

Syllabus of Histology and embryology (Experiment)

Shandong University School of Medicine

Writers: All Teachers in the department of histology and Embryology

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1. Basic information of the course

Course Name	Experiment of Histology and Embryology				
Course Code	sd02323170 sd02323181				
Teaching Department	Department of histology and Embryology				
Experiment Type	<input checked="" type="checkbox"/> Professional basic experiment <input type="checkbox"/> Professional experiment <input type="checkbox"/> Comprehensive experiment <input type="checkbox"/> Innovative experiment <input type="checkbox"/> Open experiment				
Course Type	<input checked="" type="checkbox"/> Compulsory <input type="checkbox"/> Elective				
Experimental Type	<input checked="" type="checkbox"/> Independent course <input type="checkbox"/> Non-independent course				
For Which Major	Foreign students				
Credits		Lecture Hours	32	Experiment Hours	32
Prerequisite course	Human Anatomy				
Website of the course	http://course.sdu.edu.cn/G2S/Template/View.aspx?action=view&courseType=1&courseId=157&ZZWLOOKINGFOR=G				

二、 Description of the course

Histology and Embryology are the medical basic courses, composed of two

interrelated and independent courses, Histology and Embryology. Histology is the study of microstructure of the normal human body and its related functions, including the microstructure of four basic tissues and all kinds of organs under the light microscope and electron microscopy and the relationship between the structures and functions. Embryology is the study of the development of human body and its mechanisms. It mainly introduces the development of human embryos and fetuses, as well as the congenital malformations.

三、 Learning objectives

【 Learning objectives 】

The items of basic skill training of these subjects are ①to require the students to make their studying ability progressively, to try how to take the notes briefly during listening to the lecture ,to use the teaching outline, textbook and laboratory guide efficiently;②to use and to take care of the original light microscope skillfully, to be familiar with the uses of every parts of microscope;③to draw or describe the morphologic structure feature of cells, tissues and organs observed under the microscope correctly using picture, language and writing .

【 Teaching requirements 】

Histology is a science which study the microstructure under the light microscope (L.M)and the ultra-structure under the electron microscope of the human body, and relationship between the microstructure and function. Embryology is a science which studies the development of the human body. The teaching purposes of these subjects are to induce the students who acquire the basic theories and knowledge of these two courses and gain relative basic skill training. By studying, the students should achieve such level: to distinguish the L.M structure of varieties of cells, tissues and main organs, to distinguish the ultra-structure of the main cells and tissues of the body, to know the relationship between the structure and function, to gain a systemic knowledge about the early development of the human embryo and the development of the main organs, to establish a good basis for learning other basic and clinical medical courses.

四、The sequence and the distribution of teaching hour

	Lecture	practice
Introduction	1	
Histology		
Basic tissue		
Chapter 1		
Epithelial Tissue	3	3
Chapter 2		
Connective tissue proper	2	2
Chapter 3		
Cartilage and bone	2	2
Chapter 4		
Blood	3	2
Chapter 5		
Muscle Tissue	2	2
Chapter 6		
Nerve Tissue	3	3
Chapter 7		
Circulatory System	2	3
Chapter 8		
Skin	2	2
Chapter 9		
Immune System	3	3
Chapter 10		
Endocrine System	3	3
Chapter 11		
Digestive tracts	3	2
Chapter 12		
Digestive gland	3	2

Chapter 13		
Respiratory System	3	2
Chapter 14		
Urinary System	3	2
Chapter 15		
The Male Reproductive System	3	2
Chapter 16		
The Female Reproductive System	4	3
Chapter 17		
Sense Organs	2	2

Embryology

Chapter 1		
general Embryology (early development)	8	
Chapter 2		
development of face, palate	2	
Chapter 3		
development of digestive and respiratory System	2	
Chapter 4		
development of urogenital System	3	
Chapter 5		
development of circulatory System	3	
Total	64	40

Contents of Outline

Introduction

Learning objectives

1. Know the research object and purpose of histology and embryology.
2. Know the common research technics of histology and embryology.
3. Know the relationship between the cubic morphology with varieties of sections.

Teaching contents

1. The research contents and the situation in medicine of Histology and Embryology .
2. The common research technics of Histology and Embryology. The basic principle of manufactory of Histological sections. The meaning of acidophilic, basophilic and neutrophilic affinities. The basic principle of manufactory of ultra-thin section. The meaning of high electron dense and low electron dense of transmission electron micrograph. The observation of scanning electron microscope. The basic principle of freeze etching and freeze fracture. The basic principle of histochemistry, immunohistochemistry and autoradiography(the observation of light microscope and transmission electron microscope). The method of issue culture.
3. The relationship between cubic morphology and varieties of sections.
4. The common length unit of microscope , use the international unit system correctly.

Practice contents

Specimen of L.M: H.E stain, AgNo₃ strain, histochemistry, PAS reaction, alkaline phosphatase and so on..

Electron micrograph: The structural pictures of the cell under the transmission electron microscope. The structural pictures under the scanning electron microscope. Freeze fracture, freeze etching pictures.

Demonstration: the manufactory processes of histological sections.

Histology

Basic Tissue

Learning objectives

1. Understand the conception and type of tissue.

2. Know the meaning and origin of intercellular matrix.

Teaching contents

The conception and type of tissue and basic functions of varieties of tissues.

The meaning and origin of the intercellular matrix.

Chapter 1 Epithelial Tissue

Learning objectives

1. Understand the general features and classification of epithelial tissue.
2. Understand the structured features and functions of varieties of covering epithelium.
3. Understand the L.M structure, E.M structured features and functions of microvilli and cilia.
4. Understand the ultra-structure features and functions of varieties of intercellular conjunctions.
5. Understand the position, L.M structure, ultra-structure and function of basement membrane.
6. Know the conception of glandular cells, glandular epithelium and glands, and the morphological classification of exocrine glands.

