

TAMALAPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

Honors Physiology 1-2

I. Introduction

Honors Physiology 1-2 is a one-year upper-division advanced life science elective designed primarily for highly committed and motivated 11th and 12th grade level students. The course is structured to provide an opportunity for students to have a more in-depth, enriched study of the structure and function of the human body, by building upon the foundations learned in Integrated Science 1 – 4 courses, and examining them in greater depth, with appropriate extensions to the disciplines of chemistry, physics and mathematics, than is afforded in the non-honors physiology course.

The class is lab-based, providing ample opportunities for experimental and investigational studies, with great focus placed on problem-solving skills learned from a wide array of instructional strategies and assessment techniques, ranging from research to advanced laboratory experiments. There is integration of the various science disciplines as they pertain to the functioning and structure of the human body, and the course articulates with topics covered in other upper division classes, such as AP Biology, very successfully. Course content is organized around vertebrate organ system structure and function, with the central theme of homeostatic conservation. Pertinent case history diagnosis and examination provides a central theme within each unit, allowing the students to achieve one of the key course goals, to think critically and analytically. Another primary goal is connection of the course to the medical community, afforded by mandatory community service in order to receive an “A” or “B” in the class, and the opportunity to participate in medical internships.

The Honors Physiology course addresses the following Tam 21st Century goals, by creating a learning environment where students will have opportunities to:

- experience a program designed for high-achieving students
- practice self-directed learning, decision-making and problem-solving
- pursue individual goals and aspirations and extend learning beyond the classroom by creating meaningful school-to-career opportunities and experiences
- become successful problem-solvers by increasing their independence and responsibility through project-based learning

This course addresses the following Student Learning Outcomes:

- #1: Communicate articulately, effectively, and persuasively when speaking and writing.
- #2: Read and analyze material in a variety of disciplines.
- #3: Use technology as a tool.
- #5: Apply mathematical knowledge and skills to analyze and solve problems.
- #6: Demonstrate scientific literacy.
- #10: Analyze and propose solutions to contemporary issues.
- #12: Demonstrate school-to-work/post-secondary transition skills and knowledge.

This course is designed to help students attain the relevant California Science Content Standards.

II. Student Learning Outcomes

A. During Honors Physiology 1 – 2 in the Tamalpais Union High School District, students will:

- Demonstrate scientific literacy by actively participating in the process of science through analyzing current research topics in physiology and through forming hypotheses, designing research, collecting/analyzing data and drawing conclusions regarding specific laboratory experiments related to the structure and function of the human body. **The following examples demonstrate the exposure to a greater level of depth of material provided in the Honors course in lab and lecture material:**
- **Lower Division Course: Define/explain/measure heart rate**
- **Physiology: Review above terms and calculate Cardiac Output**

