

# STUDENT MISCONCEPTIONS: WHERE DO THEY COME FROM AND WHAT CAN WE DO?

Adapted from: Pyc, Agarwal, and Roediger (2014)

Students in different disciplines come to class with a number of misconceptions or inaccurate pieces of pre-existing knowledge. These may include concepts, interpretations, and beliefs about the surrounding world. In the natural sciences, misconceptions commonly result from personal experience and interactions with the physical world. In the social sciences, they are more likely derived from social sources, such as social interactions or media misinterpretation. Misconceptions matter because all new knowledge is interpreted, analyzed, and stored relative to existing knowledge. When the prior knowledge is inaccurate, then the new knowledge can be incompletely, inaccurately, or independently stored, resulting in an even larger inaccurate and disconnected knowledge base. Correct and inaccurate conceptions

can co-exist for years before the correct information comes to dominate.

Evidence suggests that misconceptions do not change if they are not directly, repeatedly, and actively addressed. Misconceptions are highly pervasive, and they can be particularly resistant to instruction. Studies have shown that simply communicating the authoritative view to students is not likely to change their misconceptions. Moreover, even when short-term change is accomplished, it is possible that gains may disappear over time. There are many ways in which knowledge can be inaccurate and many explanations for why it may be so tenacious. To address students' misconceptions, there are a range of strategies instructors can use.

## FACTORS THAT ENABLE CHANGE

### PERSONAL EXPERIENCE

- Contributes to the development of deeply embedded, pre-instructional theories, explanations, and concepts of the surrounding world.

### SOCIAL SOURCES

- Folk wisdom, everyday language, personal social interactions, mystical beliefs, and media misinterpretation often promote mistaken assumptions and inaccurate information.

## SOURCES OF STUDENT MISCONCEPTIONS

### THE NATURE OF THE MISCONCEPTION

- When part of a conceptual network, misconceptions are more easily changed with instruction. When connected with beliefs, values and affective networks, misconceptions are harder to correct.

### COGNITIVE UTILITY OF THE INFORMATION

- In order to accept an alternative conception, the learner must comprehend the new concept, see it as plausible, and

believe the new concept will be more useful in everyday life than the prior conception.

### LEARNER CHARACTERISTICS

- Disposition or ability for critical and evidence-based thinking:
  - » Students' disposition to evaluate and question claims, as well as their motivations to do so, influence their chances of altering inaccurate prior knowledge.
- Epistemological beliefs:
  - » Beliefs about the nature of learning and knowledge have an effect on the likelihood of change (e.g., complex and changing vs. simple and certain).
- Learning goals:
  - » Performance-oriented individuals are less likely to change whereas mastery-oriented learners are more likely to change.
- Learning strategies:
  - » Shallow learning strategies will decrease the probability of changing misconceptions into correct knowledge.



## WHAT CAN INSTRUCTORS DO TO HELP STUDENTS OVERCOME THEIR MISCONCEPTIONS?

- Be deliberate in identifying student misconceptions. True/false statement sets can be useful in detecting the prevalence of the most common disciplinary misconceptions.
- Assess the degree to which students endorse such misconceptions and provide opportunities for students to think about their prior knowledge. This activation can help them attend to and notice any inaccurate understandings. Activities that externalize and monitor knowledge include concept maps, concept tests, and teacher-led discussions of common misconceptions.
- Explicitly address any misconception and purposefully scaffold the construction of new and correct knowledge. Activation alone will not produce change. Students have to be aware of their misconceptions, but they also have to be provided with an acceptable alternative they can comprehend, otherwise they are likely to keep their misconceptions intact. Instructor direction or guidance is key in this process.
- Make use of refutational readings supported by refutational instruction. Refutational teaching explicitly addresses misconceptions (activates them) and provides evidence that fails to support the inaccurate knowledge (explains and substantiates the authoritative view). Although refutational readings may be sufficient for some students, most require instructor-led activities. It is recommended that refutational lectures include interactive components and that the instructor has control of the aspects of learning that require changes in prior knowledge, regardless of the chosen instructional approach.
- Actively engage in assessing and addressing student misconceptions at all course levels. Misconceptions surface not only in introductory courses. Even when change has been achieved, students are likely to revert to their prior conceptions in upper level courses.

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