Teaching contents

1. The general features and classification of epithelial tissue. The conception and general functions of covering epithelium, glandular epithelium and sense epithelium.
2. Covering epithelium: the general features and classification of covering epithelium, epithelial polarity. The structure and function of simple squamous epithelium, simple cuboid epithelium, simple columnar epithelium, pseudostratified columnar epithelium, stratified squamous epithelium, stratified columnar epithelium and transitional epithelium.
3. The special structures of epithelial cell :The L.M and Ultra-structured features and functions of microvilli and cilia in the free surface of the epithelial cell. The distribution of conjunctive structure and junctional complex in the lateral surface of the epithelial cell. The Ultra-structured feature of plasma membrane infolding and hemidesmosome in the basal surface of the epithelial cell. The L.M. structure., Ultra-structure and function of basement membrane. The composition and formation of the basement membrane.
4. Glandular epithelium: The conception of glandular cell, glandular epithelium and gland. The

generation of glandular cell and gland. The general features of exocrine gland and endocrine gland. The classification of exocrine gland, unicellular gland and multi-cellular gland, the morphological classification of multi-cellular gland. The features of mucous gland, serous gland and mixed gland. The characteristic of merocrine, apocrine and holocrine.

5. The physiologic renew of the epithelium, and the regeneration of the epithelium after destruction. The types of glandular cell: protein secretory cell, glycoprotein secretory cell, steroid secretory cell.

Practice Contents

L.M. Specimen: simple squamous epithelium, simple cuboid epithelium, simple columnar epithelium, pseudostratified ciliated columnar epithelium, stratified squamous epithelium, transitional epithelium.

Electron micrograph: tight junction, gap junction, intermediate junction, desmosome, cilia, microvilli, hemidesmosome, basement membrane.

Chapter 2 Connective Tissue Proper

Learning objectives

1. Understand the feature and classification of the connective tissue.
2. Understand the structure and function of varied composition of the loose connective tissue.
Know the features of fibers and composition of the matrix.
3. Know the basic structure and function of the dense connective tissue, adipose tissue and reticular tissue.

Teaching Contents

1. The feature and classification of connective tissue.
2. Loose Connective tissue

Cell: The L.M. Structure and Ultra-structure of fibroblast and fibrocyte , the process of formation of fibers and matrix; the L.M. Structure, Ultra-structure of macrophage and its phagocytosis; the L.M. structure and Ultra-structure of plasma cell, the formation of antibody; the L.M. structure and its function of adipose cell; the conception of undifferentiated

mesenchymal cell and varied white cells.

Intercellular matrix : the L.M. structure and Ultra-structure , physical and chemical properties and stain feature of collagenous fiber, elastic fiber and reticular fiber. The composition, properties and functions of matrix.

3. The structured features and functions of dense connective tissue, elastic tissue and adipose tissue. The basic structure and functional significance of reticular tissue.

Practice Contents

L.M. specimen: the spreading slide and section slide of loose connective tissue, the section slide of dense connective tissue, adipose tissue and reticular tissue.

Electron micrograph: fibroblast, macrophage, plasma cell, mast cell, collagenous fiber, elastic fiber.

Chapter 3. Cartilage and Bone

Learning objectives

1. understand the structure and function of hyaline cartilage, know the features of elastic cartilage and fibro-cartilage.
2. understand the structure of osseous tissue and diaphysis of long bone.
3. know the processes of formation of bone and its remodeling .
4. Know the structure and role of osteoblast and osteoclast in regulation of blood calcium.

Teaching Contents

1. Cartilage

The structure of cartilage tissue , the L.M. Structure and Ultra-structure of chondrocyte, the matrix and the fibers of cartilage. The structure and function of perichondrium, the growing type of the cartilage. The distribution, structured features and function of hyaline cartilage., elastic cartilage and fibro-cartilage.

2. Bone

Osseous tissue and its generation: The L.M.structure and Ultra-structure of osteocyte , the intercellular matrix of bone . The structure of osseous lamella .The origin, L.M. structure ,

ultra-structure and function of the osteoblast. The basic development processes of osseous tissue, the osteoid. The origin, L.M. structure, ultra-structure and function of osteoclast. The role of osteoblast and osteoclast in regulation of blood calcium.

The structure of long bone: the structure of spongy bone and compact bone , inner circumferential lamellas, outer circumferential lamellas, intermediate lamellas and Harvensian system.

The structure of osteum.

The formation of the bone: (1) the processes of intramembranous ossification (2)the processes of endochondral ossification. The formation of the embryonic form of cartilage . perichondral ossification, the formation of bone collar, endochondral ossification, the appearance of primary ossification center. The formation of bone marrow cavity, the appearance of secondary ossification center. The growth of epiphyseal cartilage and the growth of bone. The growing thick of the bone collar and the thick of the diaphysis. The factors which influence the growth of bone .

The constant remodeling processes and its significance of bone.

Practice contents

L.M. Specimen : hyaline cartilage, elastic cartilage, fibro-cartilage, section slide of bone , generation of long bone and flatten bone .

E.M. graph: chondrocyte, osteocyte., osteoblast, osteoclast.

Chapter 4 Blood

Blood

Learning objectives:

1. Understand the structure , function and the normal quantity of different blood cells, including erythrocyte, leukocyte and thrombocyte;
2. Distinguish different blood cells in the blood smear .

