VTPP 623
BIOMEDICAL PHYSIOLOGY I
COURSE INFORMATION

Description: Biomedical Physiology I. (3-2). Credit 4. Physiological principles, review of cellular physiology, and development of an understanding of the nervous system and muscle, cardiovascular, and respiratory physiology; clinical applications related to organ systems.

Discussions: MWF: 9:10 a.m. – 10:00 a.m. (Room 309, VICI)

Recitation: Tuesdays : 12:40 - 2:30 p.m. (Room 301, VIDI)

Instructor: J.D. Herman
Office Hours: MWF 10:00 – 11:00 or by appointment
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Teaching Assistant: TBA

Required Resources: Lauralee Sherwood: *Human Physiology: from cells to systems*, 8th edition, Brooks/Cole Cengage Learning, ISBN: 978-1-111-57743-8
iClicker 2

Web-sites: http://ecampus.tamu.edu/

Course Goal: To understand the physiological significance of cells, organs and organ systems in maintaining homeostasis of the mammalian organism. (To develop critical thinking, problem solving and self-learning skills in preparation for a career in medicine/science.)

Learning Outcomes:

By the end of the course, the student will:

- investigate and solve mathematical calculations commonly used in physiology
- articulate an understanding of homeostatic control mechanisms of the:
  - central nervous system
  - muscular system
  - cardiovascular system
  - respiratory system
  - renal system
- collect and analyze physiologic data related to the
  - central nervous system
  - muscular system
  - cardiovascular system
  - respiratory system
  - renal system
- evaluate the relationship between physiology and disease
  - including insight into critical thinking in the clinical setting
  - including goals and mechanisms of some pharmacologic agents

Course Grading:

A total of 400 points are possible in the course.

Letter grades will be assigned based on total points earned:

A = 360 to 400 points
B = 320 to 359.9 points
C = 280 to 319.9 points
D = 240 to 279.9 points
F = 0 to 239.9 points

A) Major exams: 37.5% of course grade (150 points); 70 minute exams

Exam A (50 points) - Wednesday, 6:00 p.m., Room TBD
Exam B (50 points) - Wednesday, 6:00 p.m., Room TBD
Exam C (50 points) – Wednesday, 6:00 p.m., Room TBD

B) Grade contract (see attachment): 12.5% of course grade (50 points)

C) Final exam (comprehensive): 25% of course grade (100 points); 2 hour exam

Day 4, 8:00 to 10:00, 309 VICI

D) Laboratory exams and assignments: 25% of course grade (100 points)

Lab Exam 1 (24 points) – Wednesday, 6:00 – 8:00 p.m., Room TBD
Lab Exam 2 (26 points) - Monday, 6:00 – 7:10 p.m., Room TBD

VTPP 423 Course Policy Statements

Note - information in quotation marks is extracted from Texas A&M University Student Rules 2018-2019

Examinations:

Major examinations and the final examination will be written to assess a student's understanding of the information contained in the reading assignments or discussed in class with particular emphasis on the specified objectives. All students enrolled in VTPP 423 will take the major examinations at 6:00 p.m. in the room assigned for their section on the dates assigned. Laboratory examinations will also be held at 6:00 p.m. on the dates assigned. The examinations will be multiple-choice, standardized exams. ParScore Test Forms will be furnished. Students will need to bring a number 2 pencil to every examination. A non-programmable calculator is required for the lab tests and recommended for the lecture examinations. Seating for examinations is assigned on a random basis; a seating chart will be posted outside the exam room approximately 15 minutes prior to each examination.

Students who have withdrawn from or Q-dropped the course are not considered as officially enrolled in the course and, thus, Day not take major, lab or final examinations or attend lectures or participate in labs.

Grade Appeals:

Questions regarding grading of exams, worksheets, quizzes, reports, etc. must be brought to the attention of the instructor within one week following return of these materials. Grades will not be changed following this one-week grade appeal period.

Attendance:

Class attendance is expected. Your arrival to the class on time will be appreciated. Should you arrive late, please enter via the door at the back of the classroom and quietly apologize to the students who you Day disrupt as you take your seat in the classroom. If the first in-class quiz question has been completed, you will not have the opportunity to answer this question.

"The university views class attendance as an individual student responsibility. Students are expected to attend class and to complete all assignments." University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07."

Make-up examinations will only be given for excused absences. The format for make-up examinations will not necessarily be the same as for scheduled examinations; the format will be at the instructor's discretion (eg. short answer, essay, oral, etc.). Note: An Explanatory Absence from Class (http://shs.tamu.edu/attendance) does not constitute a University-approved excuse for a major exam.

The instructor will designate the date and time of make-up examinations.

