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Sarcomere in the Classroom: Learning with Undergraduate Group Projects

In most major universities today, there are many classes that assign few, if any, group projects or engage in peer to peer interaction of any kind. The reasons for this may vary and sometimes they are as simple as a large class size prohibiting effective use. However, when class size and other factors permit, group projects can be valuable teaching tools both in and out of the classroom. Currently there is a trend toward classroom teamwork, which has been stimulated by students and prospective employers of college graduates (Colbeck et al., 2000). The benefits of a group project are numerous and the project itself can have great effects on the confidence of the participating members. In most situations where a group project is assigned there are a variety of reasons for participation. Some students will want to gain experience on the subject, while others will simply focus on just getting the best grade possible (Colbeck et al., 2000). In an introduction to skeletal muscle physiology class (Dodson, 2001), maxing out at a mere 16 students of mainly upper classmen, the perfect environment for a team project was presented, and as such, a voluntary venture was assigned.

Initial Undertaking

In reality, the subject of skeletal muscle physiology can be rather dry to some and fascinating to others. One of the most important components of skeletal muscle is the sarcomere and one must know which proteins are present where, how they interact with each other and other proteins, and what the combined effects of those interactions are. The prompt for this project consisted of two major components: creating a large scale graphical representation of a sarcomere with all identified proteins correctly drawn according to their molecular shape, as well as submitting a paper containing the location, structure, function, and regulation of each protein with a copy of all sources of information. All of the information to be used in the project was required to be collected from credible, peer-reviewed scientific-based papers or journal articles. Aside from these few requirements, students were given free rein with the optional project, and if the product was up to par, participants would be rewarded with extra credit. However, differing goals led to varying levels of motivation among team members. Without specific guidance from our instructor about how to share leadership and process management roles amongst ourselves, those with high motivation became leaders and those with low motivation had the temptation to become slackers (Colbeck et al., 2000). As such, it soon became obvious as to who were team players, and who would be the less productive members. Of course, the vast variety of tasks that needed to be done, such as collecting reading materials, drawing the sarcomere or z-disc, and combining everyone's written work into one collaborative paper, ensured that every member was given the opportunity to contribute. Under the guidance of our student volunteered team captain, we were able to efficiently determine our expected roles and the project began to gradually take form.

Approach to Researching

The benefits of working in a group eliminated the need to individually research and write about all fifty-two sarcomeric proteins. Instead, we were able to reduce the workload of each person by efficiently dividing the collected list of proteins into approximately three to four proteins per person, with the project leaders willingly taking on as many as six proteins. Researching each protein took a considerable amount of time and effort and having to sift through thousands of relevant and irrelevant articles was an arduous task. To complicate matters more, it was often necessary to combine the information from multiple sources for each protein since some did not cover the structure, function, regulation, and location on the sarcomere in a clear manner. As the stack of collected information began to reach the ceiling, some students were shocked to find out that this process of sifting and uniting had to be repeated up to five times. However, the most frustrating, and time consuming, component of the project was finding an accurate graphical depiction of each protein, as the majority of the proteins were in obscure locations in the z-disc of the sarcomere or were too simple to have an actual shape.

Researching each protein took a fair amount of time and proved to be a task worth putting extra effort into. Since a few team members were unable to make the out of class meetings to work on the sarcomere model, they instead focused on the research or writing portion of the assignment. Those who spent a considerable amount of time researching papers, reading journal articles and applying what we

discovered to our collective paper of protein definitions even implicated doing more complex research projects in the future. This implies that the project itself influenced students' perspectives on how to apply what was learned to what future internships, graduate programs, or careers may entail.

Approach to Team Component

When an instructor assigns group work there are those students that are quite happy to work in a group. Sometimes it's because they work better in a social group and see that the ability to bounce ideas off of other members working towards the same goal is beneficial. Then there are those individuals that dread group work because they have been exposed to conflicts of opinions, perspectives or backgrounds and motivations, as well as the fact that typically as the size of the team increases, the potential for slacking also increases (Colbeck et al., 2000). Group projects, especially those that incorporate an out of class component, can be difficult to initiate due to the fact that individual members have different class schedules and previously made social events that prevent a collaborative meeting time. Our group was not immune to this fact, and as a result, most members of the group could not meet to work on the sarcomere model outside of class until well into the second week, thus having to focus on researching their assigned proteins first. Of course, if people did not utilize this time to research and write out their definitions, other problems could potentially be created rather than resolved.

