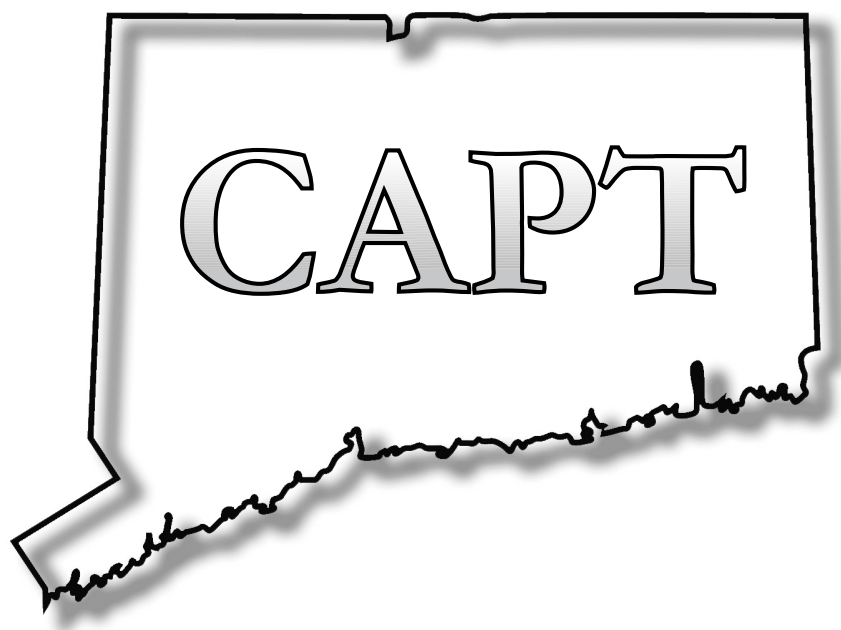


**CAPT Science
2011 Administration**



**Released Items and
Scored Student Responses**

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CAPT Science Framework

The CAPT Science test was developed with the input of Connecticut educators and reflects a growing national consensus 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 CAPT Science test assesses students' understanding of important scientific concepts, as well as their application of those concepts to realistic problems. In addition, experimentation and the ability to use scientific reasoning to solve problems are a major focus of the test.

To align with the Science Curriculum Framework, the following content strands are reported:

- Energy Transformations
- Chemical Structures and Properties
- Global Interdependence
- Cell Chemistry and Biotechnology
- Genetics, Evolution, and Biodiversity

In addition, scores are reported for the following:

- Conceptual Understanding
- Scientific Inquiry, Literacy, and Numeracy

Students respond to 60 multiple-choice (MC) and 5 open-ended (OE) items. The test is divided into two 50-minute sessions.

CAPT Science	Content Knowledge	Scientific Inquiry, Literacy and Numeracy		
Content Strand	MC Items (1 point)	MC Items (1 point)	OE Items (3 points)	Points
I. Energy Transformations	8	4	1	15
II. Chemical Structures & Properties	8	4	1	15
III. Global Interdependence	8	4	1	15
IV. Cell Chemistry & Biotechnology	8	4	1	15
V. Genetics, Evolution & Biodiversity	8	4	1	15
Totals	40 MC Items	20 MC Items	5 OE Items	75 Points

Students respond to two different types of items: multiple-choice and open-ended. On the open-ended items, students are asked to respond in writing to the question, or they may be asked to sketch a graph. Multiple-choice items are scored electronically as correct or incorrect. Open-ended items are hand-scored using a 4-point holistic rubric (0–3). Scientific Inquiry, Literacy, and Numeracy expected performances are tested using both multiple-choice and open-ended items.

A state Goal standard has been set for the CAPT Science test. Students who reach the state Goal receive a Certificate of Mastery in Science.

A curriculum-embedded science performance task has been developed for each of the five content strands. These tasks will be utilized for the entire third generation of the test. Schools are encouraged to embed these tasks into their regular grade 9 and 10 science curricula at the appropriate time. All of the open-ended items on the written test are related to the five tasks.

Core Science Curriculum Framework for Grades 9 and 10

THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY, AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 9–10 Core Scientific Inquiry, Literacy, and Numeracy	
<i>How is scientific knowledge created and communicated?</i>	
Content Standards	Expected Performances
<p>SCIENTIFIC INQUIRY</p> <ul style="list-style-type: none"> ◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain, and predict natural phenomena. ◆ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation. ◆ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. <p>SCIENTIFIC LITERACY</p> <ul style="list-style-type: none"> ◆ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science. ◆ Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. <p>SCIENTIFIC NUMERACY</p> <ul style="list-style-type: none"> ◆ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze, and present scientific data and ideas. 	<p>D INQ.1 Identify questions that can be answered through scientific investigation.</p> <p>D INQ.2 Read, interpret, and examine the credibility and validity of scientific claims in different sources of information.</p> <p>D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.</p> <p>D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.</p> <p>D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.</p> <p>D INQ.6 Use appropriate tools and techniques to make observations and gather data.</p> <p>D INQ.7 Assess the reliability of the data that was generated in the investigation.</p> <p>D INQ.8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.</p> <p>D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.</p> <p>D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence, and clear logic.</p>

