After attending this session, you should be able to:

1. Employ strategies to make a good first impression and develop authority.
2. Concisely describe the purpose of discussion and its value.
3. Plan a discussion section with start, body, and conclusion.

During this session, think about:

What helps students learn in discussion that is not provided in lecture?

What are the key elements to any discussion section?

What two active learning strategies can I use today? One to investigate further?

Action items:

☐ Refine 30-sec introduction – describe the value of coming to discussion.

☐ For your next discussion, write a detailed plan:
  ▪ Include at least 1 active learning strategy.

☐ Contact an Engineering Teaching Consultant (ETC) to discuss your discussion.

Plenary Resources: tiny.cc/plenary
Concurrent Resources: tiny.cc/concurrent
Workshops/Seminars: tiny.cc/seminars
Establishing and maintaining classroom authority

Make a strong first impression.
- Arrive early.
- Post important information on the board (class name, agenda, etc.).
- Begin (and end) on time.
- Show students that you are enthusiastic about the course content and teaching.

Establish and explain an email policy.
- How will e-mail be used? When will you respond as the GSI? 24 hrs to respond?
- Establishing policies prevents e-mails at midnight or the day before assignments and ensures that expectations are clear.

Clarify your expectations.
- Tell students what will be expected in terms of: attendance, grading, participation, assignments, late work.
- Announce important administrative information such as office hours, drop/add policies, and where to buy books/course packs.
- Allow time for student questions.

Establish your credibility.
- Share your qualifications with your students by discussing your research interests and teaching experience (in and out of the classroom).
- Focus on what you know, not gaps
- “As a PhD student in this department, I have always been interested in this topic and I look forward to working more closely with it along with you.”

Identify the value and importance
- Explain why your course is important.
- Describe why the subject matter is interesting to you and what you hope the students will gain from the course.

Establish participation ground rules.
- As a class, set ground rules for classroom interaction and discussion.
- Students will have ownership by helping establish ground rules.
- Refer to p. 54 in the GSI guidebook for some examples.

How will you introduce yourself and the course? Write a 3-5 sentence introduction.

What policies from the syllabus should you highlight?

---

1 Adapted from Nicole Stanton, “First Days of Teaching”, CRLT, University of Michigan, 2004.
## Planning your discussion section: Template

### Which elements are in your discussion?

<table>
<thead>
<tr>
<th>Course announcements</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Course logistics</td>
</tr>
<tr>
<td>□ Upcoming due dates</td>
</tr>
<tr>
<td>□ Office hours</td>
</tr>
<tr>
<td>□ Additional resources</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lecture or mini-lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Learning objectives</td>
</tr>
<tr>
<td>□ Introduction of new topic</td>
</tr>
<tr>
<td>□ Example Problem</td>
</tr>
<tr>
<td>□ Resources to study</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Homework/test debrief</td>
</tr>
<tr>
<td>□ Summary of class lecture</td>
</tr>
<tr>
<td>□ Earlier material</td>
</tr>
<tr>
<td>□ Time for questions</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Practice problem</td>
</tr>
<tr>
<td>□ Reflection</td>
</tr>
<tr>
<td>□ Active learning</td>
</tr>
<tr>
<td>▪ Clarification pauses</td>
</tr>
<tr>
<td>▪ Minute paper</td>
</tr>
<tr>
<td>▪ Think-pair-share</td>
</tr>
<tr>
<td>▪ Self-assessment</td>
</tr>
<tr>
<td>▪ Brainstorming</td>
</tr>
<tr>
<td>▪ Interactive lecture</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

### Draft a lesson plan with your elements.

- **Start/open**
- **Main body**
  - Part 1
  - Part 2
  - Part 3
- **Conclusion/wrap-up**

Template developed by Molly Kozminsky and Francisco Sotomayor, 2015
Planning your discussion section: Example from ChE

Since our last time:
- Items that needed follow-up
- Course announcements
- Homework/test debrief
- Any new questions
- Other?

Mini-lecture:
- Key learning objectives
- Short review of lecture
- Introduction of new topic
- Resources to study

Activities:
- Number and type of problems
- Draw figures

Ex Prob 1
Ex Prob 2

Active learning:
- What technique?
- How to incorporate?

