OECD Programme for
International Student Assessment 2015

PISA 2015 RELEASED FIELD TRIAL COGNITIVE ITEMS - SCIENCE

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Contents

Scientific Literacy – Overview

Thirty-five new Science items from the 2015 Field Trial were approved by the Scientific Literacy Expert Group for release as sample items. The items are presented in this document in two groups:

- **Standard units,** which consist of static materials including text, graphics, tables, and graphs and associated questions.
- **Interactive units,** which include interactive stimulus materials and associated questions.

The question intent is provided for each released item, showing how the item was classified according to the construct categories in the 2015 Scientific Literacy draft framework. These categories include: **competencies**, **types of scientific knowledge**, **contexts**, and **cognitive demand**. Each was explained more fully in the draft framework, as shown below.

COMPETENCIES

The boxes below provide an elaborated description of the kinds of performance expected for a display of the three competencies required for scientific literacy. The descriptions, framed as actions, are intended to convey the idea that the scientifically literate person both understands and is capable of undertaking a basic set of practices which are essential for scientific literacy.

1. Explain Phenomena Scientifically
Recognise, offer and evaluate explanations for a range of natural and technological phenomena demonstrating the ability to: ▪ Recall and apply appropriate scientific knowledge; ▪ Identify, use, and generate explanatory models and representations; ▪ Make and justify appropriate predictions; ▪ Offer explanatory hypotheses; ▪ Explain the potential implications of scientific knowledge for society.

2. Evaluate and design scientific enquiry
Describe and appraise scientific enquiries and propose ways of addressing questions scientifically demonstrating the ability to: ▪ Identify the question explored in a given scientific study; ▪ Distinguish questions that are possible to investigate scientifically; ▪ Propose a way of exploring a given question scientifically; ▪ Evaluate ways of exploring a given question scientifically; ▪ Describe and evaluate a range of ways that scientists use to ensure the reliability of data and the objectivity and generalisability of explanations.

3. Interpret data and evidence scientifically
Analyse and evaluate scientific information, claims and arguments in a variety of representations and draw appropriate conclusions by demonstrating the ability to: ▪ Transform data from one representation to another; ▪ Analyse and interpret data and draw appropriate conclusions; ▪ Identify the assumptions, evidence and reasoning in science-related texts; ▪ Distinguish between arguments which are based on scientific evidence and theory and those based on other considerations; ▪ Evaluate scientific arguments and evidence from different sources (e.g., newspaper, Internet, journals).

TYPES OF SCIENTIFIC KNOWLEDGE

The ability of students to demonstrate these competencies is dependent on three types of scientific knowledge. These are defined as:

- **Content knowledge**, knowledge of the content of science (including physical systems, living systems, and earth and space science),
- **Procedural knowledge**, knowledge of the diversity of methods and practices that are used to establish scientific knowledge as well as its standard procedures, and
- **Epistemic knowledge**, knowledge of how our beliefs in science are justified as a result of understanding the functions of scientific practices, their justifications, and the meaning of terms such as theory, hypothesis, and observation

CONTEXTS

The PISA 2015 assessment requires evidence of these competencies and knowledge in a range of contexts including:

- health,
- natural resources,
- the environment,
- hazards, and
- the frontiers of science and technology

in

- personal,
- local/national, and
- global settings.

COGNITIVE DEMAND

A key new feature of the 2015 PISA framework is the definition of levels of cognitive demand within the assessment of scientific literacy and across all three competences of the framework. The difficulty of any item is a combination both of the degree of complexity and range of knowledge it requires and the cognitive operations that are required to process the item. The levels defined for this assessment include:

- **Low**
  Carry out a one-step procedure, for example recall of a fact, term, principle or concept or locate a single point of information from a graph or table.

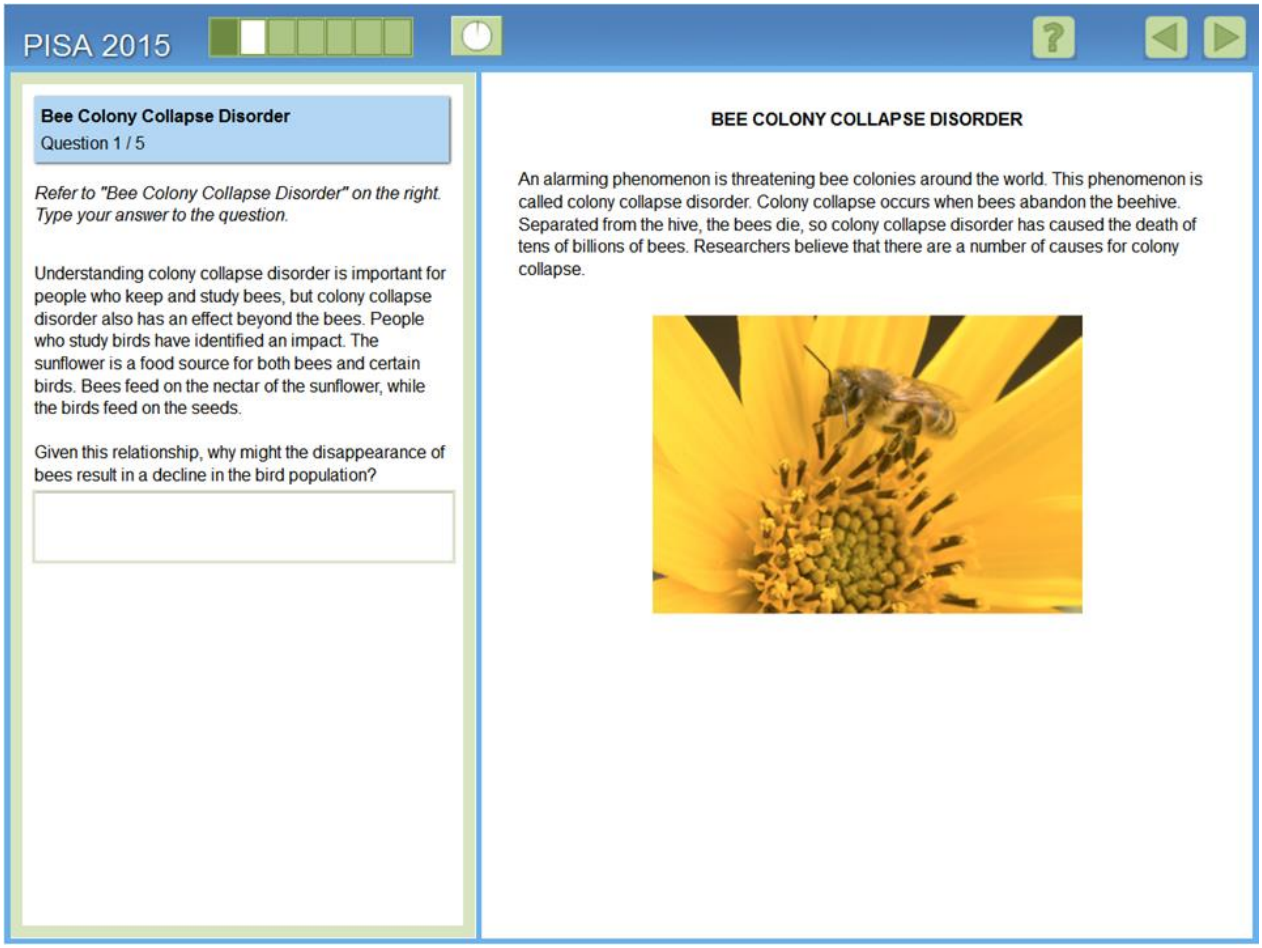
- **Medium**
  Use and apply conceptual knowledge to describe or explain phenomena, select appropriate procedures involving two or more steps, organise/display data, interpret or use simple data sets or graphs.

- **High**
  Analyse complex information or data, synthesise or evaluate evidence, justify, reason given various sources, develop a plan or sequence of steps to approach a problem.

Unit CS600 *Bee Colony Collapse Disorder*
Unit Overview

This released unit deals with the phenomenon known as bee colony collapse disorder. The stimulus materials include a short text introducing the phenomenon and a graph showing results of a study investigating the relationship between the insecticide imidacloprid and bee colony collapse disorder.

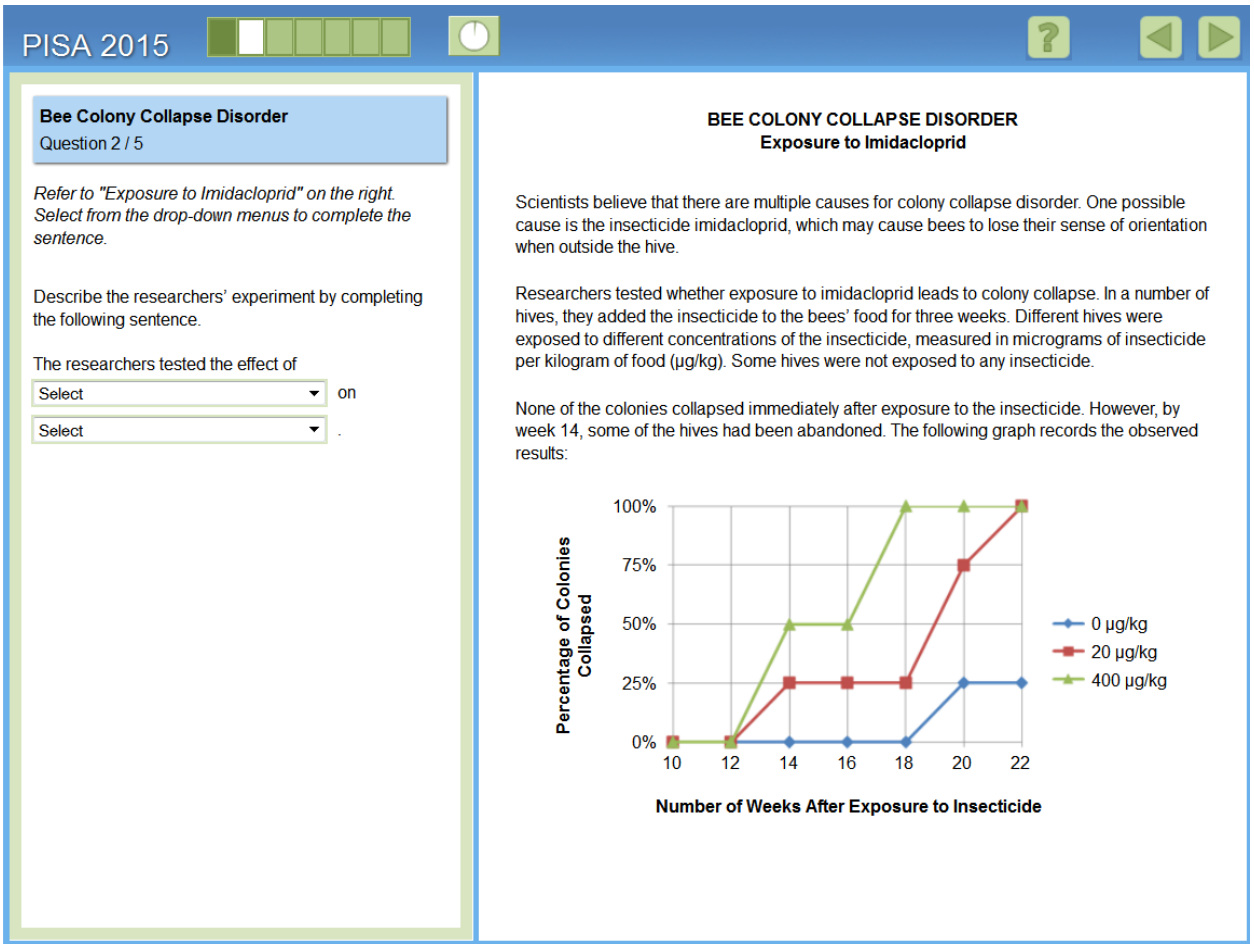
Unit CS600 *Bee Colony Collapse Disorder*
Released Item #1



To correctly answer this question, students must provide an explanation that states or implies that a flower cannot produce seeds without pollination. The competency for this item is 'Explain Phenomena Scientifically,' as students are asked to recall appropriate scientific knowledge.