Make-up Policy:

If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university approved excuse.
The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The reasons absences are considered excused by the university are listed below. See Student Rule 7 for details (http://studentrules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly Day result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1) Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2) Death or major illness in a student's immediate family.
3) Illness of a dependent family member.
4) Participation in legal proceedings or administrative procedures that require a student's presence.
5) Religious holy day. NOTE: Prior notification is NOT required.
6) Injury or illness that is too severe or contagious for the student to attend class.

a) Injury or illness of three or more class days:
Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
b) Injury or illness of less than three class days:
Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:

(i.)Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu
or (ii.) Confirmation of visit to a health care professional affirming date and time of visit.

7) Required participation in military duties.
8) Mandatory admission interviews for professional or graduate school that cannot be rescheduled.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Classroom Communication:

The university has established a formal process for handling of student grievances associated with any course. If there are major concerns about the conduct of a course, which cannot be resolved by meeting with the instructor of a course, a Classroom Communication Concerns form should be completed and submitted to the appropriate department head. (This form is available in the VTPP Departmental Office, Room 323, VIDI.)

Scholastic Dishonesty:

"It is the responsibility of students and instructors to help maintain scholastic integrity at the university by refusing to participate in or tolerate scholastic dishonesty."

"An Aggie does not lie, cheat, or steal or tolerate those who do."

All examinations in this course are closed book, closed note, and closed neighbor exams. Video recording devices and other technological means Day be used to supplement documentation of acts involving Scholastic Dishonesty. The instructors of this course regard Scholastic Dishonesty as a very serious offense and disciplinary action will be taken. Sanctions will include a grade of zero on the examination and a grade of "F" in the course.*

Unless indicated, all laboratory assignments, In Class Questions, Variable Sets, etc., are to be done independently and in your own words. Sharing of lab data, In Class Questions, Variable Set answers, etc., is not allowed. Use of unauthorized materials for exam review or sharing of exam information with other students is not allowed.

Scholastic dishonesty of any form is not tolerated in this course. If you engage in an act of scholastic dishonesty, there is a very high probability that you will be caught. The capabilities and talents of the instructors to identify and verify cheating and their commitment to prosecute cheaters should not be underestimated. Almost every semester, one or more students fail to take this warning seriously. Please do not jeopardize your reputation, academic studies or future professional career.

For additional information, please visit: http://aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

VTPP 423
COURSE SYLLABUS
SPRING SEMESTER 2018

DATE	ASSIGNMENT	Pages for reading in Sherwood are approximate. Use the Objectives to determine necessary readings
	OBJECTIVES	• to perform well in this course, you will need to understand, apply and, in some instances, quantify the concepts that are presented.
Day 1	ASSIGNMENT	**Chapter 1: Homeostasis: The Foundation of Physiology: Pages 1 – 18**
	OBJECTIVES	• Explain the logical relationship between the structure and function of cells, tissues and organs.
		• Describe the process of cellular differentiation and the importance of cellular specialization.
		• Understand the general concepts of homeostasis and the principles of positive and negative feedback in physiological systems.
Day 2	ASSIGNMENT	**Chapter 15: Fluid and Acid-Base Balance: Pages 550 – 554**
	OBJECTIVES	• Given the body weight, estimate the total body water, extracellular fluid volume, intracellular fluid volume, interstitial fluid volume, and plasma volume. Identify normal extracellular fluid (plasma) osmolarity and concentrations of Na^+& K^+ and contrast these values with those for intracellular fluids.
		• Demonstrate the ability to use the indicator dilution principle to measure plasma volume, extracellular fluid volume, and total body water, and identify compounds used to measure each volume.
Day 3	ASSIGNMENT	**Chapter 2: Cell Physiology: Pages 21 – 53**
	OBJECTIVES	• Describe the overall organization of a typical cell.
		• Explain the role of each of the membranous organelles (rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, and mitochondria).
		• Compare and contrast the production of ATP, utilization of oxygen, and production of carbon dioxide in the three stages of cellular respiration: glycolysis, citric-acid cycle, and oxidative phosphorylation.
		• Explain the functions of microtubules, microfilaments, and intermediate filaments in various cell types.
Day 4	ASSIGNMENT	**Chapter 3: Plasma Membrane and Membrane Potential: Pages 56 – 70**
	OBJECTIVES	• Describe the composition of a cell membrane. Diagram its cross section, and explain how the distribution of phospholipids and proteins influences the membrane permeability of ions, hydrophilic and hydrophobic compounds.
		• Describe the role of specialized cell junctions - desmosomes, tight junctions, and gap junctions.
		• Write Fick's Law of diffusion, and explain how changes in the concentration gradient, surface area, permeability, and distance will influence the diffusional movement of a compound.
		• Explain how the relative permeability of a cell to water and solutes will generate an osmotic pressure. Contrast the osmotic pressure generated across a cell membrane by a solution of particles that freely cross the membrane with that of a solution with the same osmolarity, but particles that cannot cross the cell membrane.
Day 5	ASSIGNMENT	**Chapter 3: Plasma Membrane and Membrane Potential: Pages 71 – 79**
	OBJECTIVES	• Describe how transport rates of certain molecules and ions are accelerated by specific membrane carrier proteins.
		• Differentiate the following terms based on the source of energy driving the process and the molecular pathway for: diffusion, facilitated diffusion, secondary active transport, and primary active transport.
		• Describe how energy from ATP hydrolysis is used to transport ions such as Na^+, K^+, Ca^{2+}, and H^+ against their electrochemical differences (e.g., via the Na^+ pump, sarcoplasmic reticulum Ca^{2+} pump, and gastric H^+ pump).