AL1
AL2
AL3

Conclusion:
- Course updates
- Upcoming due dates
- Office hours or other resources

Problem 1: Problem 3:

Problem 2: Problem 4:
Planning your discussion section: Example from ChE²

Since our last time:
- Items that needed follow-up
- Course announcements
- Homework/test debrief
- Any new questions
- Other?
- Pass back homework
  a. Mean 4.5 St. dev. 0.5
  b. conductance = 1/resistance
- Give hint for HW2 prob4
  Draw out the figure together

Mini-lecture:
- Key learning objectives
- Short review of lecture
- Introduction of new topic
- Resources to study
  Learning objectives:
  - Defining coordinate system/direction of rate/flux
  - Derive resistance in spherical coordinates

Activities:
- Number and type of problems
- Draw figures
  Ex Prob 1
  Posted online previous night
  Students instructed to print, bring to class
  Ex Prob 2

Active learning:
- What technique?
- How to incorporate?
  Student draws schematics and answers on the board
  Think-pair-share:
  divide class in 6 groups, each group diff prob
  Minute paper to end class
  “What problem was most difficult? Why?”

Conclusion:
- Course updates
- Upcoming due dates
- Office hours or other resources
  Remember, HW due on Thursday
  Remember, midterm in 3 weeks
  Remember, office hours every Wed afternoon

Problem 1:
You designed a bathysphere with: 5’ diameter of 2” steel walls, 3” insulation, and 2” steel interior. A 7” window covers 10% of the surface area. Thermal conductivities are:
  steel – 10 btu/hr-ft-F;
  insulation 0.2 Btu/hr-ft-F;
  window 0.3 Btu/hr-ft-F.
  Heat transfer coefficient is 50 Btu/hr-ft²-F.
Q1: Draw a schematic
Q2: Calculate rate of heat supply

Problem 2:
A pipe has inner radius $r_1$, outer radius $r_2$, thermal conductivity $k$, and length $L$. Assume convection is occurring inside and outside of the pipe, with $h_i$ and $h_o$, respectively.
Q1: Write an equation for determining the overall heat transfer coefficient at the inner cylinder wall in terms of: $r_1$, $r_2$, $k$, $L$, $h_i$, and $h_o$

² Example provided by Elizabeth Stewart, 2012
Sample active learning techniques

- **Clarification pauses:** This simple technique fosters active listening. Throughout a lecture, pause to allow students time to think about the information. After waiting, ask if anyone needs to have anything clarified.

- **Minute paper:** Ask the students to take out a blank sheet of paper. Then, state the topic or question that you want students to address. For example, “Today we discussed conduction as a method of heat transfer, please list as many examples of conduction that you can think of in everyday life. You have one minute – go!”

- **Think-pair-share:** Have students work individually on a problem or reflect on a question. Students then compare their responses with a partner and synthesize a joint solution to share with the entire class.

- **Self-assessment:** Students receive a quiz (typically ungraded) or a checklist of ideas to determine their understanding of the subject. Concept inventories or similar tools may be useful at the beginning of the semester or at the beginning of a new unit to help students identify misconceptions.

- **Brainstorming:** Introduce a topic or problem and then ask for student input. Give students a minute to write down their ideas and then record them on the board. An example might be — Imagine that you want to design an operating system that takes advantage of what we know about motor programs and skill learning. What factors must you consider?

- **Interactive lecture:** Instructor breaks up the lecture at least once per class for an activity that lets all students work directly with the material. Students might interpret graphs, make calculations, or predict experimental outcomes.

Choose 2 techniques that you can easily incorporate into your class:

How will these techniques improve student learning? Your teaching?

---

3 Adapted from a handout by Chris O’Neal and Tershia Pinder-Grover, CRLT, University of Michigan.
# Teaching strategies inventory

For each statement, mark the statement that best represents your experience.

