

Energy and Ecosystems: Part 6 Assessment

This is our final entry in the Energy and Ecosystems series; one more look at the topic before you go off for a well-deserved break.

Last week we examined sample assessment items and discussed what your students would need to know in order to answer the items correctly. This week we're going to take a different view of them: what if your students got the answers wrong? On a well-designed assessment, distracters are as important as any other part of the item. Therefore, if your students choose a particular distracter, that can tell you something about their science knowledge and test-taking abilities. Let's consider the value of assessment analysis...

Assessment item: Energy flow



Here's an item that we discussed last week:

Over a month's time a mouse eats corn. At the end of the month, a hawk eats the mouse. Will the hawk get all of the energy contained in the corn the mouse has eaten?

- A. The hawk will not get all of the energy contained in the corn the mouse eats because the mouse uses some of the energy to warm its body and carry out life processes.
- B. The hawk will not get all of the energy contained in the corn the mouse eats because the hawk uses energy to catch and digest the mouse.
- C. The hawk will get all of the energy contained in the corn because energy can neither be created nor destroyed.
- D. The hawk will get all of the energy contained in the corn because the hawk ate all of the mouse.

We know the correct answer is “A”, **“The hawk will not get all of the energy contained in the corn the mouse eats because the mouse uses some of the energy to warm its body and carry out life processes.”** To answer this correctly, your students must know that a great deal of energy is lost both to heating the environment and undergoing basic life functions.

However, what if your students chose **B**, **C**, or **D**? What could that tell you about their thinking? Given the interesting way students’ minds often work, we will never know for sure unless we ask. If there’s time, talking to students about their responses can tell you a great deal about what they are learning...also about how well a test is designed. If there is confusion, it’s best to determine if it is caused by lack of student understanding, an inadequately designed item, or both. With that qualification, we present some thoughts about student responses:

- Some students might answer “**B**”, **“The hawk will not get all of the energy contained in the corn the mouse eats because the hawk uses energy to catch and digest the mouse.”** The emphasis on energy is good, but it is misplaced. Students should not be concerned with how much energy the hawk is using; they should only consider what it is gaining. In an energy chain, the arrows represent the flow of energy from one organism to another. Students choosing this distracter may not understand that, once the end of the chain is reached, we are no longer concerned with energy loss. How much energy a hawk uses to carry out life functions is important if that hawk becomes prey. In that case, if we examine the energy flow from corn to mouse to hawk to wolf, we know that all of the energy that each organism gains is not obtained by the “next in line.” Heat energy goes into the environment and life processes are undertaken.
- If students choose “**C**”, **“The hawk will get all of the energy contained in the corn because energy can neither be created nor destroyed,”** they are likely falling back on an old line they’ve heard about energy but don’t really understand. Neither the energy chain, nor the energy web, nor the energy pyramid suggests energy destruction. Rather, it’s all about energy transfer among organisms and into the environment. This may be quite a large conceptual error. Instead of focusing on the large issue of energy flow, it zooms in on some traditional science vocabulary.
- What about answer “**D**”? **“The hawk will get all of the energy contained in the corn because the hawk ate all of the mouse.”** This selection may be due to a misplaced focus. It’s possible that students are concentrating on “who eats whom” within an energy chain (or food chain) and not on the flow of energy. Indeed, even the traditional term “food chain,” which is used in the NYS Core Curricula, can intuitively lead students to think along these lines. Since the energy chain is visually limited, an energy pyramid may

help students shift their thinking. The reduction in size as the pyramid rises indicates energy loss; all the energy from one tier is clearly not transferred to the next.

We've just scratched the surface here. There are other interpretations of these distracters, of course. Any thoughts? We'd love to hear your ideas! Enjoy your break, and we'll meet you back here in the new year to investigate energy and simple machines...

What do the New York State standards say?

In the Elementary Core Curriculum, Standard 4, The Living Environment,

Major Understandings state:

- 6.1c Animals that eat plants for food may in turn become food for other animals. This sequence is called a food chain.
- 6.2a Plants manufacture food by utilizing air, water, and energy from the sun.
- 6.2d The Sun's energy is transferred on Earth from plants to animals through the food chain

In the Intermediate Core Curriculum, Standard 4, The Living Environment,

Major Understandings state:

- 6.1a Energy flows through ecosystems in one direction, usually from the Sun, through producers to consumers and then to decomposers. This process may be visualized with food chains or energy pyramids.
- 6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.