Teaching contents:

1. **Erythrocyte:** the morphological characteristic, function and normal quantity; the relationship between the maintenance of normal morphology of erythrocyte and the energy supply of ATP; the life-span of erythrocyte; the structural feature of reticulocyte.
2. Leukocyte: the classification of leukocyte; the distinctive features(microstructure and ultra-microstructure),functions of neutrophil, eosinophil, basophil, lymphocyte and monocyte; the quantity of leukocyte, the percentage of every kind of leukocyte in normal blood.
3. Thrombocyte: the morphological characteristic, function and normal quantity of thrombocyte.

Practice contents:

L.M. specimen: blood smear

Bone marrow and blood generation

Learning objectives:

1. Know the structure and function of red bone marrow and yellow bone marrow.
2. Understand the basic conception of hemopoietic stem cell.
3. Know the basic role of morphologic change during the generation of blood cells.

Teaching contents:

1. The structure and function of red bone marrow and yellow bone marrow; the blood circulatory feature of the bone marrow; the conception of hemopoietic inductive microenvironment.
2. The basic characteristics of hemopoietic stem cell; splenic colony experiments; the multipotential stem cell and its differentiation; the committed stem cell of erythrocyte, granulocyte and megakaryocyte system.
3. The generation stage and changing rule of erythrocyte, granulocyte and monocyte system; the generation of megakaryocyte system and the formation of thrombocyte .
4. The transposition of the red bone marrow and yellow bone marrow under certain condition.

Practice contents:

L.M. specimen: bone marrow smear

Chapter 5. Muscle tissue

Learning objectives:

1. Understand the microstructure and function of three kinds of muscle tissues.
2. Understand the ultra-structure and different points between skeletal muscle and cardiac muscle.
3. Know the ultra-structure of the smooth muscle.

Teaching contents:

1. The properties of muscle tissues.
2. Skeletal muscle: the microstructure — sarcomere , myofibril, light band and dark band of skeletal muscle fiber; the ultra-structure — myofilament, T tubule, sarcoplasmic reticulum and triad of skeletal muscle fiber; the structural foundation of skeletal muscle contraction; the muscle satellite cell and the regeneration of skeletal muscle contraction; the structure of muscle — endomysium, perimysium, epimysium.
3. Cardiac muscle: the main different points of microstructure and ultra-structure between cardiac muscle and skeletal muscle; the ultra-structure of intercalated disk.
4. Smooth muscle: the feature of microstructure and ultra-structure ; the conjunction method between smooth fibers.

Practice contents:

L.M. specimen: the longitudinal and cross sections of skeletal, cardiac and smooth muscle.

Chapter 6 Nerve Tissue

Learning objectives:

1. Understand the basic structure of nerve tissue; the structure and function of nerve cell and neuroglia.
2. Understand the ultra-structure and classification of the synapse.
3. Understand the structure and classification of nerve fibers.

Teaching contents:

1. The basic structure of nerve tissue.
2. Nerve cell: the microstructure and ultra-structure of the cell body, dendrite and axon; the classification of nerve cell according to the morphology or neurotransmitters; the structural foundation of the anterograde and retrograde transport; the synapse — the conjunction between nerve cells, the microstructure of the synapse, the ultra-structure of the chemical synapse and electrical synapse.
3. The classification of neuroglia: the neuroglia in the CNS — the structure and function of ependymal cell, astrocyte, oligodendrocyte and microglial cell; the neuroglia in the PNS — the structure and function of neurolemmal cell and ganglionic glial cell.
4. Nerve fiber: the microstructure of myelinated nerve fiber; the formation of the neurilemma and myelin sheath and its ultrastructure; the microstructure and ultrastructure of the unmyelinated nerve fiber.
5. The degeneration and regeneration of the nerve fiber.

Practice contents:

L.M. specimen: nerve cell, synapse, neuroglia, myelinated nerve fiber, unmyelinated nerve fiber.

Chapter 7 Circulatory System

Learning objectives:

1. Know the general structure of walls of circulatory system.
2. Understand the microstructure of capillary, the ultra-structure of several kinds of capillary and its function.
3. Understand the structure and function of large artery, medium-sized artery and small artery; know the histological change of hypertrophic tunica intima of artery.
4. Know the general structure of vein.
5. Know the structure and function of every segment of microcirculatory vessel.
6. Understand the structure of heart.
7. Know the general structure of the wall of lymphatic vessel.

Teaching contents:

1. The general structure of the wall of cardiac/vascular system.
2. Capillary:the distribution and microstructure of capillary;the ultrastructure and function of continuous capillary, fenestrated capillary and sinusoid.
3. Artery:the structure and function of medium-sized artery and small artery;the structure and function of large artery;the histological change of hypertrophic tunica intima of artery, blood vessel, lymphatic vessel and nerve on the vascular wall.
4. Vein: the structure of medium-sized vein, small vein and large vein.
5. The vessel of microcirculation:the structure and function of every segment of microcirculation.
6. Heart:the constitution,structure and function of the heart wall;the structure and function of cardiac valve; the constitution and distribution of cardiac conducting system;the microstructure and ultrastructure of P cell,transitional cell and Purkinje fiber.
7. Lymphatic vessel:the microstructure,ultrastructure and function of lymphatic capillary;the structure of lymphatic vessel and lymphatic duct.
8. The microstructure and function of carotid body,aortic body and carotid sinus.

Practice contents:

L.M. specimen:medium-sized artery and vein,large artery and vein,small artery and vein,heart.

Chapter 8 Skin

Learning objectives:

1. Understand the basic structure of skin, know the keratinizing processes of epidermis.
2. Know the distribution, structure and function of melanocyte and Langerhan's cells.
3. Know the structure and function of sebaceous gland and sweat gland.
4. Know basic structure and growth of hair.