- **Honors Physiology: Review above and describe how Cardiac Output is affected by Starling's Law and peripheral resistance.**
 - Develop laboratory skills, including the use of standard physiology lab equipment, such as microscopes, sphygmomanometers, spirometers and stethoscopes and, where applicable, apply technology in the use of this equipment. **Honors Physiology students will explore laboratory techniques such as titration in respiratory physiology, and calorimetry with dimensional analysis within nutrition and metabolism, which have a chemical basis and require rigorous quantitative data collection.**
 - learn and apply knowledge of the basic anatomy and physiology of the major organ systems in the human body, and use the key concept of homeostasis (the central theme of the California State Science Standards), as well as the inclusion of clinical case histories, as focal points within each body system unit.
 - demonstrate School-to-Career / post-secondary skills and knowledge by investigating the wide range of career opportunities in health and physiology related fields, such as internships in health care, job shadowing, guest lecturers and field trips related to medicine and health.
 - Understand and apply the knowledge and skills needed to become healthy, informed citizens and consumers after studying and evaluating current information, issues, events, and research in human anatomy and physiology. **Documented evidence of medical library research and interviews with community professionals in specific areas of health and medicine outside of class, as well as clinical case history examination will all be components mandatory within the honors course.**
- B. Outcome indicators for the above-listed learning outcomes will be embedded in the student assessments and will include, but are not limited to:
- During laboratory exercises, students will:
 - dissect a whole mammal, either a rat, fetal pig, or cat, to understand interrelationships amongst the eleven organ systems.
 - use the spirometer and related lab equipment to measure lung volumes and the mechanics of pulmonary ventilation. **Lab materials and methods in the Honors course will employ the examination and use of the Gas Laws of Chemistry and Physics (Boyle's Law, Dalton's Law and Henry's Law), and Forced Expiratory Volume measurement within the unit on respiration.**
 - correctly dissect study and identify mammalian organs, including, but not limited to, specimens of brain, heart, kidney, bones/joints, and uterus/placenta.
 - identify the types, number and density of sensory receptors associated with specific sense organs. **In the Honors course, the biochemistry and connection to principles of physics, where appropriate, is an integral part of material covered, for instance, the basic physical principles behind the process of refraction and convergence, and the process by which rhodopsin is chemically derived, for the sense of vision or measurement of human horsepower in testing muscle function**
 - draw conclusions regarding the rise and fall of the female hormones estrogen and progesterone cyclically by graphing sample data. **The Honors course may involve the creation of several types of graphs (bar as well as line, pie graphs etc.) to expand upon data presentation.**
 - correctly measure the body's blood pressure and heart rate in different anatomical positions, such as standing, sitting and reclining. **In Honors, the class would include calculations of the effects of Starling's Law on Cardiac Output and the effects of peripheral resistance.**
 - design, conduct, analyze data and draw conclusions from an experiment involving the class as test subjects. **The use of chemistry and physics principles will be involved in labs such as metabolic calorimetry and respiratory physiology within the Honors course.**
 - Students will learn to think critically and to analyze material provided in lecture, text and other sources, by:
 - identifying the important anatomical features in each of the organ systems studied
 - describing the structure and function relationships in each of the organ systems studied
 - making connections to, and drawing conclusions about, the broader concept of homeostasis and relationships between body systems (replace this with the next descriptor??)

- describing connections between different body systems and the broader concept of homeostasis in evaluating the physiology of basic human activities/behaviors, such as exercise, learning, reproduction or the immune response
- applying basic knowledge learned about the body systems to correctly diagnose or evaluate patient diseases and conditions, and propose treatment or prevention plans. **Clinical case histories taken from a sourcebook for first year medical students will be a component of every unit for students in the Honors course.**
- Analyze current journal articles and textbooks of medicine in written and oral formats as a requirement for every unit in the Honors class.

- Students will conduct research in current areas/topics relevant to modern physiology, such as brain chemistry or the use of DNA profiling in forensics, and will:
 - utilize technology to identify appropriate sources in class, at the school site, at home and in community medical libraries to conduct research. **Documented evidence of research work in the medical library of UCSF, Marin General Hospital or Kaiser Permanente Hospital will be required for students in the Honors course.**
 - contact local medical professionals who are topic area experts. **The Honors class will require approval and documentation of extensive interviews with community professionals in the fields of health and medicine for each semester term project to be presented in Power Point or video format. Evaluation of students by the professionals interviewed is also required.**
 - perform original experiments, or take part themselves, where applicable, in “hands- on” learning about their topics, such as viewing a surgery, visiting a lab or testing hypotheses
 - present the results of their research in one of the following formats: written report, oral presentation, and/or multimedia presentation
 - perform a minimum of 8 hours of service within the community per semester (16 total for the year), in an approved field aligned with mental or physical health and/or medicine as a requirement for an “A” or “B” in the Honors course.

C. Connections to State Science Content Standards:

This course builds upon the State Content Standards in Biology/Life Science taught through the Integrated Science 1–4 curricula. As pre-requisite knowledge, it assumes the following: Standard Set I (Cell Biology); Standard Set II (Genetics – Meiosis and Fertilization); Standard Set 3 (Genetics – Mendel’s Laws); Standard Set 4 (Molecular Genetics). This pre-requisite knowledge allows this course to go more deeply into Standard Set 9 (Homeostasis) and Standard Set 10 (Infection and Immunology).

