Biology I ECA

Depth of Knowledge PowerPoint

Depth of Knowledge

- Depth of knowledge can vary on a number of dimensions, including
  - level of cognitive complexity of information students should be expected to know;
  - how well they should be able to transfer this knowledge to different contexts;
  - how well they should be able to form generalizations; and
  - how much prerequisite knowledge they must have in order to grasp ideas.

Source: Webb (1997).

Depth of Knowledge

- The depth of knowledge required by a learning activity or within an assessment is related to
  - the number of connections with regard to concepts and ideas a student needs to make in order to produce a response;
  - the level of reasoning; and
  - the use of other self-monitoring processes.

Source: Webb (1997).

Depth of Knowledge vs. Bloom's Taxonomy

Level 1 (Recall)	Knowledge
	Comprehension
Level 2 (Skill/Concept)	Application
Level 3 (Strategic Thinking)	Analysis
Level 4 (Extended Thinking)	Synthesis
	Evaluation

Adapted from Wyoming School Health and Physical Education Network (2002)

Depth of Knowledge Level 1 (Recall)

- Recall of information such as a fact, definition, term, or a simple procedure
- Performing a simple algorithm or applying a formula.

- A one-step, well-defined, and straight algorithmic procedure should be included at this lowest level.

- Other key words that signify a Level 1 include "identify," "recall," "recognize," "use," and "measure."
- Verbs such as "describe" and "explain" could be classified at different levels depending on what is to be described and explained.

Source: Webb (1999).

Biology DOK Level 1
Example Item

Glucose is a building block of carbohydrates.
Which of these best describes glucose?
a. nucleotide
b. protein
c. monosaccharide
d. lipid

Depth of Knowledge
Level 2 (Skill/Concept)

- The engagement of some mental processing beyond an habitual response
- Requires students to make some decisions as to how to approach the problem or activity
- Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data."
  - These actions imply more than one step.

Source: Webb (1999).

Biology DOK Level 2 Example Item

The ears of foxes help to regulate body heat. The fennec fox lives in the North African desert and has large ears that release body heat. The Arctic fox lives in cold climates and has small ears that conserve body heat.

Which of these processes led to the development of different ear sizes in foxes?

a. selective breeding
b. succession
c. natural selection
d. mutualism

Depth of Knowledge
Level 3 (Strategic Thinking)

•Requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels.

•Cognitive demands are complex and abstract.

•An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3.

Source: Webb (1999).

Biology DOK Level 3
Example Item

The allele for attached earlobes (e) is recessive to the allele for unattached earlobes (E). A woman with the genotype (Ee) and a man with the genotype (ee) have a child.

What is the probability that the child is heterozygous for attached earlobes?

a. 0%
b. 25%
c. 50%
d. 75%

Depth of Knowledge
Level 4 (Extended Thinking)

•Requires complex reasoning, planning, developing, and thinking, most likely over an extended period of time.

•The cognitive demands of the task should be high and the work should be very complex.

•Students should be required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select one approach among many alternatives on how the situation should be solved, in order to be at this highest level.

Source: Webb (1999).

Biology DOK Level 4
Example Item

Marine and land iguanas are two different species that inhabit the Galapagos Islands. Some scientists believe that both species diverged from a common ancestor. Marine iguanas eat algae. Land iguanas feed on cacti. Algae are more abundant in the ocean than cacti are on the islands. Both species lay their eggs in the sand.

Rats, cats, and goats have recently been introduced to the islands. Rats often feed on iguana eggs, cats eat baby iguanas, and goats eat cacti.

Explain how the two species of iguanas could have developed from a common ancestor. In your response, be sure to

- Name the process that explains how marine and land iguanas developed from a common ancestor
- Describe the steps involved in this process
- Explain how the introduction of rats, cats, and goats might affect both iguana species

Practical Strategies for the Classroom

Work on Content Area Reading Strategies

- Traditional science instruction involves presentation of new ideas expressed through new language.
- Science assessments are measuring conceptual understandings as well as command of scientific language.
- Tried and true reading techniques
- Pre-reading or revealing misconceptions
  - Biology Concept Inventory: http://bioliteracy.net/
  - Guiding questions-focus reading
  - Reflection

Practical Strategies for the Classroom

Content-first approach: use everyday language to introduce the primary ideas associated w/content prior to introducing scientific language.

Content first approach:

"This is the inside of an *energy pouch where plants make their own food. There are many green pigments inside of an energy pouch."*

Scientific language approach:

"This is the inside of a chloroplast where plants make glucose. There is a lot of chlorophyll inside of a chloroplast."

**adapted from Brown and Ryoo, 2008*

Practical Strategies for the Classroom

- Focus on application-Writing!

  - Use a science notebook (not a "lab notebook"!) to record data, analysis, and reflections.

- Resources: www.sciencenotebooks.org

Tools for Concept Mapping

- Software for concept mapping: http://cmap.ihmc.us/conceptmap.html

- Concept maps by hand are good for small formative assessments…science notebook provides quick check for understanding

Concept Map Example