Think-Pair-Share

One of the most popular and versatile strategies for implementing active learning. The instructor poses a question. Students are given time (30 seconds or one minute) to think of a response alone. Each student then pairs with another and both discuss their responses to the question. The instructor invites pairs to share their responses with the class as a whole. Groups may be formed formally or informally.

Advantages:

1. This is a great way to motivate students and promote higher-level thinking. Even though the activity is called think-"PAIR"-share, this is the term many instructors use for pairs and small groups (three or four students) alike.
2. Instructors find they can have a format change during lecture that only takes a small amount of class time. Preparation is generally easy and takes a short amount of time.
3. The personal interaction motivates students who might not generally be interested in the discipline.
4. You can ask different kinds and levels of questions.
5. It engages the entire class and allows quiet students to answer questions without having to stand out from their classmates.
6. This is great for problem-solving activities as the focus can easily shift to a given problem at hand.

Structured Controversy

Divide the class into groups of four. The instructor identifies a controversial topic in the field covered in the course and gathers material that gives information and background to support different views of the controversy. Students work with one partner, forming two pairs within the group of four. Each pair takes a different side of the issue. Pairs work outside of class or in class to prepare to advocate and defend their position. The groups of four meet, and each pair takes a turn stating and arguing its position while the other pair listens and takes notes without interrupting. Each pair must have a chance both to listen and take notes and to argue their position. Then all four talk together as a group to learn all sides of the issue. Next, each pair must reverse its position and argue the opposite position from the one it argued before. Lastly the group of four as a whole discusses and synthesizes all the positions to come up with a group report. There may be a class presentation in which each group presents its findings.

Advantages:

1. This is a great way to integrate higher-thinking skills and develops argumentative skills.
2. Arguing both sides encourages students to respect and view different perspectives.
Active Learning Strategies for STEM Discussion Sections

Paired Annotations
TA or students identify a number of significant articles on a topic. Each student individually outside of class writes a reflective commentary on one article. In class, students are randomly paired with another student who has written a commentary on the same article. The two partners read each other’s commentaries, comparing key points to their own commentary. Then the two students team-write a commentary based on a synthesis of both their papers.

Advantages:
1. This is a great way to incorporate active learning and thinking outside of the classroom, as it allows students to synthesize and organize ideas prior to the discussion.
2. Annotations allow students to help each other on other aspects of their writing (grammar, spelling, etc.).
3. Allows quiet students to answer questions without having to stand out from their classmates.

Roundtable
Students in small groups sit in a circle and respond in turn to a question or problem by stating their ideas aloud as they write them on paper. The conversation can go around the circle, each student in turn, more than once if desired. After the roundtable, students discuss and summarize the ideas generated and report back to the class.

Advantages:
1. The turn-based system ensures that each student in the group is able to participate.
2. Generally, students who have later turns can comment on multiple viewpoints or subjects that are brought up earlier in conversation.
3. The number of students per group can be made larger to accommodate large class sizes, or smaller to allow for more interaction (when each student has multiple turns).

Thinking-Aloud Paired Problem Solving
Students in pairs take turns thinking through the solution to a problem posed by the TA. The student who is not the problem solver takes notes, and then the two students switch roles so that each student gets a chance to be both solver and note taker. Then they can go into larger teams or back to the class as a whole and report back about the solutions and the process.

Advantages:
1. Students get to witness the flow of their thought process when looking at the notes.
2. Quieter students are less likely to be interrupted in discussion and can provide their thought process and answers in completion.
Reciprocal Peer Questioning

The TA or instructor assigns outside class reading on a topic. The TA asks students to generate a list of two or three thought-provoking questions of their own on the reading. (Note that asking productive questions can be a new skill for students to learn; you may want to give some attention to this.) Students bring the questions they have generated to class. Students do not need to be able to answer the questions they generate. Students then break into teams of three to four. Each student poses her questions to the team and the team discusses the reading using the student-generated questions as a guide. The questions of each student are discussed within the team. The team may then report back to the class on some key questions and the answers they came up with.

Advantages:

1. By teaching how to ask productive questions, the instructor trains the students to apply their knowledge to bring the most interesting answers out of the students. You may need to moderate the types of questions that are offered when starting this exercise.

