How our AACR work intersects with educational research questions

- Ross Nehm, March 8, 2012

- I'll discuss a few educational research questions that can be tackled using open-response assessment formats (but are difficult or impossible to answer using MC formats).

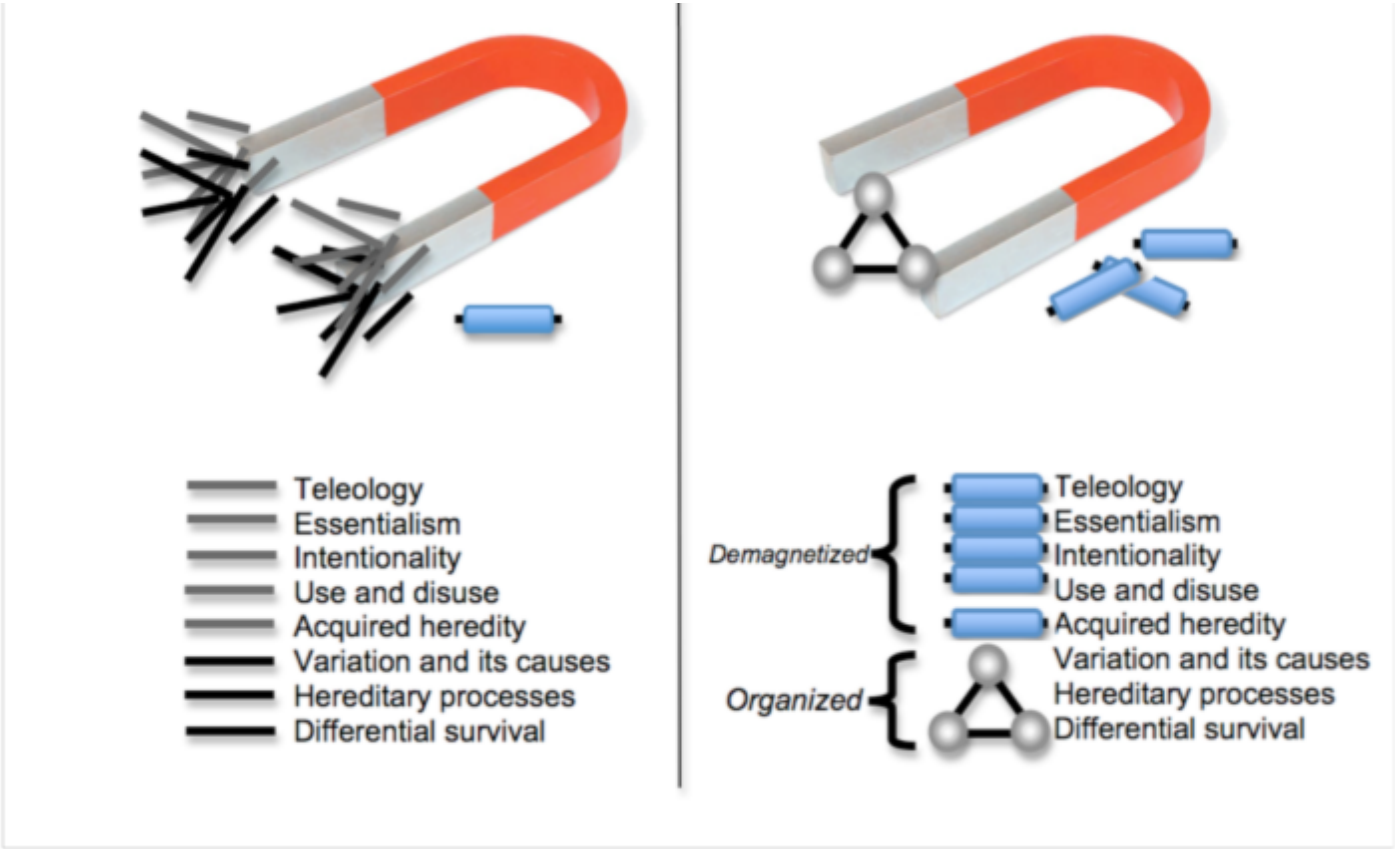
(RQ1) What is the structure of student thought? Is student science knowledge theory-like or fragmented?

Authors: Vosniadou (2008) diSessa (2008)

Goal of science learning is to foster student development of stable, coherent, and integrated theories of causation that are applied as schemas or theories (e.g., natural selection).