Grade 9

Core Themes, Content Standards and Expected Performances

Strand I: Energy Transformations

Content Standards	Expected Performances
<p><i>Energy Transfer and Transformations – What is the role of energy in our world?</i></p> <p>9.1 - Energy cannot be created or destroyed; however, energy can be converted from one form to another.</p> <ul style="list-style-type: none"> ◆ Energy enters the Earth system primarily as solar radiation, is captured by materials and photosynthetic processes, and eventually is transformed into heat. 	<p>D 1. Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.</p> <p>D 2. Explain how energy is transferred by conduction, convection, and radiation.</p> <p>D 3. Describe energy transformations among heat, light, electricity, and motion.</p>
<p><i>Energy Transfer and Transformations – What is the role of energy in our world?</i></p> <p>9.2 - The electrical force is a universal force that exists between any two charged objects.</p> <ul style="list-style-type: none"> ◆ Moving electrical charges produce magnetic forces, and moving magnets can produce electrical force. ◆ Electrical current can be transformed into light through the excitation of electrons. 	<p>D 4. Explain the relationship among voltage, current, and resistance in a simple series circuit.</p> <p>D 5. Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.</p> <p>D 6. Describe the relationship between current and magnetism.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>9.3 - Various sources of energy are used by humans, and all have advantages and disadvantages.</p> <ul style="list-style-type: none"> ◆ During the burning of fossil fuels, stored chemical energy is converted to electrical energy through heat transfer processes. ◆ In nuclear fission, matter is transformed directly into energy in a process that is several million times as energetic as chemical burning. ◆ Alternative energy sources are being explored and used to address the disadvantages of using fossil and nuclear fuels. 	<p>D 7. Explain how heat is used to generate electricity.</p> <p>D 8. Describe the availability, current uses, and environmental issues related to the use of fossil and nuclear fuels to produce electricity.</p> <p>D 9. Describe the availability, current uses, and environmental issues related to the use of hydrogen fuel cells, wind, and solar energy to produce electricity.</p>

Grade 9

Core Themes, Content Standards and Expected Performances

Strand II: Chemical Structures and Properties

Content Standards	Expected Performances
<p><i>Properties of Matter – How does the structure of matter affect the properties and uses of materials?</i></p> <p>9.4 - Atoms react with one another to form new molecules.</p> <ul style="list-style-type: none"> ◆ Atoms have a positively charged nucleus surrounded by negatively charged electrons. ◆ The configuration of atoms and molecules determines the properties of the materials. 	<p>D 10. Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.</p> <p>D 11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).</p> <p>D 12. Explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.</p>
<p><i>Properties of Matter – How does the structure of matter affect the properties and uses of materials?</i></p> <p>9.5 - Due to its unique chemical structure, carbon forms many organic and inorganic compounds.</p> <ul style="list-style-type: none"> ◆ Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including fossil fuels, synthetic polymers, and the large molecules of life. 	<p>D 13. Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.</p> <p>D 14. Describe combustion reactions of hydrocarbons and their resulting by-products.</p> <p>D 15. Explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>9.6 - Chemical technologies present both risks and benefits to the health and well-being of humans, plants, and animals.</p> <ul style="list-style-type: none"> ◆ Materials produced from the cracking of petroleum are the starting points for the production of many synthetic compounds. ◆ The products of chemical technologies include synthetic fibers, pharmaceuticals, plastics, and fuels. 	<p>D 16. Explain how simple chemical monomers can be combined to create linear, branched, and/or cross-linked polymers.</p> <p>D 17. Explain how the chemical structure of polymers affects their physical properties.</p> <p>D 18. Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.</p>

Grade 9

Core Themes, Content Standards and Expected Performances

Strand III: Global Interdependence

Content Standards	Expected Performances
<p><i>The Changing Earth – How do materials cycle through the Earth’s systems?</i></p> <p>9.7 - Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of biogeochemical cycles.</p> <ul style="list-style-type: none"> ◆ Elements on Earth exist in essentially fixed amounts and are located in various chemical reservoirs. ◆ The cyclical movement of matter between reservoirs is driven by Earth’s internal and external sources of energy. 	<p>D 19. Explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.</p> <p>D 20. Explain how solar energy causes water to cycle through the major earth reservoirs.</p> <p>D 21. Explain how internal energy of Earth causes matter to cycle through the magma and the solid earth.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>9.8 - The use of resources by human populations may affect the quality of the environment.</p> <ul style="list-style-type: none"> ◆ Emission of combustion by-products, such as SO₂, CO₂, and NO_x, by industries and vehicles is a major source of air pollution. ◆ Accumulation of metal and non-metal ions used to increase agricultural productivity is a major source of water pollution. 	<p>D 22. Explain how the release of sulfur dioxide (SO₂) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms, and human-made structures.</p> <p>D 23. Explain how the accumulation of carbon dioxide (CO₂) in the atmosphere increases Earth’s “greenhouse” effect and may cause climate changes.</p> <p>D 24. Explain how the accumulation of mercury, phosphates, and nitrates affects the quality of water and the organisms that live in rivers, lakes, and oceans.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>9.9 - Some materials can be recycled, but others accumulate in the environment and may affect the balance of Earth’s systems.</p> <ul style="list-style-type: none"> ◆ New technologies and changes in lifestyle can have positive and/or negative effects on the environment. 	<p>D 25. Explain how land development, transportation options, and consumption of resources may affect the environment.</p> <p>D 26. Describe human efforts to reduce the consumption of raw materials and improve air and water quality.</p>

