ARIZONA STATE UNIVERSITY

GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

*Copy and paste **current** course information from Class Search/Course Catalog.*

College/School: College of Integrative Sciences and Arts | Department/School: **Science, Mathematics, and Social Sciences (SMSS)**

Prefix: **BIO** | Number: **160** | Title: Introduction to Human Anatomy and Physiology | Units: 4

Course description: **This course provides an introductory experience that enables students to become conversant in the terminology, technology, and health-related concepts focused around human anatomy and physiology. This is done with the goal of empowering students to apply this depth of understanding to their intended programs of study. The course will combine lectures with laboratory experiences that will guide the student through the human body, as organized conceptually by organ systems, to reinforce understanding of basic concepts of anatomy and physiology and human health and disease. Ultimately, successful completion of this course provides a comprehensive baseline for individuals to understand health-related topics to make them better consumers of health throughout their life.**

Is this a cross-listed course? No | If yes, please identify course(s):

Is this a shared course? No | If so, list all academic units offering this course:

*Note- For courses that are crosslisted and/or shared, a letter of support from the chair/director of **each** department that offers the course is required for **each** designation requested. By submitting this letter of support, the chair/director agrees to ensure that all faculty teaching the course are aware of the General Studies designation(s) and will teach the course in a manner that meets the criteria for each approved designation.*

Is this a permanent-numbered course with topics? (Choose one)

If yes, all topics under this permanent-numbered course must be taught in a manner that meets the criteria for the approved designation(s). It is the responsibility of the chair/director to ensure that all faculty teaching the course are aware of the General Studies designation(s) and adhere to the above guidelines.

Chair/Director Initials

_____ (Required)

Requested designation: Natural Sciences–SQ

Mandatory Review: (Choose one)

*Note- a **separate** proposal is required for each designation.*

Eligibility: Permanent numbered courses **must** have completed the university's review and approval process. For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu.

Submission deadlines dates are as follow:

For Fall 2018 Effective Date: October 1, 2017

For Spring 2019 Effective Date: March 10, 2018

Area(s) proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- Literacy and Critical Inquiry core courses (L)
- Mathematics core courses (MA)
- Computer/statistics/quantitative applications core courses (CS)
- Humanities, Arts and Design core courses (HU)
- Social-Behavioral Sciences core courses (SB)
- Natural Sciences core courses (SQ/SG)
- Cultural Diversity in the United States courses (C)
- Global Awareness courses (G)
- Historical Awareness courses (H)

A complete proposal should include:

- ☒ Signed course proposal cover form
- ☒ Criteria checklist for General Studies designation being requested
- ☒ Course catalog description
- ☒ Sample syllabus for the course
- ☒ Copy of table of contents from the textbook and list of required readings/books

It is respectfully requested that proposals are submitted electronically with all files compiled into one PDF.

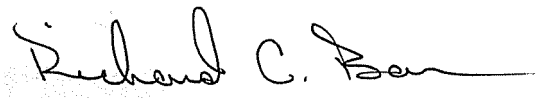
Contact information:

Name: JP Hyatt | E-mail: jphyatt@asu.edu | Phone: 602-496-0567

ARIZONA STATE UNIVERSITY

Department Chair/Director approval: ***(Required)***

Chair/Director name (Typed): Rich Bauer Date: 3/5/18

Chair/Director (Signature): 

SQ Justification: BIO 160 *Introduction to Human Anatomy and Physiology*

BIO 160 *Introduction to Human Anatomy and Physiology* was recently approved by CISA, University Senate, and the Provost's Office for the permanent course number BIO160 in Fall 2017. The course numbering and general content are consistent with Arizona-based colleges and universities allowing for ease of transfer credit, if applicable.

Introduction to Human Anatomy and Physiology is intended to expand general studies SQ course offerings at the Downtown campus. It also may be an alternative, not a replacement, for the traditional anatomy and physiology series (BIO 201 & 202). *Introduction to Human A&P* will survey anatomy, physiology, and pathophysiological topics that are thematically consistent with those covered in the 201/202 series.

This course qualifies as a general introductory course because is a one-semester course covering all 11 physiological systems plus special topics including biochemistry, the cell, genetics, and clinical and disease scenarios (e.g., pathophysiology). This differs from the more in-depth BIO 201 & 202 series that are foundational pre-professional courses typically taken for the vocational fields of health and medicine.

The human body is used as the binding theme to explore, discuss, and experiment on foundational scientific principles in biology, physics, and chemistry. Selective concepts from lecture are explored further within the laboratory that combines descriptive and mechanistic approaches toward experimentation and results interpretation. All laboratory reports ("LR") are designed to report findings quantitatively.

Introduction to Human Anatomy and Physiology will be offered covering topics in 15 units and 13 laboratories. Fall 2018 will be the first semester that BIO 160 is offered at ASU.

JP Hyatt, Ph.D.
Associate Professor
College of Integrative Sciences and Arts
411 N. Central Ave
Phoenix, AZ 85004
602-496-0752

Proposer: Please complete the following sections and attach appropriate documentation.

ASU--[SQ] CRITERIA

I. - FOR ALL *QUANTITATIVE* [SQ] NATURAL SCIENCES CORE AREA COURSES, THE FOLLOWING ARE CRITICAL CRITERIA AND MUST BE MET:

YES	NO		Identify Documentation Submitted
☒	☐	**A.** Course emphasizes the mastery of basic scientific principles and concepts.	criteria justification; detailed syllabus
☒	☐	**B.** Addresses knowledge of scientific method.	criteria justification; detailed syllabus
☒	☐	**C.** Includes coverage of the methods of scientific inquiry that characterize the particular discipline.	criteria justification; detailed syllabus
☒	☐	**D.** Addresses potential for uncertainty in scientific inquiry.	criteria justification; detailed syllabus
☒	☐	**E.** Illustrates the usefulness of mathematics in scientific description and reasoning.	criteria justification; detailed syllabus
☒	☐	**F.** Includes **weekly** laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline, and enhance the learning of course material.	criteria justification; detailed syllabus
☒	☐	**G.** Students submit written reports of laboratory experiments for constructive evaluation by the instructor.	criteria justification; detailed syllabus
☒	☐	**H.** Course is general or introductory in nature, ordinarily at lower-division level; not a course with great depth or specificity.	criteria justification; detailed syllabus

II. - AT LEAST ONE OF THE FOLLOWING ADDITIONAL CRITERIA MUST BE MET WITHIN THE CONTEXT OF THE COURSE:

☒	☐	**A.** Stresses understanding of the nature of basic scientific issues.	criteria justification; detailed syllabus
☒	☐	**B.** Develops appreciation of the scope and reality of limitations in scientific capabilities.	criteria justification; detailed syllabus
☐	☒	**C.** Discusses costs (time, human, financial) and risks of scientific inquiry.	

