Pathophysiology (Spring 2017)

Pathophysiology is a 3 credits course (11:067:490:01). **Instructor:** JP Advis DVM, PhD
**Lectures:** TF2 (10:55AM-12:15PM), Bartlett 123; **Office hours:** MTTh (12:35 - 2:00PM) in Bartlett r102, or by appointment (voice: 932-9240; email: advis@aesop.rutgers.edu) Bartlett Hall, Cook College.

**Course web site:** [http://rci.rutgers.edu/~advis/](http://rci.rutgers.edu/~advis/)

**MEETING & DATE / LECTURE & TOPIC COURSES /CHAPTERS IN COURSE TEXTBOOK**

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Lectures</th>
<th>Chapters</th>
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<tr>
<td>01 Jan 17</td>
<td>Introduction: disease, cells as patient, terms and definitions, cell adaptations</td>
<td>1-3</td>
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<td>02 20</td>
<td>Introduction: symptoms of cellular and tissue (electrolytes and buffer) diseases</td>
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<td>03 24</td>
<td>Mechanisms of self-defense: mechanical barriers and inflammation as defenses</td>
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<tr>
<td>04 27</td>
<td>Mechanisms of self-defense: adaptive immunity and stress as defenses</td>
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<td>05 31</td>
<td>Endocrine pathology: alterations of structure/function (S/F) and hormonal regulation</td>
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<td>06 Feb 03</td>
<td>Case studies on alterations of hormonal regulation, stress and diseases</td>
<td>18</td>
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<tr>
<td>07 07</td>
<td>Neuronal pathology: alterations of S/F, mechanisms of neurologic dysfunction</td>
<td>12,13</td>
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<td>08 10</td>
<td>Case studies on alterations of neurologic function of CNS and PNS</td>
<td>14,15</td>
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<td>09 14</td>
<td>Skeletal muscle pathology: alterations of S/F and associated case studies</td>
<td>36,37</td>
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<tr>
<td>10 17 REVIEW – Emphasis on material from lectures 01-09</td>
<td>1-10,12-15,17,18,36,37</td>
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<tr>
<td>11 21 EXAM #1 - 25% of final grade (lectures 01 through 10)</td>
<td>1-10,12-15,17,18,36,37</td>
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<tr>
<td>12 24</td>
<td>Cardiovascular pathology: alterations of S/F in the heart</td>
<td>19,20,22,23</td>
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<tr>
<td>13 28</td>
<td>Cardiovascular pathology: alterations of S/F in blood &amp; lymph vessels</td>
<td>19,20,22,23</td>
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<tr>
<td>14 Mar 03</td>
<td>Case studies on alterations of CV, lymphatic and blood systems</td>
<td>19,20,22,23</td>
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<tr>
<td>15 07</td>
<td>Respiratory pathology: alterations of S/F in the respiratory system</td>
<td>25,26</td>
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<tr>
<td>16 10</td>
<td>Case studies on alterations of the respiratory system function</td>
<td>25,26</td>
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**SPRING BREAK (MARCH 11-19)**

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<th>Date</th>
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<tr>
<td>17 21</td>
<td>Renal pathology: alterations of S/F in the renal system</td>
<td>28,29</td>
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<td>18 24</td>
<td>Case studies on alterations of the renal system function</td>
<td>28,29</td>
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<tr>
<td>19 28 REVIEW - Emphasis on material from lectures 12-18</td>
<td>19,20,22,23,25,26,28,29</td>
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<tr>
<td>20 31 EXAM #2 - 25% of final grade (lectures 01 through 19)</td>
<td>1-10,12-15,17-20,22,23,25,26,28,29,36,37</td>
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<td>21 Apr 04</td>
<td>Digestive pathology: alterations of S/F in the digestive system</td>
<td>33,34</td>
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<td>22 07</td>
<td>Case studies on alterations of digestive system function</td>
<td>33,34</td>
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<tr>
<td>23 11</td>
<td>Metabolic pathology: alterations of S/F in intermediary metabolism</td>
<td>17,18,33,34</td>
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<td>24 14</td>
<td>Case studies on alterations of intermediary metabolism function</td>
<td>17,18,33,34</td>
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<td>25 18</td>
<td>Reproductive pathology: alterations of S/F in the reproductive system</td>
<td>31,32</td>
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<td>26 21</td>
<td>Case studies on alterations of reproductive system function</td>
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<td>27 25 RELEVEL - Emphasis on material from lectures 21-26</td>
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<td>28 28 EXAM #3 - 25% final grade (lectures 01 through 27)</td>
<td>1-10,12-15,17-20,22,23,25,26,28,29,31-34,36,37</td>
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<tr>
<td>29 28 EXAM #4 - 25% final grade (your answers to 3 case studies)</td>
<td>25,26,28,29,31-34,36,37</td>
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**Exams:** There are no make-up exams. If a student has a valid problem with an exam date, it must be discussed with the instructor BEFORE the exam. If a student fails to do so and does not show up to take the exam at the appointed time, a grade of “F” might be assigned for the missing exam at the discretion of the instructor. Students will have the opportunity to review each of their exams and Scantron forms within a few days after each exam. The letter and % grade equivalence are: A=91-100%; B+=86-90%; B=81-85%; C+=76-80%; C=71-75%; D=61-70%; F=0-60%. Each student final grade will be curved to a 75% class average, or up to the highest single student grade (100%), whichever come first.