Grade 10

Core Themes, Content Standards and Expected Performances

Strand IV: Cell Chemistry and Biotechnology

Content Standards	Expected Performances
<p><i>Structure and Function – How are organisms structured to ensure efficiency and survival?</i></p> <p>10.1 - Fundamental life processes depend on the physical structure and the chemical activities of the cell.</p> <ul style="list-style-type: none"> ◆ Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperature and acidity conditions. ◆ The cellular processes of photosynthesis and respiration involve transformation of matter and energy. 	<p>D 27. Describe significant similarities and differences in the basic structure of plant and animal cells.</p> <p>D 28. Describe the general role of DNA and RNA in protein synthesis.</p> <p>D 29. Describe the general role of enzymes in metabolic cell processes.</p> <p>D 30. Explain the role of the cell membrane in supporting cell functions.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>10.2 - Microorganisms have an essential role in life processes and cycles on Earth.</p> <ul style="list-style-type: none"> ◆ Understanding the growth and spread patterns of viruses and bacteria enables the development of methods to prevent and treat infectious diseases. 	<p>D 31. Describe the similarities and differences between bacteria and viruses.</p> <p>D 32. Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination, and antibiotic medications in the prevention and treatment of infectious diseases.</p> <p>D 33. Explain how bacteria and yeasts are used to produce foods for human consumption.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>10.3 - Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.</p> <ul style="list-style-type: none"> ◆ The principles of genetics and cellular chemistry can be used to produce new foods and medicines in biotechnological processes. 	<p>D 34. Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.</p> <p>D 35. Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.</p>

Grade 10

Core Themes, Content Standards and Expected Performances

Strand V: Genetics, Evolution and Biodiversity

Content Standards	Expected Performances
<p><i>Heredity and Evolution – What processes are responsible for life’s unity and diversity?</i></p> <p>10.4 - In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</p> <ul style="list-style-type: none"> ◆ Genetic information is stored in genes that are located on chromosomes inside the cell nucleus. ◆ Most organisms have two genes for each trait, one on each of the homologous chromosomes in the cell nucleus. 	<p>D 36. Explain how meiosis contributes to the genetic variability of organisms.</p> <p>D 37. Use the Punnet Square technique to predict the distribution of traits in mono- and di-hybrid crossings.</p> <p>D 38. Deduce the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes.</p> <p>D 39. Describe the difference between genetic disorders and infectious diseases.</p>
<p><i>Heredity and Evolution – What processes are responsible for life’s unity and diversity?</i></p> <p>10.5 - Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.</p> <ul style="list-style-type: none"> ◆ Mutations and recombination of genes create genetic variability in populations. ◆ Changes in the environment may result in the selection of organisms that are better able to survive and reproduce. 	<p>D 40. Explain how the processes of genetic mutation and natural selection are related to the evolution of species.</p> <p>D 41. Explain how the current theory of evolution provides a scientific explanation for fossil records of ancient life forms.</p> <p>D 42. Describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>10.6 - Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.</p> <ul style="list-style-type: none"> ◆ Human populations grow due to advances in agriculture, medicine, construction, and the use of energy. ◆ Humans modify ecosystems as a result of rapid population growth, use of technology, and consumption of resources. 	<p>D 43. Describe the factors that affect the carrying capacity of the environment.</p> <p>D 44. Explain how change in population density is affected by emigration, immigration, birth rate, and death rate, and relate these factors to the exponential growth of human populations.</p> <p>D 45. Explain how technological advances have affected the size and growth rate of human populations throughout history.</p>

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 two open-ended items corresponding to curriculum-embedded performance tasks.

CSDE has developed a suggested performance task for each of the five content strands in the science framework for grades 9 and 10. Teachers are encouraged to use these tasks in the normal course of instruction when teaching the related content strand. The five constructed-response items on the CAPT will assess scientific inquiry, literacy, and numeracy, using the context of the curriculum embedded tasks. These constructed-response items total 15 points or 20 percent of the total test.

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 10 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

For each of the five content strands, eight multiple-choice items assess content knowledge, and four multiple-choice items assess scientific inquiry, literacy, and numeracy skills. The entire Science test includes 60 multiple-choice items.

To foster depth of understanding, most CAPT multiple-choice items are organized in clusters related to particular scenarios. In addition, some clusters include specific information at the beginning that 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.

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 evidence, if any, of elaboration, extension, higher-order thinking, or relevant prior knowledge. There may be evidence of significant misconceptions.

Score 0

The response, though possibly 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 Open-Ended Item: *Polymer Investigation*

A student performed the following investigation to test four different polymer plastics for stretchability.

Procedure:

1. Take a sample of one type of plastic, and measure its length.
2. Tape the top edge of the plastic sample to a table so that it is hanging freely down the side of the table.
3. Attach a clamp to the bottom edge of the plastic sample.
4. Add weights to the clamp and allow them to hang for five minutes.
5. Remove the weights and clamp, and measure the length of the plastic types.
6. Repeat the procedure exactly for the remaining three plastic samples.
7. Perform a second trial (T2) exactly like the first trial (T1).

The student recorded the following data from the investigation.

Data Table

Plastic Type	Amount Stretched (mm)	
	T1	T2
A	10	12
B	22	23
C	14	13
D	20	20

1.
 - a) Draw a conclusion based on the student's data.
 - b) Describe two ways the student could have improved the experimental design and/or validity of the results.

