Reducing Misconceptions through Lecture Tutorials and ConcepTests

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Teaching Strategies 2:20-3:10
Why do we care about misconceptions?

[The frog] told the fish about the birds, who had wings, and two legs, and many, many colors.

From *Fish is Fish* by Leo Lionni
Why do we care about misconceptions?

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Why do we care about misconceptions?

“… in 15 years… it had never occurred to me that students believe that pebbles grow.”

(Kusnick, 2002)
Why do we care about misconceptions?

“The lava comes up through hotspots and it forms basalt when it cools…”
Why do we care about misconceptions?

“The lava comes up through hotspots and it forms basalt when it cools…

Upon further questioning…

… Basalt is made from sediments. Sediments form in the core, are brought to the surface by hotspots, then mold together to form the rock basalt.”

Kortz & Murray (2009)
What are misconceptions you’ve encountered with your students?
One-quarter of students show plate coming together at divergent boundaries
The 3 most common locations students circled to indicate where rock melts to become magma that feeds volcanism.

Clark et al. (2011)
How Many Plates Are Present?
How Many Plates Are Present?

Student Responses:

2  3  4  5  6
13% 51% 29% 2% 1%
Example Misconceptions about Rocks

- Igneous rocks are not the result of magma crystallizing
- Sedimentary rocks form at or directly beneath Earth’s surface
- Pieces purposely gather to form rocks
- Black rocks = igneous
For More Info: Misconceptions

• How People Learn: Brain, Mind, Experience, and School, NRC, 2000


• Clark S.K. et al. (2011) Alternative Conceptions of Plate Tectonics held by Non-Science Undergraduates. JGE, 59, p. 251–262.

Problem:

Students have misconceptions about basic geologic concepts, and lecture doesn’t do a good job changing them.
Solution:

Use research-informed, student-centered, interactive methods.

Such as…

Lecture Tutorials and ConcepTests
Lecture Tutorials

• Worksheet students complete in pairs after a short lecture
• Written to combat misconceptions and difficult topics
• Starts with basic questions and works towards more application-type questions
Using Lecture Tutorials

• Professor lectures for a short time
• *Optional:* Students are posed a conceptually challenging question on the lecture material
• The class breaks into teams of two/three and work through the Lecture Tutorial worksheet
• Professor “debriefs” the activity highlighting the common problems
• *Optional:* Students are posed a similar question as before
• Professor returns to lecture mode
Lecture Tutorial Example

• Form groups of 2 or 3.
• Complete the Lecture Tutorial titled “Movement at Convergent Boundaries”.
• *Ask questions and pretend you are a student…
Movement at Convergent Boundaries

On the map, which two letters will eventually meet?

a. A and B
b. B and C
c. A and C
d. none of them will eventually meet
Lecture Tutorial Research Results

• After completing the Lecture Tutorial, student scores increased 18% on multiple choice questions (from 58% to 76%)

• After an extended lecture (in lieu of Lecture Tutorial) student scores increased 5% on multiple choice questions

Kortz, Smay, and Murray, 2008
Lecture Tutorial Questionnaire
Results

• 99% (n=209) of students agreed:

“The worksheets helped with my understanding of the subject”

Kortz, Smay, and Murray, 2008
For More Info: Lecture Tutorials


ConcepTests
ConcepTests

- Conceptual multiple-choice questions
  - Focus on a single concept
  - Have good multiple-choice answers
  - Are clearly worded
  - Are of intermediate difficulty
  - Usually ask at the levels of comprehension, application, or analysis
  - Are not terminology-intensive
ConcepTests

• Ask a ConcepTest question
• Students think about it and vote – 30-70% should be correct
• Students pair up and discuss, if necessary
• Students vote again
• Can be used with personal response systems ("clickers")
ConcepTest Voting

- Show of hands
- Show of fingers
- Colored cards
- Personal response systems ("clickers")
Clickers

- i>clicker
- TurningPoint
Which diagram BEST shows the directions of plate motions?

A  

B  

C  

D
Which letter indicates a location where rock melts to become magma?
For More Info: ConcepTests

- http://serc.carleton.edu/introgeo/interactive/conctest.html
- http://serc.carleton.edu/introgeo/conceptests/index.html