TEXAS A&M UNIVERSITY SYLLABUS

COURSE INFORMATION

Course Title: VTPP 123: Foundations of Physiology

Term: Spring

Credit Hours: 3

Meeting Times: MWF 9:10-10:00 OR MWF 10:20-11:10 OR MWF 11:30-12:20 OR MWF 12:40-1:30

Meeting Location: VIDI 109 (http://aggiemap.tamu.edu/?Bldg=1813)

Textbook Required: None

COURSE DESCRIPTION AND PREREQUISITES

Course Description: Introduction to fundamental concepts in physiology and the practice of physiology research through exploration of mathematical models used in physiology research: emphasis on prediction of complex adaptive behavior in health and disease from elementary math, physics, chemistry and biology.

Prerequisites: None

INSTRUCTOR INFORMATION

Name: Christopher Quick

Telephone: 979-845-2645

Email: cquick@tamu.edu

Office hours: By appointment (although available MWF 9:10-5:00 in VIDI 109).

Office: VIDI 310

CERTIFICATE PROGRAM IN BIOMEDICAL RESEARCH

The Biomedical Research Certificate Program will provide undergraduate students an opportunity to gain advanced training in biomedical research. Students in the Certificate Program will gain a broader understanding of the creation, evaluation, and dissemination of new knowledge while performing original biomedical research within a research-intensive community. This program creates research opportunities and makes it possible for students to produce original research all four years of their undergraduate program. It is not necessary to participate in the Certificate Program to be enrolled in this course, but this course is a prerequisite for all subsequent courses of the program.

STUDENT LEARNING OUTCOMES

- **Master the depth of knowledge**, including the ability to articulate disciplinary and interdisciplinary theories, concepts, principles, skills in the biomedical sciences.
- **Demonstrate critical thinking**, including the ability to evaluate, analyze, and integrate information from a variety of sources from the biomedical literature; use appropriate strategies and tools to represent, analyze, and integrate physiological data; and develop critical, reasoned positions.
- **Communicate effectively**, including the ability to demonstrate effective writing and nonverbal communication skills (tables and graphs); and effectively communicate original and creative ideas to biomedical research community.
- **Practice personal and social responsibility**, including the ability to recognize ethical dilemmas in research and apply rational decision-making in order to address it; choose ethical courses of action in research and practice.
- **Prepare to engage in lifelong learning**, including the ability to exhibit the skills necessary to acquire, organize, reorganize, and interpret new knowledge; formulate a plan of personal goals for continued professional growth; and demonstrate intellectual curiosity.

TEACHING PHILOSOPHY

This course is designed so that you learn in the process of performing authentic, original research. To achieve the course learning outcomes, all course activities are informed by authentic scientific practices. Practicing biomedical researchers 1) guide their own learning, 2) collaborate in teams, 3) develop projects in identifiable stages, 4) create new knowledge, and 5) formally communicate results. The structure of the course is designed to produce biomedical research and biomedical researchers.

UNIQUE STRUCTURE OF COURSE

Flipped class: We will use a "flipped class" model in which short video lectures or written materials are studied outside of the classroom and collaborative projects are completed in the classroom.

- Learn basic material at your own pace
- Maximize meaningful contact with experts and peers in class working on collaborative projects

Team-based projects: All projects will be performed teams of students with diverse talents, skills and backgrounds.

- Complete each project in a team with diverse abilities to produce research faster
- Identify, leverage and develop your particular research talents

Scaffolding the discovery process in phases: The class is divided into distinct phases used by practicing scientists to scaffold the discovery process and maximize productivity.

- Introduce you to the minimum required knowledge to begin research
- Transition from consumption of standard knowledge to production of new knowledge

Learning by doing: We will minimize *teaching* you facts, concepts procedures with lectures or labs with known outcomes. Instead, you will *learn* in the process of performing authentic research.

- Direct your own learning and teach each other
- Minimize the simple transfer of knowledge

Scientific Communication: All course products will be in standard forms used by biomedical scientists to communicate their results to other professionals.

- Learn to communicate in professional environments
- Course products have the potential to be submitted to conferences and peer-reviewed journals

GRADING POLICIES

Graded Products

- Team Project I (100 points)
- Team Project II (100 points)
- Team Project III (100 points)
- Team Project IV (100 points)
- Reviews (100 points)
  - Scientific Review (3X10 points)
  - Video Review (10X4 points)
  - Journal Club (3X10 points)

Grading scale:

>449 points	A
400-449 points	B
350-399 points	C
300-349 points	D
<300 points	F

Scaling grades of Team Products. Working in a team to produce research and communicate results is half the challenge of research. You are therefore expected to fully participate in developing team products. Team projects will be graded based on whether products were useful to your team. The points you receive for a project will be weighted by your relative participation in your team, as evaluated by your peers.

