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Discovering Teamwork

A Novel Cooperative Learning Activity To Encourage Group Interdependence

Maureen T. Knabb

Considerable evidence points to the positive academic as well as social implications of cooperative group learning in a variety of academic settings (Johnson et al. 1991; Cooper & Mueck 1990). The fundamental premise embedded in the cooperative classroom is that students will learn more in greater depth when they are actively involved and required to share information and help each other. Through cooperative learning, science educators can enhance critical thinking and problem solving skills (Moll & Allen 1982; Heller et al. 1992; Zohar et al. 1994). The team building, interpersonal and thinking skills gleaned from cooperative learning are recognized as important to future employers (Byrne 1997).

Several different types of cooperative learning methods have been summarized previously (Watson 1992). Common features of all types of methods include positive interdependence and individual accountability. These features are key to successful implementation of cooperative learning. Team members must work together to solve a problem, produce a product, or learn new information. During problem solving, positive interdependence can be achieved through group agreement on problem-solving strategies and solutions. Group members are assigned specific roles, such as motivator, time keeper or recorder, and these specific roles promote interdependence. To stress the importance of individual responsibility, students are called on randomly to present the results of their group work. (Johnson et al. 1991)

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The Cooperation Problem

In my introductory cell physiology course (60 students), I use cooperative group learning as part of an overall course objective to encourage students to think of themselves as scientists (Knabb 1997). The cooperative group learning problems are often more complex than the ones typically found on exams and may require data interpretation and analysis.

Sometimes difficulties arise during these problem-solving sessions. A competitive group member may dissociate from the group to work independently or a shy student may not participate in the discussion. Cooperative group assignments may still rely on the majority of work falling on a single student or the ''quicker'' students assisting the ''slower'' students when they are done. This ''hitchhiker'' problem is a concern of many instructors new to cooperative group learning and may prevent them from incorporating this instructional technique (Kerns 1996).

It is important, therefore, that educators structure group activities so that students work interdependently on a well-defined learning task. To this end I have designed and implemented a cooperative group learning technique called ''discovering teamwork''. This activity encourages higher level thinking through problem solving and promotes group interdependence and collective responsibility for learning.

How To Structure ''Discovering Teamwork''

For a discovering teamwork activity, a problem is designed that consists of a scenario in which the problem is introduced and then data are presented to help solve the problem. Students are provided with nearly identical scenarios that differ in subtle ways. Because the problems appear identical, students assume that they are working on the same problem.

For approximately 10 to 15 minutes, each group member reads and attempts to answer the question. It becomes apparent that no individual in the group has sufficient information to answer the problem. Ultimately, as group members compare their scenarios, critical differences emerge in the data section. This is the point where they discover that teamwork is required. No individual has sufficient information and all group members must share and synthesize their information to answer the problem.

An example of a discovering teamwork activity on snake venom is presented in Figures 1 and 2. This activity usually follows spring break and has been preceded by a lecture covering membrane biochemistry and methodology. Thus, the group activity is designed to apply the principles of the lecture to a problem. The differences between the two problems are illustrated in bold face type. Some of the differences are irrelevant and do not change the essence of the problem while other changes are crucial. For example, it does not matter who in the Chemistry Department performs the HPLC of the venom extract. However, it does matter which peak from the HPLC is analyzed and what biomolecule is released from the red blood cells. Students must read the entire problem to discover whether the protein component that they are testing causes hemolysis or not.

In this example, students discover that the venom is composed of two protein components. One component results in the release of amino acids from red bloods cells while the other component causes release of fatty acids. Only the second protein component that releases fatty acids from red cells causes hemolysis. Thus, the venom causes hemolysis by digesting membrane lipids rather than membrane proteins.

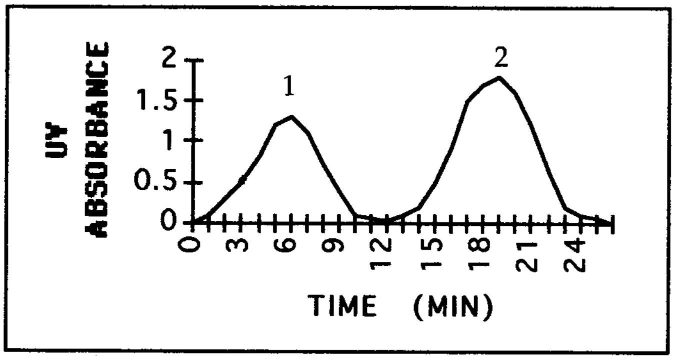
A typical group consists of three to four members and these activities are constructed so that each group member receives a slightly altered version of the problem. Groups that work cooperatively are quickest to notice the altered scenarios, whereas groups where members work independently and then come together are slowest to recognize the differences. There is no penalty for failing to finish the problem during the alloted class time but it is necessary for the groups to recognize that teamwork is required. Students are permitted to take the problem and work on it outside of class if necessary. Groups that successfully interpret the activity before the end of class may be asked to assist other groups. At the next class meeting, students are chosen randomly to explain their strategy for solving the problem.

The purpose of the activity is twofold. Students learn that the lecture information on membrane physiology has practical relevance but, more importantly, they learn that they need to work together to solve problems. This activity provides students with a challenging task that requires critical thinking and depends on a supportive group to complete the task. It also sets the stage for future group problem-solving activities that require input from all group members and synthesis of individual efforts to construct a group response.

