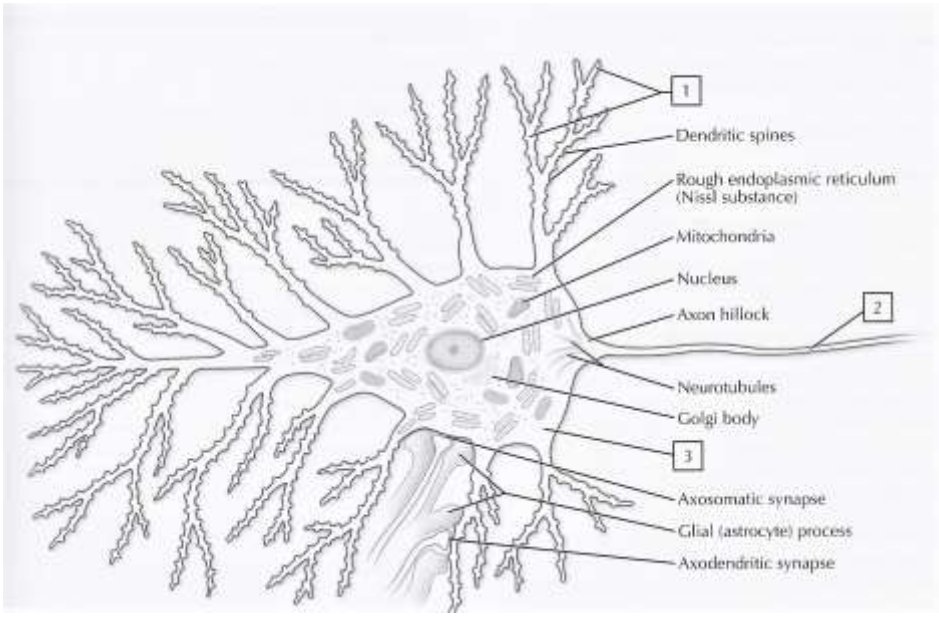
Name:

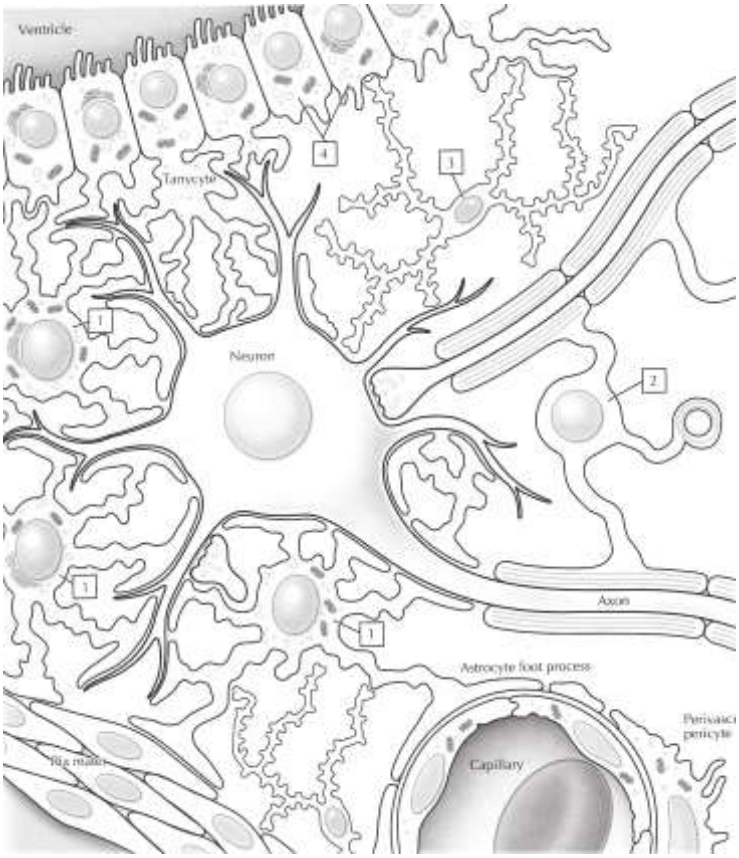
WORKSHEET NERVOUS SYSTEM (variant B)

Nerve cells are called neurons and their structure reflects the functional characteristics of an individual neuron. Information comes to the neuron largely via processes called **axons**, which terminate on the neuron at specialized junctions called **synapses**. Synapses can occur on neuronal processes called **dendrites** or on the neuronal cell body, called a **soma** or **perikaryon**

Task 1: The parts of neuron and glial cells – fill in correct numbers to the tables:



