CAPT Science Framework

The CAPT Science Framework was developed by an advisory committee of Connecticut educators and is based on current research and theory about science instruction and assessment. The CAPT Science Framework is based on the idea that science is not only a body of knowledge, but also a way of thinking about the world around us and a concern for how that knowledge is used. The framework thus addresses three major questions: What do students know in science? (Conceptual Understanding), What do students do with their scientific knowledge? (Applications), and How do students know in science? (Experimentation). The content is drawn from three major areas: (1) Life Science, (2) Physical Science and (3) Earth Science. The CAPT Science Framework was developed using the *Connecticut Guide to Curriculum Development* in science. It should be noted that the science component of the CAPT is not a test of high school science content, but rather a cumulative assessment covering science content and skills that students should have acquired in grades K-10.

Assessing Conceptual Understandings and Applications

The goal of teaching scientific concepts is to increase students' understanding of the natural world around them. But what does it mean to understand a concept? For the CAPT, understanding a concept means going beyond the recall of facts to using one's knowledge to describe, explain and make predications about various phenomena based on that knowledge.

Science does not exist in a vacuum. Rather, it is a vital part of today's world serving to inform and advance society. For this reason, students need to be able to apply scientific reasoning and knowledge to solve daily life and technological problems. In addition, students need to be able to communicate scientific understandings through words, graphs, charts and equations. The assessment of conceptual understanding and applications includes both multiple-choice and open-ended questions.

One of the goals of science education is to prepare students for adult life. This means helping students make informed decisions about issues of society, the environment and technology. The CAPT Interdisciplinary Writing test assesses students' abilities to apply their scientific knowledge and skills along with what they have learned in other subject areas to these issues. (See *CAPT Interdisciplinary Writing Test 2004 Administration: Released Items and Scored Student Responses* for more information.)

Assessing Experimentation

Science is not a matter of belief; rather, it is a matter of conclusive evidence that can be subjected to the tests of observation and objective reasoning. Experimentation and the ability to apply scientific reasoning to solve problems are a major focus of the Science assessment.

To assess experimentation, students participate in a hands-on laboratory activity several weeks prior to the written test. This performance task asks students to design and carry out their own experiment to solve a problem and write about their results in an authentic format. Students are not scored on their actual performance on this task at the state level. Rather, teachers are encouraged to score their own students' work and provide students with feedback about their performance. On the written test, students are given follow-up questions which relate directly to the hands-on task. These questions are scored at the state level and become part of the student's score on the science portion of the CAPT.

CAPT Science Process Strands

Conceptual Understanding And Application Of Scientific Knowledge

- Describe natural phenomena with appropriate scientific terms.
- Explain natural phenomena with scientific concepts.
- Predict future events based on scientific knowledge.
- Apply scientific reasoning and knowledge.
- Interpret and communicate scientific information using words, equations, graphs and charts.

Experimentation

- Recognize and define problems for scientific investigations.
- Design appropriate procedures to solve the problem.
- Predict the results based on knowledge of problem-related content.
- Conduct investigations, collect data and record observations.
- Interpret data, draw conclusions and assess their validity.

CAPT Science Content Strands

Life Science

- Ecosystems
- Genetics and Evolution
- Cells
- Human Biology

Physical Science

- Structure of Matter
- Reactions and Interactions
- Forces and Motion
- Energy Sources and Transformations

Earth Science

- Astronomy
- Earth's Natural Resources
- Meteorology
- Earth History and Dynamics

Life Science

Ecosystems

As a result of studying various ecosystems:

Students understand that while matter is recycled in an ecosystem, there is a one-way flow of energy in ecosystems.

- Explain how carbon dioxide and water are converted into energy-rich foods through an energy capturing mechanism (photosynthesis).
- Describe the transfer of energy from the sun to the environment and back to space, through food webs consisting of producers, consumers and decomposers.
- Describe the oxygen, carbon, and nitrogen cycles and explain their significance.

Students understand how the number and variety of organisms and populations are dependent on the resources and physical factors of their environment.

- Explain how changes in resources, predation and climate can affect the growth of different populations.
- Explain how organisms are adapted to environmental conditions in different biomes.
- Explain how human activity can impact the stability of various ecosystems.

Genetics and Evolution

As a result of studying patterns of heredity and historical changes in life forms:

Students understand how each organism carries a set of instructions (genes composed of DNA) for specifying the components and functions of the organism.

- Describe how genetic materials are organized in genes and chromosomes in the cells of living organisms.
- Explain how the genetic information from both parents is mixed in the fertilized egg to produce an individual with new combinations of genes and traits.
- Explain how genes are related to inherited traits and how genes can be manipulated by modern technologies.

Students understand that the basic idea of biological evolution is that the Earth's present-day species developed from earlier species.

- Explain how environmental changes can lead to the extinction and evolution of species.
- Describe how fossils and anatomical evidence provide support for the theory of evolution.

Cells

As a result of observing and studying cells in single and multiple-celled organisms:

Students understand the basic structures and functions of living cells.

- Describe the basic similarities and differences found in the structures of plant, animal and bacterial cells.
- Describe the structure and explain the main functions of skin, nerve, muscle and blood cells.
- Explain how the cell membrane helps cells to maintain its unique internal composition.

Students understand that cells divide for growth of the organism, repair, and reproduction.

- Describe the process of mitotic cell division and explain how this process is important in growth of the organism and repair of tissues.
- Describe the process producing reproductive cells (meiosis) in females (egg cells) and males (sperm cells).

Human Biology

As a result of studying the structure and function of the human body:

Students understand the structure of the human body and how environmental conditions, nutrition, physical activity, and pathogens affect its functioning.

- Describe the structure and function of the major human organ systems (e.g., the circulatory, respiratory, digestive, reproductive and nervous systems).
- Explain the role of nutrients and physical activity in the functioning of the human body.
- Explain the human body's defense system against infectious diseases and the role of antibiotics and vaccinations.

Physical Science

Structure of Matter

As a result of working with different materials and learning theories about the structure of matter:

Students understand the basic structure of atoms and the properties of elements.

- Describe the basic structure of atoms (including protons, neutrons and electrons) and how the atoms of one element are alike and different from other elements.
- Describe the organization of the elements in the periodic table, including the properties and electronic arrangements of elements in the first three periods.

Students understand the use of physical and chemical properties to classify and describe matter.

- Describe the different physical properties that are used to classify matter including density, melting point and boiling point.
- Explain that new substances are formed when atoms combine by transferring or sharing electrons (i.e., ionic and covalent bonding).
- Explain the differences among atoms, elements, molecules, compounds, and mixtures and give examples of each using common materials.

Reactions and Interactions

As a result of studying changes in matter and how they occur:

Students understand the differences between physical and chemical changes of matter.

- Describe the physical states of matter (solids, liquids and gases) in terms of the arrangement and motion of particles and explain how heat is related to changes in the physical state of matter.
- Describe the differences between chemical and physical changes of matter and explain how chemical changes involve the rearrangement of molecules, atoms or ions to form new substances.

Students understand that materials interact with each other in various forms.

- Explain that the total matter and energy are conserved in synthesis and decomposition reactions.
- Describe combustion and corrosion reactions of materials with oxygen (i.e., burning, respiration and rusting).
- Describe the chemical structures and properties of acids and bases and relate them to the properties of common household products.

Forces and Motion

As a result of studying the motion of different objects:

Students understand that energy and matter interact through forces that result in changes in the motions of objects.

- Explain the relationships among distance, time, and speed, interpret graphs of motion and perform calculations using the equation Distance = Speed x Time.
- Describe Newton's three laws of motion, apply them to everyday phenomena and perform calculations using the equation Force = Mass x Acceleration.
- Describe the effects of gravitation on the motion and weight of masses.

Students understand the nature of electricity and magnetism.

- Describe the factors that affect the electrical forces between charges and explain how electric currents and magnets exert a force on each other.
- Describe the effects of voltage and resistance on the flow of electric charges in a series circuit.

Energy Sources and Transformations

As a result of studying various forms of energy:

Students understand the nature of various forms of energy.

- Identify various forms of energy including light, heat, chemical, electrical and mechanical energy in various physical settings.
- Describe kinetic and potential energy transformations in biological, chemical, mechanical and electrical systems.
- Describe simple machines, including ramps, levers, and pulleys and explain their use in terms of work and forces.

Students understand the properties of sound and light.

- Describe different classifications within the electromagnetic spectrum in terms of their wavelengths, energies, effects on living organisms and uses in modern technologies.
- Describe the wave properties of sound, including volume and pitch.
- Explain the behavior of light including reflection, refraction, absorption and the phenomenon of color.

Earth Science

Astronomy

As a result of learning about the solar system and the universe:

Students understand the structure, motion, and composition of stars, planets, and other bodies with an emphasis on our solar system.

- Describe the orientation, direction and duration of the movement of the Earth around its axis and around the sun and relate these to day/night cycles and the seasons.
- Explain how the changes in the relative positions of the sun, moon and Earth affect the phases of the moon and eclipses and describe tidal variations.
- Describe our solar system including the estimated size, composition and surface features of the sun, planets, and lesser members.
- Explain how astronomers collect and interpret information to determine the motion, structure and composition of stars.

Earth's Natural Resources

As a result of studying the Earth's natural resources:

Students understand that the Earth has various natural resources important to all living organisms.

- Describe how essential natural resources (i.e., air, water, soil and minerals) vary in their abundance and explain the importance of conservation and recycling of natural resources.
- Describe sources of fresh water and the importance of water to life.

Students understand the use of the Earth's natural resources by humans.

- Describe renewable and nonrenewable sources of energy and the advantages and disadvantages of their use.
- Use maps to identify geological features and determine locations, scales and directions.

Meteorology

As a result of studying the Earth's weather and climate patterns:

Students understand that our atmosphere is dynamic and has patterns of weather systems.

- Explain how winds originate and are affected by the unequal heating of the Earth's surface, the rotation of the Earth and the distribution of land and water surfaces.
- Explain the water cycle and the energy that drives it.
- Explain how meteorologists collect and interpret meteorological data from various sources.

Students understand the reasons for the distribution of climates around the world.

- Explain how regional climates are determined by energy transfer from the sun and are influenced by cloud cover, the earth's rotation, oceans and mountains.
- Explain the possible causes and effects of global phenomena including El Niño, global warming and ozone depletion.

Earth History and Dynamics

As a result of studying the composition of the Earth and the changes it undergoes:

Students understand interactions among the Earth's lithosphere, hydrosphere, atmosphere, and biosphere.

- Describe how plate tectonics is related to the interior composition of the Earth including its core, mantle, and crust and relate it to major geological events including earthquakes, volcanic eruptions and mountain building.
- Explain how the formation, weathering, sedimentation and reformation of rock constitute a continuing rock cycle.
- Describe how waves, wind, water and ice shape the Earth's land surface.
- Describe how geological history and major time periods can be determined using evidence from fossils and rock sequences.

Items Found in this Packet

Open-Ended Items

Open-ended items are those for which a student must write a short response to a question. Included in this packet are the four open-ended experimentation items which appeared on the CAPT as a follow-up assessment to the hands-on performance task. In addition, one open-ended item is included for each of the three content areas (Life Science, Physical Science and Earth Science).

CAPT open-ended items are scored on a four-point scale (0-3) using a holistic scoring method. This method involves judging the overall quality of the student response. The general scoring rubric for the science open-ended items (See following page) describes the characteristics of a response at each score point. Included with each item is the content guide (description of a good response to the question), the specific scoring rubric for the item (description of each score point), and the classification of the item based on the CAPT Science Framework. This is followed by two scored student responses at each score point along with a brief discussion of why the response received a particular score.

Keep in mind that the scoring criteria are based on reasonable expectations of grade ten students responding under testing conditions. Students are given approximately five minutes to respond to each open-ended item. The responses are therefore less polished than they might be if students were given more time to revise their answers. In addition, students are asked to respond to a wide variety of scientific topics, many of which they may not have studied for some time. All of this is taken into consideration when scoring the responses.

Multiple-Choice Items

To foster depth of understanding, the CAPT multiple-choice items are organized in clusters related to particular scenarios. In addition, some clusters include specific information at the beginning which students can use in answering the questions. To stress the interdisciplinary nature of science, some clusters make connections between concepts of the major content areas. Multiple-choice items designed to assess life science, physical science and earth science are included in this packet. Also included are four multiple-choice experimentation items that were a follow-up assessment to the hands-on performance task.

Scoring Rubric for Science Open-Ended Items

Each score category contains a range of student responses which reflect the descriptions given below.

Score 3

The response is an excellent answer to the question. It is correct, complete, and appropriate and contains elaboration, extension, and/or evidence of higher-order thinking and relevant prior knowledge. There is no evidence of misconceptions. Minor errors will not necessarily lower the score.

