

# In-Class Problem Sets

**Educator:** Jeff McCauley, Faculty, Engineering

**Context:** In-class; Mechanics of Materials

**Keywords:** teams, class reflection, problem solving

**Student Activity Time:** 50 minutes class period

*Students engage in team problem solving in a mechanics of materials course.*

## Introducing the Reflection Activity

Focusing on solving problems in mechanics of materials can be difficult when students' only opportunity to do so is outside of class, and often alone. In a sophomore level mechanics of materials class, regular class meetings focus on problem solving. Similar to a flipped classroom approach, the instructor assigns reading ahead of class and prompts students to complete example problems in the text. Upon arrival in class, a very brief review of the concept and relevant theory is provided by the instructor. From there, the students are divided into groups of 3 or 4 to complete an assigned problem. For the majority of the class time, students are at the white board, working problems and presenting their solutions to each other.

Through the process, the instructor coaches students to consider the reading assignment, example problems, and their past experience in engineering work teams. Students are reminded of the heuristic to solve mechanics of materials and other engineering problems. Throughout the class session students are asked to reflect on the things they are having trouble with, how they are contributing to their team, and to begin considering what steps they can take to achieve ideal performance in the class. Students not only improve their knowledge of the class material, but also begin enacting professional engineering practice.

## Recreating the Reflection Activity

Description	
1	Assign textbook reading for homework.
2	Provide a brief (<10 minute) introduction to the topic in class.
3	Separate students into groups of 3-5 and assign problems. Give students approximately 20 minutes to solve the problem as a group.
4	Give each group approximately 5 minutes to present their solution to the class.
5	Facilitate a class dialogue about each problem.
6	Have students complete or correct problems as needed.
7	Assign textbook reading for homework.

### **In the words of the Educator: Tips and Inspiration**

*Use this to implicitly teach teaming.* It helps to ask the students some team oriented questions while they are solving the problems at the board. Simple questions like, do you know each other, and have you been in class together? I found it's important to read the group; if three of them are interacting and one is the outlier you have to step in. For many of these students, they have been in other prerequisites together, so it can be easy to take for granted that they know each other and have done group work before since we use this approach in all of our engineering classes. We want them to know it's fine to work together and we think it's an important part of their education at Green River.

*Ask the right questions.* We really want the students to learn how to format their questions so that they really learn the problem solving process – that way, they can solve any problem. I always tell them, “Format is the method you use so that you can walk into a dark tunnel. You don't know where the light at the other end is, but you know how to take one step after another.” What do I know? What do I want to know? How do they relate? If you lay out all the information that you have and need, it becomes really simple.

*What was the inspiration for the reflection activity?* I was teaching people how to work in teams when I first came, and in the first year I thought I had to be the “sage on the stage,” solve all the problems, answer any questions, and give students assignments. My colleague Bob Christiansen said, “The key is not to tell them the answer, it's to get them to tell you the answer.” In my second year, I started to try to talk the answers out of the students, but it still wasn't working. I realized I needed to change my classrooms so I went to facilities and asked to change my classroom to wall to wall whiteboards. I started out giving them one difficult problem at least one day a week to solve as a group for the next class session. I would have them present the problem and I would go over my solution after they presented. Along the way, I realized students were not reading the book, and in order to solve the problems in class I would direct them to the sample problems in the book, the text itself, and then invite students to office hours. This helped students realize that even in engineering classes they need to read the textbook. Now, two or three days a week in class are just about solving problems, because students have read the book. I just give them a quick introduction at the beginning of class, explain how the theory works, make sure their questions are answered and send them to the whiteboard to apply it.