	No.
Soma (perikaryon)	
Axon	
Dendrites	



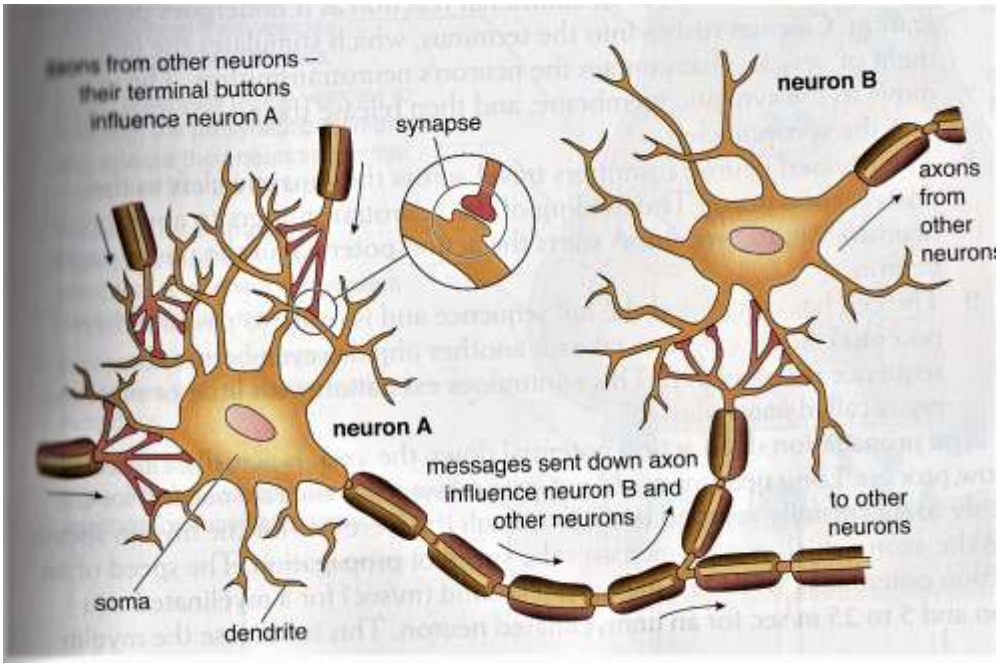
Glia are the cells that support neurons, both within the CNS (the neuroglia) and within the PNS. Glial cells far outnumber the neurons in the nervous system and, along with myelination of new axons, contribute to most of the postnatal growth seen in the CNS.

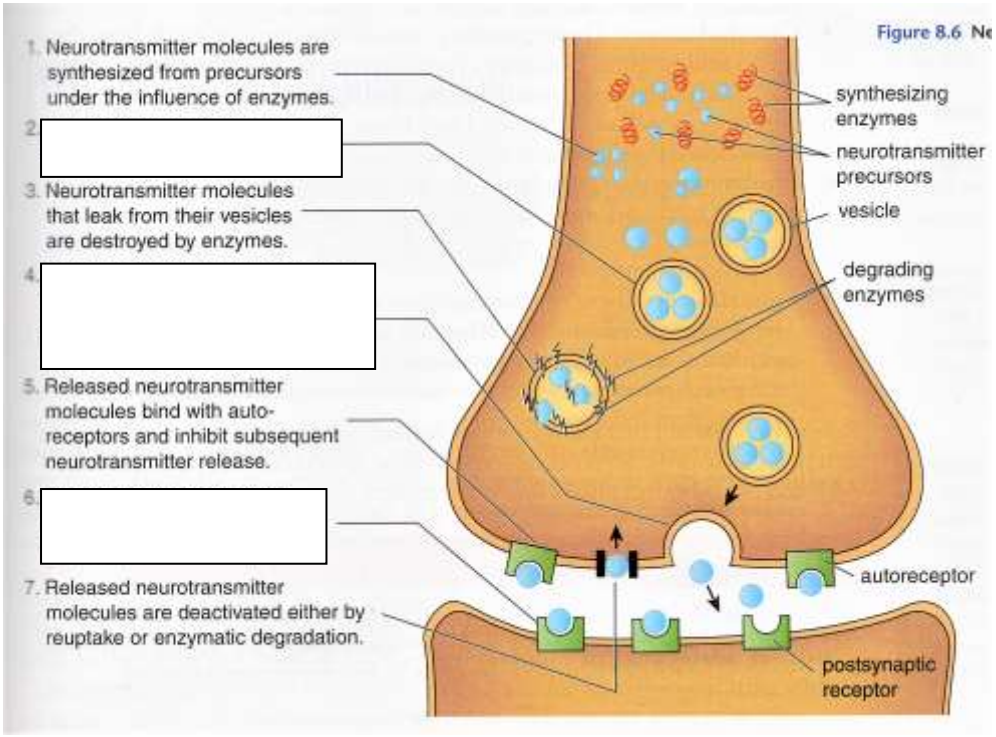
	No.
Ependymal cells: line the ventricles of the brain and the central canal of the spinal cord that contain cerebrospinal fluid	
Astrocytes: the most numerous of the glial cells, they provide physical and metabolic support for CNS neurons, and contribute to the formation of the blood-brain barrier	
Oligodendrocytes: smaller glial cells that are responsible for the formation and maintenance of myelin in the CNS	
Microglia: smallest and most rare of the CNS glia, they are phagocytic cells and participate in inflammatory reactions	

Name:

Task 2: Synapses – read the text in the boxes next to the second picture and try to decide, to which number of the box with the missing text in the picture they belong.

The major form of communication in the nervous system is by synapses, discrete sites where the axon, or its extensive branching of axonal terminals, sometimes numbering in the thousands, abut another neuron or target cell.





Neurotransmitter molecules are stored in vesicles.