		• Describe how the process of secondary active transport is used to absorb/reabsorb glucose and amino acids in the small intestine and kidneys.
		• Explain the purpose of membrane transport via endocytosis and exocytosis.
Day 6	ASSIGNMENT	**Chapter 3: Plasma Membrane and Membrane Potential: Pages 79 – 86**
	OBJECTIVES	• Based on the principle of ionic attraction, explain how a potential difference across a membrane will influence the distribution of a cation and an anion.
		• Be able to calculate an equilibrium potential for that ion using the Nernst equation.
		• Contrast the difference in E_K (the Nernst potential for K^+) caused by a 5 mEq/l increase in extracellular K^+ with the change in E_{Na} (the Nernst potential for Na^+) caused by a 5 mEq/l increase in extracellular Na^+.
		• Based on the Nernst equilibrium potential, predict the direction that an ion will take (follow) when the membrane potential is at its equilibrium potential, is more negative than the equilibrium potential, or is less negative than the equilibrium potential.
		• Explain how the resting membrane potential is generated. Given an increase or decrease in the permeability of K^+, Na^+, or Cl^-, predict how the membrane potential would change.
Day 7	ASSIGNMENT	**Chapter 4: Principles of Neural and Hormonal Communication: Pages 88 – 103**
	OBJECTIVES	• Contrast the generation and conduction of graded potentials with that of action potentials, identifying on the neuron the area in which each occurs.
		• Define, and identify on a diagram of a neuron, the following regions: dendrites, axon, axon hillock, and soma.
		• Diagram the various phases of an action potential and link each phase to the activity of voltage-gated Na^+ and K^+ channels and ion fluxes.
		• Define the following properties of ion channels: gating, activation, and inactivation.
		• Define the all-or-none law.
		• Explain the mechanism that accounts for the refractory period in an excitable cell.
Day 8	ASSIGNMENT	**Chapter 4: Principles of Neural and Hormonal Communication: Pages 103 – 115**
	OBJECTIVES	• Compare and contrast the propagation of action potentials by contiguous conduction and saltatory conduction. Predict the consequence on action potential propagation in demyelinating diseases, such as multiple sclerosis.
		○ Compare conduction velocities in a compound nerve, identifying how the diameter and myelination lead to differences in conduction velocity.
		• Describe the anatomical structure of synapses and the physiological processes involved in synaptic transmission.
		• Contrast the gating of ion selective channels by extracellular ligands and voltage.
		• Describe chemical neurotransmission, listing in correct temporal sequence events beginning with the arrival of a wave of depolarization at the pre-synaptic membrane and ending with a graded potential generated at the post-synaptic membrane.
		• Explain the mechanisms of neuronal signal processing, namely EPSPs, IPSPs, spatial summation, temporal summation and neuromodulation.
Day 9	ASSIGNMENT	**Chapter 4: Principles of Neural and Hormonal Communication: Pages 116 – 128**
	OBJECTIVES	• Describe cell surface receptor structure and function.
		• Explain the concept of cell signaling pathways and how interactions between chemical messengers and membrane receptors can alter cellular activities.
		• Understand post-translational regulation of protein function in the cell (e.g., phosphorylation).
		• Compare and contrast the mechanisms of actions of hydrophilic and lipophilic hormones.
		• Define the terms agonist and antagonist as related to membrane receptor ligands.
Day 10	ASSIGNMENT	**Chapter 5: The Central Nervous System: Pages 134 – 153**
	OBJECTIVES	• Describe the general organization of the nervous system.
		• Identify on a diagram the meninges and subarachnoid spaces.