2. This works well for large classes that do not meet as often and have more time in between discussion meetings.
Active Learning Strategies for STEM Discussion Sections

Handout Two: Bloom’s Taxonomy of Educational Objectives

Active learning draws upon the concept of experiential learning, which rests on the finding that better learning occurs when an individual produces information rather than having it delivered to them (Slamecka and Graf, 1978). Research has also shown that students remember more when they learn to handle information at the higher levels of Bloom’s Taxonomy because more reflection and elaboration is required of them (Huitt, 1992).

In 1956, Benjamin Bloom with collaborators Max Englehart, Edward Furst, Walter Hill, and David Krathwohl published a framework for categorizing educational goals. Bloom’s Taxonomy uses a multi-tiered scale to express the level of expertise required to achieve each measurable student outcome.

<table>
<thead>
<tr>
<th>Level of Expertise</th>
<th>Description</th>
<th>Question Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>• Observation and recall of information&lt;br&gt;• Knowledge of dates, events, places&lt;br&gt;• Knowledge of major ideas&lt;br&gt;• Mastery of subject matter</td>
<td>List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc. Examples: Define the balance of power. When did WW2 end?</td>
</tr>
<tr>
<td>Comprehension</td>
<td>• Understanding information&lt;br&gt;• Grasp meaning&lt;br&gt;• Translate knowledge into new context&lt;br&gt;• Interpret facts, compare, contrast&lt;br&gt;• Order, group, infer causes&lt;br&gt;• Predict consequences</td>
<td>Summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend Examples: Explain the process of mitosis / Give some examples of alliteration</td>
</tr>
<tr>
<td>Application</td>
<td>• Apply abstractions and general principles to specific concrete situations&lt;br&gt;• Use methods, concepts, theories in new situations&lt;br&gt;• Solve problems using required skills or knowledge</td>
<td>Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover Examples: How does the concept of price elasticity explain the cost of tomatoes?</td>
</tr>
</tbody>
</table>
### Active Learning Strategies for STEM Discussion Sections

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Separating a complex idea into its constituent parts, and understanding the relationship between them</td>
<td>• Use old ideas to create new ones&lt;br&gt;• Generalize from given facts&lt;br&gt;• Combine knowledge from several areas&lt;br&gt;• Predict, draw conclusions</td>
<td>• Compare and discriminate between ideas&lt;br&gt;• Assess value of theories, presentations&lt;br&gt;• Make choices based on reasoned argument&lt;br&gt;• Verify value of evidence&lt;br&gt;• Recognize subjectivity</td>
</tr>
<tr>
<td>• Recognition of hidden meanings&lt;br&gt;• Identification of components</td>
<td>• Combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite</td>
<td>• Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize</td>
</tr>
<tr>
<td>Examples: What factors affect the price of tomatoes/</td>
<td>Example: How would you design an experiment to know how shocks in the labor supply affect wage disparities?</td>
<td>Examples: To what extent does the proposed package of tax increases resolve the budget deficit? If the US ratified the Convention of the Rights of the Child, what would be the implications for public service provision in the US?</td>
</tr>
</tbody>
</table>

**Sources:**

- Center for Teaching, Vanderbilt University, [https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy](https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy)

For more information visit this page and the links provided there: [http://www.krummefamily.org/guides/bloom.html](http://www.krummefamily.org/guides/bloom.html)
Active Learning Strategies for STEM Discussion Sections

Handout Three: Designing Effective Discussion Questions

An instructor’s questions can stimulate an engaging and fruitful discussion or produce an effect not unlike deer caught in headlights! There is nothing worse than attending a discussion section where the instructor begins with something like: “So, what do you think of the readings for this week?” Not only will this produce confused silence as students wonder how to begin formulating an answer to such a general question, but it also shows a lack of preparation and attention to detail on the part of the instructor.

To the novice instructor, asking discussion questions may appear to be a task as natural as talking to a friend and one that does not require much preparation; but the experienced instructor is very well aware that asking questions that will challenge students to grapple with class material and inspire them to analyze, synthesize, interpret, and think critically requires very careful preparation.

It is therefore essential to establish goals that you want to achieve during a discussion section followed by writing down an outline of questions that will help you achieve these goals. When developing your questions, try to keep Bloom’s Taxonomy in mind to vary the types of questions you ask. However, bear in mind that preparing questions in advance does not mean that an instructor avoids being open to following a productive thread should one arise spontaneously.

When you meet students, try to:

- **Ask one question at a time.** Sometimes, in an effort to generate a response, instructors attempt to clarify a question by rephrasing it. But often the rephrasing constitutes an entirely new question. Keep your questions brief and clear. Long complex questions may lose the class.

