Using Analogical Learning in Science to Improve Conceptual Understanding

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Introduction

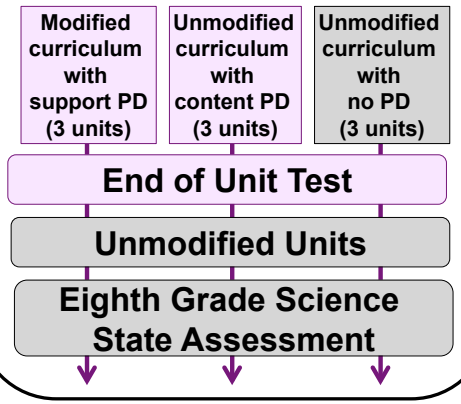
Research Questions

- What are the learning and transfer effects of pairing within-concept and between-concept comparisons?
- How can the principles of analogical comparison discovered in the laboratory be translated into classroom pedagogy?
- Does learning through contrast improve preparation for future learning?

Prior Work

- Multiple analogs, restatement of principle support schema acquisition (Gick & Holyoak, 1983)
- Guided comparison better than instructions to compare only (Gentner, Lowenstein, & Thompson, 2003)
- Contrasting cases before direct instruction are more beneficial (Schwartz & Bransford, 1998)
- Analogies used in classrooms, often without cognitive supports (Richland, Zur, & Holyoak, 2007)

Project overview



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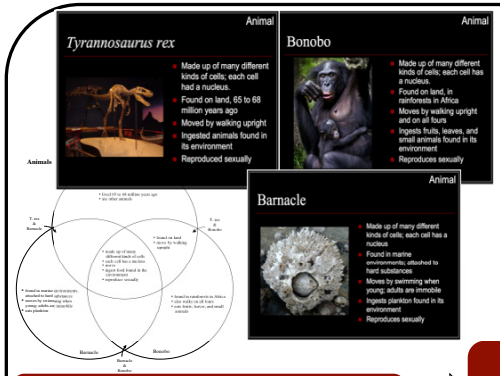
Contrasting Cases



	Cellular structure	Energy Source	Reproduction	Movement
Kingdom Protist				
Kingdom Fungi				
Kingdom Plant				
Kingdom Animal				

Conduct within-category contrasts to pull out critical features → Conduct between-category contrasts to highlight similarities and differences → Proceed with existing curriculum

Dependent measures

End of Unit Test

Contrasting Case questions

Targets content covered in curriculum and highlighted through contrasting cases

7) You are learning about a multicellular organism that has cells containing nuclei. It doesn't eat; instead, it uses digestive juices to break down substances in its surroundings and absorb nutrients. In what kingdom does this organism belong?

a. Plant
b. Bacteria
c. Fungi*
d. Protist

Transfer questions

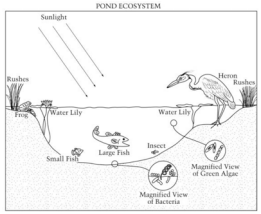
Targets content covered in curriculum and NOT contrasting cases, but contrasting cases should prepare students to learn

11) Today, what would scientists do if they encountered an organism that fit none of the four kingdoms?

a. Destroy the organism
b. Create a new category*
c. Ignore the organism
d. Change the organism

Curriculum-aligned questions

Targets content covered in unmodified curriculum



Which of the following living things in the pond system uses the energy from sunlight to make its own food?

a. Insect
b. Frog
c. Water lily
d. Small fish

Eighth Grade Test

State science assessments

Targets long-term knowledge retention and alignment of instructional content to state assessments

8. How is this fish adapted for weedy areas in freshwater lakes?

a. The upper fin of the fish looks like waves of water.
b. The lower fins of the fish look like the legs of a turtle.
c. The stripes of the fish look like plants in the water. *
d. The front of the fish looks like the surface of a rock.