

DEMS

Digestive, Endocrine and Metabolic Systems

Course Goals

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1. Describe the normal gross structure, histology and physiology of the digestive organs (salivary glands, esophagus, stomach, small bowel, colon, gall bladder, exocrine pancreas, and liver) and endocrine organs (endocrine pancreas, hypothalamus, pituitary, adrenal, thyroid and parathyroid glands).
2. Discuss the key biochemical regulatory steps in the metabolism of carbohydrates, fats and amino acids, and their role in maintaining the body's energy balance.
3. Discuss the normal nutritional requirements of the body and how energy imbalance can result in common diseases and clinical conditions such as obesity, diabetes, hyperlipidemia and osteoporosis.
4. Describe the causes (genetic, developmental, microbiologic, autoimmune, metabolic, toxic and traumatic) of digestive, metabolic and endocrine dysfunction.
5. Describe the altered structure (pathology) and function (pathophysiology) of digestive and endocrine organs as seen in common diseases and clinical conditions.
6. Apply the principles of pharmacology, therapeutics and therapeutic decision-making to digestive, endocrine and metabolic dysfunction.
7. Discuss how the principles of genomics, proteomics and bioinformatics can be used to better understand health and dysfunction of the digestive, metabolic and endocrine systems.
8. Discuss the scientific principles and limitations of laboratory and radiologic diagnostic methods in the diagnosis of digestive, metabolic and endocrine dysfunction.

Spring 2019

Digestive, Endocrine and Metabolic Systems

Session Learning Objectives

Adrenal Disorders

1. Discuss the causes, anatomic features, diagnosis and consequences of primary and secondary adrenal insufficiency.
2. Describe the genetics, clinical features, diagnostic testing and anatomical imaging of pheochromocytomas.
3. Describe the causes, clinical clues, and biochemical testing of primary aldosteronism.
4. Recognize the clinical features, diagnostic tests and differential diagnostic evaluation of Cushing's Syndrome.
5. Describe how to evaluate adrenal incidentalomas to distinguish likely benign from likely malignant and hormonally active from inactive.

Adrenal Gland Physiology

1. Identify the key steps in steroid hormone biosynthesis.
2. Describe the transport of glucocorticoids in the plasma.
3. Categorize the actions of cortisol on various systems.
4. Diagram the regulation of ACTH production and release.
5. Define the actions of ACTH.
6. Define mechanisms of epinephrine release from medullary chromaffin cells.
7. Describe the body's integrated response to stress.
8. Describe actions of epinephrine and mechanisms of adrenergic receptor action.

Adrenal Pharmacology

1. Describe the metabolic effects of glucocorticoids and explain how these effects can result in serious adverse effects when they are used as pharmacotherapeutic agents.
2. Discuss the structure-activity relationship of the following adrenocorticosteroids, especially those modifications that affect pharmacodynamic activity (mineralocorticoid vs glucocorticoid activity) or route of administration (requirement for hepatic activation), including hydrocortisone (Solu-Cortef®), prednisone-prednisolone, Dexamethasone (Decadron®), and fludrocortisone (Florinef®).
3. Compare and contrast the pharmacotherapeutic rationales for treatment of various disorders of adrenocortical insufficiency and hyperfunction (Addison's disease, Cushing's syndrome, pheochromocytoma) including the pharmacologic agents employed.
4. For the following agents [hydrocortisone, prednisone, methylprednisolone, triamcinolone, dexamethasone] used as anti-inflammatory and immunosuppressive agents, describe their mechanism of anti-inflammatory and immunosuppressive actions, routes of administration, and clinical uses.
5. For the following agents [hydrocortisone, prednisone, methylprednisolone, triamcinolone, dexamethasone] used as anti-inflammatory and immunosuppressive agents, describe their dosing considerations / pharmacokinetics and toxicities, distinguish acute vs chronic vs chronic-cumulative, and compare and contrast their relative salt-retaining vs anti-inflammatory activities vs ACTH suppression.

Adult Obesity and Metabolic Syndrome

1. Define obesity using BMI and waist circumference.
2. Define Metabolic Syndrome using the current AHA/NCEP definition.
3. List the steps in the clinical evaluation of the obese patient.
4. Describe the trajectory of obesity prevalence in the United States since 1985.
5. List the multiple causes of weight gain and obesity.
6. List the medical problems that are associated with obesity.

Approaches to Infectious Diarrhea/Introduction to Infectious Disease Block

1. Identify the two leading causes of death from infectious diseases worldwide.
2. Identify the age group preferentially affected by infectious disease syndromes.
3. Identify the leading cause of morbidity and death with diarrhea.
4. State the most reversible cause of morbidity and death with diarrhea.
5. Compare and contrast inflammatory and non-inflammatory diarrhea, both clinically and anatomically.
6. Name three organisms that cause inflammatory diarrhea and three that cause non-inflammatory diarrhea.
7. Identify the leading cause of acute bacterial diarrhea in the U.S.- all ages.
8. Describe the predominant cause of nosocomial diarrhea.

ARS Pathology Summary and Review with Cases

1. Apply the principles learned during the week to clinical cases.

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ARS Pathophysiology Summary and Review with Cases

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Biosynthesis of Fatty Acids

1. Compare and contrast the differences between saturated and unsaturated fatty acids.
2. Describe how and why fatty acid synthesis is favored when energy sources are in excess.
3. Describe the three phases of fatty acid synthesis and know the substrates for fatty acid synthesis.
4. Describe the mechanisms of action of four regulators of fatty acid synthesis.
5. Explain how chronic alcoholism causes hyperlipidemia in both the liver and serum.

Case Based Review of Carbohydrate and Fat Metabolism

1. Describe the approach to evaluating and treating a patient with high triglyceride levels.
2. Describe the approach to evaluating a patient with high LDL cholesterol using both the NCEP ATP III guidelines and the 2013 AHA guidelines.

Case Based Review of Carbohydrate Metabolism

1. Discuss the process for reviewing carbohydrate biochemistry.

Case Discussion: Vitamins and Micronutrients, Part 1 and 2

1. Describe the clinical presentation, evaluation and treatment of deficiencies of vitamins and micronutrients.

Cirrhosis

1. Describe how to diagnose cirrhosis based on physical exam, laboratory and radiographic findings.
2. Describe the mechanism of portal hypertension in cirrhosis and how it leads to varices and ascites formation.
3. Recognize how to diagnose ascites due to portal hypertension and spontaneous bacterial peritonitis.
4. Describe the mechanism developing hepatic encephalopathy and risk factors for making it worse.
5. Recognize the components of the Model for End-Stage Liver Disease (MELD score) and describe its use in ranking patients on the transplant list.

Complex Lipids & Cholesterol Biochemistry

1. Describe the sources and fates of cholesterol.
2. Describe in general the steps in the de novo synthesis of cholesterol.
3. Identify the key regulated step in cholesterol synthesis and describe how this step is regulated.
4. Describe the key features of the structures of glycerophospholipids, sphingomyelin and glycosphingolipids and the general aspects of their synthesis.
5. Describe how the different glycerophospholipids are synthesized.
6. List the important functions of phosphatidylcholine, phosphatidylinositol and sphingomyelin.
7. Describe in general the synthesis of arachidonic acid and prostaglandins.

Complications of Liver Disease

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Congenital Hypothyroidism

1. Describe how the fetal thyroid gland develops.
2. State the transcription factors important for thyroid development and differentiate these from the transcription factors involved in thyroid hormone synthesis.
3. Identify the major causes of congenital hypothyroidism.
4. Explain the importance of newborn screening for congenital hypothyroidism and recognize the method used to screen newborns in the state of Colorado.
5. Identify the normal changes in thyroid stimulating hormone (TSH) secretion in the first week of life and how they affect the interpretation of the first newborn screen.
6. Explain how laboratory tests distinguish central hypothyroidism from thyroid binding globulin deficiency.
7. List the symptoms/signs of congenital hypothyroidism.
8. Interpret newborn thyroid screening lab results and describe the treatment of a baby diagnosed with congenital hypothyroidism.

Control of Mineral Metabolism

1. Describe the physiological roles for calcium and phosphate.
2. Illustrate the various compartments involved in calcium and phosphate homeostasis and identify the mechanisms for distribution of calcium and phosphate between plasma and the bone.
3. Describe the regulation of PTH release.
4. List the actions of PTH.
5. Diagram the steps of Vitamin D synthesis and their regulation.
6. List the actions of Vitamin D.
7. Describe the role of calcium in bone health and identify at least 2 stages of life when inadequate dietary calcium may lead to increased risk of metabolic bone disease.
8. Identify dietary and lifestyle factors that may adversely impact bone health.
9. Identify food sources of calcium.
10. Describe quick assessment of patient's risk for low bone mineral density (dietary, behavioral, and additional factors).

Diabetes Complications

1. Describe the mechanisms underlying the excess macrovascular complications in diabetes and therapeutic interventions including the legacy effect.
2. Review the mechanisms by which hyperglycemia causes the development of micro-vascular diabetic complications.
3. Identify the microvascular complications of diabetes.
4. List treatment approaches that have been shown to be useful in preventing complications from diabetes.
5. Describe how these complications can be a burden and the opportunities for prevention.