NOTE: CRITERIA FOR [SG] COURSES BEGIN ON PAGE 4.

III. - [SQ] COURSES MUST ALSO MEET THESE ADDITIONAL CRITERIA:			
YES	**NO**		**Identify Documentation Submitted**
☒	☐	**A.** Provides a substantial, quantitative introduction to fundamental principles governing behavior of matter and energy, in physical or biological systems.	criteria justification; detailed syllabus
		B. Includes a college-level treatment of some of the following topics **(check all that apply below):**	
☐	☒	**a.** Atomic and molecular structure	
☒	☐	**b.** Electrical processes	criteria justification; detailed syllabus
☒	☐	**c.** Chemical processes	criteria justification; detailed syllabus
☒	☐	**d.** Elementary thermodynamics	
☐	☒	**e.** Electromagnetics	
☒	☐	**f.** Dynamics and mechanics	criteria justification; detailed syllabus
[SQ] REQUIREMENTS CANNOT BE MET BY COURSES:			
• **Presenting a qualitative survey of a discipline.**			
• **Focusing on the impact of science on social, economic, or environmental issues.**			
• **Focusing on a specific or limiting but in-depth theme suitable for upper-division majors.**			

BIO 160 Introduction to Human Anatomy and Physiology

Instructor information

Name: JP Hyatt, Ph.D.
Office Location:UCENT 335
Office Hours: Downtown: T&R: 8:45-10am or by appt.; Tempe: MWF by appt. only.
Email: jphyatt@asu.edu
Phone Number:

This course is offered by the College of Integrative Sciences and Arts. For more information about the college, visit our website: https://cisa.asu.edu/. If you have questions or concerns, please send your inquiry to cisa@asu.edu.

Course Description
Introduces essential concepts in human anatomy and physiology and the structure and function of the human body. A four credit hour course (3 lecture, 1 lab) designed for students in the health-related professions. It will acquaint the student with human anatomy, structure, and function, basic disease concepts, and terminology. Course concepts will be organized and presented by organ systems, and the laboratory component of the course will emphasize human structure and function. The course has 3 contact hours for lecture and 3 contact hours for lab per week

Enrollment Requirements
None

Course Overview
BIO 160 is designed as a one semester introduction to Anatomy and Physiology. ***It should be noted that BIO160 cannot be used as a substitute for the two-semester A&P series (BIO 201 & BIO 202) where those courses are required in for a degree program or as pre-requisites for upper division courses.*** The objective of the course is to offer students an introductory experience that enables them to become conversant in the terminology, technology, and associated concepts in anatomy and physiology. This is done with thegoal of empowering them to apply this understanding in their intended programs of study. The course will combine lectures with laboratory experiences that will guide the student through the human body, as organized conceptually by organ systems, to reinforce understanding of basic concepts of anatomy and physiology and human health and disease.

Student Learning Outcomes
Upon completion of BIO 160, Advanced Human Anatomy, the student will be able to:

1. Pronounce, define and utilize the terminology associated with topics covered in this course.

2. Identify correctly the anatomic stuctures of the major organ systems of the human body.

3. Identify and describe general physiological functions of the major organ systems of the human body.

4. Analyze changes in science and healthcare technology and make informed decisions relative to the topics of this course.

5. Describe the development of the organ systems and the impact of various disease states.

6. Demonstrate evidence-based critical thinking on exercises through exposure to topical areas of ongoing debate and controversy in human health.

7. Solve scientific and clinical problems using reasoning skills.

8. Demonstrate and model professional behavior during interactions, presentations, and communication with colleagues, staff, and faculty.

Required Materials

- **Text** - The Human Body in Health and Disease, Patton and Thibodeau, 7th ed., 2018, Elsevier, ISBN 9780323402118
- Access to Blackboard
    - Information pertaining to this class will be listed on Blackboard. To access the Blackboard course, log in to MyASU located on the ASU homepage. You will want to check Blackboard daily for announcements pertaining to the class. You will also access information here, including syllabus, lecture/lab schedules, lab terms lists, study materials, etc. If you miss a class, it is your responsibility to get the notes from another student. I suggest you get another student's email and phone number the first week of school
- Access to a computer with Microsoft Office
- Appropriate attire for lab, including lab coats and safety glasses. (Please see **Laboratory Safety**)

Assignments, Exams, and Grading

Grading Criteria

Lecture Quizzes	**= 10%**
Exam 1	**= 15%**
Exam 2	**= 15%**
Exam 3	**= 15%**
Final Exam	**= 15% (CUMULATIVE)**
Lab	**= 30%**
Total	**= 100%**

Grading Scale

A = 90 – 100%
B = 80 – 89%
C = 70 – 79%
D = 60 – 69%
F = 0 – 59%

EXAMS

There will be 2 lecture exams and one comprehensive Final Exam. **You will have 60 minutes to complete each Unit Exam, which will consist of 50 multiple choice questions. The Final Exam will also be 50 questions, and you will be allowed 60 minutes for that exam as well**. The exams will be administered in class and will be graded by scantron. The physical copy of the exam book will be collected and may not be removed from the classroom. The exams must be completed during the time provided. **No material of any kind is permitted out at your desk during testing.** All book bags and purses must be stored under the desk. **NO CELL PHONES are permitted for any reason during testing!** If you are found using a cell phone, tablet, or any personal electronic devices during an exam, we may confiscate your exam at the discretion of the proctor. We reserve the right to confiscate your exam if we suspect that you are cheating. You have 5 minutes after the start of class to arrive before you can no longer sit for the exam. **No student will be allowed to leave the room and then return during an exam,** so use the restroom before you arrive. **Bring your student ID to all exams.**

The Final Exam is cumulative. Unit Exams 1 and 2 are NOT cumulative. The Unit Exams will be administered at regular intervals throughout the semester. Each exam will consist of multiple choice questions on topics covered in the assigned reading and lecture. Your lowest unit exam score (*NOT your final exam score*) may be dropped, if the following applies: a) your score for your lowest unit exam score is greater than zero (a score of zero that was received due to an unexcused absence will **NOT** be dropped). The Final Exam location will be scheduled as per the published ASU Final Exam Schedule and will be a 60 minute exam. Once again**, *under no circumstances will the final exam be dropped.***

QUIZZES

Quizzes will cover the required reading and lecture materials. They may be administered on Blackboard or by Turning Point Clickers in class. Quizzes, both clicker and on Blackboard, will be assigned at the discretion of the faculty and ***will be announced in class***.