Rubric for *Polymer Investigation*

Sample Response:

Conclusions:

- Plastic sample B has more stretchability than the other polymer plastics.
- Plastic sample A has the least amount of stretchability compared to the other polymer plastics.
- Not all polymer plastics have the same stretchability.
- Different polymer plastics have different stretchability (and are therefore suited for different applications).
- A reasonable conclusion cannot be drawn due to procedural errors.
- Other reasonable conclusions

Experimental Design Improvements:

- Provide the before and after measurements for length (Did the samples all start out the same size?).
- Make sure the samples are all of the same thickness. Variations in thickness could have caused variations in stretchability.
- Perform additional trials. Some of the samples have similar stretchability (A and C, B and D). Two trials may not be enough to conclusively state that one is more stretchable than the other.
- Indicate how many weights were added to the clamps (Was it the same number for each sample?).
- Other acceptable responses

3-Point Rubric:

Score 3

The response draws a valid conclusion supported by the student's data and describes two ways the student could have improved the experimental design and/or the validity of the results.

Score 2

The response draws a valid conclusion supported by the student's data and describes one way the student could have improved the experimental design and/or the validity of the results.

-or-

The response describes two ways the student could have improved the experimental design and/or the validity of the results but fails to draw or incorrectly draws a conclusion from the student's data.

Score 1

The response draws a valid conclusion supported by the student's data but fails to describe, or incorrectly describes, how the student could have improved the experimental design and/or the validity of the results.

-or-

The response describes one way the student could have improved the experimental design and/or the validity of the results but fails to draw or incorrectly draws a conclusion from the student's data.

Score 0

The response provides little or no correct information from the polymer investigation.

Strand II: Chemical Structures and Properties

Expected Performance: D INQ.7 Assess the reliability of the data that was generated in the investigation.

Scored Student Responses for *Polymer Investigation*

Score 3

the data shows that plastic B stretched the most being 22 mm T1 and 23 mm T2. The students could have made the experiment better if they did one more trial also they could have been more specific in there procedure for example they should have told you the amount of weight you add to the plastic.

The student provides an acceptable conclusion based on the data: "...plastic B stretched the most..." Two correct ways to improve the experimental design and/or the validity of the results are given: "...if they did one more trial..." and "...they should have told you the amount of weight you add to the plastic."

Scored Student Responses for *Polymer Investigation*

Score 3

Based on the students data, plastic type B stretched the most, plastic type D stretched the second most, plastic type C stretched the third most, and plastic type A stretched the least. Two ways that the students could have improved the experimental design/validity of the results are having a set weight of the weights added every 5 minutes, have a set length for the plastics at the start of the test

The student provides an acceptable conclusion based on the data: "...plastic type B stretched the most..." Two correct ways to improve the experimental design and/or validity of the results are given: "...having a set weight of the weights..." and "...have a set length for the plastics at the start of the test." Adding weights every 5 minutes is a minor error and does not affect the final score of the response.

Scored Student Responses for *Polymer Investigation*

Score 2

A) Plastic type B is the most stretchable plastic of the four samples. In both trials it is stretched more than any of the other plastics.

B) The first way the experiment could have been improved was by more thoroughly explaining the procedures. Another way for improvement is by doing more trials. That will always give more accurate and more valid data.

The student provides an acceptable conclusion based on the data: "Plastic type B is the most stretchable plastic of the four samples." One correct way to improve the experimental design and/or the validity of the results is given: "...by doing more trials." Explaining the procedures more thoroughly is too vague to be considered an improvement to the experimental design and/or the validity of the results.

Scored Student Responses for *Polymer Investigation*

Score 2

I can draw from the student's experiment that plastic type B was the strongest based upon the data. One way that the student could have improved his investigation would be to give a specific length to cut the plastic pieces into as well as to put into his procedure how much of the plastic should have been on the table where it was taped. These two changes could have made a more clear experimental procedure.

This student provides an incorrect conclusion based on the student's data: "...plastic type B was the strongest..." However, two correct ways to improve the experimental design and/or the validity of the results are given: "...give a specific length to cut the plastic pieces into as well as to put into his procedure how much of the plastic should have been on the table where it was taped."

Scored Student Responses for *Polymer Investigation*

Score 1

The conclusion of this lab is that plastic B stretched the most.

The students could have improved the experiment by saying what type of plastic they used, and how high the table was that the plastic was hanging from.

The student provides an acceptable conclusion based on the data: "...plastic B stretched the most." Two ways to improve the experimental design and/or the validity of the results are given, but they are irrelevant and do not receive credit: "...saying what type of plastic they used, and how high the table was that the plastic was hanging from."

Scored Student Responses for *Polymer Investigation*

Score 1

A) Based on the information, all of the polymers had similar or the same amount stretched in the first and second trials.

B) Two ways the student could have improved the experimental design would be by having a third trial, simply because it could have helped more for comparing results. Another way they could have improved it would be by using another amount of time for comparison.

The student fails to provide an acceptable conclusion based on the data. Only a general comparison between the two trials is given. One correct way to improve the experimental design and/or the validity of the results is provided: "...by having a third trial...." The second improvement given, "...by using another amount of time for comparison [sic]," is too vague to receive credit.

