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Making Science Teams WORK

by Roxanne Greitz Miller



As science teachers, we likely have more experience with students working together than teachers in any other subject area due to teaming students for hands-on activities. While the importance of teamwork is emphasized in the *National Science Education Standards*, getting teams to actually *work*—meaning getting students to share equally in the academic assignments and to interact in a positive and productive manner—often eludes even the best of teachers. It has been my experience as a middle level science teacher that effective teaming requires careful planning, clear communication with students and parents, relevant motivational strategies, and arranging your classroom and activities to facilitate teaming—all in the first week of school.

Planning: A little goes a long way

The idea of heterogeneous grouping, with academically stronger students teamed with weaker ones, is generally the goal for cooperative learning team composition (Slavin 1986). However, at the beginning of the school year, most science teachers do not have a good idea of which students to group together due to the lack of information regarding students' prior science preparation.

To create balanced groups, I assess students in two areas, process skills and attitudes toward science. I do not consider content knowledge to be as important when creating teams because I believe that a team of four students who know *what* the content is but have little idea of *how* to pursue an investigation will not be productive. I find process skills and attitude assessments are

better indicators to use when forming science teams.

To gauge my students' ability and interest in science, I administer two assessments during the first week of school. The first assessment consists of 20 questions from the Test of Integrated Process Skills (TIPS) published by the Educational Testing Service (ETS). (This test can be downloaded as a PDF file for \$25. Visit www.ets.org/testcoll/order.html for more information. You may also be able to obtain these tests free of charge from a data clearinghouse center such as SERVE [www.serve.com]. Or, consider sharing the costs and the tests with other teachers in your department.) I use this assessment because it targets all the process skills I address in the middle level curriculum, can be administered in one class period, requires only pencil and paper, and can be machine-graded. Sample questions are shown in Figure 1.

The second assessment I administer is the Attitude Towards Science (ATS) rating scale (see Figure 2), also available from ETS. Multiple studies have shown the importance of attitude and motivation in education (see literature reviews in Gabel 1994); science is no exception. In general, upon entering the classroom, students show an interest in science, but many have had less than optimal classroom experiences with science in elementary school and/or see little relevance of science to their everyday lives. It is important

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to know which students feel this way, particularly with respect to placement in their initial cooperative learning teams.

Communicating with students and parents

Once I score these assessments, I place my students into their teams, grouping heterogeneously for both process skills ability and attitude toward science. Student teams are composed of at least one student with a high level of process skills knowledge. Students with low levels of science interest/motivation are grouped with those with higher levels, and teams have relatively equal numbers of males and females. Ideally, the four-person group will consist of one high-, two middle-, and one low-level student. Likewise, I try to blend together students with different attitudes toward science.

I explain to the students that they will be working just as real scientists do, in a team environment. As scientists, they must respect and support one another at all times, and take responsibility for their individual work as well as their team's work. By stressing and discussing the concept of respect, rather than passing out a long list of "dos and don'ts" for groups, behavioral management is simplified. I reinforce the concept of respect by presenting students with behavior scenarios and asking them to identify types of behavior that are respectful and disrespectful.

It is also important for the students to establish a group identity and get to know each other before jumping into activities, and easier for me as a teacher to refer to a group by a team name rather than by a number or by a student's name. Therefore, we devote part of a class period to team building, having each team choose a name related to that academic quarter's science theme. Team names and records are posted on a bulletin board or wall that is easily accessible for the teacher and students so that they may check their team's status at any time.

I group the students' seating (desks or tables) so that teams can sit together as much as possible. This may be the first time many of the students share space with others on a continual basis and it requires clear communication with students about your expectations for behavior during both teacher-directed and hands-on instruction. Further, I send a letter to parents explaining cooperative teaming (Figure 3) and why I am using the approach in the classroom. I find that this letter helps establish parental support for both my teaching method and any disciplinary action required due to inappropriate behavior.

Motivational strategies

To motivate the students both individually and in their teams, I award Improvement Points (IPs), a technique I learned from the professional development program at the University of Alabama (Rainey, Miller 1997). I post

FIGURE 1

Selected sample questions from the Test of Integrated Process Skills

Students in science class placed ice cubes in a cup. They were studying variables that affect how long it takes the ice to melt.

Select the variable that would most likely *not* affect the time it takes the ice to melt.

- size of cup
- number of students
- size of the ice cube
- temperature of the room

Some chickens lay an egg almost every day. Other chickens produce few eggs. A study is planned to examine factors that might affect the number of eggs produced by chickens. Which of the following is *not* a suitable hypothesis for this study?

- More eggs are produced by chickens that receive more hours of light.
- The more eggs produced by chickens the more weight they will lose.
- The larger the cage for chickens the more eggs they will produce.
- The more protein there is in the feed the more eggs they will produce.

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a tally sheet in the classroom for each team that includes the name of the team as well as its members (Figure 4). Teams are awarded IPs for individual and team academic improvement

FIGURE 2

Sample questions from the Attitude Towards Science rating scale

Check in the boxes how much you agree or disagree with each of the following statements.	Agree	Slightly agree	Slightly disagree	Disagree
Science is a waste of time.				
I can hardly wait for the school day to be over.				
Science is interesting.				
I would like to receive a microscope or chemistry set as a gift.				
Science is a good hobby.				

FIGURE 3 Letter to the parents/guardians regarding teaming

Dear Parents and Guardians:

This year in science your child will be working in a cooperative learning team. You may be familiar with this idea from previous experience, but I want to let you know how we will be using teams in our class and encourage you to contact me if you have any questions.