Score 2

The response is a proficient answer to the question. It is generally correct, complete, and appropriate although minor inaccuracies may appear. There may be limited evidence of elaboration, extension, higher-order thinking, and relevant prior knowledge, or there may be significant evidence of these traits but other flaws (e.g., inaccuracies, omissions, inappropriateness) may be more than minor.

Score 1

The response is a marginal answer to the question. While it may contain some elements of a proficient response, it is inaccurate, incomplete and/or inappropriate. There is little if any evidence of elaboration, extension, higher-order thinking, or relevant prior knowledge. There may be evidence of significant misconceptions.

Score 0

The response, although on topic, is an unsatisfactory answer to the question. It may fail to address the question, or it may address the question in a very limited way. There may be no evidence of elaboration, extension, higher-order thinking, or relevant prior knowledge. There may be evidence of serious misconceptions.

CAPT Science Performance Task

Fire Extinguisher

Some fires can be extinguished by smothering them with carbon dioxide gas (CO_2). A company is designing a fire extinguisher that uses the chemical reaction between vinegar and baking soda to produce carbon dioxide. Since the fire extinguisher must produce the gas quickly in order to put out a fire, the designers need your help in studying variables that affect how much carbon dioxide this reaction produces in a certain amount of time.

There are several variables that may affect the rate of carbon dioxide production in the fire extinguisher, such as the amount of baking soda, the concentration of vinegar solution, and the temperature of the vinegar solution. You will investigate two of these variables using a plastic bottle as a model fire extinguisher.

Your model fire extinguisher should only hold a maximum of 10 cc (cubic centimeters) of vinegar solution. Note: 1 cc = 1 mL.

Your task:

Part I: You and your partner will design and conduct an experiment to determine how the ***amount of baking soda*** affects how much carbon dioxide is produced in a ***certain amount of time.***

Part II: You and your partner will design and conduct an experiment to determine how ***another variable*** that you choose affects how much carbon dioxide is produced in a ***certain amount of time.***

During the activity, you will work with a partner (or possibly two partners). Each of you must keep your own lab notes because after you finish you will work by yourself to write a report about your investigation.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

Baking soda	**1 Thermometer**
Vinegar	**1 Graduated cylinder**
1 Plastic bottle	**Access to a watch or clock with a second hand**
1 Gas collection tube	**Access to water**
1 Rubber stopper	**Access to a balance**
1 Small scoop	**Splash-proof safety goggles**
5 Plastic cups	**Aprons**
Access to hot and cold water baths	

CAPT Science Performance Task

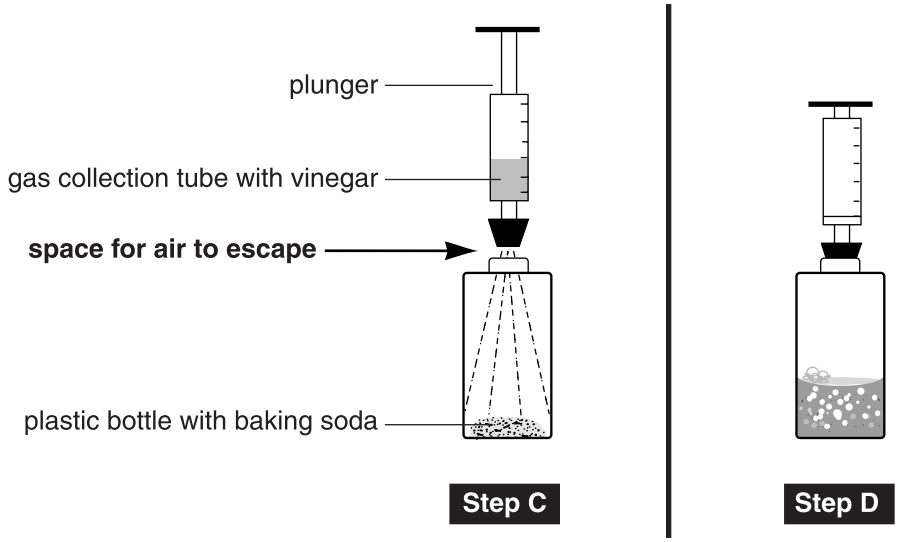
Steps to follow:

PART I

1. **State** the problem you are going to investigate. Clearly identify the ***independent*** and ***dependent*** variables that will be studied. Write your problem statement on page 5.

2. **Design** an experiment to solve the problem. Your experimental design should match the statement of the problem, should control for variables and should be clearly described so that someone else could replicate your experiment. Use a control and perform multiple trials, as appropriate. Write your experimental design on page 5.

   Use the diagram below to help you set up your experiment. **Remember, your model fire extinguisher should only hold a maximum of 10 cc of solution. Note: 1 cc = 1 mL.**



GAS COLLECTION PROCEDURE

A. Place the baking soda in the plastic bottle.

B. Draw the vinegar solution into the gas collection tube by placing the stopper end of the tube into the vinegar solution and gently pulling up on the plunger.

C. Place the end of the **gas collection tube just above the opening** of the plastic bottle without pushing the stopper into the bottle. Press down on the plunger to squirt the vinegar into the bottle. (See diagram above.)

D. Quickly push the rubber stopper into the bottle opening, sealing the bottle so that the carbon dioxide will push the plunger up. (Caution: Do not twist the rubber stopper as you place it into the bottle.)

E. After collecting the gas, pull straight up on the rubber stopper to remove the gas collection tube from the bottle (do not twist the stopper).

F. Be certain to wash bottles between each trial.

3. **Show** your design to your teacher before you begin your experiment. Your teacher's approval does not necessarily mean that your experiment is well designed. It simply means that, in your teacher's judgment, your experiment is not dangerous or likely to cause an unnecessary mess.

4. **Do** your experiment after receiving approval from your teacher.

5. **Record** the results of your experiment on the pages provided. Label any tables, charts or graphs that you use. Your notes will not be scored, but you will refer to your data later when you write a report about your experimental findings. You must keep your own notes because you will not work with your partner when you write your lab report.

PART II

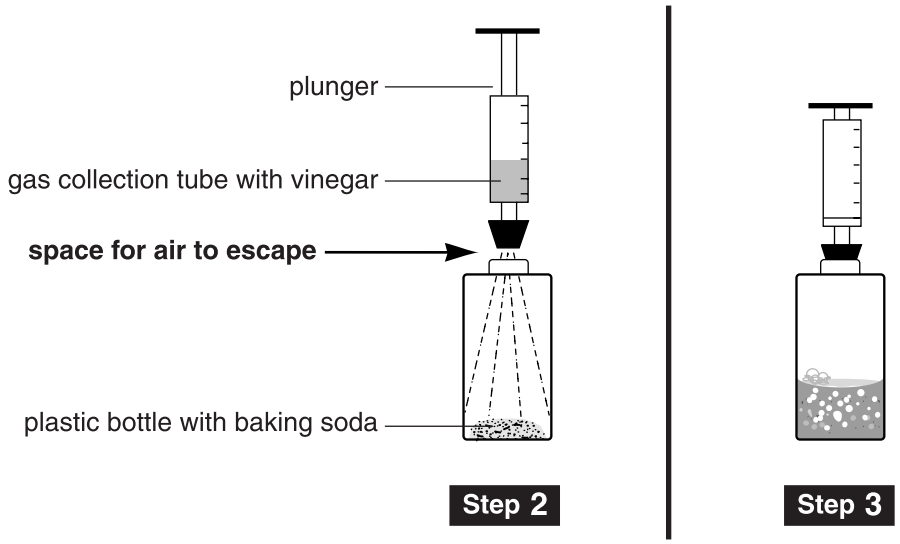
Repeat steps 1 to 5 to investigate the variable you choose for Part II.

Clean up your materials when you have finished your experiments. Your teacher will give you instructions for clean-up procedures, including proper disposal of all materials.

CAPT Experimentation Open-Ended Questions: *Fire Extinguisher*

Fire Extinguisher

Students in a science class carried out the *Fire Extinguisher* experiment. The diagrams below show the equipment and technique that the students used in their experiments.



Group A carried out the following experiment:

1. Place 0.2 grams of baking soda in a plastic bottle.
2. Add vinegar to the baking soda using the gas collection tube.
3. Place the tube on the bottle and measure how much carbon dioxide ($C0_2$) is produced.
4. Repeat the experiment using 0.4 and 0.6 grams of baking soda.

Our results are shown below:

Amount of Baking Soda	Amount of CO_2 Produced
0.2 g	29 mL
0.4 g	40 mL
0.6 g	51 mL

Fire Extinguisher (continued)

1. What is the problem that Group A is most likely trying to solve? Explain your answer fully including identifying the independent and dependent variables.

Write your answer in your answer booklet.

2. Draw a line graph of Group A's results. The independent variable should be on the horizontal (***x***) axis. Be sure to label your graph.

Write your answer in your answer booklet.

Group B carried out the following experiment.

1. Make up solutions of 100%, 75%, 50% and 25% vinegar.
2. Place baking soda in a plastic bottle.
3. Add different concentrations of vinegar to the bottle.
4. Measure how much carbon dioxide gas is collected in 20 seconds.

Our results:

Concentration of Vinegar	Amount of Baking Soda	Amount of Carbon Dioxide Collected in 20 Seconds
100%	2 scoops	42 mL
75%	2 scoops	28 mL
50%	2 scoops	16 mL
25%	2 scoops	10 mL

3. Group B did not include a control in their experiment. What would be an appropriate control? Explain your answer fully including how the control would improve their experiment.

Write your answer in your answer booklet.

4. What conclusion can be drawn from Group B's experiment and results? Explain how valid you think this conclusion is.

Write your answer in your answer booklet.

Fire Extinguisher

1. What is the problem that Group A is trying to solve? Explain your answer fully including identifying the independent and dependent variables.

Group A is most likely trying to investigate if the amount of baking soda (when mixed with vinegar) affects the amount of carbon dioxide produced in the reaction. The independent variable is the amount of baking soda. The dependent variable is the amount of carbon dioxide produced.

Score 3

The response correctly states the problem that Group A is trying to solve. Both the independent and dependent variables are identified. It is correct and elaborated.

Score 2

The response states the problem that Group A is trying to solve and identifies the independent or dependent variable. It is less complete than the Score 3 responses or contains inaccuracies.

-or-

The response fails to state the problem that Group A is trying to solve and identifies both the independent and dependent variables. It is less complete than the score 3 responses or contains inaccuracies.

Score 1

The response states the problem that group A is trying to solve or identifies either the independent or dependent variables. It contains little or no elaboration.

Score 0

The response fails to state the problem that Group A is trying to solve. Neither the independent nor dependent variables are identified. It may contain misconceptions.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 3**

In this procedure, Group A has recognized that the amount of carbon dioxide produced is the dependent variable, because it varies based on the independent variable, which is the quantity of baking soda used in the experiment, in grams. By specifically controlling the amount of baking soda involved in the reactions and by controlling the vinegar at a constant amount, the experiment attempts to determine the effect of different amounts of baking soda upon the overall quantity of carbon dioxide produced.

The problem is clearly stated and the independent and dependent variables are clearly identified. The response is correct and well elaborated.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 3**

Group A is probably trying to discover what affect the amount of baking soda I used has on the amount of CO_2 produced. By increasing the amount of baking soda by 0.2 g each trial the group has created a independent variable, & the corresponding amount of gas on the chart is dependent.

The problem is clearly stated and the independent and dependent variables are clearly identified. The response is correct and well elaborated.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 2**

The problem Group A is most likely trying to solve is building an efficient fire extinguisher. One that will work effectively and quick. The independent variable is the amount of baking soda. The dependent variable is the amount of CO_2 produced.

The problem is not specifically stated. The independent and dependent variables are identified, however, there is limited elaboration.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 2**

Group A is trying to find out if the amount of baking soda used affects the amount of CO_2 produced. The independent variable is the amount of baking soda, and the dependent variable is the amount of vinager used. This group is using three different amounts of baking soda to acheive the answer, they are .2 grams, .4 grams, and .6 grams.

The problem is adequately stated and the independent variable is identified. The dependent variable is incorrectly identified as the amount of vinegar.

Scored Student Responses for *Fire Extinguisher*

Question 1 Score 1

Group A is most like trying to solve how the amount of baking soda, when reacted with a constant amount of vinegar, affects the amount of CO_2 produced.

The response states the problem that Group A is trying to solve but does not identify any variables. There is little elaboration.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 1**

The problem that Group A is most likely trying to solve is how much carbon dioxide (CO_2) is produced.

I believe such an answer because they measured the amount of baking soda as follows: 0.2g, 0.4g, 0.6g; and also they measured the amount of CO_2 produced which is 0.2 g produced 29 mL, 0.4g produced 40mL, & 0.6 produced 51 mL

The response states the problem that Group A is trying to solve but does not identify any variables. Some elaboration is included.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 0**

Group A only completed one trial. Group A also didn't have a control in this expirement. They should have used the same amount of vinegar in each trial so that they could have had a control. because there was no control, the carbon dioxide produced could not depend on the amount of baking soda used.

