

DRK-12 Carbon Assessment, Form A

Fall, 2011

Please don't include this first sheet in student copies.

This assessment is designed to elicit middle school or high school students' accounts of carbon-transforming processes.

Items 3, 5, 6, 12, and 15 were developed by AAAS Project 2061 and are available on their assessment website: <http://assessment.aaas.org/>.

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Form A—Introduction

This test will not affect your grade, but it is important. Your teacher is participating in a research project focusing on science learning. We are trying to learn how to teach science better. You can help us by answering these questions and explaining your ideas carefully.

Practice Question

You will have several questions on this test that ask you to make two different choices about something. This is a practice question to help you understand how you should answer those questions. Try doing this practice question, then talk with your teacher if you have questions about it.

This question is about the 25 letters below:

A A A A A
A B A A B
A B A d A
A B A A A
A A A A E

Which of the following statements is true? Circle the letter of the correct answer.

- a. ALL of the letters are capital letters, OR
- b. SOME of the letters are lower case letters.

Circle the best choice to complete each of the statements about the capital letters.

How many of the capital letters are A's?	All or most	Some	None
How many of the capital letters are B's?	All or most	Some	None
How many of the capital letters are C's?	All or most	Some	None
How many of the capital letters are E's?	All or most	Some	None

Correct answers

Did you answer the questions this way?

Which of the following statements is true? Circle the letter of the correct answer.

- a. ALL of the letters are capital letters, OR
- b. SOME of the letters are lower case letters.

Note that you have to choose either a or b.

Circle the best choice to complete each of the statements about the colored rectangle.

How many of the capital letters are A's?	All or most	Some	None
How many of the capital letters are B's?	All or most	Some	None
How many of the capital letters are C's?	All or most	Some	None
How many of the capital letters are E's?	All or most	Some	None

Note that you can make a different choice for each color

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1. A mature oak tree can have a mass of 500 kg, or more, even after all the water in the tree is removed. Yet it starts from an acorn that weighs only a few grams. Where did this huge increase in mass come from?



Which of the following statements is true? Circle the letter of the correct answer.

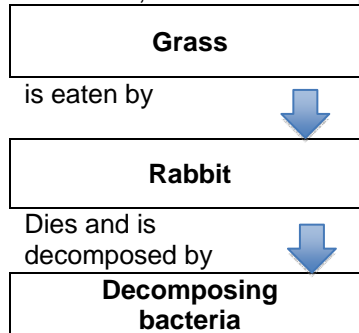
- a. ALL of the increase in mass came from matter that was originally outside the tree, OR
- b. SOME of the increase in mass came from matter that the tree made as it grew.

Circle the best choice to complete each of the statements about possible sources of mass from outside the tree.

How much of the dry mass comes from the AIR?	All or most	Some	None
How much of the dry mass comes from SUNLIGHT?	All or most	Some	None
How much of the dry mass comes from WATER?	All or most	Some	None
How much of the dry mass comes from SOIL NUTRIENTS?	All or most	Some	None

Explain your choices. How does the oak tree gain mass as it grows?

2. Here is a simple food chain with one plant, one animal, and some decomposers:



Describe what happens to matter and energy in this food chain by filling in the following table:

	Matter	Energy
Similar matter and energy	How are the materials in the grass, the rabbit, and the bacteria all alike?	How are the types of energy in the grass, the rabbit, and the bacteria all alike?
Different matter and energy	How are the materials in the grass, the rabbit, and the bacteria different from one another?	How are the types of energy in the grass, the rabbit, and the bacteria different from one another?
Connections	How are the materials in the grass, the rabbit, and the bacteria connected?	How is the energy in the grass, the rabbit, and the bacteria connected?