LABORATORY

Lab participation is factored into the course grade. The lectures and labs are structured so that participation is necessary to understand the concepts and questions covered on the examinations.

Lab Quizzes: Accounts for **10%** of total laboratory grade. Administered at the beginning of each lab section and cover material from the pre-lab and/or PowerPoint for the day.

Lab activities: Accounts for **10%** of each lab report grade. Group participation will be monitored and scored appropriately.

Lab reports (LR): Accounts for **40%** lab report grade. LRs are related to at least one in-class experiment and will be due the following week after the completion of that laboratory.

Lab Practical (2 x 20% each = **40% total laboratory grade)**: Two in-class laboratory practicals will account for 40% of toal laboratory grade.

Laboratory Safety

All university safety regulations must be obeyed. NO FOOD OR DRINKS OF ANY KIND ARE PERMITTED IN LAB. Bottled water is only allowed if it is in a closed container and kept in your bag. It may NOT be taken out or opened at ANY point in lab. If you need a drink of water, please use the water fountains outside UCENT 383. Everyone must also have proper attire for work in the lab. That means NO OPEN-TOED SHOES, no short shorts, no bared midriffs: in other words, please cover up before coming to lab. If your outfit is inappropriate for the week's lab, and may endanger your safety or another's, you may be asked to leave. Additional information about lab safety, such as the proper handling and disposal of scalpel blades, will be discussed on the first day of lab. You must review and upload your lab safety agreement before the second week of lab, or you will not be eligible to participate in Week 2. Labs are held every week unless otherwise noted. Please be aware that we may have to hold class in another location during some point in the semester. If that is the case, the instructors will notify you of the new location via Blackboard.

General Course Policies for Lecture and Lab

ATTENDANCE POLICY

Attendance is mandatory. Don't be late for lab or lecture, and plan on remaining for the entire scheduled period. If you miss a lab or lecture with an unexcused absence, you will receive a zero. If you miss an exam due to an unexcused absence, you will receive a grade of zero for that exam. Documentation to support a petition to be excused will be reviewed from students who miss exams due to documented issues. You will need to provide documentation that supports your request to be excused. The determination of whether an absence is considered excused will be at the discretion of the faculty and in accordance with relevant university policies. If you are excused from an exam, the final resolution of the grade for that assessment will be determined on a case—by-case basis at the discretion of the faculty. Participation in ASU-sponsored events must be cleared beforehand, with proper documentation, and arrangements made to take the exam.

If you leave lab early or show up more than 10 minutes late, it will be marked as an unexcused absence (unless appropriate documentation is provided). If you need to miss a lab, please let your lab instructor know in advance, and they will determine if you are excused. All excused absences must be followed up with legitimate and authentic documentation for it to be considered excused. If your absence is excused, your grade for the missing lab activity will be assigned on a case-by-case basis. Keep in mind that you must show up to lab in appropriate dress (discussedabove) or you will not be allowed in lab, which would result in an unexcused lab absence and a zero for the lab activity given that day. The course follows the required policy for excused absences related to

religious observances/practices that is in accord with ACD 304-04, and policy for excused absences related to university-sanctioned events/activities that are in accord with ACD 304-02, "Missed Classes Due to University-Sanctioned Activities."

If you miss a class with an unexcused absence, you will receive a zero for the day.

LATE OR MISSED ASSIGNMENTS
Assignments in this course are not accepted late. Late or missed assignments will earn no credit, and a grade of zero will be assigned.

EXTRA CREDIT
No extra credit is assigned or awarded in this course

TRIGGER WARNING
Please note that some course content may be deemed offensive by some students, although it is not my intention to offend anyone. In addition, some materials that we link with online might also be considered offensive, troubling, or difficult to review in terms of language or graphics. I attempt to provide warnings when introducing this kind of material; yet if I forget to do so, or if something else (in my materials or posts from fellow students) seems offensive, please contact me at EMAIL@asu.edu, or the faculty head, NAME.

CLASSROOM BEHAVIOR
Students in the BIO 160 course are expected to behave in a professional manner. Disrespect in any manner shown to fellow students, instructors, visitors, guest clinicians, or to the human cadavers we may include in parts of the lab will not be tolerated. Photographing cadavers for ANY reason is NOT permissible. Cell phone use in the cadaver lab is prohibited.

We want to build a classroom climate that is comfortable for all. It is important that we 1) display respect for all members of the classroom – including the instructor and students; 2) pay attention to and participate in all class sessions and activities; 3) avoid unnecessary disruption during class time (e.g. having private conversations, reading the newspaper, surfing the Internet, doing work for other classes, making/receiving phone calls, text messaging, etc.); and 4) avoid racist, sexist, homophobic, or other negative language that may unnecessarily exclude members of our campus and classroom. This is not an exhaustive list of behaviors; rather, it represents examples of the types of things that can have a dramatic impact on the class environment. Your final grade may be reduced by 5% *each time* you engage in these behaviors.

ESTABLISHING A SAFE ENVIRONMENT
Learning takes place best when a safe environment is established in the classroom. In accordance with SSM 104-02 of the Student Services Manual, students enrolled in this course have a responsibility to support an environment that nurtures individual and group differences and encourages engaged, honest discussions. The success of the course rests on your ability to create a safe environment where everyone feels comfortable to share and explore ideas. We must also be willing to take risks and ask critical questions. Doing so will effectively contribute to our own and others intellectual and personal growth and development. We welcome disagreements in the spirit

of critical academic exchange, but please remember to be respectful of others' viewpoints, whether you agree with them or not.