The idea of cooperative learning is that students work together to learn and are responsible for each other's learning as well as their own. In my classroom, I hope to use this technique to increase both your child's academic achievement and motivation in school.

I will organize the classroom into equal teams and each team will compete to become the **Super Team** for each grading period. Each child will be responsible for his or her individual assignments and grades, but improvement over past grades will be rewarded in a system called *Improvement Points*. The team in each class with the most Improvement Points at the end of the grading period will become the **Super Team** and receive recognition and rewards. **Please do not confuse improvement points with your child's grades.** Improvement Points are calculated by comparing your child's previous grades to their current ones. Team members have an incentive to help one another and make sure everyone is improving all the time. Improvement Points are also given for exemplary behavior in class, both individual and group.

The basic idea behind the cooperative learning team is that when students learn in small, carefully structured learning groups and are rewarded for working toward a common goal, they help each other learn, gain self-esteem, and respect their classmates. Cooperative learning teams structured like ours share some key positive characteristics:

- The cooperation required among students prevents one student from doing most of the work for the others.
- In spite of the cooperative nature of the groups, each student must learn the material in order to improve his or her own score and the team score.
- Even low achievers who may not contribute greatly can receive recognition since scores are based on individual improvement, however small, over past performances.
- Students are motivated to cooperate since they receive not just a grade on a piece of paper, but public recognition from the teacher and class.
- Use of higher reasoning skills occurs as students discuss the subject matter with each other.

If you have any questions about cooperative learning in our science class or other features of the curriculum, please do not hesitate to contact me at [phone] or [email address].

Sincerely,
[Teacher's Name]

and outstanding behavior. For example, a team that had every member turn in their homework on a given day might receive two IPs; teams in their seats with their notebooks open, quiet, and ready to begin class when the bell rings may receive two IPs; a student who takes an extra set of notes for a teammate who is absent without being directed to do so may receive five IPs; or a student whose test grade improved from a B to an A would receive ten IPs. Consistent excellence can also earn a student points. Note: IPs are never taken away for any reason; this is purely a positive reinforcement system. Improvement Points are unrelated to academic grades. However, the team with the most IPs at the end of the quarter is named the Super Team, which entitles them to rewards ranging from small gift certificates donated by parents and local businesses to a special

four-course gourmet lunch with me and the principal (prepared by yours truly, but I'm sure students would be happy with fast food if cooking isn't your forte).

Arranging your classroom and activities

As previously mentioned, I arrange my class so that teams (generally composed of four students) can sit together at all times except when taking a test. By doing so, transition time spent having students rearrange themselves between teacher-directed and hands-on activities is eliminated.

In addition, I find that the best way to organize hands-on activities is to purchase inexpensive, stackable, plastic bins for each team's workstation. (With teams of four, I typically need seven to nine bins per class period). The same bins can

FIGURE 4 Team Improvement Points record

Team name: The Investigators										
Names	Individual Improvement Points									Total
Jennifer										
Romney										
Ellen										
Brian										
Team Improvement Points										
										Grand total points

be used for each class. Whenever we have a lab activity, I photocopy the instructions and materials list for each group (rather than individual copies) and staple it inside a manila folder, labeling the tab with the name of the activity. I am able to reuse these folders from year to year. (Tip: If the activities involve water, consider laminating the instructions/materials sheet.) Inside the bin, I place the folder, all reusable materials (cylinders, glassware, etc.), and a supply of consumables (including any worksheets needed). Between class periods I replenish the consumables. I award Improvement Points to assure that materials are well maintained. With this setup, I can spend more time observing student work and less time managing materials.

Troubleshooting groups

Lest you think that my students were angels, they were not. This approach does cut down on classroom management problems, but you will still need to address the occasional setback after adopting this approach. Teaming is not a replacement for a teacher's discipline plan, nor should students be expected to resolve all conflicts or redirect team members' wayward behavior entirely on their own.

After the first school quarter is over, I change the groups, allowing each member of the first quarter's Super Team to choose one student they had not been paired with previously to begin their team "roster." Then I assign the remaining two members to each team, thus assuring that teams would be as equally balanced as possible. While students don't always get placed with students they want to work with, everyone knows that the teams

last only one grading period and everyone is expected to be able to work together for at least that long. If repeated problems arise between team members, I meet with them to identify the source of the conflict, then work with the entire team to resolve it. Key symptoms of group dysfunction—besides obvious interpersonal conflicts—can include one or more group members not completing assignments, lack of attention or participation during lab activities, and sudden decreases in student achievement.

A closing story

One November day during my first year of implementing all of these strategies, I was unavoidably detained, making me quite late for the last period of the day (a.k.a., the period most teachers hate). As such, I was understandably frantic as I hurried toward my classroom. When I arrived, I found my entire class of 35 students halfway through the lab activity—without any teacher direction. They had been so quiet that the teacher on the other side of the rolling partition—mind you, not even a *solid wall*—didn't know I was gone. I asked the class what they were doing, and they said, "We saw the bins on the tables and knew what to do, so we just started." Students who wanted to misbehave had been reined in by their teammates, and students of all achievement levels were working together successfully. I was stunned and amazed. It was then that I realized these strategies, when carefully planned and executed *together*, are extremely powerful tools for enabling all students to learn and achieve in science. (One student did confess later that he thought my tardiness was a part of a larger experiment that I must have been performing on the whole class to see how they would react, but at least he was using his inquiry skills!) ■

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