- **Be comfortable with silence.** After you ask a question, wait silently for an answer. Don’t be afraid of silence, and be patient. Think of silence as the signal that you want thoughtful participation.

- **Encourage interaction between students.** Search for consensus on correct responses. If one student immediately gives a correct response, follow up by asking others what they think. “Do you agree, Veronica?” is a good way to get students involved in the discussion.

- **Encourage students to use text.** When students provide answers, ask them to locate where they found this information in the text, or how they came to that conclusion from what they read. This helps students get used to using text in arguments—something they’ll need for writing papers—and keeps them accountable and on task.
Below are some question types and examples (the majority taken from a French class) that should lead to thoughtful, sustained discussions:

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Questions beginning with “Why...” “How would you explain...” “What is the importance of...” “What is the meaning of...” “In what way does...?” Example: “What is the meaning of Madame X’s comment about Jacque’s activities the week before their encounter at the opera?”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare and Contrast</td>
<td>“Compare...” “Contrast...” “What is the difference between...” “What is the similarity between...” Example: “What is the difference between the mother and the father’s attitudes toward the daughter’s relationship with Philippe?”</td>
</tr>
<tr>
<td>Cause and Effect</td>
<td>“What are the causes/results of...” “What connection is there between...” Example: “What is the cause of Lea’s distress when she looks at herself in the mirror?”</td>
</tr>
<tr>
<td>Clarification</td>
<td>“What is meant by...” “Explain how...”</td>
</tr>
<tr>
<td>Example</td>
<td>“Can anyone give me an example of...”</td>
</tr>
</tbody>
</table>

Below are some question types you will want to avoid:

<table>
<thead>
<tr>
<th>Simple yes-no</th>
<th>“Is the aunt expressing a desire for Gigi to marry?” “Is Radon considered a pollutant?” Produces little discussion and encourages guessing. The latter would be better framed as an analysis question: “Why do you think she chooses to end the essay this way?” “Why is radon considered a pollutant?”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elliptical</td>
<td>“What about the aunt’s sexual history?” “Well, what do you think about Don Juan’s values?” Too vague, it is not clear what is being asked.</td>
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</tbody>
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### Active Learning Strategies for STEM Discussion Sections

<table>
<thead>
<tr>
<th>Leading</th>
<th>“Don’t we have an ethical and moral responsibility to inform parents that a convicted pedophile is moving into their neighborhood?” “Don’t we have a responsibility to help our allies when they face a war?” “Why can’t we use the chi-square test here?”</th>
<th>Conveys the expected answer. The latter would be better as the analytical question: “What arguments, pro and con, can we generate about informing parents that a convicted pedophile is moving into their neighborhood?”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guess What I’m Thinking</td>
<td>“What should Bob have done to improve his focus?”</td>
<td>Teacher has a specific answer in mind and “discussion” consists of trying to guess this.</td>
</tr>
<tr>
<td>Information Retrieval</td>
<td>“What metaphor does Milton use to describe Satan in liens 617-634?”</td>
<td>Does not ask for analysis or evaluation.</td>
</tr>
<tr>
<td>Too general</td>
<td>“Who wants to comment on the fall of the Berlin Wall?”</td>
<td>A broad question, likely to be met with silence. Instead, ask: “How did the reunification of Germany affect European economic conditions?”</td>
</tr>
<tr>
<td>Too dismissive of questions</td>
<td>“Do you understand?” “Do you have any questions about this?”</td>
<td>This question is likely to be met with silence. Instead, ask students to demonstrate their understanding, asking questions such as: “What are the considerations to keep in mind when using OLS regressions?”, or “What questions do you have?” The latter implies that you expect questions and are encouraging students to ask them.</td>
</tr>
</tbody>
</table>

Adapted from the following sources:
- **Fostering Effective Classroom Discussions** by Jennifer Barton, Paul Hailer, and David Rutkowski, English Department, Virginia Tech, available at: [http://www.mhhe.com/socscience/english/tc/discussion.htm](http://www.mhhe.com/socscience/english/tc/discussion.htm)
- **Designing Effective Discussion Questions** by the Center for Teaching and Learning, Stanford University, Stanford, CA, available at: [http://ctl.stanford.edu/handouts/PDF/Master_effective_questions.pdf](http://ctl.stanford.edu/handouts/PDF/Master_effective_questions.pdf)