EMAIL COMMUNICATION
ASU email is an official means of communication among students, faculty, and staff. Students are expected to read and act upon email in a timely fashion. Students bear the responsibility of missed messages and should check their ASU-assigned email regularly. *All instructor correspondence will be sent to your ASU email account.* For help with your email go to: MyASU > Service > Live Chat OR New Ticket.

PROHIBITION OF COMMERCIAL NOTETAKING SERVICES
In accordance with ACD 304-06 Commercial Note Taking Services, written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the note taker's name as well as the instructor's name, the course number, and the date.

ARIZONA STATE UNIVERSITY

COURSE OUTLINE – BIO 160: Fall 2018

Week	Dates	Topics	Lab Dates	Topics
0 (R only)	08/16	Unit 1: Introduction	08/17	**Lab 1**: Introduction; lab safety; safety contract
1	08/21 & 08/23	Unit 2: Biochemistry, Cells & tissues	08/24	**Lab 2**: Passive Diffusion; Egg Experiment
2	08/28 & 08/30	Unit 3: Integumentary System	08/31	**Lab 3**: Fingerprint Lab; Epithelieal histochemistry
3	09/04 & 09/06	Unit 4: Skeletal System	09/07	**Lab 4**: Osteon-Straw Experiment; Bone identification
4	09/11 & 09/13	Unit 5: Muscular System; Exam 1: 9/13 (R)	09/14	**Lab 5**: Lever experiment; Skeletal muscle identification
5	09/18 & 09/20	Unit 6: Muscles and Joints	09/21	**Lab 6**: General sensory descrimination tests; Neural anatomy
6	09/25 & 09/27	Unit 7: Nervous System	09/28	Lab Practical #1
7	10/02 & 10/04	Unit 8: Endocrine System	10/05	**Lab 7**: Special senses testing; Special senses anatomy
8 (R only)	10/11	Unit 9: Blood, lymphatic system, and Immunity; Exam 2: 10/11 (R)	10/12	**Lab 8**: Blood typing; Heart dissection
9	10/16 & 10/18	Unit 10: Cardiovascular System	10/19	**Lab 9**: Electrocardiogram measurements; Blood pressure testing
10	10/23 & 10/25	Unit 11: Respiratory System	10/26	**Lab 10**: Spirometry and lung volume testing
11	10/30 &11/01	Unit 12: Digestive System	11/02	**Lab 11**: USDA diet analysis
12	11/06 & 11/08	Unit 13: Urinary System; Exam 3: 11/08 (R)	11/09	**Lab 12**: Urinalysis
13	11/13 & 11/15	Unit 14: Reproductive Systems	11/16	**Lab 13**: DNA Fingerprinting
14 (T only)	11/20	Unit 15: Genetics and Genetic Diseases	11/23	No Lab (Thanksgiving Holiday)
15	11/27 & 11/29	Unit 16: Special Topics	11/30	Lab Practical #2
		Final Exam: TBD		

Indicates week of Lab Practical

General content covered for each exam (subject to change).
Exam 1: Units 1-4
Exam 2: Units 4-7
Exam 3: Units 8-11
Exam 4: Units 12-16

Laboratory Schedule

An activity denoted with "LR" indicates that a lab report will be graded related to this activity.

Lab 1	Introduction; lab safety; safety contract
Lab 2	Passive Diffusion (LR)
	Egg Experiment (LR)
Lab 3	Fingerprint Lab (LR)
	Epithelieal histochemistry
Lab 4	Osteon/Straw Experiment (LR)
	Bone identification
Lab 5	Lever experiment (LR)
	Skeletal muscle identification
Lab 6	General sensory descrimination tests (LR)
	Neural anatomy
	Lab Practical #1
Lab 7	Special senses testing (LR)
	Special senses anatomy
Lab 8	Blood typing (LR)
	Heart dissection
Lab 9	Electrocardiogram measurements (LR)
	Blood pressure testing
Lab 10	Spirometry and lung volume testing (LR)
Lab 11	USDA diet analysis (LR)
Lab 12	Urinalysis (LR)
Lab 13	DNA Fingerprinting (LR)
	Lab Practical #2

LR: lab report due with this section

UNIVERSITY POLICIES

Academic Integrity
Arizona State University and the College of Integrative Sciences and Arts strongly believe in academic integrity; thus cheating and plagiarism is not tolerated. If a student is charged with academic dishonesty and found to be in violation, disciplinary action will be taken and a student's name will be kept on file. Academic dishonesty includes borrowing ideas without proper citation, copying others' work (including information posted on the internet), failing to turn in your own work for group projects, as well as providing materials of any type to a homework help site or a study resource site. Disciplinary action may result in a reduced grade for the assignment or class, suspension or expulsion from the university, and/or an XE on his or her transcript. For further information, please read the Student Academic Integrity policy at https://provost.asu.edu/academic-integrity.

Students with Disabilities
If you need academic accommodations or special consideration of any kind to get the most out of this class, please let me know at the beginning of the course. If you have a disability and need a reasonable accommodation for equal access to education at ASU, please call Disability Resources for Students.

The site can be found here: https://eoss.asu.edu/drc

Downtown Phoenix Campus University Center building, Suite 160 Phone: 602.496.4321 E-mail: DRCDowntown@asu.edu	**Tempe Campus** Matthews Center building, 1st floor Phone: 480.965.1234 E-mail: DRCTempe@asu.edu
Polytechnic Campus Sutton Hall - Suite 240 Phone: 480.727.1039 E-mail: DRCPoly@asu.edu	**West Campus** University Center Building, Room 130 Phone:602.543.8145 E-mail: DRCWest@asu.edu

Mental Health
As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These emotional health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. ASU Counseling Services provides counseling and crisis services for students who are experiencing a mental health concern. Any student may call or walk-in to any ASU counseling center for a same day or future appointment to discuss any personal concern. Here is the Web site: https://eoss.asu.edu/counseling. After office hours and 24/7 ASU's dedicated crisis line is available for crisis consultation by calling 480-921-1006.

