

Anatomy and Physiology I Extra Credit Special Project
Dr. McGehee

Worth 25 points (each question is worth 1 point)

Please type your answers, print them out, and hand them in. Complete sentences only.

Use only the textbook, posted lectures, and the lab manual. If you plagiarize from the given material, the points will not be awarded. Extra Credit points will not substitute for taking the comprehensive final exam. Work alone.

Look Out Below: A Case Study on Bone Tissue Structure and Repair

Mrs. Debbie Morgan is a 45-year-old female who works as a stocking clerk for a local home improvement store. While she was at work today a large box of metal rivets fell from a 20-ft.-high overhead shelf, striking her outstretched arm and knocking her to the ground. The ambulance personnel reported that she had lost quite a bit of blood at the accident scene and was “knocked out” when they arrived. To minimize further hemorrhage, the paramedics applied a pressure bandage to her arm.

You meet the paramedics as they bring Mrs. Morgan into the emergency room and begin to assess her for injuries. She is awake and alert, but complaining of severe left arm and back pain, plus she has a “killer headache.” To fully examine her injuries you remove four blood-soaked bandages from her arm. You notice a large open wound on her arm with what appears to be bone tissue sticking out of the skin. She also has bruises covering her left shoulder, left wrist, and lower back. To determine the extent of her injuries Mrs. Morgan undergoes several x-rays, which reveal the following:

- 1) fracture of the left humerus at the proximal diaphysis,
- 2) depressed fracture of the occipital bone,
- 3) fracture of the 3rd lumbar vertebral body.

Short Answer Questions

1. Define the following terms, used in the case and also in associated questions:
 - a. hemorrhage
 - b. fracture
 - c. proximal
 - d. diaphysis
2. One way bones are classified is by their shape. How would you classify the bones fractured by Mrs. Morgan?
3. The body of Mrs. Morgan’s vertebra is fractured. What type of bone tissue makes up the majority of the vertebral body? Describe the structure and function of this type of bone.

4. The diaphysis of Mrs. Morgan's humerus is fractured. What type of bone makes up the majority of the diaphysis of long bones like the humerus? Describe the layers of bone tissue found here.
5. Most connective tissue, including bone, is highly vascular. Which anatomical structures in Mrs. Morgan's compact bone house blood vessels? What sign or symptom in Mrs. Morgan's case is directly related to disruption of these structures by her bone fractures? How is the sign or symptom related to these anatomical structures?
6. Within days after a fracture, a "soft callus" of fibrocartilage forms. What fibers are found in this type of cartilage? Identify the cells required for fibrocartilaginous callus formation and list their functions.
7. As a fracture is repaired, new bone is added to the injury site. What term is used to describe the addition of new bone tissue? Identify which bone cell is responsible for this process and explain how it occurs.
8. In the final stage of bone repair, some of the osseous tissue must be broken down and removed. What term is used to define the breaking down of osseous tissue? Which bone cell would be best suited for this task?
9. The extracellular matrix (ECM) of bone is considered to be a composite material made up of organic and inorganic matter. What makes up the organic and inorganic portions of the matrix? Describe the cellular mechanism involved in breaking down this matrix; include the bone cell required for the process.

The Mysterious Episodes of Mary: A Case Study on Neuroanatomy

Episode 1

Mary Lazarro, a 44-year-old mother of two, made an appointment with her physician after experiencing a prolonged episode of numbness in her chin and lower lip. Two days prior to her appointment, she felt a prickling sensation like "pins and needles" at the right corner of her mouth. The sensation extended to her lower lip and chin. The examination revealed only a superficial hypoesthesia of the chin and lower lip (numb chin syndrome). There was no clinical evidence of palpable regional lymph nodes or other systemic or neurologic abnormalities. Her physician scheduled her for a CT scan of the affected region. These tests showed no abnormalities in the jaw, neck, or pharynx. The numbness and hypoesthesia spontaneously disappeared gradually over a few weeks.

Episode 2

Four months later, while eating dinner with her family, Mary felt a stabbing pain in her upper jaw and teeth that radiated out to the side of her nose. Over the next several days, she experienced several more episodes of this intense pain. A visit to the dentist revealed no abnormalities and she was referred to her physician for an evaluation. Prior to her

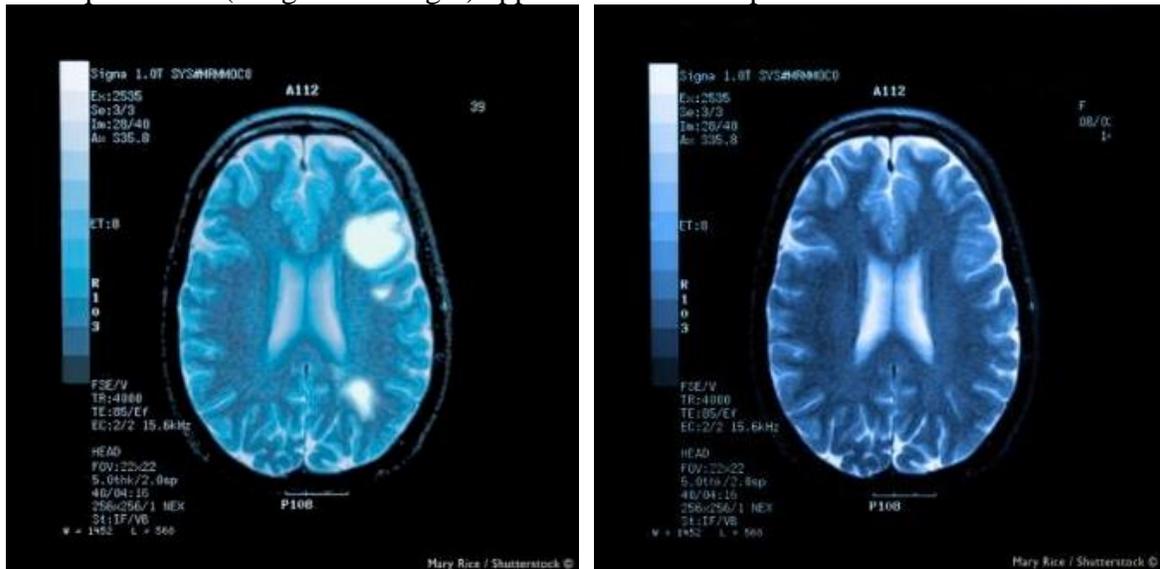
appointment, she noticed that the symptoms were subsiding as they had previously. Her physician scheduled an appointment for a complete neurological exam the following week.

