Supplemental Material

CBE—Life Sciences Education

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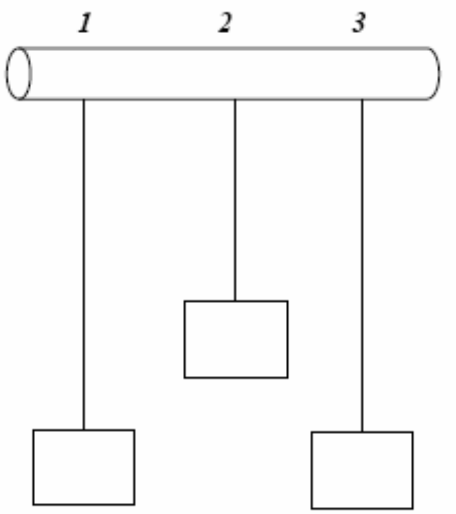
Scientific Reasoning Skills Assessment

This section consists of a series of passages. Each passage has two questions that ask you to make a prediction or solve a problem and then justify your response. Read each passage carefully and then circle the best answer for each of the two questions.

Below are drawings of three strings hanging from a bar. The three strings have metalweights attached to their ends. String 1 and String 3 are the same length. String 2 isshorter. A 10 unit weight is attached to the end of String 1. A 10 unit weight is alsoattached to the end of String 2. A 5 unit weight is attached to the end of String 3. Thestrings (and attached weights) can be swung back and forth and the time it takes to make a swing can be timed.



1. Suppose you want to find out whether the length of the string has an effect on the time it takes to swing back and forth. Which strings would you use to find out?

a. Only one string
b. All three strings
c. 2 and 3
d. 1 and 3
e. 1 and 2

2. My answer to Question #1 is correct because:

a. You must use the longest strings.
b. You must compare strings with both light and heavy weights.
c. Only the lengths differ.
d. To make all possible comparisons.
e. The weights differ.

Farmer Brown was observing the mice that live in his field. He discovered that all of them were either fat or thin. Also, all of them had either black tails or white tails. This made him wonder if there might be a link between the size of the mice and the color of their tails. So he captured all of the mice in one part of his field and observed them. Below are the mice that he captured.

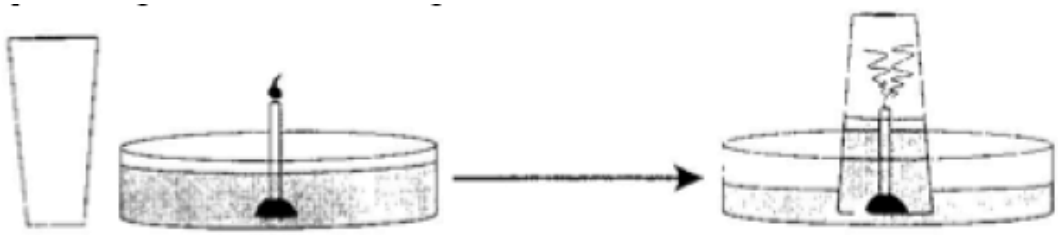
3. Do you think there is a link between the size of the mice and the color of their tails?

a. Appears to be a link
b. Appears not to be a link
c. Cannot make a reasonable guess

4. My answer to Question #3 is correct because:

a. There are some of each kind of mouse.
b. There may be a genetic link between mouse size and tail color.
c. There were not enough mice captured.
d. Most of the fat mice have black tails while most of the thin mice have white tails.
e. As the mice grew fatter, their tails became darker.

The figure below at the left shows a drinking glass and a burning birthday candle stuck in a small piece of clay standing in a pan of water. When the glass is turned upside down, put over the candle, and placed in the water, the candle quickly goes out and water rushes up into the glass (as shown at the right).



This observation raises an interesting question: Why does the water rush up into the glass? Here is a possible explanation. The flame converts oxygen into carbon dioxide. Because oxygen does not dissolve rapidly into water but carbon dioxide does, the newly formed carbon dioxide dissolves rapidly into the water, lowering the air pressure inside the glass.

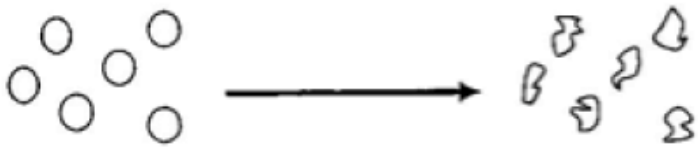
5. Suppose you have the materials mentioned above plus some matches and some dry ice (dry ice is frozen carbon dioxide). Using some or all of the materials, how could you test this possible explanation?

a. Saturate the water with carbon dioxide and redo the experiment noting the amount of water rise.
b. The water rises because oxygen is consumed, so redo the experiment in exactly the same way to show water rise due to oxygen loss.
c. Conduct a controlled experiment varying only the number of candles to see if that makes a difference.
d. Suction is responsible for the water rise, so put a balloon over the top of an open ended cylinder and place the cylinder over the burning candle.
e. Redo the experiment, but make sure it is controlled by holding all independent variables constant; then measure the amount of water rise.

6. What result of your test (mentioned in #5 above) would show that your explanation is probably wrong?

a. The water rises the same as it did before.
b. The water rises less than it did before.
c. The balloon expands out.
d. The balloon is sucked in.

A student put a drop of blood on a microscope slide and then looked at the blood under a microscope. As you can see in the diagram below, the magnified red blood cells look like little round balls. After adding a few drops of salt water to the drop of blood, the student noticed that the cells appeared to become smaller.



Magnified Red Blood Cells *After Adding Salt Water*

This observation raises an interesting question: Why do the red blood cells appear smaller? Here are two possible explanations:

I. Salt ions (Na+ and Cl-) push on the cell membranes and make the cells appear smaller.

II. Water molecules are attracted to the salt ions so the water molecules move out of the cells and leave the cells smaller.

To test these explanations, the student used some salt water, a very accurate weighing device, and some water-filled plastic bags, and assumed the plastic behaves just like red blood-cell membranes. The experiment involved carefully weighing a water-filled bag,placing it in a salt solution for ten minutes and then reweighing the bag.

7. What result of the experiment would best show that explanation I is probably wrong?

a. The bag loses weight
b. The bag weighs the same
c. The bag appears smaller

8. What result of the experiment would best show that explanation II is probably wrong?

a. The bag loses weight
b. The bag weighs the same
c. The bag appears smaller