Peer Instruction

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Advanced Chemistry Teacher
Franklin High School
① Introduction to Peer Instruction
② Identifying Challenging Concepts
③ Sample Results
④ Claim/Evidence – This Works
⑤ Reference Material:
   Writing/Modifying Concept Questions

Agenda
Introduction to peer instruction
Peer Instruction is a research-based teaching method that leverages the power of social interaction to drive learning.
Mini-lecture/learning

- Video at home or in class
- Critical reading home or in class
- Traditional Lecture
• Focus on a single concept
• Can't be solved using equations
• Have good multiple-choice answers
• Are clearly worded
• Are of intermediate difficulty

Concept question (conceptest)
“Another cool thing about ConcepTests is that they turn the Peer Instruction classroom into what I like to call a higher-order thinking sandbox, where students can, in a low-stakes environment, build expert-level cognitive skills that are conduits to the Holy Grail of learning – knowledge transfer (the ability to apply prior knowledge to solve problems in or navigate new, unfamiliar contexts).” Julie Schell
These are designed to be **TOUGH** questions. Make sure you provide time for thinking!
There are a variety of response options!

- Fingers
- Cards
- “Clickers” or e-response
- Learning Catalytics
- Poll everywhere
- Online quiz programs
- Etc.
“Once about 80% of the students in the class have responded, the ratio of correct to incorrect responses answers rapidly approaches levels indicating random guessing by the students.”
Check or estimate % correct answers

Evaluation tool or quick check

< 30 %
Leave PI process and reteach

~30- to ~70%
Continue the process

>~70%
Quick explanation or small group reteach. Don’t do peer instruction.
• Ideally, have students link up with a person who has a DIFFERENT answer.
• Can assign groups
• Can mix up within groups of 4 – ideally designed as heterogeneous groups in terms of ability.

Turn to your neighbor
• GOAL is for each student to try to convince the other what they think is the correct answer.

• The same question is re-sent/used.
• Students then enter a consensus answer.
• Much like before – evaluate the responses.
• The amount of reteach will vary.
• KEY – spending the MOST time on the MOST confusing/confounding/perplexing concepts!

Explain/reteach
Sample Results
An endothermic process has a positive entropy value. Which of the following statements best describes the process?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>It is thermodynamically favorable over all temperature ranges.</td>
</tr>
<tr>
<td>B</td>
<td>It is never thermodynamically favorable.</td>
</tr>
<tr>
<td>C</td>
<td>It is thermodynamically favorable at low temperatures</td>
</tr>
<tr>
<td>D</td>
<td>It is thermodynamically favorable at high temperatures</td>
</tr>
</tbody>
</table>
An endothermic process has a positive entropy value. Which of the following statements best describes the process?

<table>
<thead>
<tr>
<th>Option</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A It is thermodynamically favorable over all temperature ranges.</td>
<td>2</td>
</tr>
<tr>
<td>B It is never thermodynamically favorable.</td>
<td>1</td>
</tr>
<tr>
<td>C It is thermodynamically favorable at low temperatures</td>
<td>2</td>
</tr>
<tr>
<td>D It is thermodynamically favorable at high temperatures</td>
<td>5</td>
</tr>
</tbody>
</table>

**IB Chemistry: Individual Responses**
An endothermic process has a positive entropy value. Which of the following statements best describes the process?

A. It is thermodynamically favorable over all temperature ranges.
B. It is never thermodynamically favorable.
C. It is thermodynamically favorable at low temperatures.
D. It is thermodynamically favorable at high temperatures.

Options:
- A: 2 votes
- B: 0 votes
- C: 1 vote
- D: 6 votes
When a real gas is compressed from low pressure to a high pressure, the temperature increases. Predict the signs of $\Delta H$ and $\Delta S$.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$\Delta H &lt; 0$ and $\Delta S &lt; 0$</td>
</tr>
<tr>
<td>B</td>
<td>$\Delta H &lt; 0$ and $\Delta S &gt; 0$</td>
</tr>
<tr>
<td>C</td>
<td>$\Delta H &gt; 0$ and $\Delta S &lt; 0$</td>
</tr>
<tr>
<td>D</td>
<td>$\Delta H &gt; 0$ and $\Delta S &gt; 0$</td>
</tr>
</tbody>
</table>
When a real gas is compressed from low pressure to a high pressure, its temperature increases. Predict the signs of \( \Delta H \) and \( \Delta S \).