Diet and Physical Activity Assignment

1. Estimate your daily energy needs.
2. Estimate your energy intake and the quality of your diet from a diet record and a web-based tool.
3. Compare your diet to national guidelines and consider options for improving diet quality.
4. Describe the quality of your physical activity level as compared to national guidelines and options for improving activity levels.

Dietary Carbohydrates

1. Describe how to calculate the number of grams of carbohydrate consumed per day by an individual in energy balance.
2. List the chemical characteristics of sugars, oligosaccharides and polysaccharides.
3. Compare and contrast the properties of resistant starch and fiber.
4. Describe the concepts of glycemic index and glycemic load.
5. List the types of studies that can be used to inform nutritional recommendations and which of these provide the most reliable information for clinical practice.
6. Describe the biochemical pathways involved in the metabolism of fructose and galactose.
7. Describe the clinical presentation of disorders of fructose and galactose metabolism.

Dietary Fats

1. Describe the fat content of the average American diet in % fat, grams of fat and calories of fat per day.
2. Describe the pool sizes of stored triglyceride in adipose tissue, liver and skeletal muscle.
3. Describe the physical property that allows a person to distinguish saturated and trans-fats from un-saturated fats.
4. List foods that contain high levels of saturated fat, monounsaturated fat, omega-3 fat, omega-6 fat, polyunsaturated fat, and trans-fat.
5. Describe the mechanisms that underlie the relationships between a high fat diet and adverse health consequences including atherosclerosis and obesity.
6. List the components of a healthy diet as relates to dietary fat.

Dietary Guidelines

1. Describe key messages of the 2015-2020 Dietary Guidelines and the rationale behind each.
2. Describe how current typical dietary patterns and food choices in U.S. differ from Dietary Guidelines.
3. Discuss key common features of 3 diet pattern options of the 2015 Dietary Guidelines.
4. State 3 potential benefits of the 2015 Dietary Guidelines to population health and to individual patient health.
5. Describe approach to assessment, target diet and behavior change for a patient consistent with 2015 Dietary Guidelines.

Digestive System Overview, Upper GI Histology and Lower GI Histology with Accessory Organs

1. Be able to identify the 4 layers of the gastrointestinal tract and describe why variations in those layers are important along the length of the tract.
2. Describe how the major components of our food sources (proteins, nucleic acids, complex carbohydrates and lipids) are digested and absorbed. What components and conditions need to be secreted and met in order to do this?
3. Identify the mechanisms that are in place to avoid digesting ourselves.
4. Identify the fundamental aspects of mucosal structures/functions that prevent bacterial infection along the gastrointestinal tract? Describe the organization and role(s) of mucosal associated lymphoid tissue in the G.I. tract.
5. Describe the roles of smooth muscle and the enteric nervous system in gut motility, and the advantage of extrinsic control as well.
6. Delineate the requirements for pH control in different regions of the gut. Why in general do we have a much lower pH in the stomach?
7. Describe some of the effects of key endocrine cells in the G.I. tract and understand their more general roles in regulation of GI coordination.
8. Identify the normal histology of the esophagus and be able to differentiate it from other regions of the GI tract.
9. Describe the layers of the stomach, identify unique features of the cells in these layers and be able to differentiate them from other regions of the GI tract.
10. Describe the functional significance of rugae in the stomach and plicae circulares in the small intestine.
11. Be able to describe the layers of the small intestine, differences in the duodenum versus other regions, and the cell types and specific functions in these layers.
12. Describe and be able to recognize cellular structures of the exocrine pancreas. Define differences you would observe between pancreatic acini and acini of salivary glands. Describe the importance of zymogens and their activation.
13. Be able to identify normal histological features and differences among salivary glands.
14. Identify the layers of the colon, describe the cell types and their roles in the colon, and be able to differentiate the histology of the colon as compared to other regions of the G.I. tract.

Diseases of the Colon

1. Compare the clinical features, pathology, and endoscopic findings of the two variants of inflammatory bowel disease (IBD): ulcerative colitis and Crohn's disease
2. Diagnose a patient presenting with diverticulosis-related complications including lower GI bleeding or diverticulitis
3. Diagnose a patient with colonic obstruction based on the history, physical exam, and x-ray findings.
4. List the common extra-intestinal manifestations of IBD.
5. Differentiate the clinical and pathologic features of ischemic colitis from those of the other types of colitis
6. Differentiate microscopic colitis from IBD, ischemic colitis, and diverticulitis
7. Recognize the main therapies of colitis, diverticular disease, GI bleeding, and colonic obstruction

Diseases of the Gall Bladder and Biliary Tree

1. Describe the causes, mechanism, presentation, and treatment of gallstones and their complications.
2. Recognize the various treatment modalities for patients with gallstones or biliary obstruction.
3. Identify the clinical features of sphincter of Oddi dysfunction (SOD) and refer a patient with SOD for appropriate therapy.
4. List the risk factors for gallstone formation.
5. Compare and contrast the various gallstone-related complications (pancreatitis, choledocholithiasis, cholangitis) based on a history, labs, and cross-sectional imaging.
6. Compare and differentiate the various imaging studies of the biliary tree.
7. Diagnose acute cholecystitis and differentiate this disease from pancreatitis or biliary colic.

Diseases of the Lower GI (non-Neoplastic): Pathology of Small Bowel and Colon

1. Define Gluten Sensitive Enteropathy and describe the diagnostic histologic features.
2. Describe the etiology and clinical presentation of Whipple's disease.
3. List the major causes of diarrheal illness.
4. Describe acute and chronic ischemic colitis and its complications.
5. Define pseudomembranous colitis, and describe the "pseudomembrane" and the etiology of this form of colitis.
6. Describe the two histologic patterns associated with the clinical entity of microscopic colitis and explain why it is called "microscopic" colitis.
7. Compare and contrast the gross and microscopic features of Crohn's Disease and Ulcerative Colitis.
8. Describe the anatomic process underlying diverticulosis, list the clinical factors that predispose to this illness, and explain a diverticulum.
9. Describe the histologic features of appendicitis.

Diseases of the Pancreas

1. Describe the pathophysiologic mechanisms behind presenting symptoms of acute pancreatitis or chronic pancreatitis.
2. Identify the unique features of neuroendocrine tumors of the pancreas that distinguish these from adenocarcinoma.
3. Differentiate autoimmune pancreatitis from chronic pancreatitis and pancreatic cancer.
4. List the causes of acute and chronic pancreatitis.
5. Diagnose a patient with acute or chronic pancreatitis based on the history, blood tests, and cross-sectional imaging.
6. Be familiar with the complications and treatments of acute pancreatitis and chronic pancreatitis, pancreatic cancer, and autoimmune pancreatitis.
7. Diagnose and stage a patient with pancreatic cancer using a thorough history, physical exam, cross-sectional imaging, and endoscopic ultrasound.
8. Decide when to refer a patient for ERCP including the following indications – gallstone or pancreatic stone extraction, stricture management, or palliative stenting.

Diseases of the Small Bowel

1. List the tumors of the appendix.
2. Name four types of diarrhea based on stool characteristics and give examples of each type.
3. Describe the clinical presentation and causes of fat malabsorption.
4. Describe the presentation, diagnosis, and treatment of celiac disease.
5. Describe the pathogenesis diagnosis and treatment of small bowel bacterial overgrowth.

Dyslipidemias: Clinical Features and Evaluation

1. Review lipid/lipoprotein metabolism and the relationship to atherosclerosis
2. Describe how LDL cholesterol (LDL-C) levels are determined
3. Describe how to assess risk for atherosclerotic events.
4. Identify the acquired and genetic causes of dyslipidemia and their associated physical findings.

Eating Disorders

1. Identify the clinical features, evaluation, and treatment of patients with eating disorders.
2. Discuss the etiologic hypotheses, clinical features, epidemiology, course, co-morbid disorders, complications (including re-feeding syndrome), and treatment for anorexia nervosa.
3. Discuss the role of the primary care physician in the in the prevention and early identification of eating disorders.
4. Discuss the medical complications and indications for hospitalization in patients with eating disorders.

EBM - Interpreting and Applying Results of Case Control Studies

1. Critically appraise a case control study.

EBM - Interpreting Medical Literature: Applying EBM Concepts to Problems

1. Apply biostatistics and epidemiology concepts previously presented in Phase I to solve problems relevant to understanding and using the medical literature to inform patient care decision-making.

EBM - Understanding and Interpreting Case Control Studies

1. Describe characteristics of case-control studies, explain how these characteristics may result in bias, and recognize appropriate methods for minimizing these biases.
2. Discuss the strengths and limitations of case-control studies and the clinical questions best answered by this study type.
3. Recognize a population health perspective, including use of epidemiologic methods for outbreak investigation.

