INTRODUCTION

Training an individual to become a physician requires the acquisition of a foundation of knowledge, the understanding of how systems work normally and in pathological states, and the lifelong gaining of experience in diagnosing and treating patients. The standards for accrediting medical education programs are described in the document entitled "Functions and Structure of a Medical School" from the LCME. In that document there are several educational objectives that apply to teaching pathology. In particular, ED-11 states "the curriculum of a medical education program must include content from the biomedical sciences that supports students' mastery of the contemporary scientific knowledge, concepts, and methods fundamental to acquiring and applying science to the health of individuals and populations and to the contemporary practice of medicine."

Pathology is specifically named among the subobjectives of scientific disciplines to which this standard relates. Thus, medical students must learn the basic mechanisms of disease, their manifestations in major organ systems and how to apply that knowledge to clinical practice for diagnosis and management of patients. Another educational objective ED-33 refers to a curriculum committee and states "There must be integrated institutional responsibility in a medical education program for the overall design, management, and evaluation of a coherent and coordinated curriculum." With the advent of integrated curricula, Pathology must be appropriately represented in the curriculum committee to insure that there is full integration for teaching pathologic processes from basic mechanisms to organ system pathology to laboratory diagnosis.

The first educational objective ED-1 states "The faculty of an institution that offers a medical education program must define the objectives of its program. The objectives must serve as guides for establishing curriculum content and provide the basis for evaluating the effectiveness of the program." The following web-based competencies for Pathology are proposed as a national standard identifying the content for teaching pathology in three basic competencies: disease mechanisms, integration of disease mechanisms into organ system pathology, and application of pathology to diagnostic medicine. Each competency will include learning goals, objectives, and examples to assess the acquisition, integration and application of knowledge to demonstrate the development of competency.

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NOTE: These are "living" competencies, subject to regular review and updating by the APC UME Committee and UMEDS Section Council. To submit a recommendation for change or a new example, please email your suggestion to ume@apcprods.org.
COMPETENCY 2
Organ System Pathology

Once the student has mastered the fundamental mechanisms and processes for causing, sustaining, extending or resolving injury, this knowledge can be integrated to understand how pathology in each organ system affects the initial pathologic site, multi-organ systems and the overall function of the patient.

OVERVIEW
There are 22 topics within this competency area. Each topic includes general learning goals and specific objectives that medical students should be able to meet upon graduation from medical school. The table below lists the topic areas and show the number of goals and objectives for each.

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Cardiovascular Disorders resulting from abnormal development, hypoxia, immune dysregulation, infections and intrinsic muscle disease as they relate to the heart and blood vessels are enumerated.

CARDIOVASCULAR: BLOOD VESSELS

Learning Goal 1: Apply knowledge of immunologic principles, inflammation and tissue repair to explain atherosclerosis and its complications.

OBJECTIVE(S):

CBV1.1 Explain how environmental factors, including elevated cholesterol and LDL complexes, infection, and smoking, can contribute to endothelial cell injury.

CBV1.2 Describe the positive feedback loop in which damaged endothelial cells cause further endothelial damage.

CBV1.3 Predict the local and distant consequences that are likely to follow rupture of an atherosclerotic plaque.

CBV1.4 Describe the morphologic changes of atherosclerosis and discuss how atrophic changes in the vessel wall may result in aneurysm formation.

Learning Goal 2: Apply knowledge of the cellular response to injury and basic hemodynamic principles to explain how defective or excessive inflammatory and reparative processes damage blood vessels, and how this damage results in thrombus formation.

OBJECTIVE(S):

CBV2.1 Discuss the steps in thrombus formation and its predisposing factors.

CBV2.2 Compare and contrast aortic aneurysms and aortic dissections in terms of their predisposing factors, the sites of involvement, and patient populations likely to be affected.

CBV2.3 Describe the clinical consequences of an abdominal aortic aneurysm.

Learning Goal 3: Apply knowledge of microbiological principles and mechanisms of immunologically-mediated disease to discuss the pathogenesis, clinical presentation, morphological features, and laboratory diagnosis of the different vasculitides.

OBJECTIVE(S):

CBV3.1 Describe how a drug-induced vasculitis depends on a functioning immune system.

CBV3.2 Contrast the mechanisms by which an autoimmune disease can appear as a vasculitis in one specific organ or as a generalized disease in many organs.
CBV3.3 Describe the vasculitides that occur in large, medium and small vessels.

CARDIOVASCULAR: HEART

Learning Goal 1: Apply knowledge of anatomy, physiology and general pathophysiologic principles to describe the clinical presentation associated with heart failure.

OBJECTIVE(S):

CH1.1 Compare and contrast right heart versus left heart failure in terms of clinical features, pathologic features, and the short term and long term consequences.

CH1.2 Compare and contrast the clinicopathologic features of dilated, restrictive and hypertrophic cardiomyopathies.

Learning Goal 2: Apply knowledge of anatomy, physiology and general pathophysiologic principles to explain how atherosclerosis leads to heart disease and death.

OBJECTIVE(S):

CH2.1 Explain how ischemic heart disease can progress while remaining entirely free of symptoms for many years.

CH2.2 Contrast the microscopic differences between exercise induced angina and unstable angina.

CH2.3 Contrast the behavior of the myocardium that has been subjected to chronic ischemia alone from that of reperfused myocardium following therapy for infarction.

CH2.4 Describe the gross and microscopic features of acute myocardial infarction and remote myocardial infarction, and at what point gross or microscopic pathology appears.

CH2.5 Describe the histologic features of acute myocardial infarction and explain how the histologic features change from initial infarction through fibrosis.

CH2.6 Identify short term and long term complications of myocardial infarction.

Learning Goal 3: Apply knowledge of embryologic principles to describe how improper development of the heart and blood vessels leads to cardiac dysfunction.

OBJECTIVE(S):

CH3.1 Name the most common forms of congenital heart disease and outline their clinical presentation, natural history, and long and short term complications.
CH3.2 Name several common genetic disorders associated with congenital heart disease.

CH3.3 Describe a paradoxical embolus in terms of congenital heart disease.

CH3.4 Define the concepts of left to right shunt, right to left shunt and shunt reversal.

Learning Goal 4: Apply knowledge of immunological and microbiological principles to explain the role of infectious agents in myocardial dysfunction and describe related clinical presentation.

OBJECTIVE(S):

CH4.1 Describe the major manifestations of rheumatic fever and its effect on the endocardium, myocardium, and pericardium.

CH4.2 Compare the effects of rheumatic fever and bacterial endocarditis on the endocardium, myocardium, and pericardium.

CH4.3 Describe the two major patterns of infective endocarditis and the pathologic changes seen in the cardiac valves.

CH4.4 Discuss the pathologic features of non-infective endocarditis on the cardiac valves.

CH4.5 Describe the clinicopathologic features of myocarditis.

CH4.6 Summarize the common causes of pericarditis.

Learning Goal 5: Apply knowledge of the anatomy and physiology of heart valves to explain how valvular dysfunction leads to heart failure and describe the related clinical presentation.

OBJECTIVE(S):

CH5.1 Discuss the complications associated with aortic stenosis.

CH5.2 Describe the clinicopathologic features of mitral valve prolapse.

Learning Goal 6: Apply knowledge of the mechanism of response of cardiac muscle to increased resistance to describe the clinical and pathologic changes seen in systemic and pulmonary hypertension.

OBJECTIVE(S):

CH6.1 Describe the gross and microscopic adaptive changes in the myocardium that result from pulmonary hypertension.