Student Code of Conduct
Students are required to adhere to the behavior standards listed in the Arizona Board of Regents Policy Manual Chapter V –Campus and Student Affairs: Code of Conduct located online at http://students.asu.edu/srr/code and the ACD 125: Computer, Internet, and Electronic Communications available at http://asu.edu/aad/manuals/acd/acd125.html.
http://asu.edu/aad/manuals/acd/acd125.html

Students are entitled to receive instruction free from interference by other members of the class. An instructor may withdraw a student from a course when the student's behavior disrupts the educational process under USI 201-10 http://www.asu.edu/aad/manuals/ssm/ssm201-10.html. An instructor may withdraw a student from a course with a mark of "W" or "E" when the student's behavior disrupts the educational process. Disruptive classroom behavior for this purpose is defined by the instructor.

Harassment Prohibited
ASU policy prohibits harassment on the basis of race, sex, gender identity, age, religion, national origin, disability, sexual orientation, Vietnam era veteran status, and other protected veteran status. Violations of this policy may result in disciplinary action, including termination of employees or expulsion of students. Contact the professor if you are concerned about online harassment of any kind, and he/she will put you in contact with the Dean of Students office.

Title IX
Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/.

Statement on Inclusion
Arizona State University is deeply committed to positioning itself as one of the great new universities by seeking to build excellence, enhance access and have an impact on our community, state, nation and the world. To do that requires our faculty and staff to reflect the intellectual, ethnic and cultural diversity of our nation and world so that our students learn from the broadest perspectives, and we engage in the advancement of knowledge with the most inclusive understanding possible of the issues we are addressing through our scholarly activities. We recognize that race and gender historically have been markers of diversity in institutions of higher education. However, at ASU, we believe that diversity includes additional categories such as socioeconomic background, religion, sexual orientation, gender identity, age, disability, veteran status, nationality and intellectual perspective.

Syllabus Disclaimer
The course syllabus is an educational contract between the instructor and students. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen

events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email, or in the Announcements section on Blackboard.

Campus Resources
As an ASU student you have access to many resources on campus. This includes tutoring, academic success coaching, counseling services, financial aid, disability resources, career and internship help and many opportunities to get involved in student clubs and organizations.

- Tutoring: http://studentsuccess.asu.edu
- Counseling Services: http://students.asu.edu/counseling
- Financial Aid: http://students.asu.edu/financialaid
- Disability Resource Center: http://www.asu.edu/studentaffairs/ed/drc/
- Major/Career Exploration: http://uc.asu.edu/majorexploration/assessment
- Career Services: http://students.asu.edu/career
- Student Organizations: http://www.asu.edu/studentaffairs/mu/clubs/
- ASU Writing Centers: https://tutoring.asu.edu/writing-centers
- ASU Police Department: https://cfo.asu.edu/police
- International Student Resources: https://students.asu.edu/international/support/academic

BIO 160: Introduction to Human Anatomy and Physiology
Topic Outline

UNIT 1: INTRODUCTION TO STRUCTURE AND FUNCTION AND RESEARCH

- Introduction to Structure & Organization: anatomical / morphological / scientific terminology
- The Research Continuum: The Scientific Method; Inductive / Deductive Loop; hypothesis testing
- Introduction to Anatomy: organ systems, anatomical position, bodily cavities / divisions
- Introduction to Physiology: homeostasis & adaptation; positive & negative feedback loops

UNIT 2: BIOCHEMISTRY, THE CELL, & TISSUE TYPES

- Matter & Energy: Forms
- Atoms and Molecules: structure and function
- Water in the human body: chemical composition & creating polarity: ions, buffers, pH
- Substrates: carbohydrates, lipids, proteins, nucleic acids, ATP
- The cell: plasma membrane, cytosol & organelles, the nucleus
- Endomembrane system: passive and active transport
- The cell cycle
- DNA □ RNA □ Protein
- Cell death
- Four tissue types

UNIT 3: THE INTEGUMENTARY SYSTEM

- Introduction to membranes
- The skin
- Epidermis
- Dermis
- Accessory structures: mechanoreceptors, thermoreceptors, pain receptors; hair / nails
- Glands and modes of secretion
- Burns, Cancer, Injury & healing; Aging

UNIT 4: THE SKELETAL SYSTEM

- Bone types
- Biochemistry of bone
- Microarchitechture; Wolff's Law; Impact of hormones
- Gross architecture
- Bone remodeling; fractures & repair
- Bone development
- Osteopenia, osteomalacia & Rickets
- Axial & appendicular bones

UNIT 5: THE MUSCULAR SYSTEM & JOINTS

- Characteristics of muscle types
- Smooth muscle
- Cardiac muscle
- Skeletal muscle
- Excitation-contraction coupling
- The sarcomere: structure and cross-bridge cycling dynamics
- Contraction characteristics and types
- Hypertrophy, atrophy, and disease
- Gross appendicular and axial musculature
- Joint Classification
- Structure; movement types; Classification of Levers

UNIT 6: THE NERVOUS SYSTEM

- Organization
- Neural cell types
- The action potential: electrochemical gradients
- The meninges
- Spinal Cord
- Brain & neuroplasticity
- Peripheral nervous system
- Autonomic nervous system: fight or flight
- Special senses
- Injury, repair, & regeneration

UNIT 7: THE ENDOCRINE SYSTEM

- Hormones structure and function
- Endocrine, exocrine, paracrine actions
- Regulation of homeostasis
- Endocrine organs, associated hormones, and affected physiological systems
- Non-intuitive endocrine organs
- Pathophysiological conditions

UNIT 8: BLOOD, THE LYMPHATIC SYSTEM, & IMMUNITY

- Composition of blood: plasma & formed elements
- White blood cell types
- Platelets and clotting mechanisms
- Blood disorders
- Lymph structures & organs
- Innate and acquired immunity
- Antibodies
- B & T cells
- The immune response, progression & suppression
- Autoimmunity, hypersensitivities, HIV life cycle & AIDS

UNIT 9: THE CARDIOVASCULAR SYSTEM

- Heart structure and blood flow
- Neural control
- Frank-Starling law of the heart
- The electrocardiogram (ECG) & artificial pacemaker
- Coronary circulation & bypass surgery
- Heart medications
- Systemic blood flood & pulses
- Blood pressure, viscosity, and flow rates
- Venous return
- Hepatic portal system: impact for blood-glucose regulation
- Fetal blood flow