Teaching contents:

1. skin:the basic structure of epidermis and dermis;the layers,microstructure,ultrastructure and keratinizing processes of epidermis;the distribution,microstructure,ultrastructure and function of melanocyte,Langerhan's cell and Merkel cell;the layers of dermis;the structure of papillary layer and reticular layer.

2. the appendixes of skin:the structure,ultrastructure and function of sweat gland;the structure and function of myoepithelial cell;the distribution and structure of large sweat gland;the structure and function of sebaceous gland;the composition of hair;the structure of hair shaft,hair root,hair follicle,hair bulb,hair papilla;the growth and replace of hair;the position,structure and function of arrector pili muscle.
3. regeneration of skin:the phusiological regeneration and compensative regeneration of skin.

Practice contents:

L.M. specimen: scalp, finger skin.

Chapter 9 Immune System

Learning objectives:

1. Know the constitution of immune system and the conception of immunity.
2. Understand the classification of lymphocytes and the role of every kind of lymphocyte in immune reponse.
3. Understand the role of macrophage in immune reponse;the constitution and distribution of mononuclear phagocyte system.
4. Understand the structure and function of central lymphoid tissue and periphery lymphoid tissue.
5. Know the structure and function of thymus.
6. Understand the general structure and function of lymph node and spleen;know the structural change of lymph node and spleen in different immune response.

Teaching contents:

1. The constitution of immune system;the conception of immunity.
2. Lymphocyte:the generation of lymphocyte;the kinds of lymphocyte;the recognition of antigen,transform and clonal expansion of lymphocyte;B lymphocyte and the body fluid mediated immunity;T lymphocyte and the cell-mediated immunity;the feature of K lymphocyte and NK lymphocyte.

3. Macrophage:the generation of macrophage;the cooperating relationship between macrophage and lymphocyte in immune response;the contitution and distribution of mononuclear phagocytic system.
4. Lymphoid tissue:the structure,distribution and function of diffused lymphoid tissue and lymphoid nodule;the conception of central lymphoid organ and periphery lymphoid tissue.
5. Thymus:the general structure and function of thymus;the structure of cortex and medulla;the differentiation of lymphocyte in thymus;the change of thymus in different age;the distribution of vessel in thymus;the structural foundation of blood-thymus barrier.
6. Lymph node:the general structure of lymph node;the structure and function of lymphoid nodule,paracortical zone,lymphoid sinus and lymphatic cord;the structural change of lymph node during different immune response;the structure,distribution and function of dendritic cell;the structure and function of post-capillary venules;the recirculatory path and functional significance of lymphocyte;the lymphatic passage of lymph node;the distribution of blood vessels of lymph node;the function of lymph node.
7. Spleen:the general structure of spleen;the structure and function of periarterial lymphatic sheath,splenic corpuscle,marginal sinusoid,marginal zone,splenic cord and splenic sinusoid;the structural change of spleen during different immune response;the blood circulatory path of spleen;the recirculatory path of lymphocyte;the function of spleen.

Practice contents:

L.M. specimen:thymus,lymph node,spleen.

Chapter 10 Endocrine System

Learning objectives:

1. Know the general structure of endocrine gland and ultrastructure of endocrine cells which secrete the amino acid derivative hormone,peptide hormone and steroid hormone.
2. Understand the microstructure and its hormone of thyroid,parathyroid and adrenal gland.
3. Understand the microstructure and its hormone of pituitary,and relationship between hypothalamus and pituitary.

Teaching contents:

1. The composition of endocrine system;the general structure of endocrine glands;the ultrastructure of glandular cells which secrete the hormone with different property(amino acid derivatives,peptides,steroids);the meaning of target organ and target cell.
2. Thyroid:the general structure of thyroid;the microstructure and ultrastructure of follicles;the formation and releasing processes of thyroxine;the distribution,the microstructure and ultrastructure of parafollicular cells and their hormone(calcitonin);the distribution of blood vessels and innervation of thyroid.
3. Parathyroid:the general structure of parathyroid;the microstructure of chief cells and their hormone(parathyroid hormone);the microstructure of acidophilic cell.
4. Adrenal glands:the general structure of adrenal glands. 1)cortex:the microstructure and ultrastructure of zona glomerulosa,zona fasciculata and zona reticularis;and their hormone(mineralocorticoids,glucocorticoids and sexual hormone);the common feature of cortical cell. 2)medulla:the microstructure and ultrastructure of medullary cells and their hormone(adrenalin,noradrenalin);ganglionic cell. 3)the distribution of blood vessel of adrenal glands;the influence of cortex upon the adrenaline formation;the innervation of adrenal glands.
5. The structure of hypophysis:the general morphological structure and their parts of pituitary.

Adenohypophysis:the microstructure and classification of acidophilic cell in pars distalis(somatotrophs,lactotrophs);the microstructure and classification of basophilic cell(thyrotrophs,gonadotrophs,corticotrophs);the microstructure of chromophobe;the structure of pars intermedia and pars tuberalis;the common feature of ultrastructure of glandular cell. **Neurohypophysis:**the microstructure of pars nervosa;the structure of Herring's body and its hormone(oxytocin and antidiuretic hormone).

The relationship between hypophysis and hypothalamus: the structure and function of neuroendocrine cell;the relationship between nervous system and endocrine system.

1)hypothalamus-neurohypophysis system:the neuroendocrine cell of supraoptic nucleus and paraventricular nucleus and their distribution of axon.

2)hypothalamus-adenohypophysis system:the composition of hypophyseal portal system;the distribution of axon ending of tuberous nucleus of hypothalamus,and their releasing

hormone and release inhibiting hormone.

Practice contents:

L.M. specimen:thyroid,parathyroid,adrenal gland,pituitary.