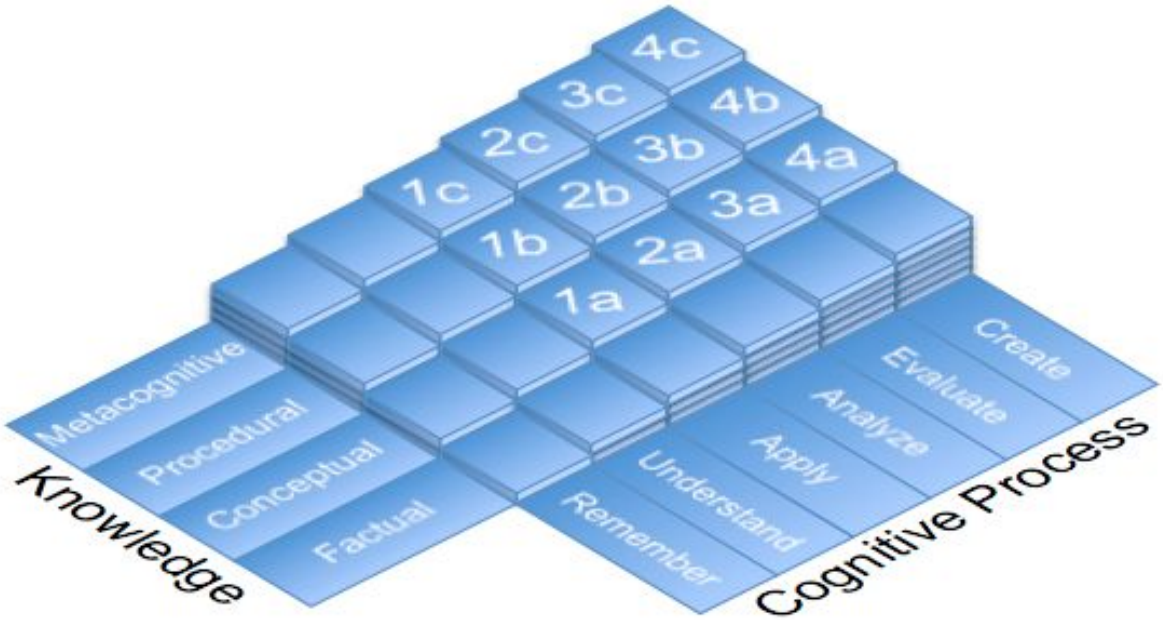
Scientific Review: Critically evaluating research products and providing *constructive* criticism is the other the other half of the challenge of research. You are therefore expected to rate and providing constructive feedback to peer projects.

Video Reviews: Video comments will be posted after watching posted videos outside of class.

Journal Club: Journal Articles will be assigned for careful reading before class. Articles will be discussed in class small groups, and summaries of discussions will be completed after class.

MAPPING COURSE PROJECTS TO SPECIFIC LEARNING OUTCOMES

The course projects described above include specific learning outcomes that address higher-order thinking skills (Cognitive Process Dimension) and higher-order knowledge (Knowledge Domain). The learning outcomes (italicized phrases in TEAM PROJECTS) can be mapped onto Bloom's revised taxonomy of educational objectives. (Anderson and Krathwohl, 2001).



TEAM PROJECTS

PHASE I: APPLY MODELING TO EXPLORE "BROKEN" SYSTEMS: Work with team to explore three research-grade cardiovascular models to discover how properties of physiological systems interact and affect critical variables (pressures, volumes, flows, and stresses).

1a *Discover effects of perturbing systems*: Use concept sensitivity analysis to identify how changes in parameters (e.g., resistance) result in abnormal values of critical variables (e.g., pressure).

1b *Discover at-risk populations*: Use parameter covariance to discover which simultaneous disease states result in particularly poor outcomes.

1c *Explain non-intuitive results*: Explain non-intuitive results when your guesses (prior to simulation!) deviate from actual simulation results.

