BIOL 4400
Course Title: ORAL HISTOLOGY AND EMBRYOLOGY

Course Description:

Study of the embryologic and histologic development of the face and oral structures and the histologic response of oral tissues specifically related to health and disease. Utilization of laboratory, and microscopic. Prerequisite: acceptance into the Dental Program and/or Dental Hygiene Program. Anatomy & Physiology

Goals:
1. To acquire an understanding of how cells, tissues, and organs develop and function in order to gain a clear perspective of these structures as a basis for understanding oral biology (in partial fulfillment of Department of Dental Hygiene Competencies 5.3, 5.6, 7.1, 8.1 and also in preparation for the national board dental examination).

2. To develop a comprehension of the principles of embryogenesis and human development with emphasis on the face and structures of the oral cavity (in partial fulfillment of Department of Dental Hygiene Competency 5.3 and also in preparation for the national board dental examination).

3. Describe, compare, and illustrate the histologic characteristics of oral tissues in health and diseased states (in partial fulfillment of Department of Dental Hygiene Competencies 5.3, 5.6, 7.1, 8.1 and also in preparation for the national board dental examination).

Assignments:
1. Exam #1 25%
2. Exam #2 25%
3. Exam #3 25%
4. Final Examination 25%

NOTE: Written examinations consist of multiple choice, short answer, essay items, and/or practical applications to test achievement of appropriate objectives as listed in the course outline.

Course Objectives:

Following assigned readings, lectures, slide/PowerPoint presentations, and class activities, the student should be able to:

DEVELOPMENTAL BIOLOGY: EMBRYOLOGY OF THE HUMAN FACE AND ORAL CAVITY

1. Explain oogenesis, ovulation and fertilization and describe the timing relationships among these processes.
2. Differentiate among the terms zygote, embryonic mass, embryo and fetus.
3. Describe the development of the zygote through the late blastula stage; describe the trophoblast and the process of implantation; state a function of the syncytiotrophoblast.
4. Summarize in chronological order the events of embryogenesis during the first 14 days of development; define the term totipotent.
5. Describe the primitive streak; state what is the significance to its appearance and form to the development of the embryo, describe the migration of cells through the primitive streak to create the mesoderm.
6. List the major tissue derivatives of the ectoderm, mesoderm, and endoderm.
7. Describe or illustrate the process of neural tube formation; list the major tissue derivatives of neural crest cells, and of the neural tube.
8. Summarize in chronological order the events of embryogenesis from day 14 to day 26; list the major structures/organs that are present in the embryo by this time.
9. Explain what is the “budding period” of development and state when this begins.
10. Using illustrations as needed, describe the formation of the pharyngeal arches and pouches and list the major muscles, nerves and bones that develop from each arch (I – IV).
11. Summarize the events of palatine development; state the consequences of failure in timing of these events on the final outcome.
12. Summarize in chronological order the major events of embryonic development from day 26 through day 60.

FOUNDATIONS OF CELL BIOLOGY AND GENERAL HISTOLOGY

1. Illustrate a generalized animal cell and list the junction(s) associated with the major cell organelles, i.e., nucleus, nucleolus, polysomes, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus, mitochondrion, lysosome, microbody, centriole, microtubules, and filaments.
2. Relate the principle functions of the cell membrane and intracellular organelles.
3. State the properties of the cells that “establish” them as the basic units of living systems.
4. Define the terms: cytodifferentiation, histodifferentiation, morphogenesis.
5. Explain how an individual’s cells – each of which contains essentially the same genetic information – differentiate into the myriad of cell types that compose that individual.

EPITHELIAL TISSUES AND THEIR CONNECTIVE TISSUE SUPPORTS

1. Name the four primary tissues; give specific examples of each.
2. State the three criteria that are used to classify epithelial tissue; list four types of epithelia and give examples of each.
3. Distinguish between exocrine glands and endocrine glands; list three types of glands as classified by their mode of secretion (e.g., merocrine secretion, etc.).
4. Describe the major anatomic features of a “generalized” (hypothetical) connective tissue (what do they all have in common?); illustrate the same.
5. List eight types of connective tissues; state a junction of each; describe/illustrate each type.
6. List and describe the three types of muscle tissue.
7. List and describe (illustrate) the general composition and appearance of nervous tissue; illustrate a neuron.
8. List and state the junction(s) of the glial cells found in the central nervous system and the peripheral nervous system; define what is meant by the term “myelinization” of nerve cell processes (axons).
9. Describe (illustrate) the microscopic anatomy of a peripheral nerve.
10. Distinguish between central nervous system and peripheral nervous system; distinguish between anatomic nervous system and somatic (voluntary) nervous system; between sensory and motor nervous systems.
11. Describe the histologic organization of peripheral (circulating) blood; why is it classified among the connective tissues?

