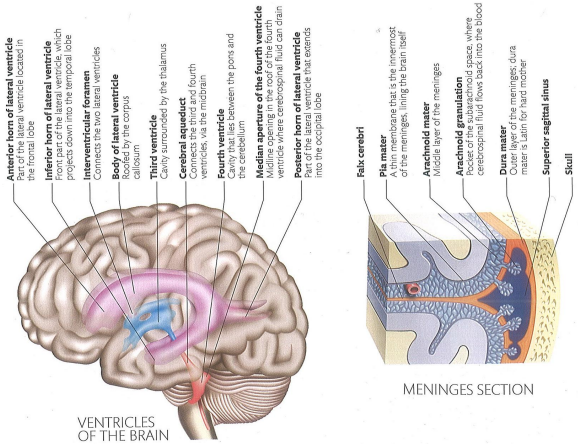
TRANSVERSE SECTION OF BRAIN



CORONAL SECTION OF BRAIN

HEAD AND NECK NERVOUS

The brain is protected by three membranes called the meninges (which become inflamed in meningitis). The tough dura mater layer is the outermost covering, which surrounds the brain and the spinal cord. Under the dura mater is the cobweb-like arachnoid mater layer. The delicate pia mater is a thin membrane on the surface of the brain. Between the pia mater and the arachnoid mater there is a slim gap – the subarachnoid space – which contains cerebrospinal fluid (CSF). Mainly produced by the choroid plexus in the brain's lateral ventricles, CSF flows through the third ventricle into the fourth, where it can escape via small apertures into the subarachnoid space.



