DRK-12 Carbon Assessment, Form C

Fall, 2013

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 C—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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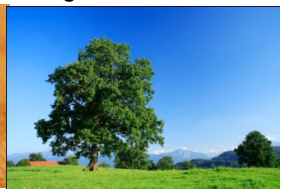
Form C: 2013-2014

1. Like all materials, the wood of a large oak tree is made of atoms. There were some atoms in the original acorn that the oak tree grew from. Where do you think the additional atoms came from? Circle the letter of the correct answer:



a. ALL of the additional atoms were originally outside the tree,
b. SOME of the additional atoms were made by the tree as it grew.

Circle the best choice to answer each question 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. As an animal grows, what happens to the food that it eats?

a. All of the food is changed into waste that leaves the animal's body.
b. All of the food is changed into energy in the animal's body and so the food is used up.
c. Some of the food is changed into energy, and the rest leaves the animal's body as waste.
d. Some of the food is changed into new substances that become part of the animal's body.

3. A student, Mike claims: "A growing plant gains most of its weight from materials that came from the soil." Another student, Lucia, disagrees. She says: "No, a plant gains most of its weight from gases in the air."

Mike adds some evidence for his claim by starting with six identical plants and growing them in identical conditions for one month except that three plants were given no fertilizer, and three plants were given fertilizer.

Plants grown without fertilizer	**Fertilizer added**	**Plants grown with fertilizer**
50 g	3 g	66 g
52 g	3 g	62 g
48 g	3 g	65 g
Average weight: 50 g	**Average weight: 3 g**	**Average weight: 65 g**

Do Mike's data support his claim that plants gain weight from materials that came from the soil? YES NO

Explain why or why not.

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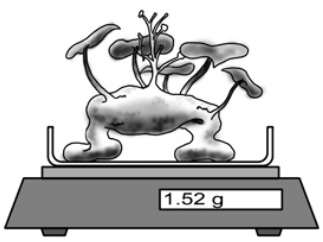
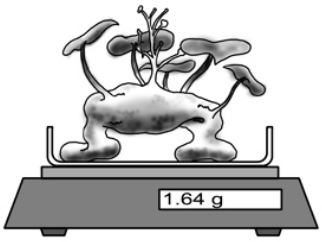
Mike could have used more plants and more pots. Explain any other weaknesses that you see in Mike's argument.

4. A scientist has discovered a new living organism: the **glubex**. He put a glubex on a scale, weighed it, and left it alone for one day.

Here is what he found:
Original mass of the glubex: 1.52 grams
Mass of the glubex after one day: 1.64 grams





Decide whether each of the following explanations is possible or not:

The atoms of the glubex got heavier when the glubex gained weight.	Possible	Impossible
Atoms that were outside the glubex moved into the glubex.	Possible	Impossible
The glubex used chemical energy stored in its fat to make new atoms.	Possible	Impossible
When the cells of the glubex divided to make new cells, it made new atoms, too.	Possible	Impossible

How do you think the glubex gained mass?

5. 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. How much of the energy stored in the living mouse is still there in the dead mouse?

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 answers. What kinds of energy are stored in the living mouse? Where did they come from?

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

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

7. Which of the following describes how energy is transferred between the sun and a tree

a. Energy is transferred as light is radiated from the sun and directly absorbed by the tree.

b. Energy is transferred as an electrical current travels from the sun to the tree.

c. Energy is transferred as thermal energy is given off from the sun and directly absorbed by the tree.

d. Energy is not transferred between the sun and the tree.

8. A student places a living plant in a jar and seals it so nothing can get in or out. He determines the total mass of the jar and everything inside it. Several weeks later, the plant is dead.

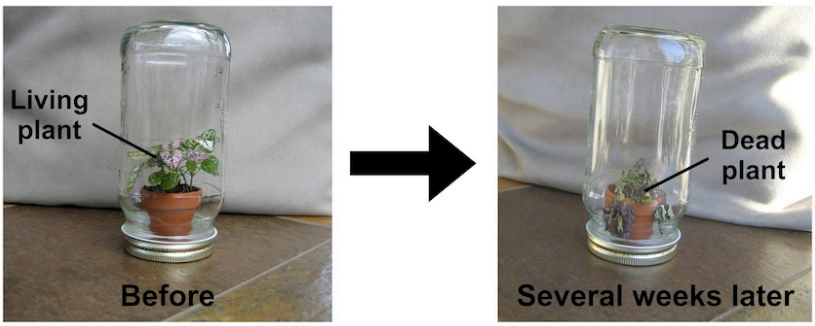
What will happen to the total mass of the jar and everything inside it after the plant dies?

a. The mass will stay the same.

