

Chromosomal Abnormalities

Our gender is determined by our twenty-third pair of chromosomes. Men have an X and Y chromosome, and women have two X chromosomes. Usually a man will contribute either an X chromosome to a child (resulting in a girl) or a Y (resulting in a boy). Occasionally, chromosomes will combine (or fail to) in an unusual way, resulting in a chromosomal abnormality. For example, babies with *Turner's syndrome* are born with only a single X chromosome in the spot usually occupied by the twenty-third pair. Turner's syndrome causes some physical characteristics, like shortness, webbed necks, and differences in physical sexual development. Babies born with *Klinefelter's syndrome* have an extra X chromosome, resulting in an XXY pattern. The effects of this syndrome vary widely, but it usually causes minimal sexual development and personality traits like extreme introversion.

Other chromosomal abnormalities may cause mental retardation. The most common type is *Down syndrome*. Babies with Down syndrome are born with an extra chromosome on the twenty-first pair. Some physical characteristics are indicative of Down syndrome: rounded face, shorter fingers and toes, slanted eyes set far apart, and some degree of mental retardation.

Practice Questions

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

- Blindness could result from damage to which cortex and lobe of the brain?
 - Visual cortex in the frontal lobe.
 - Visual cortex in the temporal lobe.
 - Sensory cortex in the parietal lobe.
 - Visual cortex in the occipital lobe.
 - Cerebral cortex in the occipital lobe.
- Paralysis of the left arm might be explained by a problem in the
 - motor cortex in the frontal lobe in the left hemisphere.
 - motor cortex in the frontal lobe in the right hemisphere.
 - sensorimotor cortex in the temporal lobe in the left hemisphere.
 - motor cortex in the parietal lobe in the left hemisphere.
 - motor cortex in the occipital lobe in the right hemisphere.

3. Deafness can result from damage to the inner ear or damage to what area of the brain?
 - (A) Connections between the auditory nerve and the auditory cortex in the frontal lobe.
 - (B) Connections between the auditory nerve and the auditory cortex in the temporal lobe.
 - (C) Connections between the areas of the sensory cortex that receive messages from the ears and the auditory cortex.
 - (D) Connections between the hypothalamus and the auditory cortex in the temporal lobe.
 - (E) Connections between the left and right sensory areas of the cerebellum.

4. According to the theory of evolution, why might we call some parts of the brain the old brain and some parts the new brain?
 - (A) Old brain parts are what exist in very young children, and the new brain develops later.
 - (B) The old brain developed first according to evolution.
 - (C) The old brain becomes more active as we grow older.
 - (D) The new brain deals with new information, while the old brain deals with information gathered when we were children.
 - (E) The old brain is most affected by age deterioration (dementias) while the new brain remains unaffected.

5. Which chemicals pass across the synaptic gap and increase the possibility the next neuron in the chain will fire?
 - (A) synaptic peptides
 - (B) inhibitory neurotransmitters
 - (C) adrenaline-type exciters
 - (D) excitatory neurotransmitters
 - (E) potassium and sodium

6. You eat some bad sushi and feel that you are slowly losing control over your muscles. The bacteria you ingested from the bad sushi most likely interferes with the use of
 - (A) serotonin.
 - (B) insulin.
 - (C) acetylcholine.
 - (D) thorazine.
 - (E) adrenaline.