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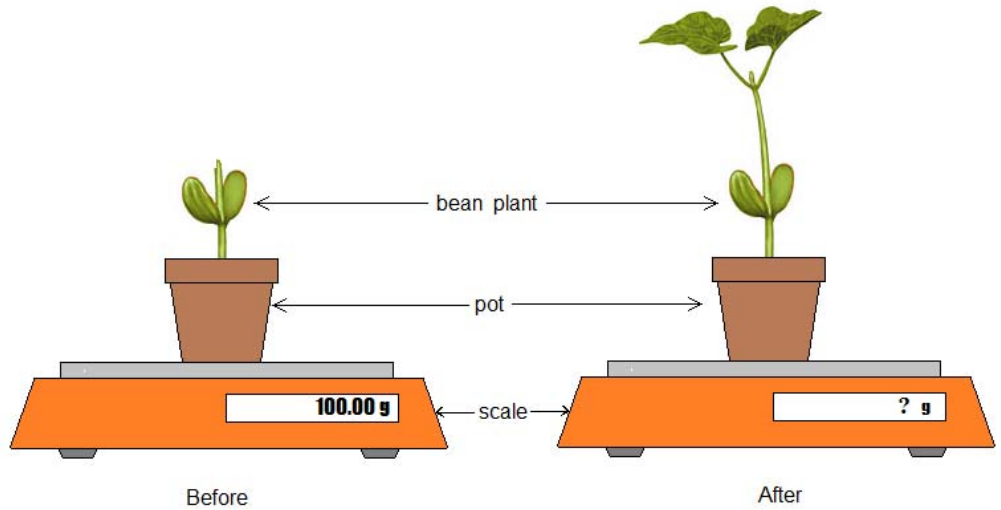
3. As an animal grows, what happens to the food that it eats?
- All of the food is changed into waste that leaves the animal's body.
 - All of the food is changed into energy in the animal's body and so the food is used up.
 - Some of the food is changed into energy, and the rest leaves the animal's body as waste.
 - Some of the food is changed into new substances that become part of the animal's body.

4. The following is an experiment regarding plant growth.

Suppose we have a growing bean plant in a small pot with plenty of soil and make sure it always has the same amount of water in the soil. Nothing can get in or out of the cup except gases and water.

At the beginning of the experiment, the pot, plant, and soil weighed exactly 100 g. At the end of the experiment, the plant has grown bigger. How much would you expect the pot, plant, and soil to weigh?

- More than 100 g.
- Still exactly 100 g.
- Less than 100 g.



Explain the reason for your prediction. If you think there will be more or less mass, explain where the mass will come from or go.

5. A tree falls in the forest. After many years the tree will appear as a long, soft lump on the forest floor. The lump on the forest floor weighs less than the original tree. What happened to the matter that used to be in the tree?



Which of the following statements is true? Circle the letter of the correct answer.

- ALL of the matter is still somewhere in the environment, OR
- SOME of the matter was consumed by the decay process and no longer exists.

Circle the best choice to complete each of the statements about possible places where the matter in the dead tree might go.

How much of the matter in the tree goes into the AIR?	All or most	Some	None
How much of the matter in the tree turns into HEAT ENERGY?	All or most	Some	None
How much of the matter in the tree goes into the SOIL?	All or most	Some	None
How much of the matter in the tree goes into WATER?	All or most	Some	None

Explain your choices. What happens to the matter in a tree as it decays?

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6. A loaf of bread was left alone for 2 weeks. 3 different kinds of mold grew on it. Assuming the bread did not dry out, which of the following is a reasonable prediction of the weight of the bread and mold after the 2 week period?

- a. The mass has increased, because the mold has grown.
- b. The mass remains the same as the mold converts bread into biomass.
- c. The mass decreases as the growing mold converts bread into energy.
- d. The mass decreases as the mold converts bread into biomass and gases.

Please explain your answer.

7. A student places some baking soda and a jar of lemon juice in a plastic bag and seals the bag. She weighs the bag and everything in it. She shakes the bag so that the lemon juice spills out of the jar and mixes with the baking soda inside the bag. The student observes that bubbles form and the bag expands. If the student weighs the bag and everything in it after the bubbling stops and compares the final weight to the starting weight, what will she find out?

