

BIOLOGY SCIENCE MISCONCEPTIONS

Misconceptions are located on the left side of the tables, and references about the corresponding misconception are on the right.

STANDARD I: Students will understand that living organisms interact with one another and their environment.

Objective 1: Summarize how energy flows through an ecosystem.

Often students will only address the components of a food chain that they can see. This is often reinforced by teachers using those components that are observable in their particular local.	Wildlife; Government
Students believe the 'food chain' is actually a linear chain.	Boreal Forest; Sofia; Cajun?
Students believe there is a starting and ending point in the food chain.	Zephyrus
Diagrams of energy pyramids that indicate decreases in energy (without indicating that the energy is given off as heat) can reinforce students' misconception that energy is not conserved.	Steve
Students believe energy can be recycled through an ecosystem many times.	Nyserda

Objective 2: Explain relationships between matter cycles and organisms.

Students believe the same water goes around the water cycle forever (the water you are drinking is the same water a dinosaur drank millions of years ago).	Resources that teaches misconception: Environment Canada.
Students believe fragments of oxygen and carbon cycle are used to create a Carbon Dioxide Cycle. This does not actually have its own cycle, but rather CO ₂ is created and destroyed in parts of other cycles.	Resources that teaches misconception: University of Tennessee; Beginning Teacher Training Center
Most students do not understand that theories are based on evidence, not inference. They believe that a theory implies there is little-to-no evidence or it is just a guess.	
Students believe the greenhouse effect is caused when gases in the atmosphere behave as a blanket and trap radiation, which is then re-radiated to the Earth.	
Students are taught global warming is a myth.	

Objective 3: Describe how interaction among organisms and their environment help shape ecosystems.

Students believe the simpler the organism, the simpler the food it eats. Therefore, they believe as an organism increase in complexity the more complex the food it eats.	Marek (1986)
Students believe energy only flows from the top of the food chain down,	Munson (1994)

with those at the top having the most energy and increasing in number at the expense of those below.	
Students believe energy flow is one-way, rather than cyclical or two-way.	Hogan (2000)
Students believe organisms in a population are important only to those other organisms on which it preys for food sources.	Griffiths & Grant (1985)
Students believe a population located higher on a given food chain within a food web is predator of all populations located below it in the chain.	Barman, Griffiths, & Okebukola (1995).
Students believe producers in a community are the most numerous because energy in a food chain goes on diminishing and less energy passes to each animal. It is wasted in respiration and growth.	Leach, Driver, Scott, & Wood-Robinson (1996)
Students believe a size change in one population will have not too much effect over another population of the same food web because the chains are spread out.	Webb & Bolt, 1990
Students believe in a food web, a size change in one population will only affect another population if two populations are directly related as predator-prey.	Barman & Mayer, 1994
Students believe populations will increase indefinitely because the resources are unlimited.	Brody & Koch
Students believe there is no link between fluctuations in population size and environmental issues like food supply.	Munson, 1991
Students believe chemical pollutants undergo no change in form as they move through food chains.	Hogan, 2000

STANDARD II: Students will understand that all organisms are composed of one or more cells that are made of molecules, come from pre-existing cells, and perform life functions.

Objective 1: Describe the fundamental chemistry of living cells.

Students might think cells are within the human body, but do not make up the body.	sciencenetlinks
--	-----------------

Objective 2: Describe the flow of energy and matter in cellular function

Students believe respiration is the same as breathing	Driver, 1994
Students believe plants get food from soil.	Driver, 1994
Students believe tree growth material (mass) comes from soil.	Driver, 1994
Students believe sunlight, carbon dioxide, water, and minerals (fertilizers) are food.	Driver, 1994
Students believe plants breath in carbon dioxide and drink water	Driver, 1994
Students believe food is anything that goes into the organism including minerals, water,	Driver,

carbon dioxide, and sun (for plants).	1994
---------------------------------------	------

STANDARD III: Students will understand the relationship between structure and function of organs and organ systems.

Objective 1: Describe the structure and function of organs.

Students believe the blood in your veins is blue	ENC
Students believe the capillaries have a smaller diameter and thus have an increase in resistance that inhibits flow.	Chinese University of Hong Kong; Unknown
Students believe muscle cells can push and pull.	Jeff's Website
Students believe the small intestine is short; the large intestine is long.	Jeff's Website
Students believe the stomach just holds food.	Jeff's Website

Objective 2: Describe the relationship between structure and function of organ systems in plants and animals.

Students believe roots are feeding organs.	Driver, 1994
--	--------------

STANDARD IV: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may later genetic expression.

Objective 1: Compare sexual and asexual reproduction.