**Textbook:** Students should have unlimited access to the following textbook: Understanding Pathophysiology, 5th edition, by Sue E Huether and Kathryn L McCance, Mosby Elsevier, 2011. This book will be available at the Cook-Douglas Cooperative Bookstore on the Cook / Douglass Campus, & at the Rutgers Fennen Mall College Bookstore.

**Preparing for this course:** This is an intense course that will cover all of the bodily systems. There will be a large amount of material to understand. It is expected that all students in the class have a solid background from material
they studied in biology, chemistry, endocrinology and physiology as this information will serve as the foundation to discuss pathological alterations of various physiological systems / processes.

A requirement for this course is a course in Integrative Physiology or System Physiology.

**MAIN TALKING POINTS PER LECTURE TOPIC**

**Meetings #01 and #02: AN INTRODUCTION TO PATHOPHYSIOLOGY**

**What is a disease?**
- Life, death, suspended life and the elementary patient: the cell
- Terms and definitions: pathogenesis, etiology, idiopathic, iatrogenic, signs, symptoms, diagnosis, prognosis, acute / chronic disease, remission, exacerbation, complication
- Cellular adaptation: regeneration, hypertrophy, hyperplasia, atrophy, phenotypic changes (modulation and metaplasia), activation, and priming cells

**Symptoms of cellular disease**
- Intracellular accumulations: edema, lipids, glycogen and related materials, pigments
- Pathology of the organelles: plasma membranes, mitochondria, smooth endoplasmic reticulum and Golgi, lysosomes and peroxisomes, cytoskeleton, nucleus
- Cell injury: general mechanism, hypoxic, free radicals and reactive O2, mechanical / chemical, unintentional and intentional, infectious, immunologic and inflammatory
- Cellular death: necrosis, apoptosis
- Pathologic calcification and extracellular pathology

**Symptoms of tissue disease (fluids and electrolytes, acids and bases)**
- Distribution of body fluids, electrolytes and water balance, and buffer systems
- Alterations of water movement (Edema)
- Alterations of sodium, chloride and water balance (hypertonic and hypotonic)
- Alterations of potassium and other electrolytes (hypokalemia and hyperkalemia)
- Alterations of acid – base balance (acidosis and alkalosis – respiratory and metabolic)

**Meetings #03 and 04: MECHANISMS OF SELF-DEFENSE**

**An overview of the lines of self-defense (barriers, inflammation, adaptive immunity)**
- First line of defense: anatomical and biochemical barriers, broadly specific, no memory
- Second line of defense: inflammation, signs, cells, acute & chronic, resolution & repair
- Third line of defense: adaptive immunity, general characteristics, antigens and immunogens, humoral response, cellular response, clonal diversity, immune response

**Inflammation, the 2nd line of self-defense**
- Actors, their language, and the four cardinal signs of inflammation
- The leukocyte’s call to phagocytosis (chemotaxis, activation, margination, phagocytosis)
- Inflammatory exudate (dynamics, functions, types, its future) and chronic inflammation
- Wound healing (by 1st & 2nd intention, models, pace, disorders) and General Inflammation effects (fever, leukocytosis, acute phase response, RBC sedimentation rate, and others)
- Variations and aberrations of the inflammatory response (tissues w/o blood vessels, tissues in different organs, organs w/o blood tissue barriers, invertebrates, plants, inflammation as a cause of damage, failure of the inflammatory response)