CH6.2 Describe the gross and microscopic adaptive changes in the myocardium that result from systemic hypertension.
HEMATOPATHOLOGY

HEMATOPATHOLOGY: RED CELL DISORDERS

Learning Goal 1: Apply knowledge of nutritional biochemistry, erythropoiesis, red blood cell structure and function to a discussion of the behavioral, hereditary, developmental and chronic causes of anemia.

OBJECTIVE(S):

HRC1.1 Explain the contribution of iron to red blood cell development and function. Describe behaviors and conditions that lead to iron deficiency and contrast the morphology and laboratory parameters of normal red cells versus iron deficient cells.

HRC1.2 Discuss the pathophysiology of hereditary spherocytosis.

HRC1.3 Discuss the pathophysiology of anemias of chronic diseases or anemia of inflammatory response and the contribution of hepcidin to this condition.

HRC1.4 Discuss the role of vitamin B12 and folic acid in red cell development and describe the pathophysiology of anemias arising in B12 and folic acid deficiency.

HRC1.5 Explain the mechanisms by which anemia is produced on the basis of shortened red cell survival, distinguishing between intrinsic and extrinsic causes of red cell destruction.

HRC1.6 Compare and contrast congenital and acquired forms of aplastic anemia.

HRC1.7 Describe the structural alterations and regulatory abnormalities associated with hemoglobinopathies and thalassemias, and discuss how these abnormalities give rise to the clinical manifestations of these diseases.

HEMATOPATHOLOGY: White cell disorders, lymph nodes, spleen and thymus

Learning Goal 1: Apply knowledge of anatomy and physiology to describe the normal development of white blood cells and non-neoplastic conditions leading to increased or decreased numbers.

OBJECTIVE(S):

HWC1.1 Describe the maturational pathway of white blood cells, naming and describing the morphology of the cells present at each stage for each white blood cell type.

HWC1.2 Define the role of growth factors in the development and maturation of white blood cells.

HWC1.3 Define leukocytosis, describe several etiologies leading to it, and contrast it with leukemoid reaction.

HWC1.4 Explain the causes and mechanisms that lead to leukopenia.
HWC1.5 Describe common causes for neutrophilia, lymphocytosis, monocytopsis, eosinophilia, and basophilia.

HWC1.6 Discuss common causes for neutropenia, lymphopenia, and leukopenia.

**Learning Goal 2:** Apply knowledge of general concepts of neoplasia to explain how genetic mutations can produce hematologic malignancies and how the clinical behavior of different malignancies can be explained by different mutations.

**OBJECTIVE(S):**

HWC2.1 Explain the difference between germ line and somatic mutations; give examples and explain how each mutation contributes to the development of hematologic malignancies.

HWC2.2 Compare and contrast, with examples, translocations that result in malignancy by activation of oncogenes with those that produce fusion proteins.

*EXAMPLE: IgH translocations in B cell lymphomas vs bcr-abl in CML, or RUNX1-RUNX1T1 in AML with t(8;21)*

HWC2.3 Explain how dysregulation of cell proliferation or of cell death can give rise to lymphomas, and compare and contrast diseases arising by each mechanism with respect to morphologic appearance and clinical behavior.

*EXAMPLE: follicular lymphoma/bcl-2 vs Burkitt lymphoma/myc*

HWC2.4 Describe how understanding the molecular pathogenesis of leukemia and lymphoma can suggest targets for therapeutic intervention, and give examples of diseases currently treated by targeted therapy.

*EXAMPLE: tyrosine kinase inhibitors in CML; ATRA in APL; also FLT-3 inhibitors in FLT3 mutated AML*

HWC2.5 Describe the clinicopathologic features of multiple myeloma in terms of clinical presentation, laboratory findings, radiologic findings, and histologic features.

**Learning Goal 3:** Apply knowledge of hematopoiesis to discuss the pathophysiologic basis for the classification of leukemias and lymphomas.

**OBJECTIVE(S):**

HWC3.1 Describe the morphologic features that characterize typical cases of acute leukemia and lymphoma.

HWC3.2 Compare and contrast myelodysplastic syndromes, myeloproliferative neoplasms, and acute myeloid leukemia with respect to morphologic appearance, clinical features, and underlying pathophysiology.
HWC3.3 Compare and contrast low grade or indolent lymphomas, and high grade or aggressive lymphomas with respect to underlying pathophysiology that yields specific morphologic features and clinical behavior.

HWC3.4 Identify the morphologic appearance of a blast, and be able to distinguish acute myeloid leukemia from chronic myelogenous leukemia.

HWC3.5 Recognize the histologic appearance of typical cases of follicular lymphoma, diffuse large B cell lymphoma, small lymphocytic lymphoma/chronic lymphocytic leukemia, and Hodgkin lymphoma.

HWC3.6 Compare and contrast Hodgkin lymphoma with at least two non-Hodgkin lymphomas with respect to age and clinical symptoms at presentation, sites and pattern of spread of disease, cell of origin, histologic appearance, and prognosis and response to therapy.

**Learning Goal 4:** Discuss the clinical manifestations of hematolymphoid neoplasms including age distribution of different tumors, presenting symptoms and signs, disease complications, natural history, and response to therapy.

**OBJECTIVE(S):**

HWC4.1 Identify the tumors of bone marrow most likely to present with anemia, leukopenia or thrombocytopenia, and discuss the presenting clinical features most likely to be associated with each of these.

HWC4.2 Define B symptoms, list those lymphomas most and least likely to be associated with them, and discuss the prognostic implications of B symptoms in these diseases.

HWC4.3 Define staging as it applies to lymphoma and give examples of different lymphomas in which staging has different clinical implications.

*EXAMPLE: follicular lymphoma vs Hodgkin or diffuse large B cell lymphoma*

HWC4.4 Identify lymphomas most likely to present in or involve extranodal sites such as the GI tract, bone marrow, blood, skin, or central nervous system.

**Learning Goal 5:** Describe how stem cells give rise to the diverse cell populations seen in bone marrow and lymph nodes and discuss how knowledge of hematopoietic cell development can provide a framework for understanding hematolymphoid neoplasia.

**OBJECTIVE(S):**

HWC5.1 Outline, with examples, the difference between the cell of origin of a neoplasm and the morphologic expression of that disease.

*EXAMPLE: acute myeloid leukemia vs chronic myelogenous leukemia*
HWC5.2 Discuss evidence that supports the existence of stem cells in myeloid leukemias, and list features of chronic myeloproliferative neoplasms that suggest they are derived from stem cells.

*EXAMPLE: Thrombocytosis in CML or P Vera; lymphoid blast crisis in CML*

HWC5.3 Describe the morphologic and molecular changes that take place within a lymph node in response to B cell activation, and explain how these changes relate to different types of B cell non-Hodgkin lymphoma.

**Learning Goal 6:** Apply knowledge of the anatomy and function of the thymus to summarize how developmental anomalies, immune disorders and malignant transformation of epithelial and lymphoid cells lead to immune dysfunction.

**OBJECTIVE(S):**

- HWC6.1 Compare and contrast thymoma from lymphoma and describe the clinicopathologic features of thymic neoplasms.
- HWC6.2 Explain how deficits in particular stages of thymic development can produce specific types of disease.

**Learning Goal 7:** Apply knowledge of the anatomy and function of the spleen to explain how developmental anomalies, immune and metabolic disorders neoplasia lead to splenic dysfunction.

**OBJECTIVE(S):**

- HWC7.1 Describe clinicopathologic features neoplastic and non-neoplastic disorders leading to splenomegaly.
- HWC7.2 Explain the contribution of normal splenic function to non-neoplastic diseases.

**HEMATOPATHOLOGY: PLATELETS and COAGULATION DISORDERS**

**Learning Goal 1:** Apply knowledge of platelet structure and function to discuss qualitative and quantitative disorders leading to abnormal bleeding.