7. The three major categories researchers use to organize the entire brain are the
- (A) old brain, new brain, and cerebral cortex.
 - (B) lower, middle, and upper brain.
 - (C) hindbrain, midbrain, and forebrain.
 - (D) brain stem, limbic system, and cerebral cortex.
 - (E) neurons, synapses, and cerebral cortex.
8. A spinal reflex differs from a normal sensory and motor reaction in that
- (A) a spinal reflex occurs only in response to extremely stressful stimuli.
 - (B) in a spinal reflex, the spine moves the muscles in response as soon as the sensory information reaches the spine while usually the impulse must reach the brain before a response.
 - (C) in a normal sensory/motor reaction, the spine transmits the information through afferent nerve fibers, while reflex reactions are transmitted along special efferent nerves.
 - (D) spinal reflexes are part of the central nervous system response, while normal sensory/motor reactions are part of the peripheral nervous system.
 - (E) spinal reflexes occur only in animals because humans are born without instinctual responses.
9. Antidepressant drugs like Prozac are often used to treat mood disorders. According to what you know about their function, which neurotransmitter system do these types of drugs try to affect?
- (A) serotonin
 - (B) adrenaline
 - (C) acetylcholine
 - (D) endorphins
 - (E) morphine
10. Which sentence most closely describes neural transmission?
- (A) An electric charge is created in the neuron, the charge travels down the cell, and chemicals are released that cross the synapse to the next cell.
 - (B) A chemical change occurs within the cell, the change causes an electric charge to be produced, and the charge jumps the gap between the nerve cells.
 - (C) The electric charge produced chemically inside a group of neurons causes chemical changes in surrounding cells.
 - (D) Neurotransmitters produced in the hindbrain are transmitted to the forebrain, causing electric changes in the cerebral cortex.
 - (E) Neural transmission is an electrochemical process both inside and outside the cell.

11. Dr. Dahab, a brain researcher, is investigating the connection between certain environmental stimuli and brain processes. Which types of brain scans is he most likely to use?
- (A) MRI and CAT
 - (B) CAT and EKG
 - (C) PET and EEG
 - (D) EKG and CAT
 - (E) lesioning and MRI
12. Split-brain patients are unable to
- (A) coordinate movements between their major and minor muscle groups.
 - (B) speak about information received exclusively in their right hemisphere.
 - (C) speak about information received exclusively in their left hemisphere.
 - (D) solve abstract problems involving integrating logical (left-hemisphere) and spatial (right-hemisphere) information.
 - (E) speak about information received exclusively through their left ear, left eye, or left side of their bodies.
13. When brain researchers refer to *brain plasticity*, they are talking about
- (A) the brain's ability to quickly regrow damaged neurons.
 - (B) the surface texture and appearance caused by the layer known as the cerebral cortex.
 - (C) the brain's versatility caused by the millions of different neural connections.
 - (D) our adaptability to different problems ranging from survival needs to abstract reasoning.
 - (E) new connections forming in the brain to take over for damaged sections.
14. Mr. Spam is a 39-year-old male who has been brought into your neurology clinic by his wife. She has become increasingly alarmed by her husband's behavior over the last four months. You recommend a CAT scan to look for tumors in the brain. Which two parts of the brain would you predict are being affected by the tumors?
- List of symptoms: vastly increased appetite, body temperature fluctuations, decreased sexual desire, jerky movements, poor balance when walking and standing, inability to throw objects, and exaggerated efforts to coordinate movements in a task
- (A) motor cortex and emotion cortex
 - (B) somato-sensory cortex and hypothalamus
 - (C) hypothalamus and cerebellum
 - (D) cerebellum and medulla
 - (E) thalamus and motor cortex

15. In most people, which one of following is a specific function of the left hemisphere that is typically not controlled by the right hemisphere?
- (A) producing speech
 - (B) control of the left hand
 - (C) spatial reasoning
 - (D) hypothesis testing
 - (E) abstract reasoning