MESENCHYMAL-EPITHELIAL RELATIONSHIPS, TOOTH DEVELOPMENT, TOOTH ERUPTION

1. With regard to both chronologic order and morphologic precision, list the six basic stages of tooth development and describe and/or illustrate these processes and anatomical transitions.
2. Describe the general relationships which exist between the oral epithelium and ectomesenchyme during development.
3. Describe and/or illustrate the microscopic anatomy of a “generalized” tooth, including the features which are listed below. Alternatively, you should be able to identify these features when presented with a figure or photomicrograph which demonstrates these features.

**General:** crown, root, “clinical” crown, cervical margin, pulp chamber, pulp horns, root canal, cementum layer, dentin layer, enamel layer, dento (or dentino-) enamel junction, cementoenamel junction.

**Dentin Layer:** mantle dentin, 1 and 2 dentin, predentin, odontoblast layer, dentinal tubules, peritubular dentin, intertubular dentin, globular and interglobular dentin, incremental growth lines (of von Ebner), contour lines of Owen, neonatal line (also seen in enamel), granular layer of Tomes.

**Pulp chamber:** cell-free zone (of Weil), cell-rich zone, blood vessel(s) and nerves in the “pulp core”, nerve plexus of Raschkow.

**Enamel layer:** enamel rods or prisms, prism sheaths, striae of Retzius, Hunter-Shreger bands, gnarled enamel, enamel tufts, enamel lamellae, enamel spindles, perikymata on the enamel surface, (salivary) acquired pellicle.

AMELOGENESIS AND ENAMEL STRUCTURE

1. Describe/illustrate the inductive interactions which promote the formation of dentin and enamel.
2. List the four cell types of the enamel organ; state the functions of each.
3. State the eventual “fate” of the enamel organ following amelogenesis.
4. Explain, define, describe, etc. the following terms, processes or structures (within the context of this course): reciprocal induction, cyto-, histo-, and morphodifferentiation, amelogenesis, dentinogenesis, succedaneous lamina, vestibular and labial laminae.
5. List the physical and chemical properties of enamel.
6. State the topographic, structural, and clinical difference between prismless and prism type enamel.
7. Describe the histologic structure, pathway, and organization of enamel rods within enamel.
8. Describe the growth lines of enamel.
9. Describe the enamel lamella, enamel tuft, and enamel spindle.
10. Describe the optics-related phenomena which form the foundation for the appearance of gnarled enamel and Hunter-Schreger bands.
11. Describe the enamel structures termed perikymata.

**ODONTOGENESIS**

**STRUCTURE OF THE DENTIN-PULP COMPLEX**

1. List the basic histologic characteristics of bone.
2. List the principal functions of bone.
3. Describe the histologic characteristics of compact lamellar bone, spongy lamellar bone, and woven bone.
4. Describe the lamellar patterns of compact lamellar bone.
5. Describe the basic parts of the dental pulp.
7. Describe the connective tissue components and cells of the four layers/zones of a deciduous or young pulp.
8. Describe the distribution of neurovascular bundles and the parietal plexus.
9. Describe the changes that occur in an aging dental pulp.
10. State the difference in distribution and histology between a true denticle and a false denticle.
11. Describe and/or illustrate the process of dentin formation (dentinogenesis) including formation and biochemical characteristics of the matrix, mineralization patterns which account for the histologic appearance of dentin, movements and morphology of odontoblasts.
12. Explain the formation of dentin and state its significance.
13. State the histologic features of pulp stones (denticles).
14. List the cells usually found in the pulp chamber; histologically classify this tissue.
15. Explain the (three) mechanisms which are thought to account for dentin sensitivity to pain.
16. State the origin and describe the formation of the dental follicle.

**DEVELOPMENT OF TOOTH ROOTS**

**STRUCTURE AND FUNCTION OF THE PERIODONTIUM**
1. Describe the origin, functional significance, and fate of the Hertwig’s epithelial root sheath.
2. Relate the epithelial diaphragm to Hertwig’s epithelial root sheath.
3. Describe the general sequential and reciprocal epithelial-mesenchymal interactions during root formation.
4. Describe the current postulated events associated with the formation of cementoblasts and the deposition of cementum on radicular dentin.
5. Describe the formation of multirooted teeth.
6. Describe the origin and clinical significance of accessory canals, enamel pearls, and enamel projections.
7. Describe/illustrate the differentiation and growth of cells of the follicle to become: cementoblasts, osteoblasts, and periodontal ligament.
8. Describe/illustrate the formation and histologic appearance of: cementum, bone lining the alveolus (crypt), and periodontal ligament.
9. State three general functions of the periodontium.
10. Name and describe/illustrate (in proper anatomic placement) the major or principle collagen fiber bundles that comprise the periodontal ligament, the gingival ligament and the transeptal ligament.
11. Describe/illustrate the circulation and innervation of the periodontium.
12. Describe and/or illustrate (or identify the structures from an illustration) the histoarchitecture of the dento- gingival tissue complex. Include the sulcus and sulcular epithelium, gingival fiber groups, attachment (junction) epithelium, and the epithelial attachments including ultrastructural aspects.
13. Describe the process of tooth eruption and the accompanying processes that lead to the formation of the dento- gingival tissue complex.
14. List the various processes and resultant structures to which the enamel organ contributes e.g., induction of odontoblastic activities, formation of enamel, secretion of the primary enamel cuticle, contributions to the formation of the dento-gingival tissue complex, etc.
15. Describe (illustrate and/or identify from an illustration) the histoarchitecture of the oral mucosa. Explain the variations in structure that are seen in different regions of the oral cavity. (e.g., the gingival mucosa vs. the buccal mucosa). Describe the general histoarchitecture of the tongue.
16. Describe the process of keratinization. Explain the terms ortho- and parakeratinization. State where the oral epithelium is keratinized or non-keratinized.