Scored Student Responses for *Polymer Investigation*

Score 0

In trial 1,
a) The Plastic Type A wrap stretched 10mm, the Plastic type B wrap stretched 22 mm, the Plastic Type C wrap stretched 14mm, and the Plastic Type D wrap stretched 20mm. In trial 2, the A wrap stretched 12mm, the B wrap stretched 23mm, the C wrap stretched 13mm, and the D wrap stretched 20mm. b) The student could have improved the validity of the results by stretching the plastic wraps to see which one stretched the longest.

The student repeats data from the chart and does not provide a valid conclusion. One way to improve the experimental design and/or the validity of the results is provided ("The student could have improved the validity of the results by stretching the plastic wraps to see which one stretched the longest."), but it does not receive credit because it merely repeats part of the procedure for this investigation.

Scored Student Responses for *Polymer Investigation*

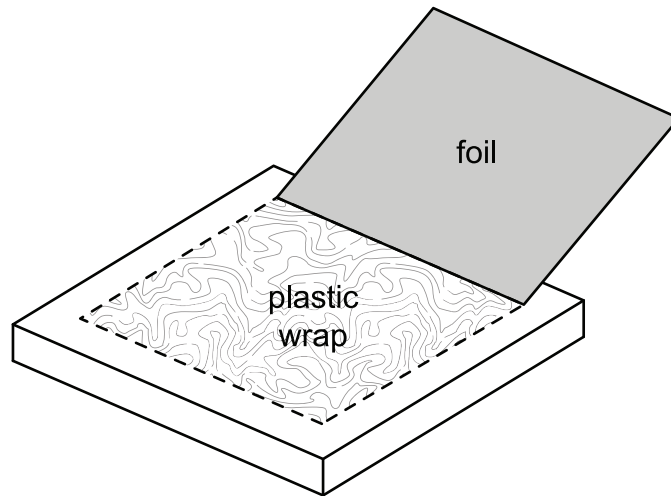
Score 0

Test 1 was good. Test 2 for plastic type A and B stretched longer than Test 1. They could have had more different kinds of plastics and kept the weights on.

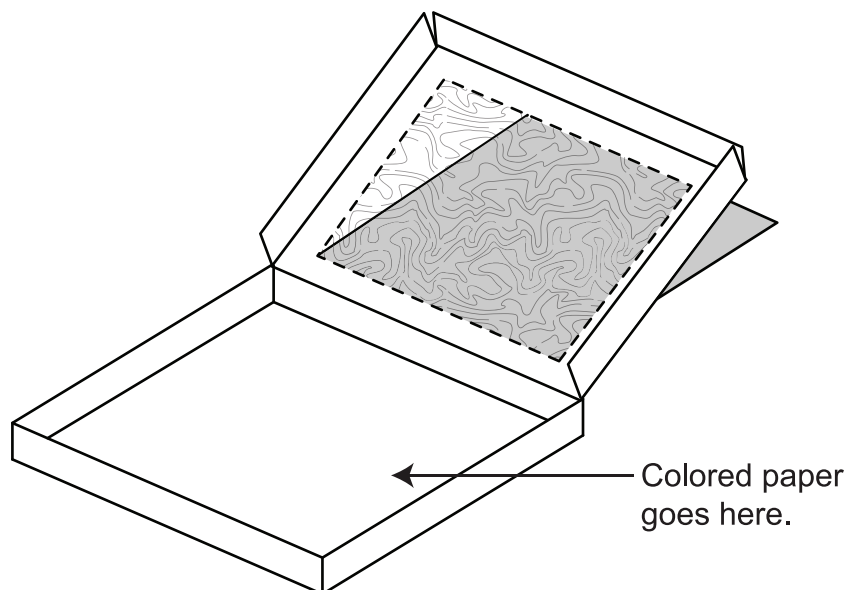
The student appears to be comparing trials rather than plastic types and does not provide a valid conclusion. "They could have had more different kinds of plastics and kept the weights on" are not valid ways to improve the experimental design and/or the validity of the results.

CAPT Science Open-Ended Item: *Solar Cooker*

A group of students want to determine whether changing the color of the floor in a solar cooker will affect the rate at which food cooks. They use a pizza box to make a solar cooker. First, they cut a window in the box top, as shown below. They cover the flap with aluminum foil. The opening is covered with plastic wrap, which allows sunlight to enter the box.



Several different colors of construction paper are obtained to line the floor of the box, each color to be used in a different trial. The finished solar cooker is shown below.



2.
 - a) Explain why the flap on the top was covered with aluminum foil.
 - b) Besides allowing sunlight through, what might be another purpose for covering the hole with plastic wrap?
 - c) Identify the independent variable in this investigation.

Rubric for Solar Cooker

Sample Response:

- a) • The flap is covered with aluminum foil to reflect* the sunlight/heat into the box and warm the food in the solar cooker.
OR
• The foil helps make the box hotter.
- *unacceptable words: attract, draw, conduct, absorb, radiate
- b) • The plastic wrap prevents the warmed air inside the box from escaping.
OR
• The plastic wrap insulates the box.
- c) • The colors of the box floor/the construction paper sheets are the independent variable.

3-Point Rubric:

Score 3

The response provides a valid explanation for why the flap is covered with aluminum foil, why the box opening is covered with plastic wrap, and correctly identifies the independent variable in the investigation.

