

Questions: Chapter 2

Question 1. What is the timeframe at which the three phases of cutaneous wound healing occur relative to the time of the injury?

Answer 1. (1) Inflammation occurs early in the process (within hours of the injury).
(2) Tissue formation occurs early (within days) and is characterized by cell proliferation, adhesion, and migration.
(3) Tissue remodeling occurs later (weeks to years) as a result of cell differentiation, matrix degradation, and new matrix secretion.

Question 2. Name three important characteristics of extracellular matrix molecules.

Answer 2. Extracellular matrix molecules: (1) have large molecular weights with low diffusivities, (2) contain peptide motifs that enable cell attachment or bind other ECM molecules, (3) possess the ability to influence cell fate processes, (4) provide a conduit for cell migration, and (5) bind and retain bioactive molecules in the wound site

Question 3. Describe two categories of cells that can be used in tissue-engineered constructs to promote cutaneous wound regeneration.

Answer 3. (1) Epithelial cells (i.e. keratinocytes) grow in contiguous sheets and are tightly connected
(2) Mesenchymal cells (i.e. dermal fibroblasts) have the ability to migrate, turnover the existing ECM, and secrete new ECM
(3) Stem cells
(a) Bone marrow-derived mesenchymal stem cells can home to sites of injury and differentiate into cell types necessary in skin regeneration
(b) Adipose-derived stem cells have demonstrated the ability to remodel scars

Question 4. Name three properties of biomaterials that can be modified to influence wound healing?

Answer 4. (1) Degradation rate, (2) pore size, (3) mechanical strength, (4) immunogenicity, (5) surface finish, (6) degradation products, (7) cell adhesivity

Question 5. Define the three major mediators of “dynamic reciprocity.”

Answer 5. Cells, bioactive molecules, and extracellular matrix molecules.

Question 6. What role do bioactive molecules play in cutaneous wound healing?

Answer 6. Bioactive molecules are produced by a signaling cell and are secreted to reach a target cell. For example, many cytokines and growth factors cause proliferation and differentiation, whereas chemokines induce cell migration.

Question 7. What are the three ways that cells communicate?

Answer 7. (1) The secretion of bioactive molecules.
(2) Cell-matrix interactions
(3) Direct cell-cell interactions

Question 8. Identify three requirements for a successful tissue-engineered construct.

Answer 8. (1) Adherence and integration into the injured site, (2) biocompatibility, (3) ability to restore function and mechanical stability, (4) cost and availability, and (5) tolerance by the immune system.

Question 9. Name three processes that can be used to alter surface topography of the tissue-engineered construct.

Answer 9. (1) Phase separation with particle leaching, (2) electrospinning, (3) molding, (4) printing

Question 10. Identify long-term considerations necessary for the commercialization of a tissue-engineered construct.

Answer 10. A tissue-engineered construct must be characterized by its cellular and non-cellular components. The Food and Drug Administration (FDA) requires clinical trials before approval. A cellular component of the tissue-engineered construct complicates the FDA-approval process. Ethical issues must be considered, such as cell source. In addition, a packaging and preservation process must be developed, quality controlled, and validated.

Questions: Chapter 3

Question 1. Aside from water, which two acellular sub-nano components are fundamental to the structure of all bone?

Answer 1. Type I collagen and hydroxyapatite are fundamental to the structure of all bone. Hydroxyapatite is present between each collagen triple helix. The packing of type I collagen results in contiguous gaps in two dimensions and channels in three dimensions. Within these gaps and channels, hydroxyapatite crystals are also present.

Question 2. What is the central functional unit of bone? What is its composition and function?

Answer 2. The central functional unit of bone is the Haversian system or osteon. It is composed of lamellae organized in concentric sheets around the Haversian canal. Within the Haversian canal reside blood vessels, lymphatic vessels, and nerves. These ultimately allow communication and exchange of nutrients for osteocytes housed in neighboring canaliculi.

Question 3. What is the primary difference between woven and lamellar bone? What are the two types of lamellar bone and how do they differ?

Answer 3. Woven bone is the osseous tissue present in early bone healing and is a part of the embryonic skeleton. It is less organized and arranged haphazardly, compared to lamellar bone. The two types of lamellar bone include both cortical and trabecular bone. Cortical bone typically composes the cortex of a bone and is more compact and stronger than trabecular bone, causing it to be effective in protection and support. Conversely, trabecular bone is less dense, has a higher surface area-to-volume ratio, in comparison to cortical bone, and is therefore ideal for metabolic activity.

Question 4. What are the two types of ossification that take place in direct and indirect fracture healing? Briefly explain the differences between them.