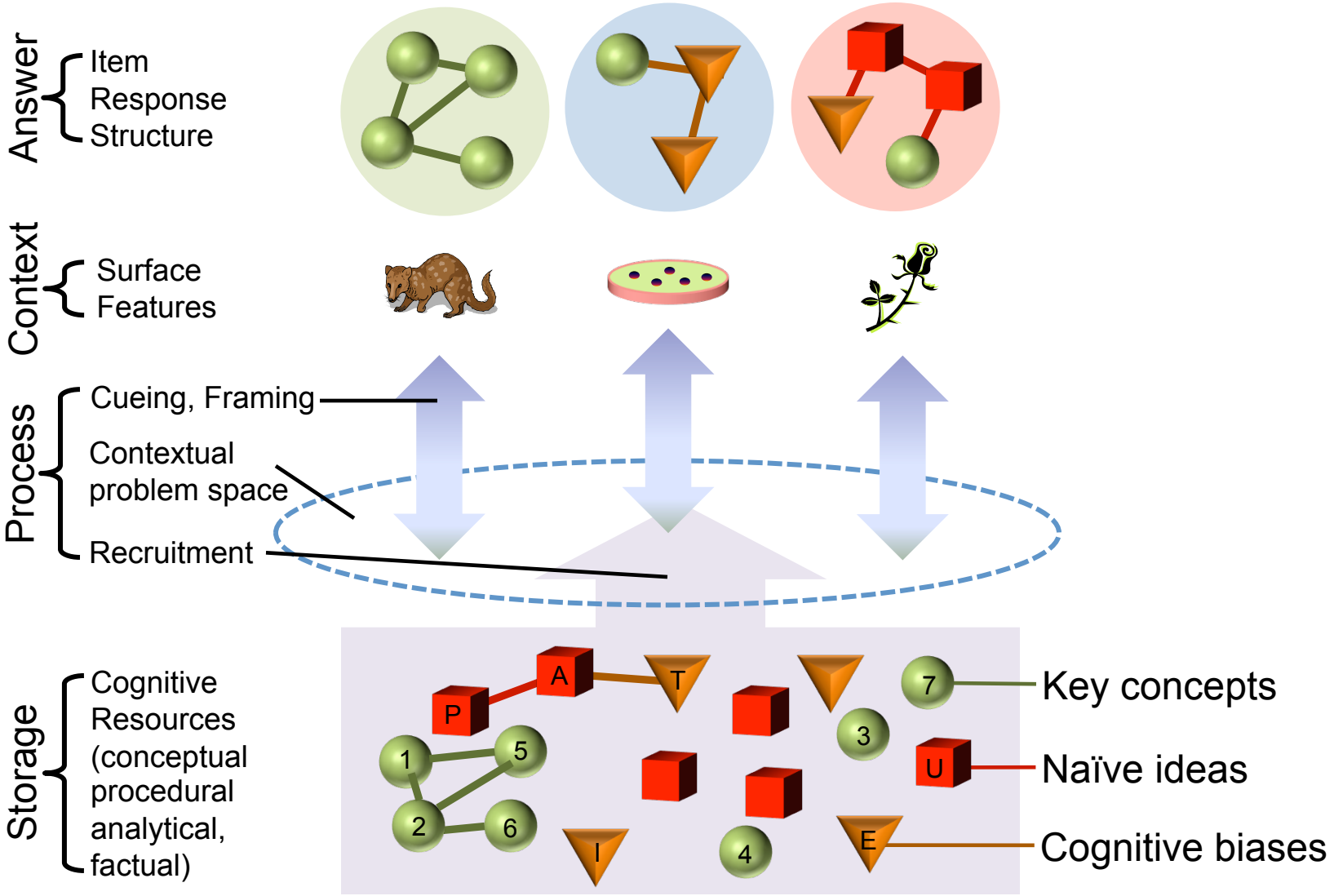
MC cannot examine whether students who know all the pieces have knowledge coherence

Ideas drawn to problems



From Nehm (2010) JBME

Model of evolution problem solving



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(RQ2) Are student knowledge levels predictive of competencies relating to authentic scientific practices (LP models)?