The response fails to state the problem or identify the independent and dependent variables. The elaboration is not related to the question.

Scored Student Responses for *Fire Extinguisher*

Question 1 **Score 0**

The problem is that the students in a science class carried out the fire Extinguisher.

The response fails to state the problem or identify the independent and dependent variables. There is no elaboration.

Fire Extinguisher

2. Draw a line of Group A's results. The independent variable should be on the horizontal (x) axis. Be sure to label your graph.

The following characteristics are important:

- independent variable (amount of baking soda) is on the horizontal axis
- proper labeling of both axes including units:
  horizontal (x) axis—amount of baking soda (grams)
  vertical (y) axis—amount of carbon dioxide produced (mL or cc)
- proper scaling of both axes
- accurate plotting of data points

Score 3

A line graph with all of the characteristics listed above.

Score 2

A line graph with one error in one of the characteristics listed.

-or-

A bar graph with no errors in the characteristics listed above.

Score 1

A line graph with two errors in the characteristics listed above.

-or-

A bar graph with one error in one of the characteristics listed above.

-or-

A partially correct bar or line graph with the independent variable on the horizontal axis.

Score 0

A line graph with three or more errors in the characteristics listed above.

-or-

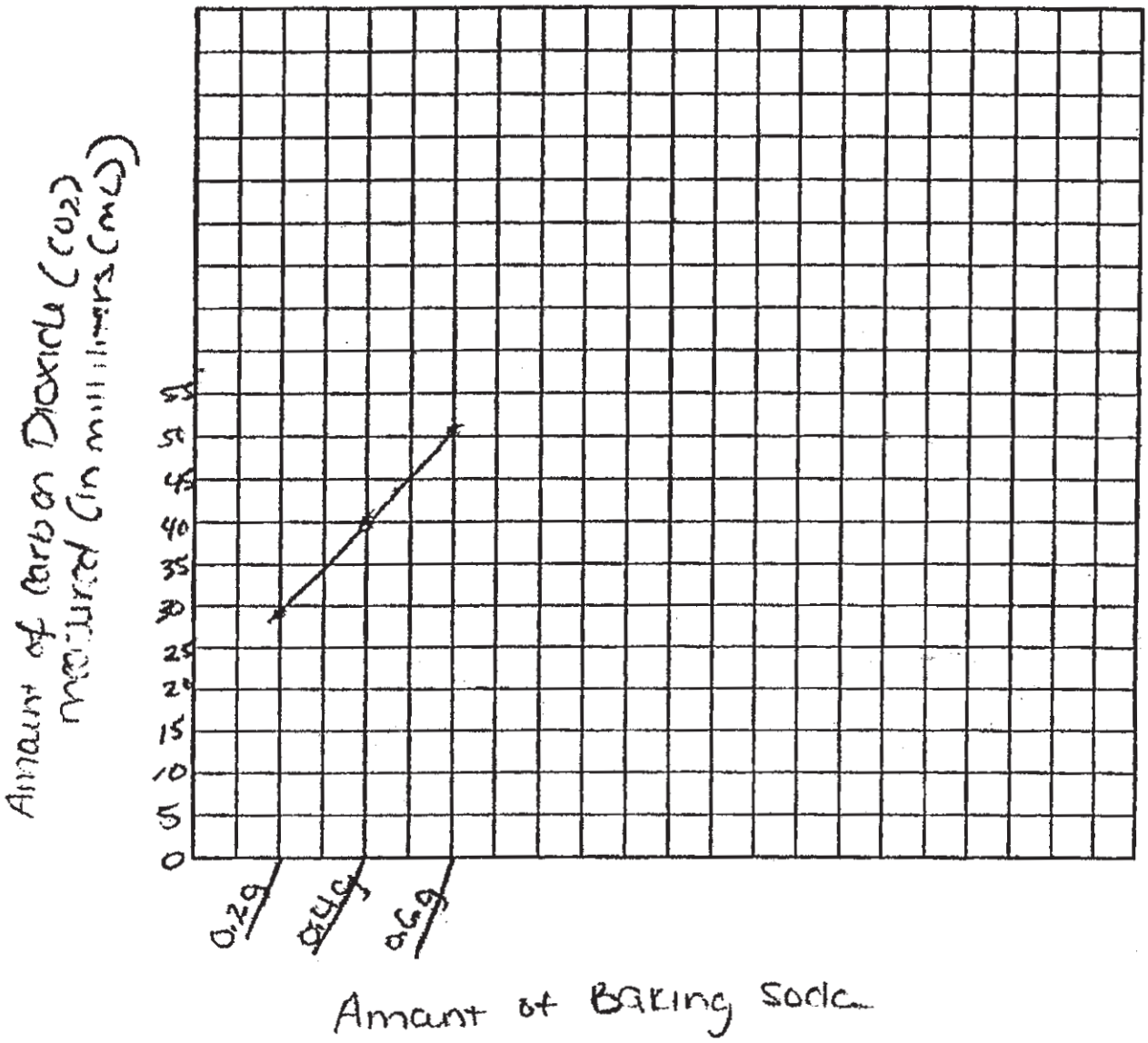
A bar graph with two or more errors in the characteristics listed above.

-or-

A blank graph or graph with multiple errors with the independent variable on the horizontal axis.

Scored Student Responses for *Fire Extinguisher*

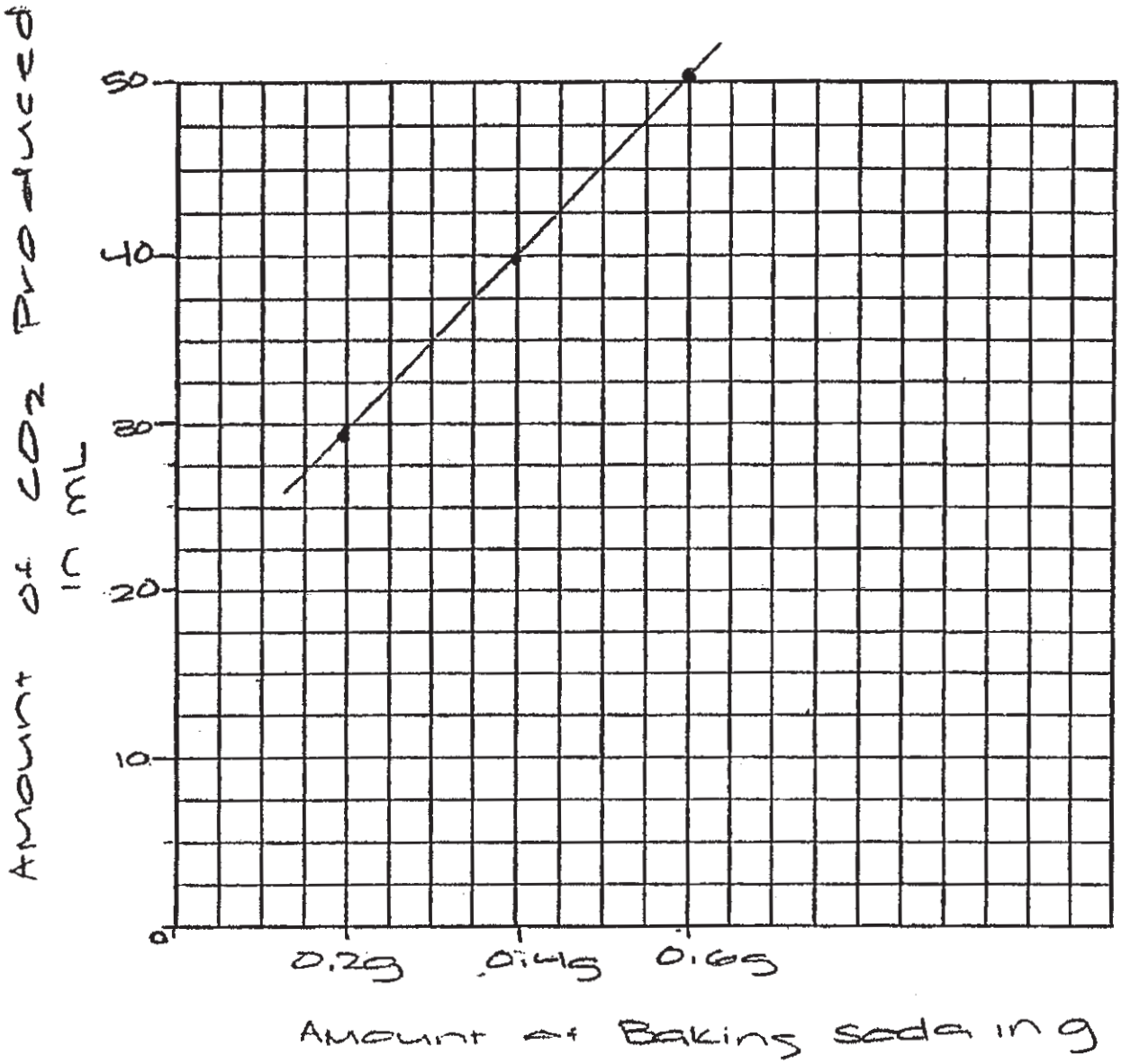
Question 2 **Score 3**



The student response shows a line graph with no errors.

Scored Student Responses for *Fire Extinguisher*

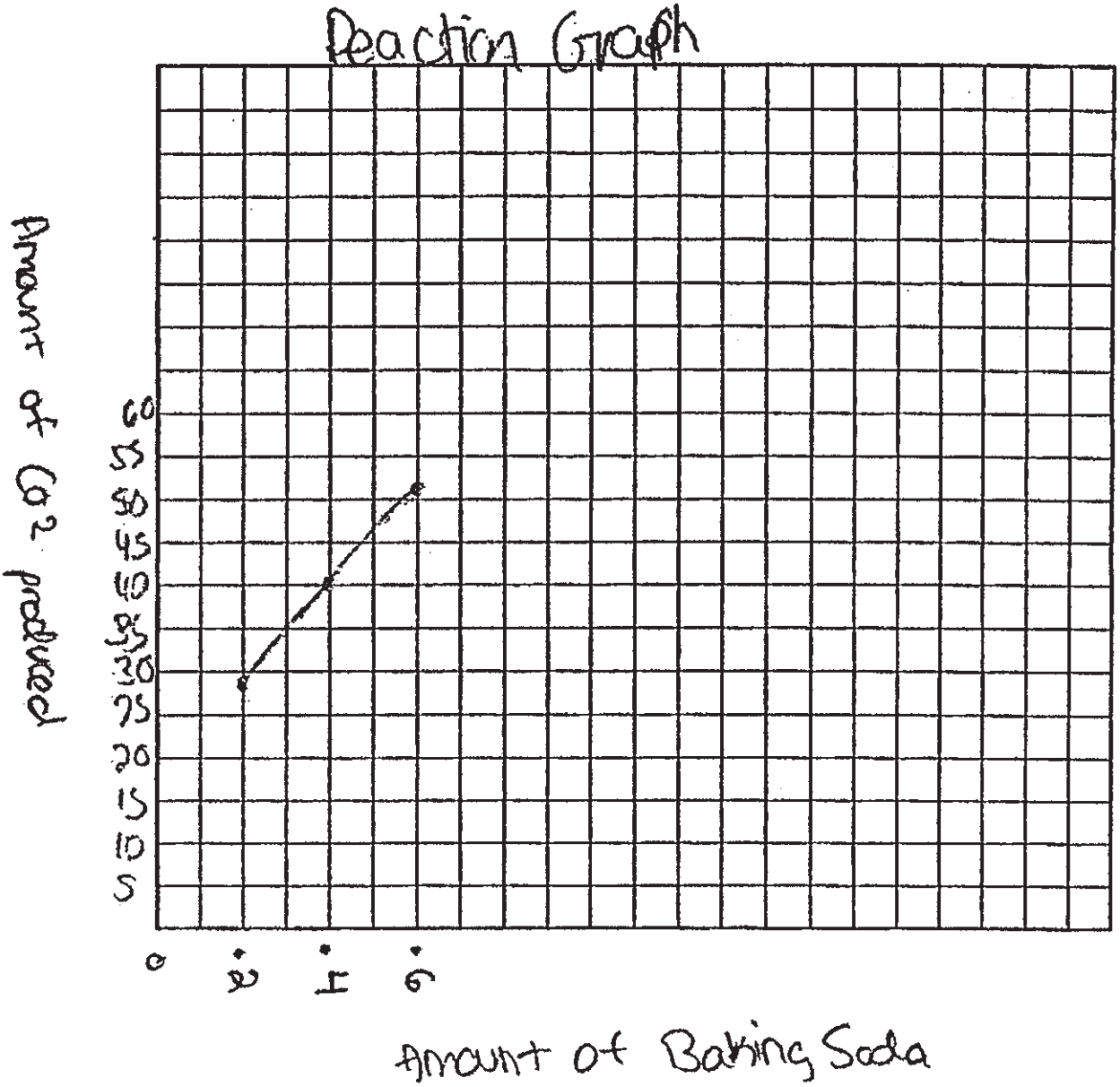
Question 2 **Score 3**



The student response shows a line graph with no errors.

