Science Item Examples

Item 1

A biology student wants to determine the carrying capacity of trout in a region. He selects a lake that is open to the public that does not have trout but is capable of supporting trout. He plans to follow the steps shown to determine the carrying capacity of trout in the lake.

1. Stock the public lake with a predetermined number of trout.
2. Count the trout population three times a year for two years.
3. When the trout population begins to decrease, count individual trout for an additional three years.

Which statement describes a weakness of this investigation?

A. The student will use a predetermined number of trout.

B. The student plans to conduct the study using a public lake.

C. The student will evaluate the lake for three years after the trout population decreases.

D. The student plans to count the trout population three times a year for two years.

Item 2

An enzyme called pectinase is used by the fruit juice industry to increase the yield obtained during the juice extraction process. A researcher is investigating the effectiveness of pectinase by using this procedure.

1. Label two beakers A and B.
2. Add 50 g of chopped apple to each beaker.
3. Add 4 milliliters (mL) of prepared pectinase solution to beaker A.
4. Add 4 mL of distilled water to beaker B.
5. Stir the contents of both beakers.
6. Allow the beakers to remain undisturbed for 30 minutes.
7. Filter out the solids and measure the juice in each beaker.

Click on the variables you want to select and drag them into the boxes.

Independent Variable	Dependent Variable	Controlled Variables

Variables

- amount of chopped apple used
- presence of pectinase
- amount of juice extracted
- number of minutes

Item 3

Plants live in symbiosis with soil microbes. These microbes colonize plants' roots. Researchers hypothesized that because different microbes perform different functions to aid plant growth, a greater microbial diversity will lead to a greater uptake of plant nutrients, such as nitrogen and phosphorus. Researchers performed an investigation of two species of microbes (AM fungi and rhizobia) in a grassland community containing two types of plants: grasses and legumes.

Which observation provides evidence that *best* supports this hypothesis?

A. Grasses have higher survival rates than legumes when rhizobia are present in the soil.

B. Legumes contain greater phosphorus concentrations than grasses when AM fungi are present in the soil.

C. Plants take up more phosphorus when AM fungi are present in the soil and more nitrogen when both species of microbes are present.

D. Plant communities are more diverse when both species of symbiotic microbes are present in the soil than when only rhizobia are present.

Item 4

Two teams of researchers studied the interactions between fungi and trees. Team A found that when olive trees form a symbiotic relationship with the fungus *G. mosseae*, the trees grow larger roots and shoots because *G. mosseae* provides the trees with increased nutrients, including nitrogen, phosphorus, and potassium. This table shows the results of team A's study.

	Control	*G. mosseae*
Shoot Surface Area (cm^2)	66.98	206.60
Root Surface Area (cm^2)	80.58	282.36

Team B found that when white spruce trees form a symbiotic relationship with the fungus *P. scopiformis*, populations of the tree's insects decline due to toxins within the fungus that kill adult and larval insects. This table shows the results of team B's study.

	Control	*P. scopiformis*
Larval Survival	59%	50%
Total Survival	55%	40%

Which statement *best* evaluates the teams' results?

A. Team A's results are more reliable because this team studied two characteristics of the trees.

B. Team B's results are more reliable because this team studied the effects on both the trees and the insects.

C. Neither team's results are reliable because both teams only tested a single species of fungus, resulting in similar effects.

D. Both teams' results are reliable because both teams tested different fungus and tree species, so different effects are expected.

Item 5

There are two general types of dissolved organic matter (DOM) found in freshwater ecosystems that are classified by their origin. Type 1 DOM originates on land while Type 2 DOM originates in freshwater. Microbes degrade DOM as part of the carbon cycle, making the matter available for use by other organisms. Two groups of scientists (X and Y) studied DOM origin and degradation.

Group X collected and isolated oomycetes, which are closely related to algae, from lake banks and organized them into two treatments: carbon from terrestrial sources and carbon from water sources. This group found that the oomycetes could only degrade Type 2 DOM and concluded that it is more difficult for some freshwater organisms to degrade Type 1 DOM than Type 2 DOM.

Group Y collected stream water and isolated bacteria from that water. Then, the group placed isolated bacteria in three samples of water from the same stream and measured the time required for most DOM to be degraded. The group found no difference between the amount of Type 1 and Type 2 DOM remaining at the end of the experiment, suggesting that bacteria can degrade both types of DOM.

Which statement *best* evaluates the groups' findings?

A. Only Group X is most likely correct because this group used a control group as a base for comparison.

B. Only Group Y is most likely correct because this group used organisms and DOM from the same stream.

C. Both groups are equally likely to be correct because both groups studied completely different organisms.

D. Neither group is likely to be correct because both groups used completely different methods and are thus incomparable.

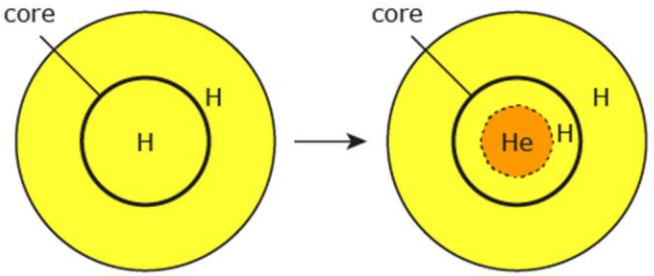
Item 6

When the Sun formed, three-fourths of its mass was hydrogen (H), while one-fourth was helium (He). Helium is more dense than hydrogen and therefore is always found closer to the core of the Sun.