**OBJECTIVE(S):**

- HPCD1.1 Summarize the role played by platelets in hemostasis, including platelet adhesion, activation, and aggregation.
- HPCD1.2 Identify examples of each of the following pathogenetic categories of thrombocytopenia: decreased production, decreased platelet survival, sequestration, dilutional.

*EXAMPLES: Generalized bone marrow dysfunction, Selective impairment of platelet production, Ineffective megakaryopoiesis, Immunologic destruction, Nonimmunologic destruction*
HPCD1.3 Compare and contrast the following thrombocytopenia syndromes: immune thrombocytopenic purpura, drug-induced thrombocytopenia, heparin-induced thrombocytopenia.

HPCD1.4 Compare and contrast thrombotic thrombocytopenic purpura with hemolytic uremic syndrome.

HPCD1.5 Explain the biochemical basis of the following congenital and acquired defective platelet disorders: Bernard-Soulier syndrome, Glanzmann thrombasthenia, storage pool disorders, aspirin related dysfunction, uremia-related dysfunction

HPCD1.6 Explain the bases of marrow aplasia/myelophthisis, nutritional deficiency and myelodysplasia as causes of thrombocytopenia form of marrow failure.

**Learning Goal 2:** Apply knowledge of normal hemostasis, interaction of platelets and procoagulant and anticoagulant factors to describe qualitative and quantitative disorders leading to abnormal bleeding and thrombosis.

**OBJECTIVE(S):**

HPCD2.1 Distinguish among the following manifestations of hemorrhage: hematoma, petechiae, purpura, ecchymoses.

HPCD2.2 Identify the following stages of hemostasis: vasoconstriction, primary hemostasis, secondary hemostasis, antithrombotic counterregulation.

HPCD2.3 Outline the process of secondary hemostasis, in terms of intrinsic pathway, extrinsic pathway, common pathway, fibrin formation and fibrinolysis.

HPCD2.4 Describe how particular proteins that regulate the proteases to activate the clotting cascade either promote or inhibit coagulation.

HPCD2.5 Compare and contrast the roles of endothelial injury, stasis, and alterations in the regulation of blood clotting in the development of the hypercoagulable state.

HPCD2.6 Give examples and discuss the pathophysiology of inherited versus acquired conditions that increase the risk of thrombophilia.

HPCD2.7 Discuss disseminated intravascular coagulopathy (DIC) in terms of etiologies, pathogenesis, clinical presentation, and course.

HPCD2.8 Discuss the pathogenesis and clinical and laboratory manifestations of hemophilia A and explain how it differs from hemophilia B.

HPCD2.9 Describe the pathogenesis and clinical and laboratory findings in liver disease and vitamin K deficiency.

HPCD2.10 Compare and contrast types I, II and III von Willebrand disease and explain the quantitative or qualitative abnormalities and the laboratory features observed in each type.
HPCD2.11 Describe the pathogenesis and clinical and laboratory findings in antiphospholipid antibody syndrome.

HPCD2.12 Explain the mechanism of heparin-induced thrombocytopenia/thrombosis and describe its clinical presentation and approach to therapy.

HPCD2.13 Explain the risk of thrombophilia in cancer, describe the context of Trousseau syndrome, and give classic examples of malignancies associated with thrombophilia.

RESPIRATORY SYSTEM

Learning Goal 1: Apply knowledge of the structure and function of blood vessels to explain the pathogenesis, clinical manifestations, and pathologic findings in pulmonary embolism, pulmonary hypertension, and diffuse pulmonary hemorrhage syndromes.

OBJECTIVE(S):

- RS1.1 Compare and contrast the clinical manifestations, radiographic and pathologic findings, and potential consequences of pulmonary embolism in terms of single versus multiple and small versus large emboli.
- RS1.2 List the factors, including underlying conditions, which can impact the incidence and clinical significance of pulmonary embolism.
- RS1.3 List the structural cardiopulmonary conditions that are frequently associated with pulmonary hypertension.
- RS1.4 Explain how each of the following cardiopulmonary conditions contributes to pulmonary hypertension: increase pulmonary blood flow or pressure, increase pulmonary vascular resistance, or left heart resistance to blood flow.
- RS1.5 Describe the pathogenesis of pulmonary hypertension in hereditary and secondary forms and the characteristic gross and microscopic morphologic features of each.

  EXAMPLE: BMPR2 mutation, decreased prostacyclin and nitric oxide, endothelial activation, growth factors and cytokines

- RS1.6 Compare and contrast the clinical manifestations, pathogenesis, and pathologic findings in Goodpasture Syndrome and Wegener Granulomatosis.

Learning Goal 2: Apply knowledge of the local pulmonary defense mechanisms and systemic host resistance to infection to discuss pathogenesis, classification, clinical manifestations, and pathologic findings in lower respiratory tract infections in immunocompetent and immunocompromised hosts.
OBJECTIVE(S):

RS2.1 Name the common infectious agents that produce pulmonary disease that are generally associated with defects in innate, humoral, or cell-mediated immunity.

RS2.2 Describe the classification of pneumonias by clinical setting and name the common etiologic agents for each category.

RS2.3 Compare and contrast the clinical presentation and manifestations, gross and microscopic pathology, prognosis, and potential complications for each category of pneumonias.

RS2.4 Define bronchopneumonia, lobar pneumonia, and atypical pneumonia/interstitial pneumonitis and compare and contrast the common etiologic agents and gross microscopic findings for each.

RS2.5 Compare and contrast the clinical presentation, and gross and microscopic findings in primary, secondary/reactivation, and miliary tuberculosis.

RS2.6 Define antigenic drift and antigenic shift in influenza viruses and discuss how these can result in epidemics and pandemics.

RS2.7 Compare and contrast the pathologic findings in upper and lower respiratory tract influenza infections.

RS2.8 Name risk factors for aspiration pneumonia and describe the pathology, prognosis, and potential complications.

RS2.9 Define lung abscess in terms of pathogenesis, typical microorganisms, clinical presentation and course, and pathologic findings.

RS2.10 Compare and contrast the causative agents, geographic locations, clinical presentation, and pathologic findings in chronic pneumonia caused by fungal organisms.

RS2.11 Discuss the differences in clinical presentation and etiologic agents of pneumonia in immunocompetent versus immunocompromised hosts.

Learning Goal 3: Apply knowledge of the molecular basis of neoplasia to describe clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of lung neoplasms.

OBJECTIVE(S):

RS3.1 Describe the common locations for the different types of lung cancer.

RS3.2 Identify key gross and histopathologic features that may help differentiate between small cell, adenocarcinoma, and squamous cell carcinoma.

RS3.3 Describe features that favor the diagnosis of metastatic carcinoma over a primary lung tumor.
RS3.4 Describe the contribution of specific genetic mutations that contribute to particular lung cancers and explain how these mutations affect therapeutic decisions.

RS3.5 Explain the environmental factors that predispose to the development of lung cancer and illustrate how these factors interact with genetic factors in the development of cancer.

**Learning Goal 4:** Apply knowledge of the genetic and environmental factors leading to cell injury to explain the clinical and pathophysiological consequences that result in obstruction to airflow.

**OBJECTIVE(S):**

RS4.1 Describe the role of smoking in emphysema; name the four (4) different types of emphysema, which is most common, and which lobes are most involved in centrilobular emphysema.

RS4.2 Explain the gross morphologic changes associated with bronchiectasis and name two diseases which may lead to bronchiectasis.

RS4.3 Describe the clinicopathologic features of the pneumoconioses.