Scored Student Responses for *Fire Extinguisher*

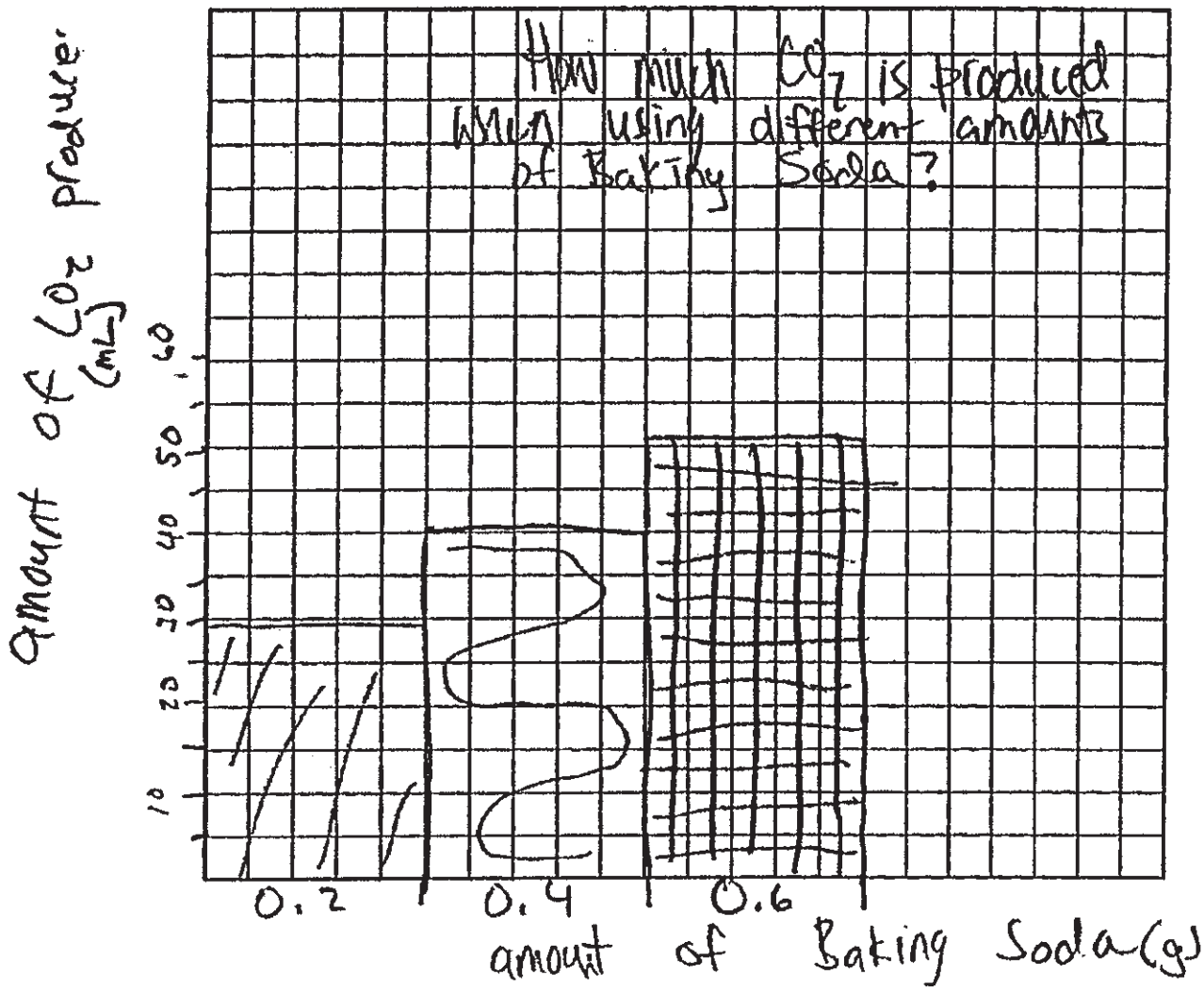
Question 2 **Score 2**



The student response shows a line graph with an error in one of the characteristics listed (improper labeling of both axes, units not included).

Scored Student Responses for *Fire Extinguisher*

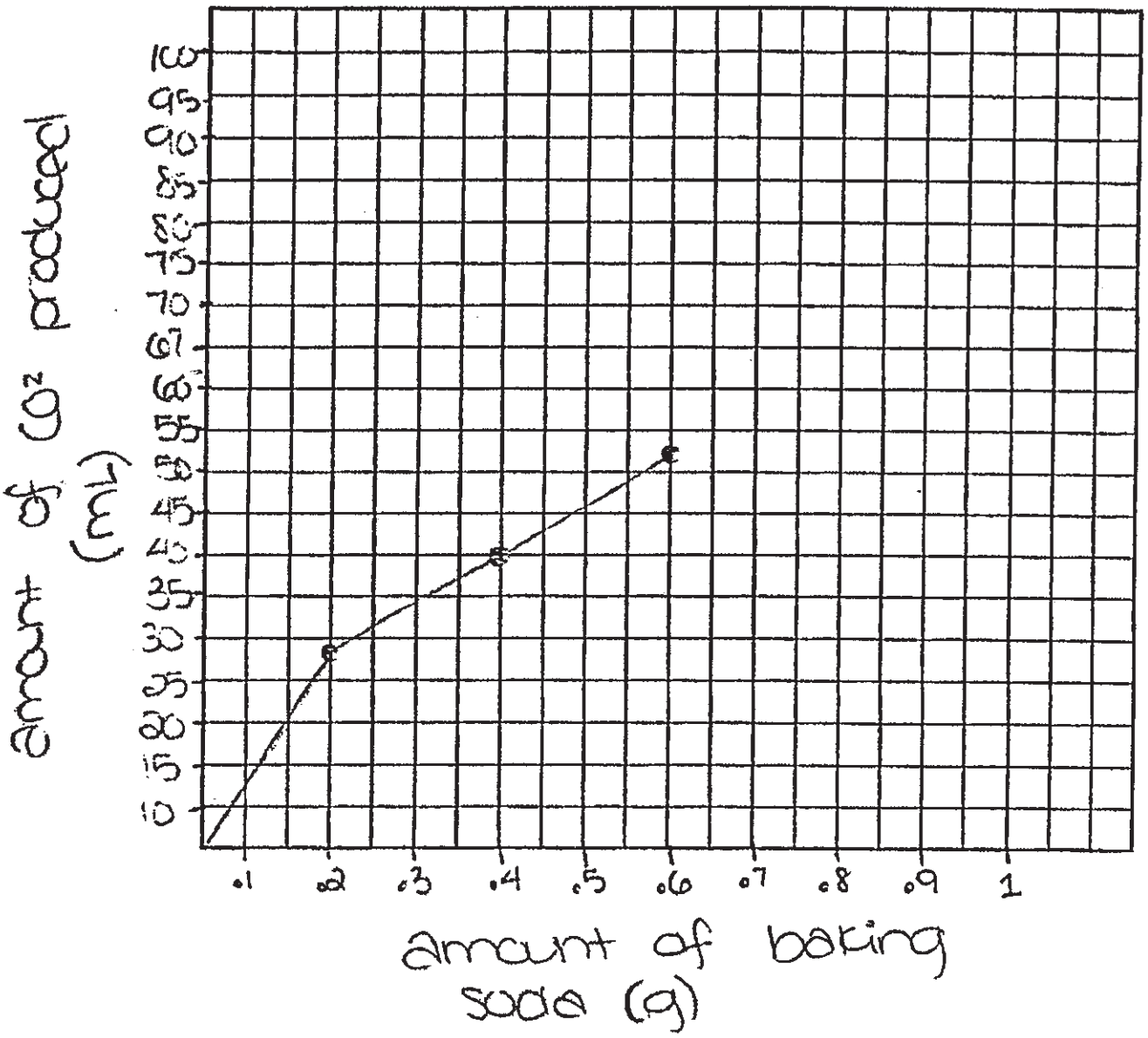
Question 2 **Score 2**



The response shows a bar graph with no errors.

Scored Student Responses for *Fire Extinguisher*

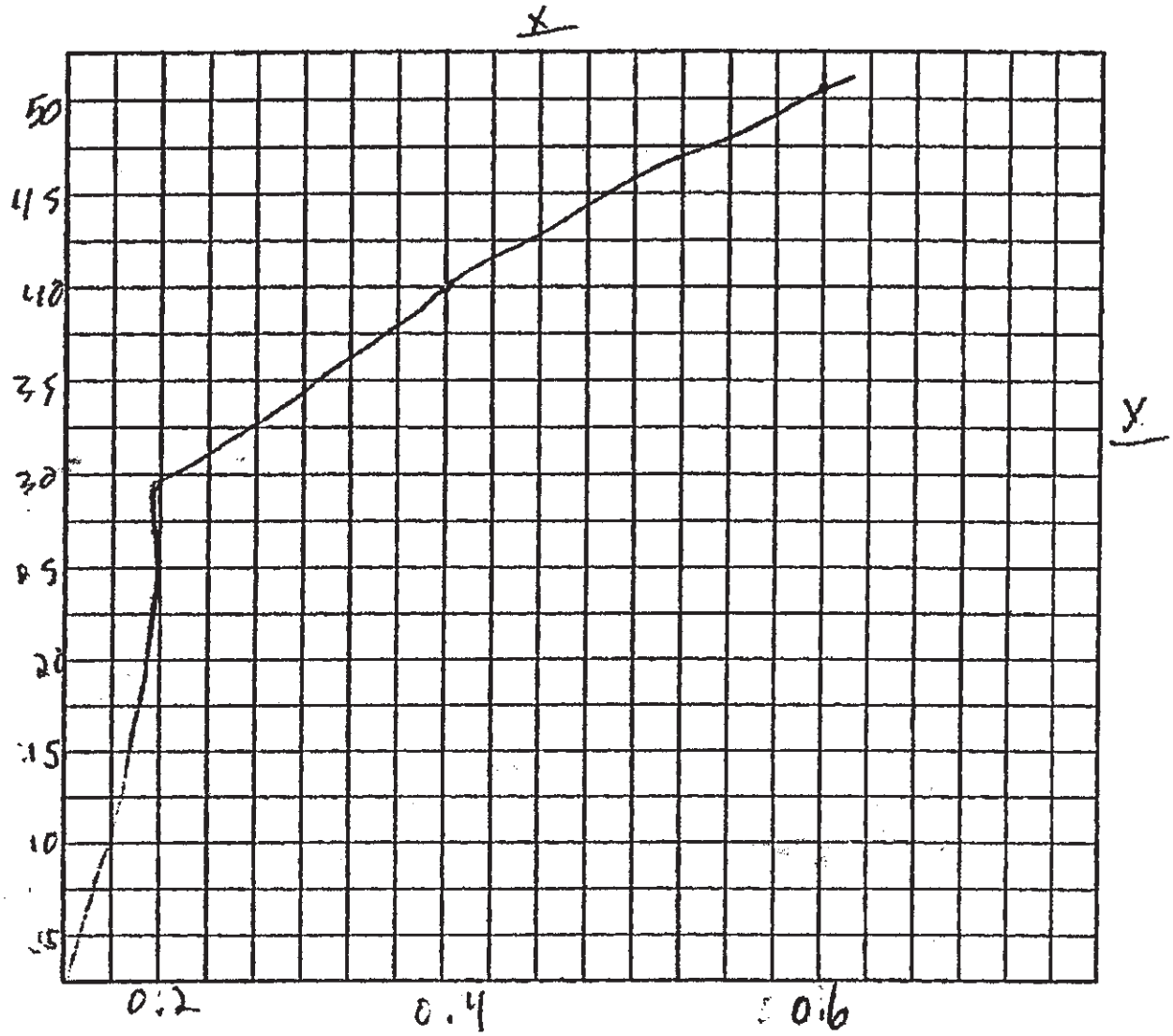
Question 2 **Score 1**



The response shows a line graph with two errors (The scaling of both axes near the origin and the line drawn from 0 to .2 g.).

