Many studies show students benefit from working cooperatively. Rarely published in STEM literature are guidelines to help educators effectively incorporate research teams in the classroom. We explain how to create a positive learning experience by explaining group dynamics, and by using group contracts and team-building activities. We also share templates for evaluating group projects.

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their own without instructions as to what they could expect from each other, what normal group behavior might resemble, or how to work through challenging group dynamics. Our approach was reactive rather than proactive. When students would come to us about problems with group members, sometimes our response would be little more than “work it out amongst yourselves.” Our subsequent professional development activities, however, showed us that this response is not effective in building student skills.

This article focuses on logistics instructors face when group members work together on a semester-long independent research project, such as in our team-taught animal behavior, conservation ecology, molecular techniques, and ornithology courses. All of these courses are upper-division electives taken by junior and senior science majors, and all have weekly laboratories. We use laboratory periods for teaching students techniques and for independent student research projects. We devote from one quarter to three quarters of the laboratory periods, depending on the course, to student projects. Students are expected to work on their projects outside of regularly scheduled class time. Final projects result in poster presentations.

Group formation

There are three common ways of determining group composition: random, student-directed, and faculty-directed. We have used random and student-directed group determination, but have not tried the faculty-directed method. We sometimes randomly assign students to groups because it reflects real-life situations; you do not often get to pick whom you work with on committees or assignments. Ways we have ensured randomness include having students draw playing cards or numbers out of a hat.

Random group formation also avoids the perception that faculty members treat students unequally. Although students often express apprehension about this form of group determination, these groups often work out very well; we have had students who first met working on a lab project in our class become inseparable friends for the rest of their college career.

Occasionally we allow students to self-select group members. Most students seem to prefer this method, saying that they know whom they can or cannot work with, that they may have similar course schedules, and that they know how seriously they are taking the assignment. One drawback we have witnessed is that these groups are more likely to support a “free rider,” a friend let off the hook without contributing to the group (Michaelsen, Knight, and Fink 2002). Another drawback we have seen is that students who do not know anyone in the classroom can feel left out.

It is useful for group formation to occur within the first two laboratory periods of the semester. This allows the group to begin functioning as a team during our team-building activities and to work together on all aspects of the independent project: creating a group contract, forming hypotheses, reviewing relevant literature, collecting data, and analyzing and presenting the results.

Conflict anticipation—explaining group dynamics

Groups need to know from the beginning that there are phases of group performance. We sometimes refer to them as forming, norming, storming, and performing. On the day we determine group composition, we talk with students about what happens in each stage. In the forming stage, group members get to know each other and a group contract is agreed upon. Students begin to work together on all aspects of the independent project: creating a group contract, forming hypotheses, reviewing relevant literature, collecting data, and analyzing and presenting the results.
to share information about themselves and what they expect from the project. The norming phase occurs when group members strive to meet each other’s expectations. Even if group members work independently of each other during this stage, trust begins to build as each group member completes tasks on time and at the standard the group expects. The storming phase occurs when one or more of the members do not live up to the contract. Nearly every group experiences this phase and it is critical that students understand that this is normal. The intensity and duration varies from group to group and project to project. Events that trigger a storming phase usually involves the failure of a group member to meet a given deadline or when a group member hands in something that is at a lower standard than other group members’ work (Michaelsen, Knight, and Fink 2002). Other times, one group member can alienate others by taking on too much responsibility or by redefining the project. We have seen the storming phase occur immediately prior to important deadlines, or as a result of outside pressures. The last group phase, performing, occurs when the group works past the conflict and the group’s performance becomes much stronger as a result of overcoming their difficulties.

**Conflict anticipation—group contracts**

We conduct a team-building activity before we talk about the group’s contract. In creating a contract, we ask students to list all the tasks they think will be associated with carrying out an independent research project. Each group creates a contract that addresses the tasks, how important (on a scale of 1–10) each task is, and what deadline should be set for each task. As the group lists the tasks, group members choose which tasks they will handle. For example, if two of the three group members have a paper due the week of the poster presentation, the third member is responsible for making sure the poster is proofread and printed. Another issue included in the contract is how group members hold each other accountable. What happens if the person who said they would write the introduction fails to meet the deadline? By establishing ground rules before anyone drops the ball, students become aware of the consequences and realize that all group members will be treated consistently. The group contract also decides how conflicts are managed. Would all group members be part of the conversation? Would the conversation be face to face? Having team members think through how they will handle conflict before it occurs is a powerful way for groups to learn about conflict resolution.