Team Task: Produce a table of results from models 1, 2, and 3 (Google Sheet). A template will be provided, which one team member will share with other team members. Each team will be assigned a % change in parameters to explore. Before changing a parameter, guess if the perturbing the parameter will increase or decrease the variables. Record simulation results as a % change from baseline conditions. Highlight each result that your team guessed incorrectly, and add a *short* sentence explaining the misconception. Identifying such non-intuitive results are valuable, since experienced biomedical scientists may share similar misconceptions. Choose one particularly surprising non-intuitive result from one of the models, and construct a logical argument (using equations, figures, flow charts or qualitative graphs) that leads to an *incorrect* result. Such qualitative, logical arguments are common in the literature, and you may identify one that can be debunked with a clever model-based publication. Identify an at-risk population by simulating simultaneous changes in two parameters that have synergistic (and particularly negative) effects.

Individual Review: Use the supplied rubric to rate the contribution of the members to the product. Use the other supplied rubric to evaluate and provide constructive criticism of other team projects.

PHASE II: ANALYZE POTENTIAL CLINICAL INTERVENTIONS: Work with a new team to analyze potential strategies to return an assigned variable (e.g. systemic arterial pressure) to a normal range.

2a *Compare potential clinical interventions*: Determine how much each parameter of the system must change to return the critical variable back to a normal value.

2b *Identify costs of clinical interventions*: Perform "cost analysis" for interventions in terms of consequences of intervention on other variables.

2c *Identify scientific biases*: Identify potential biases that could lead you or clinical researchers to propose human clinical studies with potentially lethal consequences.

Team Task: Produce a table of results (Google Sheet) and a 1-page conference abstract (Google Doc) following supplied templates. Each team will be assigned a parameter of a model that is abnormal. Create a chart that indicates the change in each of the other parameters that returns a critical variable (e.g., systemic arterial pressure) to normal. Altering some parameters may only partially restore the critical variable. Also report resulting values of the less critical variables, highlighting those that are *made worse* by the intervention. In the abstract, identify parameters that may be potential targets for clinical research, because they return a critical variable to normal and the secondary effects on the other variables are either minor or beneficial. Identify potential biases in your interpretation of results that can arise from specific assumptions of the model. Also identify parameters that should *not* be targets for manipulation in a human clinical trial, because of a potential for fatal complications (i.e., a specific variable may fall outside of a physiological range). Develop an argument *based on simulation results and model limitations* for the need for controlled in vivo experiments.

Individual Review: Use the supplied rubric to rate the contribution of the members to the product. Use the other supplied rubric to evaluate and provide constructive criticism of other team projects.

PHASE 3: EVALUATE ONGOING RESEARCH PROJECTS: Work with a new team to evaluate novelty, importance, correctness, and appeal of projects presented at Student Research Week.

3a *Evaluate novelty and importance*: Rate the novelty and importance of research projects.

3b *Evaluate correctness of methods*: Judge the correctness of the research methods.

3c *Evaluate appeal of projects*: Select projects that are consistent with your professional and learning goals, interests, talents.

Team Task: Submit presentation review forms for at least 4 Biomedical Research Certificate Program (BRC) presentations, and 4 non-BRC presentations at Student Research Week. From analysis of abstracts and presentations, produce a 10-slide conference-style presentation in Google Slides arguing for novelty, importance, correctness, and appeal for the best BRC presentation and the best non-BRC presentation. Include a graphical representation of their homeostatic mechanisms. There will be a process in place to allow choice of presentations evaluated and still ensure a diversity of projects are reviewed. For evaluation of BRC presentations, include evaluation of archived abstracts, posters, and Mathematica files, and answers to follow-up questions posed after Student Research Week. Include citations to relevant research in the literature. Using answers to questions of presenters about the nature of research as they experienced it, argue for appeal of selected research projects, in terms of scientific approach, research environment, and expectations of participants.

Individual Review: Use the supplied rubric to rate the contribution of the members to the product. Use the other supplied rubric to evaluate and provide constructive criticism of other team projects.

PHASE 4: CREATE RESEARCH PROJECTS: Work in a team to create a novel research project.

4a *Formulate a novel research question*: Critically evaluate three modeling or three experimental journal articles to identify limitations in existing models or gaps in current knowledge.

4b *Design a novel model or experiment*: Design a novel model or experiment that includes a homeostatic mechanism that addresses a gap in knowledge.

4c *Create a team learning plan*: Design a plan to learn critical information necessary to successfully complete a research project.

Team Task: Produce variation of an existing model or experiment. Produce a 2-page proposal following a provided template. First page: develop a novel model, identifying potential gaps in knowledge to be addressed supported by three references. Second page: develop a plan for your team to direct its own learning based on discussions with participants at Student Research Week.