Score 2

The response provides a valid explanation for why the flap is covered with aluminum foil and why the box opening is covered with plastic wrap but fails to identify, or incorrectly identifies, the independent variable.

-or-

The response provides a valid explanation for why the flap is covered with aluminum foil or why the box opening is covered with plastic wrap and correctly identifies the independent variable in the investigation.

Score 1

The response provides a valid explanation for why the flap is covered with aluminum foil or why the box opening is covered with plastic wrap and fails to identify, or incorrectly identifies, the independent variable.

-or-

The response correctly identifies the independent variable but fails to explain, or incorrectly explains, why the flap is covered with aluminum foil and why the box opening is covered with plastic wrap.

Score 0

The response provides little or no correct information.

Strand I: Energy Transformations

Expected Performance: D INQ.6 Use appropriate tools and techniques to make observations and gather data.

Scored Student Responses for Solar Cooker

Score 3

A.) The flap on the top was covered with aluminum foil so that it could reflect any sunlight going toward it onto the plastic wrap and then the heat would cook the food. Without the foil, the pizza box flap would've absorbed the heat.

B.) Another purpose for covering the hole with plastic wrap is to keep the heat inside the solar cooker. With nothing there, the heat energy would transfer from inside the solar cooker out to the air until both were the same temperature.

C.) The independent variable in the investigation is the color of the paper that the students put in the solar cooker.

The student provides a valid explanation for why the flap on the top was covered with aluminum foil: "...so that it could reflect any sunlight going toward it onto the plastic wrap and then the heat would cook the food." Another purpose of covering the hole with plastic wrap is correctly provided: "...to keep the heat inside the solar cooker." The independent variable is correctly identified as "the color of the paper."

Scored Student Responses for Solar Cooker

Score 3

a) The top flap was covered with foil to reflect the sunlight into the inside of the box.

b) The plastic wrap will also trap the heat inside the box.

c) Independent variable: The different colored papers.

Dependent variable: The rate at which food cooks.

The student provides a valid explanation for why the flap on top was covered with aluminum foil: "...to reflect the sunlight into the inside of the box." Another purpose for covering the hole with plastic wrap is correctly provided: "The plastic wrap will also trap the heat inside the box." The independent variable is correctly identified as "the different colored papers."

Scored Student Responses for Solar Cooker

Score 2

The flap on the top was covered in Aluminum foil so the sunlight would reflect off the foil and cook the food. The sunlight bounces off the foil and is directed at the food, which then cooks because of the solar energy. Another purpose for the plastic wrap may be so the food doesn't receive the full amount of solar energy. This could diffuse the light slightly so the food is evenly cooked. The independent variable in this equation is the color of the paper used at the bottom of the cooker.

The student provides two valid explanations for why the flap on top was covered with aluminum foil: "...so the sunlight would reflect off the foil and cook the food" and "The sunlight bounces off the foil and is directed at the food..." Either statement is valid for credit. Another purpose for covering the hole with plastic wrap is incorrectly provided: "...so the food doesn't receive [sic] the full amount of solar energy." The independent variable is correctly identified as "the color of the paper used at the bottom of the cooker."

Scored Student Responses for Solar Cooker

Score 2

The top was covered with aluminum foil to draw the heat in the pizza box. They covered the hole to let no heat out. The colored paper is the independent variable because that's what I change.

The student fails to provide a valid explanation for why the flap on top was covered with aluminum foil. "[T]o draw the heat in the pizza box" is inaccurate. Another purpose of covering the hole with plastic wrap is correctly provided: "...to let no heat out." The independent variable is correctly identified as "the colored paper."

Scored Student Responses for Solar Cooker

Score 1

a.) The flap was covered with aluminum foil because it will absorb heat that passes through the plastic wrap to give the food a surface to cook on.

b.) The wrap may help heat stay beneath the pizza box so that the food can cook, rather than have it escape out from the sides.

c.) The independent variable would be the plastic wrap and aluminum foil because they do not change throughout the experiment.

The student fails to provide a valid explanation for why the flap on top was covered with aluminum foil. “[I]t will absorb heat that passes through the plastic wrap...” is inaccurate. Another purpose for covering the hole with plastic wrap is correctly provided: “...help heat stay beneath the pizza box so that the food can cook, rather than have it escape out from the sides.” The independent variable is incorrectly identified as “the plastic wrap and aluminum foil.”

Scored Student Responses for Solar Cooker

Score 1

A) The flap was covered with aluminum foil because the sun will go off it and it will be cool instead.

B) Another purpose could be so the foil has something to set on.

C) The independent variable is color of construction paper

The student fails to provide a valid explanation for why the flap on top was covered with aluminum foil. “[B]ecause the sun will go off it and it will be cool instead” contradicts the purpose of the aluminum foil. Another purpose for covering the hole with plastic wrap is incorrectly provided: “...so the foil has something to set on.” The independent variable is correctly identified as the “color of [the] construction paper.”

Scored Student Responses for Solar Cooker

Score 0

- a.) The flap was covered with aluminum foil because it will heat up in the sun quickly since its a type of metal.
- B.) Plastic melts quickly so if it melts you know the food is done.
- c.) independent variable: sunlight

The student fails to provide a valid explanation for why the flap on top was covered with aluminum foil. "The flap was covered with aluminum foil because it will heat up in the sun quickly since its [sic] a type of metal" is too vague. Another purpose for covering the hole with plastic wrap is incorrectly provided: "Plastic melts quickly so if it melts you know the food is done." Food preparation is irrelevant to this experiment. The independent variable is incorrectly identified as "sunlight."