Scored Student Responses for *Fire Extinguisher*

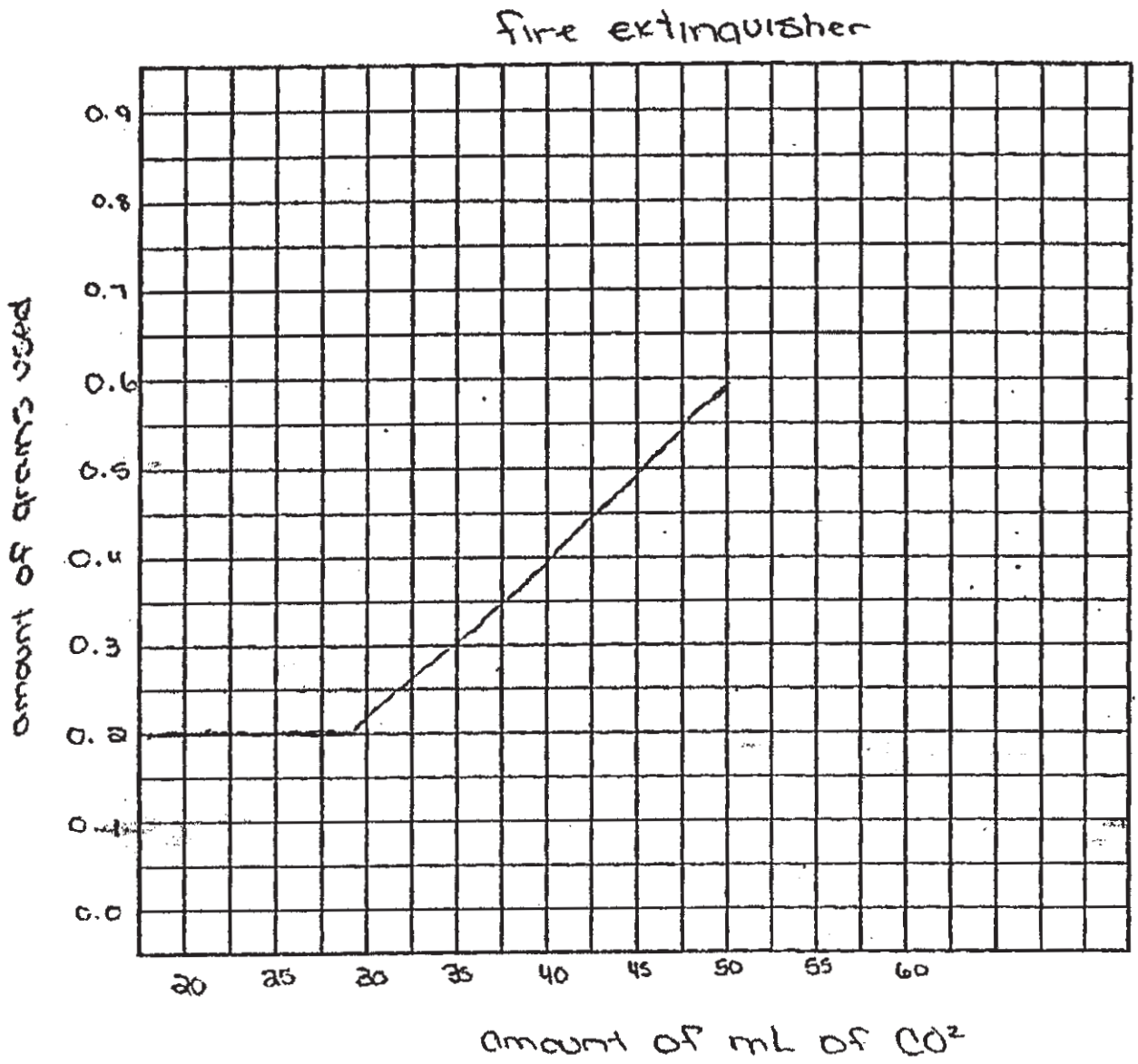
Question 2 **Score 1**



The response shows a partially correct line graph with the independent variable on the horizontal axis. However, there are no labels on the axes, the scaling of both axes near the origin is incorrect and a line is drawn from 0 to .2g.

Scored Student Responses for *Fire Extinguisher*

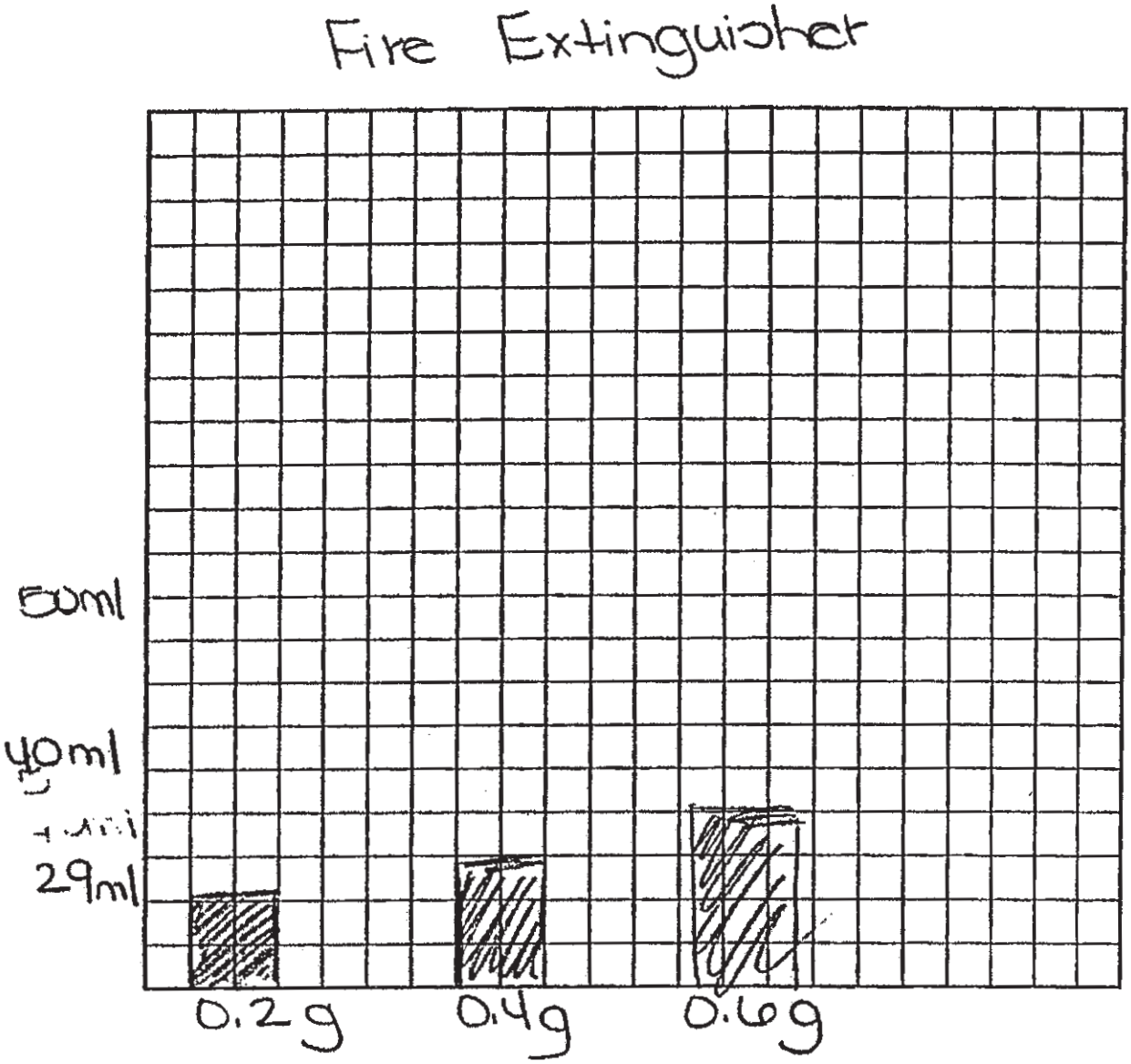
Question 2 **Score 0**



The response shows a line graph with several errors(i.e.,scaling of axes near origin, poor label on vertical axis, independent variable on vertical axis, errors in plotting data).

Scored Student Responses for *Fire Extinguisher*

Question 2 **Score 0**



The response shows a bar graph with three errors in the characteristics listed (poor scaling, inaccurate plotting of data points, poor labels on axes).

Fire Extinguisher

3. Group B did not include a control in their experiment. What would be an appropriate control? Explain your answer fully including how the control would improve their experiment.

An appropriate control would be a trial using 0% vinegar solution (water only) mixed with 2 scoops of baking soda. All other conditions and procedures should remain constant with the other trials.

The control serves as a basis of comparison to determine if water alone will produce carbon dioxide when mixed with baking soda.

Score 3

The response correctly describes an appropriate control for the experiment. The response explains how the control might improve the experiment. It is well elaborated.

Score 2

The response describes a control for the experiment and explains how the control might improve the experiment. The response is not as well elaborated as the score 3 responses or contains inaccuracies. The response may include a less appropriate control (i.e., “no vinegar”, ‘baking soda only).

Score 1

The response either correctly describes a control or explains how the control might improve the experiment with little or no elaboration.

Score 0

The response fails to correctly describe a control or explain how the control might improve the experiment.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 3**

An appropnate control could be water with 2 scoops of baking soda in it. Water would be appropriate because it is used to dilute the vinegar Once the concentration decreases. Also, considering that all of the experiments were conducted with a cargain amount of vinegar, a control having no vinegar would show what the vinegar does in the chemical reaction.

The response correctly describes an appropriate control and explains how it might improve the experiment. It is well elaborated.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 3**

Using a 0% solution of vinegar and 2 scoops of baking soda would be a control. This shows what happens when no vinegar is present and gives the group something to compare their results to.

The response correctly describes an appropriate control and explains how it might improve the experiment. Elaboration is included.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 2**

An appropriate control would be just baking soda without vinegar. This would show that the baking soda itself produces no carbon dioxide

The response includes a less appropriate control ("bottle without vinegar") and explains how this control might improve the experiment. The elaboration is adequate.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 2**

A strait water solution would have made a good controle. Thust proving that it was the vinisar affecting the production of CO^2 and not the water.

The response describes a control and explains how it might improve the experiment. It is less elaborated than the score 3 responses.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 1**

An appropriate control would be to include a 5% vinegar solution

The response describes a control but lacks elaboration on how this control would improve the experiment.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 1**

The control could have been water to see if the experiment would differ. It would improve the experiment by seeing the changes in it.

The response describes a control but does not adequately describe how it would improve the experiment.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 0**

an appropriate control would be either 100% vinegar or 0% vinegar. It would have helped with the data, making it more complete.

The response fails to correctly describe a control or explain how it improves the experiment.

Scored Student Responses for *Fire Extinguisher*

Question 3 **Score 0**

I feel ~~theeg~~ the amount of time and ~~am~~ baking soda was a good enough control for this experiment. The control gives ya something to compare and I feel they did a good job on it.

The response fails to identify a correct control or to explain how it improves the experiment.

Fire Extinguisher

4. What conclusion can be drawn from Group B's experiment and results? Explain how valid you think this conclusion is.

The conclusion that can be drawn from Group B's experiment is that as the concentration of the vinegar decreases (from 100% to 25%) the amount of carbon dioxide produced also decreases (from 42 mL to 10 mL).

The following factors can be seen as contributing to the validity of the conclusion:

- The group kept certain key variables constant including the amount of baking soda and the time that the carbon dioxide was collected.
- The group measured a wide variety of concentrations of vinegar.

The following factors can be seen as contributing to a lack of validity of the conclusion:

- The group carried out only one trial
- The group did not specify the procedure for collecting the gas, including whether certain aspects of this procedure were kept constant
- The group did not specify how the concentration of vinegar was measured
- The group did not specify if the amount of vinegar was kept constant
- The group did not measure the mass of the baking soda
- The group did not include information about the temperature of the reactants
- The group did not include a control in their experiment (reaction of water and baking soda)

Score 3

The response draws an appropriate conclusion and at least one factor related to the validity of the conclusion is discussed. The response is well elaborated (this may include a discussion of other factors related to the validity of the conclusion including positive or negative aspects of the experimental design or the results of the experiment.)

Score 2

The response draws a reasonable conclusion and discusses one or two factors related to the validity of Group B's experimental design. There is less elaboration than the score 3 responses or it contains inaccuracies.

-or-

The response draws a reasonable conclusion and supports it with a discussion of the results of the experiment. There is no discussion of factors related to the experimental design.

-or-

The response fails to draw a reasonable conclusion but discusses more than one factor related to the experimental design.

Score 1

The response draws an appropriate conclusion from Group B's experiment, but fails to explain any factors that affect the validity of the conclusion (either positive or negative). There is little or no elaboration.

-or-

The response fails to draw an appropriate conclusion from Group B's experiment but explains at least one factor that affects the validity of the conclusion (either positive or negative). There is little elaboration. Inaccuracies may be present.