		• Describe formation and reabsorption of cerebral spinal fluid, including the anatomy and function of the choroid plexi.
		• Describe the endothelial basis of the blood-brain barrier, and predict the consequence of this barrier for the central nervous system distribution of intravenously administered hydrophilic and hydrophobic drugs.
		• Describe the cortical areas important for language.
		• Describe the cortical area important for spatial relations.
		• Describe the functions of the prefrontal association cortex.
		• List the major differences in hemispheric function in humans.
Day 10	**Exam 1**	**Objectives from Day 1 to Day 9 – 6:00 p.m.**
Day 11	**Review Exam 1: Attendance Optional but Recommended**	
Day 12	ASSIGNMENT	**Chapter 5: The Central Nervous System: Pages 154 – 169**
	OBJECTIVES	• Describe the functions of subcortical structures.
		• Describe the overall function of the basal ganglia in the initiation and control of motor function.
		• Describe the major functions of the limbic system. • Explain the mechanisms proposed for short term and long-term memory storage.
		• List three functional divisions of the cerebellum. Be able to differentiate the functions of each.
Day 13	ASSIGNMENT	**Chapter 5: The Central Nervous System: Pages (153) 169 – 182; 290 – 291**
	OBJECTIVES	• List the functions of the brain stem.
		• Describe the behavioral, EEG, and other characteristics of the stages of slow-wave sleep and rapid-eye-movement (REM) sleep.
		• Diagram the anatomical organization of the spinal cord including the functions of the major ascending and descending spinal cord tracts.
		• Describe the properties of the withdrawal reflex initiated by touching a hot stove. Identify the neuronal connections and role of the crossed extensor reflex.
		• Trace the neuronal activity initiated by striking the patellar tendon with a percussion hammer (the patellar tendon reflex) that leads to contraction of a muscle, particularly comparing monosynaptic vs. poly-synaptic reflexes.
Day 14	ASSIGNMENT	**Chapter 6: The Peripheral Nervous System: Afferent Division; Special Senses: Pages 186 – 196**
	OBJECTIVES	• Explain the process of transduction, the law of specific nerve energies and the labeled line principle.
		• Compare and contrast the responses of tonic and phasic receptors.
		• Explain why the threshold for two-point discrimination changes in different areas of the body surface, e.g., lips, fingertips and back.
		• Explain the process of pain transduction and diagram transmission of pain information to higher centers.
		• Describe the control of pain perception, including central processing and the role of endorphins.
		• Describe the mechanism of referred pain of visceral origin.
Day 15	ASSIGNMENT	**Chapter 6: The Peripheral Nervous System: Afferent Division; Special Senses: Pages 196 – 205**
	OBJECTIVES	• Describe the refraction of light as it passes through the eye to the retina, identifying the eye components that account for refraction of light.
		• Explain the formation and movement of ocular fluids.
		• Describe the process of accommodation, contrasting the refraction of light by the lens in near vision and in far vision.
		• Describe the refractive deficits that account for myopia, hyperopia, presbyopia, and astigmatism, and their correction by eyeglasses or contact lenses.
Day 16	ASSIGNMENT	**Chapter 6: The Peripheral Nervous System: Afferent Division; Special Senses: Pages 205 – 216**
	OBJECTIVES	• Explain the transduction process for rods and the three types of cones, including the range of visible wavelengths of light.
		• List and compare four functional properties of scotopic and photopic vision.

		• Describe the mechanism for dark and light adaptation of photoreceptors.
		• Predict the visual field defects resulting from the following lesions in the visual pathway: retinal lesion, optic nerve lesion, optic chiasm, optic tract, lateral geniculate nucleus, optic radiations, and primary visual cortex.
		• Diagram the neuronal pathway associated with the pupillary light reflex. Be able to predict possible neurological lesions based on altered direct and indirect pupillary light reflexes.
Day 17	ASSIGNMENT	**Chapter 6: The Peripheral Nervous System: Afferent Division; Special Senses: Pages 217 – 230**
	OBJECTIVES	• Describe the function of the outer ear, middle ear, and inner ear, listing in order the mechanical structures over which sound energy is transmitted to auditory receptors.
		• Explain how deformations of the basilar membrane are converted into action potentials in auditory nerve fibers.
		• Diagram the auditory pathway.
		• Describe how pitch, loudness, and localization of sounds in space are coded by the auditory system.
		• Distinguish conductive and sensorineural deafness.
		• Describe the structure, normal stimulus, transduction at the receptor level, and function of the semicircular canals.
		• Describe the structure, normal stimulus, transduction at the receptor level, and function of the otolith organs.
		• Describe nystagmus and the clinical signs of vestibular dysfunction.
Day 18	ASSIGNMENT	**Chapter 7: The Peripheral Nervous System: Efferent Division: Pages 239 – 244**
	OBJECTIVES	• Contrast the sympathetic and parasympathetic branches of the autonomic nervous system based on: spinal cord division of origin, length of preganglionic and postganglionic neurons, neurotransmitters and receptors at the ganglionic and target organ synapse.
		• Describe the physiological effects of enhanced parasympathetic tone.
		• Describe the physiological effects of enhanced sympathetic tone.
Day 19	ASSIGNMENT	**Chapter 7: The Peripheral Nervous System: Efferent Division: Pages 244 – 247**
	OBJECTIVES	• Identify autonomic neurotransmitter substances and the classification of autonomic receptors. Be able to identify receptors associated with target tissues/organs.
		• Be able to predict what effect receptor agonists / antagonists will have.
		• List the major central nervous system control centers of the ANS.
Day 20	ASSIGNMENT	**Chapter 7:The Peripheral Nervous System: Efferent Division: Pages 248 – 255**
	OBJECTIVES	• Compare and contrast a synapse with a neuromuscular junction.
		• List in sequence the steps involved in neuromuscular transmission in skeletal muscle and point out the location of each step on a diagram of the neuromuscular junction.
		• Distinguish between an endplate potential in skeletal muscle and an excitatory post-synaptic potential.
		• Describe how various agents might affect neuromuscular transmission at the neuromuscular junction.
Day 21	ASSIGNMENT	**Chapter 8: Muscle Physiology: Pages 258 – 264**
	OBJECTIVES	• Compare and contrast the characteristics of skeletal, cardiac and smooth muscle.
		• Draw and label a skeletal muscle at all anatomical levels, from the whole muscle to the molecular components of the sarcomere. At the sarcomere level, include at least two different stages of myofilament overlap.
		• Diagram the structure of the thick and thin myofilaments and label the constituent proteins. Understand how this relates to banding in striated muscle.
		• Explain the sliding-filament mechanism of muscle contraction.
Day 22	ASSIGNMENT	**Chapter 8: Muscle Physiology: Pages 264 – 278**

