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6.3: Grading the Animals Unit Posttest

This posttest is the same as the Animals Unit Pretest (Activity 1.1). The file "1.1_Assessing_the_Animals _Unit_Pretest" explains how the unit pretest can be used for formative assessment, providing insight into students' reasoning using the Learning Progression Framework. This file explains how the posttest can be used for grading, holding students accountable for the ideas that they have studied in the Animals Unit.

*Correct responses are in **bold blue italics** below. Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers.*

These are difficult questions, so even the most sophisticated reasoners will miss a few of them. You should decide how to translate the number of points that students earn into grades for report cards. Here are some ideas about levels of points that represent excellent, good, and adequate performance.

Total possible: 36 points	***For higher demand high school courses***	***For middle school or lower demand high school courses***
Excellent	*29 points (~80%)*	*25 points (~70%)*
Good	*25 points (~70%)*	*22 points (~60%)*
Acceptable	*22 points (~60%)*	*18 points (~50%)*

1. When a baby was five months old, she weighed 8 kg. After 7 years, the baby has grown into a girl, weighing 25 kg. Where did her increase in mass come from?

a) Select True or False for the following statements.

		Some of the girl's mass:
True	***False***	*is created by the girl.*
True	***False***	*comes from air.*
True	***False***	*comes from sunlight.*
True	False	*comes from water.*
True	False	*comes from food.*

1 point for correctly answering each line. 5 points total.

b) Which ONE of the following do you think provides the MOST mass to the girl?

a. Mass the girl's body created

b. Air

c. Sunlight

d. Water

e. Food

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1 point for correct answer.

c) Explain your choices. Where do you think the increase in the mass of the girl comes from?

Level 4 responses explain that organic molecules in the girl's body come from organic molecules in food.

1 point for correct answer.

d) How does the girl's digestive system (stomach and intestines) help her gain mass as she grows?

Level 4 responses recognize that the digestive system makes large organic molecules in food into small organic molecules that enter her blood. Level 4 responses do not equate digestion to cellular respiration or use vague terms such as "breaking down" food.

1 point for correct answer.

e) How does the girl's blood help her gain mass as she grows?

Level 4 responses recognize that blood carries small organic molecules to all the cells the body.

1 point for correct answer.

2. Fat is mostly made of molecules such as stearic acid: $C_{18}H_{36}O_2$.

a) Decide and circle whether each of the following statements is true or false about what happens to the atoms in a man's fat when he exercises and loses weight.

True	False	Some of the atoms in the man's fat are incorporated into CARBON DIOXIDE in the air.
True	***False***	Some of the atoms in the man's fat are converted into ENERGY that he uses when he exercises.
True	***False***	Some of the atoms in the man's fat are BURNED UP AND DISAPPEAR.
True	***False***	Some of the atoms in the man's fat are converted into HEAT.
True	False	Some of the atoms in the man's fat are incorporated into WATER VAPOR in the air.

1 point for correctly answering each line. 5 points total.

b) Explain the pattern in your answers. What happens to the atoms in the fat of a person who loses weight?

Level 4 students recognize the connection between this question and the Matter Change Question for cellular respiration. They could explain this connection in two ways:

- ***They may simply explain that the fat molecules are being used for cellular respiration, meaning that the products are CO_2 and H_2O.***
- ***They may invoke conservation laws and "follow the rules."***
  - ***Atoms cannot be burned up or disappear.***
  - ***Atoms cannot change into forms of energy.***
  - ***There must be products of the Matter Change that include the atoms in stearic acid: C, H, and O.***

1 point for explaining the connection in either of the above ways

3. A class was interested in how animals grow. The teacher started the lesson by telling his students that a cricket eats a lot of food each week but only gains a little bit of weight. The teacher asked, "What happened to the mass of the rest of the food?"

a) Three students shared their ideas about what happened. Do you agree or disagree with what each student claims?

Agree	***Disagree***	Daryll: "The cricket's body turned the mass of the food into energy in order to grow."
Agree	***Disagree***	Marisol: "The cricket breathed out most of the extra mass of the food as gases, like CO_2."
Agree	***Disagree***	Bai: "The cricket's body got rid of most of the extra mass of the food as solid waste (feces)."

1 point for correctly answering each line. 3 points total. Note that based on the information given, either agreeing or disagreeing with Marison and Bai is reasonable (see explanation below).

b) Provide an explanation. Why did you agree or disagree with each student's claim?