Score 0

The response fails to draw an appropriate conclusion from Group B's experiment and fails to explain at least one factor that affects the validity of the conclusion (either positive or negative). Misconceptions may be present.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 3**

From Group B's experiment and results, it appears as though a higher concentration of vinegar produces more CO_2. 42 mL of CO_2 were produced when the concentration of vinegar was 100% and only 10 mL of CO_2 were produced when the concentration of vinegar was 25%. These results seem accurate because it seems as though the amou of baking soda used each time was controlled. They would be even more valid, though, if there were multiple trial done at each concentration.

The response draws an appropriate conclusion based on a discussion of the results of the experiment. The response also discusses two factors related to the validity of the conclusion (amount of baking soda was controlled, no multiple trials). It is well elaborated.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 3**

With more vinegar concentration, the higher the level of CO_2 is produced. The lower the concentration, the lower the level of CO_2 produced. With 100% vinegar concentration, 42 mls of CO_2 were produced. With 75% vinegar solution, 28 mls of CO_2 were produced. With 50% vinegar solution, 16 mls of CO_2 were produced. With 25% vinegar solution, 10 mls of CO_2 were produced. This conclusion is not that valid because there was no control, and there were not multiple trials done.

The response draws an appropriate conclusion based on a discussion of the results of the experiment. The response also discusses two factors related to the validity of the conclusion (no control, no multiple trials). It is well elaborated.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 2**

The higher the concentration of vinegar in a solution, the more CO_2 will be produced in 20 seconds. If the experiment has been repeated several times then the results are valid.

The response draws a reasonable conclusion and discusses one factor related to the validity of the experimental design. The elaboration is adequate.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 2**

they could conclude that the higher the concentration of vinegar, the more gas will be produced. the conclusions are valid, but would be better if they had included a control and conducted the whole expirement more than once.

The response draws a reasonable conclusion but does not specifically identify the gas produced. It mentions two factors related to the validity of the experimental design (a control, multiple trials).

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 1**

What conclusion could be drawn from Graph B's experiment is that the less concetrated the vinegar the higher ammount of carbon dioxide will be given off. This conclusion is not valid because in the experiment there's no control, you don't know how much vinegar was used in each cup, you don't know the time between capping the bottle.

The response fails to draw an appropriate conclusion but explains two factors that affect the validity of the conclusion.

Scored Student Responses for *Fire Extinguisher*

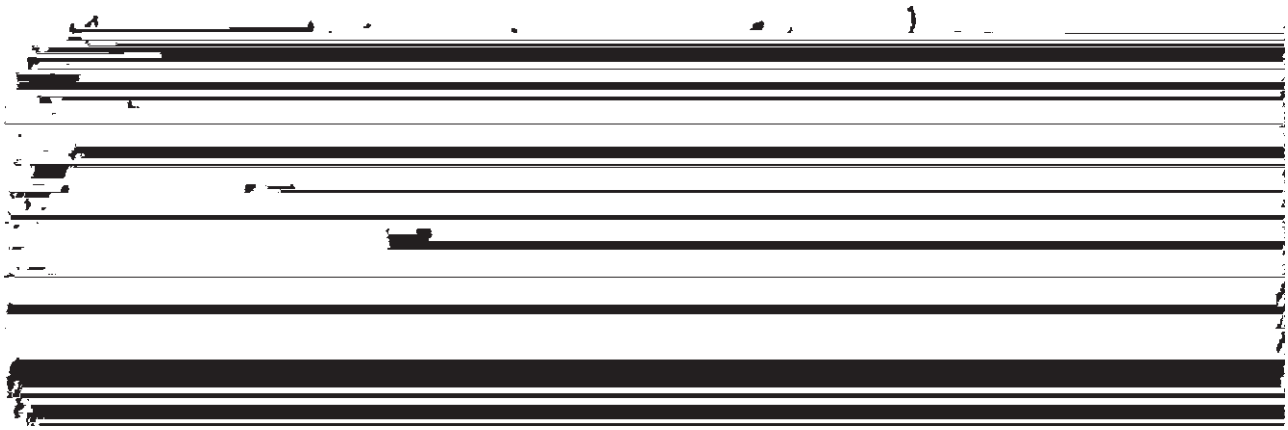
Question 4 **Score 1**

That putling more vinger in
maile the carbon dioxide go up

The response draws an appropriate conclusion but fails to explain factors that affect the validity of the conclusion. There is no elaboration.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 0**



The response fails to draw an appropriate conclusion and fails to include a factor that affects the validity of the conclusion.

Scored Student Responses for *Fire Extinguisher*

Question 4 **Score 0**

If they did not make changes to their experimental design their results would not be accurate. They do not have a very valid conclusion without the changes in the experiment.

The response fails to draw an appropriate conclusion and fails to include a factor that affects the validity of the conclusion.

Fire Extinguisher

Group C carried out the following experiment:

1. Put some baking soda in the bottle.
2. Add 10 mL of vinegar solution to the bottle using the gas collection tube and quickly push the rubber stopper end of the tube into the bottle.
3. Measure how much CO_2 gas goes into the collection tube.
4. Repeat the procedure using a different amount of baking soda.

Our data:

Amount of Baking Soda	Amount of CO_2 Produced	Amount of Time
0.5 grams	60 mL	38 seconds
1.0 grams	54 mL	25 seconds
1.5 grams	41 mL	22 seconds

5. In order to replicate Group C's experiment, which of the following information do you need?

a. The concentration of the vinegar ✪

b. Amount of baking soda added

c. Amount of carbon dioxide collected

d. Amount of time the carbon dioxide was collected

CAPT Experimentation Multiple-Choice Questions: *Fire Extinguisher* (continued)

Group D carried out the following experiment:

1. Mix different concentrations of vinegar solutions by adding water to vinegar.
2. Add 2 scoops of baking soda into the bottle.
3. Push the plunger to add 20 mL of vinegar solution to the baking soda.
4. Measure the amount of carbon dioxide in the collection tube after 10 seconds.
5. Repeat steps 2 through 4 using different concentrations of vinegar solutions.

Our data is shown below:

Amount of Vinegar (mL)	Amount of Water (mL)	Amount of Baking Soda	CO_2 Produced in 10 Seconds	
			Trial 1	Trial 2
20	0	2 scoops	17 mL	25 mL
15	5	2 scoops	12 mL	19 mL
10	10	2 scoops	8 mL	10 mL
5	15	2 scoops	2 mL	3 mL

6. What should Group D do to address the differences in the CO_2 measurements in Trial 1 and Trial 2?

f. Ignore the data from trial 1 and only use the data from trial 2.

g. Ignore the data from trial 2 and only use the data from trial 1.

h. Calculate the average of the data from both trials for each concentration of vinegar. ✪

j. Calculate the total amount of CO_2 produced for trial 1 and trial 2 separately.

7. Which of the following conclusions is **best** supported by Group D's results?

a. Increasing the concentration of the vinegar solution produces more carbon dioxide in 10 seconds. ✪

b. Increasing the amount of baking soda produces greater amounts of carbon dioxide in 10 seconds.

c. There is no relationship between the vinegar concentration and the amount of carbon dioxide produced.

d. There is no carbon dioxide produced when baking soda is mixed with pure water.

CAPT Experimentation Multiple-Choice Questions: *Fire Extinguisher* (continued)

Group E carried out the following experiment:

1. Make up 100% vinegar solutions at 5°C, 25°C and 40°C.
2. Add .5 grams of baking soda to the plastic bottle.
3. Add 10 mL of 5°C vinegar solution to the bottle using the collection tube.
4. Put the collection tube on the bottle sealing it tight.
5. Wait 30 seconds and measure the amount of carbon dioxide collected in the tube.
6. Repeat the experiment with the 25°C and 40°C vinegar solutions.

Our results:

Amount of Baking Soda	Amount of Vinegar Solution	Temperature of Vinegar Solution	Amount of CO_2 Collected
0.5 grams	10 mL	5°C	5 mL
0.5 grams	10 mL	25°C	21 mL
0.5 grams	10 mL	40°C	43 mL

8. Group E made the following statement in their report, "We added 10 mL of vinegar solution in each of our trials." This statement _____.

f. is a conclusion supported by the group's results

g. is a conclusion not supported by the group's results

h. identifies the dependent variable tested in the experiment

j. refers to a variable held constant in the group's experiment ⍟

CAPT Physical Science Open-Ended Question:
All That Energy

All That Energy

The girl shown above uses energy that originated from the sun to kick a soccer ball. Describe the energy transformations that occur to accomplish this.

All That Energy

Some of the solar energy that reaches the Earth is captured by plants that use this energy to convert carbon dioxide and water into organic compounds that contain chemical potential energy. The girl, like all other animals, eats foods that come from plants or from other animals that eat plants. In her body the organic compounds are broken down and the released chemical energy is captured and stored in small energy-rich molecules. When the girl kicks the ball, potential energy stored in these molecules is converted to kinetic energy of her movement. As her moving foot hits the soccer ball, some of the kinetic energy is transferred to the ball and makes it move. Eventually the ball stops moving, as its kinetic energy is dissipated as heat in the environment.

Score 3

The response describes the major energy changes that occur from the sun to the kicking of the soccer ball. It is correct and well elaborated.

Score 2

The response describes most of the major energy changes that occur from the sun to the kicking of the soccer ball. It is less elaborated than the score 3 responses. It may contain inaccuracies.

Score 1

The response describes some of the major energy changes that occur from the sun to the kicking of the soccer ball. It contains limited elaboration. Misconceptions may be present.

Score 0

The response describes none of the major energy changes that occur from the sun to the kicking of the soccer ball. Misconceptions may be present.

Scored Student Responses for *All That Energy*

Score 3

Energy from the sun is transferred to plants through photosynthesis when chloroplasts in the plants transform the rays into energy to keep the plant green + growing. The girl will eat the plant (such as lettuce) during a meal and receive the sun's energy in the form of calories + vitamins from the plant source. (chemical energy) Calories are the human-unit of measuring energy, using energy from those calories the girl can move her muscles, especially those in her leg. This movement is kinetic energy transferred from her leg to the soccer ball in what is known as a "kick". as a result, the soccer ball moves. As an overview, energy travelled from the sun to plants, the girl ate the plant receiving calories, used that energy to move her leg + in turn kick the soccer ball.

The response describes the major energy changes that occur from the sun to the kicking of the soccer ball. It is correct and well elaborated.

Scored Student Responses for *All That Energy*

Score 3

The first transformation that occurred is the energy from the sun was converted to chemical potential energy in glucose in producers that undergo photosynthesis. After that the girl either ate a the producer or a consumer that ate the producer and got that glucose. Then the glucose was broken down and became thermal energy, but only briefly because the adenosine triphosphate once again stored the energy as chemical potential energy. Finally that chemical energy was used to contract her leg muscles and kick the ball which is kinetic energy.

The response describes the major energy changes that occur from the sun to the kicking of the soccer ball. It is correct and well elaborated.

Scored Student Responses for *All That Energy*

Score 2

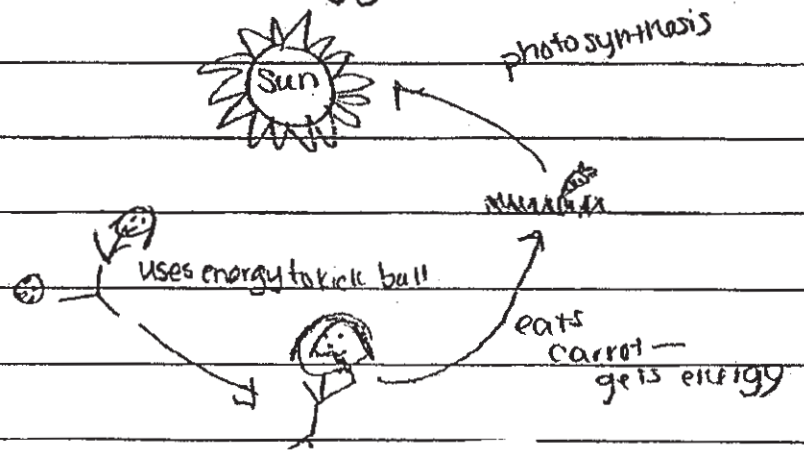
The energy from the sun is absorbed by plants by the chlorophyll in the leaves. It then goes through the process of photosynthesis to change the energy into compounds that release energy when broken down. Herbivores eat the plants and obtain the compounds containing the energy. The girl obtained these energy containing compounds by eating the plants or the herbivores that ate them. Her body breaks down the compounds and uses the energy.

The response describes the major energy changes that occur from the sun to the girl. It fails to describe the energy transformation from the girl when she kicks the ball. The elaboration is adequate.