Consequently, our group definitely had mixed feelings about working together in a troupe of thirteen and apprehensions about the difficulties that could be faced while working with the majority of a class began to surface. However, these insecurities dissipated as we learned how to best approach individual learning with doing. Once members realized their role within the group and how to effectively work together for a common goal, the haphazardly put together collection of classmates became a productive team.

Rainbow of Proteins

To display our behemoth of a project, we purchased a large tri-fold poster board to create our model of the skeletal muscle sarcomere. The center of the board exhibited a large interpretation of the macro structure of the sarcomere and cytoskeleton, while the side panels sported 3D drawings of specifically selected proteins drawn by each student in our group. In addition, an extensive drawing of the z-disc of the sarcomere was added to display the proteins not visible on the macro structure. Most students contributed to the poster board by drawing their assigned proteins on the central sarcomere or junctional complexes located on the z-disc drawing. Of course for some, the word "drawing" had more power to cause emotional turmoil than the words "group project" or "pop quiz", as some members saw art as their downfall rather than strong point. In fact, thoughts of potentially screwing up a fantastic looking sarcomere drawing with their hideously drawn, permanently affixed proteins were downright overwhelming. On the other hand, there were a select few talented artists who had no anxiety over drawing. These students stepped up within their roles and were more than willing to assist the other group members who were unable to draw.

After the initial sarcomere skeleton was completed, permanent markers were used to color each section of the display, with each protein assigned to a different color. However complicated it may sound, this use of a color code made it possible to unify the macro structure with the additional 3-D and z-disc drawings organized around the panels of the tri-fold. Since fifty-two proteins were the focus of this project, our resulting masterpiece was the ultimate rainbow of proteins.

Conclusion

The comprehension of the three-dimensional visualization was the solution to making our expanded view of the sarcomere. The sheer number of junctional, myofibrillar, regulatory and structural proteins required us to utilize various methods of visualization, thus, enabling us to create a mostly accurate and complete model of the sarcomere. This physical model enhanced the learning experience by providing a visual compilation of the proteins we had researched that was far more detailed than the average "textbook" version and gave us tangible proof of our accomplishment. The project also had an additional benefit. Aside from learning more about each respective protein, the drawing itself was often referenced by some as a means to study the sarcomere prior to a test. Participation in this group project improved communication, conflict management, and problem solving skills even when we received

minimal guidance about how to work together (Colbeck et al., 2000) and were striving toward completion before a deadline.

At the beginning of the project, most people were motivated only by the promise of extra credit, but no matter their field of interest, whether it was veterinary medicine, zoology, animal management, or human medicine and therapy, the majority agreed in the end that expanding our knowledge on the skeletal muscle sarcomere would ultimately benefit all of us by providing a universal application of what we had learned in class to our future careers. This end revelation was possible as a result of the group project and is one of many important benefits of working as a group (Colbeck et al., 2000).

In reality, people became sick, papers were accidentally deleted, and no one wanted to take the poster board home, but with a few days designated as a cushion, the apocalypse was averted by the time the due date rolled around. As the impending date approached, people were stressed and hunting for the color coding key, but overall, when the project was completed and dumped on our professor's desk, everyone shared a sense of relief and an even greater sense of accomplishment.

Working together in a large group may have had its benefits and setbacks, but ultimately it became an excellent way for individuals to gain knowledge on their own without wasting class time. Each student fueled individual interest in the subject and simultaneously made the material more interesting. Students discovered that there were many ways to solve the same problem, while having to organize their work, learn time management, and collaborate effectively in order to complete the tasks on time. Group, or class, projects provide an excellent way for instructors to introduce hands-on learning to their students and encourage out of class collaboration, which helps students understand the subject at their own pace and in their own unique way.

References

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