<table>
<thead>
<tr>
<th>Inclusive Teaching Strategies</th>
<th>YES</th>
<th>MAYBE</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to successful experts who are from groups who are underrepresented in the field</td>
<td></td>
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<tr>
<td>Establish guidelines for class participation and professionalism</td>
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<tr>
<td>Structure discussion participation to include all students or all volunteers (e.g. using a queue, using a round, rotating discussion leadership)</td>
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<tr>
<td>Seek multiple answers or perspectives to discussion questions</td>
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<tr>
<td>Talk with students about discussion dynamics (e.g. eliciting their suggestions for discussion guidelines, identifying patterns of participation, etc.)</td>
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<tr>
<td>Calling students by name during class interactions</td>
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<tr>
<td>Have a plan for dealing with difficult situations</td>
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<tr>
<td>Act as an ally for students when disrespectful comments are made</td>
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<tr>
<td>Ask students to discuss a question in pairs before the group discussion</td>
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<tr>
<td>Frame group assignments so that everyone has an explicit role</td>
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<tr>
<td>Form student teams balanced for student knowledge and background</td>
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<tr>
<td>Create student teams that do not isolate students who are underrepresented in your class or discipline</td>
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<tr>
<td>Monitor the student-to-student interaction in small groups</td>
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<tr>
<td>Ask students to reflect on what they have learned from their group members</td>
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<tr>
<td>Model how to critique ideas and statements rather than the people who made them</td>
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<tr>
<td>Stop or intervene in a discussion if comments become inappropriate</td>
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</tr>
<tr>
<td>Communicate your high expectations for all students</td>
<td></td>
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<tr>
<td>Communicate your belief that all students can succeed</td>
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<tr>
<td>Emphasize that achievement on tests and assignments reflects work, not intrinsic ability.</td>
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<tr>
<td>Remind all students that success can involve struggle. Normalize and discuss frustrations or challenges and ways to overcome them.</td>
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</tr>
<tr>
<td>Advertise &amp; recommend that students use support and resources</td>
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<td></td>
</tr>
<tr>
<td>Elicit feedback from students (including feedback on class climate)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide opportunities for students to get to know one another</td>
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</tbody>
</table>

*Adapted from the CRLT GSI Teaching Orientation*
Before the first day: Things to think about

Before the first day: Things to think about

Below you will find a list of some issues you will want to talk about with your professor or other GSIs so that you’ll share consistent standards and ensure that you have the resources to teach effectively. Many of these issues will also help you in developing a course syllabus (see sample syllabus in GSI Guidebook for more ideas).

Add/drop: What is the procedure for adding/dropping students?

Meetings: How often does the professor want to get together with all the GSIs?

Grading: What is the process like? What is your grading rubric? How will you communicate grading standards? Late work policy? Regrades? Extra credit?

Goals: What are the goals for discussion sections? Labs? Are you supplementing, facilitating, reviewing, teaching, moderating, or all of the above?

Feedback: How would the professor like GSIs to communicate students’ feedback on the lectures? Does the professor want to observe the GSI?

Classroom: Does it have enough seats and can you arrange them to suit the teaching method you’ll be using more often? If not, what can you do to improvise?

Resources: What other GSIs or professors have taught this course before and can give you information about student expectations, their level of knowledge and potential pitfalls of the course? Which administrative assistant in the department can help you?

Roster: Check out your roster online to get a sense of how full the class is, how many students are on the waitlist, etc.

Practice: A great deal of anxiety can be relieved by trying out your lesson in advance. Ask a friend to listen or simply talk in an empty room to work out the quirks.

Adapted from “Getting Started: Teaching Undergraduates” Matt Kasper and Paul Ching, 2003.
Strategies to initiate a discussion section

My first assumption is that an effective discussion, like most anything, depends upon good planning. The content goals for any given class period usually suggest employing different teaching strategies. We would like to be able to select from among many discussion possibilities with confidence. The purpose of this article is to expand the range of the options by describing very precisely several different ways of starting a discussion.

(1) Generating questions:
We have our own important questions to ask about a course material. And we should ask them. But students also have their questions and they can learn to formulate better ones. Being able to ask the right questions about a particular problem may be the first way of understanding the content more deeply.

A. Ask students to e-mail one or two questions about homework problems before class.
B. As students walk into the classroom ask them to write down one or two questions about the homework. Ask one student to read several questions for discussion.
C. Divide the class into pairs or small groups and charge each group to decide upon one salient question to put to the rest of the class.

(2) Breaking into smaller groups:
No matter the size of a class, sixty or one hundred and sixty, it can always be broken down into smaller groups of four, five, eight, fifteen, or whatever. The purpose, quite simply, is to enable more people to say something and to generate more ideas about a problem or topic. There are three crucial things to consider in helping small groups to work well.