	OBJECTIVES	• List the steps in excitation contraction coupling in skeletal muscle, and describe the roles of the sarcolemma, transverse tubules, sarcoplasmic reticulum, thick filaments, thin filaments, and calcium ions.
		• Describe the roles of ATP in skeletal muscle contraction and relaxation.
		• Draw a force versus velocity curve for skeletal muscle.
		• Distinguish between a twitch and tetanus in skeletal muscle and explain why a twitch is smaller in amplitude than tetanus and the continuum of force development between a twitch and tetanus including the intracellular events.
		• Define a motor unit and describe the order of recruitment of motor units during skeletal muscle contraction of varying strengths.
		• Describe the relationship of the length of the H zone and the overall muscle length - force relationship.
		• Distinguish between an isometric and isotonic contraction.
Day 22	**Exam 2**	**<u>Objectives from Day 10 – Day 21 – 6:00 p.m.</u>**
Day 23	**Review Exam 2**	**Attendance optional, but encouraged**
Day 24	ASSIGNMENT	**<u>Chapter 8: Muscle Physiology: Pages 278 – 285</u>**
	OBJECTIVES	• Describe how the origin and insertion of a skeletal muscle to the skeleton can influence mechanical performance of the muscle.
		• List the energy sources of muscle contraction and rank the sources with respect to their relative speed and capacity to supply ATP for contraction and how they are different in the three muscle types.
		• Construct a table of structural, enzymatic, and functional features of the three major categories (fast glycolytic, fast-oxidative-glycolytic, and slow oxidative fiber types) of skeletal muscle fiber types and their relative plasticity.
		• Define fatigue as it applies to muscle. List factors that contribute to fatigue.
		• Discuss mechanisms for the hypertrophy and atrophy of skeletal muscle fibers.
Day 25	ASSIGNMENT	**<u>Chapter 8: Muscle Physiology: Pages 285 – 300</u>**
	OBJECTIVES	• Draw a "box" diagram of motor control systems, including cerebral cortex, basal ganglia, cerebellum, thalamus, brainstem motor nuclei, and spinal cord. Indicate with arrows the flow of information among these structures and, ultimately, to the alpha motor neurons.
		• Describe the anatomical location, function, and afferent neurotransmission of muscle spindle and Golgi tendon organs.
		• Describe the role of the gamma efferent system in the stretch reflex, and explain the significance of alpha-gamma co-activation.
		• Describe the proprioceptive role of the Golgi tendon organ.
		• Compare and contrast the contraction mechanisms of cardiac, smooth, and skeletal muscle.
Day 26	ASSIGNMENT	**<u>Chapter 9: Cardiac Physiology: Pages 305 – 315</u>**
	OBJECTIVES	• Describe the organization of the circulatory system and explain how the systemic and pulmonary circulations are linked physically and physiologically.
		• Understand the basic functional anatomy of the atrioventricular and semilunar valves, and explain how they operate.
		• Explain the ionic mechanism of pacemaker automaticity and rhythmicity, and identify cardiac cells that have pacemaker potential and their spontaneous rate. Identify neural and humoral factors that influence their rate.
		o Beginning in the SA node, diagram the normal sequence of cardiac activation (depolarization) and the role played by specialized cells. Predict the consequence of a failure to conduct the impulse through any of these areas.
		o Explain why the AV node is the only normal electrical pathway between the atria and the ventricles, and explain the functional significance of the slow conduction through the AV node. Describe factors that influence conduction velocity through the AV node
Day 27	ASSIGNMENT	**<u>Chapter 9: Cardiac Physiology: Pages 315 – 326</u>**