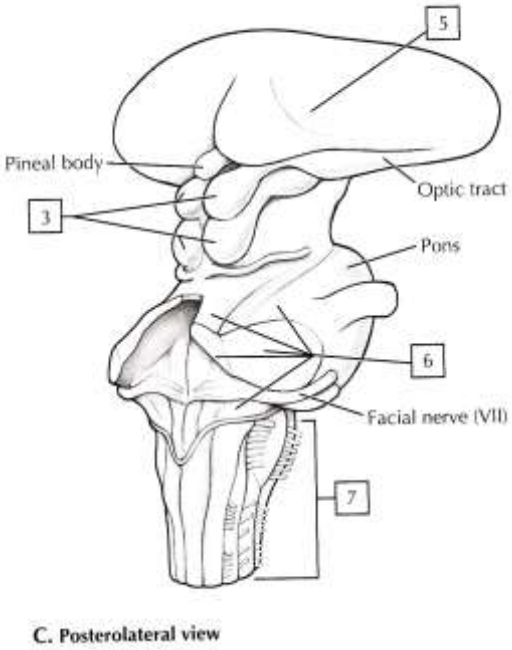
Released neurotransmitter molecules bind to postsynaptic receptors.

Action potentials cause vesicles to fuse with the presynaptic membrane and release their neurotransmitter molecules into the synapse.

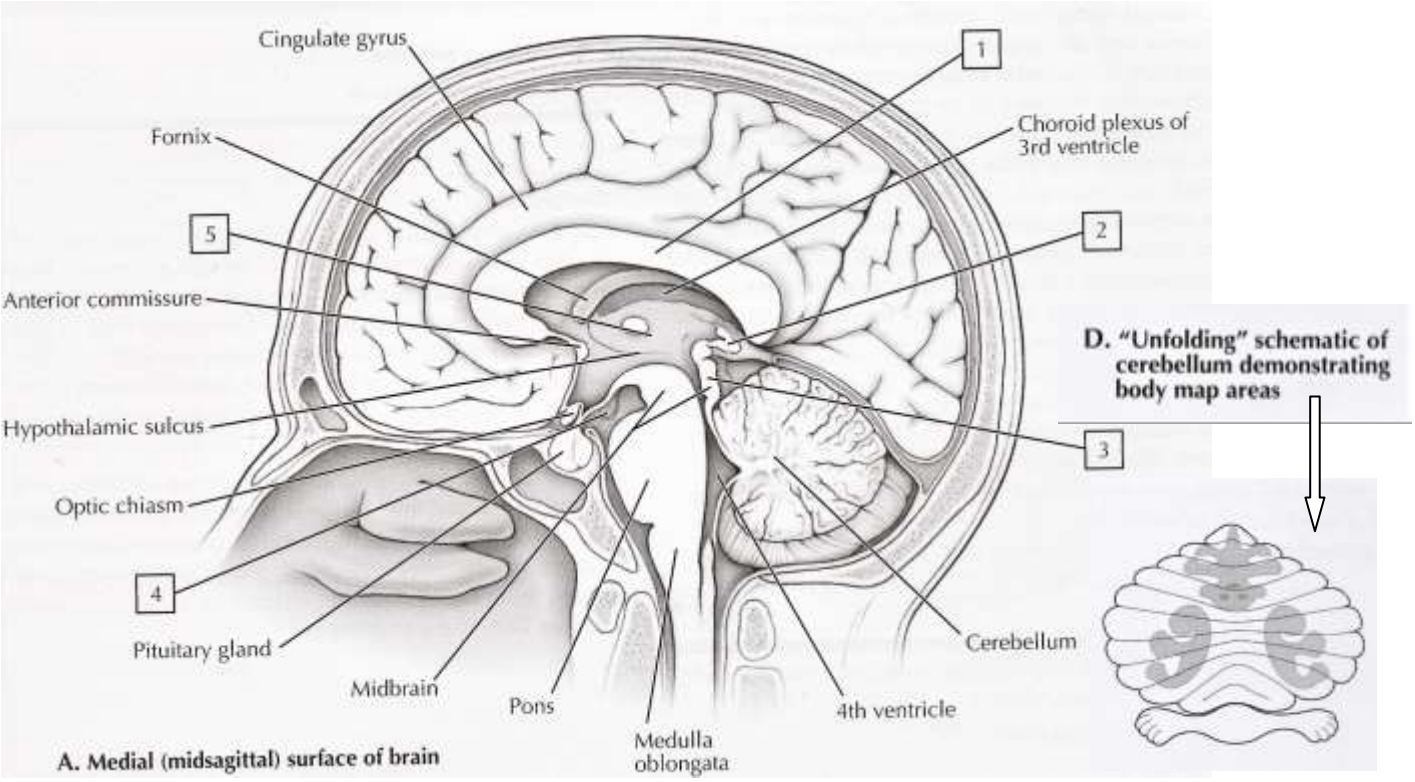
Name:

Task 3: The main parts of human brain – colour with different colors:

- Cerebrum (cerebral cortex)
- Diencephalon (thalamus, hypothalamus, and pineal gland)
- Midbrain (also called the mesencephalon, a part of the brainstem)
- Pons (connects to the cerebellum and medulla and is part of the brainstem)
- Medulla oblongata (connects to the spinal cord and is part of the brainstem)
- Cerebellum