Endocrine Embryology

1. For the pituitary gland, describe the origins of the anterior and posterior pituitary and vasculature. Define stomodeum, Rathke's pouch, sella turcica, and the difference between neural ectoderm and oral ectoderm. Describe the origins of the pars distalis, pars intermedia, pars tuberalis, pars nervosa and infundibular stalk.
2. For the thyroid, describe which portions of the pharynx it originates from, detailing the initial origins (endoderm, ectoderm, mesoderm) of the cells that will make up the thyroid follicular cells, calcitonin cells and blood vessels, explaining how the calcitonin cells become incorporated into the thyroid gland during development, and defining the thyroid diverticulum, the thyroglossal duct, descent of the thyroid, the ultimobranchial body and the pyramidal lobe of the thyroid.
3. For the parathyroids, describe which portions of the pharynx they originate from, detailing the initial origins (endoderm, mesoderm) of the cells that will make up the blood vessels and parathyroid cells and explaining how the parathyroid becomes embedded onto the thyroid gland during development.
4. For the adrenal glands, describe the origin and migration(s) of cells that will make up the zona reticularis, zona fasciculata and zona glomerulosa. Describe the origin and migration of cells that become the medulla. Define the terms urogenital ridge, neural crest, sympathogonia and chromaffin cells.

Endocrine Histology

1. Describe the overall structures and subdivisions of the pituitary, thyroid, parathyroid and adrenal glands.
2. Describe the hormones and/or classes of hormones associated with each region or zone of the glands.
3. Name the specific blood vessels running into and out of the glands.
4. For the anterior pituitary, describe the relationship of pituitary cells relative to the neurosecretory cells of the hypothalamus and the arrangement and importance of the hypophyseal portal system, and describe why this overall arrangement is so crucial to their function(s).
5. For the thyroid, describe the arrangement and structure/function of the epithelial cells, the colloid and the calcitonin-releasing cells, and describe why this overall arrangement is so crucial to their function(s).
6. For the parathyroid, be able to differentiate the parathormone-releasing cells, the oxyphil cells, and adipose cells, characterize the basic arrangement of cells relative to each other and to blood vessels in these glands.
7. For the adrenal cortex, be able to discriminate the three layers of the cortex as well as the subcapsular arterial plexus and the medullary sinusoidal region, and describe the types of cells in each region and what they release and whether or not they respond to ACTH.
8. For the posterior pituitary, describe axonal transport and the mechanism of release of its relevant hormones.
9. For the adrenal medulla, define any innervation and explain what the endocrine cells in the adrenal medulla respond to.

Endocrine Pathology

1. For the thyroid, name and distinguish inflammatory diseases (Hashimoto thyroiditis and Graves' disease) and their associated antibodies.
2. For the thyroid, name and distinguish the following neoplastic diseases: follicular adenoma, papillary thyroid carcinoma, follicular carcinoma, anaplastic carcinoma and medullary carcinoma.
3. For the parathyroid, distinguish primary vs. secondary hyperparathyroidism, parathyroid hyperplasia, parathyroid adenoma, and parathyroid carcinoma (very rare).
4. For the adrenal, distinguish the following entities and their associated effects: Waterhouse-Frederickson syndrome, Addison disease, Cushing syndrome.
5. For the adrenal, distinguish adrenocortical neoplasms (adrenocortical hyperplasia, adrenocortical adenoma and adrenocortical carcinoma) and adrenal medulla neoplasms (pheochromocytoma).
6. Define organs involved in multiple endocrine neoplasia (MEN-1, MEN-2A, MEN-2B) and recognize autoimmune polyendocrine syndrome.

Endocrine-Related Depression

1. Compare symptomatic themes common to psychiatric and endocrine disorders.
2. Briefly list endocrine disorders commonly associated with psychiatric symptoms.
3. Explore the complex relationship between thyroid and central nervous system.
4. Highlight the impact of thyroid abnormalities on severity of mental illness and response to treatment.
5. Describe common endocrine abnormalities caused by psychiatric medication treatment.
6. Practice establishing differential diagnostic considerations for case presentations.

Evaluation of Worrisome Growth

1. Define "worrisome growth."
2. Recognize the difference in growth patterns between children with normal variants of short stature and pathological causes.
3. List common causes of short stature and recognize their growth patterns.
4. Describe the manifestations of hypothyroidism and growth hormone deficiency and how the diagnosis is made for each.
5. List some of the manifestations of a girl with Turner syndrome.
6. Produce a strategy for the evaluation of a poorly growing child.
7. Identify the "FDA-approved" uses of growth hormone from 1985 to the present.
8. List some of the ethical issues surrounding growth hormone treatment.

Exocrine Pancreas and Salivary Gland Physiology

1. List the 6 main constituents of saliva and their function.
2. Explain the structure and function of the salivary gland
3. Contrast the plasma and pancreatic concentrations of Na⁺, Cl⁻, and HCO₃⁻ - at low secretion rates and at high secretion rates and the principal cell types involved in each secretion rate.
4. List the major ionic and peptide/protein components secreted by the pancreas.
5. State three types of stimuli that increase pancreatic secretion.
6. Explain the function of CCK, where it is released from, what cells it works on and what the outcome of its actions are.
7. List the eight different infection/immunological salivary gland diseases
8. Discuss characteristics of benign and malignant salivary neoplasia and be able to describe examples of both.
9. List eight forms of endocrine and eight exocrine pancreatic cancers, identify their key features and how the TNM method of staging is used to grade them

Fat Soluble Vitamins

1. Identify circumstances in which risk of vitamin deficiency or toxicity is high.
2. Identify clinical features of toxicity of vitamins A, D, and E.
3. Describe the laboratory findings of deficiency and insufficiency of vitamin D.
4. Describe the biochemical functions and major physiologic metabolic roles, major dietary sources, and characteristic deficiency findings for each vitamin discussed.
5. Identify clinical features of deficiency of vitamins A, D, E, and K.

Fatty Acid Oxidation

1. Explain why fatty acids are a major/preferred fuel source for liver, heart and muscle (but not the brain) at all times, and the major energy source for all tissues under starvation conditions.
2. Explain the three stages of fatty acid oxidation.
3. Explain how fatty acid breakdown and synthesis are coordinately regulated, and connected to carbohydrate metabolism.
4. Describe what ketone bodies are, how they are made and used and the result of their overproduction.
5. Explain why patients with type 1 diabetes can have high levels of ketone bodies.

Feeding and Fasting

1. Describe the effect of insulin or glucagon on key enzymes in glycolysis, gluconeogenesis and glycogen metabolism.
2. Describe the role of insulin and glucagon on fatty acid synthesis, fatty acid mobilization and ketogenesis.
3. Describe the changes in insulin, glucagon, triglycerides, fatty acids and glucose following a meal.
4. Distinguish between glucose metabolism in the liver, RBCs, muscle and brain under fed and fasting conditions.

Functional Histology of the Liver

1. Describe the basic pattern of blood flow through the liver, including flow from the hepatic portal vein and separately from the hepatic artery.
2. Be able to describe the three lobular descriptions of the basic microstructural organization of the liver.
3. Be able to describe the flow of bile within the liver.
4. Describe the functions of the hepatocyte.
5. Describe the relationship of the hepatocyte to the blood and bile from a structural viewpoint.
6. Be able to define the arrangement of the liver sinusoidal endothelial cells and Kupffer cells within the liver.
7. Describe the walls of the bile canaliculi, canals of Hering and interlobular bile ducts.
8. Be able to describe the mucosa of the gall bladder and explain what it does and what is unique about its structure as compared to other digestive mucosae.

Functional Liver Tests, Part 1 and Management of Chronic Hepatitis

1. Recognize common liver chemistry tests and their clinical implications when abnormal, including AST and ALT, Alkaline phosphatase, and Bilirubin.
2. Characterize patterns of liver chemistry test abnormalities for hepatocellular and cholestatic liver diseases.
3. Describe bilirubin metabolism and causes of jaundice, including conjugated bilirubin and unconjugated bilirubin.
4. Recognize abnormal liver chemistry test algorithms for jaundice, including elevated AST and ALT (<5x nml) and elevated alkaline phosphatase.
5. Discuss abnormal liver chemistry tests cases.
6. Recognize the treatments and indications for treatment of the most common causes of chronic hepatitis, including hepatitis B virus infection, hepatitis C virus infection, hereditary hemochromatosis, autoimmune hepatitis, primary biliary cirrhosis, primary sclerosing cholangitis, Wilson disease, and non-alcoholic steatohepatitis.

General Overview of the Reproductive Axis

1. Recognize the cholesterol molecule and correctly number the carbon atoms in the steroid nucleus.
2. List the molecules synthesized from cholesterol throughout the body, including examples from each of the three major classes of steroid hormones and the three major classes of sex steroids.
3. Describe key features in the biosynthesis of the sex steroids and describe the rate-limiting step.
4. List the endogenous sex steroids and classify them into the three major classes of sex steroids on the basis of the number of carbon atoms they contain.
5. Name the hormones involved in the hypothalamic - pituitary - gonadal axis and label them on a diagram of that axis.
6. List the primary areas of the hypothalamus responsible for the production of GnRH and describe key features of hypothalamic GnRH secretion.
7. Describe the structure, functions and mechanisms of action of the hormones involved in the hypothalamic - pituitary - gonadal axis in both men and women.
8. Describe the 2-cell theory of sex steroid production and name the gonadal cells responsible for the production of sex steroids in men and women.
9. List the major extra-gonadal sources of various sex steroids.
10. Compare and contrast features of the normal hypothalamic-pituitary-gonadal axis in men and women.
11. Label a diagram of the ovarian/menstrual cycle and describe how disruptions of the hypothalamic-pituitary-ovarian axis can lead to irregular periods in women.
12. Frame discussions of the physiology, pathophysiology, and pharmacology of the reproductive system in terms of the hypothalamic-pituitary-gonadal axis.