Item Number	CS600Q01
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Local/National – Environmental Quality
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

Unit CS600 *Bee Colony Collapse Disorder*
Released Item #2



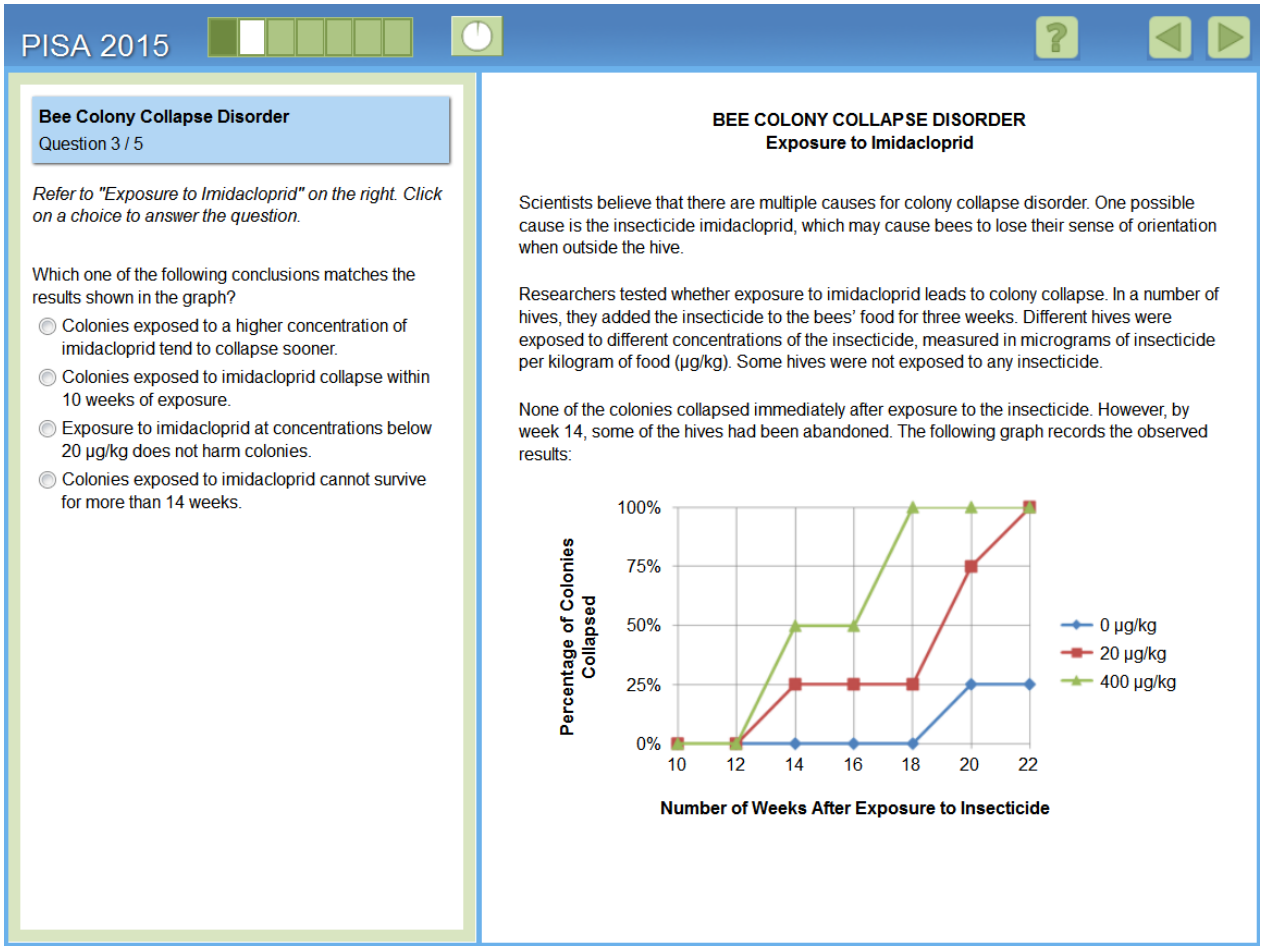
Students are asked to select from among three options in each drop-down menu to demonstrate their understanding of the question being explored in the researchers' experiment. Those options include:

- collapse of bee colonies
- concentration of imidacloprid in food
- bee immunity to imidacloprid

The response that the researchers tested the effect of *concentration of imidacloprid in food* on *collapse of bee colonies* correctly identifies the independent and dependent variables in the experiment.

Item Number	CS600Q02
Competency	Evaluate and Design Scientific Enquiry
Knowledge – System	Procedural
Context	Local/National – Environmental Quality
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

Unit CS600 *Bee Colony Collapse Disorder*
Released Item #3

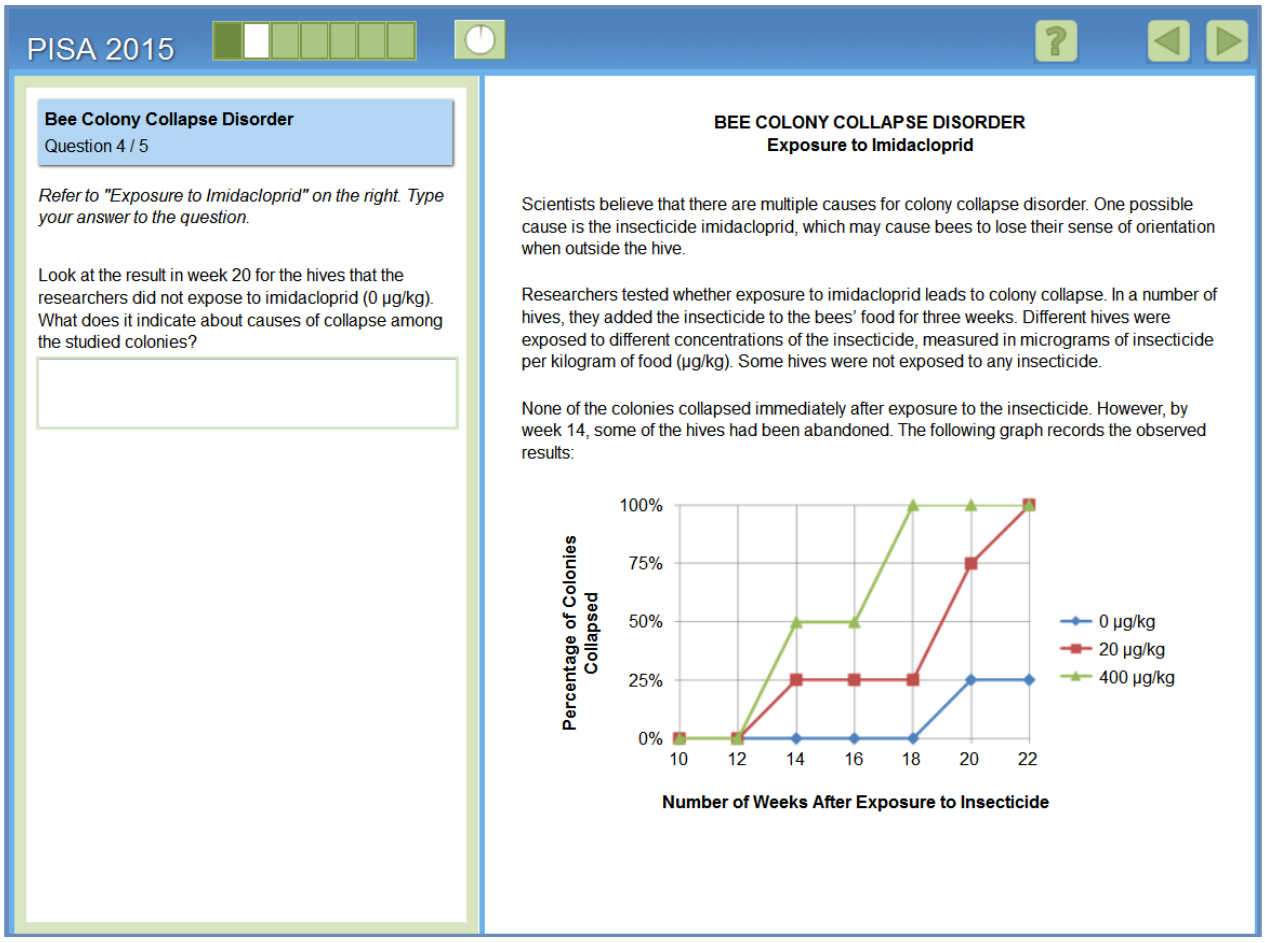


This question requires interpretation of a graph that presents data related to the relationship between concentrations of the insecticide and the rate of colony collapse over time.

The correct response is the first option (*Colonies exposed to a higher concentration of imidacloprid tend to collapse sooner*) as the graph shows that the percentage of colonies that collapsed is higher when the hives were exposed to a concentration of 400 µg/kg of the insecticide as compared with 20 µg/kg during weeks 14-20 of the experiment.

Item Number	CS600Q03
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Local/National – Environmental Quality
Cognitive Demand	Medium
Item Format	Simple Multiple Choice – Computer Scored

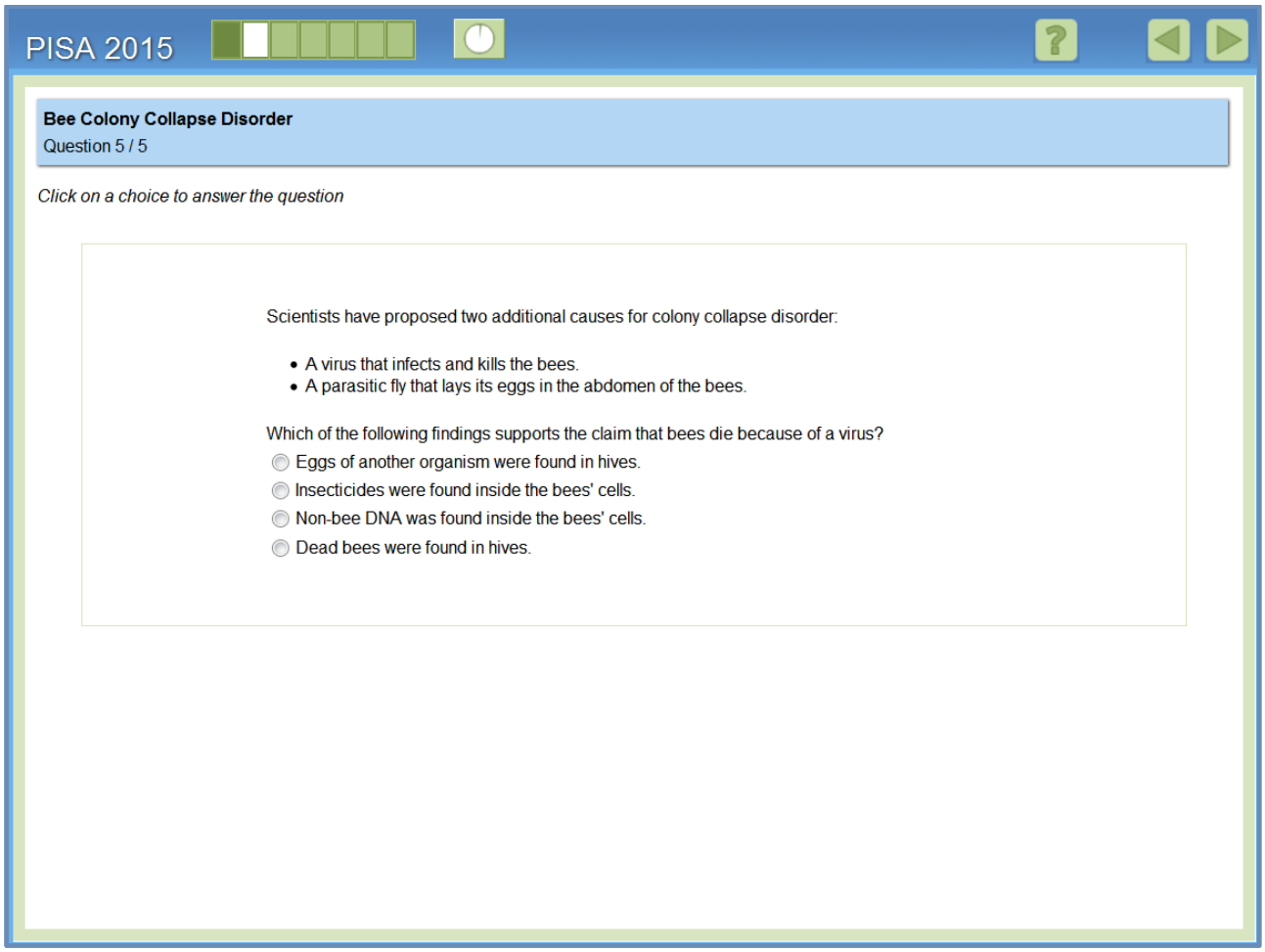
Unit CS600 *Bee Colony Collapse Disorder*
Released Item #4



Students must provide a hypothesis for the collapses among the control colonies. A correct response indicates either that there must be another natural cause of colony collapse for the studied colonies or that the hives in the control group were not properly protected from exposure.

Item Number	CS600Q04
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Local/National – Environmental Quality
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

Unit CS600 *Bee Colony Collapse Disorder*
Released Item #5



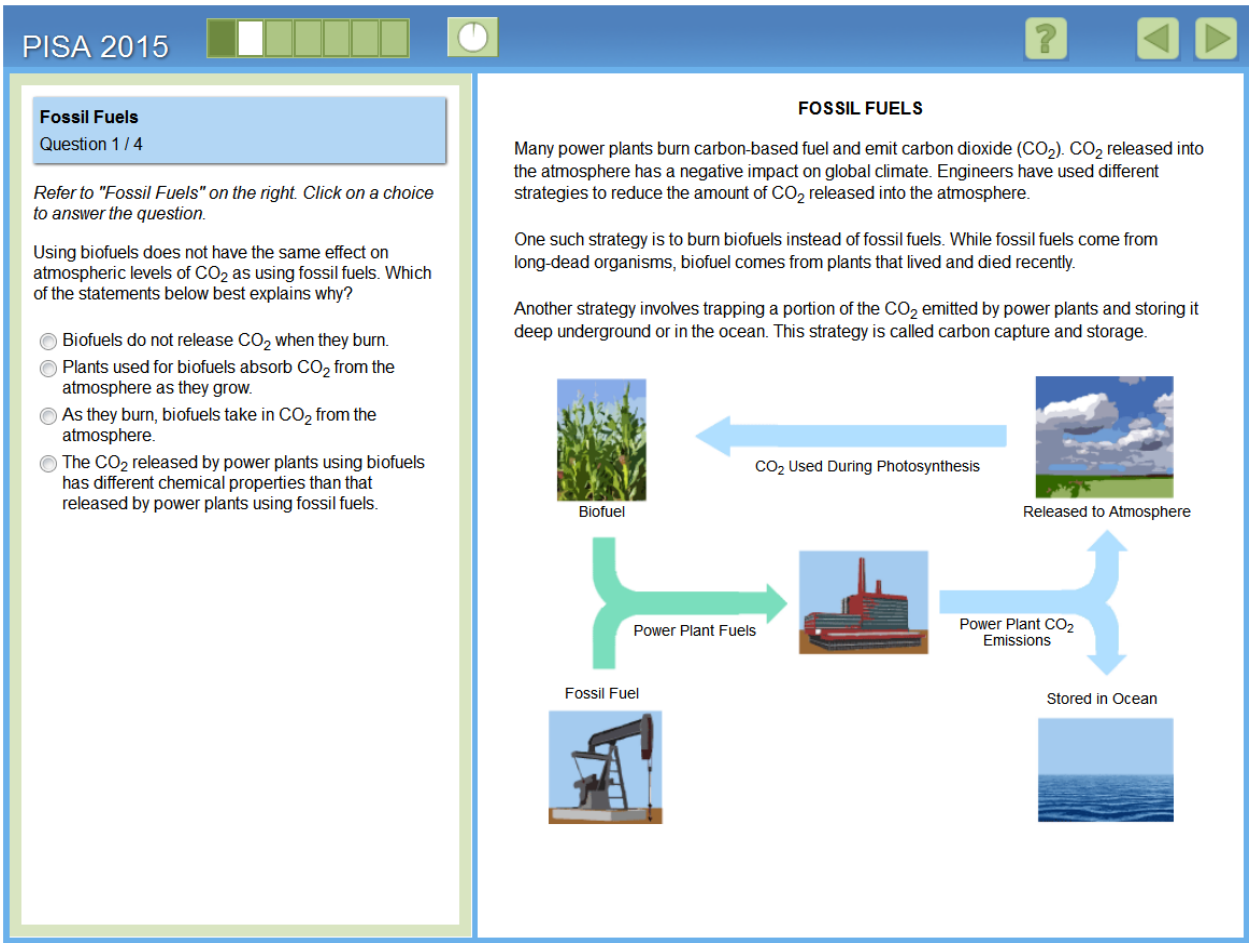
Students must use appropriate scientific content knowledge about the viral infections to explain the phenomenon described in this item. The correct response is the third option: *Non-bee DNA was found inside the bees' cells.*