Scored Student Responses for *Solar Cooker*

Score 0

Aluminum foil is a good conductor
for heat. The independent variable
is the materials used like aluminum
foil

The student fails to provide a valid explanation for why the flap on top was covered with aluminum foil. "Aluminum foil is a good conductor for heat" does not receive credit. No attempt is made to explain what might be another purpose for covering the hole with plastic wrap. The independent variable is incorrectly identified as "the materials used like aluminum foil."

CAPT Science Multiple-Choice Items

Typhoid Mary

Mary Mallon was the first known “healthy carrier” of typhoid fever in the early 1900s. Health officials in New York investigated the households in which she worked as a maid and determined that she had transmitted the disease to dozens of people.

Typhoid fever is caused by the bacterium *Salmonella typhi*. It is generally transmitted by eating food and drinking water that has come into contact with contaminated fecal matter. Symptoms of typhoid fever include headache, fever, diarrhea, and loss of appetite.

1. Typhoid fever is **best** treated with _____.
 - a. surgery
 - b. vaccines
 - c. antibiotics ✖
 - d. gene therapy

Strand IV: Cell Chemistry and Biotechnology

Expected Performance: D 32. Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination, and antibiotic medications in the prevention and treatment of infectious diseases.

2. In 1910, Mary Mallon was banned from ever working in kitchens again. Five years later, health officials suspected that Mary had violated the ban. What **most likely** alerted health officials to the fact that Mary might be working in kitchens again?
 - f. a new typhoid outbreak in New York ✖
 - g. the fact that she changed her name to Mary Brown
 - h. identification of other healthy carriers in New York
 - j. discovery of the typhoid bacterium on local vegetables

Strand IV: Cell Chemistry and Biotechnology

Expected Performance: D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

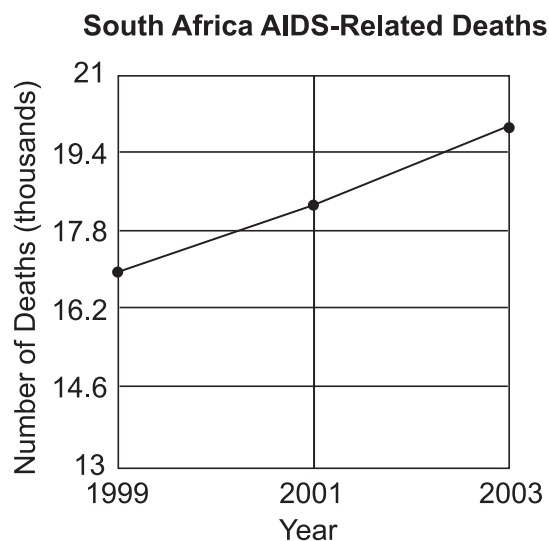
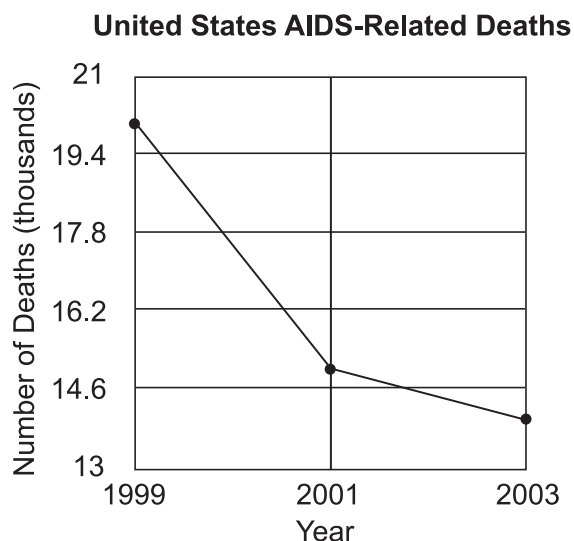
CAPT Science Multiple-Choice Items

3. A scientist conducted a study of an organism and found that its body cells contained 40 chromosomes. These cells were cultured in the laboratory, and cell division was observed. What difference, if any, would the scientist expect to observe between body cell division and sex cell division in the organism?
- Body cells divide by mitosis, and sex cells divide by meiosis. ⚡
 - Body cells divide by meiosis, and sex cells divide by mitosis.
 - There is no difference; body cells and sex cells both divide by mitosis.
 - There is no difference; body cells and sex cells both divide by meiosis.

Strand V: Genetics, Evolution and Biodiversity

Expected Performance: D 36. Explain how meiosis contributes to the genetic variability of organisms.

4. The graphs below show the annual number of AIDS deaths in the United States and in South Africa from 1999–2003.



What conclusion is **best** supported by the data in the graphs?

- AIDS has been cured in the United States but not in South Africa.
- AIDS has caused a greater population decline in South Africa than it has in the United States. ⚡
- The number of AIDS deaths in each country is solely responsible for the population growth rate in each country.
- The population in South Africa has increased regardless of AIDS, whereas the United States population has decreased as a result of AIDS.