Scored Student Responses for *All That Energy*

Score 2

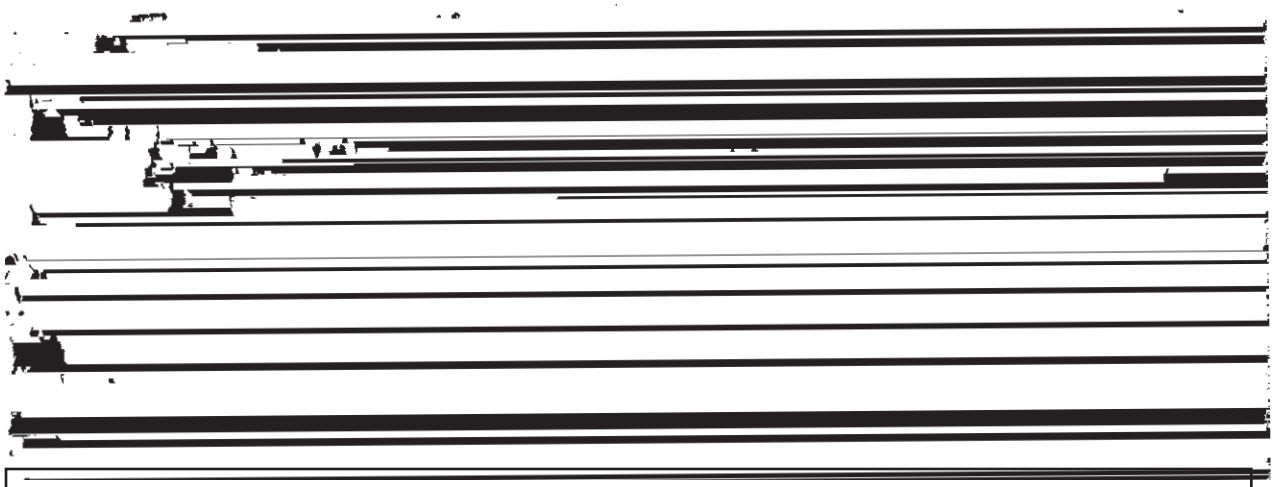
First, a plant goes through photo synthesis which obtains energy from the sun. Then, she eats the plant, such as a potato which contains many carbohydrates. She uses these carbohydrates as energy to kick the soccer ball.



The response describes most of the major energy changes that occur from the sun to the kicking of the soccer ball. It is less elaborated than the score three response.

Scored Student Responses for *All That Energy*

Score 1



The response describes some of the major energy changes that occur from the sun to the kicking of the soccer ball. It contains limited elaboration.

Scored Student Responses for *All That Energy*

Score 1

First energy goes into the trees and vegitation which we eat and get our energy from. Also we get our oxygen from the trees so if we didn't have the sun we would die b/c we wouldn't have air, food, or energy.

The response describes minimal energy changes that occur from the sun to the kicking of the soccer ball. It contains limited elaboration.

Scored Student Responses for *All That Energy*

Score 0

The sun's energy is great. The earth rotates arounet it in order to gain power from it. The sun is lighting up the field and prouding energy do- the gire in order to kick the soccer ball.

The response describes none of the major energy changes that occur from the sun to the kicking of the soccer ball. Misconceptions are present.

Scored Student Responses for *All That Energy*

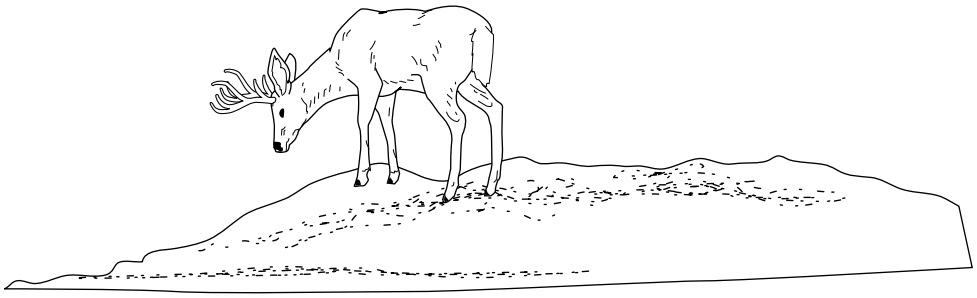
Score 0

The light from the sun is sent out in UV rays through space and ~~itn~~ to the atmosphere. Once in the atmosphere it hits the girls skin. The light energy is now transformed to create endorphins. Endorphins are used to keep people happy and energized, because the sun is hitting her skin and creating endorphins to work and use, she is able to use her "new" energy to kick the soccer ball.

The response describes none of the major energy changes that occur from the sun to the kicking of the soccer ball. Misconceptions are present.

CAPT Life Science Open-Ended Question:
Deer Population

Deer Population



The deer population in Connecticut has grown significantly over the past century. Describe two factors that may have led to the increase in the deer population.

Deer Population

The deer population in Connecticut has grown significantly in the last century due to the favorable environmental conditions and the lack of natural deer predators. Due to a decrease in farming in the last century, the Connecticut environment contains more woods and open spaces that provide the deer population with more food and shelter. In addition, the number of natural predators of deer such as bears and wolves has been reduced. The increase in natural resources and the decrease in predators, together with state laws that limit deer hunting, provide an ideal habitat for the deer and therefore the deer population is continuously growing.

Score 3

The response correctly identifies two factors that may have contributed to the increase of the deer population over the past century. It is correct and well elaborated.

Score 2

The response correctly identifies two factors that may have contributed to the increase of the deer population over the past century. It is less elaborated than a score 3 response or contains inaccuracies.

-or-

The response correctly identifies one factor that may have contributed to the increase of the deer population over the past century. It is correct and well elaborated.

Score 1

The response correctly identifies one factor that may have contributed to the increase of the deer population over the past century. It contains limited elaboration. It may contain misconceptions.

Score 0

The response fads to identify any factors that may have contributed to the increase of the deer population over the past century. It may contain misconceptions.

Scored Student Responses for *Deer Population*

Score 3

One factor that may have led to the increase in deer population is probably an increase in food supply. If the deer have more food to eat, they can support their babies and will live longer. Also, there are more strict hunting laws than there were 100 yrs. ago. This could lead to the fact that less deer are being killed so they produce more babies, increasing the population.

The response correctly identifies two factors (increased food supply, hunting laws) which may have contributed to the increase of the deer population over the past century. It is correct and well elaborated.

Scored Student Responses for *Deer Population*

Score 3

Factors that may have led to the increase of the deer population are food and predators. Food may have become more abundant, therefore, increasing the deers chance of survival. Another reason is that there are not many predators such as wolves or other animals in Connecticut that feed off deer. There are some predators such as Coyotes that are more common but there are so many deer that they don't impacte the population.

The response correctly identifies two factors (more food, fewer predators) that may have contributed to the increase of the deer population in Connecticut. It is correct and well elaborated.

Scored Student Responses for *Deer Population*

Score 2

The deer population in Connecticut over the past century could have grown significantly due to the decrease or endangerment of their predators such as wolves. Also, a factor in their population growth could be migration to Connecticut due to climate changes elsewhere.

The response correctly identifies two factors (fewer predators, migration) that may have contributed to the increase of the deer population. It is less elaborated than a score 3 response.

Scored Student Responses for *Deer Population*

Score 2

The fact that hunters have to have a lincense to hunt. There isnt many people hunters out their hunting deer. As years pass the enviroment changes, there could have been a change, where deer are able to survive better, better food. Allows them to live longer so they can produce

The response correctly identifies two factors (less hunting, more food) that may have contributed to the increase in the deer population in Connecticut. It is less elaborated than a score 3 response.

Scored Student Responses for *Deer Population*

Score 1

An increase in deer population may have come about because we tend to get very cold winters in newengland, particularly in maine, New Hampshire, and vermont. They may have come down to Connecticut because it's a little warmer. Also, The deer may be reproducing more. If this is true, we would see more deer, which is happening.

The response correctly identifies one factor (migration) that may have contributed to an increase in the deer population in Connecticut. There is limited elaboration.

Scored Student Responses for *Deer Population*

Score 1

The deer population may have grown because (a) there has been restrictions put on hunting. There is now an off season where it is illegal to hunt deer. (b) They also have probably adapted better so they live longer.

The response correctly identifies one factor (less hunting) that may have led to an increase in the deer population in Connecticut. It contains limited elaboration.

Scored Student Responses for *Deer Population*

Score 0

On factor of the deer population is reproduction. Since the population was grown theier had to have been more reproduction. Another factor is that the deer's have been moved from harmfull enviorment which would lower the rate of deers being hunted.

The response does not identify any factors that may have contributed to an increase in the deer population in Connecticut. It contains misconceptions (deer have been moved).

Scored Student Responses for *Deer Population*

Score 0

Two factors that may/or helped the deer population grow is making the land they live on a reservation. Also putting them on the endangered species list

The response fails to identify any factors that may have contributed to an increase in the deer population in Connecticut. It contains inaccuracies (on endangered species list, on a reservation).

CAPT Earth Science Open-Ended Question:
Reasons For The Seasons

Reasons For The Seasons

There are several factors that cause Earth to experience seasons. Explain why there are seasons on Earth.

Reason for the Seasons

Two factors, both related to the tilt of the Earth on its rotation axis, contribute simultaneously to the seasons. The tilt of the Earth's axis causes the sunlight to strike the Earth's surface at different angles. When the sun's rays are closer to vertical, their energy is absorbed by a smaller portion of the surface, resulting in greater heating. When the sun's rays are further from the vertical, their energy is spread over a greater portion of the surface, resulting in less heating. In the summer, the Earth's north pole is tilted towards the sun, and the northern hemisphere experiences a longer period of daylight and heating, resulting in higher temperatures. In the winter, the Earth's north pole is tilted away from the sun, and the northern hemisphere experiences a shorter period of daylight, resulting in less heating and lower temperatures. The seasons are reversed in the Southern hemisphere.

Areas between the Tropics of Cancer and Capricorn have relatively minor annual variation in daylight hours. The areas between the tropics and the polar circles have the greatest variation in daylight hours throughout the year.

Score 3

The response explains how the Earth's revolution around the sun and the tilt in its axis combine to cause the Earth to experience different seasons. It is correct, complete and well elaborated.

Score 2

The response explains how the Earth's revolution around the sun and/or the tilt in its axis cause the Earth to experience different seasons. It is less elaborated than the score 3 responses. It may be incomplete or contain inaccuracies.

Score 1

The response partially explains how the Earth's revolution around the sun or the tilt in its axis causes the Earth to experience different seasons. It contains limited elaboration. Misconceptions may be present.

-or-

The response gives a less significant factor that contributes to the Earth experiencing seasons.

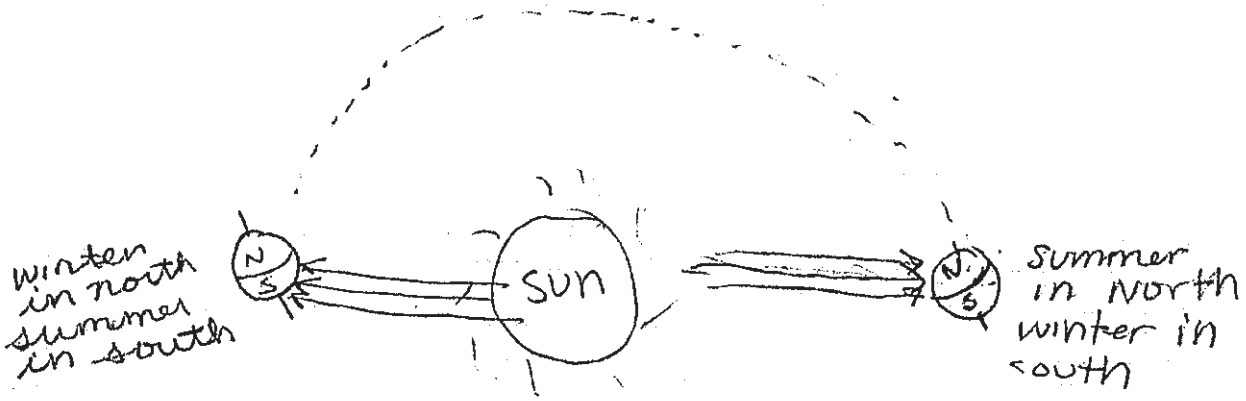
Score 0

The response fails explain how the Earth's revolution around the sun or the tilt in its axis causes the Earth to experience different seasons.

Scored Student Responses for
Reasons For The Seasons

Score 3

The earth's axis is on a tilt. As the earth revolves around the sun in a period of time labeled a year, certain parts of the earth are tilted towards or away from the sun recieving more direct or less direct rays from the sun. When the northern hemisphere is angled towards the sun, it will be warm from the direct rays, causing summer. The southern hemisphere will then be in winter



The response explains how the Earth's revolution around the sun and the tilt in its axis combine to cause the Earth to experience different seasons. It is correct, complete and well elaborated.

