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INTRODUCTION

The dissection of preserved specimens has been an integral part of biological education. The benefits of dissection include reinforcing concepts through visualization outside of models and diagrams and developing skills ranging from manual dexterity to problem-solving skills (1). However, with all of the benefits that dissection encompasses, the main hurdle many instructors face is student engagement during the dissection process. First, formal lectures with dissection have been criticized as being ineffective and outdated, since they do not consider the students' different learning styles and backgrounds in the course (2). Students passively learn the information when using this method and often do not understand the relationship between basic science and what they observe while dissecting the specimen. The next hurdle is students' opinions of dissection. In almost every lab, some students are disgusted by the idea of dissecting. Part of this reaction can be attributed to students' ethical, religious, and cultural beliefs (3). Once students are disgusted by the idea of dissection, their interest becomes dampened, and engagement is diminished (4). Therefore, biology instructors must find more inclusive tools to engage students during dissections.

The Anatomy and Physiology I and II classes at Kingsborough Community College (KCC) are prerequisite or corequisite for students interested in pursuing allied health careers. Unfortunately, students taking basic science courses such as Anatomy and Physiology lose about one-third of their knowledge and often work harder in their respective programs to relearn and apply the content (5, 6). Yet, these basic courses are the foundations for science, technology, engineering, art, and mathematics jobs, and instructors should introduce interactive and cooperative practices into their classrooms (see the AAAS report, "Vision and Change: a Call to Action" [7]). Biology instructors have answered the call by incorporating active learning approaches, such as gamification (8–12), body painting (13), flashcards (5, 14), comics (15), and escape rooms (16), to improve students' understanding of Anatomy and Physiology. Flipping the class to include gamification can facilitate active learning and teamwork and improve decision-making in a course such as Anatomy and Physiology lab. Finally, the advantage of using games is that it gives students with diverse learning styles immediate feedback by discussing the rationale behind the correct answer (8). I developed a simple card game called Incision Precision to motivate and engage students with diverse learning styles in Anatomy and Physiology labs. This game can be used in courses with labs that include the dissection of the fetal pig, cat, cow eye, sheep brain, and heart.

PROCEDURE

Materials list

To play Incision Precision, instructors need a stopwatch or timer, card stock or printer paper, scissors or paper trimmer, a laminator, 4-in. by 6-in. thermal laminating pouches, and the cards found in the supplemental material (see Appendices S1 and S2). Cards were created based on structures that students had difficulty identifying during formal assessments. Specimen-specific anatomical and functional cards (structure and function cards) were made using three laboratory manuals (17–19) and organized based on the specimens commonly used in two-semester Anatomy and Physiology labs (Appendix S2). All the designated functional cards have a red star in the upper lefthand corner to distinguish them from the anatomical cards. Instructions on how to print and cut out the cards and a scorecard example can be found in Appendix S1. Depending on the course, instructors can add or remove cards from the deck based on their lesson plans.

Game design

Incision Precision is a basic game with goals that allow students to learn about common organ systems taught in Anatomy

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TABLE 1
Incision Precision rules

Game rules
Each student in the group must contribute to naming and identifying the organ. • If a group member who has previously answered a question knows the answer to the second card, that student cannot substitute for one of their group mates.
Group members whose turn has passed become the Clue Giver. • The job of the Clue Giver is to use phrases and directional indications to locate the organs. For example, if the answer for the card is "stomach," the Clue Giver can give clues such as "the first digestive organ in the abdominal cavity." Or, the Clue Giver can say "up" or "down," "right" or "left," and "hot" or "cold" to direct them toward the organ as the student (teammate) moves the probe to locate the organ. However, the Clue Giver cannot make a statement such as "sounds like ancreas" (pancreas) or rhymes with "alt in test again" (small intestines).
Students are not allowed to use abbreviations that represent the organ.

and Physiology. This game incorporates similar mechanics to those of Hasbro's Taboo and Operation. The game's objective is for each student to correctly name and identify the dissected structure indicated on each card. There are seven dissection topics or decks used to make Incision Precision. These include dissection cards for the general rat, cat skeletal muscle, sheep brain, cow eye, fetal pig digestive system, sheep heart, and sheep kidney. In addition, most decks will contain separate structure and function cards. Before playing Incision Precision, the instructor is responsible for demonstrating the appropriate methods of dissecting the specimen. After the demonstration, students will separate into groups. The groups are given time to dissect their specimen (each group is given one specimen) and locate the organs or structures on their specimens before distributing the cards. Once the groups have dissected the specimen, each group should be given a topic-based deck to practice and test their knowledge while dissecting their specimen. At this time, students should determine their role when playing the game, i.e., either the student who verbally names the structure or who identifies the structure that their group member named.