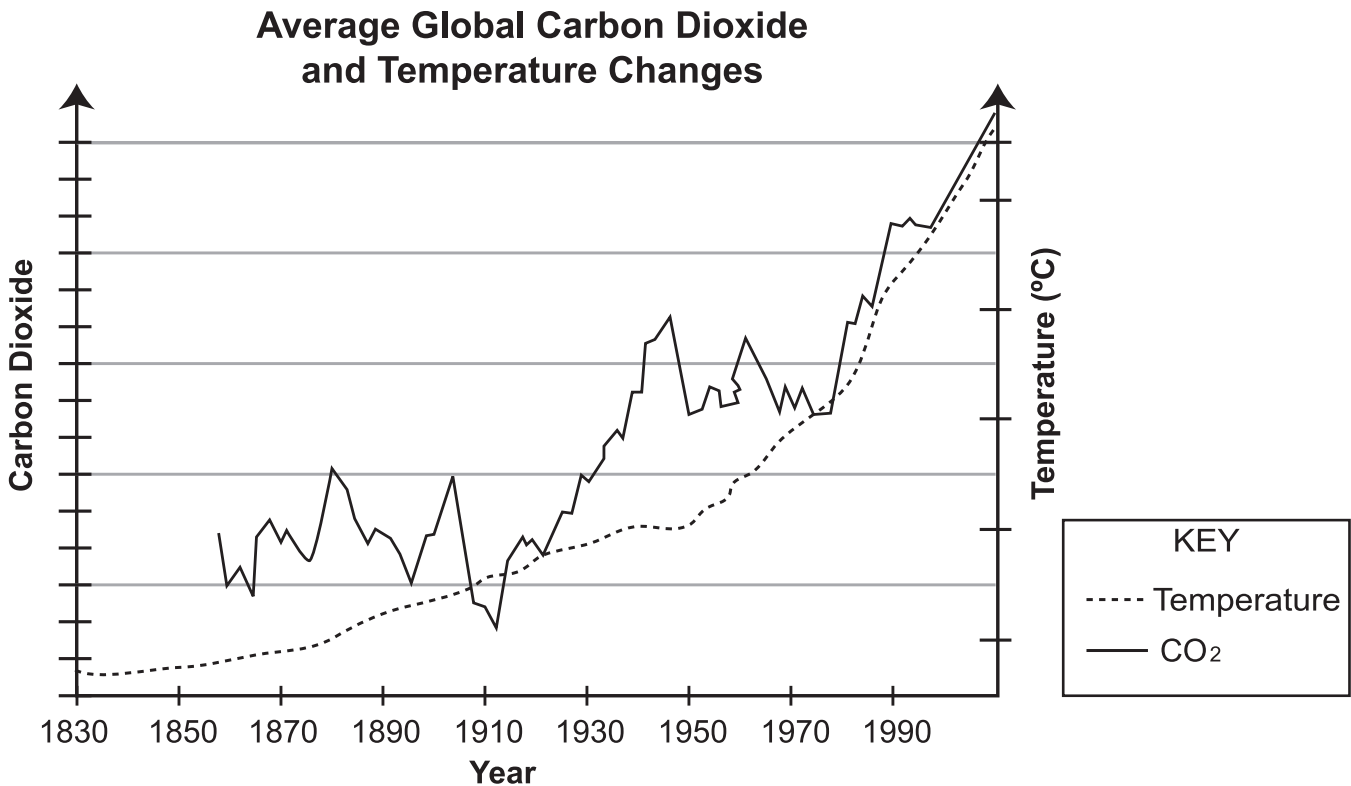
Strand V: Genetics, Evolution and Biodiversity

Expected Performance: D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

CAPT Science Multiple-Choice Items

Global Warming

The burning of fossil fuels to heat homes, power factories, and run automobiles is largely responsible for increasing carbon dioxide emissions. Many scientists hypothesize that the increase in these greenhouse gases contributes directly to global warming. The graph below shows average global changes in carbon dioxide and temperature over an extended period of time.



5. The natural greenhouse is a phenomenon that is beneficial as it results in _____.
- the maintenance of Earth's temperature ☼
 - a thinning of Earth's atmospheric ozone layer
 - an increase in the amount of carbon dioxide in Earth's atmosphere
 - the bending of the rays of sunlight that penetrate Earth's atmosphere

Strand III: Global Interdependence

Expected Performance: D 23. Explain how the accumulation of carbon dioxide (CO₂) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes.

CAPT Science Multiple-Choice Items

6. A business claims to be doing “everything possible” to reduce greenhouse gas emissions. Which company practice would cause a consumer to question this claim?
- f. The company vehicles all use diesel fuel. ⓧ
 - g. The building lights are triggered by motion.
 - h. The building is powered by geothermal energy.
 - j. The company purchases recycled paper products.

Strand III: Global Interdependence

Expected Performance: D INQ.2 Read, interpret, and examine the credibility and validity of scientific claims in different sources of information.

7. Assume the use of fossil fuels continues to increase over the next decade. What prediction are scientists **most likely** to make for carbon dioxide and temperature change?
- a. Carbon dioxide will increase, causing an increase in temperature. ⓧ
 - b. Temperature will increase, causing a decrease in carbon dioxide.
 - c. Carbon dioxide will increase, and temperature will remain the same.
 - d. Temperature will increase, and carbon dioxide will remain the same.

Strand III: Global Interdependence

Expected Performance: D INQ.8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.