- A \( \Delta H < 0 \) and \( \Delta S < 0 \) (4 points)
- B \( \Delta H < 0 \) and \( \Delta S > 0 \) (2 points)
- C \( \Delta H > 0 \) and \( \Delta S < 0 \) (4 points)
- D \( \Delta H > 0 \) and \( \Delta S > 0 \) (1 point)
When a real gas is compressed from low pressure to a high pressure, its temperature increases. Predict the signs of $\Delta H$ and $\Delta S$.

- A $\Delta H < 0$ and $\Delta S < 0$: 7
- B $\Delta H < 0$ and $\Delta S > 0$: 0
- C $\Delta H > 0$ and $\Delta S < 0$: 4
- D $\Delta H > 0$ and $\Delta S > 0$: 0

**AP Chemistry: Peer Responses**
Claim/Evidence
– This Works 😊
Show me the DATA!

IN GOD WE TRUST
ALL OTHERS MUST SHOW DATA
College physics - Calculus based physics. Typically has stronger students, at least stronger math/science

<table>
<thead>
<tr>
<th>YEAR</th>
<th>METHOD</th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Traditional</td>
<td>~70</td>
<td>78</td>
<td>8</td>
</tr>
<tr>
<td>1991</td>
<td>Peer Instruction</td>
<td>71</td>
<td>85</td>
<td>14</td>
</tr>
<tr>
<td>1994</td>
<td>Peer Instruction</td>
<td>70</td>
<td>88</td>
<td>18</td>
</tr>
<tr>
<td>1997</td>
<td>Peer Instruction</td>
<td>67</td>
<td>92</td>
<td>25</td>
</tr>
</tbody>
</table>
Algebra based physics
- Typically has students who are weaker math/science

<table>
<thead>
<tr>
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<th>METHOD</th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Peer Instruction</td>
<td>50</td>
<td>83</td>
<td>33</td>
</tr>
<tr>
<td>1999</td>
<td>Traditional</td>
<td>(48)</td>
<td>69</td>
<td>21</td>
</tr>
<tr>
<td>2000</td>
<td>Peer Instruction</td>
<td>47</td>
<td>80</td>
<td>33</td>
</tr>
</tbody>
</table>
Results of a unit test

Circle average of conceptual questions
Square is the average of quantitative questions
White is traditional
Black circle/square is PI
Humanities – Critical Thought Course

Critical Thinking course taught with PI and other methods

% improvement

13.90
7.90
7.20
6.70
17.37

Semester 1 2004 Argument mapping & traditional lecture
Semester 2 2004 Traditional lecture
Semester 1 2005 Traditional lecture
Semester 2 2005 Traditional lecture
Semester 1 2006 Peer Instruction

Critical Thinking, Monash University, 2006
High school math

Lecture vs. Flip vs. Peer Instruction Flip

<table>
<thead>
<tr>
<th>Course Proficiency Averages</th>
<th>Calculus</th>
<th>Pre-Calculus</th>
<th>Algebra 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>71.3</td>
<td>74.2</td>
<td>82.9</td>
</tr>
<tr>
<td>Trad. Flip</td>
<td>74.7</td>
<td>80.7</td>
<td></td>
</tr>
<tr>
<td>Peer Flip (4 sem.)</td>
<td>84.9</td>
<td>85.5</td>
<td>95.7</td>
</tr>
<tr>
<td>Peer (Fall 13)</td>
<td>89.0</td>
<td>86.6</td>
<td>98</td>
</tr>
</tbody>
</table>

https://sites.google.com/site/troyfaulknerprofessional/peer-instruction/does-peer-instruction-work
“ASIDE FROM STUDENT PERFORMANCE GAINS, WE WOULD BE REMISS NOT TO MENTION HOW MUCH MORE FUN IT IS TO TEACH WITH PI. WE GET TO SPEND MORE TIME ANSWERING IMPORTANT, DEEP QUESTIONS AND STUDENTS ARE ANIMATEDLY TRYING TO FIGURE OUT HOW THINGS WORK (RATHER THAN TEXTING, FACEBOOKING, ETC.)”
Survey, Certificate, and Downloads

To complete a brief survey about this webinar, and to generate your certificate of attendance, visit:


To Download Resources:

Reference Material for ConceptTests
Writing & modifying multiple choice questions
QUALITIES OF A GOOD STEM
Stem applies to many objectives

Which of the following is a true statement?
A. Flipped learning is an ancient technique.
B. Flipped learning was pioneered by two chemists.
C. Camtasia is a document camera

Stem directs the thought process

Which of the following statements best describes Flipped Learning?
Question involves simple memorization

How many steps are there in the Peer Instruction Process?
A. 4
B. 5
C. 6
D. 7

Stem leads to higher order, critical thinking

Shoot for analysis, synthesis, evaluation etc.