UNIT 10: THE RESPIRATORY SYSTEM

- Structures and organs of upper and lower respiratory tracts
- The J-Hypothesis
- Gas exchange: Boyle's Law
- Gas transport
- Pulmonary volumes & the spirometer
- Neural regulation of breathing
- Chemo- & mechanoreceptors
- Aerobic vs. anaerobic metabolism
- Adaptation at high altitude
- Erythropoiesis and blood adaptation
- Disorders of the respiratory system

UNIT 11: THE DIGESTIVE SYSTEM & METABOLISM

- Structures and organs of the alimentary canal
- Digestive enzymes and substrates
- The mesentery
- Mechanical digestion
- Chemical digestion & absorption: carbohydrates, protein, lipids
- Transport and storage
- Metabolism
- Vitamins and Minerals
- Metabolic rates; thermoregulation: conduction, radiation, evaporation, convection
- Circulatory convection system: aerobic exercise example
- Disorders of the digestive systems and nutritional deficiencies

UNIT 12: THE URINARY SYSTEM

- Structures and organs
- The nephron & juxtaglomerular apparatus
- Filtration, absorption, secretion
- Active & passive transport
- Renin-Angiotensin-Aldosterone System
- Urinalysis
- Obstructive, glomerular, renal disorders

UNIT 13: THE REPRODUCTIVE SYSTEMS, GROWTH & DEVELOPMENT

- Structure and function of male & female reproductive systems
- Spermatogenesis & oogenesis
- Hormonal regulation of systems
- Estrus cycle & mechanisms of ovulation
- Pathophysiological disorders
- Contraception
- Embryonic germ layer
- Neural development
- Pregnancy, labor, and parturition
- Stages of growth & impact of aging

UNIT 14: INTRODUCTION TO GENETICS AND GENETIC DISEASES

- Review of DNA structure
- Genes, traits, & inheritance
- Autosomes and sex chromosomes / karyotype chart
- Punnett square; dominant & recessive
- Crossing over
- DNA fingerprinting
- Mechanism of genetic disease; mutation types
- Chromosomal genetic diseases

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	**How course meets spirit (contextualize specific examples in next column)**	**Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)**
I. A. Course emphasizes the mastery of basic scientific principles and concepts.	This course will require the study of scientific principles from different fields and disciplines using the human body as the model to highlight these concepts.	Examples: **Biological**: Units 1-16; **Chemistry**: Unit 2: Energy, atoms/molecules, water & polarity, pH, buffers, structure of substrates; Unit 4: Biochemistry of bones; Unit 8: hormones structure/function; Unit 8: Antibodies; Unit 11: Gas Transport, Anerobic/Aerobic metabolism; Unit 12: Chemical digestion/absorption; Unit 13: Urinalysis; **Physics**: Unit 4: Wolff's Law; Unit 5: Stress-Strain / Length-tension curves, Biomechanics (Classification of Levers); Unit 11: Boyle's Law; Unit 9, 10 & 13: viscosity & hydrostatic pressures; Units 3 & 10: mechanoreceptors; Unit 12: mechanical digestion; **Thermodynamics**: Unit 1: negative feedback loop (thermoregulation); Unit 10: circulatory convection system & evaporative cooling **Electrical**: Unit 5 & 6: electrochemical gradients of action potential; Unit 10: electrocardiograms (ECGs)

I. B. Addresses knowledge of scientific method.	The use of the scientific method will be an integral component of the class to address scientific hypotheses / questions. This approach will be emphasized mostly within laboratories to predict outcomes and accept/reject those predictions based on experimental results.	Examples: **Unit 1**: The research continuum **Egg Experiment**: "Based on the composition of the bathing solution, predict whether the (egg) cell will increase or decrease in volume?" **USDA diet analysis**: "Is it possible to increase food intake by weight (grams) and decrease your caloric consumption?"
I. C. Includes coverage of the methods of scientific inquiry that characterize the particular discipline.	This course will use methodological approaches of descriptive and mechanistic techniques to allow students to experience the spectrum of inquiry.	Examples: **Descriptive**: microscopy laboratory: epithelial histochemistry; bone / muscle / neural anatomy (anatomical models) **Mechanistic**: Osteon-straw experiment
I. D. Address potential for uncertainty in scientific inquiry.	Some laboratories focus on how inter-individual variability impacts outcomes, such as the uncertainty of environmental influence or the amount of load needed to induce physiological or anatomical failure.	Examples: **Urinalysis**: "How does hydration status impact the specific gravity of urine?" **Osteon-straw Experiment**: "How does your simulated osteoporosis (cuts to the straws) impact the failure of your simulated osteon? Compare straw cuts with a neighboring group."
I. E. Illustrates the usefulness of mathematics in scientific description and reasoning.	This course will directly address the necessity of quantitative measurement / calculation in scientific testing and reasoning.	Example: **Lever Experiment**: "Calculate the skeletal muscular force (in Newtons) from the biceps brachii required to lift a 50 lb dumbbell."

I. F. Includes weekly laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline, and enhance the learning of course material.	The course includes weekly laboratories to emphasize concepts covered in lecture.	All 16 Units. All 13 Laboratories.
I. G. Students submit written reports of laboratory experiments for constructive evaluation by the instructor	Students will be required to submit weekly lab reports (denoted as "LR" in the syllabus) which will include hypotheses/prediction statements, methodological description, analysis of data, and how these findings relate to / integrate with a particular physiological concept.	All 16 Units. All 13 Laboratories.
I. H. Course is general or introductory in nature, ordinarily at lower division level; not a course with great depth or specificity.	This is a survey course that integrates a variety of disciplines to allow students to build a solid understanding of health and well-being through a broad exploration of anatomy and physiology	See answer for I. A.