- a. The final weight will be greater than the starting weight because new atoms are produced during the experiment.
- b. The final weight will be less than the starting weight because some of the atoms are destroyed during the experiment.
- c. The final weight will be the same as the starting weight because the number of each kind of atom does not change during the experiment.
- d. The final weight will be the same as the starting weight because some atoms are destroyed, but new ones are created during the experiment.

8. A student has two different liquids in open jars. She pours the liquid from one jar into the other jar, and she observes bubbles. After the bubbling stops, she finds that the total weight of the liquids is now less than the total weight of the liquids before they were mixed together. How can her observation be explained?

- a. Some atoms went into the air.
- b. Some atoms were destroyed.
- c. Some atoms became heavier.
- d. Some atoms became lighter.

9. A tomato plant needs energy to live and grow. How does it get its energy?

Which of the following statements is true? Circle the letter of the correct answer.

- a. ALL of the tomato plant's energy came originally from sources outside the plant, OR
- b. SOME of the tomato plant's energy was made by the tomato plant as it grew.



Circle the best choice to complete each of the statements about possible sources of energy from outside the tomato plant.

How much of the tomato plant's energy come from the AIR?	All or most	Some	None
How much of the tomato plant's energy come from the SUNLIGHT?	All or most	Some	None
How much of the tomato plant's energy come from the WATER?	All or most	Some	None
How much of the tomato plant's energy come from the SOIL NUTRIENTS?	All or most	Some	None

Explain your choices. How does the tomato plant get its energy?

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10. A student was studying how mice grow. He collected these data:

Mass of mouse at the beginning of the experiment: 50 g

Mass of mouse one week later: 60 g

Mass of water that the mouse drank: 30 g

Mass of food that the mouse ate: 30 g

The student said, "The food and the water weighed the same amount, so growing mice get half of their weight from food and half from water."

Do you think that the student's conclusion is correct? Yes No

Explain your reasoning. Why is the student's conclusion correct or incorrect?

11. Milk contains water, carbohydrates, proteins, minerals, and fat. Is milk food for people?

a. No, because liquids cannot be food, and milk is a liquid

b. No, because for something to be food it must provide both energy and building materials, and milk does not provide energy

c. Yes, because for something to be food it must provide energy, and the minerals in milk provide energy

d. Yes, because food is a source of energy and building materials, and milk provides energy and building materials

12. When a tree is alive it has energy stored in its living parts (roots, trunk, branches and green leaves). When the tree dies all the parts are still there (including fallen brown leaves). How much of the energy stored in the living tree is still there in the dead tree?

a. ALL of the energy

b. MOST of the energy

c. SOME of the energy

d. A LITTLE of the energy

e. NONE of the energy



Explain your answer.

What kinds of energy are stored in the living tree? Where did they come from?

What kinds of energy are stored in the dead tree (if any)? How are they connected to the energy in the living tree?

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13. In autumn, people pile fallen leaves and send them to the trash dump. After several weeks, the pile becomes warm. Where does the heat come from?



14. A potato is left outside and gradually decays. One of the main materials in the potato is the starch, which is made of many sugar molecules ($C_6H_{12}O_6$) bonded together. What happens to the atoms in starch molecules as the potato decays? Circle True (T) or False (F) for each option.

- T F Some of the atoms are changed into soil nutrients: nitrogen and phosphorus.
- T F Some of the atoms are used up by decomposers and no longer exist.
- T F Some of the atoms go into the air in carbon dioxide.
- T F Some of the atoms are turned into energy by decomposers.
- T F Some of the atoms go into the air in water.

15. A national park is home to large populations of mountain lions, deer, rabbits, and grass. Recently, park rangers decided to introduce wolves to the park. Mountain lions and wolves both eat deer and rabbits. Deer and rabbits both eat grass. If the number of deer and rabbits eaten by the mountain lions stays the same, what will happen to the grass after wolves are introduced? Use only the relationships between the plants and animals described above.

- a. The amount of grass will increase.
- b. The amount of grass will stay the same.
- c. The amount of grass will decrease until it is all gone.
- d. The amount of grass will decrease, but some will remain.