Teaching Enhancement Grants
Scholarship of Teaching and Learning

Breaking from Traditional Curriculum. Designing an Undergraduate Human Anatomy and Physiology Laboratory to Promote Active Learning

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Executive Summary

The objective of this proposal is to redesign the curriculum for anatomy and physiology laboratories. Traditional curriculum emphasizes content volume, rote memorization, and lab practical performance. The new curriculum will emphasize active learning exercises that foster application and clinical relevance of learned concepts. Using a scaffolding approach, students will progress in activities from basic learning to activities that teach functional, clinical and comparative application. Content selectivity will grant students the opportunities, during class time, to assess their learning, demonstrate concepts, design and review experimental protocols, and engage in group discussions.

Project Proposal

There is a growing interest in redesigning undergraduate science labs. Integration of an active learning curriculum, in addition to traditional curriculum, has shown success in student achievement and interest. Some science labs showed success in learning and interest using semester-long research projects, applying and analyzing learned content, and emphasizing problem solving, in addition to learning of core concepts (Brown, 2010; Brownell et al, 2012; Gasper et al, 2013; Johnston and McAllister, 2008). Anatomy and physiology labs, particularly, have come under scrutiny for their long-standing traditional approach. Typically, these labs implement physiological experiments paired with anatomical identification of respective systems. The anatomy component is relegated to memorizing lengthy lists of structures. Little emphasis is placed on the relevant function of anatomy to human health and performance. Students spend most of the anatomy lesson labelling subpar models and workbook diagrams. Physiology experiments often follow a cook-book style method with little discussion of the hypothesis, experimental design, or application to respective anatomy. The core objective for these traditional AP labs is dense memorization for lab exams. The overload of information leaves many students struggling to engage in the concepts and understand the relevance and relationship between anatomy and physiology (Husmann, 2016).

This project will examine improved learning and interest of students using a redesigned curriculum for the first semester of a two-semester anatomy and physiology lab. Students will use innovative models and comparative organisms, with emphasis on functional application. Students will develop and analyze experiments based on real life observations and learned anatomy. These labs while maintain some traditional components of anatomy and physiology labs, such as practicals, but will reduce work load to foster application and problem solving.

Methods and Materials

Semester lab activities are categorized in units. Each unit will consist of approximately one week of a body system anatomy. This is followed by one week of the same body system physiology. Students will conduct all activities in groups of 4 to 5 members.

Body Systems Anatomy

Students receive a brief introduction on the anatomy for that system. Each group will dissect, when appropriate, and label provided structures (approximately 20-25) on organisms and models. Groups will also use an online virtual cadaver for comparison and guidance. Time of activity is approximately 50 minutes. Following the dissection session, groups will participate in a timed identification challenge. The instructor will announce a structure or function and the model. Groups have 10 seconds to identify the structure. Time of activity is approximately 10 minutes. For the final activity, groups are presented a

series of application questions and scenarios. Students will use organisms, models, and each other to demonstrate function, clinical significance, pathologies, and comparison to other vertebrates. Students will record their answers for submission at the conclusion of lab. Students will complete a 15-question identification practical during the following lab. The practical will only cover the anatomy learned during the specific period.

Body Systems Physiology
Following completion of the anatomy period, groups conduct a series of experiments that demonstrate the physiology of the learned anatomy. Students will formulate a hypothesis about an observation. With guidance, students will outline and conduct an experiment to test the hypothesis. Following the experiment, student groups will record their data in a lab report. Students will answer questions requiring data analyses using basic statistics, graph construction, critiquing of experimental procedures, and discussion of application. See Appendix for examples of anatomy and physiology activities

Materials
Students will use organisms and organs for dissection. These include rats, a widely used biomedical research model, and sheep brains. Students will use anatomical models of torso mannequin, skeletons, and skeletal muscle arms and legs.

To gauge the effectiveness and accessibility of the redesigned curriculum, students will complete two surveys. Prior to the first lab, students will complete the attitudes and learning preference survey administered through SAALG. At the conclusion of the semester, students will complete an exit survey measuring attitudes and learning gains through SAALG. The objective is to publish the results from these studies, along with a detailed protocol of the lab design, in HAPs, the journal for The Human Anatomy and Physiology Society. Data from the semester will also be presented at regional and international HAPS meetings for 2021 or 2022.

References

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Appendix
The following are brief descriptions of selected laboratory activities.

Functional Anatomy Activities

Example 1: Groups label a selected list of muscles on dissected rats, supplemented with models and a virtual cadaver. Groups participate in a 10-minute identification and labelling recall exercise using the rat. Next, students review exercises the stimulate the pectoral muscles and muscles of the shoulder joint. Students then identify these muscles on the rat, demonstrating the origin and insertion of muscles stimulated by the exercises. Students will sever selected muscles and tendons to demonstrate how that impacts exercise and muscle performance.

Example 2: Groups dissect and label a selected list of brain structures on sheep brain, supplemented with models and a virtual cadaver. Groups participate in a 10-minute identification and labelling recall exercise. Next, students review a case study on head trauma. Based on signs and symptoms of the case study subject, students identify, on a sheep brain, potential areas underlying the signs and symptoms.

Physiology Experiments

Example 1: Following the skeletal muscle anatomy period, students observe that grip strength changes with wrist position. Students develop a hypothesis and conduct an experiment to test tension and force production of the forearm flexor muscles using a hand dynamometer. Students graph and analyze their data.

Example 2: Following the brain anatomy period, students review a series of unknown conditions caused by cranial nerve damage. Based on observations, students develop a hypothesis about which cranial nerves may be damaged. Students research and determine how to test suspected cranial nerves. Students conduct these tests on each other. Results of the test are recorded.