Game play

An instructor can opt to play this game by either acting as the moderator for individual groups (Instructor Lead) or by having groups compete against each other (Tournament). The time permitted for each lab will determine which gameplay can be used.

(i) Instructor Lead. The instructor acts as a moderator for the game and will test each group on their knowledge of the organ or organ system dissected during that lab. An example of an instructor-led game that uses the fetal pig's digestive system deck will be used to explain the game's mechanics. The fetal pig's digestive system deck contains 36 cards describing an organ's unique anatomy or function. The class should be divided into groups for more effective gameplay, with 3 to 4 students per group. This configuration ensures that all group members participate. KCC's Anatomy and Physiology classes consist of a maximum of 24 students; therefore, there are usually six groups dissecting and playing the game. The instructor will collect the cards after each group has reviewed the information. The instructor will then act as the moderator, shuffle a deck of cards, and fan out the cards with the printed side facing the instructor. Next, a group member will draw two cards from the deck and place them face down. Once the cards are selected, the instructor will read the description on each card and give the group 2 to 4 min to name and identify the organ associated with the description. For example, if a group has four students, two are responsible for naming the organ based on one of the two cards chosen. At the same time, the remaining two are responsible for identifying the organ. Allowing each pair of students in a group a card to name and identify a card ensures that every student participates. For example, if a group has three students (on rare occasions, two students), then a student can answer twice.

(ii) Tournament. Instructors can increase the group size or keep the groups size similar to what was described in the "Instructor Lead" game. Using roles established at the beginning of the game, groups will compete against each other until one group is left. The order in which the groups compete can be done randomly or based on the groups' location in the lab. It is recommended that the groups use their dissected specimen because of familiarity, but they can rotate on a specimen that the professor has previously dissected. Similar to what was described in the "Instructor Lead" game, competing groups will pick 2 cards each for a total of 4 cards. The instructor will read the description of each card and give the groups 2 to 4 min to correctly name and identify the organ associated with the description. The first group to correctly name and identify the organ will receive the points. This is repeated until all four cards are read. Play continues until one group is left.

A summary of rules and scoring can be found in Tables 1 and 2. In addition, instructors have the option to modify and add rules based on their classroom needs.

Card modifications

The Incision Precision cards (Appendix S2) were made based on common specimens (fetal pig and cat) used for dissection in an undergraduate anatomy and physiology lab. The four decks correspond to organs (brain, eye, heart, and kidney). Other than the size and development of certain senses, these decks require little to no modification. Modifying the three remaining whole

TABLE 2
Incision Precision scoring

Scoring: gaining and losing points
For points to count, group members must agree and each answer must be correct.
Instructor Lead game • Points are lost by answering incorrectly, running out of time, or passing on a card.
Tournament game • A group gains points if the opposing group fails to answer correctly, runs out of time, or passes on a card. • In a tie game, a card is chosen randomly, and both groups are given 3 min to discuss the organ they must name and identify. The group that knows the answer must raise their hand and correctly name and identify the organ to win the game.

organism decks requires various modifications, with the fetal pig digestive system deck requiring little to no modification if you want to play the game using other mammalian specimens. Cards were given a CC By-NC-SA 4.0 license to allow for any additional changes or adaptions to the cards.

Safety issues

There are no safety issues raised by this learning tool.

CONCLUSION

Lab activities are designed to engage students and reinforce and apply concepts presented in the lecture. Unfortunately, in the case of dissections labs, there are some students with negative inclinations about specimen dissections, and they often shy away from the activity. Or, after the dissections, students are left wondering about the next steps after finding the organs. The Incision Precision game was designed to engage students beyond dissecting a specimen by using cards related to various anatomical and physiological characteristics of the structures they view. Although not formally assessed, I have observed a high degree of engagement while students play the game. Identifying students with negative inclinations about dissections is beneficial so that you can pair them with individuals willing to dissect. Before playing the game, students test their group members on being able to identify the cards. Students uncomfortable with handling the specimens work on naming and guiding their fellow group members to identify the organ or structure on their group's specimen. Incision Precision is a unique, quick active learning activity that focuses on animal tissue dissection in a fun, engaging, and inclusive manner.

SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

SUPPLEMENTAL FILE 1, DOCX file, 0.04 MB.
SUPPLEMENTAL FILE 2, DOCX file, 1.4 MB.

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