Chapter 11 Digestive Tract

Learning Objectives

- 1, understand the basic structure of digestive tract and structure and function of every segment.
- 2, know the digestive and immunity.
- 3, know the distribution, main type and function of endocrine cells of digestive tract.

Teaching Contents

- 1, the basic structure of digestive tract: the structure and function of tunica mucosa, submucosa, tunica muscularis and adventitia.
- 2, pharynx: the structure of pharynx.
- 3, esophagus: the structure of esophagus, esophageal gland.
- 4, the structure of stomach and gastric mucosa, the LM structure, ultrastructure and function of epithelium. The structure of gastric gland, the LM structure, ultrastructure and function of chief, parietal cell. The structure of mucous neck cell, Cardiac gland and pyloric gland. The structure of other layers of stomach.
- 5, Small intestine: the structure of interestinal mucosa, the structure and function of villi. The LM structure, ultrastructure and their absorptive function of absorptive cell, the distribution, structure and function of goblet cell. The structure of intestinal gland, the structure and function of Paneth cell. The structure of other layers of small intestine. The structure of duodenum, jejunum and ileum.
- 6, large intestine: the structure and function of colon, the structure of appendix.
- 7, the digestive tract and immunity: the distribution of lymphoid tissue of digestive tract, the functional significance of secretory IgA.
- 8, the endocrine cells of the digestive tract: the distribution, LM structure and ultrastructure of the endocrine cell in digestive tract, the hormone secreted by several main cells and its functional

significance. The conception of APUD system.

9, the blood vessels, lymphatic vessels and nerve of digestive tract.

10, the structure of peritoneum.

Practice Contents

L.M. specimen: pharynx, esophagus, gastric fundus, pyloric portion, duodenum, jejunum, ileum, colon, appendix, endocrine cells of digestive tract.

E.M. graph: chief cell, parietal cell, small intestinal epithelium, endocrine cell of digestive tract.

Chapter 12 Digestive gland

Learning Objectives

1. understand the structure of serous alveoli, mucous alveoli and mixed alveoli, understand the ultrastructure of digestive glandular cells.
- 2, understand the structure and function of liver, the structure of hepatic lobule and portal area.
- 3, understand the ultrastructure and function of hepatocyte, hepatic sinusoid.
- 4, understand the features of blood circulation of liver and their relationship with hepatic function.
- 5, know the structure of gall, bladder and bile duct.
6. understand the structure and function of pancreas.
7. know the ultrastructure of pancreas islet cells and its hormone.

Teaching Contents

1. Salivary gland: the basic structure of salivary gland, parenchyma and interstitial substance, secretory portion and excretory portion. The structure of every grade of duct, the structure and function of serous alveoli, mucous alveoli and mixed alveoli. The ultrastructure of digestive glandular cells. The structure of parotid, submandibular and sublingual glands.
2. liver: the general structure of liver. Parenchyma and interstitial substance, hepatic lobule and portal area.

hepatic lobule: the structure of hepatic plate (hepatic cord).the LM structure, ultrastructure and function of hepatocyte. The ultrastructure of bile canaliculi. The LM structure and ultrastructure of hepatic sinusoid. The structure and function of kupffer cell. The structure and function of

perisinusoidal space and fat-storing cell.

Portal area: the composition and structure of portal area. The features of blood circulation of liver and their relationship with hepatic function. The lymphatic vessels of liver.

3. gallbladder and bile duct: the structure and function of gallbladder. The structure of bile duct.

The excretory path of bile and intestine-liver circulatory path.

4. the general structure of pancreas, exocrine portion and endocrine portion.

5. exocrine portion: the LM structure and ultrastructure and function of acini, the structure of duct.

6. endocrine portion: the distribution and structure of pancreas islet. The quantity of four kinds of cells. The ultrastructure of secretory granule and their hormone.

Practice Contents

L.M. specimen: the structure of parotid, submandibular and sublingual glands.

pig liver, human liver, hepatic glycogen, kupffer cell, bile canaliculi, the injection of hepatic vessels, gallbladder, pancreas, pancreas islet cells (special staining).

E.M. graph: taste bud, serous acini, mucous acini, hepatocyte, hepatic sinusoid, bile canaliculi, perisinusoidal space and fat-storing cell, pancreas cells and pancreas islet cells.

Chapter 13 Respiratory system

Learning Objectives

1, know the structure of mucous membrane of nasal cavity and paranasal sinuses.

2, understand the structure of trachea.

3, understand the structure of lung and ultrastructure and function of alveoli.

Teaching Contents

1, Nasal cavity: the divisions of nasal cavity, the structure and function of the mucous membrane of vestibular region, respiratory region and olfactory region. The structure of mucous membrane of paranasal sinuses.

2, the structure of mucous membrane of nasopharynx and larynx.

3, trachea and bronchi: the structure of the wall of trachea and bronchi, the LM structure ,

ultrastructure and function of epithelia. The immune function of the trachea and bronchi.

4, lung: the general structure of lung, pulmonary lobule. The constitution and gradual structural changes of the duct part in the lung. The structure of terminal bronchiole, the constitution of respiratory part, the structure of respiratory bronchiole, alveolar duct, alveolar sac and pulmonary alveoli, the ultrastructure and function of type I and type II alveolar cell. The structure of interalveolar septum, alveolar pore. The composition and function of blood-air barrier. The distribution and function of alveolar macrophage. The distribution of pulmonary endocrine cells and their hormone; the blood vessel, lymphatic vessel and nerve of lungs.; the structure of pleura.

Practice Contents

L.M. Specimen: the mucous membrane of respiratory region and olfactory region, trachea, lung, injection of pulmonary blood vessels.

E.M. graph: epithelium of trachea, alveoli and alveolar septum.