**Conflict anticipation—team-building activities**

In each laboratory period, we pit teams against each other using some simple activities that take less than 15 minutes to complete. We do these activities to build team spirit; we use a variety of activities to capitalize on multiple intelligences and to help groups work through problems (Manner 2001). If we know groups are experiencing conflict in their project, we choose an activity that will help diffuse conflict among team members (usually something silly). If we notice that a specific group member has taken on a more aggressive role in their group, we choose an activity that evens out individual contributions to the team score. If we see that one student is being excluded from group conversations, we choose an activity that gives individual members different information. The communication and coordination of all that information is critical to the successful completion of the task. Teams play Pictionary and complete mind puzzles. We give math problems and have students compete physically, throwing tennis balls into targets at varying points in the landscape. We play a version of the newlywed game, asking questions like, “How many pets will your partner say she has?” We also have a funniest joke contest.

**APPENDIX B. STUDENT EVALUATION OF POSTERS**

We ask for your thoughtful consideration of your classmates’ work. Doing a careful job on this is part of your responsibility (and counts towards your grade). Please go back and rate all posters except your own as outlined below.

Each poster should be ranked from 1 (the best of the bunch) to 5 (the weakest) in each category. There are no ties allowed—you must rank all the posters.

**Content**

- Did the project address an interesting question?
- Were the data gathered in a way that answered the question convincingly?

**Analysis/depth**

- Were the data analyzed in a way that made the results clear?
- Did the presenters do appropriate statistical analyses and present the results clearly?
- Were the introduction and discussion well thought out, logical, and supported by evidence from published sources?

**Style**

- Were the results presented clearly?
- Were the conclusions clear?
- Was the poster easy to read and understand?
- Was the poster visually appealing?
- Were you drawn into the story?

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(blank boxes supplied for each poster to be ranked)
Grading responsibility—incorporating student input in project grading

We determine the majority of the grade for student projects, but we incorporate peer evaluations, both as a check on our own perceptions and as an exercise in critical reading for students. The part of the grade determined by us is based on traditional criteria that address the quality of the research and the quality of the presentations (Appendix A). Because unexpected hurdles can derail a seemingly excellent research plan, and a semester-long project often does not allow time for redesign of failed experiments, we consider both the quality of data gathered and the good faith effort expended when we evaluate the project. We also incorporate peer input into the grade for each project. Each student is responsible for evaluating the other groups’ presentations. We require that students rank the posters on several criteria and that they include comments to justify their perceptions (Appendix B). As instructors, we use student input to focus our attention on features of the project we might have overlooked in our own evaluation.

Grading individual students—incorporating partner evaluations

Students are responsible for grading both their own performance and the performance of each of their group members. We explicitly tell students that their evaluations of themselves and members. We explicitly tell students performance of each of their group members. We want it to be enough so that students are concerned with doing well, but not so much that the focus is on the group dynamics, rather than on the project itself. The end result is that the group’s project is evaluated as the primary determinant of each member’s grade, but we reserve the right to adjust any group member’s grade up or down by up to 10% based on the input from peers. In practice we rarely apply adjustments that large, but having this spelled out in advance leaves students knowing that even if they encounter difficult group dynamics, each person’s contribution is evaluated fairly.

We do not have any formal assessment of whether our inclusion of group contracts, team-building activities, and clarification of grade determination have improved learning in our classes. We do have student comments on annual evaluations and some anecdotal evidence that it has paid off. Before we began incorporating these activities, half to three-quarters of student comments about group work were negative; after our changes, three-quarters of student comments were positive. Students have remarked that our courses have been the best they have taken and that they really liked working in a group. One student said she no longer worried about fighting group members, as she realized it was normal and that they had a contract to help them through it. We no longer have students complain that they did not know how much their grade depended on other group members’ perceptions or that they did not get along with other members of their team so the course “really sucked.” Lastly, colleagues have commented that group projects seem to go much more smoothly for us than for them.

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References