Item Number	CS600Q05
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Local/National – Environmental Quality
Cognitive Demand	Medium
Item Format	Simple Multiple Choice – Computer Scored

Unit CS613 *Fossil Fuels*
Unit Overview

This released unit explores the relationship between the burning of fossil fuels and CO_2 levels in the atmosphere. The stimulus material includes a diagram illustrating how carbon cycles in the environment and a short text describing strategies for reducing the amount of CO_2 released into the atmosphere, a table comparing the characteristics of ethanol and petroleum when used as fuel, and a graph illustrating the results of a mathematical model that calculates carbon capture and storage at three different ocean depths.

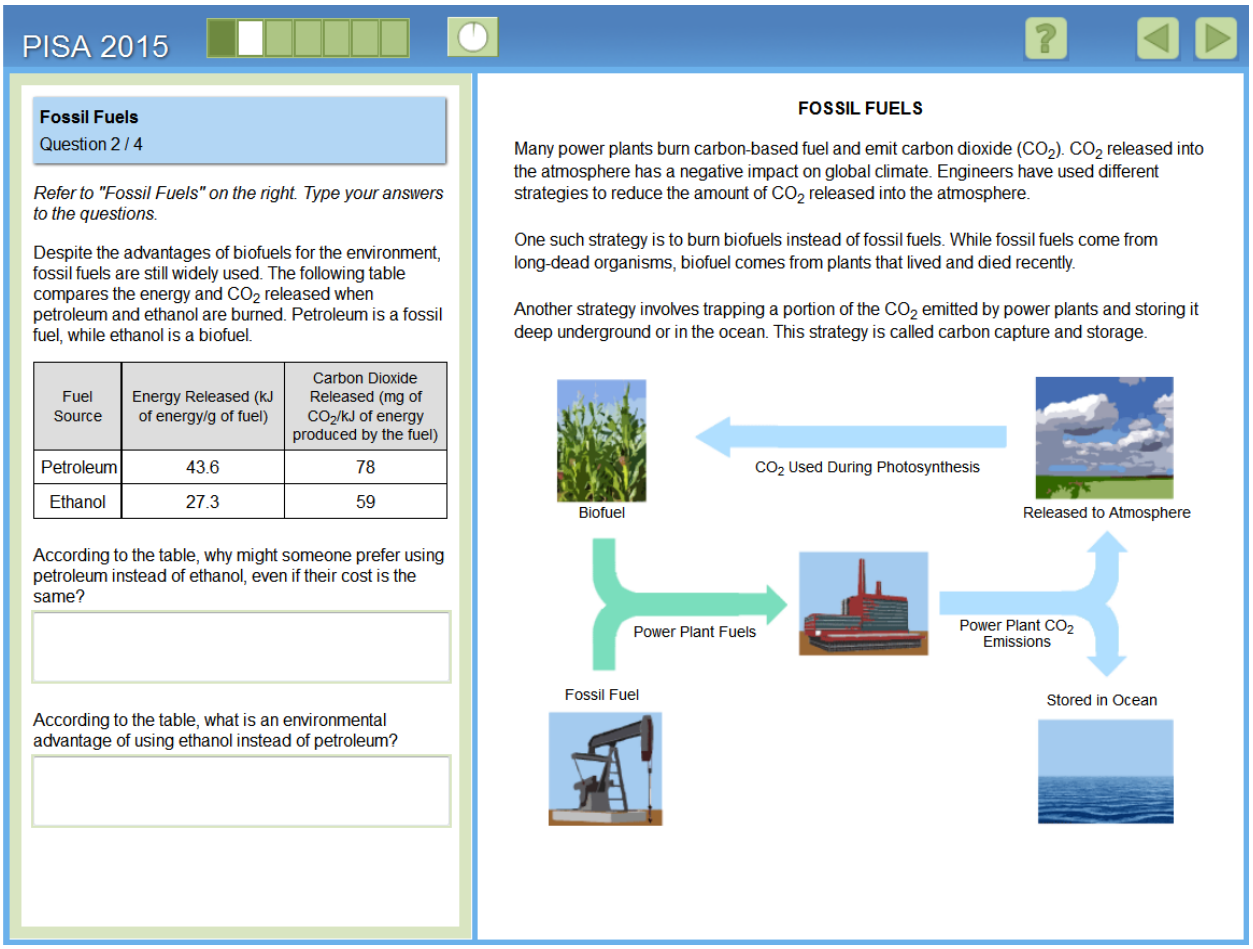
Unit CS613 *Fossil Fuels*
Released Item #1



Students must use appropriate scientific content knowledge to explain why the use of plant-based biofuels does not affect atmospheric levels of CO_2 in the same manner as burning fossil fuels. The second option is the correct response: *Plants used for biofuels absorb CO_2 from the atmosphere as they grow.*

Item Number	CS613Q01
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Physical
Context	Global – Natural Resources
Cognitive Demand	Medium
Item Format	Simple Multiple Choice – Computer Scored

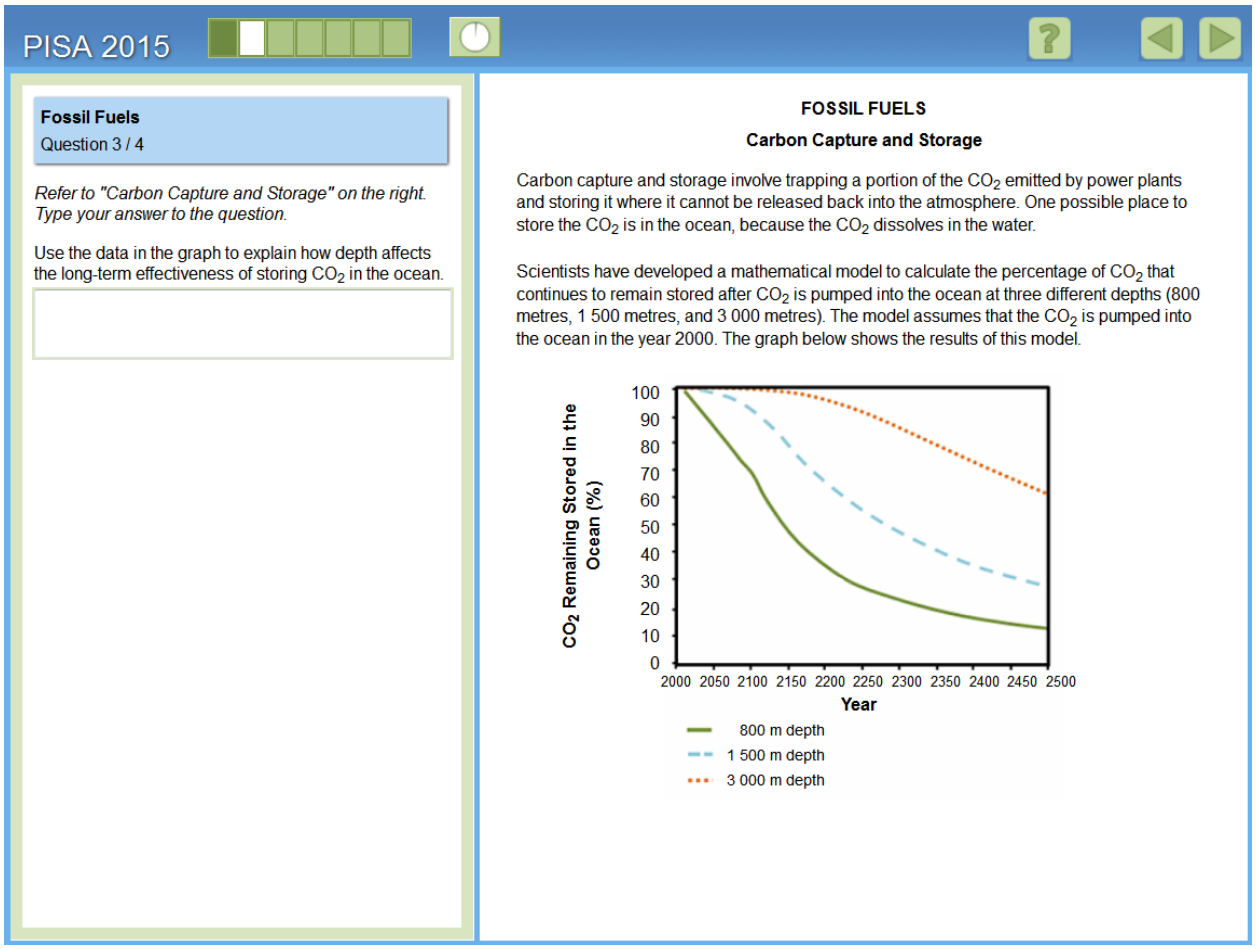
Unit CS613 *Fossil Fuels*
Released Item #2



The item asks students to analyse data presented in a table to compare ethanol and petroleum as fuel sources. Students should determine that people might prefer using petroleum over ethanol because it releases more energy for the same cost and that ethanol has an environmental advantage over petroleum because it releases less carbon dioxide.

Item Number	CS613Q02
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Local/National – Natural Resources
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

Unit CS613 *Fossil Fuels*
Released Item #3[1]



Students must interpret data presented in a graph to provide an explanation that summarises the overall finding that storing carbon dioxide deeper in the ocean leads to better retention rates over time than storing it at shallower depths.

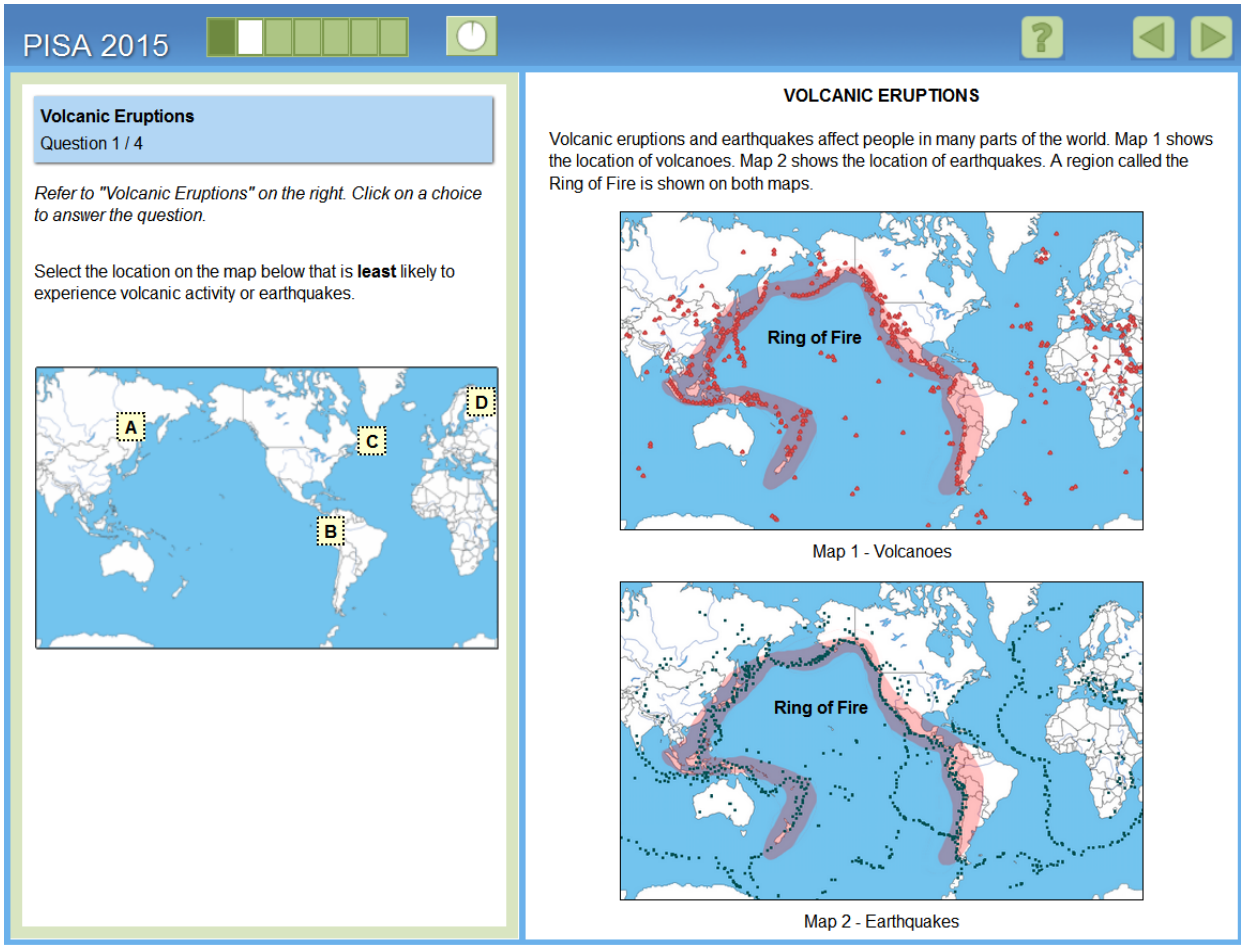
Item Number	CS613Q03
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Global – Natural Resources
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

[1] Note that the fourth item in this unit, CS613Q04, is not included among the released items.