VENTRICLES OF THE BRAIN

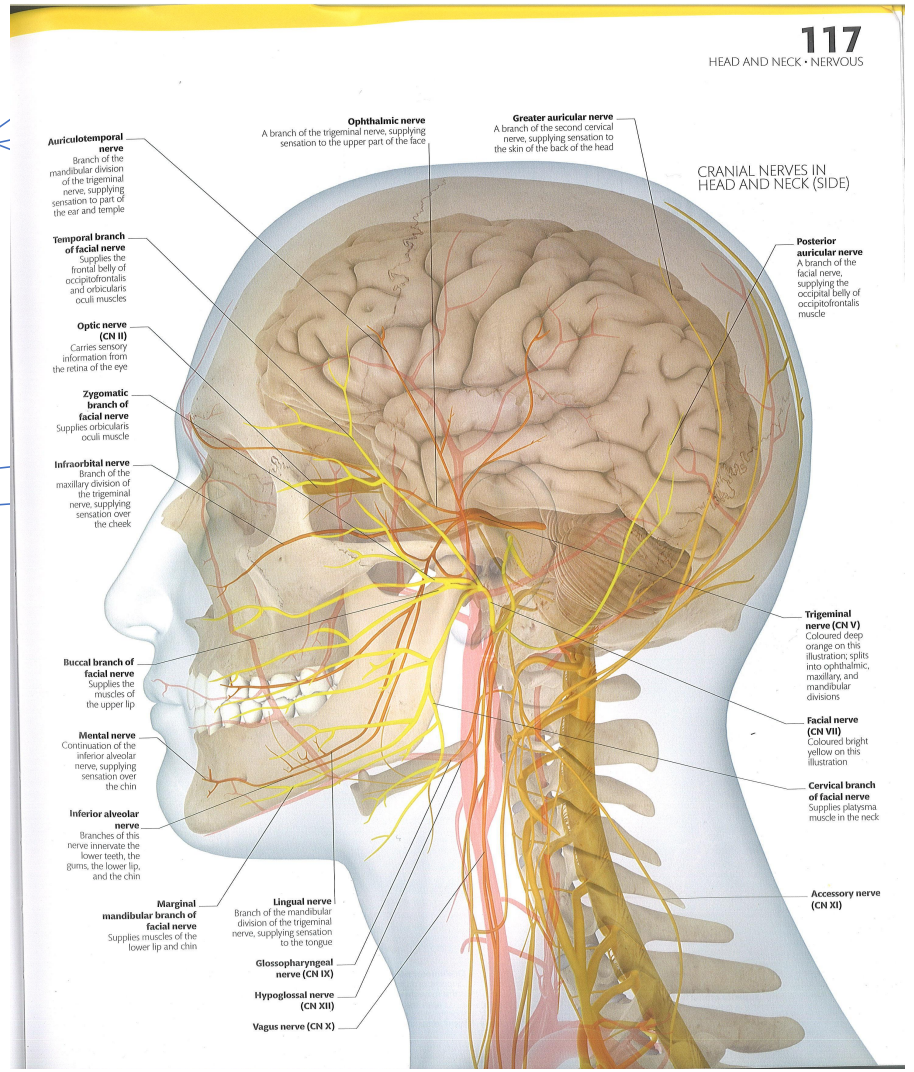
MENINGES SECTION

Central Neural System

Brain/脑

- Brain stem/脑干
- Diencephalon/间脑
- Cerebrum/大脑
- Cerebellum/小脑

Spinal cord/脊髓

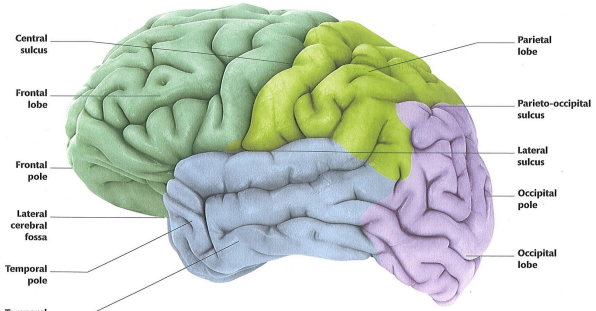


Central Neural System

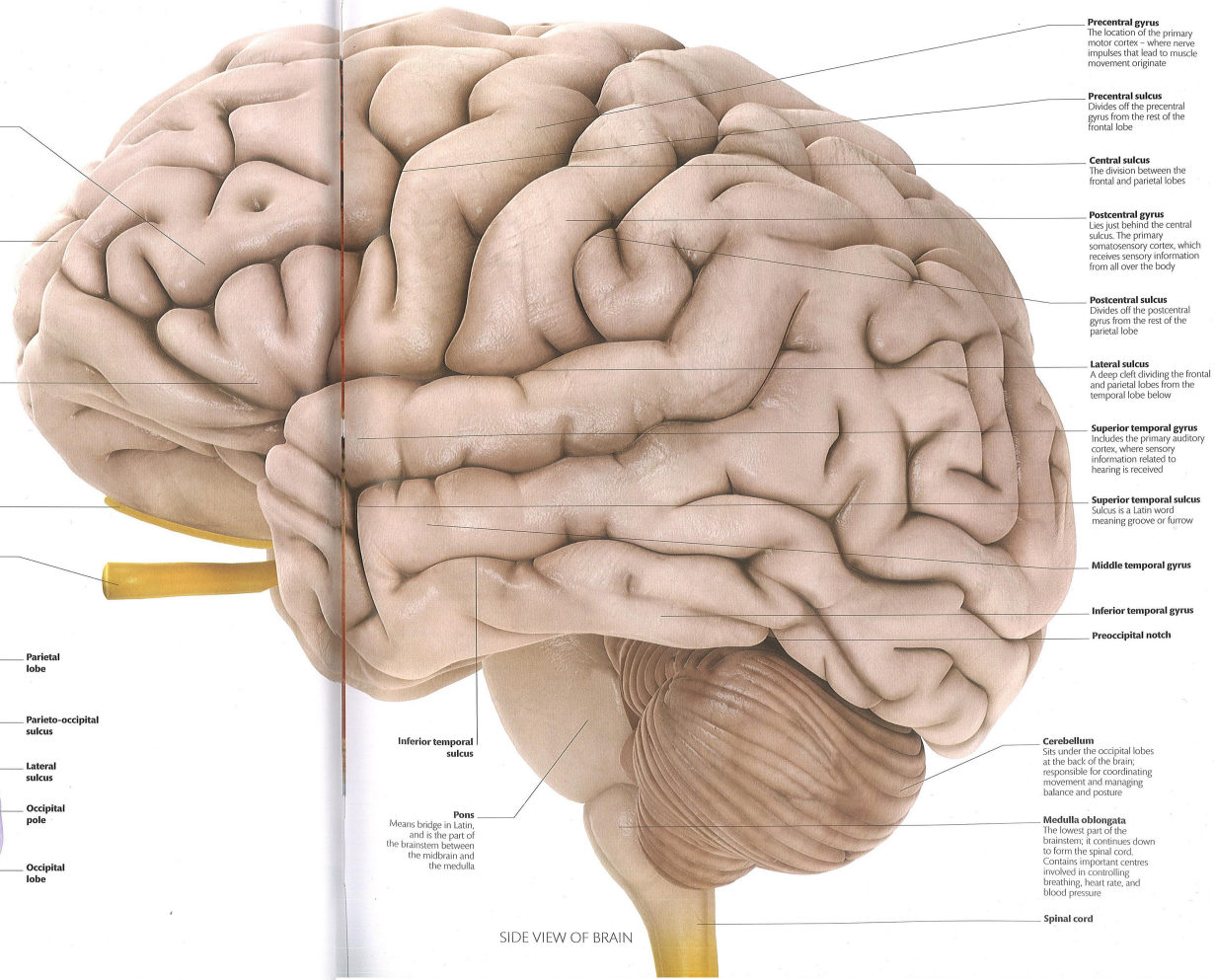
Brain/脑

HEAD AND NECK
NERVOUS

Compared to other animals, we humans have massive brains for the size of our bodies. The human brain has grown larger and larger over the course of evolution, and it is now so overblown that the frontal lobes of the brain lie right over the top of the orbits that contain the eyes. Think about any other mammal, perhaps a dog or a cat for easy reference, and you will quickly realize what an odd shape the human head is – and most of that is down to our huge brains. Looking at a side view of the brain, you can see all the lobes that make up each cerebral hemisphere: the frontal, parietal, temporal, and occipital lobes (individually coloured, below). Tucked under the cerebral hemispheres at the back of the brain is the cerebellum (Latin for little brain). The brainstem leads down, through the foramen magnum of the skull, to the spinal cord.



LOBES AND POLES



SIDE VIEW OF BRAIN

Central Neural System

- Brain/脑
  - Brain stem/脑干
    - Medulla oblongata/延髓
    - Pons/脑桥
    - Mesencephalon/中脑
  - Diencephalon/间脑
    - Thalamus/丘脑
    - Hypothalapms/下丘脑
  - Cerebrum/大脑
    - Grey matter/灰质
    - White matter/灰质
  - Cerebellum/小脑

Spinal cord/脊髓

Central Neural System

Thanks!