

MOTOR SYSTEM

Relevant reading: Kandel, Schwartz, & Jessell, *Principles of Neural Science*, chapters 35 - 43 (especially 40 - 42).

1. Within a muscle cell, calcium influx regulates binding between what pair of proteins responsible for muscle contraction?
2. What are the three types of muscle fibres, and how do they differ in terms of force exerted and mode of metabolism used?
3. In the terminology of control theory, how does a closed-loop system differ from an 'open-loop' system?
4. What are spasticity and myoclonus, and how are they related to closed-loop control?
5. Where are Renshaw cells found, and what effect do they have on motor excitation?
6. What is loop delay and how does it figure in the organisation of the vestibulo-ocular reflex?
7. Direct electrical stimulation at location X within the superior colliculus evokes a saccade to $(5^\circ, 5^\circ)$, whereas stimulation of point Y evokes a saccade to $(-5^\circ, 5^\circ)$. What is the result of simultaneous stimulation at X and Y, and what does this result say about how visuomotor space is represented in the superior colliculus?
8. What is efferece copy and how can it be useful when a true closed loop cannot be implemented?
9. Through what structures does efferece copy pass on its way from cerebral cortex to cerebellar cortex, what microanatomical structures contribute to its processing in cerebellar cortex, and how does the result of this cerebellar computation get back to cerebral cortex? In the sagittal image on the last page, label all of

the gross anatomical structures in this loop.

10. A small stroke within motor cortex is liable to produce localised weakness (paresis) rather than a localised absence of voluntary movement (paralysis). How is this phenomenon a product of the way in which movements are represented in cortex?
11. The corpus striatum consists of which two nuclei? Why is it called the striatum?
12. Two radical treatments for Parkinsonism are pallidotomy, the partial destruction of the internal segment of the globus pallidus, and thalamotomy, lesioning of the ventrolateral thalamus. Pallidotomy tends to ameliorate resting tremor, rigidity, and bradykinesia, whilst thalamotomy tends more selectively to reduce tremor. Ironically, both of these therapeutic procedures consist of the destruction of healthy tissue. Explain these facts in terms of the functional anatomy of the extrapyramidal motor system.
13. In general terms, how does the cerebellum augment cerebral processing? (Hint: it isn't just for motor control.)
14. Identify all the structures of the extrapyramidal system visible in the attached (photocopy of a) myelin-stained coronal section.
15. In the attached axial section through the hindbrain, identify the following structures: inferior cerebellar peduncle, inferior olive, medial lemniscus, pyramidal tract.
16. In the attached mid-sagittal section, identify the following structures: precentral gyrus, pons, cerebellum (vermis), thalamus (massa intermedia). In what order to these structures connect to each other?

VISUAL SYSTEM

Relevant reading: Kandel, Schwartz, & Jessell, *Principles of Neural Science*, chapters 28 - 31.

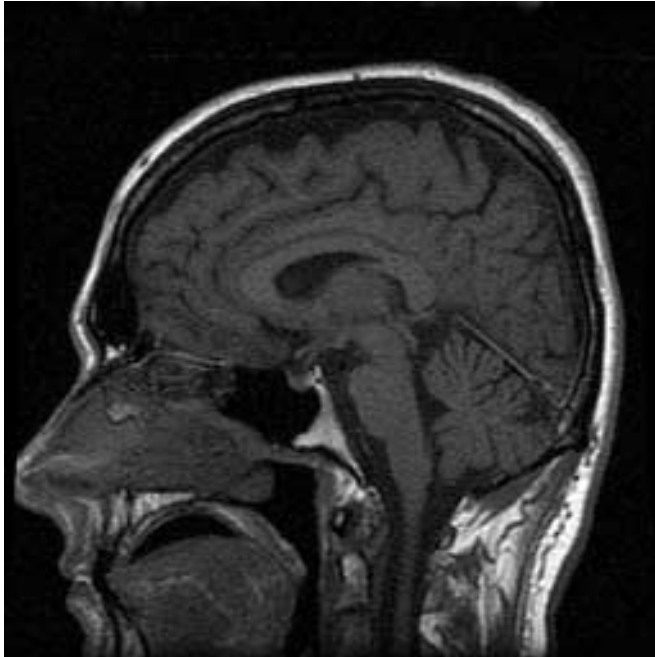
1. What are myopia and presbyopia?
2. What is accommodative strabismus? Explain in terms of the

functional anatomy of the accommodative response why it is that an effort to change the shape of the lens should have any effect on vergence angle.

3. Briefly describe the steps in phototransduction in the vertebrate retina.
4. What is the mechanism of photoreceptor adaptation?
5. Imagine that there is a disease that causes the selective degeneration of horizontal cells in the retina. What symptoms would you expect in such a condition?
6. What visual deficit might be expected following a selective lesion of layers 1 and 2 (the two most ventral layers) of the left lateral geniculate nucleus?
7. What is the line of Gennari, in what region and in what layer of the cerebral cortex is it found?
8. What are the theorised relationships between the outputs of centre-surround cells and the inputs of simple cells, and between the outputs of simple cells and the inputs of complex cells? To what sorts of stimuli does each of these types of cells respond best?
9. The striate cortex is organised into two sorts of columns. What are they, and by what sorts of experiments were they identified?
10. Briefly explain amblyopia in terms of a developmental 'critical period'.
11. After closed head injury, a patient cannot see the left side of space with his left eye, nor the right side of space with his right eye. Where is his lesion?
12. A cancer patient is about to undergo aggressive resection of a tumour that has invaded the left inferior bank of the calcarine sulcus. Where in her visual field can she expect to have a scotoma?
13. A stroke patient can recognise friends from their voices, but cannot recognise them from pictures. Where is his lesion?

14. What is blindsight, and what anatomical features might explain it?

15. In the attached mid-sagittal slice, locate the optic chiasm, the superior colliculus, and the calcarine sulcus.



ESSAY

ESSAY – CHOOSE ONE OF THE FOLLOWING:

Considering both the peripheral nervous system and all levels of the central nervous system, what anatomical projections and physiological processes mediate the perception of pain, and in what ways can these processes be manipulated pharmacologically in order to alleviate pain?

In what structures and by what mechanisms does motor learning take place?