GI Cancer Syndromes

1. Describe what is meant by "Cancer Genetics."
2. Describe Lynch Syndrome and its components: Pathogenesis, clinical features, diagnosis, management.
3. Describe Familial Adenomatous Polyposis and its components: Pathogenesis, clinical features, diagnosis, management.
4. Identify other polyposis conditions.
5. Explain why you should care about these conditions.

GI Digestion and Absorption

1. Explain where carbohydrate digestion occurs, what enzymes are required and which sugars they target.
2. Predict the small intestine and colonic consequence of a deficiency in the enzyme lactase following the consumption of dairy products.
3. Compare and contrast the carbohydrate uptake mechanisms in terms of location, ions involved and specificity.
4. List the four mechanisms of protein uptake
5. Explain the roles of pancreatic lipase, colipase, and micelles. Discuss how fat soluble vitamins are absorbed and the consequences of fat malabsorption (steatorrhea) on their uptake.
6. Describe the composition and formation of chylomicrons, their movement across the enterocyte basolateral membrane, and the route of entry into the cardiovascular system.
7. Describe the absorption of water-soluble vitamins, including the role of intrinsic factor in the absorption of vitamin B12.
8. Explain the physiological significance of the regulation of luminal water content and daily fluid balance. Understand the role of the intestinal epithelia in regulating fluid movement along with the pathways of secretion and absorption of major ions in the small and large intestine.
9. List the different classes of diarrhea and the mechanisms by which oral rehydration fluids are able to counter the loss of water and electrolytes.

GI Motility and Regulation

1. Describe the two major types of motility in the GI tract, their function in digestion and the differences between them.
2. Explain how the sympathetic and parasympathetic systems communicate with intestinal smooth muscle.
3. Describe the characteristics of the basic electrical rhythm (BER) of the small intestine and its relation to smooth muscle contractile activity.
4. List the stimulus that initiates the swallowing sequence and the events that follow. Identify the point at which the swallowing sequence switches from voluntary to involuntary.
5. Explain the mechanism of esophageal motility and peristalsis, and the role of the upper and lower esophageal sphincters in this process.
6. Describe the storage, digestion, and motility roles of the stomach
7. List the phases of the migrating motility complex (MMC)].
8. Compare and contrast the colonic motor activity during a “mass movement” with that during haustral shuttling and the consequence of each type of colonic motility.
9. Describe the sequence of events occurring during defecation, differentiating those that are under voluntary control from those under involuntary control.

GI Secretion and Digestion

1. List the functions of secreted gastric acid.
2. Describe the protective mechanisms in place to limit toxicity of gastric acid, including occasions where these processes might be disrupted.
3. Discuss the modulation of gastric acid secretion throughout the day and night.
4. In general terms, describe how the three parietal cell secretagogues induce acid secretion.
5. Describe the mechanism of gastric acid generation and secretion, including the role of K^+ , Cl^-/HCO_3^- , carbonic anhydrase and H^+-K^+ ATPase.
6. Describe the protective barrier of the gastric surface.
7. Describe the role of the stomach, if any, on the gastric digestion of carbohydrates, proteins, and fats.

Glycogen and HMP Shunt (Pentose Phosphate Pathway)

1. Describe the structure of glycogen and why this is important.
2. Describe the pathways for the formation and breakdown of glycogen including the key intermediates.
3. List the key regulated steps in glycogen synthesis and breakdown and describe their regulation.
4. Describe the coordinate regulation of glycogenesis/glycogenolysis and in what metabolic conditions each are favored.
5. List the key products of the pentose phosphate pathway.
6. Name the key enzyme in the pentose phosphate pathway.
7. Describe the clinical presentation of G6PD deficiency.

Glycolysis

1. List and describe the key steps and intermediates in glycolysis.
2. Name the enzymes that catalyze glycolytic reactions.
3. Describe the regulation of the key glycolytic enzymes.
4. Describe the situations in which flux through glycolysis is increased or decreased.
5. List the final products of aerobic and anaerobic glycolysis.

Hormones and Receptors

1. Distinguish the structure of peptide, steroid and thyroid hormones.
2. Contrast the structures and cellular locations of the peptide and the steroid/thyroid hormones types of receptors.
3. Identify the mechanisms of signaling of peptide hormones.
4. Compare the mechanisms of action of steroid and thyroid hormones.
5. Identify different forms of regulation of hormone synthesis and release.
6. Describe the major types of methods for measuring hormone concentrations in the blood.

Hospital-Based Nutrition

1. Describe an approach to deciding when to begin feeding a hospitalized patient who cannot feed themselves.
2. Describe an approach to estimating the number of calories per day that a sick patient in the hospital will need.
3. Describe an approach to writing an order for nutritional support in a hospitalized patient.
4. Describe an approach for determining if a person who is getting long term nutritional support is being fed adequately.
5. List the special issues associated with feeding a hospitalized patient with respiratory failure, liver failure, kidney failure, cardiac disease or diabetes.

Hypercalcemia and Hypocalcemia

1. Contrast the mechanisms underlying the main causes of hypercalcemia, including primary hyperparathyroidism and hypercalcemia of malignancy.
2. Describe the effects of prolonged untreated hyperparathyroidism on the bones and kidneys.
3. Compare and contrast the pathophysiology and treatment of primary hyperparathyroidism when caused by adenoma versus hyperplasia.
4. Describe the calcium receptor and the abnormalities caused by its dysfunction: resistance and hypersensitivity.
5. List five causes of hypocalcemia and the mechanisms of each of these disorders.
6. Describe the clinical and laboratory features of hypoparathyroidism.

Hypothalamic and Pituitary Dysfunction

1. Recognize the clinical presentations and diagnoses of pituitary/hypothalamic diseases.
2. Describe the etiologies and treatment of hypopituitarism.
3. Identify the most common posterior pituitary disorders and their treatments.

Hypothalamic and Pituitary Imaging

1. Describe the basic principles of MRI that apply to pituitary imaging.
2. Identify the anatomic structures visualized in an MRI of the sellar and parasellar regions.
3. Recognize the variable appearance of lesions in the sellar and parasellar regions.

Hypothalamic and Pituitary Pathology

1. Contrast the normal histology and the pathology of a pituitary adenoma.
2. List the different types of anterior pituitary tumors and their prevalence.
3. Name other types of hypothalamic and pituitary lesions that can occur, and identify their pathological features.
4. Describe clinical findings related to the disruption of structures surrounding the sella turcica by a large pituitary tumor.

Hypothalamic and Pituitary Pharmacology

1. Explain the role of release inhibiting drugs (octreotide and bromocriptine) in the management of hyper-secretion of GH and prolactin.
2. Compare the structure, pharmacokinetics and actions of vasopressin and analogs such as desmopressin.
3. Identify the effects of vasopressin on receptor subtypes and signal transduction systems in vascular smooth muscle and the kidney.
4. Compare drugs that affect vasopressin release or action and their relationship to the therapy of diabetes insipidus (DI) and SIADH (chlorpropamide, demeclocycline, desmopressin and vasopressin).
5. List drugs that can cause ADH hypofunction (nephrogenic diabetes insipidus) and hyperfunction (SIADH).
6. Contrast the role of releasing (sermorelin) and replacement (recombinant GH) therapy drugs in the management of hypo-secretion of GH.

Hypothalamic Control of the Pituitary Gland

1. Identify the hypothalamic hormones that regulate anterior pituitary function.
2. Describe the general principles of hormone release from hypothalamic neurons.
3. Identify the receptors and signal transduction mechanisms for hypothalamic hormones.
4. Diagram the general mechanisms of feedback control for hypothalamic hormone release.
5. Outline the interrelationships among various hypothalamic centers, their inputs from other areas of the brain, and their outputs to the pituitary gland.

Inborn Errors 1 & 2: Hypoglycemia and Disorders of Fat Oxidation

1. List the most common glycogen storage diseases, the details of the biochemical abnormalities and their clinical features.
2. Describe the details of the biochemical abnormalities and clinical features of inborn errors of fructose and galactose metabolism.
3. List the most common genetic disorders of fat metabolism, the details of the biochemical abnormalities in these disorders and their clinical features.
4. List other causes of hypoglycemia in infants and adults.
5. List the key laboratory studies that should be obtained in the patient with hypoglycemia that will help elucidate the underlying cause.

Inborn Errors: Glycolipid Disorders

1. Discuss and differentiate clinical presentations for glycolipid disorders.
2. Discuss and differentiate important complications of key glycolipid disorders.
3. Apply and interpret diagnostic tests to diagnose key glycolipid disorders.
4. Explain the basis of and discuss the various treatment approaches for key glycolipid disorders.