	OBJECTIVES	• Sketch a typical action potential in a ventricular muscle cell, labeling both the voltage and time axes accurately. Describe how ionic currents contribute to the four phases of the cardiac action potential.
		○ Explain what accounts for the long duration of the cardiac action potential and the resultant long refractory period. Discuss the advantage of the long plateau of the cardiac action potential and the long refractory period.
		• Name the parts of a typical bipolar (Lead II) ECG tracing and explain the relationship between each of the waves, intervals, and segments in relation to the electrical state of the heart.
		• Draw, in correct temporal relationship, the pressure, volume, heart sounds, and ECG changes in the cardiac cycle. Identify the intervals of isovolumetric contraction, rapid ejection, reduced ejection, isovolumetric relaxation, rapid ventricle filling, reduced ventricular filling and atrial contraction.
		• Know the various phases of ventricular systole and ventricular diastole. Contrast the relationship between pressure and flow into and out of the left and right ventricles during each phase of the cardiac cycle.
Day 28	ASSIGNMENT	**Chapter 9: Cardiac Physiology: Pages 327 – 333**
	OBJECTIVES	• Explain the determinants and regulation of cardiac output.
		• Describe the role of Starling's Law of the Heart in keeping the output of the left and right ventricles equal.
		• Define venous return.
		• Describe the difference in the way changes in preload and changes in contractility influence ventricular force development.
		• Define afterload and explain how arterial pressure influences afterload.
		• Define ejection fraction and be able to calculate it from end diastolic volume, end systolic volume, and/or stroke volume. Predict the change in ejection fraction that would result from a change in preload, afterload, and contractility.
Day 29	ASSIGNMENT	**Chapter 9: Cardiac Physiology: Pages 334 – 340**
		• Describe the phasic flow of blood to the ventricular myocardium through an entire cardiac cycle.
		• Explain the mechanism whereby coronary blood flow is coupled to myocardial workload, and identify stimuli that cause increases in coronary blood flow to occur.
		• Describe the pathogenesis of coronary artery disease.
Day 30	ASSIGNMENT	**Chapter 10: The Blood Vessels and Blood Pressure: Pages 343 – 352**
	OBJECTIVES	• Be able to differentiate between flow and velocity in terms of units and concept.
		• Understand the relationship between pressure, flow, and resistance in the vasculature.
		• Explain how Poiseuille's Law influences resistance to flow. Use it to calculate changes in resistance in a rigid tube (blood vessel).
		• Understand the functional significance of arteries.
		• Understand the concept of "mean systemic pressure," its normal value, and how various factors can alter its value.
		• Describe how arterial systolic, diastolic, mean, and pulse pressure are affected by changes in stroke volume, heart rate, arterial compliance, and total peripheral resistance.
Day 31	ASSIGNMENT	**Chapter 10: The Blood Vessels and Blood Pressure: Pages 352 – 367**
	OBJECTIVES	• Describe the regulation of blood flow by arterioles.
		• Identify the role of PO_2, PCO_2, pH, adenosine, and K^+ in the metabolic control of blood flow to specific tissues.
		• Describe the contribution of myogenic tone to blood flow regulation.
		• Explain the effects of nitric oxide (EDRF, endothelial derived relaxing factor) and endothelin on vascular smooth muscle.
		• Define the forces involved in bulk flow and discuss how each component influences fluid movement across the capillary wall.