Unit CS644 *Volcanic Eruptions*
Unit Overview

This released unit focuses on the distribution pattern of volcanoes and the impact of volcanic eruptions on climate and the atmosphere. Stimulus materials include a map showing the location of volcanoes and earthquakes around the globe and graphs illustrating the impact that volcanic eruptions have on the amount of solar radiation that reaches Earth's surface and on carbon dioxide concentrations in the atmosphere.

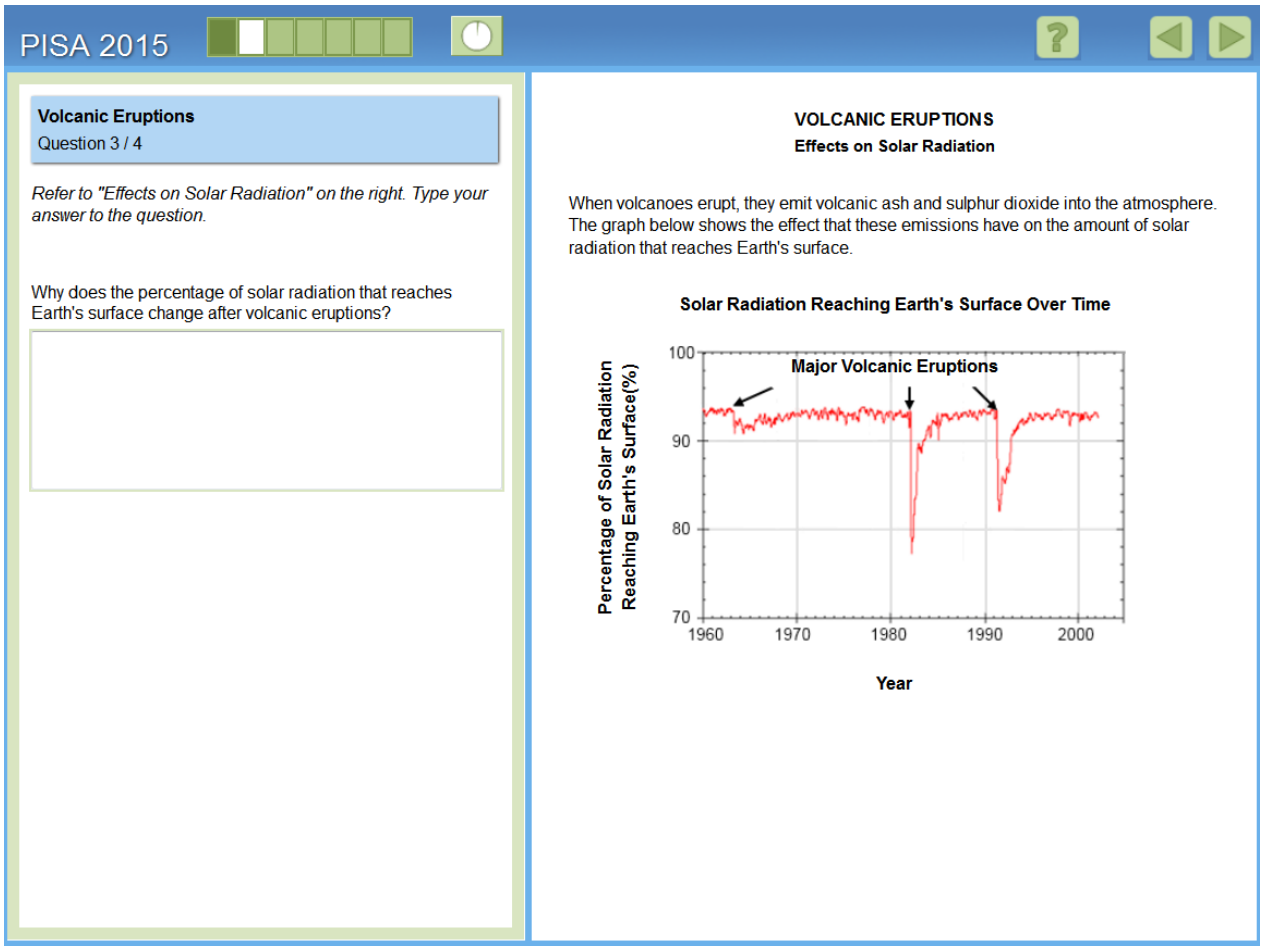
Unit 644 *Volcanic Eruptions*
Released Item #1



Students must interpret data presented on a map to identify the location least likely to experience volcanic activity or earthquakes. The correct response is map location *D*, over northern Europe.

Item Number	CS644Q01
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Global – Hazards
Cognitive Demand	Low
Item Format	Simple Multiple Choice – Computer Scored

Unit 644 *Volcanic Eruptions*
Released Item #2[2]

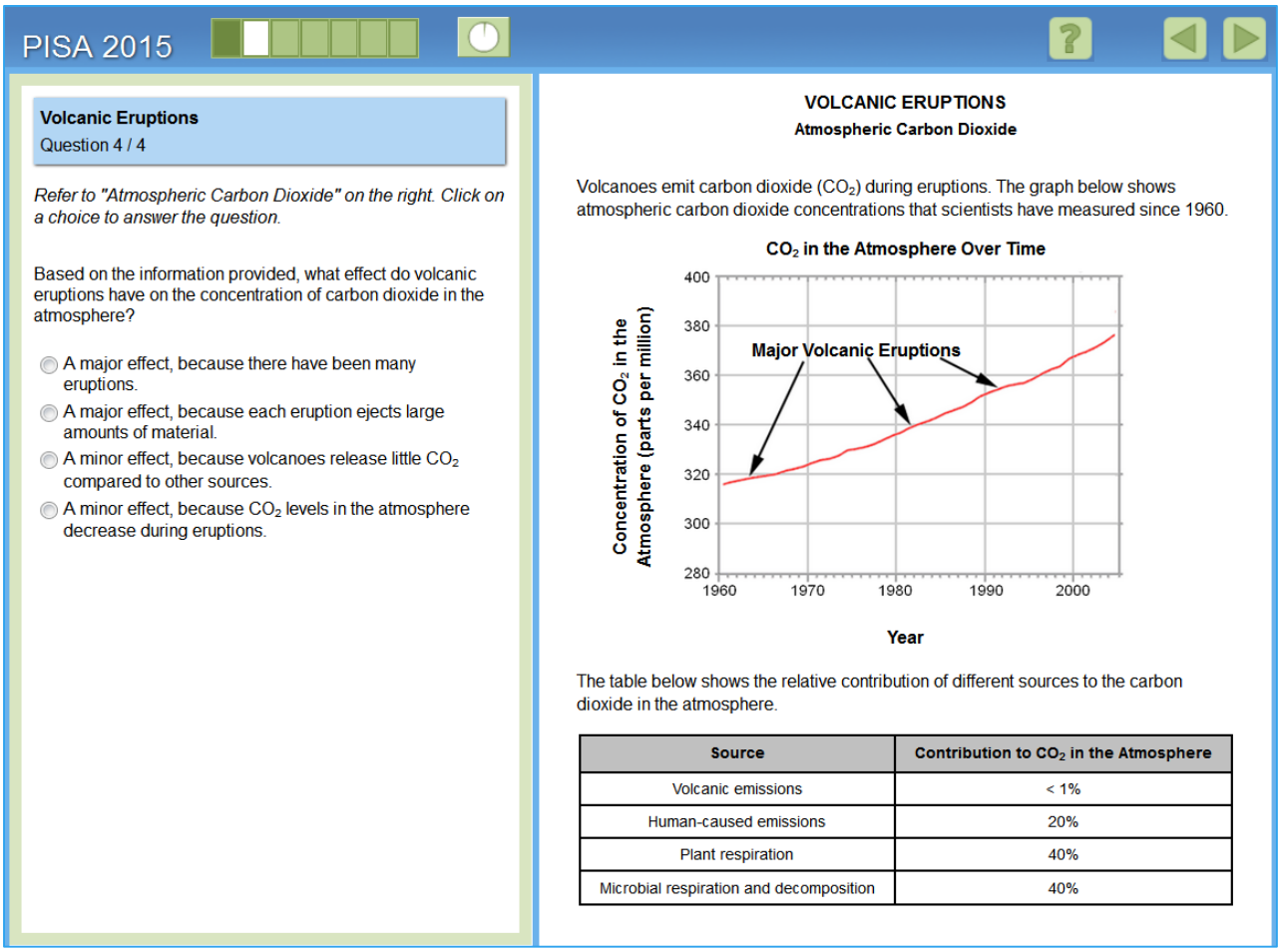


Students must correctly interpret the graphed data as showing that the percentage of solar radiation reaching Earth's surface is reduced during major volcanic eruptions, and provide an explanation indicating or implying that volcanic emissions reflect or absorb solar radiation.

Item Number	CS644Q03
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Earth and Space
Context	Global – Hazards
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

[2] Note that the second item in this unit, CS644Q02, is not included among the released items.

Unit 644 *Volcanic Eruptions*
Released Item #3



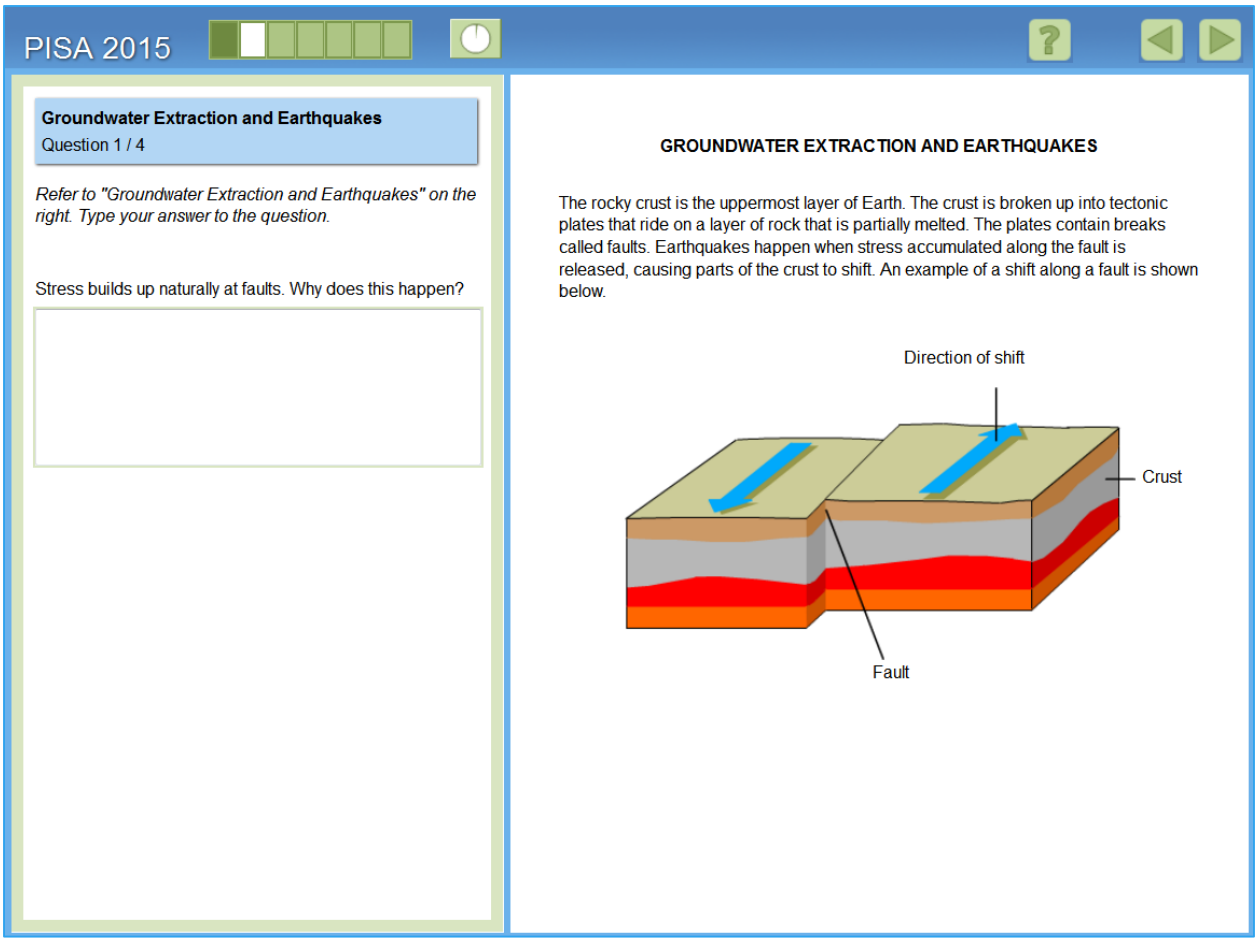
Students must interpret the provided data as supporting the third response which says that volcanoes have a minor effect on the concentration of carbon dioxide in the atmosphere because they release little CO_2 compared to other sources.