Individual Review: Use the supplied rubric to rate the contribution of the members to the product.

COURSE TOPICS, CALENDAR OF ACTIVITIES, MAJOR ASSIGNMENT DATES					
Phase	**Day**	**Date**	**Due 5PM**	**In Class**	**Focus**
Phase 1	Wed	01/17	Self Assessment	Introduction to Course	pumps, chambers, conduits, closed loop system, micro-vasculature, interstitial fluid balance lymphatic function hierarchical organization emergent behavior; mechanical stress;
	Fri	01/19	Video 1&2	Closed Loop Model	
	Mon	01/22		Work in Group	
	Wed	01/24		Work in Group	
	Fri	01/26	Video 3&4	Work in Group	
	Mon	01/29	Journal Article 1	Edema Model	
	Wed	01/31		Journal Club 1	
	Fri	02/02	Video 5&6	Work in Group	
	Mon	02/05		Work in Group	
	Wed	02/07		Work in Group	
	Fri	02/09	Project 1	Work in Group	
Phase 2	Mon	02/12	Proj 1 Reviews	Work in Group	parameters versus variables; physiological tradeoffs; modeling methodologies; writing abstracts; algebra vs simulation
	Wed	02/14		Work in Group	
	Fri	02/16	Video 7&8	Work in Group	
	Mon	02/19	Journal Article 2	Work in Group	
	Wed	02/21		Journal Club 2	
	Fri	02/23	Video 9&10	Work in Group	
	Mon	02/26		Work in Group	
	Wed	02/28	Project 2	Work in Group	
	Fri	03/02	Proj 1 Reviews	In class reviews	
	Mon	03/05		Demonstrations	
	Wed	03/07	Journal Article 3	Abstract Analysis	
	Fri	03/09		Journal Club 3	
Spring Break					
Phase 3	Mon	03/19	↑	↑	negative feedback; homeostasis; modeling and epistemology; scientific presentation; balance points; inductive vs deductive
	Wed	03/21	SRW Reviews	Student Research Week	
	Fri	03/23	↓	↓	
	Mon	03/26		Discuss presentations	
	Wed	03/28		Work in Group	
	Fri	03/30	No class	No class	
	Mon	04/02		Work in Group	
	Wed	04/04		Work in Group	
	Fri	04/06	Proj 3 Due	Work in Group	
Phase 4	Mon	04/09	Proj 3 Reviews	Work in Group	gaps in knowledge; literature review; grant proposal basics; levels of knowledge; formulating hypotheses
	Wed	04/11		Work in Group	
	Fri	04/13		Work in Group	
	Mon	04/16		Work in Group	
	Wed	04/18		Work in Group	
	Fri	04/20		Work in Group	
	Mon	04/23		Work in Group	
	Wed	04/25		Work in Group	
	Fri	04/27	Proj 4 Due	Work in Group	
	Mon	04/30	Proj 4 Reviews	Intro to VTPP 223/234	

CLASS ATTENDANCE

The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. **Late work will not be accepted without a University-approved excuse.** Make-up Policy: If an absence is excused, the instructor will either provide the student an opportunity to make up any work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. 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 may 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 healthcare 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. Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. 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.

AMERICANS WITH DISABILITIES ACT(ADA)

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.

SPECIAL NOTE REGARDING DISABILITIES AND LEARNING DIFFERENCES

Whether or not a student is registered with Disability Services, rooms are available for those who would perform better in a quieter environment. Students are encouraged to freely move about the computer lab and adjust computer accessibility settings. Attempts have been made to incorporate the principles of "universal design" in classroom activities and online resources. We expect participation of all students to help make the class accessible and inclusive so that the diverse talents of all students are fully engaged. In fact, the existence of the Certificate Program in Biomedical Research, the unique structure of the course, and the high-impact educational practices it employs, arose from innovations generated from an ongoing partnership of faculty and students with learning differences.

ACADEMIC INTEGRITY

"An Aggie does not lie, cheat, or steal, or tolerate those who do."
For additional information please visit: http://aggiehonor.tamu.edu

SPECIAL NOTE REGARDING SCIENTIFIC INTEGRITY

Whether or not a student has satisfied minimal requirements of academic integrity for classwork, there are heightened expectations for behavior arising from the potential for publication in the peer-reviewed literature. It is necessary to ensure due diligence for assigning credit to previously-published research that impacts claims for novelty, importance and correctness of your results. Standards of a particular society sponsoring a scientific conference or archival journal that governs whether a contribution to joint work requires co-authorship.