First, the instructions should be utterly clear, simple, and task oriented. Ask one question with a clearly defined task – “solve problem X, raise hand when your group has finished.”

Second, vary the ways in which groups are formed. Pair off (“with someone you don’t know”) one day; count off by fives around the room another; form groups of “about eight” around clumps of students sitting near one another on a third day.

Third, vary the ways in which groups report out when reassembled. Variations include:

• Each group reports orally, with the teacher recording results on the board
• Space is provided for each group, when ready, to write their results on the blackboard
• Each group keeps notes on a handout
• No reporting out is necessary, or reactions are invited from several groups, but not necessarily from all of them

2 Adapted from Peter Frederick, “The Dreaded Discussion: Ten Ways to Start”
Examples of higher-order learning objectives

<table>
<thead>
<tr>
<th>Bloom’s Revised Taxonomy</th>
<th>Sample Learning Objectives for Heat and Mass Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apply</strong></td>
<td>Students will be able to:</td>
</tr>
<tr>
<td>1. <strong>Use</strong> their understanding of conduction, convection, and radiation to solve steady-state and transient problems in 1-D, 2-D, and 3-D.</td>
<td></td>
</tr>
<tr>
<td><strong>Analyze</strong></td>
<td>2. <strong>Formulate</strong> a simple model for predicting the temperature-time history of an object in a given context.</td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td>3. <strong>Recommend</strong> appropriate materials (including material type and dimensions) and <strong>justify</strong> that recommendation based on the knowledge of heat transfer.</td>
</tr>
<tr>
<td><strong>Create</strong></td>
<td>4. <strong>Design</strong> heat and mass transfer processes and equipment.</td>
</tr>
</tbody>
</table>

Sample verbs for Bloom’s Revised Taxonomy

<table>
<thead>
<tr>
<th>Remember</th>
<th>Understand</th>
<th>Apply</th>
<th>Analyze</th>
<th>Evaluate</th>
<th>Create</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrange</td>
<td>Associate</td>
<td>Calculate</td>
<td>Break down</td>
<td>Appraise</td>
<td>Assemble</td>
</tr>
<tr>
<td>Define</td>
<td>Classify</td>
<td>Construct</td>
<td>Combine</td>
<td>Argue</td>
<td>Build</td>
</tr>
<tr>
<td>Describe</td>
<td>Compare</td>
<td>Demonstrate</td>
<td>Compare</td>
<td>Assess</td>
<td>Compose</td>
</tr>
<tr>
<td>Duplicate</td>
<td>Contrast</td>
<td>Develop</td>
<td>Contrast</td>
<td>Check</td>
<td>Construct</td>
</tr>
<tr>
<td>Identify</td>
<td>Describe</td>
<td>Employ</td>
<td>Debate</td>
<td>Conclude</td>
<td>Design</td>
</tr>
<tr>
<td>Label</td>
<td>Differentiate</td>
<td>Estimate</td>
<td>Diagram</td>
<td>Critique</td>
<td>Formulate</td>
</tr>
<tr>
<td>List</td>
<td>Discuss</td>
<td>Examine</td>
<td>Examine</td>
<td>Detect</td>
<td>Generate</td>
</tr>
<tr>
<td>Locate</td>
<td>Exemplify</td>
<td>Execute</td>
<td>Experiment</td>
<td>Judge</td>
<td>Integrate</td>
</tr>
<tr>
<td>Name</td>
<td>Explain</td>
<td>Formulate</td>
<td>Extrapolate</td>
<td>Justify</td>
<td>Produce</td>
</tr>
<tr>
<td>Recall</td>
<td>Infer</td>
<td>Implement</td>
<td>Formulate</td>
<td>Monitor</td>
<td>Propose</td>
</tr>
<tr>
<td>Recite</td>
<td>Interpret</td>
<td>Modify</td>
<td>Illustrate</td>
<td>Rank</td>
<td>Rearrange</td>
</tr>
<tr>
<td>Recognize</td>
<td>Paraphrase</td>
<td>Sketch</td>
<td>Organize</td>
<td>Rate</td>
<td>Set up</td>
</tr>
<tr>
<td>Reproduce</td>
<td>Restate</td>
<td>Solve</td>
<td>Predict</td>
<td>Recommend</td>
<td>Transform</td>
</tr>
<tr>
<td>Select</td>
<td>Summarize</td>
<td>Use</td>
<td>Question</td>
<td>Select</td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>Translate</td>
<td></td>
<td>Test</td>
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<td></td>
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<td></td>
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<td>Weigh</td>
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</tbody>
</table>