Authors: NRC, 2001; NRC 2012 (Framework)

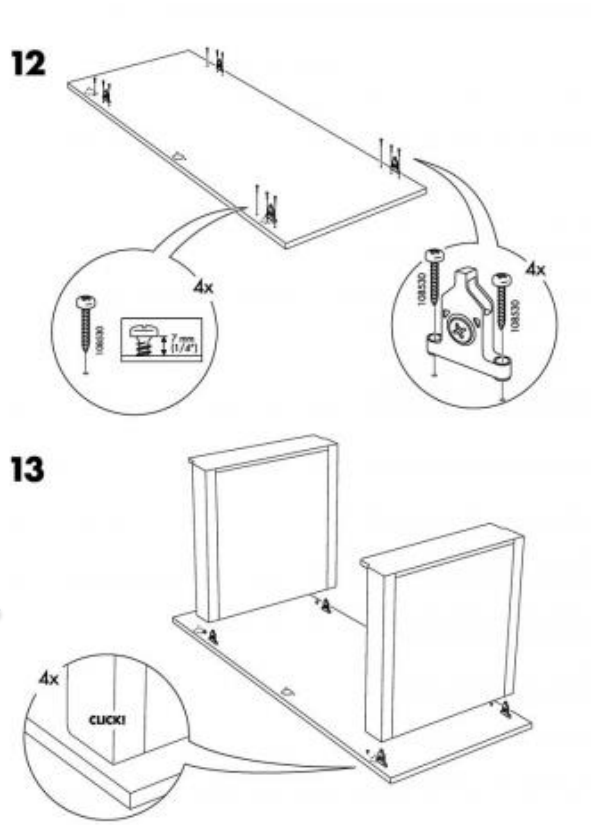
Goal of science learning is to not just to foster student development of stable, coherent, and integrated theories of causation, but also to foster real-world competencies relating to ASPs, such as explanation, argumentation, communication, etc.

Existing Cis do not measure any scientific practices

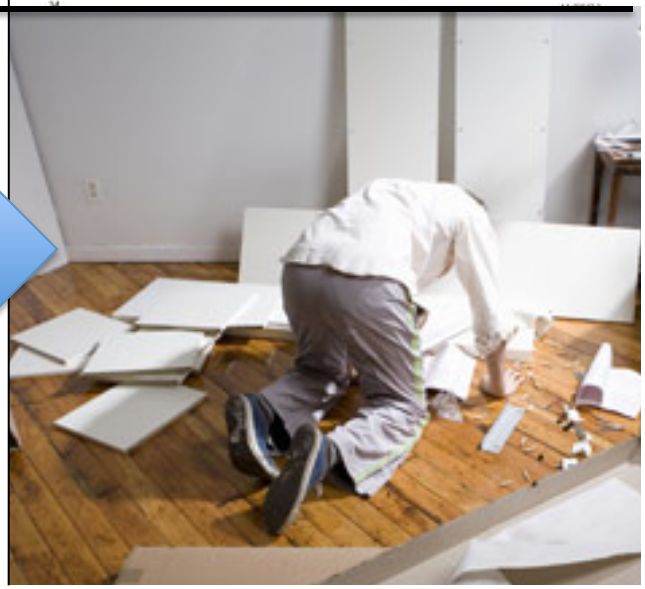
MC cannot examine students' competencies relating to if or how knowledge growth and ASPs develop in concert, independently, etc.

Building and communicating a robust and functioning evolutionary explanation

Identifying the appropriate elements of an evolutionary explanation



Knowing the parts and tools needed to assemble furniture does not mean that you can actually built it effectively (is the whole more than the sum of its parts?)



(RQ3) What reasoning patterns characterize the novice to expert transition?

Authors: Chi and Olsson (2008); Vosniadou (2008); Nehm and Ridgway 2011

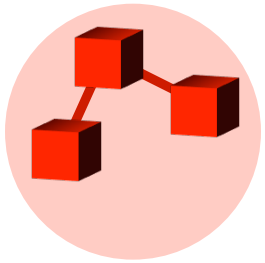
Research in cognitive psychology and educational theory (constructivism) argues that knowledge growth (learning) will involve the addition and possible integration of new knowledge into existing frameworks.

Thus, the null model is that synthetic models of native and expert knowledge elements will characterize knowledge development in novices as they progress towards expertise.

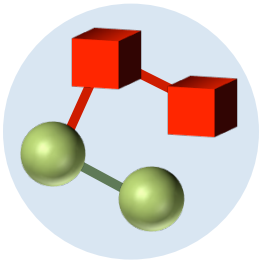
MC often assumes either a (1) accurate or (2) inaccurate way of thought, and yet a growing body of work suggests that this is not how undergraduates reason.