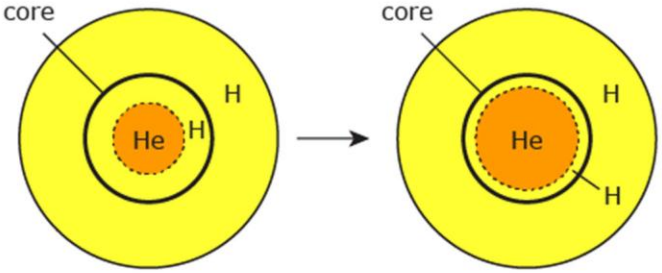
The core of the Sun is also hotter, and some of the hydrogen at the core is hot enough to fuse hydrogen into helium. Over time, the amount of hydrogen will decrease, and the amount of helium will increase.

Which set of diagrams *best* represents the Sun as it changes over time?

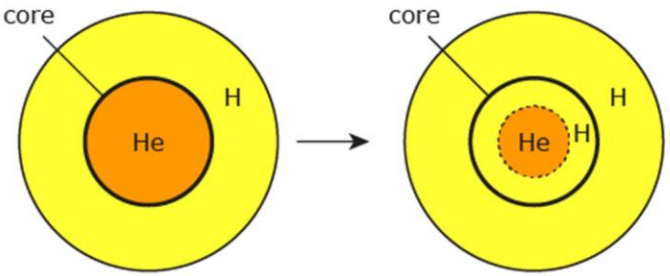
A.



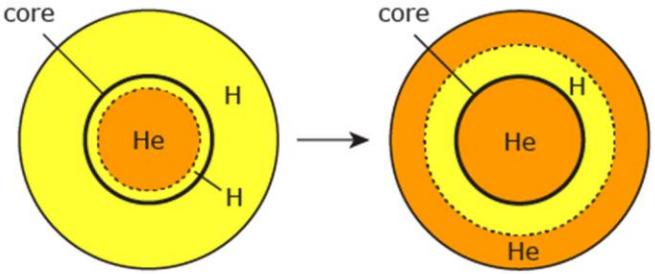
B.



C.



D.



Teaching Strategies - Investigations

An investigation is conducted to test the effectiveness of different insulation materials. Identical boxes are filled with different materials and left in direct sunlight. The temperature inside the boxes is monitored throughout the day. The results are shown in degrees Celsius (°C) in the table.

Insulation Material	9 a.m.	10 a.m.	2 p.m.	5 p.m.	8 p.m.
none	21	25	30	26	24
fiberglass	21	22	25	25	23
wool	21	21	25	24	23

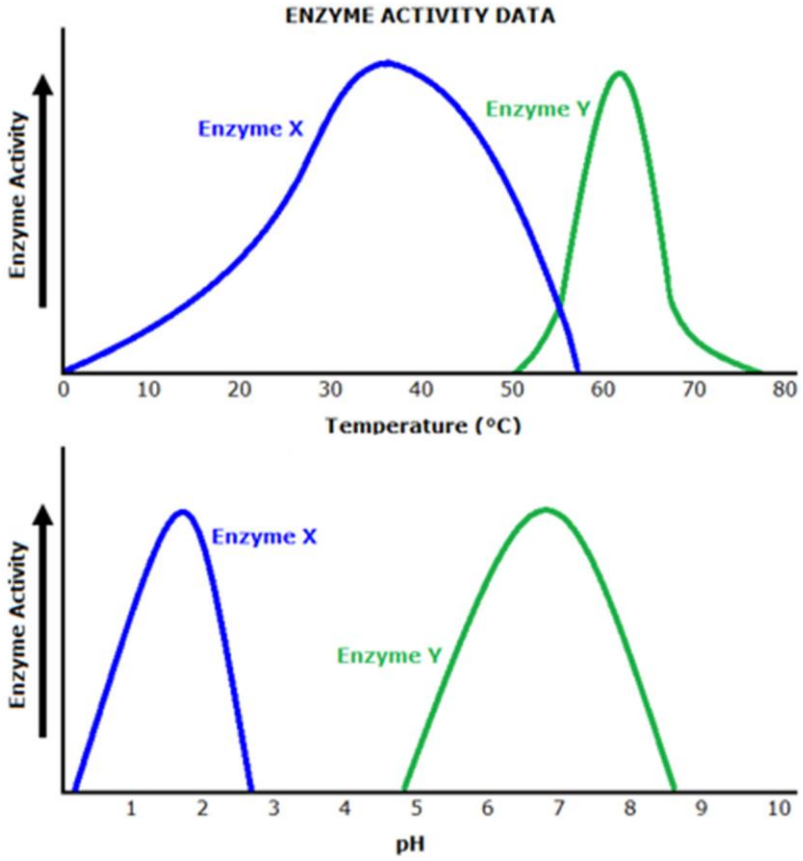
Which change will *most* improve the investigation by providing more specific results?

- A. include temperature measurements taken at nighttime
- B. seal the boxes completely with reflective tape
- C. use a thermometer that measures temperature to tenths of a degree
- D. inspect the materials in the boxes to look for damage

POSSIBLE ADDITIONAL QUESTIONS:

- What is the purpose of the investigation?
- What are the independent and dependent variables?
- Is there a control group?
- What is a probable hypothesis?
- What conclusion can be reached based on the data?
- What graph represents the data?
- What are the mean, median, and mode of the data?

Teaching Strategies – Evaluating Graphs



- What is presented in each of the graphs?
- What are the independent and dependent variables for each investigation?
- What is the relationship between the variables in each graph?
- How does enzyme activity compare at different temperatures and at different pH levels?
- What statement can be used to reconcile the results of both investigations?