Inborn Errors: Urea Cycle Defects and Amino Acidopathies

1. Use accepted criteria to determine disorders that are appropriate for newborn screening from those that are not.
2. Apply knowledge of disorders that are covered by newborn screening to care of pediatric patients.
3. Interpret diagnostic test results for disorders of amino acids metabolism and the urea cycle
4. Recognize when testing for disorders of amino acid metabolism or the urea cycle is indicated based on clinical presentation
5. Explain appropriate care for patients with disorders of amino acid metabolism and the urea cycle based on the pathophysiology of these disorders

Insulin, Glucagon, GLP-1 and Counter-Regulatory Hormones

1. Describe the hormone secreting cells of the pancreas.
2. Describe structure of insulin and the stimuli that lead to its release.
3. Describe the cellular mechanisms leading to the secretion of insulin in response to an increase in serum glucose.
4. Describe the mechanisms for insulin signaling within target cells for metabolic and mitogenic actions.
5. List the actions of insulin on Muscle, Liver and Adipose tissue.
6. Describe in general what insulin resistance is.
7. Describe the incretin effect and list the effects of GLP-1.
8. List the effects of the counter-regulatory hormones glucagon, catecholamines, cortisol and growth hormone.

International Nutrition

1. Name three nutrition related 2015 Sustainable Development goals (SDG).
2. Describe the contextual factors that contribute to malnutrition.
3. State and describe three major nutrition problems in developing countries, including growth, dietary, reproductive outcomes and impact of climate change.
4. Describe the role of the impoverished gut & the triple burden of poverty: diarrhea, stunting, & chronic disease
5. Describe four approaches to improving nutritional status in vulnerable populations and list the pros and cons of each.

Introduction to Nutrition

1. Describe 2 situations that place a patient at risk for nutritional problems.
2. Identify & describe the 4 components of nutrition assessment within medical assessment.
3. Define nutrient requirement and allowance and how these relate to RDA's.
4. Describe how to initiate & implement dietary and lifestyle change counseling with a patient.
5. Apply "Start the Conversation" (or other dietary assessment tool) to assess diet quality: questions to be asked, content to be seeking & devise recommendations for diet change based on assessment.
6. Use height & weight measurements to calculate BMI, categorize BMI for adult and BMI/age for 2-20 yr olds; and plot length & weight measurements/age & interpret on growth chart.

Lipoprotein Physiology

1. List the relative polarities of cholesterol ester, triglyceride, unesterified cholesterol and phospholipids.
2. Describe the characteristics of the five classes of lipoproteins.
3. Describe the fate of the five classes of lipoproteins in the chylomicron, VLDL and HDL pathways.
4. List the functions of apo-lipoproteins and give examples of each.
5. Describe the functions of CETP, ABCa1 and LCAT.

Living with Diabetes: Patient Presentation

1. List the signs and symptoms that a person with new onset diabetes might experience.
2. Describe the clinical features of the 4 types of diabetes.
3. List the tools available to a person with diabetes that allow them to assess their own blood sugar level.
4. List factors that will tend to make a person with diabetes have an increase in their blood sugar levels.
5. List factors that will tend to lower blood glucose levels in a person with diabetes.
6. Describe the Chronic Care Model.
7. Describe the differences in patients' and physicians' perspectives on diabetes mellitus.
8. Identify ways to improve communication between the physician and patient with a chronic illness such as diabetes mellitus

Lower GI Pharmacology

1. Describe the mechanism of action of each class of laxatives, drawbacks to use, and guidelines for use.
2. Describe the mechanism of action and explain the rationale for and guidelines for the use of antidiarrheal agents.
3. Describe the site and mechanism of action of major IBS agents and list their side effects.

Malnutrition

1. Define malnutrition and describe its environmental and biological causes & clinical consequences.
2. Compare and contrast energy and substrate metabolism in short term and long term starvation.
3. Describe the pathophysiology and adaptive responses to PEM, and to compare and contrast features of marasmus/severe acute malnutrition and kwashiorkor.
4. Identify likely physical exam findings associated with the two major types of undernutrition.
5. Describe general appropriate treatment approaches to PEM.
6. Describe metabolic derangements associated with "refeeding syndrome."

Micronutrients and Trace Elements

1. Describe physiologic functions, dietary sources, and factors that affect bioavailability of iron and zinc.
2. Describe key aspects of the homeostatic regulation of zinc and iron and compare and contrast differences in the regulation of these two trace minerals.
3. Describe etiology and consequences of deficiency, and comment on prevalence of deficiency of iron and zinc.
4. Describe and compare toxicity potential for iron and zinc.

Motility Disorders of the GI Tract

1. Recognize the key features of normal GI motility and how they are altered in GI motility disorders.
2. Describe the perturbations in gastrointestinal motility in several example disease states: scleroderma (esophagus and small intestine), gastroparesis, functional dyspepsia, Chronic Intestinal Pseudo-Obstruction, Hirschsprung's disease, and dyssynergic defecation.
3. Recognize basic tests to evaluate GI motility including: esophageal manometry, gastric emptying studies, antroduodenal manometry, barium studies, sitz marker studies, anorectal manometry.

Neuroendocrine Control of Feeding

1. Describe the respective roles of the hypothalamus, specifically the arcuate nucleus, paraventricular nucleus, ventromedial nucleus, and lateral hypothalamus in the regulation of energy balance and body weight regulation.
2. Describe the mechanisms used by the hypothalamus to promote and inhibit food intake, and predict the impact on food intake and body weight of:
 - a. 'knocking out' the POMC gene (and therefore, α -MSH).
 - b. 'knocking out' the NPY gene.
 - c. loss-of-function mutations in the melanocortin receptor (MCR).
3. Describe the role of peripheral hormones derived from the GI tract (ghrelin, CCK, PYY, and GLP-1), pancreas (insulin), and adipose tissue (leptin) in regulating food intake and body weight.
4. Discuss the role of brain reward pathways and environmental cues in the development of obesity.

Nutritional Counseling for Behavior Change

1. List the "stages of change" and typical responses that a patient might make in a clinical interview that help you establish their stage.
2. Describe the primary utility of "stages of change" theory in clinical practice.
3. Describe the primary goal of motivational interviewing and list the key principles of this counseling style.
4. Describe two important steps in "Values-based counseling."
5. Identify the key criteria addressed in the "health belief model."
6. Identify situations where cognitive behavioral therapy might be the best counseling model to use.
7. List the key elements of effective behavior change counseling.

Obesity Treatment: Diet and Physical Activity

1. Recognize the appropriate application of diet, physical activity, and behavioral changes in obesity treatment.
2. Recognize that weight bias exists and is prevalent among clinicians and become familiar with the use of people first language for describing patients with obesity.
3. List the types of eating plans that can be recommended to help patients with obesity achieve a negative energy balance and lose weight, including macronutrient differences and energy density.
4. Define the amount of physical activity that is recommended to maintain general health, to prevent weight gain, and to prevent weight regain in individuals that were previously obese.
5. Understand the differences between weight loss and weight loss maintenance and the challenges involved for patients.
6. List the behaviors that individuals in the National Weight Control Registry report to help them maintain a reduced weight.

Obesity Treatment: Drugs, Surgery

1. List the medications that are currently available for the treatment of obesity, describe their mechanisms of action, and list their side effects.
2. List the common medications that are used for other health problems that contribute to weight gain and describe an approach to minimizing this problem.
3. List the risks and benefits of gastric bypass surgery, sleeve gastrectomy, laparoscopic banding and ileal bypass surgeries.
4. Describe the patient who is best suited to either pharmacological and surgical treatments for obesity.

Osteoporosis and Other Metabolic Bone Disorders

1. Identify the modes of presentation of osteoporosis.
2. Contrast the prevalence and causes of osteoporosis in men and women of different ages.
3. Recognize the impact of osteoporotic fractures on health and the economy.
4. Diagram normal and abnormal bone formation and resorption.
5. Define osteoporosis and identify its risk factors.
6. Define osteomalacia and list its causes.
7. Recognize the clinical presentation and course of Paget's disease.
8. Contrast the pathological features of bones affected by osteoporosis, osteomalacia and Paget's disease.

Overview of Biochemical Pathways, Metabolism, Energy Balance

1. List the components of the energy balance equation including components of energy expenditure.
2. Comment on the accuracy of methods for estimating and measuring energy expenditure and energy intake.
3. Estimate the pool sizes of stored fat, carbohydrate and protein in the body.
4. List the hierarchy of fuels for oxidation and discuss how this relates to weight gain.
5. Identify the structures of glucose, fatty acids and amino acids.
6. Explain the general functions of the biochemical pathways.
7. List the eight main biochemical pathways involved in carbohydrate, fat, and amino acid metabolism.
8. Describe the general layout of the main metabolic pathways for carbohydrate, fat, and amino acids.

Overview of Carbohydrate Metabolism

1. Describe the features that make a particular step in a linked enzyme pathway a "key step."
2. Describe the primary functions of glycolysis, gluconeogenesis, glycogen synthesis and breakdown.
3. Describe the primary functions of the TCA cycle and the electron transport system.
4. Describe in a general sense the flux through these pathways in liver and skeletal muscle in the fasted and fed states.

