Ideas-to-think-with:

Useful knowledge pieces about natural selection

Evolution is the primary scientific explanation for the diverse forms of life. Despite the importance of this topic, evolutionary mechanisms like natural selection are notoriously difficult to understand. NS is poorly understood at all levels: by the general public, children of all ages and even biology majors (Alters, 2005; Bardapurkar, 2008).

A majority of this work is founded on the premise that people have stable coherent theories about NS that do not fit with its scientific explanation. Consequently, for learning to take place, these researchers suggest that misconceptions need to be confronted and replaced if they are to be corrected (Seattlage, 1994; Ferrari & Chi, 1998; Alters & Nelson, 2002; Passmore & Stewart, 2002).

This replacement model of learning does not align with a constructivist view of learning (Smith, diSessa & Roschelle, 1993) and is likely to result in dissociated forms of learning (Papert, 1980). Papert argues that children have powerful intuitive and informal ideas about the world. They possess fragmentary and incompletely specified knowledge pieces that can be used as a starting point to build on more sophisticated understandings (1980). However, very little research has been done to explore children's productive knowledge pieces about evolutionary mechanisms like NS.

In an attempt to answer this question, the present study was conducted to explore useful knowledge pieces related to NS that children draw on while reasoning about change in a hypothetical population of butterflies. By useful pieces of knowledge, we mean ideas that can serve as resources in further learning about NS.

Data was collected in a sixth and eighth grade science class using semi-structured interview. Students constructed and reasoned about a hypothetical scenario of natural selection in a species of butterflies. The interviews were transcribed and coded using a top-down coding approach based on the core ideas of natural selection adapted from Gregory (2009).

The preliminary findings suggest that students do have some productive knowledge pieces that

are activated and used when reasoning about NS. For instance, a sixth grader, Laura recognized that some traits are more advantageous for survival in an environment than others. She was able to estimate how selective pressure on populations might result in long term changes in proportions of traits. However, there was no clear evidence that Laura understood that a trait is heritable.

The goal is to draw comparisons between subjects to converge on elements of NS that a majority of students possess. So far, a cursory glance at the data suggests that students recognize that certain traits are advantageous in an environment and influence chances of survival. However, the probability of reproduction influencing chances of a trait being perpetuated or not in a population seems to be backgrounded for students.

In conclusion, we do not intend to claim that students do not have any misconceptions about evolutionary mechanisms like natural selection, nor that students have a sophisticated understanding of NS. Our study seeks to investigate the existence of ideas-to-think-with that help students learn about NS.

References

Alters, B. & Nelson, C. (2002). Teaching evolution in higher education. *Evolution*, 56, 1891-901.

Alters, B. (2005). Teaching biological evolution in higher education. Boston: Jones and Bartlett.

Bardapurkar, A. (2008). Do students see the "Selection" in organic evolution? A critical review of the causal structure of student explanations. *Evolution Education Outreach*, 1, 299-305.

Ferrari, M., Chi, M. (1998). The nature of naïve explanations of natural selection. *International Journal of Science Education, 20, 1231-56.*

Gregory, T.R.(2009). Understanding natural selection: Essential conceptions and misconceptions. Evolutionary Education Outreach, 2, 156-175.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.

Passmore, C., Stewart, J. (2002). A modeling approach to teaching evolutionary biology in high schools. *Journal of Research in Science Teaching*, 39, 185-204.

Seattlage, J. (1994). Conceptions of natural selection: a snapshot of the sense-making process*. Journal of Research in Science Teaching, 31, 449-57.*

Smith, John P., III; DiSessa, A.; Roschelle, J. (1994). Misconceptions reconceived: a constructivist analysis of knowledge in transition. *Journal of the Learning Sciences(2): 115–163.*