Item Number	CS644Q04
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Global – Hazards
Cognitive Demand	Low
Item Format	Simple Multiple Choice – Computer Scored

Unit 655 *Groundwater Extraction and Earthquakes*
Unit Overview

This unit focuses on natural and human processes that may lead to earthquakes. The stimulus materials include a text and graphic illustrating the relationship of faults to earthquakes, a map showing levels of stress in one region of Earth, and a short text about an earthquake believed to have been caused by groundwater extraction.

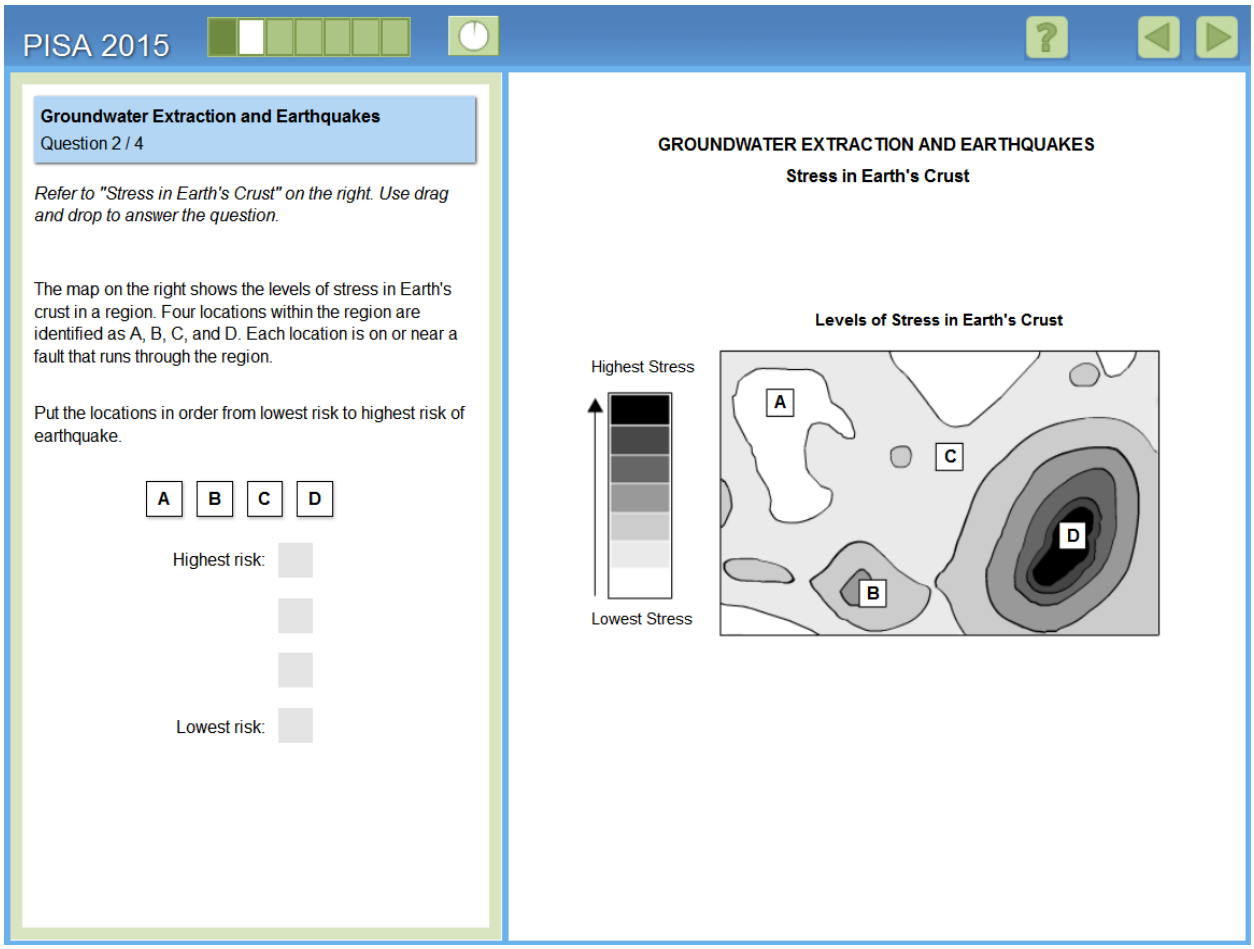
Unit 655 *Groundwater Extraction and Earthquakes*
Released Item #1



Using the description and representation of faults provided in the stimulus, students must provide an explanation that indicates or implies that the movement of tectonic plates leads to the build-up of stress and/or that rock or land moving in different directions is stopped by friction at a fault.

Item Number	CS655Q01
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Earth and Space
Context	Local/National – Hazards
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

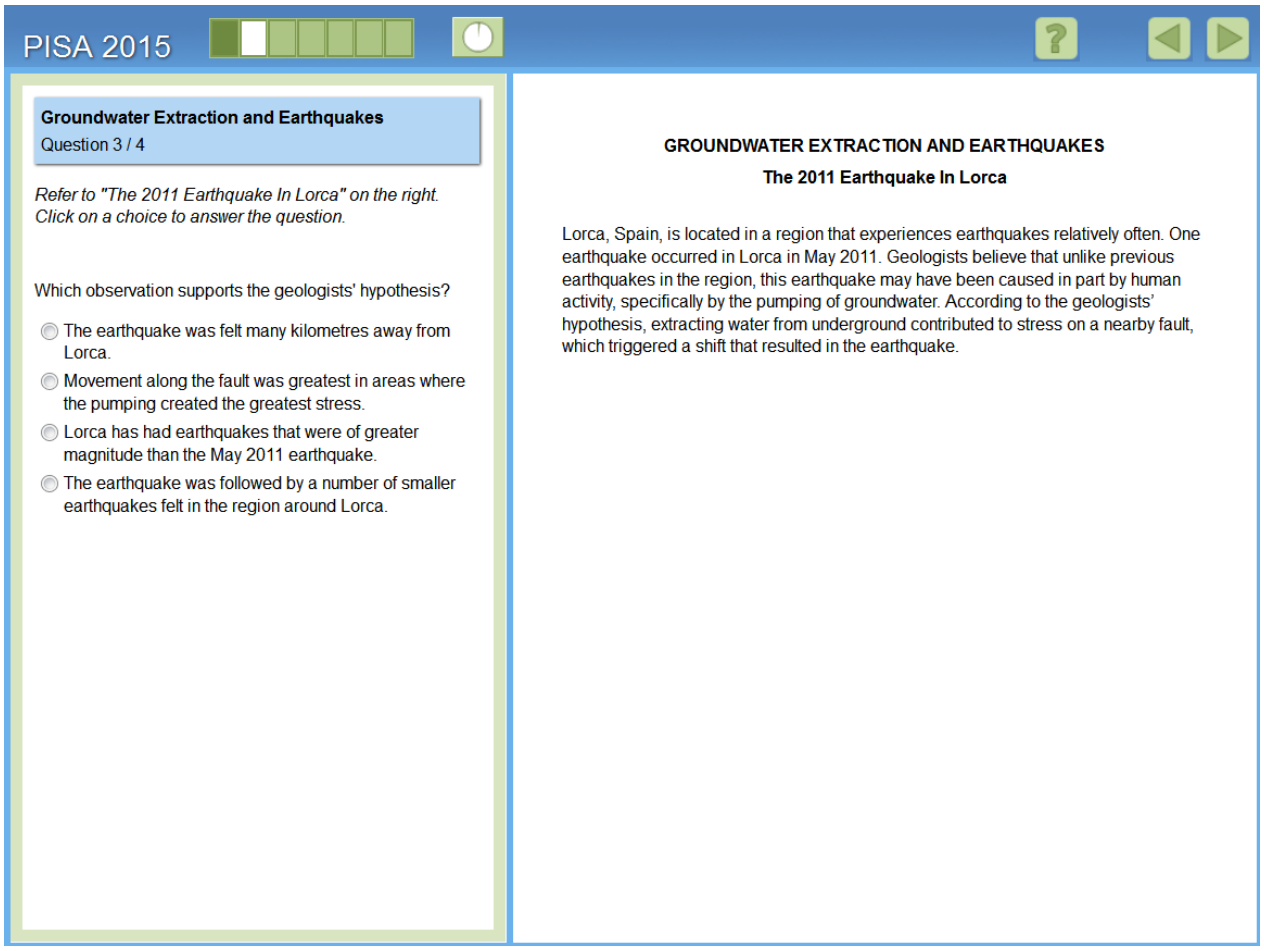
Unit 655 *Groundwater Extraction and Earthquakes*
Released Item #2



Students must apply their understanding of the relationship between stress in Earth's crust and earthquakes to predict the risk of earthquakes in four specific locations that are near faults. The location with the highest risk is the one labelled "D" on the diagram, followed by "B", "C" and finally "A", which has the lowest risk because it has the lowest level of stress.

Item Number	CS655Q02
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Local/National – Hazards
Cognitive Demand	Low
Item Format	Complex Multiple Choice – Computer Scored

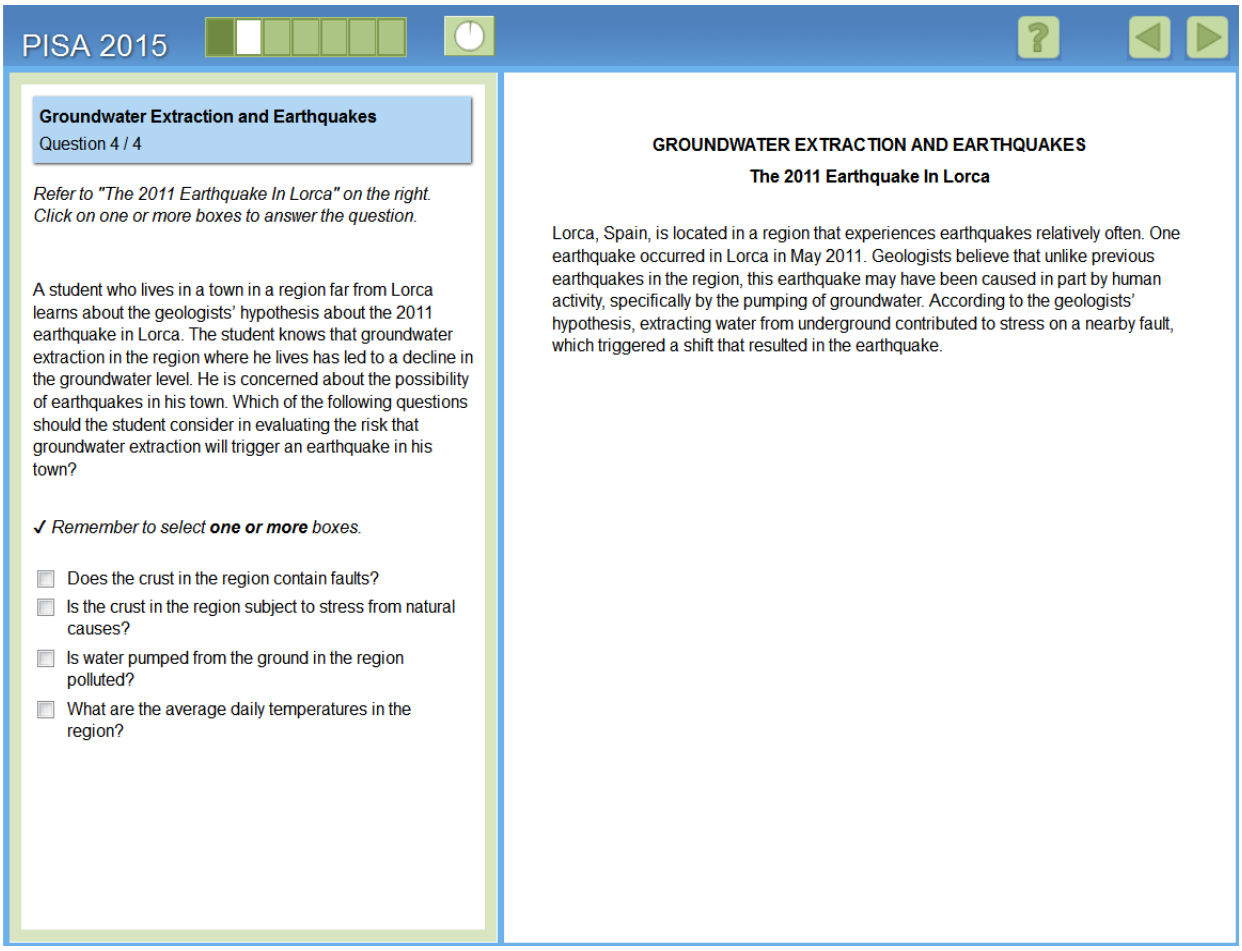
Unit 655 *Groundwater Extraction and Earthquakes*
Released Item #3



Students must identify the one observation that supports the hypothesis presented in the stimulus that groundwater extraction triggered an earthquake by contributing to stress on a nearby fault. The second option (*Movement along the fault was greatest in areas where the pumping created the greatest stress*) is the correct response as it supports an association between the water extraction and the earthquake.

