

DRK-12 Carbon Assessment, Form B

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 B—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.

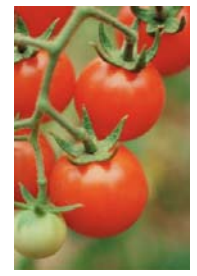
Circle the best choice to complete each of the statements about the colored rectangle.

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 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?

2. 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

a. Which group would you put these materials in?

Salt	Group A	Group B
Sugar	Group A	Group B
Pork	Group A	Group B
Carbon dioxide	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?

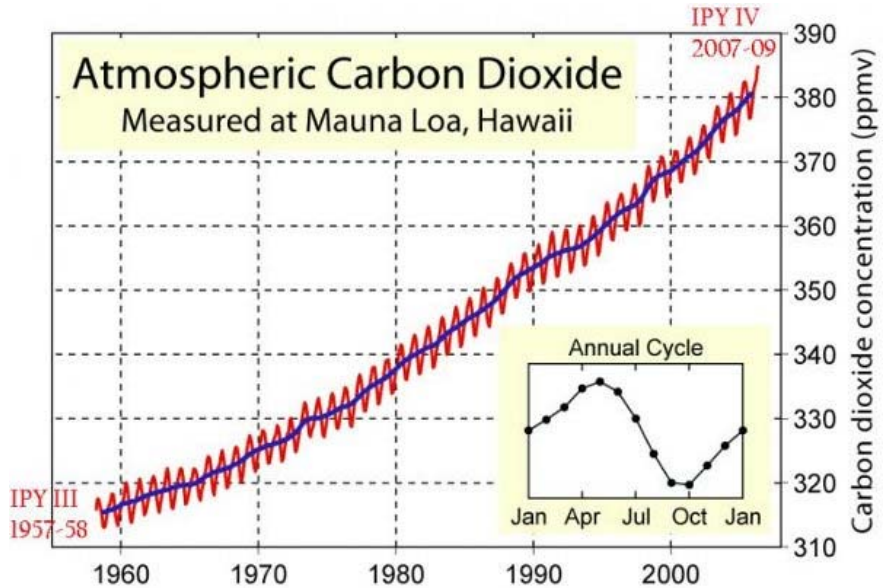
c. Is there a different way of grouping the materials that makes more sense to you? YES NO

d. Explain your answer. How would you group the materials differently, or why do you like these groups?

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3. Milk contains water, carbohydrates, proteins, minerals, and fat. Is milk food for people?
- No, because liquids cannot be food, and milk is a liquid
 - No, because for something to be food it must provide both energy and building materials, and milk does not provide energy
 - Yes, because for something to be food it must provide energy, and the minerals in milk provide energy
 - Yes, because food is a source of energy and building materials, and milk provides energy and building materials

4. The graph given to the right shows changes in concentration of carbon dioxide in the atmosphere over a 47-year span at Mauna Loa observatory at Hawaii, and the annual variation of this concentration. Other measurements in different parts of the Earth show the same pattern.



a. Why do you think this graph shows atmospheric carbon dioxide levels decreasing in the summer every year and increasing in the winter?

Circle the best choice to complete each of the statements about what process causes the annual cycle in carbon dioxide concentration.

How much of the annual cycle is caused by HUMANS BURNING COAL AND GASOLINE?	All or most	Some	None
How much of the annual cycle is caused by CHANGES IN PLANT GROWTH?	All or most	Some	None
How much of the annual cycle is caused by NUCLEAR POWER PLANTS?	All or most	Some	None
How much of the annual cycle is caused by CHANGES IN WIND AND WEATHER?	All or most	Some	None

Explain your choices. Why does atmospheric carbon dioxide decrease every summer and increase every winter?

b. Why do you think this graph shows that there is more carbon dioxide in the atmosphere each year?

Circle the best choice to complete each of the statements about what process is causing the continuing rise in carbon dioxide concentration.

How much of the continual rise is caused by HUMANS BURNING COAL AND GASOLINE?	All or most	Some	None
How much of the continual rise is caused by CHANGES IN PLANT GROWTH?	All or most	Some	None
How much of the continual rise is caused by NUCLEAR POWER PLANTS?	All or most	Some	None
How much of the continual rise is caused by CHANGES IN WIND AND WEATHER?	All or most	Some	None

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

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5. When a match burns, the ashes weigh less than the original match. What happened to the matter that used to be in the match?