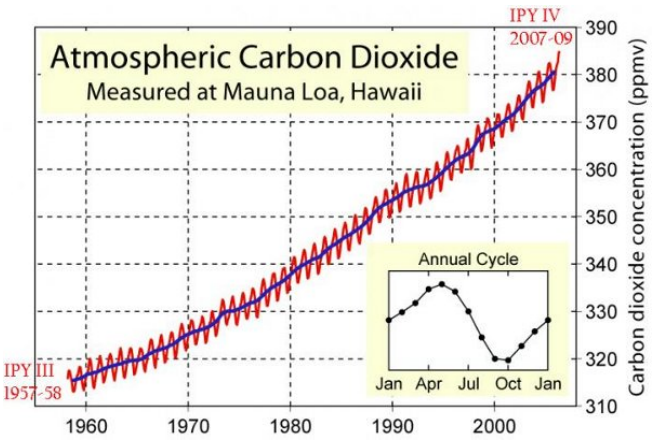
b. The mass will increase.

c. The mass will decrease.

d. It depends on the type of plant.



9. This graph shows changes in carbon dioxide in the atmosphere over a 47-year span in Hawaii. Other measurements in different places on the Earth show the same pattern.



Why do you think carbon dioxide levels go down in the summer and go up in the winter? Circle the best choice to complete each of the statements. How much of the annual cycle is…

… caused by HUMANS BURNING COAL AND GASOLINE?	All or most	Some	None
… caused by CHANGES IN PLANT GROWTH?	All or most	Some	None
… caused by NUCLEAR POWER PLANTS?	All or most	Some	None
… caused by CHANGES IN WIND AND WEATHER?	All or most	Some	None

Explain your choices. Why does atmospheric carbon dioxide go down every summer and go up every winter?

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Why do you think carbon dioxide in the atmosphere goes a little higher each year? Circle the best choice to complete each of the statements. How much of the continual rise is…

… caused by HUMANS BURNING COAL AND GASOLINE?	All or most	Some	None
… caused by CHANGES IN PLANT GROWTH?	All or most	Some	None
… caused by NUCLEAR POWER PLANTS?	All or most	Some	None
… caused by CHANGES IN WIND AND WEATHER?	All or most	Some	None

Explain your choices. Why is there a little more carbon dioxide in the atmosphere each year?

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

10. A student, Lucia claims: "A growing plant gains most of its weight from gases in the air." Another student, Mike, disagrees. He says: "No, a plant gains most of its weight from materials that came from the soil."

Lucia adds some evidence for her claim by growing five plants from seeds. She weighed the dry seeds and the soil at the beginning of the experiment. At the end of the experiment two months later she removed the plants from the soil and both were dried and weighed. The figure below shows the change in mass from the beginning to the end of the experiment.

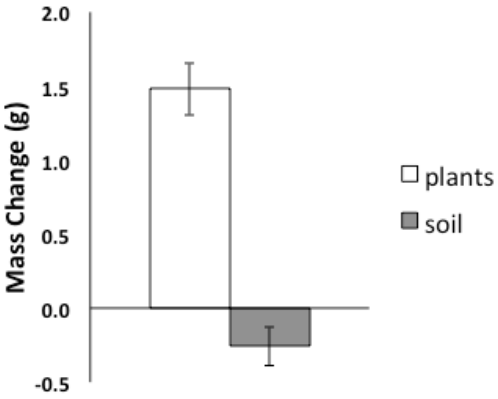

Figure of average mass changes

Do Lucia's data support her claim that plants gain weight from materials that came from the air? Choose one: YES NO

Explain why or why not.

Lucia could have used more plants and more pots. Explain any other weaknesses that you see in Lucia's argument.