**FORMATION AND HISTOLOGY OF THE TMJ**

1. Describe the development of the TMJ.
2. Describe the histology of the adult TMJ with special reference to the capsule, disc and articulating surfaces of the involved bones.
3. From the perspective of development of the mandible and TMJ, what are some causes of subluxation or dislocation? In what direction does the glenoid fossa postnatally enlarge?
4. Explain the origin and functions of synovial fluid? Describe the histology of a synovial membrane (synovial villus).
5. What is the blood supply to the TMJ? The nerve supply?
6. Compare the development of a long bone with that of the mandible.
7. Name and locate the three ligaments that support the TMJ.

**STRUCTURE, FUNCTION AND REGIONAL VARIATION OF THE ORAL MUCOSA**

1. Describe the histologic structure of the mucosa and lamina propria layers of the oral mucosa.
2. Describe the histologic and clinical differences between a lining mucosa, a masticatory mucosa, and a specialized mucosa.
3. Describe the histologic characteristics of the vermilion border of the lips.
4. Describe the anatomic structures and “zones” of the mucosa of the hard palate.
5. Describe the histologic structure and clinical appearance of the free gingiva, attached gingiva, and alveolar mucosa.
6. Define the structures; col, free gingival groove, and mucogingival line.
7. Describe the four types of papillae found on the dorsal surface of the body of the tongue.
8. Relate the relationship between the glands of von Ebner and the circumvallate papillae.
9. Locate the sulcus terminalis and foramen cecum and relate them to embryonic development.
10. Describe the histology of the root of the tongue.
11. Name the three tonsil organs.
12. Describe and illustrate the histologic characteristics of masticatory (mucoperiosteum) and lining mucosae of the vestibule and/or oral cavity including both the epithelium and subepithelial connective tissues.
13. With reference to the histology of their associated mucosae (and underlying submucosae, if present) explain why substances that are injected through a hypodermic needle will diffuse more readily when applied to lining areas than when applied to masticatory areas of the vestibule or oral cavity.

**STRUCTURE AND FUNCTION OF SALIVARY GLANDS**

**IMMUNOBIOLOGY OF LYMPHOID NODULES & NODES**

1. State the anatomic distribution (location) of the minor and the three pairs of major salivary glands.
2. Differentiate (i.e., list or state the differential characteristics) among the major anatomic classes of exocrine glands including simple, compound, branched, tubular, tubuloalveolar, and acinar types.
3. Describe the general microanatomic organization and histoarchitecture of a composite compound salivary gland and relevant ultrastructural details, including serous secretory endpieces (acini), mucous secretory endpieces (tubuloalveoli), serous demilunes, myoepithelial cells, intracellular canaliculi, intercalated ducts, striated ducts, intralobular ducts, interlobular ducts, excretory ducts.
4. Provide requisite details of the connective tissue investments and associated blood supply and innervation (i.e., describe the stroma) of a composite compound salivary gland.
5. List the components of mixed saliva.
6. State the ways by which salivary secretions are regulated.
1. Describe the innervation of the major salivary glands.
2. State the effects of sympathetic vs. parasympathetic activation on the composition of saliva.
9. Describe the histologic structure of lymphatic vessels and capillaries.
10. Describe the histologic structure of a lymph node including cortex and medulla, stroma, sinuses, and parenchyma.
11. State the significance of a lymphoid nodule and germinal center.
12. Describe the thymus-dependent zone.
13. Detail the functional significance of the high endothelial venules.
15. Describe the histologic structure of the epidermis and dermis layers of the skin, and the hypodermis.
16. State the difference between thick skin and thin skin.
17. Describe the surface terrain of the skin.
18. Define the structures epidermal rete ridge and dermal papilla.
19. Describe the histologic structure of the five named layers of keratinocytes found in the epidermis of thick skin.
20. State the function of keratohyaline granules and membrane-coating granules.
21. Describe the structure and function of the melanocyte, Langerhans cell, and Merkel cell.
22. Describe the papillary and reticular layers of the dermis.
23. Relate the significance of Langer lines.
24. Describe the histologic structure of eccrine sweat glands, apocrine glands, and sebaceous glands and state their functions.