**HEAD and NECK**

**Learning Goal 1:** Apply knowledge of the structure and function of the salivary glands to an understanding of the clinicopathologic features associated with disorders presenting with gland enlargement.

**OBJECTIVE(S):**

HN1.1 Describe the potential causes for obstruction of the salivary gland duct.

HN1.2 Name disorders arising from lymphocytic infiltration of the salivary glands and discuss their potential neoplastic complications.

HN1.3 Define Sjogren syndrome and discuss how it relates to salivary gland dysfunction.

**Learning Goal 2:** Apply knowledge of the etiology, pathogenesis, morphological appearance and classification of neoplasms involving the salivary glands, oral cavity, upper airways and larynx to their diagnosis, prediction of biological behavior, prevention, and treatment.

**OBJECTIVE(S):**

HN2.1 Distinguish the clinicopathologic features of the two benign tumors, mixed and Warthins, from the malignant mucoepidermoid carcinoma.

HN2.2 Discuss the pathogenesis of squamous cell carcinoma of the oropharynx and the spectrum of histologic findings from normal mucosa to invasive disease.
HN2.3 Compare and contrast HPV-driven and alcohol/tobacco-driven development of squamous cell carcinoma including tumor formation and progression, anatomic location, and survival rate.

GASTROINTESTINAL TRACT

Learning Goal 1: Apply knowledge of the embryology of the foregut, midgut and hindgut to summarize the morphological features and clinical presentation of developmental anomalies.

OBJECTIVE(S):

GT1.1 Outline the clinicopathological features of tracheoesophageal fistula, pyloric stenosis, intestinal atresia, and Hirschsprung diseases.

Learning Goal 2: Apply knowledge of the gross anatomy of the GI tract and hemodynamic principles to discuss vascular disorders.

OBJECTIVE(S):

GT2.1 Outline the pathogenesis and clinicopathological features for common disorders of the GI tract that arise from hypoxia or ischemia.

GT2.2 Compare and contrast the pathophysiology of necrotizing enterocolitis from bowel infarction due to shock and atherosclerosis.

Learning Goal 3: Apply knowledge of the molecular basis of neoplasia to explain the clinical presentation, inheritance risk, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of gastrointestinal neoplasms.

OBJECTIVE(S):

GT3.1 Outline the precursor lesions, risk factors, and hereditary cancer syndromes that lead to GI neoplasia.

GT3.2 Summarize the molecular basis and clinicopathologic features, local and systemic, for esophageal cancer, gastric cancer, GI lymphoma, GIST, colon and anal cancer.

GT3.3 Describe the location of adenocarcinomas versus squamous cell carcinomas of the esophagus and list the major risk factors for each.

GT3.4 List the two most important prognostic factors for colon cancer and explain why they are most important.

GT3.5 Describe the different types of polyps and the risk of developing cancer.
Learning Goal 4: Apply knowledge of the gross anatomy of the GI tract and its blood supply to describe presenting signs and symptoms, and pattern of spread of gastrointestinal neoplasms.

OBJECTIVE(S):

GT4.1 Distinguish between carcinomas arising in the left and right colon in terms of symptoms and morphology.

GT4.2 Describe how colon cancers are staged and list the common sites of metastases.

Learning Goal 5: Apply knowledge of immune system dysregulation to discuss specific immune-related disorders.

OBJECTIVE(S):

GT5.1 Compare and contrast the pathophysiology and clinicopathological features of inflammatory bowel disease.

GT5.2 Explain the pathophysiology of gliadin hypersensitivity (Celiac disease).

GT5.3 Describe the distribution of Crohn’s disease and how transmural involvement is related to complications.

Learning Goal 6: Apply knowledge of gastrointestinal anatomy and physiology to summarize the clinicopathologic features, diagnostic criteria, and therapy of disorders presenting with malabsorption.

OBJECTIVE(S):

GT6.1 Compare and contrast the pathogenesis and clinicopathologic features of systemic disorders leading to malabsorption.

EXAMPLES: diabetes, cystic fibrosis, amyloidosis

GT6.2 Outline disorders of the pancreas and bile acid metabolism, and discuss how they lead to malabsorption.

GT6.3 Explain how Celiac disease, sprue, gastroenteritis, and inflammatory bowel disease lead to malabsorption.

Learning Goal 7: Apply knowledge of common pathogens and principles of immunity to describe the morphological features and clinical presentation of infectious diseases affecting immunocompetent and immunocompromised patients.

OBJECTIVE(S):
GT7.1 Compare the underlying mechanism and clinicopathologic features of GI tract involvement by common bacterial, fungal and parasitic pathogens.

GT7.2 Relate the clinicopathologic features of Helicobacter to chronic gastritis and ulcer formation.

**Learning Goal 8:** Apply knowledge of GI anatomy and physiology to explain the clinicopathologic features, diagnostic criteria and therapy of disorders resulting in acid reflux, abnormal GI motility and gastrointestinal tract obstruction.

**OBJECTIVE(S):**

GT8.1 Describe the pathophysiology and clinico-pathological features of disorders presenting with dysphagia.

GT8.2 Compare and contrast the pathophysiology of gastrointestinal disorders that present with GI obstruction.

GT8.3 Describe the complications of diverticulosis.

**HEPATOBIILIARY**

**Learning Goal 1:** Apply knowledge of pathogenic organisms infecting the liver and their transmission, natural history, pathogenesis, laboratory profiles, and histopathological patterns of injury to the prevention and diagnosis of hepatitis.

**OBJECTIVE(S):**

HB1.1 Explain the routes of transmission of different hepatotropic viruses and how they relate to the public health measures that have been implemented to prevent their transmission.

*EXAMPLES: screening of donated blood, improved public hygiene, prophylaxis against venereal spread.*

HB1.2 Compare and contrast the possible clinical outcomes of the major hepatotropic viruses with particular reference to the incidence of progression to chronic hepatitis and cirrhosis.

HB1.3 Describe the pathophysiology associated with the major hepatotropic viruses and explain how this knowledge can be used to assess the presence of hepatitis, and the management and prognosis of the disease.

HB1.4 Explain the pathogenetic mechanisms of injury that result in the histopathological findings observed in acute and chronic viral hepatitis.

HB1.5 Describe the etiology of hepatic abscesses and the pathways that infectious agents may take to reach the liver.
HB1.6 Classify types of cirrhosis, in terms of etiology, pathogenesis, morphologic pattern (gross and microscopic), and their relationship to neoplasia.

**Learning Goal 2:** Apply knowledge of the cellular response to injury, the pathogeneic mechanisms leading to disease and the biochemical alterations of hepatic function to explain the clinicopathologic features, prognosis and treatment of disorders resulting from ethanol and other drugs and toxins.

**OBJECTIVE(S):**

- HB2.1 Describe the clinicopathologic features of excessive ethanol ingestion, focusing on biochemical pathways and short and long term complications, and contrast them with nonalcoholic fatty liver disease.

- HB2.2 Describe the clinicopathologic features of excessive acetaminophen ingestion focusing on biochemical pathways and short and long term complications.

**Learning Goal 3:** Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of hepatic neoplasms.

**OBJECTIVE(S):**

- HB3.1 Compare and contrast, in the context of geographic location, the epidemiological importance of the known etiologic agents associated with the development of hepatocellular carcinoma and suggest public health measures that might decrease its incidence.

- HB3.2 Discuss the pathogenesis of hepatocellular carcinoma arising in the setting of hepatitis B and hepatitis C, chronic hepatitis, and cirrhosis.

- HB3.3 Describe how the molecular basis of a hepatic adenoma contributes to the risk of malignant transformation.