Chapter 14 Urinary system

Learning Objectives

- 1, understand the distribution, LM structure, ultrastructure and function of nephron, collecting tubule and papillary duct.
- 2, understand the constitution, structure of juxtaglomerular complex and the function of juxtaglomerular cell.
- 3, know the general structure of renal calyces, renal pelvis, ureter and bladder.

Teaching Contents

1, kidney

The general structure of kidney: the position and composition of capsule, cortex, medulla, labyrinth, medullary ray and renal column. The constitution of uriniferous tubule.

Nephron: the segments of nephron and their location. The structure, ultrastructure and function of renal corpuscle (glomerular, mesangium and renal capsule). The structure, ultrastructure and function of renal tubule (proximal tubule, thin segment and distal tubule). The constitution of

medullary loop. The structure, ultrastructure and function of collecting tubule and papillary duct. Cortical nephron and juxtamedullary nephron. The position and constitution of juxtaglomerular complex, the structure, ultrastructure and function of juxtaglomerular cell. The structure and function of macula densa and extraglomerular mesangial cell; the composition and distribution of renal interstitial substance, the structure and function of interstitial cell; the characteristics of renal blood circulation, the composition of renal lobule, the distribution of lymphatic vessel and nerve in the kidney.

2, urinary passages: the general structure of renal calyx, renal pelvis, ureter and bladder.

Practice Contents

L.M. Specimen: kidney, juxtaglomerular cell, macular densa, injection of renal blood vessels, ureter and bladder.

E.M. graph: renal corpuscle, capillary of glomerulus, podocyte, filtration barrier, mesangial cell, proximal tubule, distal tubule.

Chapter 15 Male Reproductive System

Learning Objectives

- 1, know the general structure of testis. Understand the structure of seminiferous tubules, the processes of spermatogenesis, blood-testis barrier, the structure, ultra-structure and function of interstitial endocrinal cells.
- 2, know the structure of epididymis and ductus deferens.
- 3, understand the structure of prostate.

Teaching Contents

1, Testis: the general structure of testis.

The structure of seminiferous tubules: the structure of basement membrane and myoid cell. The structure of spermatogenic epithelium in prepuberty and postpuberty. The structure, ultrastructure and function of Sertoli cell; blood-testis barrier and the inner circumstance of spermatogenesis; the structure and the arrangement of spermatogenic lineage cell. The structure and ultrastructure of spermatozoon, the structural changes of the seminiferous tubule with the

age. The structure of tubuli recti and rete testis. The interstitial substance of testis, the structure, ultrastructure and function of interstitial cell.

2, epididymis: the structure and function of ductuli efferentes and ductus epididymis.

3, the structure of ductus deferens and ejaculatory duct.

4, prostate: the composition of prostate, the structure of alveoli, the interstitial substance of prostate.

Practice Contents

LM specimen: testis, epididymis, prostate, ductus deferens, spermatozoon smear.

E.M. graphy: sertoli cell, interstitial cell, spermatozoon.

Chapter 16 Female reproductive system

Learning Objectives

1, understand the structure of ovary, the growth and development of ovarian follicle. The conception of ovulation; the formation, structure and function of corpus luteum; know the relationship between ovary and pituitary hormone.

2, understand the structure of uterus, the relationship between the cyclic changes of endometrium and ovary.

3, know the structure of oviduct, vagina and mammary gland.

Teaching Contents

1, ovary: the general structure of the ovary. The development and maturation of ovarian follicle, the structure and endocrine function of ovarian follicle; the maturation division of oocyte. The process and mechanism of ovulation; the structure and function of corpus luteum; the formation of corpus albicans, atretic follicle and interstitial gland. The relationship between the ovary and pituitary hormone. The blood vessel and nerve of ovary. The ovary of menopause.

2, oviduct: the structure and function of oviduct, the periodical change of epithelial cell.

3, uterus: the endometrium, myometrium and perimetrium. The relationship between the periodical change of endometrium and ovary hormone. The structure and ultrastructure of endometrium during the proliferation phase and secretory phase. The mechanism of destroying

of endometrium during menstrual phase. The structure of mucous membrane of uterine cervix.

The blood vessel and nerve of uterus.

4, vagina: the structure of vagina, the cyclic change of epithelium.

5, mammary gland: the general structure of mammary gland. The structure of mammary gland during resting stage, pregnancy stage and lactation stage.

Practice Contents

L.M. specimen: ovary, oviduct, uterus

Chapter 17 Sense Organ

Learning Objectives

- 1, understand the structure and function of the wall of eye ball and lens system.
- 2, know the structure of eyelid.
- 3, know the structure of membranous labyrinth of inner ear, understand the structure and function of crista ampullaris, maculae staticae and spiral apparatus.

Teaching Contents

Eye

1, eye ball: fibrous tunic, vascular tunic and retina, the lens system.

Fibrous tunic: the structure and physiological feature of every layer of cornea. The structure of sclera.

Vascular tunic: the structure of choroids membrane. The structure of ciliary body, the distribution and function of ciliary muscle. The ultrastructure of ciliary epithelium and its relationship with the formation of aqueous humor, the composition and significance of blood-aqueous barrier. The structure of iris, the structure and function of dilator muscle of pupil and constrictor muscle of pupil. The structure of sinus venosus sclerae , trabecular web and their role in the circulation of aqueous humor.

Retina: the LM structure, ultrastructure and function of pigment epithelium, rod cell and cone cell. The structure and function of bipolar cell, ganglion cell, horizontal cell and amacrine cell. The structure and function of Müller cell. The layers of retina. The structure and function of macula

lutea, papilla of optic nerve and optic nerve.

The lens system: the eye chambers and aqueous humor, the circulatory path of aqueous humor.

