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Activity 1.1: Assessing the Systems and Scale 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 log burns, there is heat and light energy in the flame. Where does the heat and light energy come from? Select True or False for the following statements.

Some heat and light energy:

T **F** *comes from the air*[1]
T **F** *is created* by the flame
T F *comes from the log*
T **F** *comes from the person* who lit the log[2]

Which ONE of the following do you think provides the MOST energy to the flame?
a. Energy stored in the air
b. Energy created by the flame
c. Energy stored in the log
d. Energy from the person who started the fire

Explain your choices. Where does the heat and light energy in the flame come from?

A level 4 response might state that the energy comes from the bond energy, chemical energy or potential energy in the log (just saying "the log" is not enough). These students may mention the person lighting the log and the air as they do contribute to energy.
A Level 3 response may state that the energy comes from the match, the wood, or the "sugars" in the wood or the explanation contains a matter/energy conversion, or does not show a clear separation of matter and energy. Level 2 responses tend to state that the energy comes from the flame or person who lit the log, and that it disappears afterwards. If the response seems to be bordering an L2/L3, use the choice selections to decide. An L3 will probably select that most of the energy comes from the match, and an L2 will probably select that most of it comes from the air, person, or water vapor.

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[1] *A **system** of oxygen and organic materials has chemical potential energy that is released when organic molecules in the wood react with oxygen. See "Carbon TIME Content Simplifications" at http://carbontime.bscs.org/resources for a discussion of different conventions for "locating" chemical energy within the system. In Carbon TIME we focus on C-C and C-H bonds as indicators of chemical energy that can be released through reaction with oxygen. With this convention, the correct answer to this question is "false."*

[2] *The person added some energy to the system but not to the flame. Thus the correct answer to this question is "false."*

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2. After a log burns for a while, it weighs less than it originally did before it was burned. What happened to some of the matter that used to be in the log? Select True or False for the following statements.

Some matter from the log *was converted into*

T F *ashes*
T F *carbon dioxide*
T **F** *heat and light energy*
T F *water vapor*

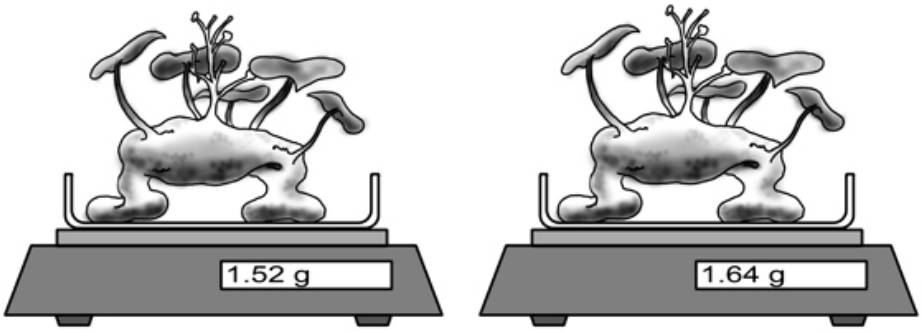
Which ONE of the following do you think MOST of the matter in the burning log was converted into?
a. Ashes
b. Carbon dioxide
c. Heat and light energy
d. Water vapor

Explain your choices. What happened to the matter in a log as it burned?
Level 4 responses clearly recognize that the burning log's matter goes to the air in form of CO_2 (and/or H_2O). *Level 3 responses recognize that at least some of the matter goes to the air, but also invoke matter/energy conversions. They may describe materials as mostly released into the air and tend to explain the situation in terms of matter/energy conversion (e.g. the materials from the match turn in to light and heat energy) or conservation of matter. Level 2 responses may explain that the matter transforms to different outputs (including energy and ashes) but it is not clear that these outputs are a result of a chemical transformation.*

3. A scientist has discovered a new living organism: the glubex. He put a glubex on the scale, weighed it, and then returned it to its habitat for one day. The next day he weighed it again. Here is what he found:

Original mass of the glubex: 1.52 grams

Mass of the glubex after one day: 1.64 grams



Decide if you agree or disagree with each of the students below.

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A student, Patrick, claims: "The **chemical energy** stored in the glubex's fat **was used** to make new **atoms**. These new atoms caused the increase in the mass of the glubex."

Circle one: AGREE **DISAGREE**

Another student, Joaquin, claims: The increase in the mass was caused by the movement of atoms from outside the glubex to inside the glubex."
Circle one: **AGREE** DISAGREE

Another student, Devin, claims: The glubex didn't have to take in atoms or make new atoms. Instead the glubex grew because its cells grew and divided.
Circle one: AGREE **DISAGREE**

Explain your reasoning for your choices.
Level 4 responses will indicate that atoms cannot gain or lose weight, cannot be created or destroyed and that energy cannot create atoms. They will follow all "rules".

Level 3 responses may follow the rules by stating that atoms cannot gain or lose weight, cannot be created or destroyed and that energy cannot create atoms. However, they may break rules by stating that atoms are created (either by energy or by dividing cells), by atoms getting heavier or by stating that atoms don't move in and out of objects. Level 2 responses will break rules. They might explain that atoms cannot move into the glubex, or that atoms reproduce, divide are created or get larger. These responses may also use circular reasoning such as "the glubex got heavier because it gained weight."

Choose ONE claim for which you agree with from above. Explain how this claim could be further tested to offer evidence that better supports the claim.

A Level 4 response might offer a test that "followed all the rules" and that was focused on tracing matter from outside the glubex to inside the glubex.

A Level 3 response may attempt to do this, but may have scientific inaccuracies or matter/energy conversions. A Level 2 response will not fit into either of the above levels. The written idea for how the claim could be further tested may not reasonably "better support the claim."

4. A scientist started sorting materials into two groups. Here are the first materials that she put into each group:
Group A: *Gasoline, alcohol, wood* ***Group B:*** *Sand, water, steel, carbon dioxide*

a. How would the scientist sort the following materials?

Salt	Group A	***Group B***
Sugar	***Group A***	Group B
Pork	***Group A***	Group B
Soil minerals that help plants grow	Group A	***Group B***
Leaves of a living tree	***Group A***	Group B

b. Explain how you decided. How are the materials in Group A different from the materials in Group B?

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A Level 4 response will state that they can be sorted in one of the following ways: Organic/inorganic, contains carbon/does not contain carbon, or contains energy/does not contain energy.

A Level 3 response might explain that Group A can BURN and Group B cannot burn, with no mention of energy bonds, etc. They may explain that Group A was ONCE LIVING and Group B was never living. A Level 2 response provides an explanation that does not focus on the properties of the materials themselves, and may contain faulty or unclear reasoning. Sorting schemes may include alive/dead, natural/man-made, animal/not animal, or states of matter (solid, liquid, gas).

5. Answer these true-false questions.

True	False	Carbon is a kind of atom.
True	***False***	Carbon is a kind of molecule.
True	False	There is carbon in pure air.
True	***False***	There is carbon in pure water.
True	False	There is carbon in alcohol.
True	False	There is carbon in wood.
True	False	There is carbon in our muscles.