Level 4 explanations will consider answers to the Matter Movement and Matter Change Questions: Three things can happen to food that animals eat (undigested large organic molecules eliminated as feces, digested food used either for cellular respiration and energy or biosynthesis and growth) and use this knowledge to evaluate the students' claims:

- ***Darryl's claim is incorrect because it violates the principle of conservation of matter: Matter cannot be converted to energy in chemical or physical changes.***
- ***Marisol's claim correctly recognizes CO_2 as a product of cellular respiration. A Level 4 response could reasonably be "not sure" if there is an explanation that we can't be sure how much of the food is used for cellular respiration.***
- ***Bai's claim correctly recognizes that undigested food leaves the cricket's body as feces. Again, a Level 4 response could recognize that there is no information about how much of the food is digested by the cricket.***

1 point for rejecting Darryl's claim as impossible
1 point for recognizing Marisol's claim as possible due to cellular respiration (but possibly disagreeing with the claim that cellular respiration accounts for MOST of the mass)
1 point for recognizing Bai's claim as possible due to undigested food (but possibly disagreeing with the claim that undigested food accounts for MOST of the mass)
3 points total

The class generated some data. They measured the starting mass of 5 crickets and put each cricket in its own container. Then they gave each cricket 3 grams of food and made sure the

crickets always had the same amount of water. After one week, the students measured the mass of the cricket, leftover food and cricket feces. Below are the data they generated.

Sample	Increase in cricket mass (g)	Decrease in mass of food (g)	Mass of solid waste (g)
1	+0.2	-2.0	+0.4
2	+0.2	-2.1	+0.5
3	+0.3	-2.3	+0.5
4	+0.1	-1.9	+0.4
5	+0.4	-2.3	+0.7
Average	**+0.3**	**-2.1**	**+0.5**

c) Which claim do you think is best supported by the data?

a. Daryll's claim
b. Marisol's claim
c. Bai's claim

1 point for correct answer

d) Explain how the patterns in the data support the claim that you chose.

The best responses recognize that undigested food (solid waste) and growth (change in cricket mass) together account for only an average of 0.8 out of 2.1 grams that the average cricket ate. So the data support Marisol's claim better than the other two.

1 point for pointing to mass differences as evidence

d. What additional evidence would you collect to help show that the claim you chose is the best claim?

The best responses propose questions that target limitations in the data (recognize there is an unaccounted for matter pool, i.e., water); they focus on matter tracing and are constrained by principles such as matter to energy conversion.

1 point for identifying additional evidence that could be collected (could be water, oxygen, CO_2, or other conditions)

4. How do you think food contributes to people's body heat?

Level 4 responses recognize that stored energy (chemical/potential/bond energy OR C-C, C-H bonds, or calories) in the food is converted to heat. They may mention that heat is released in the process of cellular respiration.

1 point for identifying that the chemical energy in food is converted to heat or that heat is released during cellular respiration

5. When a girl breathes, she breathes in air that has more oxygen, and she breathes out air that has more carbon dioxide. Where in her body is the carbon dioxide produced?

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a) Circle True or False.

True	False	Some of the carbon dioxide is produced in the girl's LUNGS.
True	False	Some of the carbon dioxide is produced in the girl's HANDS.
True	False	Some of the carbon dioxide is produced in the girl's BRAIN.

1 point for correctly answering each line. 3 points total.

b) Explain how the carbon dioxide is produced in the girl's lungs, hands, and/or brain.

Level 4 responses recognize that all living cells in the body undergo cellular respiration, and therefore produce CO_2 as a waste product that must be removed from the body. They may also state that the carbon comes from food or from stored biomass.

1 point for identifying carbon dioxide as a product of cellular respiration

6. When a mouse is alive it has energy stored in its living parts (muscles, fat, blood, etc.). When the mouse dies all the parts are still there, but no longer alive.

a) Does a dead mouse still contain energy?

a. Yes

b. No

1 point for correct answer.

b) Explain your answer. If you answered YES, what kind(s) of energy are in the mouse after it dies and where is energy stored? If you answered NO, why does a dead mouse not have energy?

Level 4 responses may recognize that mice are composed primarily of protein and fat and that these are organic substances with many high-energy C-C and C-H bonds. The chemical potential energy in these bonds can be transformed to kinetic energy and heat in the living mouse. Level 4 responses recognize that although the mouse is no longer alive, the materials (protein, fat) are still there and have the same chemical potential energy as before.

1 point for identifying that the mouse has chemical energy.
1 point for identifying that the chemical energy is in the large organic molecules (in C-C and C-H bonds) that make up the mouse.
1 point for identifying that the materials that make up the dead mouse still have the same chemical energy.
3 points total.