The structure and function of lens and zonular ciliaris. The structure of vitreous body.

2, eyelid: the structure of eyelid, zeisian gland, Moll's gland and Meibomian gland.

Ear

1, external ear: the structure of auricle and the wall of external auditory meatus.

2, Middle ear: the structure of tympanum and mucous membrane of auditory tube, the LM structure of tympanic membrane.

3, internal ear: the structure of the wall of osseous labyrinth, the structure of membranous labyrinth. The position, structure and function of macula sacculi, macula utriculi and crista ampullaris. The structure of every part of cochlea wall, the structure and function of spiral apparatus. The formation and absorption of inner lymph and outer lymph.

Practice Contents

L.M. Specimen: eye ball, eyelid, internal ear

E.M. graph: rod cell, cone cell, spiral apparatus

Embryology

Chapter 1 General Embryology

Learning objectives:

1. Know the definition of embryology and the development periods of the fetus .
2. Know significance of capacitation of spermatozoon.
3. Understand the definition, place, time, process, conditions and the significances of fertilization.
4. Know the meaning of the cleavage, morula and the blastocyst.
5. Understand the structure of blastocyst.
6. Understand the definition, time, place, process, and conditions of implantation, and the ectopic implantations.
7. Understand the meaning of the decidua and the deciduas reaction .

8. Understand the formation and the differentiation of trilaminar germ disc.
9. Understand the composition ,structure and significance of fetal membrane ,.
10. Understand the structure and the function of the placenta.
11. Know the calculation of the expected delivery date and the measuring method of fetal age.

Teaching Contents:

Introduction of human development, the development and mature of gametes, the capacitation of spermatozoon. The meaning of embryo, fetus and pregnancy body.

1.From fertilization to the formation of blastocyst.(1st week)

The time ,place,condition, processes and significance of fertilization.

The processes of cleavage, morula and the structure of blastocyst, inner cell mass trophoblast and blastocoel.

The definition, time ,place, processe and conditions of implantation, and the ectopic implantations and their causes, the decidual response and deciduas, cytotrophoblast, and syncytiotrophoblast.

2.Bilaminar stage (2nd week)

The formation of bilaminar germ disc (epiblast ,hypoblast),amniotic cavity and yolk sac.The extraembryonic mesoderm, the extraembryonic cavity, extraembryonic somatic mesoderm and extraembryonic splanchnic mesoderm, structure of the chorion and the body stalk.

3.Trilaminar stage(3th week)

The appear of primitive streak and the decision of middle axis of embryo. The formation of notochord and endoderm, intraembryonic mesoderm and ectoderm.

The differentiation of the trilaminar germ disc : formation of neural plate, neural groove and neural tube as well the neural crest; the formation of paraxial mesoderm (somite), lateral plate(mesoderm) and the intermediate mesoderm; buccopharyngeal membrane, cloacal membrane, and intraembryonic coelom

somatic mesoderm and splanchnic mesoderm, and body stalk.

4. embryonic stage (4th-8th week)

Infolding of embryonic disc. The formation of primitive gut and yolk stalk. The formation of umbilical cord, the introduction of appearance change of fetus.

5. Fetal stage (9th week to birth)

The summary of main changes every month during fetal stage, the calculation of the expected delivery date and the measuring method of fetal age. The factors which influence the fetal growth.

6. Fetal membrane and placenta

The formation of chorion, yolk sac, amnion, allantois and umbilical cord and their functions and abnormality in fetal development. The structure and function of placenta, placental barrier. Hydatidiform mole.

7. Twins: monozygotic twins and dizygotic twins.

Practice contents:

Specimen, models and pictures: the embryo and fetal membrane from zygote to the embryo at the 8th week, trilaminar germ disc, the cross and longitudinal section of models in embryo stage (show the notochord, somite, neural tube, primitive gut, intrabryonic coelom, oropharyngeal membrane, cloacal membrane, and umbilical cord), fetal membrane and placenta.

Chapter 2 The Development of Face and Palate

Learning objectives:

Know the formation processes of nose, mouth and palate and understand their congenital malformation: cleft lip, cleft palate and oblique facial cleft.

Teaching Content.

1. The formation of branchial arch and branchial groove, pharyngeal pouches and branchial membrane. The meaning of branchial apparatus.
2. The formation of face: the formation of frontonasal prominence, maxillary

prominence and mandibular prominence. The generation of stomodeum and olfactory pit, median nasal prominence lateral nasal prominence, the formation of nose and mouth. Congenital malformation: cleft lip, oblique facial cleft.

3. The formation of palate: the generation and mergence of median palatine process and lateral palatine process. Congenital malformation: cleft palate.

Practice Contents:

Specimen, model or picture: facial formation , palatine formation.

Chapter 3 The Development of Digestive and Respiratory system

Learning objectives:

1. Know the formation and differentiation of primitive gut.
2. Understand the position and differentiation of pharyngeal pouch, the development of thyroid and its malformation.
3. Know the development of digestive tract and understand its malformation.
4. Know the development of liver, gallbladder and pancreas and their malformation.
Know the development of respiratory system and understand its malformation.

Teaching Contents:

1. Primitive gut: The differentiation of foregut, midgut and hindgut, oropharyngeal membrane and cloacal membrane.
2. The development of thyroid and its congenital malformation: thyroglossal cyst or fistula.
3. The development and differentiation of pharynx and pharyngeal pouches: the relationship between pharyngeal pouch, branchial arch and branchial groove, derivatives of every pharyngeal pouch, the development of palatine tonsil, thymus ,parathyroid and ultimobranchial body.
4. The development of esophagus and stomach.
5. The development of intestine: the formation of intestinal loop and the physiological umbilical hernia, the rotation processes of intestine. The separation

of cloaca, the formation of anal pit and rupture of anal membrane. Congenital malformation: Meckel's diverticulum, umbilical fistula, congenital umbilical hernia, intestinal stenosis or stricture, imperforate anus and so on.