Item Number	CS655Q03
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Earth and Space
Context	Local/National – Hazards
Cognitive Demand	Medium
Item Format	Simple Multiple Choice – Computer Scored

Unit 655 *Groundwater Extraction and Earthquakes*
Released Item #4

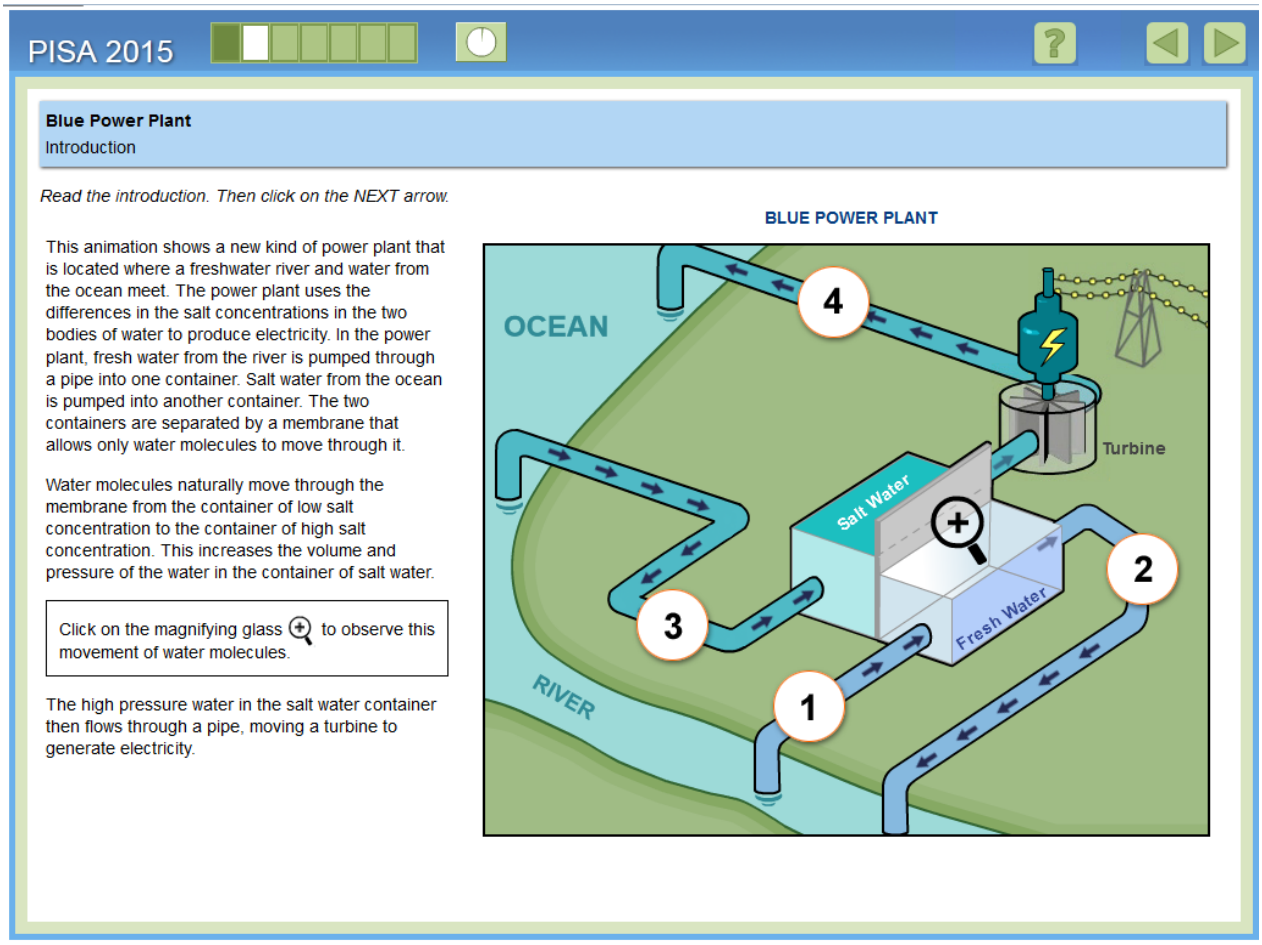


In this item, students must use their understanding of earthquakes and the provided information about the earthquake in Lorca to identify the question or questions most likely to provide information about the risk of earthquakes in a particular region. Both the first and second questions would provide that information: *Does the crust in the region contain faults?* and *Is the crust in the region subject to stress from natural causes?*

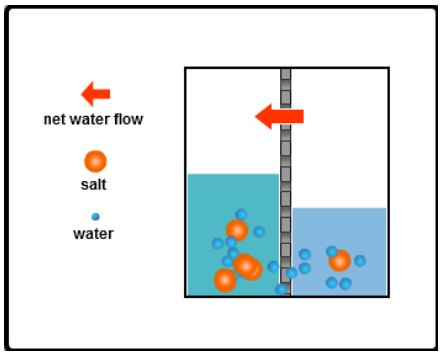
Item Number	CS655Q04
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Earth and Space
Context	Local/National – Hazards
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

Unit 639 *Blue Power Plant*
Unit Overview

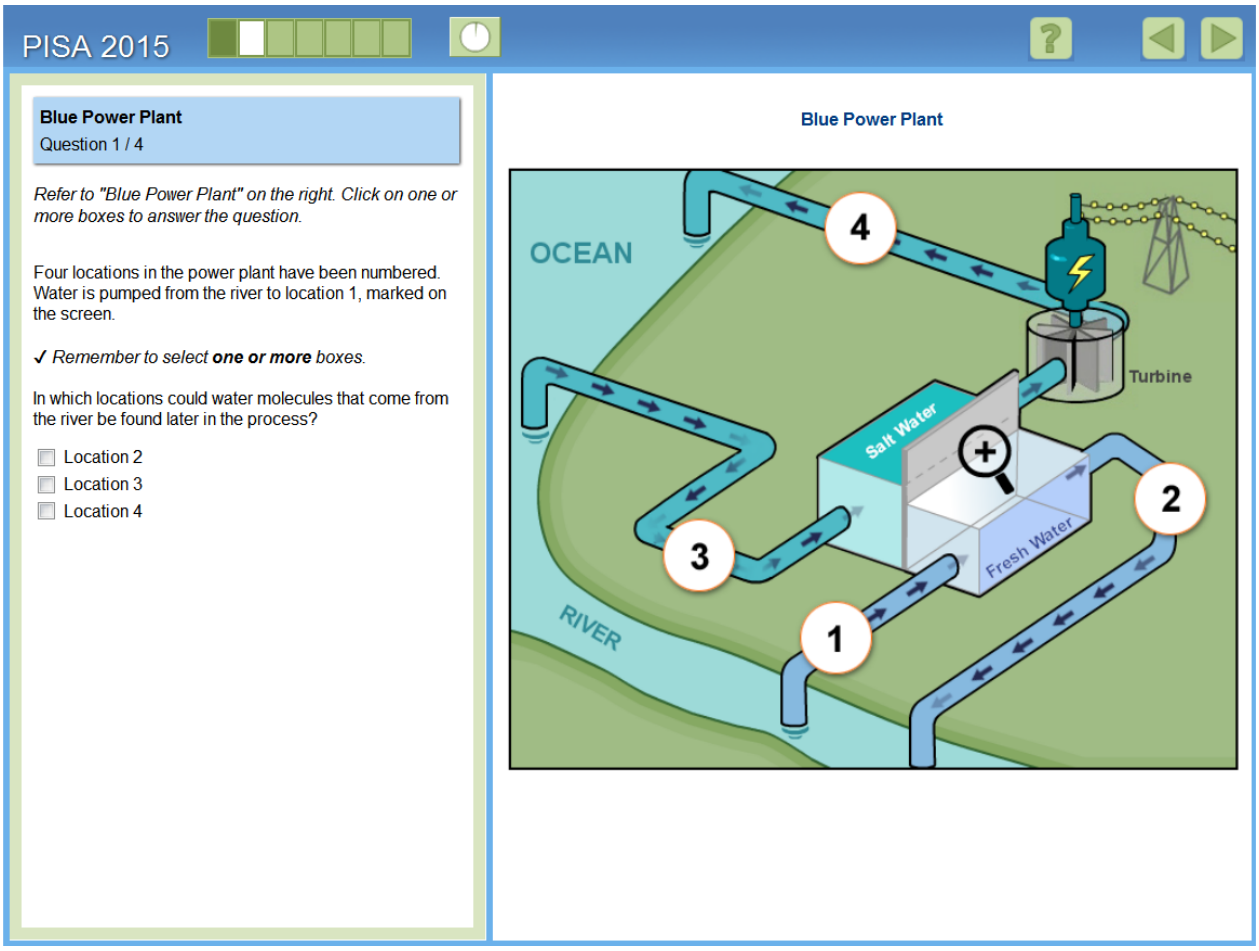
This released unit focuses on a power plant that uses the differences in the salt concentration between salt water and fresh water to generate electricity. The stimulus includes text describing this process and an animation showing the movement of water through the plant and the movement of water molecules across a semipermeable membrane.



View with the magnifying glass:



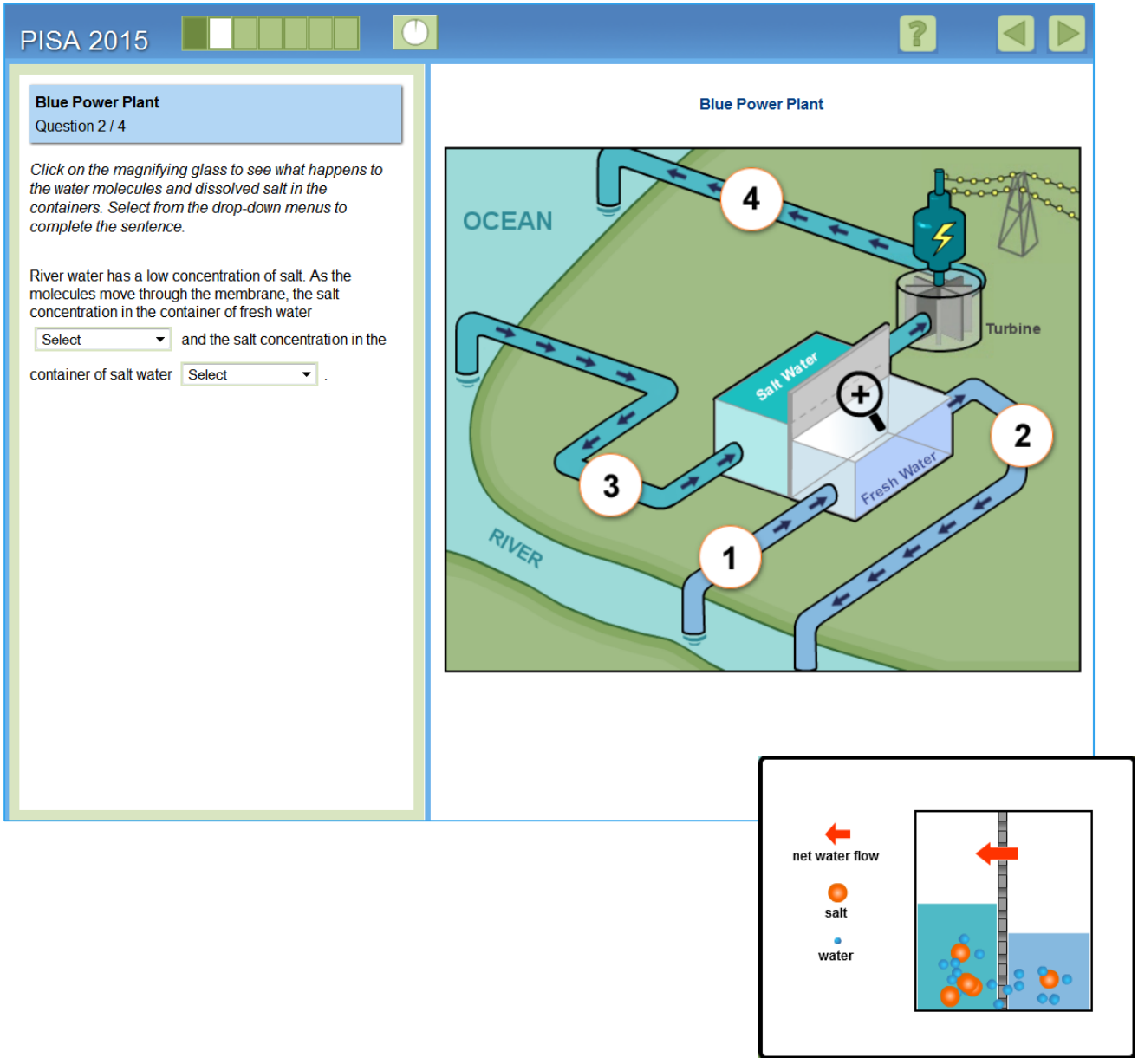
Unit 639 *Blue Power Plant*
Released Item #1



Students must apply their understanding of how water moves through the power plant presented in the diagram to identify *Location 2* and *Location 4* as containing water molecules from the river.