Novice to expert explanations

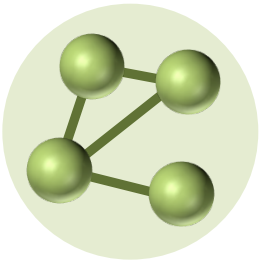
Naïve model



Mixed model



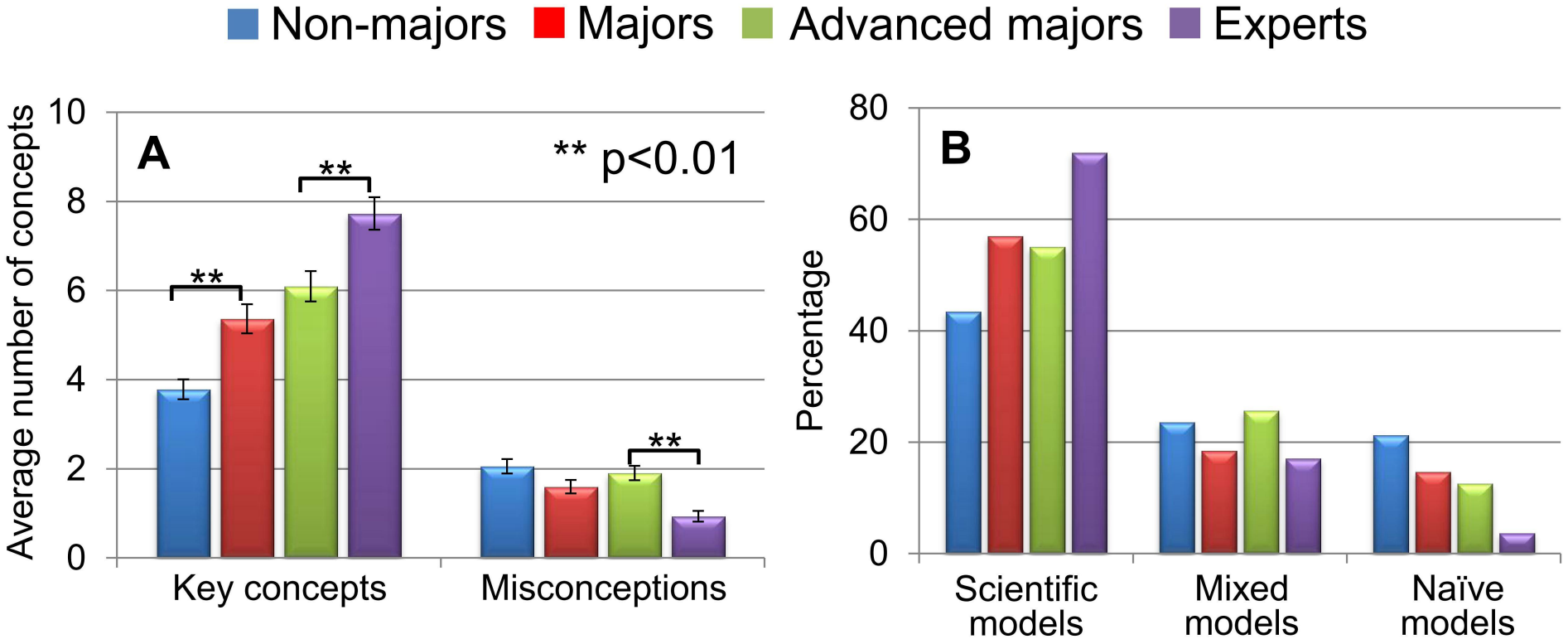
Scientific model



"One day snails had to have a poison in order to fight predator [Need]. Then, environmental pressure then caused them to have poison [Pressure]. Therefore, they all has changed into poisonous snails [Essentialism]."

"One day snails had to [Need] a mutation for poison [Variation]. The poisonous snail had gradually adapted to their environment [Adapt] so the population of the snail increase [Change of pop.]."

"One day there was a mutation [Variation] that produced a poison. The poisonous snail was better able to produce more offspring [Differential survival] in the environment passing on his trait [Heredity]."



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Questions

- (RQ1) What is the structure of student thought? Is student science knowledge theory-like or fragmented?
- (RQ2) Are student knowledge levels predictive of competencies relating to authentic scientific practices (LP models)?
- (RQ3) What reasoning patterns characterize the novice to expert transition?
- (RQ4) How do students learn the language of science?

References

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