**Appendix and Supplemental Tables**

**Questions from the survey**

Data from Table 1 were abstracted from name and email information collected.

Data from Table 2 were collected using the following questions.

1. Are any of your required courses in the major taught [entirely online, hybrid, flipped]:
   1. All
   2. Some
   3. None

Data from Tables 3, 4, 5, 6 and 7 were collected using the following question. This question was iterated for each course.

1. What are the supporting courses from the list below in your program? Choose the option below for both LECTURE and LAB that most clearly represents their offering at your institution.
   1. Not available to students in the major
   2. Available elective in the major
   3. Selective option for meeting a major requirement
   4. Required in the major program

Data from Table 8 were collected using the following question. The first question was iterated for each opportunity. Example of survey view in figure S1.

1. What are the other opportunities from the list below in your program?
   1. Not available to the students in the major
   2. Offered as an option in the major
   3. Required in the major program

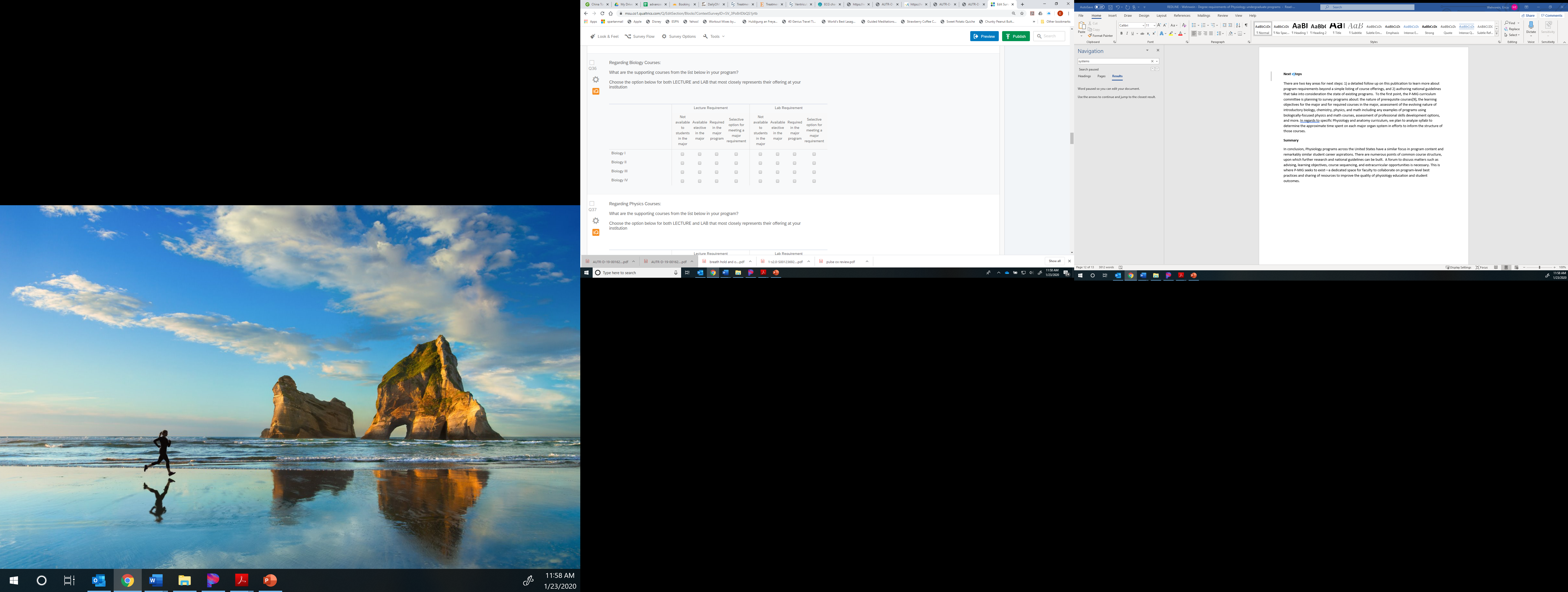


Figure S1. Survey view of the question(s) used to collect program requirements on Biology courses.

1. If research experience is offered or required, what is the venue for the research experience? Check all that apply.
   1. Formal in the classroom
   2. With individual faculty on campus
   3. With faculty in off campus venues
   4. In clinical research setting
   5. Other

Appendix data (Tables S1-S3) was ascertained using the following questions.

1. Describe the nature of your anatomy labs (cadaver, models, virtual lab, traditional lecture, etc), if applicable.
2. Describe the nature of your physiology labs (human, animal, project based, etc), if applicable.
3. Define/describe/elaborate on your "core physiology" course or course sequence as it stands in your major. This should include as many details as possible:
   1. 1. Course number (200, 300, 400, etc)
   2. 2. Number of credits per course
   3. 3. Year typically taken in college process
   4. 4. Primary focus (human, animal, cellular, etc)
   5. Etc.