		○ Explain how water and solutes traverse the capillary wall. Use Fick's equation for diffusion to identify the factors that will affect the diffusion-mediated delivery of nutrients from the capillaries to the tissues.
		○ Describe how histamine alters the permeability of the capillaries and post-capillary venules and how the loss of albumin into the interstitial space promotes localized edema.
Day 32	ASSIGNMENT	**Chapter 10: The Blood Vessels and Blood Pressure: Pages 368 – 375**
	OBJECTIVES	• Describe the lymphatics, and explain how the structural characteristics of terminal lymphatics allow the reabsorption of large compounds, such as proteins.
		• Contrast the structure of lymphatic capillaries and systemic capillaries, including the significance of the smooth muscle in the walls of the lymphatic vessels.
		• Identify critical functions of the lymphatic system in fat absorption, interstitial fluid reabsorption, and clearing large proteins from the interstitial spaces.
		• Explain how edema develops in response to: venous obstruction, lymphatic obstruction, increased capillary permeability, heart failure, tissue injury or allergic reaction, and malnutrition.
		• Describe the functional significance of veins and factors influencing venous return, including the effect of gravity on venous pressure.
Day 33	ASSIGNMENT	**The Blood Vessels and Blood Pressure; Chapter 10: Pages 375 – 386**
	OBJECTIVES	• List the anatomical components of the baroreceptor reflex.
		• Explain the sequence of events in the baroreflex that occur after an acute increase or decrease in arterial blood pressure. Include receptor response, afferent nerve activity, CNS integration, efferent nerve activity to the SA node, ventricles, arterioles, and veins.
		• Contrast the sympathetic and parasympathetic nervous system control of heart rate, contractility, total peripheral resistance, and venous capacitance. Predict the cardiovascular consequence of altering sympathetic nerve activity and parasympathetic nerve activity.
		• Contrast the relative contribution of neural and renal mechanisms in blood pressure and blood volume regulation.
		• List the causes of hypertension, hypotension, and circulatory shock.
		• Describe the direct cardiovascular consequences of the loss of 30% of the circulating blood volume on cardiac output, central venous pressure, and arterial pressure. Describe the compensatory mechanisms activated by these changes.
Day 33	**Exam 3**	**Objectives from Day 21 – Day 32 – 6:00 p.m.**
Day 34	Review Exam 3	Attendance optional, but encouraged
Day 35	ASSIGNMENT	**Chapter 13: The Respiratory System: Pages 456 – 473**
	OBJECTIVES	• Describe the anatomy of the respiratory system.
		• Diagram how pleural pressure, alveolar pressure, airflow, and lung volume change during a normal quiet breathing cycle. Identify on the figure the onset of inspiration, cessation of inspiration, and cessation of expiration. Describe how differences in pressure between the atmosphere and alveoli cause air to move in and out of the lungs.
		• Identify the forces that generate the negative intrapleural pressure when the lung is at functional residual capacity, and predict the direction that the lung and chest wall will move if air is introduced into the pleural cavity (pneumothorax).
		• Define surface tension and describe how it applies to lung mechanics, including the effects of alveolar size and the role of surfactants. Define atalectasis and the role of surfactants in preventing it.
		• Describe the effects of airway diameter and turbulent flow on airway resistance.
Day 36	ASSIGNMENT	**Chapter 13: The Respiratory System: Pages 473 – 484**
	OBJECTIVES	• Draw a normal spirogram, labeling the four lung volumes and four capacities. List the volumes that comprise each of the four capacities. Identify which volume and capacities cannot be measured by spirometry.
		• Differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category.

		• Define and contrast the following terms: anatomic dead space, physiologic dead space, total minute ventilation and alveolar minute ventilation.
		• Define and contrast the relationships between alveolar ventilation and the arterial P_{CO_2} and P_{O_2}
Day 37	ASSIGNMENT	**Chapter 13: The Respiratory System: Pages 484 – 488**
	OBJECTIVES	• Define partial pressure and fractional concentration as they apply to gases in air. List the normal fractional concentrations and sea level partial pressures for O_2 and CO_2.
		• Name the factors that affect diffusive transport of a gas between alveolar gas and pulmonary capillary blood.
		• List the normal airway, alveolar, arterial, and mixed venous PO_2 and PCO_2 values. List the normal arterial and mixed venous values for O_2 saturation.
		• Draw an oxyhemoglobin dissociation curve (hemoglobin oxygen equilibrium curve) showing the relationships between oxygen partial pressure and hemoglobin saturation. Compare the relative amounts of O_2 carried bound to hemoglobin with that carried in the dissolved form.
		• Show how the oxyhemoglobin dissociation curve is affected by changes in blood temperature, pH, PCO_2, and 2,3-BPG, and describe a situation where such changes have important physiological consequences.
Day 38	ASSIGNMENT	**Chapter 13: The Respiratory System: Pages 488 – 499**
	OBJECTIVES	• List the forms in which carbon dioxide is carried in the blood. Identify the percentage of total CO_2 transported as each form.
		• Identify the enzyme that is essential to normal carbon dioxide transport by the blood and its location.
		• Describe the importance of the chloride shift in the transport of CO_2 by the blood.
		• Identify the regions in the central nervous system that play important roles in the generation and control of cyclic breathing.
		• List the anatomical locations of chemoreceptors sensitive to changes in arterial PO_2, PCO_2, and pH that participate in the control of ventilation. Identify the relative importance of each in sensing alterations in blood gases.
Day 39	ASSIGNMENT	**Chapter 14: The Urinary System: Pages 505 – 518**
	OBJECTIVES	• Describe in sequence the tubular segments through which filtrate flows after it is formed at Bowman's capsule to when it enters the renal pelvis. Identify each structure as being located in the renal cortex or renal medulla. Based on the glomerulus location and the length of the loop of Henle, distinguish between cortical and juxtamedullary nephrons.
		• Describe in sequence the blood vessels through which blood flows when passing from the renal artery to the renal vein, including the glomerular blood vessels, peritubular capillaries, and the vasa recta.
		• Define renal blood flow, renal plasma flow, glomerular filtration rate, and filtration fraction and list typical values.
		• Identify the filtration barriers, if any, which impede the filtration of H_2O, Na^+, inulin, albumin, and red blood cells.
		• Given the capillary and Bowman's capsule hydrostatic and oncotic pressures, calculate the net filtration force at the glomerular capillaries. Predict the changes in glomerular filtration caused by increases or decreases in any of those pressures.
		• Describe the myogenic and tubuloglomerular feedback mechanisms that mediate the autoregulation of renal blood flow and glomerular filtration rate.
Day 40	ASSIGNMENT	**Chapter 14: The Urinary System: Pages 518 – 528**
	OBJECTIVES	• Describe the cellular mechanisms for the transport of Na^+, Cl^-, K^+, Ca^{2+}, phosphate, organic solutes (e.g., glucose, amino acids, and urea), and water by the major tubular segments. Describe the cellular mechanisms for the transport of Na^+, Cl^-, K^+, Ca^{2+}, phosphate, organic solutes (e.g., glucose, amino acids, and urea), and water by the major tubular segments.