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

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

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

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

Explain your choices. What happens to the matter in a match as it burns?

6. Gasoline is mostly a mixture of hydrocarbons such as octane: C_8H_{18} . Choose whether each of the following statements is true (T) or false (F) about what happens to the atoms in a molecule of octane when it burns inside a car.

- T F Some of the atoms in the octane are incorporated into carbon dioxide in the air.
- T F Some of the atoms in the octane are incorporated into air pollutants such as ozone (O_3) or nitric oxide (NO_2).
- T F Some of the atoms in the octane are converted into energy that moves the car.
- T F Some of the atoms in the octane are burned up and disappear.
- T F Some of the atoms in the octane are converted into heat.
- T F Some of the atoms in the octane are incorporated into water vapor in the atmosphere.

Is air needed for the car to use the gasoline? If so, how does the air change as the car runs?

7. Which of the following is food for a plant?

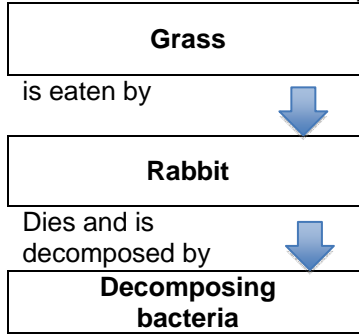
- a. Sugars that a plant makes
- b. Minerals that a plant takes in from the soil
- c. Water that a plant takes in through its roots
- d. Carbon dioxide that a plant takes in through its leaves

8. Where does the food that a plant needs come from?

- a. The food comes in from the soil through the plant's roots.
- b. The food comes in from the air through the plant's leaves.
- c. The plant makes its food from carbon dioxide and water.
- d. The plant makes its food from minerals and water.

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9. 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?

10. A scientist is investigating plant growth. She planted seeds in soil with different fertilizers. She weighed the seeds and the containers full of soil. After two months she wants to know which plants have grown the most.

Which is the **best** way to measure the growth of the plants?

- a) measure each plant's height
- b) weigh each plant in its container
- c) remove the soil from each plant's roots, dry the entire plant and weigh it
- d) measure the number and size of each plant's leaves

Explain your choice. Why is the method you chose better than the others?

11. 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.

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12. Fluorescent light bulbs use less energy than incandescent light bulbs.

Do you think that using fluorescent light bulbs instead of incandescent light bulbs can reduce the amount of carbon dioxide going into our atmosphere? Yes No



Explain your answer. How can using fluorescent bulbs help reduce the amount of carbon dioxide going into our atmosphere, or why will they not help?

13. A burning candle is put into an air-tight container. After some time, the candle stops burning.

Predict whether the air inside the jar will have more, the same, or less of the gases below.

Gas	Prediction:		
Oxygen	More	Same	Less
Carbon dioxide	More	Same	Less
Water vapor	More	Same	Less



Explain your answers. How did the burning candle change the gases in the jar?

Where did the carbon in the carbon dioxide come from?

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14. When a match burns, there is heat and light energy in the flame. Where did that energy come from?



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

- a. ALL of the energy came from the match or another source, OR
- b. SOME of the energy was created by the flame as it burned.

Circle the best choice to complete each of the statements about possible places where the energy in the flame might come from.

How much of the energy in the flame comes from the AIR?	All or most	Some	None
How much of the energy in the flame came from the PERSON WHO STRUCK THE MATCH?	All or most	Some	None
How much of the energy in the flame came from the WOOD OF THE MATCH?	All or most	Some	None
How much of the energy in the flame came from the WATER VAPOR?	All or most	Some	None

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

After the flame goes out, does the energy still exist? Yes No

15. A patient is in the hospital. The nurse put a needle into his arm and connected it to a solution of sugar dissolved in water. Is the sugar and water solution that enters his body a source of food for the patient?

- a. Yes, because food is anything that provides energy, and the water in the solution provides energy
- b. Yes, because food is anything that is a source of both energy and building materials, and the sugar in the solution is a source of energy and building materials
- c. No, because liquids cannot be food, and the solution is a liquid
- d. No, because food has to enter the body through the mouth, and the sugar and water solution does not enter the patient's body through the mouth