**Free Response Questions from Survey**

Free response questions have been censored to remove highly identifiable information, including institution names and course codes. All censoring was completed by indicating the nature of the content, for example “Michigan State’s introductory biology course BIO 101…” would be censored to “[Institution]’s introductory biology course [course code] [100 level] …”.

**Table S1. Nature of Anatomy Labs**

|  |  |
| --- | --- |
| 1 | combined wet labs and simulations |
| 2 | [blank] |
| 3 | Our labs are human cadaver based labs supplemented with models and accompanied by lecture components. In the [300 level] course - students use prosected cadavers. In the [400 level] series they do the actual dissections themselves, generating the cadavers that will subsequently be used as prosected cadavers in later [300 level] courses. |
| 4 | Cadaver based with models |
| 5 | Cadaver |
| 6 | Not applicable. |
| 7 | N/A |
| 8 | no required lab; a very few students can get into cadaver or prosection as an elective credit |
| 9 | models and mammalian non-human tissue |
| 10 | Human/Animal cadavers, plastinated models, "virtual human dissection", traditional lecture, dissection for top students. |
| 11 | cadaver lab |
| 12 | lectures of 150 students per section with cadaver based labs of 24 students per section |
| 13 | wet specimens, prosection |
| 14 | Models, virtual, dissection of organs |
| 15 | Cadaver, virtual, models |
| 16 | A&P labs include models and specimens, plus some cadaver parts borrowed from medical school |
| 17 | Models |
| 18 | Models and animal dissections (e.g. sheep pluck) |
| 19 | required: specimens, animal dissection; elective: cadaver dissection |

**Table S2. Nature of Physiology Labs**

|  |  |
| --- | --- |
| 1 | project based, conceptual, animal and human |
| 2 | [blank] |
| 3 | The lab component of our physiology [300 level] course exposes students to all three types of lab exercises. In some cases they perform lab exercises i.e. spirometry, heart rate assessments etc. on themselves or one another. In other cases they use animals to experiment on (ovary/testes removal in rats), effects of various stimulatory/inhibitory agents on animal organs/tissues, etc. In some cases they do group projects where they research and then provide oral presentations to peers regarding physiologically relevant topics/disease states/etc. |
| 4 | Human and simulation. |
| 5 | Human |
| 6 | Not applicable. |
| 7 | Traditional Animal Labs |
| 8 | human, project based |
| 9 | human, animal, models |
| 10 | Human physiology labs are computer based. |
| 11 | human subject BioPac projects |
| 12 | lectures of 150 students per section with human based labs (PowerLab: ADInstruments) of 24 students per section |
| 13 | human, animal, project based, |
| 14 | iWorx, case studies |
| 15 | Human, Applied/Exercise |
| 16 | Our senior level physiology lab is exercise based |
| 17 | Human |
| 18 | Mixture of human and animal physiology, and a mixture of traditional and inquiry based lab exercises |
| 19 | human measurement, independent project development |