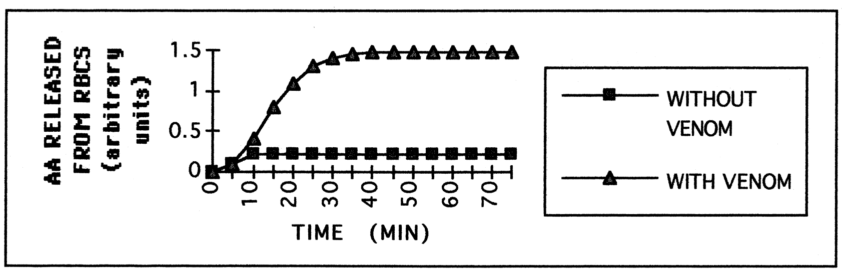
During spring break, a friend of yours had the opportunity to travel to the Amazon to collect plants for pharmacological use. While there, she was bitten by a venomous water snake and nearly died from extensive hemolysis. A true biologist, your friend captured the snake before she passed out and she has asked you to analyze the venom to discover the basis of its hemolytic activity.

When you return to the lab, you immediately collect some blood and start your experiments. You find that the venom causes rapid hemolysis of horse blood. If you boil the venom, however, the venom no longer causes hemolysis. This leads you to hypothesize that the active ingredient in the venom is a protein.

Dr. Cichowicz in the Chemistry Department helps you isolate the protein components of the venom using High Performance Liquid Chromatography (HPLC). The profile of the proteins eluted from the column looks like this:



You choose to investigate the activity of ***Peak 1***. In your experiment, you incubate red blood cells for various periods of time with the purified venom extract and analyze the chemical composition of the products released into the solution. You obtain the following results (AA = amino acids):



You also determine after extensive incubation with the purified venom from ***Peak 1*** that ***no hemolysis occurs***.

What is the composition of the venom? How does the venom cause hemolysis?

Figure 1. The Snake Venom Problem/Version 1.

Incentives for Group Learning

Researchers generally agree that structured incentives are an important component for successful cooperative group learning activities (Watson 1992). In my course, the group learning component accounts for 10% of the final grade involving a total of 8 to 10 group activities. Students receive a group score for an activity when it is completed and a group member must be present to get credit. This semester I assigned this problem as a take-home test question and all of the groups successfully answered the problem. My class seems to enjoy the challenge of this type of question and looks forward to future group activities that involve synthesizing different types of information.

Advantages & Disadvantages

As the group work facilitator, I constantly circulate among the learning groups. Compared to other types of cooperative learning activities, this one stimulates all students to participate and encourages cooperative behavior. One unexpected benefit of the venom problem is that it has resulted in further interest in poisonous plants and animals (poison dart frogs, for example).

Some students are very frustrated by their inability to solve the problem

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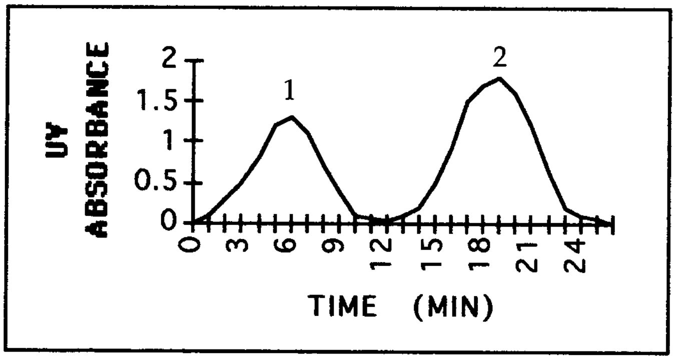
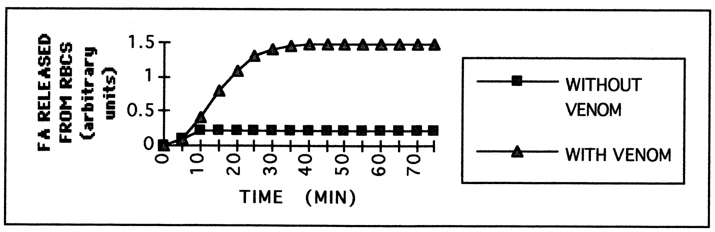


You choose to investigate the activity of ***Peak 2***. In your experiment, you incubate red blood cells for various periods of time with the purified venom extract and analyze the chemical composition of the products released into the solution. You obtain the following results (FA = fatty acids):



You also determine that after extensive incubation with the purified venom from ***Peak 2*** that **hemolysis occurs**.

What is the composition of the venom? How does the venom cause hemolysis?

Figure 2. The Snake Venom Problem/Version 2.

independently. They fail to recognize that they must work together. In general, it takes about 15 minutes for students to recognize the important differences in the problem and, if a group does not see it within 30 minutes, I will guide them toward that discovery. Subsequent group activities are met with careful screening of the problem so that new "discovering teamwork" activities are immediately recognized and students work together more quickly and successfully.

Conclusion

In summary, I have developed a new cooperative group learning strategy that encourages students to work together so that they learn the importance of sharing and synthesizing information. Since most of the students in my class are biology majors who will choose to enter the workforce after graduation, it is important for them to be comfortable with problem solving in a group. This technique represents one type of strategy that I use to develop the teamwork skills our graduates need.

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