- HB3.4 Identify the major space-occupying lesions that may be seen on radiographic imaging of the normal and cirrhotic liver, and discuss complications of cirrhosis.

- HB3.5 Describe the factors that lead to metastasis to the liver and the features of metastatic disease that distinguish it from primary neoplasms.

**Learning Goal 4:** Apply knowledge of the cellular response to injury, the pathogeneic mechanisms leading to disease and the biochemical alterations of hepatic function to describe the clinicopathologic features, prognosis and treatment of intrahepatic and extrahepatic biliary tract diseases.

**OBJECTIVE(S):**
HB4.1 Outline how autoimmune hepatitis, primary and secondary biliary cirrhosis, and primary sclerosing cholangitis differ regarding associated conditions, incidence, sex predilection, etiology, laboratory features, clinical features and prognosis.

HB4.2 Compare and contrast the etiology and treatment of biliary atresia and neonatal hepatitis.

**Learning Goal 5:** Apply knowledge of the molecular basis of neoplasia to an understanding of the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of neoplasms involving the biliary tree.

**OBJECTIVE(S):**

HB5.1 Describe the epidemiology, morphology, and clinical features of gallbladder and extrahepatic biliary tract carcinoma.

HB5.2 Describe the presenting symptoms of cholangiocarcinoma and how the symptoms relate to the location.

**Learning Goal 6:** Apply knowledge of both the embryonic principles of hepatic and bile tract development and mechanisms of fibroinflammatory injury to an understanding of disorders due to maldevelopment and acquired abnormalities of the biliary tree.

**OBJECTIVE(S):**

HB6.1 Describe the inheritance, etiology, clinical and laboratory features, and prognosis of congenital hepatic fibrosis.

HB6.2 Describe the inheritance, etiology, clinical and laboratory features, and prognosis of polycystic liver disease.

**Learning Goal 7:** Apply knowledge of general biochemical principles to an understanding of how gallstones develop, risk factors for their development, and their clinical presentation and complications.

**OBJECTIVE(S):**

HB7.1 Describe the risk factors, clinical features, complications, mechanisms, and composition of gallstones.

HB7.2 Differentiate the epidemiology, morphology, clinical features, and complications of acute and chronic cholecystitis.

HB7.3 Differentiate the etiology, pathogenesis, morphology, and clinical features of empyema and hydrops of the gallbladder.
PANCREAS

Learning Goal 1: Apply knowledge of the structure and function of the pancreas to an understanding of the clinicopathologic features, diagnostic criteria of disorders resulting from cellular injury to the exocrine pancreas.

OBJECTIVE(S):

P1.1 Compare and contrast acute and chronic pancreatitis in terms of etiology, pathogenesis, morphologic features and complications.

P1.2 Describe genetic disorders that affect the function of the exocrine pancreas.

Learning Goal 2: Apply knowledge of the molecular basis of neoplasia to an understanding of the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of pancreatic neoplasms.

OBJECTIVE(S):

P2.1 Describe the major types of neoplasms affecting the exocrine pancreas.

P2.2 Explain how the location of a pancreatic neoplasm determines its presenting symptoms and name risk factors for pancreatic adenocarcinoma.

P2.3 Describe neoplasms of the endocrine pancreas.

KIDNEY AND URINARY TRACT

KIDNEY AND URINARY TRACT: Kidney

Learning Goal 1: Apply knowledge of the molecular basis of neoplasia to explain the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of renal neoplasms.

OBJECTIVE(S):

UTK1.1 Compare and contrast the 3 major types of renal cell carcinoma (clear cell, papillary, and chromophobe) in terms of clinical presentation, diagnostic morphological features, and molecular pathogenesis.

UTK1.2 Compare pelvic urothelial malignancies with renal cell carcinomas in relation to risk factors, microscopic appearance, and biological behavior.

UTK1.3 Describe how renal cell carcinoma is graded and staged and discuss what determines prognosis.
UTK1.4 Describe the clinical and pathologic features and molecular basis for Wilms tumor and list the histologic features that are important to recognize in determining prognosis.

**Learning Goal 2:** Apply knowledge of kidney structure and function to summarize how acquired and hereditary abnormalities of the renal tubules and interstitium cause acute and/or chronic renal dysfunction.

**OBJECTIVE(S):**

UTK2.1 Describe the clinicopathological features and pathogenesis of tubulointerstitial diseases and discuss how their pathogenesis relates to treatment and outcomes.

UTK2.2 Compare and contrast acute pyelonephritis, drug-induced interstitial nephritis, and lupus nephritis in terms of pathogenesis, clinical presentation, histopathological appearance, and treatment.

UTK2.3 Compare and contrast ischemic and nephrotoxic forms of acute tubular injury, including typical clinical contexts, pathogenesis of renal failure, microscopic appearance, and expected outcome.

**Learning Goal 3:** Compare and contrast the common causes of renal vascular dysfunction in terms of size and type of vessel involved, characteristic gross and microscopic morphology, pathogenesis, and clinical presentation.

**OBJECTIVE(S):**

UTK3.1 Compare thrombotic and embolic causes of renal arterial occlusions in terms of underlying pathogenesis, gross and microscopic pathological anatomy and clinical presentation.

UTK3.2 Discuss how the pathogenesis of hypertension leads to structural changes in the renal vasculature and how the characteristic pathological vascular lesions of the kidney seen in hypertension cause renal dysfunction.

UTK3.3 Compare and contrast typical hemolytic uremic syndrome (HUS), atypical HUS, and thrombotic thrombocytopenic purpura (TTP) in terms of clinical presentation, renal histopathology, pathogenesis, and prognosis.

**Learning Goal 4:** Apply knowledge of the embryologic principles of kidney and lower urinary tract development to explain developmental anomalies.

**OBJECTIVE(S):**

UTK4.1 Compare autosomal dominant and autosomal recessive polycystic kidney disease in terms of pathological anatomy, molecular pathogenesis, and clinical presentation.
Learning Goal 5: Apply knowledge of the structure and function of the kidney to describe the pathogenetic mechanisms, diagnostic criteria and clinicopathologic features of glomerular diseases presenting with asymptomatic proteinuria, nephrotic and nephritic syndrome.

OBJECTIVE(S):

UTK5.1 Describe the proliferative and pro-inflammatory pathologies of conditions presenting with nephritic syndrome.

UTK5.2 Describe the pathophysiology and morphologic features of nephrotic syndrome.

UTK5.3 Compare and contrast the mechanisms of immune complex and antibody mediated glomerulonephritis.

UTK5.4 Describe the pathogenesis of diabetic nephropathy and the associated clinicopathologic features.

UTK5.5 Describe the pathogenesis of the nephropathies associated with dysproteinemia.

KIDNEY AND URINARY TRACT: Bladder

Learning Goal 1: Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of bladder neoplasms.

OBJECTIVE(S):

UTB1.1 Compare and contrast the different precursor lesions of urothelial carcinoma in terms of architecture, cytologic features, molecular-genetic changes, and propensity for invasion/progression.

EXAMPLE: papillary urothelial carcinoma; carcinoma in situ=flat lesion

UTB1.2 Relate the risk factors for urothelial carcinoma to general principles of carcinogenesis.

UTB1.3 Describe the typical clinical presentation of urothelial carcinoma and the advantages and limitations of urine cytology in diagnosis and surveillance of urothelial carcinoma.

UTB1.4 Relate stage of bladder cancer to prognosis and therapy, including the role of BCG, in treatment of low-stage tumors.

Learning Goal 2: Apply knowledge of innate and adaptive immunity, pathogenic organisms infecting the bladder and their transmission to explain the natural history, pathogenesis, diagnosis, laboratory profiles, histopathological features, and prevention of cystitis.