Item Number	CS639Q01
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Physical
Context	Local/National – Frontiers
Cognitive Demand	Low
Item Format	Complex Multiple Choice – Computer Scored

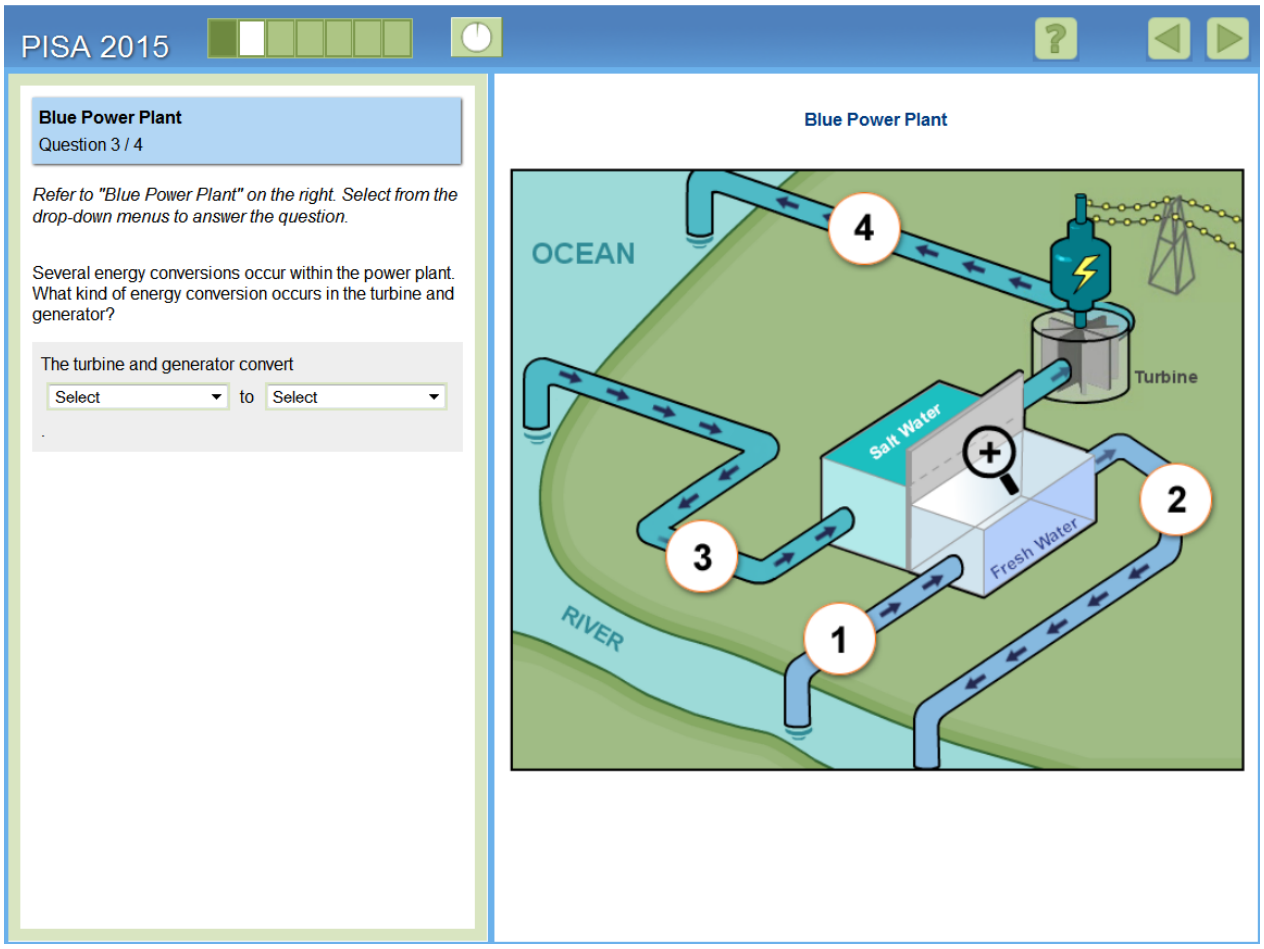
Unit 639 *Blue Power Plant*
Released Item #2



Students are asked to use the animation to determine the effect the movement of water across the membrane on the salt concentration of the fresh water and the salt water. The correct response is: As the molecules move through the membrane, the salt concentration in the container of fresh water *increases* and the salt concentration in the container of salt water *decreases*.

Item Number	CS639Q02
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Global – Frontiers
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

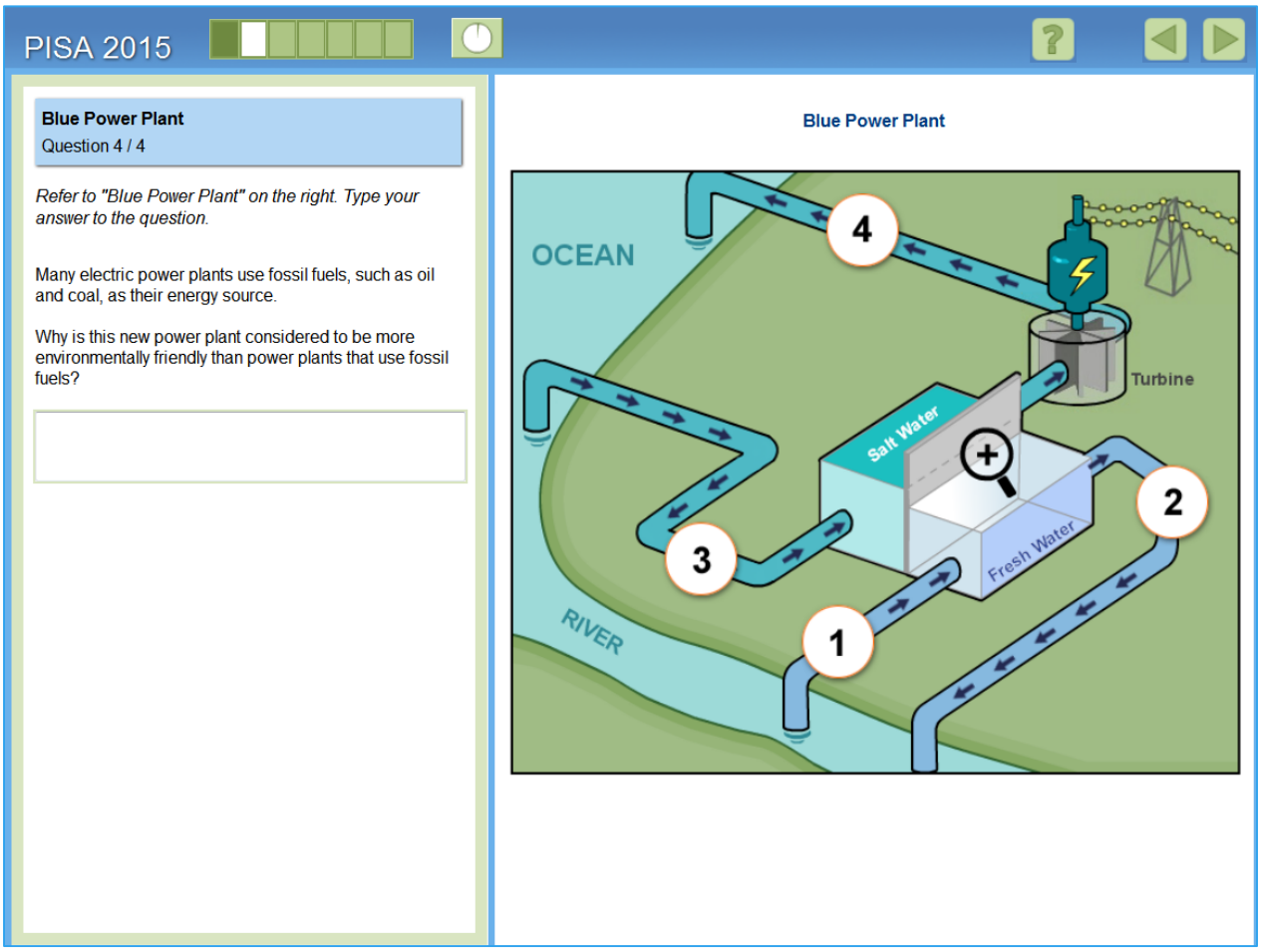
Unit 639 *Blue Power Plant*
Released Item #3



Each drop-down menu in this item lists four types of energy: gravitational, potential, kinetic and electrical. Students must correctly interpret the animated diagram and specify that the turbine and generator convert *kinetic* to *electrical* energy.

Item Number	CS639Q04
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Physical
Context	Local/National – Frontiers
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

Unit 639 *Blue Power Plant*
Released Item #4

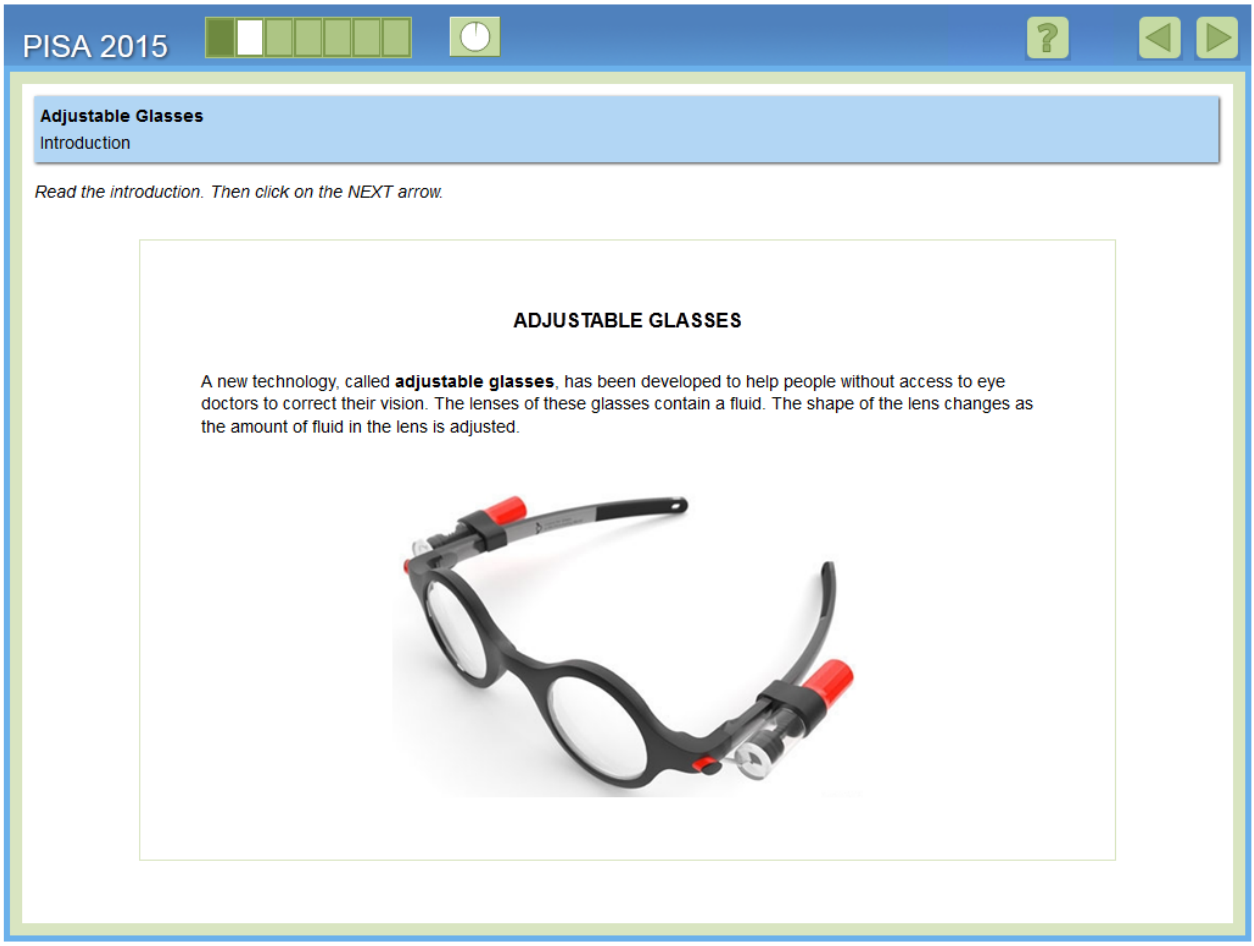


Students must provide an explanation that identifies a way in which plants that burn fossil fuel are more harmful to the environment than the new power plant illustrated in this unit, or identify a feature of the new power plant that makes it more environmentally friendly.

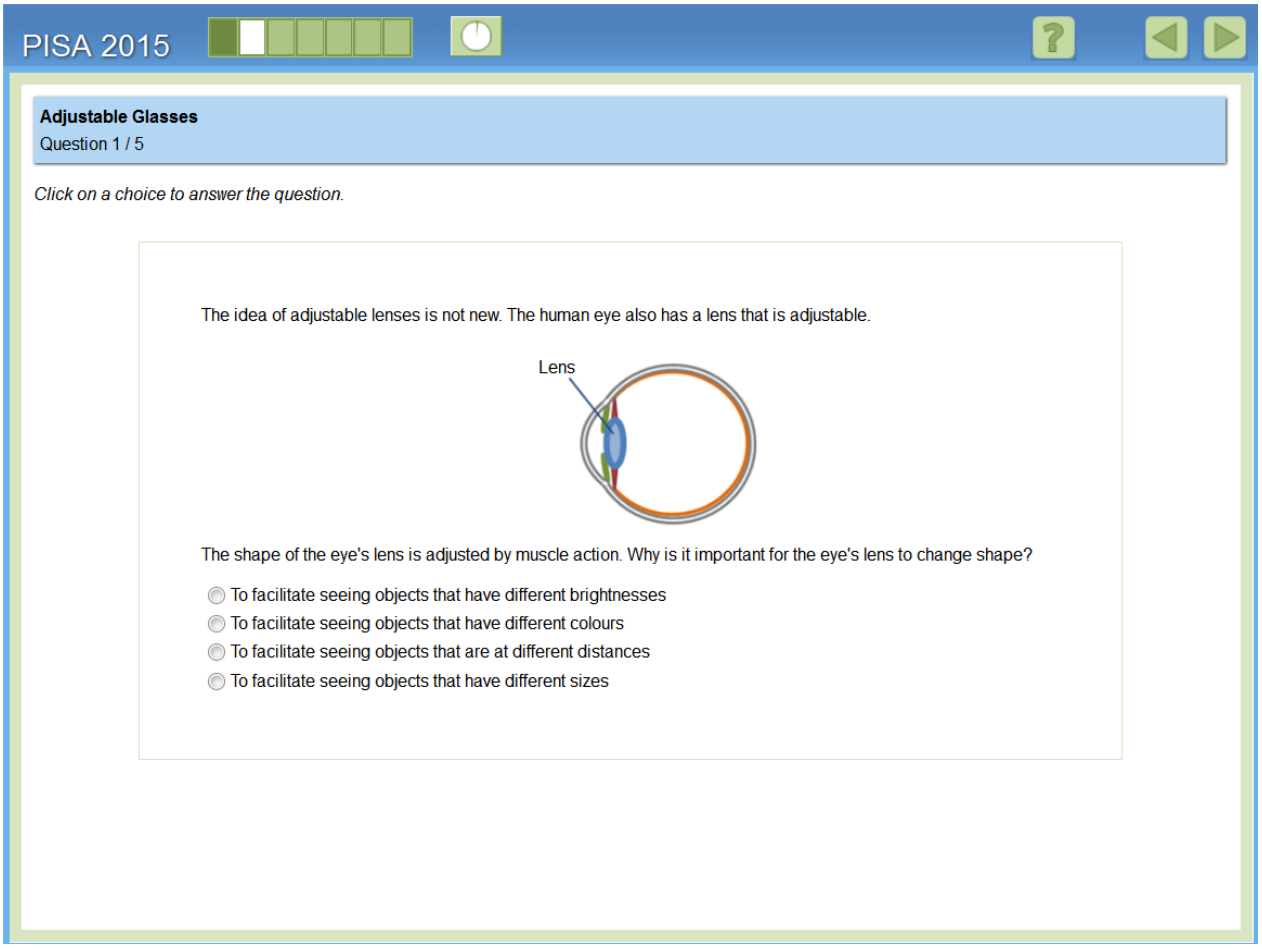
Item Number	CS639Q05
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Physical
Context	Global – Frontiers
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

Unit 621 *Adjustable Glasses*
Unit Overview

This released unit describes an innovative type of eyeglasses that use fluid to adjust the shape of the lenses. The interactive portion of the unit first allows students to investigate the effect of adjusting the amount of fluid in the lens on the shape of the lens. Students are then able to investigate the effect of the lens adjustments on the vision of three different people: one with normal vision, one with farsighted vision, and one with nearsighted vision.