Students believe sexual reproduction always involves mating. They do not understand other mechanisms of sexual reproduction besides mammalian reproduction.	Driver, 1994
Students believe Hermaphroditism is the same as asexual reproduction	Driver, 1994
Students do not understand the distinction between reproduction and the act of copulation in mammals.	Driver, 1994
Students believe plants cannot sexually reproduce.	Driver, 1994
Students believe asexual reproduction is restricted to microorganisms only.	Driver, 1994
Students believe asexual reproduction results in weakness and sexual reproduction always produces stronger individuals.	Driver, 1994

Objective 2: Predict and interpret patterns of inheritance in sexually reproducing organisms.

Students do not understand both parents contribute genes for each characteristic. They believe that one parent contribute genes for some characteristics, while the other features come from the other parent.	Kargbo et al., 1980
Students believe that inherited traits are blended, but the male parent's characteristics are stronger in expression or always dominant.	Driver, 1994
Some students think that boys get their traits from their dad and girls get their mom.	Driver, 1994; Kargbo et al., 1980
Students believe male animals are always bigger and stronger than females.	Driver, 1994

STANDARD V: Students will understand that biological diversity is a result of evolutionary processes.

Objective 1: Relate principles of evolution to biological diversity.

Students believe animals consciously plan their reproductive strategies.	Driver, 1994
--	--------------

REFERENCES

Barman, C., Griffiths, A., & Okebukola, P. (1995). High school students concepts regarding food chains and food webs: A multinational study. *International Journal of Science Education*, 17(6), 775-782.

Beginning Teacher Training Center - <http://www.specialedprep.net/MSAT%20SCIENCE/cycleCO1.htm>

Boreal Forest - http://www.borealforest.org/school/food_chain.jpg

Brody, M.J. and H. Koch. 1989. An assessment of 4th, 8th, and 11th grade students' knowledge related to marine science and natural recourse issues: *The Journal of Environmental Education*: 21 (2): 16-26.

Cajun Games - <http://www.cajungames.com/foodchain/>

Chinese University of Hong Kong - <http://www.fed.cuhk.edu.hk/~johnson/index.htm>

Clough, E. E., & Wood-Robinson, C. (1985). Children's understanding of inheritance. *Journal of Biological Education*, 19(), 304-310.

Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (1994). *Making sense of secondary science: Research into children's ideas*. New York: Routledge.

ENC - <http://www.enc.org/features/focus/archive/misconceptions/document.shtm?input=FOC-003301-answers>

Environment Canada- http://www.ec.gc.ca/water/en/info/pubs/Intwfg/e_chap1b.htm

Government - <http://estuaries.gov/pdf/energyflow.pdf>

Griffiths, A. K., & Grant, B. A. C. (1985). High school students' understanding of food webs: Identification of learning hierarchy and related misconceptions. *Journal of Research in Science Teaching*, 22(5), 421-436.

Hogan, K. (2000). Assessing students' system reasoning in ecology. *Journal of Biological Education*, 35(1), 22-28.

Jeff's Website - <http://jeffcoweb.jeffco.k12.co.us/isu/science/lsgbigidea.html>

Kargbo, D. B., Hobbs, E. D., & Erikson, G. L. (1980). Children's belief and inherited characteristics. *Journal of Biological Education*, 14(), 137-146.

Leach, J., Driver, R., Scott, P., & Wood-Robinson, C. (1996). Children's ideas about ecology: Three ideas found in children aged 5-16 about the interdependency of organisms. *International Journal of Science Education*, 18(2), 129-141.

Marek, E. (1986). They misunderstand but they'll pass. *The Science Teacher*, 53(9), 32-35.

Munson, B.H. 1991. Relationships Between an Individual's Conceptual Ecology and the Individual's Conceptions of Ecology: Unpublished doctoral dissertation, University of Minnesota, Minneapolis.

Munson, B. H. (1994). Ecological misconceptions. *Journal of Environmental Education*, 24(4), 30-34.

Nyserda - http://www.nyserda.org/schools/1_energy_misconceptions.pdf

Sciencenetlinks - http://www.sciencenetlinks.com/lessons_printable.cfm?DocID=65

Sofia - <http://sofia.usgs.gov/publications/fs/166-96/fig1.gif>

Steve - <http://www.stevetrash.com/booking/lessons/pyramid.htm>

Unknown - http://www.personal.psu.edu/users/s/j/sjk206/misconception_interview_protocol.htm

Wildlife - http://www.wildlife-art.co.uk/new_site/graphics/earth_science/food_chain.jpg

Zephyrus - <http://www.zephyrus.co.uk/landfoodchain.html>