**Table S3. Core Physiology Course Descriptions**

|  |  |
| --- | --- |
| 1 | 300 level, 5 credits, taken by juniors, comparative |
| 2 | Human Anatomy & Physiology I: Cells and Tissues ; Human Anatomy & Physiology II: Organ Systems |
| 3 | [blank] |
| 4 | [course code] [300 level] Human Physiology 1 (3 cr) taken sophomore year, human focus; [course code] [300 level] Human Physiology II (3 cr) late sophomore or junior year human focus; [course code] [300 level] Human Physiology lab (2 cr) Junior year; (NOTE: we are changing to a one semester physiology lecture Fall 2020); Students need 15 cr from upper division core courses taken Jr/Sr year which include: [course code] [400 level] Cell Phys (4 cr) Human focus using worm models; [course code] [400 level] (3 cr) Immunology - Human focus; [course code] [400 level] (5 cr) Biomechanics - Human focus; [course code] [400 level] (3cr) Sleep Physiology- human focus; [course code] [400 level] (5 cr) Exercise Physiology - human focus; [course code] [400 level] (4 cr) Neurophysiology- human focus |
| 5 | [course code] [300 level] Human Physiology, after Human Anatomy, taken in 4th or 5th semester. 3 credits + 1 credit lab. Exercise Physiology ([course code] [400 level]) and lab taken 6-8 semester |
| 6 | 1. 300-level course ([course code] [300 level]); 2. 3 credit hours; 3. Most often taken in junior year. Introductory biology is the sole prerequisite. 4. human physiology |
| 7 | [blank] |
| 8 | [course code] [400 level] and [400 level], 3 cr each, junior or senior, systems physiology, mix of systems and molecular |
| 9 | After 2-semester 9-credit lecture/lab course in General Biology and a 2nd year, 2-semester, 10-credit sequence in anatomy and physiology, students are required to take a 300 level Cellular and Integrative 6-credit lecture/laboratory course, followed by a 300-level, 2-credit seminar in Experimental Approaches in Physiology. They are then required to take 12 more credits in upper level biology/physiology courses (from a selection of ~15 courses, including the opportunity to take research for credit. There are some constraints on their 12 credits of electives to ensure broad exposure to physiology as well as development of oral communication skills. Focus is part human, part animal; it also encompasses the cellular level. |
| 10 | [course code] [200 level] (3 cr)-Intro to [Biomedical Sciences], second sem 1st yr, physiological mechanisms/concepts; [course code] [300 level] (Fundamentals of Physiology) (4 cr); 2nd sem. 2nd year, more advanced physiological mechanisms/concepts; [course code] [300 level] (2 cr), Physiology Laboratory, 2nd semester 2nd year, Human systems physiology. Three capsone classes with [Biomedical Sciences] rubrics; each 5 credits in senior year. Each has lecture component and seminar portion focussing on disease mechanism with writing and speaking components. |
| 11 | The Core Physiology courses at the [institution] are [300 level] courses: [course code] [300 level] Principles of Physiology (4 cr), [course code] [300 level] Research Paper for Physiology Majors (1 cr) and [course code] [300 level] Physiology Lab (2 cr). [300 level]: Has 4 50 minute lectures/week and is a systems-based human physiology course. The course is taught by a team of faculty each covering a region of the body in which they are expert. It is recommended that students take the class in fall of their junior year. [300 level]: Has 1 lecture/week for 5 weeks followed by 8 weeks of semi-independent study related to the literature review drafting and then producing a finished research paper in the style of a scientific mini-review. During the independent study phase, students are expected to confer with a faculty mentor on their project and receive feedback on an outline and rough draft before proceeding to the composition of the final draft of the paper. [300 level]: Has 1 2 hour lab session per week. Students work in teams of 3 - 4 to measure human physiological performance characteristics using a variety of BioPac sensors to collect data. Lab reports are collaborative and a student-designed final project is executed and presented by each lab group. |
| 12 | [course code] [300 level] Human Physiology (lecture/lab) - 4 semester credit hours. Taken in the sophomore year. Prerequisites of [course code] [100 level] and [100 level] General Biology 1&2 AND [300 level] Human Anatomy (lecture/lab) 4 credits each. |
| 13 | Our program major is Biological Sciences with a pre-med focus. We have Anatomy and Physiology courses at the 2000 level for nursing students, and one at the 3000 level for Athletic Training and Exercise Science. The nursing course is 3 credits while the one for the [Athletic Training] and [Exercise Science] students is 5 credits. The other pre-health majors take a sequental 3000 level course of 4 credits each - A&P I and II. Additionally there is a 4000 level 3 credit Advanced Human Physiology course. The focus for all is human. |
| 14 | [course code] [100 level] (physiology based), 4 credits, freshman year; PSIO 241, 4 credits, sophomore year; Advanced Physiology of Exercise I and II with lab, 4 credits each, junior year |
| 15 | [blank] |
| 16 | 1) Human Anatomy and Physiology I and II ([course code] [200 level] and [course code] [200 level]), lecture and lab combined, 4 credits each, taken mostly in sophomore year, focus on systems physiology and human function. 2) Integrative Cellular Physiology ([course code] [300 level]), lecture, 3 credits, taken by juniors, focus on cellular physiology in the context of a systemic program (i.e. metabolic syndrome). 3) Integrative Systems Physiology ([course code] [300 level]), lecture, 3 credits, taken by juniors, focus on systems physiology around 3 areas: homeostasis, growth and development, adaptation and response to trauma. |
| 17 | [course code] [200 level] - Human anatomy, 3 credits, sophomore; [course code] [200 level] - Human phys, 3 credits, Sophomore; [course code] [300 level] - Exercise phys, 4 credits, junior |
| 18 | [course code] [100 level] Cell Biology, 4 Units, Junior, Cell [course code] [100 level] Human Physiology, 4 Units, Junior, Human; [course code] [100 level] Physiology Lab, 4 Units, Junior, Human/Animal; [course code] E183 Exercise Physiology, 4 Units, Junior, Human/Animal; [course code] [100 level] Neurobiology & Behavior, 4 Units, Junior, Human/Animal; [course code] [100 level] Animal Sensing & Motion, 4 Units, Junior, Human/Animal; [course code] [100 level]: Physiology of Extreme Environments, 4 Units, Junior, Human/Animal; [course code] [100 level] Physiology of Human Nutrition, 4 Units, Junior, Human; [course code] [100 level] Exercise Sciences Seminar, 4 Units, Senior, Human/Animal; [course code] [100 level] Applied Human Anatomy, 6 Units, Senior, Human; [course code] [100 level] Neurobiology Lab, 4 Units, Senior, Human/Animal; [course code] [100 level] Molecular Biology Lab , 4 Units, Senior, Molecular; [course code] [100 level] Biochemistry Lab 4 Units, Senior, Molecular |
| 19 | [course code]:[300 level] Human Physiology with Lab, 5 SH physiology lecture/lab combination, typically completed junior year, primary focus is human physiology, pre-requisite for most electives |