OBJECTIVE(S):
UTB2.1 Recognize the typical clinical symptomatology of acute cystitis.

UTB2.2 Identify the most common non-infectious causes of cystitis.

UTB2.3 Describe situations in which cystitis may result in mass lesions of the urinary bladder.

Learning Goal 3: Apply knowledge of the anatomy and physiology of the kidney to describe how disorders may lead to obstruction of urinary outflow.

OBJECTIVE(S):

UTB3.1 Describe the pathogenesis of bladder diverticula, including congenital and acquired, and their potential role in infection, lithiasis, and obstruction and occult carcinoma.

UTB3.2 List the different chemical types of nephrolithiasis, and explain the pathophysiologic mechanisms related to development, and therapy/prevention of urinary stones.

UTB3.3 Explain several causes of urinary obstruction.

MALE REPRODUCTIVE SYSTEM

MALE REPRODUCTIVE SYSTEM: Prostate

Learning Goal 1: Apply knowledge of the molecular and cellular origins of prostate cancers, specifically adenocarcinoma, to summarize the epidemiology, clinicopathological features, natural history and treatment strategies for this disease.

OBJECTIVE(S):

MP1.1 Outline the cellular phenotype of the typical adenocarcinoma cell and describe its molecular and immunohistochemical characteristics.

MP1.2 Define the histopathological diagnostic criteria for the diagnosis of adenocarcinoma.

MP1.3 Explain the epidemiology of prostate cancer with respect to age, race and family history.

MP1.4 Explain the significance of “histological” adenocarcinoma versus a “clinically significant” adenocarcinoma.

Learning Goal 2: Apply knowledge of the molecular and cellular origins of non-neoplastic disorders of the prostate, specifically prostatitis and nodular hyperplasia, to explain the epidemiology, clinicopathological features, natural history and treatment strategy for these diseases.

OBJECTIVE(S):
MP2.1 Explain the molecular and hormonal origins of nodular hyperplasia, the area of the prostate affected, the natural history of the disease, various treatment strategies, and anticipated outcomes of treatment.

MP2.2 Describe the pathophysiologic basis for inflammatory conditions affecting the prostate.

*EXAMPLE: idiopathic, infectious*

**MALE REPRODUCTIVE SYSTEM: Testes**

**Learning Goal 1:** Apply knowledge of the molecular and cellular origins of non-neoplastic disorders of the testis to explain the epidemiology, clinicopathological features, natural history and treatment strategy for these diseases.

**OBJECTIVE(S):**

MT1.1 Name the structure through which the testes descend during fetal development and what is brought with the testes in the descent. Describe the complications observed for failure of the testes to descend (cryptorchidism).

MT1.2 Describe the clinicopathologic features that occur in the testis due to torsion of the spermatic cord.

MT1.3 List several inflammatory conditions affecting the testis and the clinicopathologic features associated with each.

**Learning Goal 2:** Apply knowledge of the molecular and cellular origins of the common types of testicular cancer to explain the epidemiology, clinicopathological features, natural history and treatment strategies for this disease.

**OBJECTIVE(S):**

MT2.1 Name the most important risk factors for development of a germ cell tumor of the testis and outline the clinicopathologic features for the different morphologic patterns seen.

MT2.2 Outline a differential diagnosis for a testicular mass.

**BREAST**

**Learning Goal 1:** Apply knowledge of the embryology, cellular responses to injury, underlying etiology, and biologic and molecular alterations to describe the clinical presentation, inheritance risk, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and therapy of non-neoplastic disorders of the breast.

**OBJECTIVE(S):**
BR1.1 Identify the most frequently diagnosed breast lesions by age of the patient, based on the most common clinical presentations.

BR1.2 Discuss silicone breast implants in terms of the morphologic changes in the adjacent breast and the risk of subsequent autoimmune disease and cancer.

BR1.3 Compare and contrast reactive breast conditions in terms of etiology, pathogenesis, morphology and clinical features.

BR1.4 Discuss the clinical significance of proliferative and non-proliferative fibrocystic change, with and without atypia, and describe how family history affects the subsequent risk of developing breast cancer.

**Learning Goal 2: Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of breast neoplasms.**

**OBJECTIVE(S):**

BR2.1 Compare and contrast fibroadenoma and phyllodes tumor in terms of clinical features, morphologic findings, and prognosis.

BR2.2 Describe the proposed precursor-carcinoma sequence in breast cancer and name the characteristic morphologic changes.

BR2.3 Compare and contrast ductal carcinoma in situ (DCIS) and lobular carcinoma in situ (LCIS) in terms of incidence, clinical presentation, morphology, biomarker expression, pattern of spread, natural history, treatment, and prognosis.

BR2.4 For the most common breast cancer susceptibility genes, describe the normal function of the gene product, incidence of gene mutation, reasons for its association with cancer, percent of hereditary breast cancer, and risk of breast cancer by age 70.

BR2.5 Explain the major molecular classes of invasive ductal carcinoma of the breast identified by gene expression profiling, and describe how each correlates with prognosis and response to therapy.

BR2.6 Construct a table to compare and contrast invasive ductal carcinoma (NOS), invasive lobular carcinoma, medullary carcinoma, colloid (mucinous) carcinoma, tubular carcinoma, and metaplastic carcinoma of the breast in terms of incidence, age predilection, etiology, pathogenesis, clinical presentation, gross and microscopic morphology, grade, molecular classification, patterns of spread, clinical course, prognostic indicators, treatment options and survival rates.

BR2.7 Explain the prognosis and likelihood of recurrence and response to therapy for a breast cancer patient based on knowledge of molecular classification and/or gene expression profiling, morphologic classification, grade, prognostic marker studies, and other predictive factors.
FEMALE REPRODUCTIVE TRACT

FEMALE REPRODUCTIVE TRACT: Uterus

Learning Goal 1: Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of uterine neoplasms.

OBJECTIVE(S):

FU1.1 Describe common uterine neoplasms, including important clinical features, and relate pathologic features to treatment and prognosis.

FU1.2 Compare and contrast the precursors, clinical setting, risk factors, pathologic findings and prognosis for type I and type II carcinomas of the endometrium.

FU1.3 Discuss the relationship of endometrial carcinoma to hereditary non-polyposis colorectal carcinoma.

FU1.4 Define the natural history, clinical presentation and management of benign smooth muscle tumors of the uterus and their risk for malignant transformation.

Learning Goal 2: Apply knowledge of uterine physiology, endocrinology and anatomy to compare and contrast the clinical presentation and pathology of common non-neoplastic uterine disorders.

OBJECTIVE(S):

FU2.1 Define endometrial hyperplasia and discuss its etiology, classification and prognosis.

FU2.2 Identify the phases of the menstrual cycle and the major hormonal changes that occur, comparing normal menstruation to common causes of abnormal bleeding in adolescents, perimenopausal, and postmenopausal women.

FU2.3 Compare and contrast the pathology of adenomyosis with endometriosis.

FEMALE REPRODUCTIVE TRACT: Ovary

Learning Goal 1: Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of ovarian neoplasms

OBJECTIVE(S):

FO1.1 Describe the embryologic development and the histologic components of the ovary, including surface mullerian epithelium, germ cells and the sex-cord stromal cells.
FO1.2 Describe the risk factors, genetic associations and molecular basis, including hereditary cancer syndromes, for ovarian neoplasms.

Learning Goal 2: Apply knowledge of infectious diseases, embryology and immunology to explain the major pathologic features of processes affecting the ovary.

OBJECTIVE(S):

FO2.1 Describe the pathogens, bacterial, fungal and parasitic, that can cause ovarian disease and explain the underlying mechanisms, clinicopathologic features, and complications.