**Adaptive immunity, the third line of self-defense**
- Hypersensitivities: allergic, autoimmunity, alloimmunity
- Infection: microorganisms, pathogenic defense mechanisms, infection and injury, clinical manifestations of infections, countermeasures against pathogenic defenses
- Immune Deficiencies: Initial clinical presentation, primary (congenital) and secondary (acquired) pathologies, evaluation, replacement therapies

**Stress and Disease**
- Concepts of stress: general adaptation syndrome, psychologic mediators and specificity
- The stress response: neuroendocrine regulation, psychoneuroimmunologic regulation, role of the immune system
Meetings #05 and #06: PATHOPHYSIOLOGY OF THE ENDOCRINE SYSTEM
Overview of Main Mechanisms of Hormonal Regulation
a) Regulation of hormonal release, hormone transport, mechanism of hormone action
b) Structure and function of endocrine glands, hypothalamic – pituitary systems, thyroid and parathyroid glands, endocrine pancreas, adrenal glands, neuro-endocrinology of stress

Alterations of Hormonal Regulation
a) Mechanisms of hormonal alterations
b) Alterations of hypothalamic – pituitary systems: diseases of the AP, diseases of the PP
c) Alterations of thyroid function: hyperthyroidisms, hypothyroidisms, thyroid carcinoma
d) Alterations of parathyroid function: hyperparathyroidism, hypoparathyroidism
f) Alterations of adrenal function: disorders of adrenal cortex, disorders of adrenal medulla

Case studies in Endocrine Pathophysiology

Meetings #07 and #08: PATHOPHYSIOLOGY OF THE NERVOUS SYSTEM
Overview of Structure and Function of the Nervous System (CNS, PNS, ANS)
a) Cells, potentials, synapses, blood supply, sensory function, pain, temperature regulation

Concepts of Neurologic Dysfunction
a) Alterations in cognitive networks: arousal, conciousness, breathing, pupillary changes, oculomotor responses, motor responses, vomiting, seizures, data processing deficits
b) Alterations in cerebral homeostasis: cerebral hemodynamics, increased intracranial pressure, cerebral edema, hydrocephalus
c) Alterations in motor function: in tone, in movement, in complex motor performance, extrapyramidal motor syndromes

Alterations of Neurologic Function
a) CNS Disorders: trauma, degenerative disorders of the spine, cerebrovascular disorders, infection and inflammation of the CNS, degenerative diseases
b) PNS and Neuromuscular Junction Disorders: PNS disorders, Neuromucular junction disorders, myopathies
c) Tumors of the CNS: cranial tumors, spinal cord tumors

Case studies in Neurologic Pathophysiology

Meeting #09: PATHOPHYSIOLOGY OF THE SKELETAL MUSCLE
Overview of Structure and Function of Skeletal Muscles
a) Motor unit, sensory receptors, muscle fibers, myofibrils, muscle proteins and non-proteins constituents, contraction at a molecular level, muscle metabolism and mechanics, types of muscle contractions, movement of muscle groups

Alterations of Skeletal Muscle Function
a) Secondary Muscle Dysfunction: contractures, stress-induced muscle tension, disuse atrophy, fibromyalgia
b) Muscle Membrane Abnormalities: myotonia, periodic paralysis
c) Metabolic Muscle Diseases: endocrine disorders, diseases of energy metabolism
d) Inflammatory Muscle Diseases: myositis, polymyositis, dermatomyositis and inclusion-body myositis, toxic myopathies
e) Muscle Tumors: rhabdomyoma, rhabdomyosarcoma

Case studies in Skeletal Muscle Pathophysiology

Meetings #10 and #11: REVIEW and TEST #01

Meetings #12, #13 and #14: PATHOPHYSIOLOGY OF THE CARDIOVASCULAR SYSTEM
Overview of Structure and Function of the Cardiovascular System
Alterations of the Heart
a) Diseases of the heart wall: disorders of the pericardium, disorders of the myocardium (the cardiomyopathies), disorders of the endocardium, cardiac complications of AIDS
b) Manifestations of heart disease: dysrhythmias, heart failure
c) Shock: impairment of cellular metabolism, types of shock, clinical manifestations, treatment for shock, multiple organ dysfunction syndrome

Alterations of the Blood and Lymphatic vessels
a) Diseases of the arteries and veins: diseases of veins, hypertension, orthostatic hypotension, aneurysm, thrombus formation, embolism, peripheral vascular disease, arteriosclerosis, atherosclerosis, peripheral arterial disease, coronary artery disease, myocardial ischemia and acute coronary syndrome