C. Posterolateral view

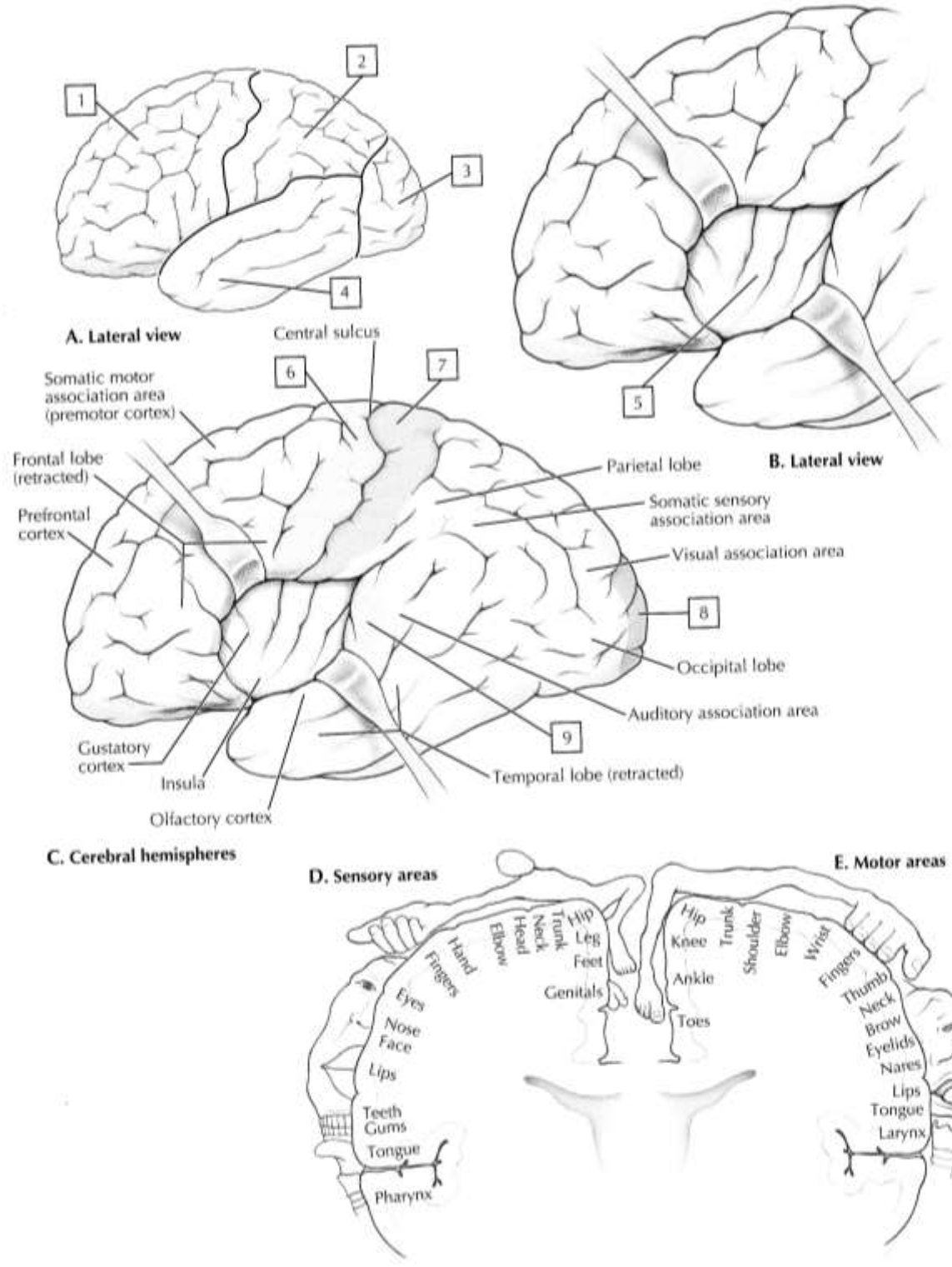


Task 4: The cerebrum is divided into two large hemispheres and is characterized by its convoluted cerebral cortex, which significantly increases the surface area for neurons by folding the tissue into a compact volume. The cerebral cortex is divided into four visible lobes and one lobe that lies deep to the outer cortex. Regions of the cerebral cortex are associated with specific functional attributes. Many of these areas overlap, and some may be more or less developed in individuals with specific talents or with specific deficits, either from congenital anomalies (birth defects) or from pathology, such as a stroke.

Colour the five lobes of the cerebral cortex, using a different color for each lobe and the following functional regions of the cerebral hemisphere, using a different color for each region:

Name:

1. Frontal lobe
2. Parietal lobe
3. Occipital lobe
4. Temporal lobe
5. Insula: a fifth, deep lobe lying medial to the temporal lobe
6. Primary motor cortex
7. Primary somatosensory cortex
8. Primary visual cortex
9. Primary auditory cortex