		• Predict the change in renal blood flow and glomerular filtration caused by: increased synthesis of angiotensin II, increased release of atrial natriuretic peptide, and increased nitric oxide formation.
		• Describe the relationships between sodium balance and plasma volume as they contribute to cardiovascular hemodynamics and arterial pressure.
		• Describe the role of the renin-angiotensin-aldosterone systems in the regulation of sodium balance and arterial pressure with emphasis on the actions of angiotensin II on renal hemodynamics and tubular transport.
Day 41	ASSIGNMENT	**Chapter 14: The Urinary System: Pages 528 – 541**
	OBJECTIVES	• Describe the mechanisms for tubular secretion of hydrogen ion potassium ions and organic ions.
		• Explain the clearance principle. Use the clearance equation and an appropriate compound to estimate the glomerular filtration rate and renal plasma flow.
		• Given the plasma and urine concentrations and the urine flow rate, calculate the filtered load, tubular reabsorption, excretion rate, and plasma clearance of inulin, creatinine, para-amino hippuric acid (PAH), glucose, and penicillin. Predict how changes in filtration, reabsorption, and secretion will affect renal excretion of each compound.
Day 42	ASSIGNMENT	**Chapter 14: The Urinary System: Pages 541 – 546**
	OBJECTIVES	• Describe the role of the ascending limb of the loop of Henle in producing a high renal interstitial fluid osmolarity. Beginning with the loop of Henle, contrast the tubular fluid and interstitial fluid osmolarity changes that allow either dilute or concentrated urine to be produced and excreted.
		• Identify the cellular mechanism by which ADH increases permeability to water. Describe the role of these changes on the ability of the kidney to produce either dilute or concentrated urine.
Day 43		Final Exam

VTPP 623
PHYSIOLOGY
RECITATION INFORMATION

Recitation Sessions: Tuesdays, 12:40-2:30 pm (Room 301 VIDI)

Instructor: Charles Long
Office Hours: by appointment
RSL Telephone: 979/845-2331
clong@cvm.tamu.edu

Textbook: Lauralee Sherwood: *Human Physiology: from cells to systems*, 8th edition, Brooks/Cole Cengage Learning, ISBN: 978-1-285-86693-2

Recitation Goals: To develop critical thinking, problem solving and scientific skills in preparation for a career in biomedical science. To gain experience in the use of modern physiological data acquisition equipment and the application of computers in the statistical analysis of data. To reinforce physiological principles discussed in lecture sessions.

Recitation Grading: A total of 100 points are possible in the recitation portion of this course.

Your arrival to recitation on time will be appreciated. Recitation attendance is required; authorized absences require a written excuse. If you are unable to attend a particular laboratory section (but can attend another lab section), you will be expected to contact the instructor to obtain permission to switch sections.

The VTPP 623 Course Policy Statements (distributed in lecture) also pertain to the laboratory portion of this course.

VTPP 623
RECITATION SYLLABUS

DATE	*LABORATORY EXERCISE(S)* • *Highlighting some objectives from lecture*	*Instructor*
Week 1	Introduction and Cellular Physiology	Long/Suva
Week 2	Cellular Signaling and Second Messenger Systems	Golding
Week 3	Analysis of Cell Signaling Pathways	Ivanov
Week 4	Evoked Potentials/Excitable Membranes	Long
Week 5	CNS 1	Patterson
Week 6	CNS 2 • Review article selection and approval due	
Week 7	Skeletal Muscle	Davis
Week 8	Properties of Smooth Muscle Properties of Cardiac Muscle	Heaps
Week 9	The Electrocardiogram	
Week 10	Cardiovascular Physiology	Stallone
Week 11	Blood Vessel Fluid Dynamics	Ramadoss
Week 12	Respiratory Physiology	Han
Week 13	Renal Physiology .	Newell-Fugate
Week 14	Written Assignment due	Long

A total of 12 laboratory exercises will be assigned and graded. Specific rubrics will be accessed on eCampus.

Total point value = 100 points.

ple-choice and partial credit will not be given.