Teaching for retention in science, engineering, and mathematics: A guide for graduate student instructors

The United States (and the American college-going population) is becoming increasingly diverse, but the diversity of science, engineering, and mathematics (STEM) students and graduates does not reflect the nation’s demographics. Further, although the overall number of bachelor’s degrees awarded annually in the U.S. has risen by nearly 50% over the last twenty years, (NSF, 2008), the proportion of university students achieving bachelor’s degrees in STEM fields has declined by almost 40% (NAS, 2007). We introduce research-based principles and associated teaching strategies that you can easily incorporate into your classroom teaching practice to supplement departmental and institutional retention efforts.

**Principle: Create a welcoming and supportive learning environment.**

Undergraduate students often report that classroom climate (how welcome they feel in class, how well supported they are by instructors, and instructor rapport with students) significantly influences their decisions to stay in or leave STEM disciplines (O’Neal, Wright, Cook, Perorazio, & Purkiss, 2007). In contrast, when students perceive instructors as disengaged, disrespectful, or uncommitted to student learning, it has a negative impact on their interest in taking STEM courses in the future. In your role as a GSI, you can actively create a learning environment that welcomes students from all backgrounds by incorporating the following teaching strategies:

- Assign challenging (not trivial) work at a challenging (not overwhelming) pace.
- Organize and strategically use teams.
- Advertise available support and resources to all students.
- Actively cultivate instructor-student rapport.
- Become aware of unconscious biases and subtle messages given to students.

**Principle: Bring real-world relevance into the classroom and highlight careers in STEM.**

For many students, interest in STEM may be influenced by how readily they make connections between course content and its relevance or usefulness in the “real world.” GSIs wishing to encourage student interest and persistence by bringing the real world into the classroom might consider the following strategies:

- Highlight connections between STEM learning and real-world applications.
- Introduce students to career opportunities related to STEM learning.

---

4 Adapted from M. Kendall Brown, C. Hershock, C. Finelli, & C. O’Neal, (2009).
5 To learn about all 4 principles visit: http://www.crlt.umich.edu/publinks/CRLT_no25.pdf
Strategies for effective lesson planning

A lesson plan is the instructor’s road map of what students need to learn and how it will be done effectively during the class time. Before you plan your lesson, you will first need to identify the learning objectives for the class meeting. Then, you can design appropriate learning activities and develop strategies to obtain feedback on student learning. A successful lesson plan addresses and integrates these three key components:

- Objectives for student learning (what do I want students to learn?)
- Teaching/learning activities (what activities will I use?)
- Strategies to check student understanding (how will I know students learned?)

Specifying concrete objectives for student learning will help you determine the kinds of teaching and learning activities you will use in class, while those activities will define how you will check whether the learning objectives have been accomplished.

1. Outline learning objectives
   - What is the topic of the lesson? What do I want students to learn?
   - What do I want them to understand and be able to do at the end of class?

2. Develop the introduction
   - How will I introduce the topic? What do students know? Potential misconceptions?

3. Plan the specific learning activities (the main body of the lesson)
   - What will I do to explain the topic? How can I engage students in the topic?
   - What are some relevant real-life examples, analogies, or situations to help students learn?

4. Plan to check for understanding
   - How will you know that students are learning?
   - What questions will I ask students to check for understanding?
   - What activities can students do to demonstrate understanding of learning objectives?

---

**Sample feedback form**

I find it particularly useful when:

To improve the class, I (the student) can:

My learning would be strengthened if:

I am still confused about/would like more clarification on:

Please check as many or as few of the following as appropriate:
__ I’d like more small group work.
__ I’d like more review of class concepts.
__ I’d like more in-class problem solving.

It would be useful in the second half of the term if we:

Other comments (on assignments you particularly like/disliked, office hours, the class as a whole):

Or you can contact the CRLT-Engin for a free and confidential Midterm Student Feedback (MSF) session at: http://crlte.engin.umich.edu/services/