II. A. Stresses the understanding of the nature of basic scientific issues.	Although this course emphasizes the exploration of specific anatomical structures and function of physiological systems, the human body is used as a model to understand how concepts within the basic sciences interact to keep the body working properly. This course is an exploration at a reductionistic and wholistic level and how governing principles of the Laws of Physics, chemical structures, and the Central Dogma of Life coalesce to make a functional body.	All 16 Units. All 13 Laboratories.
II. B. Develops appreciation of the scope and reality of limitations in scientific capabilities.	This class gives perspective to the limits of integrative physiology and how "rate limiting factors" modulate the extremes of physiological functioning.	Examples: **Unit 5**: Muscular system discussion on the Length-Tension and Stress-Strain curves **Unit 11**: Limits of high altitude on respiratory physiology & oxygen disassociation **Spirometry laboratory**: limits in lung volumes (inhalation / expiration)
III.A. Provides a substantial, quantitative introduction to fundamental principles governing behavior of matter and energy, in physical or biological systems.	Although the primary focus of Introduction to Human A&P is the human body at multiple levels, there is ample discussion on how the physiological systems are governed by the laws of nature including, but not limited to, the transfer / use of energy and how the different forms of matter interact with and modulate these organ systems at a chemical level.	Examples: **Unit 2**: water involved in dehydration synthesis & hydrolysis **Unit 4**: Wolff's Law and bone formation **Unit 11**: Gas exchange / transport; anaerobic / aerobic metabolism and ATP production; Boyle's Law **Unit 12**: chemical / mechanical process of digestion & absorption; ATP **Labs**: Passive Diffusion; Osteon/Straw Experiment; Electrocardiogram; Spirometry; USDA diet analysis

III. B. Includes college-level treatment of some of the following topics:		
a. Atomic and molecular structure		
b. Electrical processes	Students must understand how resting membrane potential in a muscle or nerve cell, and the electrochemical exchange of ions through that membrane, impact cell-to-cell communication. Ohm's Law introduced.	**Unit 5**: a muscle action potential **Unit 6**: electrochemical gradients of an action potential **Unit 9**: electrocardiograms (ECGs) **Lab**: electrocardiogram analysis
c. Chemical processes	Students must understand how different forms of matter are created / used within physiological systems. particularly with metabolic pathways and the creating and use of energy (e.g. ATP). The concept of concentration gradients is a continual theme as a discussion of chemical transport throughout the body.	**Unit 2**: Biochemistry **Unit 8**: The Endocrine System and chemical signaling for immunity **Unit 11**: The Respiratory System and gas exchange and transport **Unit 12**: The Digestive System / nutrition and metabolism **Unit 13**: The Urinary System; urine formation, fluid balance, buffering **Labs**: Passive Diffusion & Egg Experiments; USDA diet analysis; Urinalysis;

d. Elementary thermodynamics	Students must understand that heat transfer is essential for thermoregulation and maintaining an internal body temperature of 37˚C, irrespective of external environment	**Unit 1**: Negative Feedback Loops **Unit 5**: Muscular system (e.g., shivering) **Unit 8**: Endocrine system (e.g., thyroxine increase heat production) **Unit 10**: Cardiovascular system (e.g., blood as a distributor of bodily heat) **Unit 13**: Urinary System and fluid balance; thermoregulation through conduction, convection, radiation, and evaporation
e. Electromagnetics		
f. Dynamics and mechanics	Students must understand the how the body resists and develops around the physical forces acting upon various physiological systems.	**Unit 4**: The Skeletal System (e.g. Wolff's Law) **Unit 5**: The Muscular System (e.g., length-tension & stress-strain curves) **Labs**: Osteon-Straw Experiment; Lever experiment

Criteria Justification: Introduction to Human Anatomy and Physiology ASU [SQ] Criteria

I. Critical Criteria

A. Course emphasizes the mastery of basic scientific principles and concepts.

The study of the human body is very personal to students who are interested in this topic for the simple reason that students want to know more about themselves. Starting from this base, we are able to funnel that interest into a discussion that broadly introduces the Scientific Method / research and fundamental concepts from other scientific disciplines using the human body as the model. Moreover, these transdisciplinary topics are framed to the students in ways that are less intimidating because they are contextualized in within the topics anatomy and physiology including basic biomechanics, elasticity, the production and transfer of heat, electrochemistry, and the properties of water. Some of these concepts are reinforced within laboratory exercises.

B. Addresses knowledge of scientific method.

The Scientific Method as a model for research inquiry is specifically addressed within Unit 1 of this course. Specifically, this portion of Unit 1 walks students through the Induction-Deduction loop of inquiry, hypothesis testing, and confirmation. In addition, students are presented with an example of the "research continuum" highlighting how research in multiple, and seemingly unrelated disciplines, are, in fact, all connected. Furthermore, we discuss how the results from one part of this continuum can be used as support for other aspects of the continuum.

The Scientific Method is employed within selective laboratory exercises where there is an unknown outcome to the experiment. This is particularly apparent in the Egg Experiment where students must use the semipermeable membrane of a vinegar-digested chicken egg to hypothesize which way water travels across the membrane considering the solution(s) in which the egg is immersed. Also, the Osteon-Straw Experiment determines how many (and in which orientation) straws, which represents the bone osteon, are required to support a given load. The outcome for this project is different for each group inasmuch as the number and position of the straws is different for each group.

C. Includes coverage of the methods of scientific inquiry that characterize the particular discipline.

Methodological approaches in the biological sciences are diverse, like in all basic sciences. At the core of these methods are descriptive observations of the results, e.g.,

"what did you see?" The descriptions are coalesced into a mechanistic argument that attempts to put observations together, in parallel with the existing knowledge (e.g., the literature), to explain function of biological systems sequentially and logically. *Introduction to Human Anatomy and Physiology* captures these approaches through descriptive and mechanistic results. Examples of descriptive science within the class include histological observation through the microscope or examination to describe the characteristics of the heart during dissection or bone examination. More mechanistic labs include Passive Diffusion, the Egg Experiment, the Osteon-Straw Experiment, and Urinalysis to explain why, or how, the observations were made. This is accomplished, in part, by drawing on lecture material to put the pieces together that rationally justify the experimental findings. For example, students will prepare straws (simulating bone osteons) to support (vertically) a weight applied to the top of the collection of straws. In a follow-up test, the students place small cuts in the straws to simulate osteoporosis and reduce the structural integrity of the straws / osteons. Students can describe how osteoporosis reduces the ability of the bone to (mechanistically) support body weight.

D. Addresses potential for uncertainty in scientific inquiry.

The human body is surrounded by uncertainty including environmental conditions, exposure to pathogens, and physical trauma. This uncertainty is partially captured within the laboratory exercises. For example, students are required to perform a urinalysis on their own samples and will be asked to reflect how the changes in food consumption and hydration status impact the findings. Similarly, the uncertainty of the findings is individual-specific: the presence of white blood cells may indicate an infection; the changes in specific gravity may reflect the heat of the ambient temperature. Students are asked to parallel their findings with the recent and on-going individual and environmental circumstances. These concepts are addressed in other labs including the Egg Experiment, the Osteon-Straw experiment, the USDA diet analysis, and the Blood Typing laboratory (using simulated blood that is commercially available).