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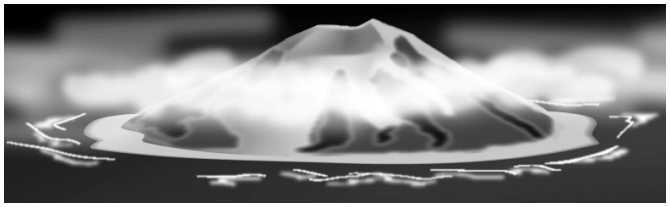
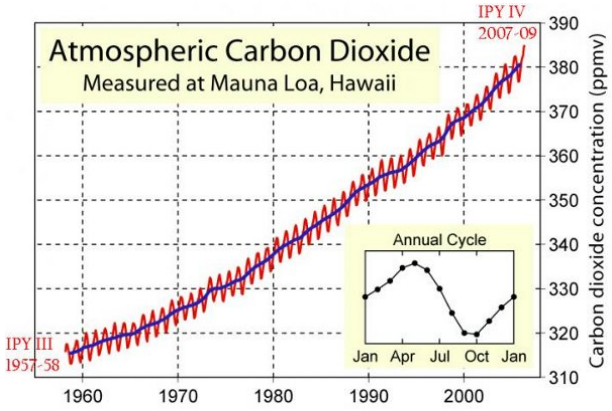
12. This graph shows levels of carbon dioxide concentrations in the atmosphere in the past 50 years. These data were collected at Mauna Loa.

Mauna Loa is a tall mountain on the island of Hawaii in the middle of the Pacific Ocean. A scientist named Charles Keeling collected these data.





Why do you think Charles Keeling went to Mauna Loa in Hawaii to collect these data instead of some other place?

Do you think we could use these data to tell us anything about how CO_2 concentrations are changing in your state during this period? Circle one: YES NO

Why or why not?

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

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

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14. When a baby was five months old, she weighed 8 kg. After 7 years, the baby has grown into a big girl, weighing 25 kg. Where did her increase in mass come from? Which of the following statements is true? Circle the letter of the correct answer.

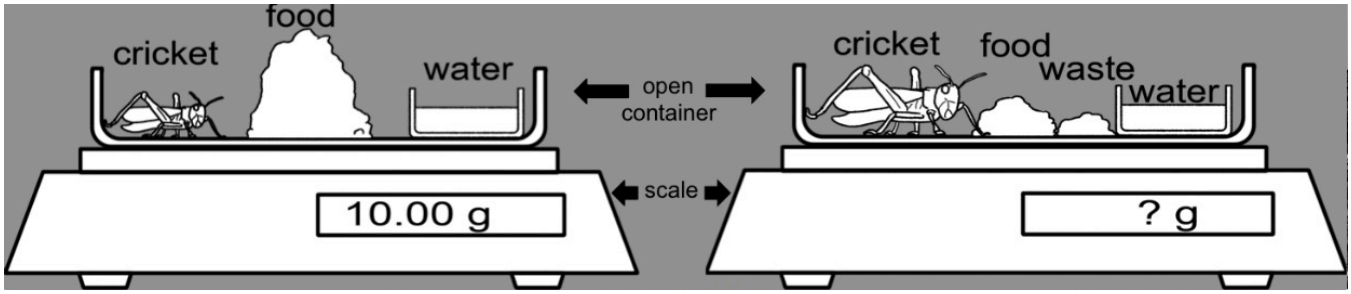
a. ALL of the increase in mass came from matter that was originally outside the girl, OR
b. SOME of increase in mass came from matter that the girl made as she grew.

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

How much of the girl's mass came from the AIR?	All or most	Some	None
How much of the girl's mass came from SUNLIGHT?	All or most	Some	None
How much of the girl's mass came from WATER?	All or most	Some	None
How much of the girl's mass came from FOOD?	All or most	Some	None

Explain your choices. How does the girl gain mass as she grows?

15. The following is an experiment regarding animal growth. Suppose we put a cricket in a container with plenty of food and make sure that it always has the same amount of water. The container is NOT sealed. Gases and water are the only things that can get in or out. At the beginning of the experiment, the container with cricket, water, and food weighs exactly 10 g.



At the end of the experiment, the cricket has eaten some of the food and gotten bigger. Some of the cricket's waste (feces or poop) is also in the container. How much would you expect the container (with cricket, food, water, and waste) to weigh?

a. More than 10 g.
b. Still exactly 10 g.
c. Less than 10 g.

Explain the reason for your prediction.

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16. Is water a source of food for plants and animals? Why or why not?

a. Yes, because food is anything that is needed by plants and animals, and water is needed by plants and animals

b. Yes, because food is anything that provides energy to plants and animals, and water provides energy to plants and animals

c. No, because liquids cannot be food for plants and animals, and water is a liquid

d. No, because food must contain molecules that have carbon atoms linked to other carbon atoms, and water molecules do not have carbon atoms linked to other carbon atoms