EXAMPLES: tubo-ovarian abscess, various STDs, actinomycosis, and parasitic

FO2.2 Explain the pathophysiologic basis of polycystic polycystic ovary syndrome.

FO2.3 Explain the mechanism(s) where dysregulation of the immune system gives rise to ovarian disease and describe the pathology observed.

EXAMPLES: autoimmune oophoritis

FO2.4 Describe the clinicopathologic features of menopause and the basis for treatment.

FEMALE REPRODUCTIVE TRACT: Disorders of Pregnancy

Learning Goal: Apply knowledge of embryology, cellular responses to injury, hemodynamics and molecular alterations to summarize the clinical presentation, morphologic appearance, classification, diagnosis, biologic behavior and therapy of disorders of pregnancy.

OBJECTIVE(S):

FDP1.1 Describe risk factors, characteristic morphologic findings, potential outcomes, and the medical/surgical options for management of ectopic pregnancy in relation to the pathogenesis and likelihood of adverse consequences.

FDP1.2 List two (2) fetal and six (6) maternal causes for spontaneous abortion and indicate which is most common.

FDP1.3 Describe how disorders of late pregnancy can lead to effects that threaten the mother and/or fetus.

EXAMPLES: cord knots, placental infection, placental abruption, abnormal implantation, maternal vascular disease

FDP1.4 Discuss the ascending and hematogenous infections occurring during pregnancy in terms of etiology, pathogenesis, morphology, methods of diagnosis, prognosis and treatment.
FDP1.5 Explain the principal pathophysiologic aberrations of the placenta and maternal circulation in pre-eclampsia and eclampsia; the characteristic morphologic features in the placenta, liver, kidney and brain; and how management is affected by gestational age and severity of disease.

FDP1.6 Explain how to differentiate forms of gestational trophoblastic disease based on etiology, pathogenesis, morphologic features, clinical features, and laboratory findings, including potential consequences and/or subsequent risks, treatment, and prognosis for each.

EXAMPLE: partial and complete hydatidiform mole, invasive mole, choriocarcinoma, and placental-site trophoblastic tumor

FDP1.7 Describe the pathophysiologic effects of diabetes mellitus on the mother and fetus.

ENDOCRINE

Learning Goal 1: Apply knowledge of pituitary physiology to describe the pathophysiology and clinicopathologic features of disorders associated with hyperpituitarism and hypopituitarism.

OBJECTIVE(S):

EN1.1 List several causes for destruction of the anterior pituitary and the clinicopathologic features associated with each.

EN1.2 Define Sheehan's syndrome and the clinicopathologic features associated with it.

EN1.3 Outline the clinicopathologic features associated with disorders affecting the posterior pituitary gland.

Learning Goal 2: Apply knowledge of thyroid physiology to explain the pathophysiology and clinicopathologic features of disorders associated with hyperthyroidism and hypothyroidism.

OBJECTIVE(S):

EN2.1 Compare and contrast the causes of hyperthyroidism versus hypothyroidism.

EN2.2 Compare and contrast the clinicopathologic features of hyperthyroidism versus hypothyroidism.

Learning Goal 3: Apply knowledge of immune system dysregulation to summarize immune-related disorders of the thyroid.

OBJECTIVE(S):

EN3.1 Outline the pathophysiology and clinicopathologic features of Graves disease, Hashimoto thyroiditis, and subacute lymphocytic thyroiditis.
EN3.2 Compare and contrast immune-mediated thyroid disease with subacute granulomatous thyroiditis (DeQuervain thyroiditis).

**Learning Goal 4:** Apply knowledge of adrenal physiology to describe the pathophysiology and clinicopathologic features of disorders associated with adrenocortical hyperfunction (hyperadrenalism) and adrenocortical insufficiency.

**OBJECTIVE(S):**

EN4.1 Compare and contrast the causes and clinicopathologic features of hypercortisolism (Cushing syndrome) and the pathophysiologic basis distinguishing between these causes and the management of this disease.

EN4.2 Compare and contrast the causes and clinicopathologic features of hyperaldosteronism.

EN4.3 Outline the clinicopathologic features of congenital adrenal hyperplasia.

EN4.4 Compare and contrast the causes of adrenocortical insufficiency, including the pathogenesis of primary acute and chronic adrenocortical insufficiency.

**Learning Goal 5:** Apply knowledge of the molecular basis of neoplasia to explain the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of endocrine neoplasms.

**OBJECTIVE(S):**

EN5.1 Compare and contrast the clinicopathologic features of follicular adenomas, follicular carcinoma, and papillary thyroid carcinoma.

EN5.2 Describe the molecular basis and clinicopathologic features of medullary thyroid carcinoma.

EN5.3 Outline the clinicopathologic features of pheochromocytoma and compare and contrast the hereditary cancer syndromes associated with paragangliomas/pheochromocytomas.

EN5.4 Explain the clinicopathologic features of pituitary adenomas and their associated clinical syndromes.

**Learning Goal 6:** Apply knowledge of the structure and function of the endocrine pancreas and biochemical principles of carbohydrate metabolism to summarize the clinicopathologic features, diagnostic criteria and therapy of disorders resulting from excess or decreased production of insulin and other islet cell hormones.

**OBJECTIVE(S):**

EN6.1 Compare and contrast the clinicopathologic features of Type 1 and Type 2 diabetes.
EN6.2 Outline the pathologic complications of diabetes mellitus.

EN6.3 Compare and contrast MEN 1 with MEN 2 and 3.

SKIN

Learning Goal 1: Apply knowledge of histology, cell biology, inflammation and neoplasia to an understanding of the clinical presentation, biologic behavior, morphologic appearance, and classification of diseases of the skin.

OBJECTIVE(S):

SK1.1 Describe the pathophysiologic basis for changes in the color, surface texture, swelling, temperature, and sensitivity of skin.

Examples of color: erythema, blanching, jaundice
Examples of surface texture: scaling, ulceration, necrosis, pustules, peeling
Examples of swelling: induration, cellular mass, foreign body, edema
Examples of temperature: increased vs. decreased temperature
Examples of sensitivity: itching, hypersensitive

Learning Goal 2: Apply knowledge of the anatomic and immunologic structure of the skin to discuss the role of skin in protecting against direct invasion of skin and appendages by pathogens.

OBJECTIVE(S):

SK2.1 Explain the anatomic basis for the skin as a barrier and the role of normal flora that colonize the skin in this function.

SK2.2 Describe common bacterial, viral, fungal and parasitic agents that may cause cutaneous infections and the particular sites that they infect.

Example: human papillomavirus infects keratinocytes
Example: bacteria responsible for acne – is this infection or disruption of symbiosis
Example: MRSA, MSSA; group A strep; herpes simplex virus

Learning Goal 3: Apply knowledge of basic concepts in immunopathology and the key immunologic functions of components of the skin to understand the pathologic basis of disease caused by reactivity to exogenous agents versus immunologically-driven disease with a genetic component.

OBJECTIVE(S):

SK3.1 Describe the clinical features and pathologic basis for skin manifestations to exogenous antigens including infectious organisms, drugs, chemicals and environmental agents.
SK3.2 Describe the clinical features and pathologic basis for the following immunologically-driven diseases with a genetic component: eczema, psoriasis and vitiligo.

Learning Goal 4: Apply knowledge of genetics, skin structure and function and basic principles of pathology to an understanding non-neoplastic inherited disorders of the skin.

OBJECTIVE(S):

SK4.1 Describe the genetic basis for blistering diseases affecting the skin.