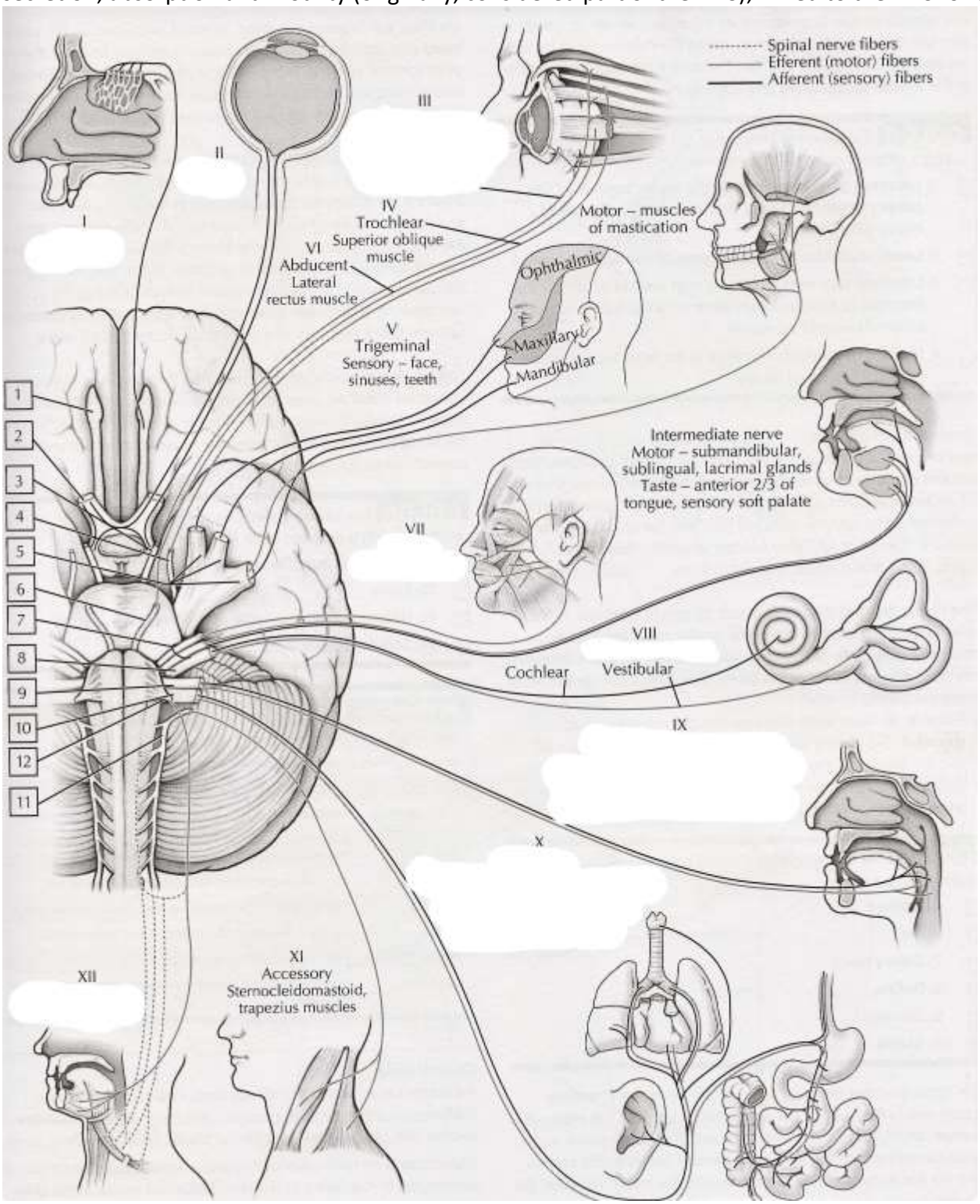
Name:

Task 5: PNS - Cranial nerves – 12 pairs. Components of the PNS include the:

Somatic nervous system: sensory and motor fibers to skin, skeletal muscle, and joints (illustrated in part *B*, somatic components)

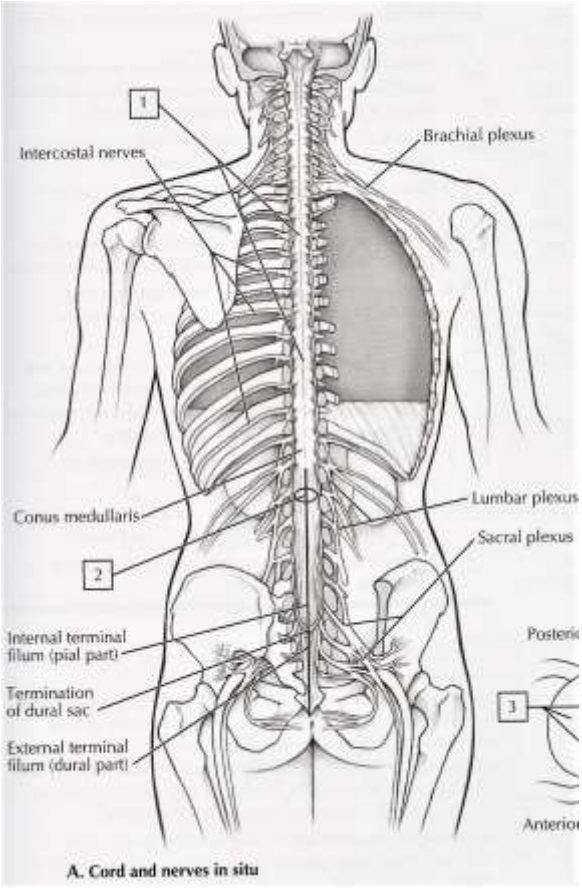
Autonomic nervous system (ANS): sensory and motor fibers to all smooth muscle (including viscera and vasculature), cardiac muscle (heart), and glands (illustrated in part *B*, efferent components)

Enteric nervous system: plexuses and ganglia of the gastrointestinal tract (GI) that regulate bowel secretion, absorption and motility (originally, considered part of the ANS); linked to the ANS for optimal