6. The development of liver, gallbladder, pancreas: the development and growth of hepatic diverticulum, the formation of liver, gallbladder and bile duct. The development and merger of dorsal pancreas and ventral pancreas, the formation of common pancreatic duct and accessory pancreatic duct, the development of pancreatic islet.

Congenital malformation: absence of gallbladder, stenosis or atresia of hepatic duct or bile duct, annular pancreas and so on.

7. The development of respiratory system, the development and growth of laryngotracheal groove, laryngotracheal diverticulum, the formation of larynx, trachea and lung. Congenital malformation: esophagotracheal fistula, neonatal hyaline membrane disease.

Practice Contents:

Specimen, models or picture: the development and differentiation of the pharyngeal pouch, the development of digestive tract and digestive gland, the development of respiratory system.

Chapter 4 The Development of urogenital System

Learning objectives:

1. Know the development of pronephros and mesonephros, understand the development of metanephros and its congenital malformation.
2. Know the formation and change of urogenital sinus and its congenital malformation.
3. Know the development of gonad and the mechanism of sexual differentiation.
4. Know the sexual differentiation mechanism of genital duct and external genitalia and their congenital malformation.

Teaching Contents:

A. The development of urinary system

1. The development of pronephros: the development of pronephric duct and pronephric tubules.
2. The development of mesophros: the development of mesonephric duct and mesonephric tubules.
3. The development of metanephros: the formation and change of ureteric bud and metanephrogenic blastema, the change of position of metanephros . Congenital malformation: horse-shoe kidney, polycystic kidney and ectopic kidney and so on.
4. The separation and change of cloaca: the formation of urogenital sinus, the development of bladder and urethra and their malformations: urachal fistula or cyst; extrophy of bladder.

B. The development of reproductive system.

1. The development of gonad: the origin of primordial germ cell, the components of gonadal ridge, the differentiations of gonad. The descent of the testis and ovary.
2. The development of genital duct: The different changes of mesonephric duct and mesonephric tubules in male and female, the formation of paramesonephric duct and the different change in male and female. The relationship between sexual differentiation of genital duct and androgen .
3. The development of external genitalia: the formation of genital tubercle, urogenital fold, labioscrotal swelling and their sexual differentiation. The relationship between sexual differentiation of the external genitalia and androgen.
- 4 .Congenital malformation: true hermaphrodites and pseudohermaphrodites, double uterus ,vaginal atresia, cryptorchidism, inguinal hernia and so on.

Practice and Contents:

Specimen, model or picture: urogenital ridge, gonadal ridge, mesonephric ridge, mesonephric duct, the composition and change of position of metanephros, the separation of cloaca, the development of urogenital sinus and external genitalia: genital tubercle, urogenital fold, labioscrotal swelling and genital groove.

Chapter 5 The Development of Circulatory System

Learning objectives:

1. Understand the development of heart and the congenital malformation of heart and large blood vessels.
2. Understand the fetal blood circulatory path, feature and the change after birth.
3. Know the development of blood cell during fetal stage.

Teaching Content

1. The formation of blood vessels: the development of extra-embryonic blood vessels and intra-embryonic blood vessels, the establishment of fetal early blood circulation.

2. The development of heart.

The formation of heart tube: the development of cardiogenic area and pericardial coelom, the formation of heart tube and its rotation, the division of heart tube (bulbus cordis, ventricle, atrium sinus venosus). The formation of heart loop.

The formation of cardiac septum and valves : the formation interatrial septum and interventricular septum ,the separation of aortic roots and bulbus cordis.

3. The outline of development of vascular system ,the establishment of vitelline circulation , umbilical circulation and somatic circulation. The development and change of aortic arch.

4. The path, feature and the change after birth fetal blood circulation.

5. Congenital malformation: atrial septal defect, ventricular septal defect, tetralogy of Fallot, patent ductus arteriosus.

6. The development of lymph vessel: the development and change of primitive lymph sac.

7. The development blood cells during fetal stage.

Vitelline hemopoiesis(the development of blood island, the origin of hemopoietic stem cell),liver hemopoiesis, spleen hemopoiesis and bone marrow hemopoiesis.

Practice Contents

Specimen, model or picture: the heart of newborn baby, the development of cardiovascular and their congenital malformation.

4. Annual update of the experimental projects

5. The corresponding relationship of experimental teaching

	1.Practical Ability	2.The ability to use knowledge to analyze phenomena	3.Strengthen the ethical concept of experimental animal	4.Cultivating clinical thinking ability	
Experiment 1					
Experiment 2					
Experiment 3					
Experiment 4					

6. Assessment and evaluation methods

【 Examination contents 】

Laboratory report + Final exam

【 Achievement evaluation 】

Laboratory report:20%, Final exam: 80%

7. Textbooks and bibliography

【 Textbooks 】

T. W. Sadler: Langman's Medical Embryology Ninth Edition (Japanese, M. Yasuda Ed.), Medical Science International.

W. J. Larsen: Human Embryology 3rd Edition, Churchill Livingstone.

K. L. Moore and T. V. N. Persaud: The Developing Human 6th Edition (Japanese, H.

Seguchi Ed.), W. B. Saunders.

组织学与胚胎学（八年制教材，第三版），人民卫生出版社，2015

奈特氏人体胚胎学彩色图谱，人民卫生出版社，2004

组织学与胚胎学（英文版），科学出版社，2014

组织学与胚胎学（第2版），高英茂主编，高等教育出版社，2015年，

【Bibliography】