ANSWERS TO PRACTICE QUESTIONS

1. **(D)** The visual cortex is located in the occipital lobe. The other locations are incorrect for the visual cortex. The sensory cortex interprets touch stimuli, and the cerebral cortex is the term for the entire wrinkled surface of the brain, so those items are incorrect.
2. **(B)** The motor cortex (which is located in the frontal lobe) in the right hemisphere controls the left side of the body. No such thing as the sensorimotor cortex exists, and the other locations for the motor cortex are incorrect.
3. **(B)** The auditory cortex is located in the temporal lobe and is connected to the inner ear by the auditory nerve. Other locations given for the auditory cortex are incorrect. The sensory cortex, hypothalamus, and cerebellum are not involved in hearing.
4. **(B)** The old or reptilian brain exists in all mammals and is thought to have developed first. As humans evolved into primates, the cerebral cortex developed and grew larger, allowing us to solve more complex problems. All brain structures are present in children from birth. All parts of the brain might deal with new or old information. Dementia is not more likely to affect the old or new brain.
5. **(D)** Excitatory neurotransmitters increase the likelihood that the next neuron will fire. Inhibitory neurotransmitters actually decrease the chance the next neuron will fire when received by the cells' dendrites. Synaptic peptides and adrenaline-type excitors are not relevant to neuroanatomy (or any other anatomy—they are nonsense terms!). Potassium and sodium are integral in the process of depolarization but are not secreted from terminal buttons into the synaptic gap.
6. **(C)** Acetylcholine is the neurotransmitter involved in muscle control. Serotonin is also a neurotransmitter, but it would not be responsible for losing control over your muscles. Insulin is involved in hunger control. Thorazine is an antipsychotic drug prescribed by psychiatrists. Adrenaline is a hormone released by the adrenal glands in response to stressful situations.

7. (C) The hindbrain, midbrain, and forebrain are three of the traditional categories of brain structures. The new brain is synonymous with the cerebral cortex. The brain stem, limbic system, and cerebral cortex are divisions of the brain but not overall categories that include the entire brain. Neurons and synapses are parts of neuroanatomy, not major divisions of the brain.
8. (B) Spinal reflexes, such as the reflex that causes your leg to move when a doctor strikes your leg just below your kneecap, are controlled by the spine, not the brain. Stress is not relevant to the process, nor are afferent and efferent nerves. All spinal reflexes involve the peripheral nervous system. Humans do have some spinal reflexes; they are not limited to animals.
9. (A) Serotonin is the only neurotransmitter on the list that is identified as being involved in mood disorders. Adrenaline is a hormone released by the adrenal glands in response to stressful situations. Acetylcholine is a neurotransmitter that controls muscle movements. Endorphins are painkillers in the brain that might temporarily elevate mood but would not be responsible for long-term mood disorders. Morphine is a drug that interacts with our endorphins to alleviate pain.
10. (A) Neural firing involves an electric charge within the cell and chemical transmission between cells (across the synapse). It is electric within the cell and chemical between the cells. The electric charge does not jump the gap between neurons. The question refers to an individual neuron firing, not a group of neurons. Neurotransmitters are not confined to the hindbrain or the forebrain.
11. (C) The PET and EEG scans both give information about brain function (the PET measures brain activity, and the EEG measures brain waves). The MRI and CAT scans give information about brain structure, not function. An EKG is a medical test for heart function. Lesioning involves destroying brain tissue and would not be used in this type of research.
12. (B) Since the left hemisphere typically controls speech, split-brain patients are usually unable to talk about information exposed to only the right hemisphere. Their muscle coordination is usually normal (possible after a short adjustment period). Their ability to solve abstract problems is not affected. Visual information from the left part of each eye is transmitted to the right hemisphere, not the entire left eye. Both hemispheres receive auditory information from the left ear.
13. (E) Plasticity refers to the brain's ability to rewire itself to recover functions lost through some type of brain damage. This process occurs most quickly in children but can happen to a limited extent in adults. The brain does not quickly regrow neurons, it reconnects existing neurons in new ways. Plasticity has little to do with the texture and appearance of the cerebral cortex. The adaptability referred to in choice D is related to plasticity, but the correct answer E is a much more specific explanation.

14. (C) A tumor on the hypothalamus would explain the first three symptoms since the hypothalamus controls (at least in part) body temperature, libido, and hunger. The cerebellum coordinates some types of movements, including throwing objects and our sense of balance. The motor cortex controls voluntary muscle movements, but the specific movements described in the question are controlled by the cerebellum. The medulla controls our life-support functions, like heart rate and respiration. The thalamus directs signals coming in from the spinal cord to different parts of the brain.

15. (A) As mentioned previously in the analysis of split-brain patients, the left hemisphere typically controls speech. The left hand is controlled by the motor cortex in the right hemisphere. Some evidence indicates that the right hemisphere is more active in spatial reasoning. Both hemispheres are involved in hypothesis testing and abstract reasoning.