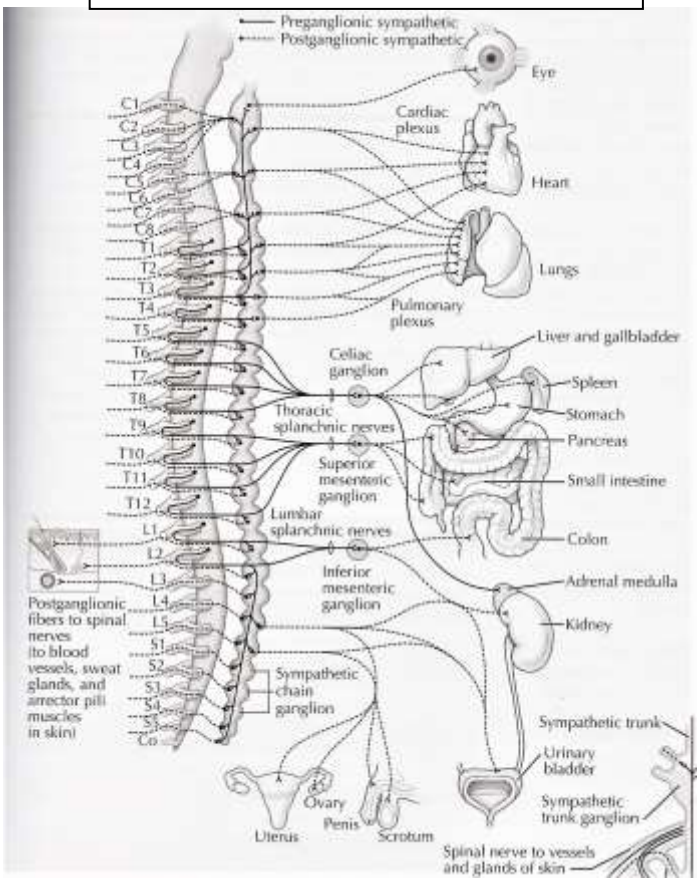
Name:

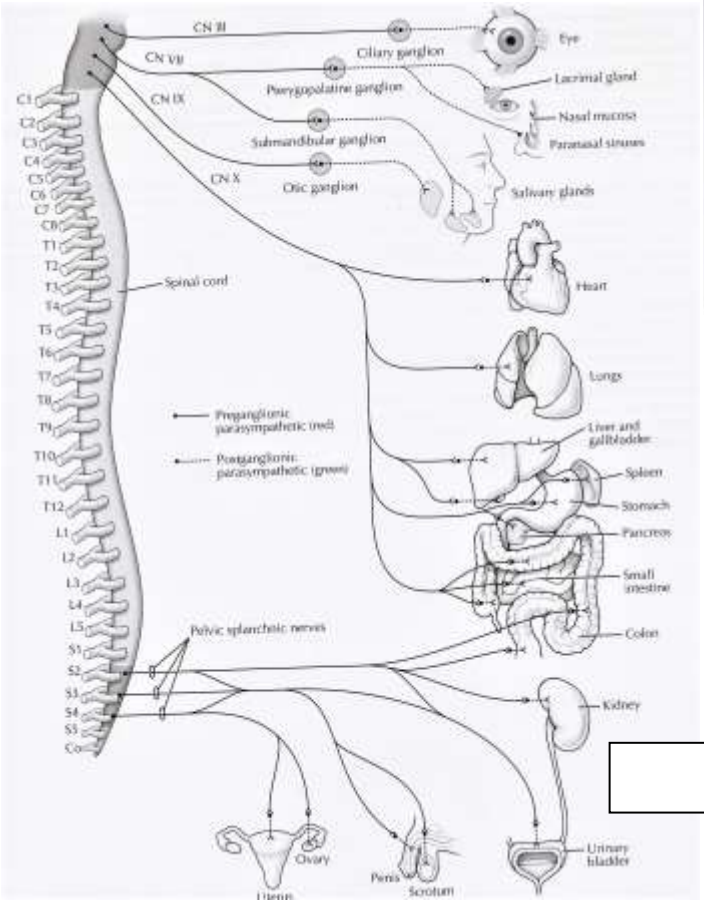
Task 6: PNS - Spinal nerves – 31 pairs. Fill in the texts into the tables.



The ANS is divided into the **sympathetic** and **parasympathetic divisions**. The ANS is a visceral system because many of the body's organs are composed of smooth muscle walls and/or contain secretory glandular tissue.

Sympathetic divison





Parasympathetic divison

Name:

STRUCTURE	Sympathetic division of ANS: variant B
	Dilates the pupil
Lacrimal glands	
	Increases heart rate and force of contraction
Coronary arteries	
	Assists in bronchodilation and reduced secretion
Digestive tract	
	Causes glycogen breakdown, glucose synthesis and release
Salivary glands	
	Causes ejaculation and orgasm, and remission of erection
	Constricts male internal urethral sphincter muscle
Urinary system	