Overview of Lipid Biochemistry

1. Identify the structures of fatty acids, phospholipids, cholesterol and cholesterol esters.
2. Describe the chemical properties of each of these lipids.
3. Describe the sources of lipids, the uses of these lipids, and the relative amounts of stored lipids in adipose tissue, skeletal muscle and liver.
4. Describe in general the "outline" of the following pathways: lipogenesis, beta-oxidation, ketogenesis, the lipoprotein pathways, cholesterol synthesis, and phospholipid synthesis.

Overview of Protein Biochemistry, Including Amino Acids and Protein Degradation

1. List a number of different ways to categorize amino acids.
2. Describe how proteins are broken down to amino acids in the gut and in tissues.
3. Describe the flow of nitrogen from an amino acid to urea.
4. List some of the special issues associated with sulfur-containing, gluconeogenic, ketogenic, branched chain and aromatic amino acids.

Oxidative Phosphorylation and Gluconeogenesis

1. Describe the mechanisms that are responsible for the generation of the energy that is used to drive oxidative phosphorylation.
2. Describe the components of the electron transport chain and their location within the mitochondria and their functions.
3. List the substrates and products of oxidative phosphorylation.
4. List inhibitors of electron transport.
5. Describe the consequences of defects in electron transport.
6. Describe the role of PGC1 alpha mitochondrial biogenesis.
7. List the biomolecules that are the source of carbons for gluconeogenesis.
8. Describe the regulation of the key steps in gluconeogenesis that result in the coordinate regulation of this pathway with glycolysis.
9. List the key steps in gluconeogenesis.
10. Describe which parts of gluconeogenesis occur in the mitochondria and which occur in the cytoplasm.
11. Describe the sources of energy for gluconeogenesis.
12. List the unique roles of muscle, red blood cells, adipose tissue, liver, and kidney in the process of gluconeogenesis.

Pathology of GI Polyps and Carcinoma

1. State the nomenclature of polyps, including sessile vs. pedunculated, tubular vs. villous, serrated vs. conventional adenomas, and neoplastic vs. non-neoplastic.
2. Recognize the names and clinical features of different types of non-neoplastic polyps discussed in the lecture and state which ones are associated with syndromes.
3. Compare and contrast the differences between hyperplastic polyps and sessile serrated polyps/adenomas.
4. State the basic facts about neoplastic polyps, the concept of cytologic dysplasia, and what features confer increased risk for malignancy.
5. List the four main molecular/pathway aberrations associated with colon cancer.
6. State the important risk factors for colorectal carcinoma.
7. Explain the basis for the hereditary cancer syndromes of FAP and HNPCC.
8. Describe the various ways colorectal carcinoma can present and the tools we use to screen and diagnose cancer.
9. Recognize the basic histologic features of invasive colorectal carcinoma.
10. Recognize the most important prognostic features for colorectal carcinoma and describe their importance in staging.
11. Describe the importance of KRAS mutational status in the treatment of colon cancer with EGFR inhibitors.

Pathology of the Esophagus

1. Describe the features of most prevalent form of esophagitis, reflux esophagitis, in greater detail, and be able to explain its relation to Barrett esophagus.
2. Describe how to diagnose Barrett's esophagus and discuss why you look for dysplasia.
3. Compare and contrast the features of esophageal squamous cell carcinoma and adenocarcinoma.
4. Be able to discuss the general features of esophagitis and the various causes of esophagitis.
5. Describe the various causes of esophageal obstruction.
6. Explain the etiology and significance of esophageal varices.
7. Be acquainted with the common congenital abnormalities of the esophagus.

Pathology of the Gall Bladder, Biliary Tree and Pancreas

1. List the clinical factors that increase risk for cholelithiasis, including the major types of gallstones and clinical implications of each type.
2. List at least three important complications of cholelithiasis.
3. Compare and contrast the macroscopic (visible appearance) and microscopic features of acute and chronic cholecystitis.
4. Describe the histopathologic features of gallbladder cancer.
5. Compare and contrast the histopathologic and clinical features of acute and chronic pancreatitis.
6. Describe a pancreatic pseudocyst and state the clinical settings where a pseudocyst sometimes occurs.
7. Recognize the two common types of pancreatic neoplasms and compare and contrast the clinical syndromes and microscopic appearance of each type of lesion.
8. State procedures that can help establish the diagnosis of cholelithiasis, and identify under what conditions will one procedure not be informative.

Pathology of the Stomach

1. Describe the protective and damaging processes that are commonly deranged in gastric disease.
2. List the general features and causes of acute and stress-related gastritis
3. Describe the pathophysiology, epidemiology, and common sequelae of Helicobacter infection.
4. Describe the pathophysiology and common sequelae of autoimmune gastritis.
5. Discuss the causes, appearance, and complications of peptic ulcer disease.
6. Compare and contrast the appearance of the common types of gastric polyps, their associated conditions, and their relationship to gastric cancer.
7. Be acquainted with the risk factors, epidemiology, associations, and natural history of gastric adenocarcinoma.
8. Describe the appearance, natural history, and molecular features of gastrointestinal stromal tumors.

Pathophysiology of the Esophagus

1. Conceptualize the etiology of dysphagia symptoms based on symptoms.
2. Highlight some cardinal esophageal disorders including: Achalasia, Eosinophilic Esophagitis, Gastroesophageal Reflux Disease (GERD), Barrett's Esophagus and Esophageal Cancer.
3. Introduce therapeutics for cardinal esophageal disorders including: Medical, endoscopic and surgical treatments for achalasia, 3 "Ds" for Eosinophilic Esophagitis, Medical and surgical therapy for GERD, and Endoscopic treatment for Barrett's Esophagus.

Pathophysiology of the Stomach

1. Identify the causes of gastritis.
2. Describe the epidemiology, pathophysiology, and treatment of H. pylori infection.
3. Compare and contrast the five most common gastric neoplasms.
4. Describe peptic ulcer disease pathogenesis.
5. Explain peptic ulcer disease treatment.

Pathophysiology of Type 1 Diabetes

1. Define the metabolic and immunologic events in each of the proposed stages for the progression of type 1 diabetes (T1D).
2. Define the four autoantigens that are characteristic of T1D
3. Predict the likelihood of progression to T1D given the presence of 1, 2, or 3 autoantibodies in a child over the ensuing 10 years.
4. Explain how specific HLA genotypes can confer either risk or protection from the development of T1D.
5. Apply the criteria for diagnosing diabetes and differentiate type 1 from type 2 diabetes based on clinical presentation and laboratory findings.

Pathophysiology of Type 2 Diabetes

1. Recognize the criteria used to define diabetes, prediabetes (impaired glucose tolerance, impaired fasting glucose) and gestational diabetes.
2. Discuss the 2 key factors in the pathophysiology of type 2 diabetes (insulin resistance and beta cell dysfunction) and increased risk factors leading to increased rates of diabetes.
3. Summarize interventions that have been shown to prevent type 2 diabetes in high-risk subjects.
4. Describe the role of genetics in the development of type 2 diabetes and current approaches.
5. Recognize the acute complications of diabetes including Diabetic Ketoacidosis and Hypoglycemia Unawareness.

Pediatric Gastrointestinal Diseases and Developmental Defects

1. List the anatomic features and describe the pathogenesis of each of the following: Tracheo-esophageal fistula, Infantile hypertrophic pyloric stenosis, Meckel diverticulum, Omphalocele vs. Gastroschisis, Intestinal malrotation, Gastrointestinal duplications/cysts, Intestinal stenosis/atresia, and Imperforate anus/rectal agenesis.
2. Describe the underlying developmental abnormality in Hirschsprung's Disease.
3. Describe the predisposing factors and proposed pathogenesis of Necrotizing Enterocolitis.
4. Compare and contrast allergic and reflux esophagitis.

Pediatric Liver Disease

1. State the differential diagnosis of neonatal jaundice.
2. Describe the presentation, diagnosis and therapy of biliary atresia.
3. Describe the genetic defects in and clinical consequences of hereditary hyperbilirubinemias.
4. Recognize the most common benign and malignant primary hepatic neoplasms in the pediatric population.
5. Describe the presentation, diagnosis and therapy of hepatoblastoma.

Pediatric Obesity: Health Implications

1. State the definitions and classification of childhood weight status, and demonstrate the use of BMI-for-age/sex charts.
2. Describe the current epidemiology of childhood overweight & obesity, including national rates and racial/ethnic disparities.
3. Describe the major co-morbidities associated with childhood obesity.
4. Describe key components of assessment (including diet, physical activity/sedentary behaviors, sleep, family and social histories, review of systems, physical exam, and labs).
5. Briefly describe essential treatment principles.

Pharmacology of Parathyroid & Metabolic Bone Disease

1. Describe how PTH, Vitamin D, FGF23, and calcitonin coordinate to regulate Ca⁺⁺ levels and describe the effects of each at the GI tract, bone, and kidney.
2. List the sites of Vitamin D metabolism and activation (D3, 25-OH D3, 1,25-(OH)2D3) and use of the various analogs in deficiency states.
3. Describe the treatment of and pharmacotherapeutic options for osteoporosis, hypercalcemia, and hypocalcemia.
4. Compare and contrast the effect on Ca⁺⁺ levels for calcitonin, estrogens, glucocorticoids, thiazide diuretics, bisphosphonates, teriparatide, and denosumab.
5. Describe the mechanism of action, pharmacokinetics, clinical uses, and adverse effects of specified parathyroid and bone disorder drugs.