Which of the following is a plausible explanation for how Peer instruction improves learning?
### Avoid Interior Blanks

In addition to the nucleus, ______ are organelles that contain DNA.

A. Golgi bodies  
B. Mitochondria and chloroplasts  
C. Ribosomes

### Pose a question

In addition to the nucleus, which organelles contain DNA?

A. Golgi bodies  
B. Mitochondria and chloroplasts  
C. Ribosomes

---

**Stem posing question or completing statement**
Avoid “never”, “not”, “all true except” (i.e. negative questions)

<table>
<thead>
<tr>
<th>Confusing, give away information</th>
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</thead>
<tbody>
<tr>
<td>A nurse is assessing a client who has pneumonia. Which of these assessment findings indicates that the client does NOT need to be suctioned?</td>
</tr>
<tr>
<td>A. Diminished breath sounds.</td>
</tr>
<tr>
<td>B. Absence of adventitious breath sounds.</td>
</tr>
<tr>
<td>C. Inability to cough up sputum.</td>
</tr>
<tr>
<td>D. Wheezing following bronchodilator therapy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clearer – more focussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which of these assessment findings, if identified in a client who has pneumonia, indicates that the client needs suctioned?</td>
</tr>
<tr>
<td>A. Absence of adventitious breath sounds.</td>
</tr>
<tr>
<td>B. Respiratory rate of 18 breaths per minute.</td>
</tr>
<tr>
<td>C. Inability to cough up sputum.</td>
</tr>
<tr>
<td>D. Wheezing prior to bronchodilator therapy.</td>
</tr>
</tbody>
</table>
Are you testing a concept or a student’s reading ability?

Suppose you are a mathematics professor who wants to determine whether or not your teaching of a unit on probability has had a significant effect on your students. You decide to analyze their scores from a test they took before the instruction and their scores from another exam taken after the instruction. Which of the following t-tests is appropriate to use in this situation?

When analyzing your students’ pretest and posttest scores to determine if your teaching has had a significant effect, an appropriate statistic to use is the t-test for:
QUALITIES OF GOOD DISTRACTORS
The gas that was produced was collected over water. This involves an application of which of the following laws?

A. Dalton’s Law  
B. Charles’ Law  
C. Ideal Gas Law  
D. Denzel’s Law

Every organism is made of cells and every cell comes from another cell. This is the:

A. Relativity Theory  
B. Evolution Theory  
C. Heat Theory  
D. Cell Theory

Plausible choices for students who did not grasp concept
Which of the following best describes how the atmosphere around the earth is warmed?

A. warm air cannot escape, as in a greenhouse
B. molecules in the atmosphere are warmed by radiation from Earth and retain that heat.
C. fossil fuels release heat
D. plants absorb CO₂
Avoid “all” or “none” of the above

- “ALL OF THE ABOVE” – Partially assesses. Student needs to know two are true to get correct answer.

- “NONE OF THE ABOVE” – no indicator that the student knows the correct answer. Also does not provide helpful analysis of misconceptions provided by other distractors.
Which of the following is one of the ways that the membranes of winter wheat are able to remain fluid when it is extremely cold?

A. by increasing the percentage of cholesterol molecules in the membrane.
B. by decreasing the percentage of unsaturated phospholipids in the membrane
C. by decreasing the percentage of short-chain fatty acids in the phospholipids of the membrane.
D. by increasing the percentage of saturated phospholipids in the membrane.
Only one correct answer!
references

• http://blog.peerinstruction.net/author/peerinstruction/

  http://mazur.harvard.edu/publications.php?function=display&rowid=113


• *How We Teach Impacts Student Learning: Peer Instruction vs. Lecture in CSO*, Jaime Spaco et al. 
  http://www.peerinstruction4cs.org/
• Troy Faulkner,
https://sites.google.com/site/troyfaulknerprofessional/peer-instruction/does-peer-instruction-work

• *ConcepTest Response Times in Peer Instruction Classrooms.* Kelly Miller, Nathaniel Lasry, Brian Luko, Julie Schell, and Eric Mazur.
http://mazur.harvard.edu/publications.php?function=display&rowid=113