Alterations of the Hematologic Systems
a) xx

Case studies in Cardiovascular Pathophysiology

Meetings #15 and #16: PATHOPHYSIOLOGY OF THE RESPIRATORY SYSTEM
Overview of Structure and Function of the Respiratory System
a) Conducting & gas exchange airways, pulmonary & bronchial circulation, chest wall & pleura, ventilation, its control, breathing mechanics, gas transport, control of pulmonary circulation

Alterations of the Respiratory System
a) Clinical manifestations: signs and symptoms of pulmonary disease, conditions caused by pulmonary disease or injury
b) Pulmonary disorders: restrictive lung disease, obstructive lung disease, respiratory tract infections, pulmonary vascular disease, respiratory tract malignancies

Case studies in Respiratory Pathophysiology

Meetings #17 and #18: PATHOPHYSIOLOGY OF THE RENAL SYSTEM
Overview of Structure and Function of the Renal System
a) Kidney and urinary structures, auto-regulation of intra-renal blood flow, neural and hormonal regulation of renal blood flow, nephron function, hormones and nephron functions, renal hormones, the concept of clearance

Alterations of the Renal System
a) Urinary tract obstruction: upper obstruction, lower obstruction, tumors
b) Urinary tract infections: causes, types
c) Glomerular disorders: glomerulonephrities, nephritic syndrome
d) Renal failure: types of renal failure

Case studies in Renal Pathophysiology

Meetings #19 and #20: REVIEW and TEST #02

Meetings #21 and #22: PATHOPHYSIOLOGY OF THE DIGESTIVE SYSTEM
Overview of Structure and Function of the Digestive System
a) The gastro-intestinal tract: mouth and esophagus, stomach, small intestine, large intestine, intestinal bacteria, splanchnic blood flow
b) Accessory organs of digestion: liver, gallbladder, exocrine pancreas

Alterations of Digestive Function
a) Disorders of the GI tract: clinical manifestations of GI dysfunction, disorders of motility, gastritis, peptic ulcer disease, malabsorption syndrome, inflammatory bowel disease, appendicitis, irritable bowel syndrome, vascular insufficiency, disorders of nutrition
b) Disorders of the accessory organs of digestion: clinical manifestation of liver disorders, disorders of the gallbladder, disorders of the pancreas
c) Cancer of digestive system: cancer of GI tract, cancer of accessory organs of digestion
Case studies in Gastrointestinal Pathophysiology

Meetings #23 and #24: PATHOPHYSIOLOGY OF THE INTERMEDIARY METABOLISM

Overview of Structure and Function of the Intermediary Metabolism
a) Structure and Function of the Endocrine Pancreas: the islet of Langerhans
b) Structure and Function of the Adrenal Zona Faciculata: cortisol secretion
c) Structure and Function of the GH axis: GH abuse

Alterations of the Intermediary Metabolism
a) Alterations of the Endocrine Pancreas: Diabetes Mellitus
b) Alterations of the Adrenal Zona Faciculata: Addison and Cushing Diseases
c) Alterations of the GH axis: Metahypophyseal Diabetes Mellitus

Case studies in Intermediary Metabolic Pathophysiology

Meetings #25 and #26: PATHOPHYSIOLOGY OF THE REPRODUCTIVE SYSTEM

Overview of Structure and Function of the Reproductive System
a) Development: sexual differentiation in uterus, puberty
b) Female system: external genitalia, internal genitalia, sex hormones, cycle
c) Male system: external genitalia, internal genitalia, spermatogenesis, sex hormones
d) Structure and function of the breast: female breast, male breast

Alterations of the Reproductive System
a) Alterations of sexual maturation: delayed puberty, precocious puberty
b) Female disorders: hormonal and menstrual alterations, infection and inflammation, pelvic relaxation disorders, benign growth and proliferative conditions, cancer, sexual dysfunction, impaired fertility
c) Male disorders: disorders of the urethra, disorders of the penis, disorders of the scrotum, testis and epididymus, disorders of the prostate gland, sexual dysfunction
d) Disorders of the breast: disorders of the female breast, disorders of the male breast

Case studies in Reproductive Pathophysiology

Meetings #27, #28 and #29: REVIEW and TESTS #03 and #04.

Test #04 is a voluntary / optional report on three case studies students may send by the indicated deadline. For students that do not send these optional reports, a grade equal to the average of their tests #01 through #03 will be used as their grade for test #04.