Pituitary Physiology (GH/PRL)

1. Describe the effects of growth hormone on organs and systems.
2. Explain the mechanism of action of growth hormone through binding to its receptor.
3. Categorize the functions of IGF-1 and its mechanism of action.
4. List the actions of prolactin and identify the mechanism of action of prolactin.

Psych - Illness Among Physicians

1. List the occupational hazards physicians face which can undermine health as well as the delivery of quality patient care.
2. Discuss the health risks associated with chronic stress
3. Learn to recognize the warnings signs suggesting that you are or a colleague is significantly stressed/ill.
4. Become familiar with stress management strategies for yourself and your patients.
5. Discuss how self care can contribute to delivering quality patient care.

Purine and Pyrimidine Metabolism

1. Identify the sources of the atoms in purine and pyrimidine bases, the key co-factors and the sources of energy involved in their de novo synthesis.
2. List the key differences between the synthesis of purine and pyrimidine nucleotides.
3. Name the key regulated steps and feedback loops within the de novo purine and pyrimidine synthesis and degradation pathways.
4. Identify the enzyme that reduces ribose to deoxyribose, describe the regulation of this enzyme and name its substrates.
5. List the enzyme deficiencies and describe the pathophysiology of: Gout, Severe Combined immunodeficiency syndrome, and Lesch-Nyhan syndrome.
6. Describe how 5-fluorouracil and similar drugs inhibit nucleotide synthesis.

Radiologic Studies of the GI Tract

1. Recognize the systematic approach for interpreting abdominal radiographs.
2. Recognize free intra-abdominal free air on abdominal radiographs and computed tomography (CT) and describe how patient positioning affects sensitivity for its detection.
3. Discuss the imaging modalities used to evaluate the GI tract and accessory organs (liver, gallbladder, pancreas).
4. Compare and contrast the different contrast agents used in GI radiology and the potential benefits, risks, and complications of each.
5. Explain the ACR Appropriateness Criteria to order appropriate imaging tests.

Regulation of Thyroid Hormone Synthesis

1. Describe the uptake of iodine from plasma by the thyroid gland.
2. Explain the synthesis and release of thyroglobulin into the lumen of the thyroid follicle.
3. Identify the steps in thyroid hormone synthesis and its release into the blood.
4. Describe the transport of thyroid hormones in the plasma.
5. Categorize the actions of thyroid hormone.
6. Diagram the normal regulation of thyroid hormone levels by the hypothalamic-pituitary axis.

Review Session, Protein Biochemistry/Nutrition

1. Review material presented on nutrition in preparation for exam.
2. Review material presented on protein biochemistry in preparation for exam.

Small Groups: Adrenal Disorders (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of adrenal disorders.

Small Groups: Calcium and Metabolic Bone Disorders (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of parathyroid and metabolic bone disorders.

Small Groups: Cirrhosis and Chronic Liver Injury (REQUIRED)

1. List the major hepatotropic viruses which manifest with hepatitis and state the route(s) of transmission for each.
2. State the approximate proportion of patients who go on to chronic disease in Hepatitis A, B and C.
3. Compare and contrast key: 1) clinical and laboratory, and 2) histologic features in the liver in the acute and chronic phases of hepatitis C.
4. List clinical features that may be seen in a patient with cirrhosis, regardless of etiology.
5. Describe the three key histologic features that -- in combination -- characterize "cirrhosis," regardless of etiology: bridging fibrosis, regenerative nodules, and architectural distortion with concomitant alteration of blood flow.
6. Describe key clinical features of, and possible treatment modalities for, hepatic encephalopathy.
7. Distinguish the etiology of hemochromatosis vs. hemosiderosis.
8. List the organs affected by iron overload.
9. Describe (1) laboratory findings and (2) histologic features in the liver in hemochromatosis.
10. Name treatment options for hemochromatosis and hemosiderosis.
11. Name primary neoplasms of the liver based on cell type affected.

Small Groups: Diabetic Cases: Type 1 and 2 (Ketoacidosis, Chronic Glucose Management) REQUIRED

1. Identify the key features that differentiate the clinical presentations of type 1 versus type 2 versus pancreatic diabetes.
2. List the diagnostic tests that should be obtained in a patient you think has diabetes.
3. Describe the approach to managing diabetes in outpatients and inpatients with diabetes including the management of ketoacidosis.
4. List the specific steps that can be taken to prevent the development of secondary complications of diabetes.

Small Groups: Diseases of the Gallbladder and Exocrine (REQUIRED)

1. Distinguish between acute and chronic pancreatitis clinically, by imaging, and microscopically.
2. Name the two major etiologic processes associated with pancreatitis in the United States.
3. Discuss the role of evaluation of serum lipase level in diagnosing acute pancreatitis.
4. Identify the cell of origin of pancreatic neuroendocrine tumors.
5. List hormones that may be seen clinically in a functional pancreatic endocrine neoplasm (PEN).
6. Identify features that suggest malignancy / carcinoma in a pancreatic endocrine neoplasm (PEN).
7. Identify the cell of origin and greatest risk factor for development of (exocrine) pancreatic tumors.
8. State the prognosis for pancreatic carcinoma.
9. Identify the most common etiology of cholecystitis.
10. Describe findings macroscopically and microscopically for acute and chronic cholecystitis.
11. Compare and contrast radiopaque vs. radiolucent gallstones.
12. Identify which location(s) lead to pancreatitis if a gallstone is trapped there.

Small Groups: Diseases of the Lower GI-Non-Neoplastic (REQUIRED)

1. Distinguish Celiac disease (autoimmune), wheat allergy (allergic), and gluten sensitivity (lacks autoimmune and allergic markers).
2. Describe EGD and biopsy findings in duodenum with celiac disease.
3. Identify serologic testing needed and conditions that must be excluded when testing for celiac disease, gluten-sensitive enteropathy, and non-tropical sprue.
4. Define the term "inflammatory bowel disease" (IBD).
5. Identify key features that may distinguish Crohn disease from ulcerative colitis.
6. Generate a differential diagnosis for bloody diarrhea.
7. Describe how ischemic colitis can occur with respect to reduced blood flow to the colon.
8. Describe anatomic sites of particular vulnerability to ischemic colitis (boundary zone regions) in hypoperfusion.
9. Identify layers of the colon potentially affected by ischemic colitis.
10. Name the etiologic agent and association with antibiotic therapy in pseudomembranous colitis.
11. Identify clinical testing options for pseudomembranous colitis.
12. Describe macroscopic and microscopic appearance of the involved colon associated with pseudomembranous colitis.

Small Groups: Diseases of the Upper GI (REQUIRED)

1. Compare and contrast the etiology, histologic and endoscopic appearance of esophagitis and Barrett esophagus.
2. Describe the development of dysplasia and adenocarcinoma associated with Barrett esophagus.
3. Distinguish the usual location, histologic appearance, and clinical associations of adenocarcinoma versus squamous cell carcinoma of the esophagus.
4. Compare and contrast the etiology, histologic and endoscopic appearance, treatment modalities, and typical complications of duodenal and gastric peptic ulcers.
5. Describe the association of gastric and duodenal ulcers with H. pylori infection, including treatment options.
6. Describe gastric neoplasms associated with chronic H. pylori infection and gastritis (+/- gastric ulcer).
7. Describe the etiology, and histologic and endoscopic appearance of gastric adenocarcinoma.
8. Distinguish the two major subtypes of gastric adenocarcinoma: intestinal type and diffuse type.

Small Groups: Eating Disorders (REQUIRED)

1. Discuss how the basic science principles related to eating disorders can be applied to clinical medicine and case studies.

Small Groups: Endocrine-Related Depression with Patients (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of endocrine-related psychiatric disease.

Small Groups: GI Tumors (REQUIRED)

1. Distinguish between sessile and pedunculated polyps.
2. Describe the macroscopic and microscopic appearance, and malignant potential for the following gastrointestinal polyps: hyperplastic polyp, adenomatous polyps (tubular, villous, tubulovillous), and those found in familial adenosis polyposis.
3. Discuss the American Cancer Society Guidelines pertaining to the detection of polyps and carcinoma.
4. Compare and contrast the microscopic features of adenoma and adenocarcinoma.
5. Define the components of the "TNM" staging system.
6. List regions of the gut where GI neuroendocrine tumors can be present and their relative prognosis based on location.
7. List the clinical features of the "carcinoid syndrome."

Small Groups: Growth Charts (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of growth disorders.

Small Groups: Hepatitis and Acute Liver Injury (REQUIRED)

1. Name organs other than liver where disease can lead to the following laboratory abnormalities: elevated AST, elevated alkaline phosphatase, and/or reduced albumin.
2. With respect to acute / active alcohol-related liver disease: 1) name liver chemistry testing findings, and 2) list microscopic findings that characterize steatosis and hepatitis.
3. Compare and contrast the main clinical and histologic findings in acute versus chronic hepatitis B infection.
4. Identify the protein that composes the ground glass structures seen in the cytoplasm in chronic cases.
5. Distinguish patterns of liver damage / dysfunction and name key liver chemistry laboratory tests relevant to hepatocellular damage and cholestasis.
6. Compare and contrast clinical / laboratory / histologic features of primary biliary cirrhosis (PBC) and primary sclerosing cholangitis (PSC).