Episode 3

Three nights prior to her scheduled visit to the neurologist, Mary stopped at an intersection and experienced intense double vision when looking to the right to check for traffic. The double vision was less intense when looking forward, and her vision when looking left was unaffected. Her husband noticed that her right eye appeared to be turned slightly inward when she looked straight ahead. A day later, Mary noticed that the vision in her left eye started to blur. The neurologist later suggested that the two visual problems she was experiencing were related. The double vision when looking right was found to be caused by cranial nerve palsy—a form of muscle paralysis caused by a dysfunction in one of the cranial nerves. The problem with the left eye was diagnosed as optic neuritis (inflammation). Both of these signs and symptoms, along with the previous episodes, pointed to a diagnosis of multiple sclerosis (MS). The neurologist prescribed oral steroids and ordered an MRI. As with her previous episodes, Mary's visual symptoms began to diminish over time.

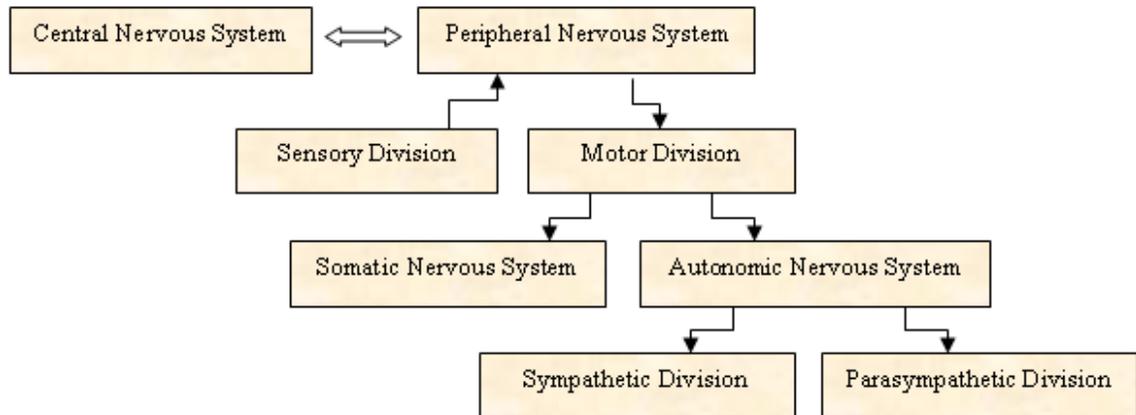
Finale

The results of the MRI, shown below, were consistent with a diagnosis of relapsing-remitting multiple sclerosis (RRMS). Relapsing-remitting multiple sclerosis is a form of MS in which symptoms randomly flare up (Mary's episodes) and then resolve on their own. The lesions seen on the MRI on the left were associated with another episode in which Mary experienced sensory and motor disjunction in her left lower extremity. A subsequent MRI (image on the right) appeared to show improvement after three months.



Short answer questions

1. *Related to Episode 1:* What is hypoesthesia? How does it differ from paresthesia?
2. *Related to Episode 1:* Using the flowchart below, identify the part of the human nervous system that is usually associated with symptoms of hypoesthesia and paresthesia.



3. *Related to Episode 1:* Which of Mary's cranial nerves is affected in this episode?
4. *Related to Episode 2:* Which of Mary's cranial nerves is affected in this episode?
5. *Related to Episode 3:* Name all of the cranial nerves that are involved with eye movements.
6. *Related to Episode 3:* Which of Mary's affected cranial nerves is responsible for her double vision when looking right? Why does she not experience double vision when looking left?
7. *Related to Episode 3:* Which of Mary's affected cranial nerves is responsible for her blurred vision?
8. *Related to Finale:* In the MRI images shown in the case, you can see the lesions as bright "white spots" on the brain. Using what you know about the structure of a neuron, explain what is causing this spot to appear in the MRI.
9. *Related to Finale:* Three months later, you can see that the spots in the MRI appear to be smaller. Using what you know about the structure of a neuron, explain what is happening to the neurons in the area where the lesions are disappearing.

Extra Credit Essays

1. During exercise, blood flow to skeletal muscles increases. The initial response that increases blood flow is automatic and independent of the nervous and endocrine systems. Which type of homeostatic regulation is this? Why?
2. Blood has a very narrow normal pH range but urine has a very broad normal pH range. What does that indicate about the physiology of pH?
3. How does the DNA molecule control the appearance and function of a cell?
4. Which is likely to heal faster, a bone injury or a cartilage injury? Why?
5. A new mother notices that her 8-month-old infant has a yellow-orange complexion. Fearful that the child may have jaundice, she takes him to her pediatrician. After examining the child and learning about the infant's diet, the pediatrician declares him perfectly healthy and advises the mother to watch the child's diet. What is likely the cause for the change in skin color?
6. What is osteopenia? Name and define two forms of osteopenia.
7. Billy is injured during a high school football game. His chest is badly bruised and he is experiencing difficulty in breathing. What might the problem be?