Helping Students Learn through Questions:
Clickers and Peer Instruction

Stephanie Chasteen
Stephanie.Chasteen@Colorado.edu
http://blog.sciencegeekgirl.com

Jenny Knight
Jenny.Knight@Colorado.edu

Resources:

CU Clicker Resource page
(videos, instructor guide, question collections)
http://STEMclickers.colorado.edu

Framing project page
(slides and activities for creating student buy-in)
http://colorado.edu/sei/fac-resources/framing.html

What is Peer Instruction?

Peer Instruction is a flexible pedagogy that can be used with electronic voting systems ("clickers") or with low-tech voting options like colored cards, or holding up fingers.

Peer Instruction cycle:

1. Ask a question
2. Students vote on their own
3. Students discuss the reasoning with their peers
4. Students re-vote
5. Instructor holds a whole-class debrief discussion

Why use Peer Instruction?

Multiple studies show that Peer Instruction….

- Helps students mater difficult concepts
- Increase student engagement and participation
- Helps students feel accountable for their learning
- Changes classroom culture to be more collaborative
- Can increase student preparation for class

Peer instruction can be used at various points during instruction of a topic: before instruction (to set up an idea), during instruction (to explore and learn), and after instruction (to assess understanding) – see next page.

Question Cycle

Before Instruction

✎ **Motivate** students
- Why is it important to…?
- What might we want to…?
- What can go wrong?

✎ Help them **discover** information
- What do we have to take into account when we…?
- What needs to happen when…?
- Predict: Since X causes Y, what do you think will happen when…?

✎ Assess **prior knowledge** or **provoke** thinking/discussion
- What do you think about…?
- Would you/do you…?
- What do you think will happen if…?

During Instruction

✎ Test **knowledge** of facts
- What are the three types of…?
- Can you define…?

✎ Test **comprehension** of concepts
- Which statements support…?
- What examples can you think of?

✎ Test **applications** of concepts
- What would happen if…?
- Which of the following are X?

✎ Help them **analyze** what they are learning
- Based on the symptoms, what would you say is going on?
- What is the relationship between…?

✎ Test their ability to **evaluate**
- Which solution is more appropriate and why?
- Which of these is more important?

✎ Provoke them to **synthesize** their understanding.
- How would you test…?
- Propose a way to…

✎ Elicit a **misconception**
- Ask questions where a common student misconception will result in a particular response

✎ Exercise a **skill**
- How would you…?
- What is the next step in this problem?

After Instruction

✎ Have students **recap** what they have learned
- What steps did you go through to solve the problem?
- What are the most important things to remember?
- Exit poll: What did we learn today?

✎ Ask them to relate information to the **big picture**
- How does this lead into the next topic?

✎ Demonstrate **success** and **limits** of understanding
- Ask questions that students have built an understanding of during the class.
- Ask questions that go beyond what was done in class

[1] *Rosie Piller, Making Students Think: The Art of Questioning. Short papers published in: Computer Training & Support Conference, 1995; ISPI International Conferences, 1991 and 1996; ASTD National Conference on Technical & Skills Training, 1990. Related workshop description at http://www.educationexperts.net/mstworkshop.html.*

Writing Questions

- What kinds of questions should I ask?
- How do I write questions that meet the diverse needs of students in my class?

Best Practices:
- Find existing questions from other instructors or online question banks (some available at http://STEMclickers.colorado.edu and http://www.peerinstruction.net)
- Ask questions several times during lecture
- Ask challenging, meaningful questions that prompt discussion and emphasize reasoning
- Look for places in your lecture where you can ask, instead of telling.
- Where do students struggle? Ask questions on difficult, key ideas.
- Use a variety of question strategies (e.g., bringing out a misconception, predicting an outcome, reminding students what they already know) to keep it engaging.
- Ask a variety of questions – simpler ones to boost confidence and complex ones to facilitate learning.
- Consider two-tiered questions – one simple recall, and one more challenging one to build off of it.
- Show questions to colleagues to get feedback before class
- Use plausible distractors. Sources of good distractors are homework and exams, student questions in office hours, student responses to an open-ended version of the question, or documented misconceptions.
- Have a challenge question at the bottom for those who finish early

Question Types
1. Conceptual "one right answer" questions
2. Discussion "no one right answer" questions
3. Predict an outcome (e.g., of experiment)
4. Survey questions / personal opinion / past experiences
5. Embed reasoning in answers ("Slower, because gravity is acting against it." "Slower, because it loses energy to friction.")
6. Use images as answer choices

See more on writing questions, and example questions, at http://STEMclickers.colorado.edu

Facilitation Tips for Success

Facilitation Tip	Detail
#1 Use a cue that encourages students to do what you feel is most important, and encourage any helpers in the classroom (LAs, Tas) to do the same	For example: "As you answer this question…. -"make sure to consider why each answer is correct or incorrect" OR -"construct an argument with reasons and evidence for your choice" OR -"be ready to share the reasons for your answers with your neighbors and the rest of the class"
#2 Don't show the histogram to the class after the first vote, unless it is an equal split	Popular choices may sway the second vote. • A student who picked an unpopular choice may be reluctant to discuss it • Everyone will think the popular vote is correct
#3: Don't spend time going over things that students already know	You may not wish to discuss questions in great detail if 80% of the class (or more) gets it right. But do emphasize the reasoning behind the answers (why the wrong answer is wrong and why the right answer is right)
#4. Give students opportunity to discuss their reasons for answers whenever an incorrect answer, or two or more votes, are popular	Split-votes are golden opportunities, as students are motivated to resolve the conflict. And even when most of the students got the question wrong, they can still benefit from discussion. Without student-student discussion, much of the benefit of the technique is lost (and students may be unhappy).
#5: Encourage them to rely on each other's ideas: let them explain their reasons to the rest of the class rather than YOU telling them more information	During the wrap-up discussion, focus on hearing students' ideas, rather than only giving your own explanation. Ask multiple students to share their ideas. But make sure that the correct answer is clear by the end of discussion.

#6: Encourage participation, likely with grading credit… but not too much credit!	Credit for participation is one way to communicate the value you place on the experience of peer instruction. But too much credit, and students stress too much about getting the right answer. Consider the "whiff of credit," which has a few possible permutations.
	1. **Participation only** (no additional credit for correct answers):
	  • Pro: likely to generate the most honest discussion and exchange of ideas
	  • Con: students may not try as hard to achieve correct answer
	2. **Participation with additional credit for correct answer**
	  • Pro: students usually willing to work for a bonus
	  • Con: students may just try to get "right" answer without really thinking about the reasons
	Some ways to deal with credit:
	  • At the end of the semester, substitute the average clicker score for the worst homework score *if it is better.*
	  • Achieving 75% correct = full clicker credit (or some other scaling).

#7: Encourage participation in non-credit ways, too	Make it clear why you're using clickers, allow enough time for discussion, establish culture of respect, circulate class to model good reasoning and pick up student ideas to use during whole-class discussion, use questions that they really want to discuss, use the results to guide your instruction, use non-threatening wording ("Why might someone have answered 'C'?") and reward students who speak up (e.g., with candy or praise).