Small Groups: Hyperlipidemia and Obesity (REQUIRED)

1. List the possible causes of obesity.
2. Define Metabolic Syndrome using the current AHA/NCEP definition.
3. List the steps in the clinical evaluation of the obese patient.
4. List the health problems that are associated with obesity.
5. Describe the clinical approach to evaluating the obese patient.
6. Describe the approach to selecting a treatment strategy for an obese patient.

Small Groups: Illness Among Physicians (REQUIRED)

1. Discuss the prevalence of illness including substance use and abuse among physicians.
2. Discuss the etiologic hypotheses for the development of substance use/abuse among physicians.
3. Discuss the clinical symptoms and signs of illness among physicians and the impact of physician illness on medical practice.
4. Discuss the treatment of physicians who are ill, particularly substance using/abusing physicians.

Small Groups: Pituitary Disorders (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of pituitary disorders.

Small Groups: Thyroid Disorders (REQUIRED)

1. Apply knowledge acquired in previous lectures to participate in small group discussions of cases of thyroid disorders.

Sulfur-Containing and Aromatic Amino Acids

1. Describe the types of post-translational modifications that can be made on amino acids.
2. Describe the pathophysiology of scurvy.
3. List the sulfur containing amino acids.
4. Describe the biological utility of Cys in regard to its oxidative state (alone or within GSH).
5. Describe Methionine metabolism, its relation to SAM and the energy provided in SAM.
6. Describe diseases related to Cys, Met metabolism: Hyperhomocysteinemia, Homocystinuria, Cystinuria, Vascular disease.
7. Describe where vitamins are used in Cys, Met metabolism: Folate, B6, B12.
8. List biologically important molecules derived from Trp metabolism.
9. Describe how tyrosine is used in thyroid hormone synthesis.
10. Describe heme metabolism and porphyrias.

Supplements in Metabolic Disease

1. Define Integrative Health and Medicine (IHM).
2. Explain the purpose of Dietary Supplement and Health Education Act (DSHEA) 1994.
3. Distinguish a higher quality supplement due to product labeling.
4. Recognize the most commonly used over the counter (OTC) products and supplements for treatment of different aspects of the metabolic syndrome.
5. Differentiate between those OTCs and supplements that have evidence in treating metabolic diseases versus those lacking solid evidence.
6. Identify those OTCs and supplements that have safety concerns when used in metabolic diseases.
7. Recognize the potential for drug interactions and side effects with OTCs and supplements.

Surgical Approach to Pituitary Tumors

1. Identify the types of pituitary tumors that most often require surgical treatment.
2. Recognize the potential for complications from surgery on the pituitary gland.

TCA Cycle

1. List the substrates that provide carbon skeletons to the TCA cycle.
2. List the key intermediates of the TCA cycle and why they are important.
3. List the principle products of the TCA cycle.
4. Describe the metabolic role of the TCA cycle.
5. Describe how glycolysis and gluconeogenesis are coordinately regulated.

The GI Tract and Systemic Immunity

1. Describe the generation of the subsets of helper T cells in a lymph node.
2. Describe the cytokine milieu in a Peyer's patch under normal and stress/infection conditions, and the consequences for the development of Th subsets.
3. Discuss genetic, environmental, and immunological contributions to Crohn, ulcerative colitis, and celiac disease.
4. Describe how a particular HLA allele can be a critical determinant of inflammatory bowel disease or autoimmune disease.
5. Discuss current thought about non-celiac gluten sensitivity.

The Oral-Systemic Health Link

1. Describe normal child and adult oral anatomy.
2. Describe how oral and systemic health are inter-related (caries, periodontal disease, cancer, obesity, diabetes, coronary heart disease, adverse pregnancy outcome, cognitive and behavioral).
3. Actively encourage medical and dental collaboration.

Thyroid Dysfunction

1. Identify the major symptoms and signs of hyperthyroidism.
2. List the disorders leading to hyperthyroidism.
3. Recognize the major symptoms and signs of hypothyroidism.
4. Name the conditions leading to hypothyroidism.
5. Interpret the different tests used to evaluate thyroid function.

Thyroid Nodule Pathophysiology

1. Recognize the pathological disorders that can lead to the appearance of a solitary or multiple thyroid nodules.
2. Describe the tests that are helpful to evaluate a thyroid nodule.
3. Differentiate the cytological features seen in samples of fine needle aspiration biopsies.
4. Outline the general principles of treatment of benign and malignant thyroid tumors.

Thyroid Pharmacology

1. Describe the process and regulation of the biosynthesis and release of thyroid hormones with special emphasis on sites-targets for pharmacotherapeutic intervention in hyperthyroidism.
2. Explain the treatment of hypothyroidism.
3. Compare and contrast the advantages and disadvantages of various preparations for thyroid hormone replacement.
4. Describe the pharmacokinetics, mechanism of action, and toxicities of antithyroid agents.
5. Explain the treatment of hyperthyroidism and thyroid storm.
6. Compare and contrast antithyroid drugs vs. thyroidectomy vs. radioactive iodine in the treatment of hyperthyroidism.

Thyroid Radiology

1. List available imaging modalities for thyroid disease.
2. Identify thyroid and surrounding structures on imaging.
3. Describe the normal appearance of the thyroid gland in imaging tests.
4. Recognize the appearance of the thyroid on imaging in common disease states.

Transamination and Urea Cycle

1. Describe the transamination reaction.
2. List the common enzymes that catalyze transamination and the regulation of this reaction.
3. Describe the flow of nitrogen from an amino acid to urea and identify the key steps in this process.
4. Describe the regulation of the key steps in the urea cycle.
5. List the means of ammonia transport in the blood.
6. Explain the difference between ketogenic and glucogenic amino acids.

Treatment of Diabetes - Oral Agents

1. Describe how the commonly-used medications for glucose-lowering act upon the main organs/systems that play a role in regulating glucose homeostasis.
2. Outline blood glucose and hemoglobin A1c goals for adults with diabetes.
3. Discuss major factors that would be important to consider in individualizing a hemoglobin A1c goal.
4. Use knowledge of the mechanisms and common adverse effects of various glucose-lowering medications to decide which medications should be avoided in patients with renal insufficiency or congestive heart failure.
5. Describe routine screening, monitoring and preventive care for individuals with diabetes.

Treatment of Dyslipidemias

1. Describe in general the clinical evidence behind each lipid lowering therapy.
2. Identify the mechanism of action of the lipid lowering drugs.
3. Describe the primary drug class to treat elevated LDL-cholesterol and elevated triglycerides. Know the options for secondary drugs for these conditions.
4. Explain the adverse effects of the lipid lowering drugs.

Treatment of Type 1 and 2 Diabetes - Insulins

1. Describe the physiologic pattern of insulin secretion.
2. Explain the different components of basal bolus therapy.
3. Compare the pharmacokinetics of insulin therapies and outline how each is used in basal-bolus insulin therapy.
4. Describe 2 situations in which insulin therapy is used in type 2 diabetes.
5. Give an example of physiologic insulin dosing for type 1 diabetes.
6. Explain the 3 basic principles of inpatient management of diabetes.

Upper GI Pharmacology

1. Describe the site and mechanism of action and relative efficacy of the major antisecretory agents.
2. Describe the possible side effects and drug interactions of PPIs and H2 antagonists.
3. Explain the rationale for antibiotic therapy of peptic ulcers.
4. Describe the actions of proton pump inhibitors and prostaglandins in protecting the gastrointestinal tissues.
5. Describe the general properties, primary ingredients, general mechanisms of action, and guidelines for use of antacids.
6. Describe the site and mechanism of action of major prokinetic agents and list their side effects.
7. Describe the site and mechanism of action and the relative efficacy of the major antiemetic agents and list their side effects.

Viral and Non-Viral Liver Disease, Part 1 and 2

1. Compare and contrast the clinical and histologic features of acute and chronic hepatitis.
2. Identify the various histologic patterns of liver injury.
3. Compare and contrast features of the hepatotropic viruses and the hepatitises they cause.
4. Compare and contrast the grade of disease and stage of disease in chronic hepatitis.
5. Compare and contrast primary biliary cirrhosis and primary sclerosing cholangitis
6. Identify the features of autoimmune hepatitis.
7. Identify the features of drug induced liver injury including acetaminophen toxicity.
8. Describe the major metabolic liver diseases and their histologic findings.
9. Compare and contrast the benign and malignant tumors commonly found in the liver.

Water Soluble Vitamins

1. For each of the vitamins discussed in class, describe the biochemical functions and major physiologic metabolic roles, major dietary sources, and characteristic deficiency findings.
2. Identify circumstances in which risk of vitamin deficiency or toxicity is high.
3. Apply assessment approach to identify potential vitamin deficiency in a clinical scenario.