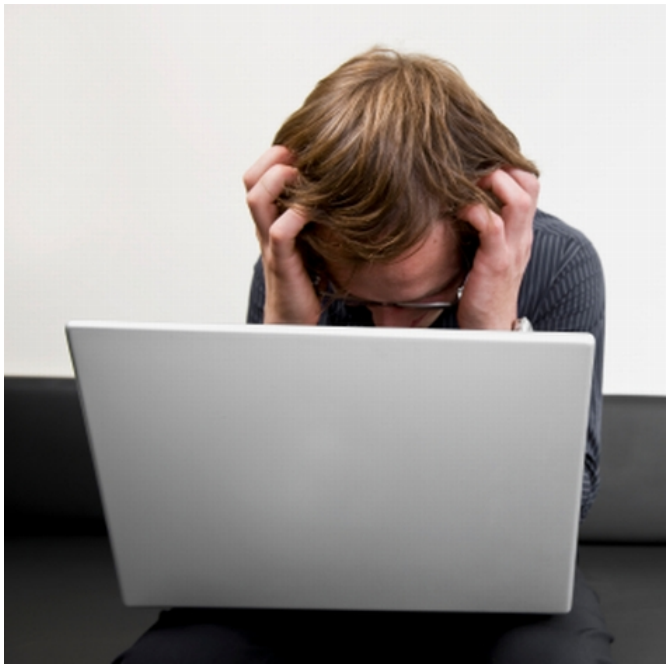
Evolution



Evolution is a notoriously difficult concept for students to understand.

Education research has revealed many of the problem concepts as well as ideas for improving student understanding.

Evolution

- Our experience with evolution misconceptions
- "Understanding Evolution" list of misconceptions.
- Application to scientific studies
- Concept Inventories of Misconceptions

Evolution

What is a misconception (prior conception/ alternative conception)?

"Alternative conceptions are ideas that differ from the corresponding scientific explanations. They are usually held by a significant proportion of students and are highly resistant to instruction."

Anderson DL., Fisher, KM., Norman, GJ, 2002. Development and evaluation of the Conceptual Inventory of Natural Selection. Journal of Research in Science Teaching 39:952-978.

Evolution

What misconceptions do you see in yourself, your students or others?

Evolution

Many studies of misconceptions

Many lists of misconceptions

- Need
- Use and disuse
- Adaptation
- Randomness

Evolution

Misconceptions about evolution and how it works:

"Evolution is a theory about the origin of life."
"Evolution is like a climb up a ladder of progress; organisms are always getting better."
"Evolution means that life changed 'by chance.'"
"Natural selection involves organisms 'trying' to adapt."
"Natural selection gives organisms what they 'need.'"

http://evolution.berkeley.edu/evolibrary/misconceptions_faq.php

Evolution

Misconceptions about the evidence for evolution:

"Evolution is 'just' a theory."

"Evolution is a theory in crisis and is collapsing as scientists lose confidence in it."

"Gaps in the fossil record disprove evolution."

"Evolutionary theory is incomplete and is currently unable to give a total explanation of life."

"The theory of evolution is flawed, but scientists won't admit it."

"Evolution is not science because it is not observable or testable."

"Most biologists have rejected 'Darwinism' (i.e., no longer really agree with the ideas put forth by Darwin and Wallace)."

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Evolution

Misconceptions about the implications of evolution:

"Evolution leads to immoral behavior. If children are taught that they are animals, they will behave like animals."

"Evolution supports the idea that 'might makes right' and rationalizes the oppression of some people by others."

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Evolution

Misconceptions about evolution and religion:

"Evolution and religion are incompatible."

Misconceptions about teaching evolution:

"Teachers should teach 'both sides' and let students decide for themselves."

"Evolution is itself 'religious,' so requiring teachers to teach evolution violates the First Amendment."

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- **Misconceptions about evolution and the mechanisms of evolution**
  Misconceptions about evolution and how it works:
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- "Evolution is like a climb up a ladder of progress; organisms are always getting better."
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Evolution

If students can't understand the Nature of Science, the cannot understand the evidence for evolution.

In the Gompel and Carroll article.

What question is being addressed?

What are the larger questions it relates to?

Why are these important questions?

How did this study/finding come about?

What does it tell us about evolution?

Evolution

Reactions to the Gompel and Carroll article demonstrate abundant misconceptions.

Work together in pairs, how many misconceptions can you identify?

Evolution

How do we know which misconceptions our students have?

We use some Million Dollar Questions to find them.

Evolution

Concept Inventories

- Research based
- Measure conceptual understanding
- Originated in Physics

Evolution

What can we do about misconceptions?

- Targeted active learning strategies (D'Avanzo, 2008)
- Simulations http://ats.doit.wisc.edu/biology/ (Heitz, JG, et al 2010)

Evolution

In pairs choose a misconception and write a question about it. Share and critique your questions with another pair.