Example: Epidermolysis bullosa

Learning Goal 5: Apply knowledge of the molecular basis of neoplasia to an understanding of the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and therapy of benign and malignant skin neoplasms.

OBJECTIVE(S):

SK5.1 Describe the clinical presentation and histopathologic findings of benign skin growths of the following cellular origins: Basal cell, Squamous cell, Melanocytes.

SK5.2 Describe the clinical presentation, precursor lesions, risk factors and hereditary cancer syndromes that lead to the following skin cancers: Basal cell carcinomas, Squamous cell carcinoma, Melanoma.

SK5.3 Identify the genetic disorders with high risk of development of skin cancers and explain the molecular basis of that risk as well as the genomic mutations involved.

Example: dysplastic nevus (BK mole/familial melanoma) syndrome.

SK5.4 Explain the role of Ultraviolet light and other environmental factors in development of various skin cancers.

SK5.5 Describe the various clinical presentations of cutaneous T cell lymphoma/mycosis fungoides and discuss the natural course of the disease.
Learning Goal 1: Apply knowledge of the molecular basis of neoplasia to describe the clinical presentation, biologic behavior, morphologic appearance, classification, diagnosis, prognosis and targeted therapy of bone neoplasms.

OBJECTIVE(S):

MS1.1 List examples of bone forming, cartilage forming, and other common bone tumors.

MS1.2 Describe the most common benign and malignant bone forming tumors in children and adolescents in terms of clinical presentation, radiologic findings, histologic features, treatment and prognosis.

MS1.3 Describe the most common benign and malignant cartilaginous tumor of bone in children and adolescents in terms of clinical presentation, radiologic findings, histologic features, treatment and prognosis.

MS1.4 Describe the tumors that commonly metastasize to bone, the radiologic manifestations of metastatic lesion involving bone, and the difference between osteoblastic and osteolytic metastases.

MS1.5 Describe the common soft tissue tumors including the genetic contribution to tumor development and progression.

Learning Goal 2: Apply knowledge of histology, immunology, microbiology, and biological and molecular alterations to discuss clinical presentation, biological behavior, morphological appearance and natural history of non-neoplastic disorders of bones, joints, and skeletal muscle.

OBJECTIVE(S):

MS2.1 Compare and contrast osteomalacia and rickets with respect to pathogenesis and clinicopathologic features.

MS2.2 Discuss the pathogenesis of osteomyelitis, including predisposing factors, organisms involved, morphologic appearance, and complications.

MS2.3 Distinguish primary from secondary osteoporosis in terms of etiology, pathogenesis, and morphology.

MS2.4 Describe the common degenerative diseases of the spine.

MS2.5 Compare and contrast pathologic versus non pathologic fractures including the potential for healing.
NERVOUS SYSTEM

**Learning Goal 1:** Apply knowledge of the pathological and molecular basis of common brain tumors to describe their clinical behavior, effects on the nervous system, and therapies.

**OBJECTIVE(S):**

NS1.1 Explain the pathophysiology underlying the signs and symptoms associated with brain tumors.

NS1.2 List the common types of brain tumors that affect the cerebrum, the cerebellum, the meninges, and the cranial nerves in adults and children; and outline their molecular basis and clinicopathologic features.

NS1.3 Describe the major hereditary tumor syndromes of the nervous system, the genes responsible for each syndrome, and the spectrum of tumors associated with each syndrome.

NS1.4 Explain the pathophysiologic basis for grading primary brain tumors and discuss how grading relates to prognosis and governs patient management.

NS1.5 List several complications of brain tumors.

NS1.6 List carcinomas that commonly metastasize to the central nervous system and describe the locations in which metastases may be seen.

**Learning Goal 2:** Apply knowledge of clinical features, neuroimaging studies and location of lesions(s) to develop a differential diagnosis for CNS infection.

**OBJECTIVE(S):**

NS2.1 Compare and contrast the clinical, gross, and microscopic manifestations of common bacterial, viral, and fungal infections of the central nervous system.

*EXAMPLE: Strep/Staph-focal abscess; Neisseria-acute meningitis; Arboviruses-rhombencephalopathy with microglial nodules; Polio-neuronophagia anterior horns; Aspergillus-angioinvasive hemorrhagic lesions*

NS2.2 List five (5) common opportunistic infections which involve the CNS of immunocompromised individuals and describe their pathologic features.

NS2.3 Outline the clinicopathologic features of Progressive Multifocal Leukoencephalopathy (JC virus) and contrast them with infiltrative astrocytoma.

NS2.4 Describe the gross and microscopic features of acute suppurative meningitis and brain abscess; and name the organisms most commonly associated with each.
Learning Goal 3: Apply knowledge of neuroanatomy, pathogenesis, and biologic behavior to develop differential diagnoses and determine appropriate therapy for disorders of the spinal cord.

OBJECTIVE(S):

NS3.1 Describe the importance of distinguishing ependymoma from infiltrative astrocytoma intraoperatively and list the histologic features of each.

NS3.2 Explain how examination of a spinal cord at autopsy is important for the diagnosis and classification of demyelinating and/or neuromuscular diseases.

NS3.3 Describe the pathogenesis, clinical presentation, and gross and microscopic pathologic features of Multiple Sclerosis.

Learning Goal 4: Apply knowledge of clinical, anatomic and neuropathologic principles to the diagnosis of neuromuscular disorders.

OBJECTIVE(S):

NS4.1 Describe the etiology, pathogenesis, and clinical features of Amyotrophic Lateral Sclerosis.

NS4.2 Describe the etiology, pathogenesis, and clinical features of two types of mitochondrial diseases affecting muscle; and explain why it may be important to obtain fresh frozen muscle to aid diagnosis.

Learning Goal 5: Apply knowledge of structure and function and general pathologic concepts to describe disorders where dementia is a component.

OBJECTIVE(S):

NS5.1 Define the essential underlying abnormalities of amyloid and tau proteins in the most common causes of dementia in the US.

NS5.2 Describe the protein processing abnormalities responsible for multiple neurodegenerative diseases.

NS5.3 Describe the clinical features, gross pathology and histopathology of Alzheimer’s disease and name three (3) regions of the brain that are usually involved.

NS5.4 Name three (3) genes in which mutations have been identified in patients with early onset Alzheimer’s disease.

NS5.5 Name several diseases which involve the basal ganglia and describe how to distinguish among the diseases in terms of gross, microscopic, and clinical pathology.
Learning Goal 6: Apply knowledge of the structure and function of the brain and general immunopathology concepts to summarize disorders that result in demyelination in terms of their etiology, pathogenesis, clinical and morphologic features, natural history and therapeutic options.

OBJECTIVE(S):

NS6.1 Describe the autoimmune mechanism mediated by CD4+ T cells that react against self myelin antigens in Multiple Sclerosis and outline the clinicopathologic features of the disease.

Learning Goal 7: Apply knowledge of the structure and function of the brain and general pathology concepts to discuss disorders resulting from altered blood supply and hypoxia to the brain.

OBJECTIVE(S):

NS7.1 Compare and contrast the two major mechanisms for stroke and how treatment would differ for each.

NS7.2 Describe the pathologic findings seen in the most common causes of traumatic brain injury.

NS7.3 Compare and contrast the etiologies and clinical presentations of epidural, subdural, subarachnoid hemorrhages, basal ganglionic, and lobar hemorrhages.

NS7.4 Describe the mechanism of hypertensive hemorrhage and name three common locations in which this occurs.

NS7.5 Describe how embolic infarcts differ from athero-thrombotic infarcts in pathologic appearance and name three sources of emboli.

NS7.6 Compare and contrast the gross and histopathologic appearance of acute versus remote brain infarction.