Scored Student Responses for
Reasons For The Seasons

Score 3

There are seasons on Earth because of the revolution of the Earth around the Sun and the rotation of the Earth. When the Northern Hemisphere is tilted away from the sun the sun's rays went as direct and it gets colder and becomes cold and it is winter. At the same time the Southern hemisphere is tilted toward the sun and is getting very direct rays and it is warm and summer time. then it happens the other way around it the seasons change

The response explains how the Earth's revolution around the sun and the tilt in its axis combine to cause the earth to have different seasons. It is correct and contains good elaboration.

Scored Student Responses for
Reasons For The Seasons

Score 2

There are several reasons why there are seasons on Earth. Mainly it deals with Earth's rotation around the sun, and the angle of the earth's axis. During the equinoxes and solctices the angle and position of the earth's axis changes causing the sun to be either closer or farther depending on the position. For example, during the winter solctice the axis is pointed away from the sun so there is less light and it becomes colder. The opposite occurs during the summer solctice.

The response explains how the tilt in the Earth's axis causes the Earth to experience different seasons. It is less elaborated than the score 3 response.

Scored Student Responses for
Reasons For The Seasons

Score 2

There are seasons on Earth because as it rotates arand the sand, it is tilted on it's axis. When the northern hemisphere is experiencing Summer, it is because the Earth's axis is pointed towards the sun. When the northern hemisphere is experiencing winter it is because the Earth's axis is pointed away from the sun. Spring and fall are the seasons when the axis is in between.

The response explains how the Earth's revolution (though stated as rotation) around the sun and the tilt on it's axis cause the Earth to experience different seasons. It is not as well elaborated as a score 3 response.

Scored Student Responses for
Reasons For The Seasons

Score 1

The reason for seasons is the way the earth rotates around the sun. Summer is because we face the sun and It gets more humid. Autumn is because the sun is just starting to leave, and its not humid anymore. winter is when all the trees start to die and we get snow. Spring is when things start to grow. As you can see, we have seasons because the sun can't cover the whole earth at the same time.

The response partially explains how the Earth's revolution around the sun causes the Earth to experience different seasons. It is incomplete and contains little relevant elaboration.

Scored Student Responses for
Reasons For The Seasons

Score 1

There are seasons on Earth because when the Earth revolves around the sun the Earth goes in an eliptical path. When the Earth is fartner from the sun it is winter and when the Earth is closer to the sun it is summer

The response partially explains how the Earth's revolution around the sun causes the Earth to experience different seasons. It contains misconceptions and is not well elaborated.

Scored Student Responses for
Reasons For The Seasons

Score 0

There are seasons on earth because the Earth rotates around the sun & when the earth spins the parts of the world that are facing the sun move away causing summer to winter.

The response fails to explain how the Earth's revolution around the sun or the tilt in its axis causes the Earth to experience different seasons.

Scored Student Responses for
Reasons For The Seasons

Score 0

There are seasons on Earth because while the Earth rotates the weather changes worldwide. It could be summer in the United states while other countries are experiencing winter. It's apart of mother nature.

The response fails to address how the Earth's revolution around the sun or the tilt in its axis causes the Earth to experience different seasons.

CAPT Physical/Life Science Multiple-Choice Questions: *The Bicycle Ride*

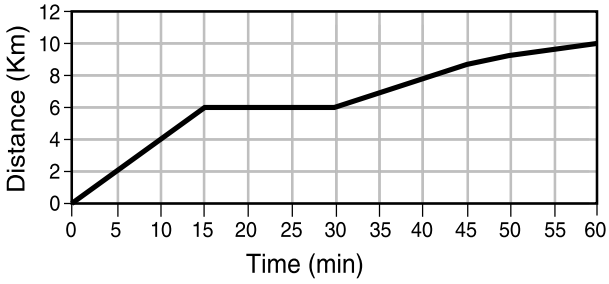
The Bicycle Ride

A bicycle rider went out for a 10-kilometer ride. The rider traveled at a constant speed within each of the four parts of the ride. Use the table below to answer question 1.

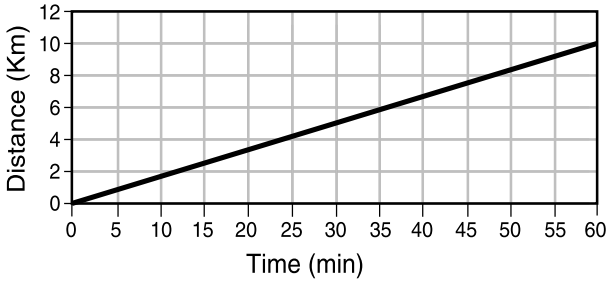
Bicycle Ride Summary

Part	Distance (km)	Time (min)
1	6	15
2	0	15
3	3	15
4	1	15
Total	10 km	60 minutes

1. Which of these graphs **best** illustrates the 10-kilometer distance covered by the bicycle rider?



a. ⊛



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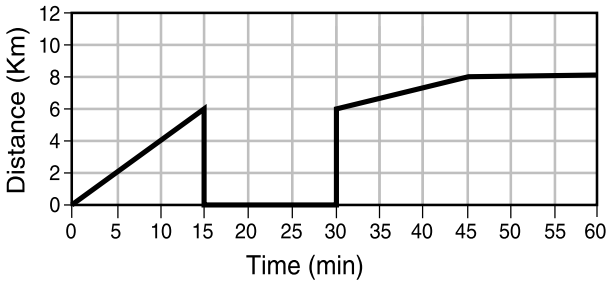
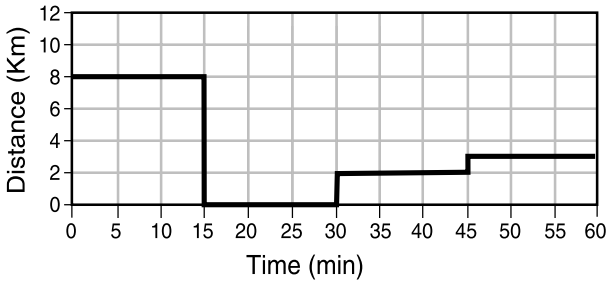


c.



d.

CAPT Physical/Life Science Multiple-Choice Questions: *The Bicycle Ride* (continued)

2. The bicycle rider ate breakfast before the ride. Which of the following energy transformations occurred during the bike ride?

f. Kinetic energy to chemical energy
g. Chemical energy to kinetic energy ⍟
h. Kinetic energy to nuclear energy
j. Nuclear energy to kinetic energy

3. As the bike rider goes up a hill, the force of gravity acts to _____.

a. increase the weight of the rider
b. increase the acceleration of the rider
c. decrease the mass of the rider
d. decrease the speed of the rider ⍟

CAPT Life Science Multiple-Choice Questions: *Adaption to Change*

Adaptation To Change

Over time, new species have evolved while others have become extinct.

1. A male horse and a female donkey can be bred to produce an offspring known as a mule. This is possible because the two parents _____.

a. have adapted to similar environments
b. are domesticated mammals
c. are almost genetically identical ⍟
d. eat the same types of foods

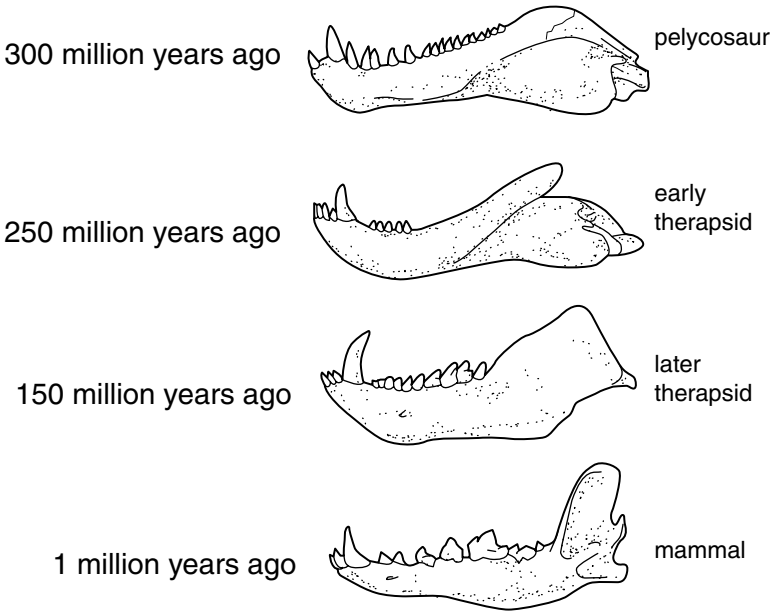
2. John and Mary have three daughters. What are the chances that their fourth child will be a boy?

f. 1 out of 8 (12.5%)
g. 1 out of 4 (25%)
h. 1 out of 2 (50%) ⍟
j. 3 out of 4 (75%)

3. Which of the following **most likely** supports how giraffes evolved long necks?

a. More long-necked giraffes survived to pass on their genes. ⍟
b. More short-necked giraffes survived to pass on their genes.
c. Short-necked giraffes modified their diets to evolve into a new species.
d. Short-necked giraffes grew longer necks to reach higher leaves.

CAPT Life Science Multiple-Choice Questions: *Adaption to Change* (continued)



4. The fossilized jawbones in the diagram above show the changes in organisms over time. According to the diagrams, which of the following is a likely conclusion?

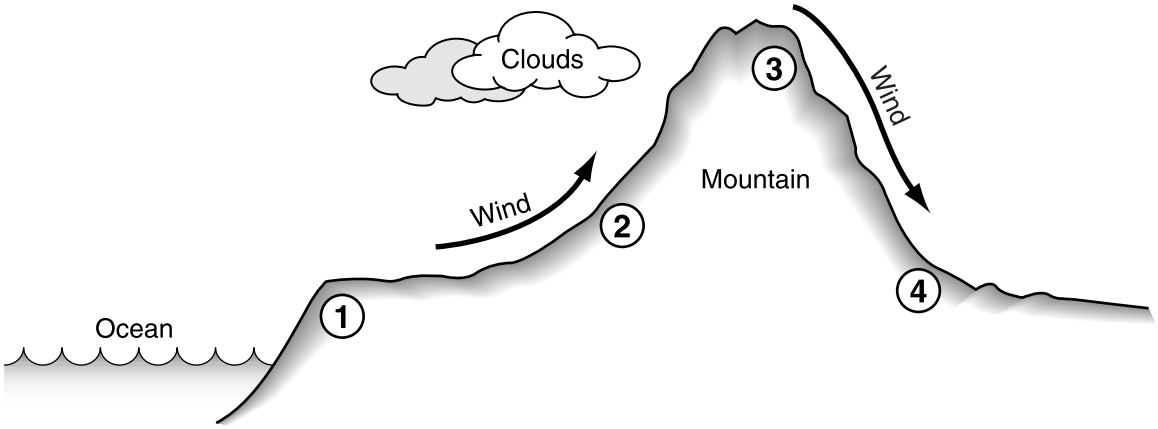
f. These fossils provide evidence that evolution occurs rapidly.
g. These fossils provide evidence that evolution occurs over long periods of time. ✪
h. These fossils belonged to organisms that were large and slow moving.
j. These fossils lack similar characteristics in their structural design.

CAPT Earth Science Multiple-Choice Questions: *Weather*

Weather

Forces acting on Earth's surface continually cause changes to the land formations. In turn, these land formations influence the weather.

The diagram shows a cross section of a mountain range on the west coast of the U.S. Use the diagram to answer questions 1 and 2.



1. A cloud forms at the area indicated in the diagram because _____.

a. relative humidity increases as the air rises ✪
b. air pressure increases at higher elevations
c. air temperature increases as the air rises
d. amount of oxygen increases at higher elevations

2. The climate at Point 4 is **most likely** _____.

f. similar to the climate at point 1
g. tropical, with frequent rainfall
h. dry, with little precipitation ✪
j. similar to the climate at point 2

CAPT Earth Science Multiple-Choice Questions: *Weather* (continued)

3. The relative humidity of the air near the ocean is 90%. This means the air is holding _____.

a. 10% of the amount of the water vapor it can hold at that temperature
b. 90% of the amount of the water vapor it can hold at that temperature ⍟
c. 10% of the available water vapor in the area at that temperature
d. 90% of the available water vapor in the area at that temperature

4. On a sunny summer afternoon, winds generally blow from the ocean towards land because the _____.

f. land heats up faster than water ⍟
g. water heats up faster than land
h. Earth is farther away from the sun than in the morning
j. Earth is closer to the sun than in the morning

5. Increased levels of carbon dioxide (CO_2) in the atmosphere contribute to global warming. Which of the following might reduce levels of CO_2?

a. deforestation
b. using fossil fuels
c. burning wood
d. planting trees ⍟