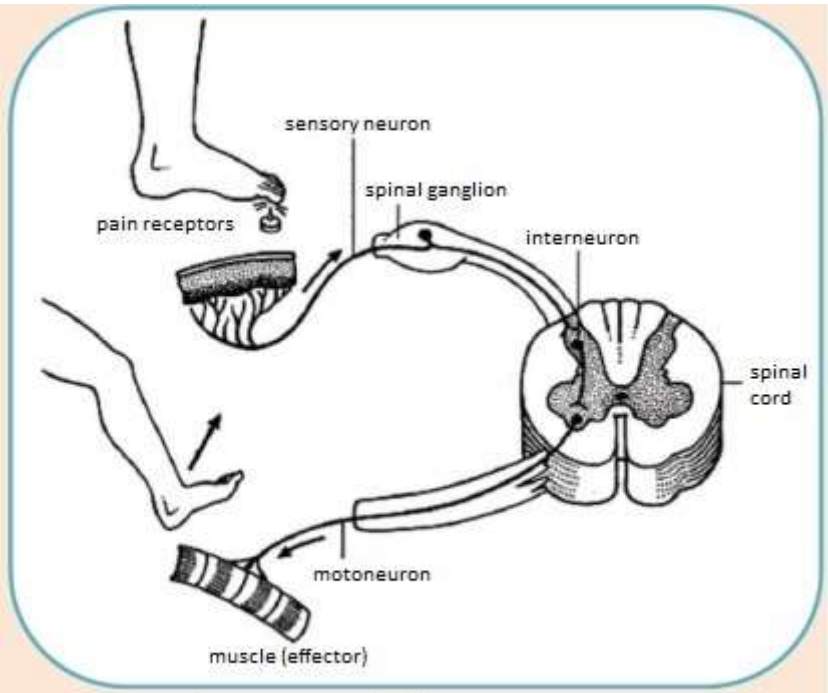
STRUCTURE	Parasympathetic division of ANS
	Constricts pupil
Lacrimal glands	
	Decreases heart rate and force of contraction
Coronary arteries	
	Causes bronchoconstriction and increased secretion
Digestive tract	
	Aids glycogen synthesis and storage
Salivary glands	
	Promotes engorgement of erectile tissues
Urinary system	

Name:

Task 7: Interesting facts about nervous system – Find the partner with the second correct part of your text.

Task 8: Human reflexes

Reflex is an involuntary response of the organism caused by receptor irritation.



Picture 1 - Defensive spinal reflex

The structural basis is a reflex arc:

- Receptor
- Centering path / afferent
- Centrum
- Centrifugal path / efferent
- Executive organ

_____ irritation information is directed via the centripetal path directly or through inserted neurons to _____- deposited in the spinal cord or brain stem. The response to irritation is a change in the activity of motor neurons and corresponding muscle fibres. However, this largely unchanging response is also under the influence of _____because, in addition to transmitting information from the receptors within the _____, the neurons of the motor neurons are simultaneously integrated with information from the higher CNS compartments. The resulting motoneuron activity is then determined by the sum of _____ and inhibitory effects from the involved structures of the nervous system. Therefore, it is the basis not only for reflective but also free motor skills. Individual reflexes have precisely _____defined reflex arcs (path and centre). Their knowledge allows the examiner to characterize the reflex response to a certain stimulus, to _____= to determine the site of the nervous system. For a complete clinical examination, _____need to be examined to make the picture of the nervous system as complete as possible.

Receptor	motoneurons	superior structures	reflex	excitatory
anatomically	*diagnose topically*	a number of reflexes		

Name:

Task 9: Observation of human reflexes:

When examining unconditional reflexes, we observe:

Reflexibility - every reflex may be missing in a certain percentage of cases even in a healthy individual.

Quantitative response changes - weakening (hyporeflexia) or strengthening (hyperreflexia) of the response, or extension of the reflexogenic zone, i.e. increasing the area from which the reflex can be induced.

Qualitative changes of the response - we receive a response of a different kind from the same stimulus (pendular reflex, reflex irradiation, etc.)

It is always necessary to compare the answers of the same reflexes of the right and left sides of the body to see if the quality and quantity of the response are the same on both sides. Unilateral changes, even weak, are more severe than bilateral in some reflexes. In some disorders of the central nervous system, other normally unrecoverable reflexes, called pathological reflexes, appear.

Procedure:

Most of the reflexes are equipped with a quick, flexible hammer stroke, or a pinky hand at the appropriate receptors. The hit must be reasonably strong, painless, fast and accurate.

The limbs or muscle groups involved in the reflex response must be sufficiently relaxed, usually by supporting the examined limb in semiflexion or semipronation, mostly by the examiner's hand.

If we fail to trigger the reflex even with the right procedure, we will try to improve the ability of the so-called **amplification manoeuvres** to increase the tension of antagonists. With **Jendrassik manoeuvre**, the investigator locks his hands together and tries to stretch them hard. Sometimes we have to take the attention of the examined person, for example, by performing a simple numerical action during the examination (counting the number series backwards etc.).

1) <u>Pupillary examination</u>

We assess whether the pupil of the examined person is identical in shape and size and whether they are round. Next, we examine the pupil's response to light, convergence, and divergence.

a) **Photoreaction (pupil response to exposure, pupillary or pupil reflex)**

Equipped with a flashlight, we illuminate one patient's eye. The response is a narrowing of the enlightened pupil, in that case we are talking about a direct photoreaction. Likewise, we observe pupil narrowing, unlit, indirect (consensual) photoreaction. For constriction of the pupil we use the term myosis, for their dilation we use the term mydriasis.

b) **Pupil's response to object movement in the anteroposterior direction (convergence and divergence)**

These are so-called disjunctive movements (vergence), when the eyeballs move symmetrically but in the opposite direction. This is easily simulated by following the finger that is approaching or moving

away from the eyes. We ask the examiner to observe our finger. We either approach it from a distance of about 1m towards its eyes, when the eyeballs converge and, at the same time, we observe the myosis of both pupils. Moving the finger away from the immediate vicinity of the eyes results in the divergence of the eyeballs accompanied by pupillary mydriasis.

Evaluation:

Pupil reaction	Equipment (quality) + answer		Notes
	right eye	left eye	
direct photoreaction			
indirect photoreaction			
konvergence			
divergence			

2) The cranial nerve VII., *n. facialis*

We start the *n. facialis* examination with a test of the facial abilities of the examined person. We tell him/her to:

- to raise eyebrows
- to frown
- to bare teeth
- to close eyes
- to whistle
- to inflate cheeks

We notice symmetry, eventually the inability to execute the instruction.