E. Illustrates the usefulness of mathematics in scientific description and reasoning.

Although mathematics is not a central component within BIO 160 *Introduction to Human Anatomy and Physiology*, it is employed within the Lever Laboratory Experiment. Students are asked to calculate the required amount of force produced by their muscles to lift a certain resistance (dumbbell) and how changes to force or resistance arms change the mechanical advantage for the person. Students can physically experience these changes in lab while expressing their experiences mathematically.

F. Includes weekly laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline and enhance the learning of course material.

With the exception of an introductory week and a week dedicated to each laboratory practical, there is a hands-on laboratory each week to explore concepts that are present in parallel with the lecture material. One goal of *Introduction to Human Anatomy and Physiology* is to provide students a mixture of laboratory experiences in the biological sciences that they can personally relate to through experimentation and description. The students work in groups but will be encouraged to compare outcomes with other groups to determine how variability in structure changes function.

G. Students submit written reports of laboratory experiments for constructive evaluation by the instructor.

Students in *Introduction to Human Anatomy and Physiology* are required to submit weekly lab reports (denoted "LR" on the syllabus) that may include any combination of answering questions about the labs related to form (anatomy) and function (physiology), provide a well-structured hypothesis, a description of their methods and presentation of weekly data gathered. If required, an analysis of the data and interpretation of these values should be provided in lab reports. Students are not be marked with lower scores if a hypothesis is not confirmed. All reports are assessed by Instructional Assistants or the Instructor.

H. Course is general or introductory in nature, ordinarily at lower division level; not a course with great depth or specificity.

BIO 160 *Introduction to Human Anatomy and Physiology* is a one-semester course covering all 11 physiological systems plus special topics including biochemistry, the cell, genetics, and clinical and disease scenarios (e.g., pathophysiology). Given that BIO 201 and 202 cover anatomy and physiology only over two semesters underscores that BIO 160 is kept at an introductory level.

II. At least one of the following additional criteria must be met

A. Stresses the understanding of the nature of basic scientific issues.

Although this course emphasizes the exploration of specific anatomical structures and function of physiological systems, the human body is used as a model to understand how concepts within the basic sciences interact to keep the body working properly. This course is an exploration from a reductionistic (atoms and molecules) to wholistic (organ and systems) level and how governing principles of nature, including but not limited to, the Laws of Physics, chemical structures, and the Central Dogma of Life coalesce to make a functional human body.

B. Develops appreciation of the scope and reality of limitations in scientific capabilities.

Physiological systems work together to perform a function that would otherwise be impossible by any one system alone. As these systems are stressed, or challenged, the limits of particular systems become more apparent, which are taught as "rate limiting factors." For example, physical exercise is commonly used as an example within the course to highlight why we cannot sprint a marathon or lift a one-thousand-pound dumbbell. Limits of physiology become apparent during exercise or if stressed against the environment (high altitude, cold/hot environments), or disease (HIV-AIDS). The limit of the human body are a continual theme within the course an give a perspective to the student why we experience limits in function and performance.

C. Discusses costs (time, human, financial) and risks of scientific inquiry.

N/A

III. Additional Criteria

A. Provides a substantial, quantitative introduction to fundamental principles governing behavior of matter and energy, in physical or biological systems.

Although the primary focus of BIO 160 *Introduction to Human Anatomy and Physiology* is the human body at multiple levels, there is ample discussion on how the physiological systems are governed by the laws of nature including, but not limited to, the transfer / use of energy and how the different forms of matter interact with and modulate these organ systems at a chemical level. These are covered in Unit 2 (water; dehydration synthesis; hydrolysis), Unit 4 (Wolff's Law and bone formation), Unit 11 (gas exchange / transport; anaerobic / aerobic metabolism and ATP production and Boyle's Law), Unit 12 (chemical / mechanical process of digestion & absorption and ATP), and reflected in laboratory exercises: Passive Diffusion; Osteon/Straw Experiment; Electrocardiogram; Spirometry; USDA diet analysis.

B. Includes a college-level treatment of some of the following topics:

a. Atomic and molecular structure

N/A

b. Electrical processes

Students must understand how resting membrane potential in a muscle or nerve cell, and the electrochemical exchange of ions through that membrane, impact cell-to-cell communication. Ohm's Law introduced. These are covered in Unit 5: a muscle action potential, Unit 6: electrochemical gradients of a neural action potential, Unit 9: electrocardiograms (ECGs), and explored in the laboratory: electrocardiogram analysis.

c. Chemical processes

Students must understand how different forms of matter are created / used within physiological systems. particularly with metabolic pathways and the creating and use of energy (e.g. ATP). The concept of concentration gradients is a continual theme as a discussion of chemical transport throughout the body. These are covered in Unit 2 (biochemistry), Unit 8 (endocrine system and chemical signaling for immunity), Unit 11 (the Respiratory system and gas exchange and transport), Unit 12 (the digestive system / nutrition and metabolism), Unit 13 (the urinary system; urine formation, fluid balance, buffering), and reflected in laboratories: Passive Diffusion & Egg Experiments; USDA diet analysis; Urinalysis.

d. Elementary thermodynamics

Students must understand that heat transfer is essential for thermoregulation and maintaining an internal body temperature of 37˚C, irrespective of external environment. These are covered in Unit 1 (negative feedback loops discussing thermoregulation), Unit 5 (shivering as a mode of heat production and transfer), Unit 8 (the endocrine system discussing how thyroxine increases heat production system-wide), Unit 10 (the cardiovascular system and how blood is a distributor of bodily heat), and Unit 13 (the urinary system and fluid balance; thermoregulation through conduction, convection, radiation, and evaporation).

e. Electromagnetics

N/A

f. Dynamics and mechanics

Students must understand the how the body resists and develops around the physical forces acting upon various physiological systems. This is covered in Unit 4: (the skeletal system through the formation of bone along stress lines, or Wolff's Law), Unit 5 (the muscular system discussing the mechanics of force production and transfer to bone as emphasized by the length-tension & stress-strain curves), and reflected in laboratories: Osteon-Straw Experiment; Lever experiment