

1.1: Assessing Animals Unit Pretest

This pretest is designed to help students to express a wide range of ideas, even if they are incorrect. Ideally, students will come to recognize that they have many different ideas about animal growth, as well as unanswered questions.

*Level 4 responses are in **bold blue italics** below. Remember Level 4 is the eventual learning goal; we do not expect most, possibly any, students to produce these responses at this point in the unit. We also have suggestions based on our research about likely Level 2 and Level 3 responses. This worksheet has “assessing” in the title because we do NOT recommend giving your students a grade based on the scientific accuracy of their responses at this point in the unit. It is designed to be used as a tool for formative assessment.*

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 <i>is created by the girl.</i>
True	False <i>comes from air.</i>
True	False <i>comes from sunlight.</i>
True	False <i>comes from water.</i>
True	False <i>comes from food.</i>

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

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

Level 4 responses explains that the digestive system breaks down food into molecules that are used in biosynthesis AND blood is the vector of matter transport throughout the body. Level 3 responses explain that the digestive system digests/breaks down food into smaller constituents with no mention of biosynthesis (may say blood primarily carries oxygen), or explain that the digestive systems breaks down food for energy to help the girl grow. Level 2 responses explain that eating makes you grow/gain mass, provides a general explanation of digestion, explain that air and/or sunlight provide the girl with mass, and/or explain the girl grows as she gets bigger or older.

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 extracts matter/nutrients from food to be used in biosynthesis, and blood is the vector of matter transport throughout the body. Level 4 responses do not equate digestion to cellular respiration. Level 3 responses recognize that the digestive system extracts matter/nutrients from food, but are vague/unclear about what happens to the nutrients after this process (e.g., the nutrients "help" the girl grow); students may focus on blood as primarily a mode of oxygen transport. Level 3 responses may equate digestion to cellular respiration and getting energy from food. Level 2 responses do not attempt to provide a mechanistic answer about digestion (i.e., the girl eats so she grows); they may not be exactly sure what blood does in the body.

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

Level 4 responses recognize that blood is the vector of matter transport throughout the body. Level 3 responses may focus on blood as primarily a mode of oxygen transport. Level 2 responses may not show knowledge of what the blood actually does in the body.

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.

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

Level 4 students will answer this entire sequence of questions correctly. These students may recognize that the atoms in the fat molecules (which contain lots of high-energy C-C and C-H bonds) are rearranged to provide chemical energy for exercise, and that this process produces inorganic CO_2 and water vapor as waste that is released into the air. Level 3 students may explain that the atoms in fat molecules are converted into energy/heat, while Level 2 students may believe that the fat is "burned off" and disappears.

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)."

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

Level 4 responses disagree with Daryll because matter cannot be converted into energy and agrees or disagrees with Marisol and Bai because they are both possible matter-tracing pathways. Level 3 responses say that food/matter can be converted into energy, and/or matter cannot be breathed out as CO₂/gas. Level 2 responses only reason about 1 or 2 of the claims. Level 1 responses reason about the claims in a non-matter tracing way, talking in general terms about the cricket needing food to live.

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

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. Level 3 responses identifies all matter pools, or recognizes missing pools, but agrees with Daryll's claim that violates principles (Matter to Energy conversion), agrees with Bai's claim which is inconsistent with the data, or agrees with Marisol's claim but has flaws in his/her reasoning. Level 2 responses choose Bai because the mass of the waste produced is greater than the increase in mass of the cricket from growth. Level 1 responses explain that the more food the cricket ate, the more it grew, and/or the more waste it produced (within row data), recognizes relationships among some matter pools but doesn't relate them to the claims (may provide an explanation about food use for rationale), and /or uses the presence of a matter pool to justify a claim.

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

Level 3 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. Level 2 responses propose evidence that partially address limitations in the data. Level 1 responses identify aspects of the system that students are curious about independent of the data, they critique the experimental design, or do not recognize that additional evidence needs to be collected.

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. Level 3 responses will likely contain a matter/energy conversion where they state that the food itself is converted or turned into heat. Level 2 responses will likely explain that food gives people energy or that food is an enabler for activities/life processes or that it warms us. These responses may discuss the importance of food temperature or that "fat" warms up the body.

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?

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.

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 CO₂ as a waste product that must be removed from the body. They will also know that the carbon comes from food or from stored biomass.

Level 2 and Level 3 responses will likely know that CO₂ is released when we exhale, but may not know that all cells undergo cellular respiration. Therefore, they may say that only lungs produce CO₂ because they are the site for gas exchange with the environment. They may not be able to identify the source of the carbon or know where the CO₂ is produced.

In Lesson 5, students practice tracing the source of carbon dioxide to the organic materials that make up organisms and their food.

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

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. Level 3 students will recognize that some of the mouse's stored energy is still in its body, but may associate the energy only with specific materials (e.g., sugar, ATP), not recognizing that virtually all of the materials making up the mouse's body have stored chemical energy. Level 2 students will associate energy with life, so they will feel that the mouse's energy is lost when it dies. Level 2 and 3 students may believe that once the mouse has died (and is no longer moving) that the energy goes away or disappears.