Next, we investigate the **acoustic-facial reflex** when we observe the blink of an eye in response to clapping

Nasopalpebral reflex: a stroke of a neurological hammer on the root of the nose, the response is blinking

We induce **a blinking reflex** by rapidly moving the hand in front of the eyes

The reflexes induced from the median line are called **axial**, most of which are present only in infancy and are related to the maturation of the brain tissue**. In adulthood they are pathological**. These include **the upper and lower labial reflexes**, when the lips are lightly tapped the children purse the lips, and **sucking reflex** followed by a light touch of the lips.

	Equipment (quality) + answer	Notes
Acustic-facial reflex		
Nasopalpebral reflex		
Blinking reflex		
Labial reflex		
Sucking reflex		

3) Masseter reflex

With the mouth open, we use a hammer to hit the wood spatula attached to the teeth of the lower jaw or to the thumb resting against the chin of the examined person. The reflex response is the grip (closing) of the mouth.

Evaluation:

4) Bicipital reflex

The hit on the thumb placed on the tendon of the m. biceps brachii in the semi-flectated forearm causes flexion of the forearm.

Evaluation:

5)Styloradial reflex

The hit on the palmar area of the radius of processus styloideus with semi-flectated and semipronated forearm causes pronation and flexion of the forearm.

Evaluation:

6)Tricipal reflex

Support with hands the flexed limb above the elbow and hit on the tendon m. triceps brachii over the olecranon of the ulna which causes the extension of the forearm.

Evaluation:

7)Patellar reflex

Examined person folds one leg over the other, or he/she lifts it with a hand in the popliteal (below knee). By hitting the tendon under the patella, we cause the leg extension.

Evaluation:

8) Achilles tendon reflex

The examined person kneels with one leg on his chair, or we hold his/her leg with our hand in flexion and hit the on the Achilles tendon to cause plantar flexion.

Evaluation:

9) Medioplantar reflex

Tap into the centre of the foot sole to induce plantar flexion of the foot.

Evaluation:

10) Plantar reflex

With the tip of the hammer, we press the outer side of the sole of the foot with moderate pressure, plantar flexion and finger adduction occurs. When the pyramidal pathways are damaged, we equip the so-called Babinsky phenomenon in this way, dorsal flexion of the fingers with fan-shaped stretching occurs.

Evaluation:

Task 9: Reaction time - sort the sentences into the correct order:

1. The longest is a response to optical stimuli, shorter to acoustic stimuli and quick respond to tactile stimuli.
2. The reaction time depends on the type of stimulus used, its intensity, the state of the organism and the motivation.
3. ***Reaction time*** is the time that elapses from the start of a stimulus (light, sound, etc.) to the point when the person being examined responds with an agreed response.
4. Before running the executive (motor) response, other cognitive processes take place, such as engaging work memory, selecting the right answer and preparing it, making a decision to answer.

5. As a rule, the upper limb reacts after a shorter latency than the lower limb.
6. The reaction time includes a number of sub processes.
7. The selected motor region then activates the corresponding muscle groups by descending pathways.
8. The stimulus must first be decoded in the corresponding sensory organ from where it is conducted in the form of nerve impulses to the primary and other association cortex regions where it is recognized.
9. It is prolonged when choosing the right stimulus from a series of similar stimuli to which the examined person is not to respond, or if he/she is to respond to different stimuli with different responses.
10. As the signal or response complexity increases, the probability of a greater number of errors increases.

Procedure:

1) Check your reaction time on computer

a) Catching sheep (http://www.bbc.co.uk/science/humanbody/sleep/sheep/reaction_version5.swf)

- who are you ? …….

b) Light: …… Sound:…… Speed: ……..

(http://flashgamesspot.com/cs/play/world-reaction-a-reaction-time-test-game-to-test/flash-game/)

Result: (*compare with others in the group)*

2) Check your reaction time on tablet - on hunting ladybugs

a) on the bug hunting without aliens: ……

b) on the bug hunting with aliens: ……

(http://clovekonline.cz/na-lovu-berusek/)

Compare the results:

3) Catching a falling object

Tools: long ruler

The examined person sits and puts his hand over the edge of the table, he/she grasps (stops the fall) the ruler with the thumb and finger. The zero point of the scale is 5cm from the bottom edge. The examiner verbally warns the examined person that he/she will release the ruler in the next 4 seconds. The task of the examined is to capture the ruler as soon as possible by grasping fingers and thumb. The examined fixes the black mark on the scale, not looking at the examiner's hand. The result is read at the top of the thumb. Repeat 5x to calculate the arithmetic mean.

The examined person sits against the wall and stops the falling ruler by pressing the toe of the foot against the wall. The distance of ruler from the wall is about 2.5 cm. Repeat five times. Calculate the arithmetic mean.

Compare the response speed of your hand and foot and compare your results with others in the group.

4) One second shock

Over a slightly open hand of you classmate, hold a banknote and ask him to catch it when you drop it.

Result:

Your classmate is not able to do it. When his/hers eye sees the banknote fall, he/she gives the brain a signal and it gives his hand a command to catch the banknote. With this, however, is a precious tome lost. You will succeed because the commands to release and catch the banknote are sent simultaneously by your brain.