The course content prepares students on the following California Science Content Standards:

9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:
 - a. *Students know* how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.
 - b. *Students know* how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.
 - c. *Students know* how feedback loops in the nervous and endocrine systems regulate conditions in the body.
 - d. *Students know* the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.
 - e. *Students know* the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.
 - f.* *Students know* the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.
 - g.* *Students know* the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.
 - h.* *Students know* the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca⁺², and ATP.
 - i.* *Students know* how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.
10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the

human immune response:

- a. *Students know* the role of the skin in providing nonspecific defenses against infection.
- b. *Students know* the role of antibodies in the body's response to infection.
- c. *Students know* how vaccination protects an individual from infectious diseases.
- d. *Students know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.
- e. *Students know* why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.
- f.* *Students know* the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.

III. Assessment

A. Student Assessment

Students will be assessed using a combination of the following:

- On-demand assessments using a combination of multiple choice, matching, true-false, fill-in, labeling, short answer and application essay questions. **Honors student assessments will include a focus on biochemical and mathematical applications of material learned within each unit, as well as more open-ended assessment questions on exams and quizzes.**
- Lab Practical Exams/Quizzes
- Laboratory Reports
- Projects
- Presentations
- Reading Analysis/Evaluation
- **For the Honors course: A minimum of 8 hours per semester of service in the community in an approved area related to anatomy or physiology will be required for an "A" or a "B", as will a reflection paper and evaluation by the community supervisor.**
- **Evaluation of, and by, guest speakers within the classroom will be required for Honors students**

B. Course Assessment

The course assessment will be based on a common laboratory activity – Sheep Brain Dissection. The assessment will have two common components:

- Lab Performance Assessment. This assessment will address student laboratory skills.
- Lab Practical/Brain Anatomy Quiz. This assessment will address the content learned as a result of the lab activity.

Students will be given the grading criteria and course expectations, preferably in writing, at the beginning of the course.

IV. Methods and Materials

A. Methods

A variety of instructional methods may be used to further the understanding of students including but not limited to labs, projects, presentations, critical reviews, discussions, research reports, demonstrations and lectures. The selection of methodologies will be aligned with desired student outcomes.

B. Materials

The primary text for the class will be a college level Physiology textbook as approved by the Board of Trustees (see approved book list). Also current articles in science periodicals will be incorporated where appropriate. Specimens for dissection will also be used. **The Honors course will include Case Histories taken from a clinical text for first year medical students.**

C. Technology

Students will be using computers to research and generate presentations, microscopes to view various tissue types, stereoscopes to aid in dissection. Additionally, various medical devices such as sphygmomanometers or stethoscopes may be utilized to aid in the understanding of human physiology.

D. School to Career

Utilize guest speakers, career investigation, job shadow, community service and a close relationship with the school-to-career liaisons at the school site.

E. Suggested Instructional Time Allocation

1. Instructional Strategies

Laboratory Activities	~40%	
Lecture/Discussion	~30%	
Group Activities	~10%	
Videos	~10%	
Projects		~5%
Guest Speakers	~5%	

2. Curricular Topics

Introduction -Systems, Biochemistry, Tissues, Homeostasis	2–3 wks	
Skeletal System		3–4 wks
Muscular System	3–4 wks	
Nervous System	4–5 wks	
Cardiovascular System	4–5 wks	
Respiratory System	3–4 wks	
Immunity/Lymphatic System	2–3 wks	
Endocrine System	<u>2–3 wks</u>	
	23–31 wks	

The remaining time is allocated, at site discretion, amongst the Integumentary, Urinary, Reproductive and Digestive systems, as well as topics such as human development, human metabolism or exercise physiology that are cross-disciplinary.

V. General Information

A. Prerequisites

Honors Physiology 1-2 is a 10 credit life science course open to students who have successfully completed the district's lower division core curriculum in science Integrated Science 1-4 with an "A-" or higher in the regular courses, or "B-" or higher in the Honors Integrated class. Beginning in spring of 2006, all students who wish to enroll in Honors Physiology will be required to take an entrance assessment, as well as meet the criteria above and have current science teacher recommendation. Students may be concurrently enrolled in Integrated Science 3–4 with permission of the instructor, if the above criteria are all met satisfactorily.

B. Requirements Met

This course may be used as elective credit towards graduation, but does not meet any specific graduation requirement.

This course is accepted towards the laboratory science (d) requirement for UC and CSU admissions.

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