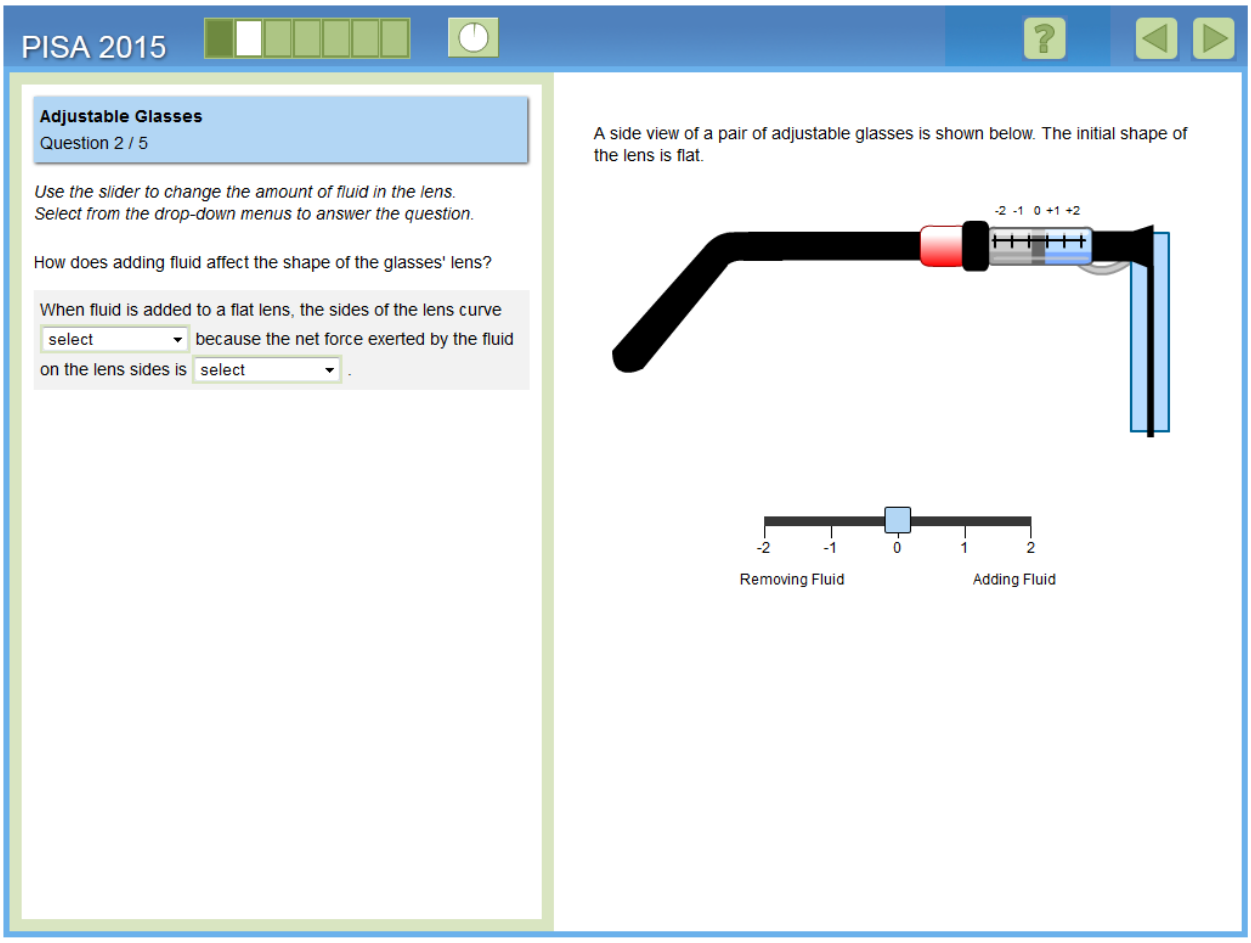
Unit 621 *Adjustable Glasses*
Released Item #1



Students must use content knowledge to correctly identify the third option, that the eye's lens must change shape *to facilitate seeing objects at different distances*.

Item Number	CS621Q01
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Personal – Health and Disease
Cognitive Demand	Low
Item Format	Simple Multiple Choice – Computer Scored

Unit 621 *Adjustable Glasses*
Released Item #2

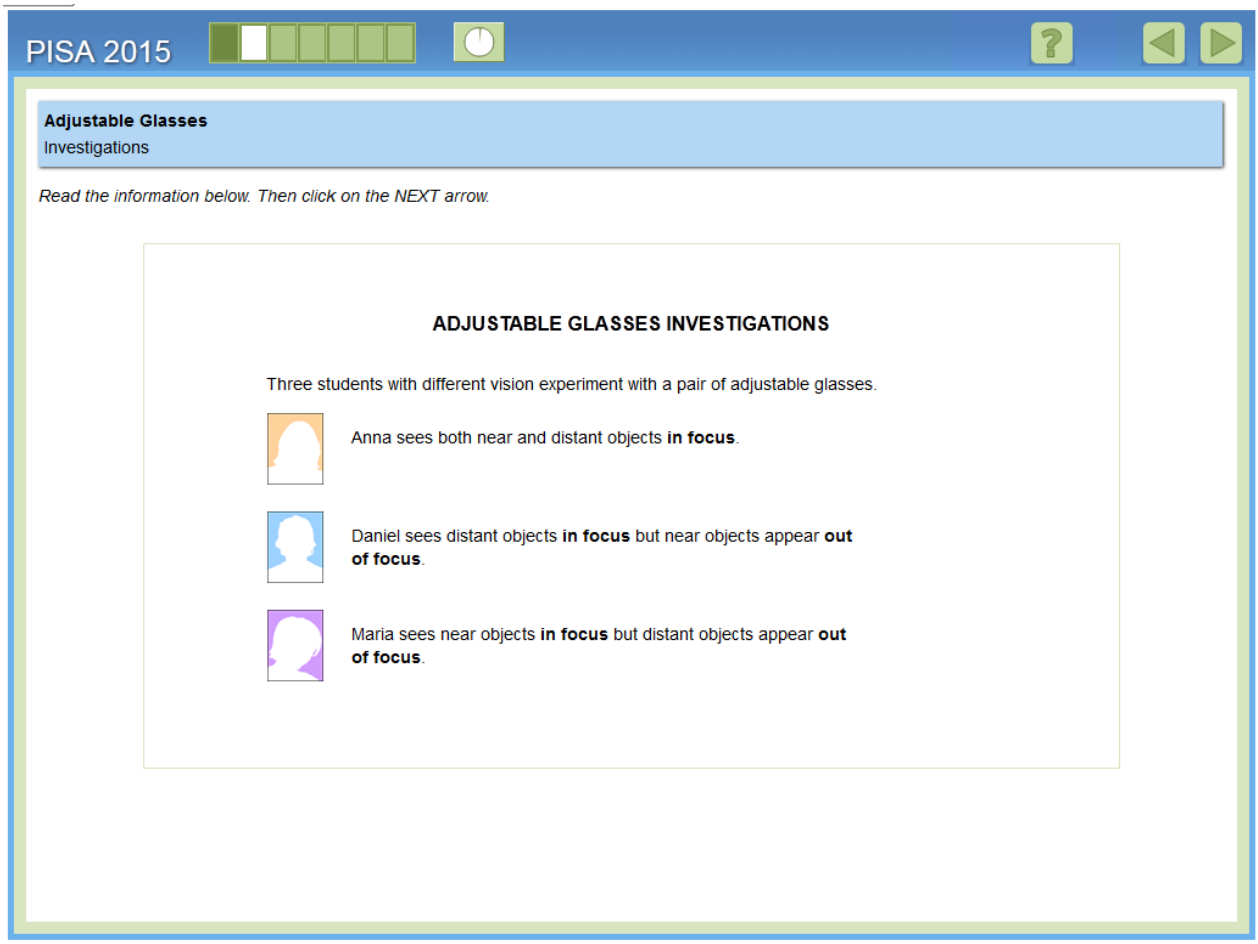


The options in the drop-down menus are outward and inward for the first menu and more and less for the second. Using the simulated adjustable glasses, students are asked to determine that when fluid is added to a flat lens, the sides of the lens curve *outward* and then interpret the simulation to specify that this is because the net force exerted by the fluid on the lens is *more*.

Item Number	CS621Q02
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Physical
Context	Personal – Frontiers
Cognitive Demand	Low
Item Format	Complex Multiple Choice – Computer Scored

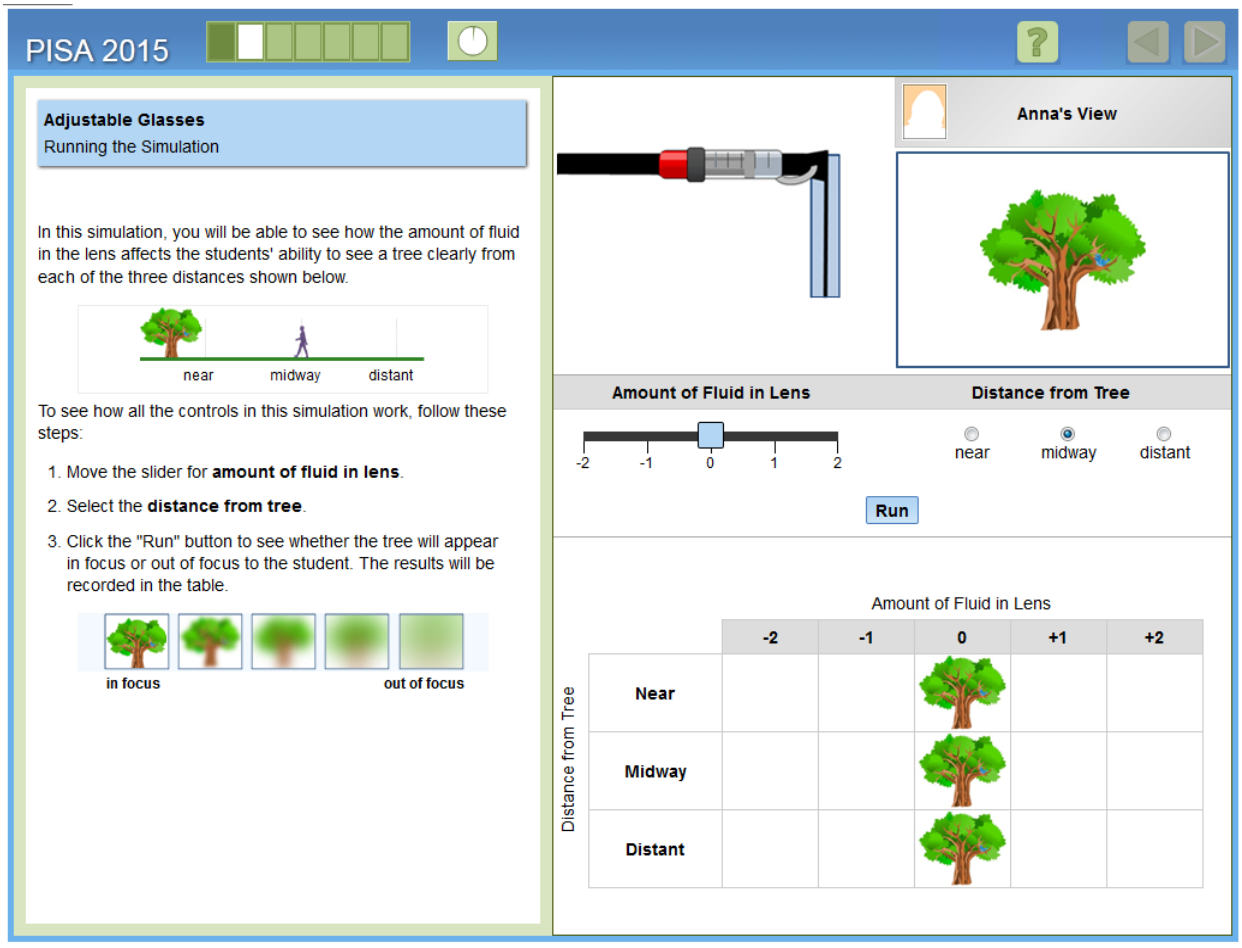
Unit 621 *Adjustable Glasses*
Introduction to second simulation

The introduction provides information about the vision of three students, each of whom will be investigated using the simulation.

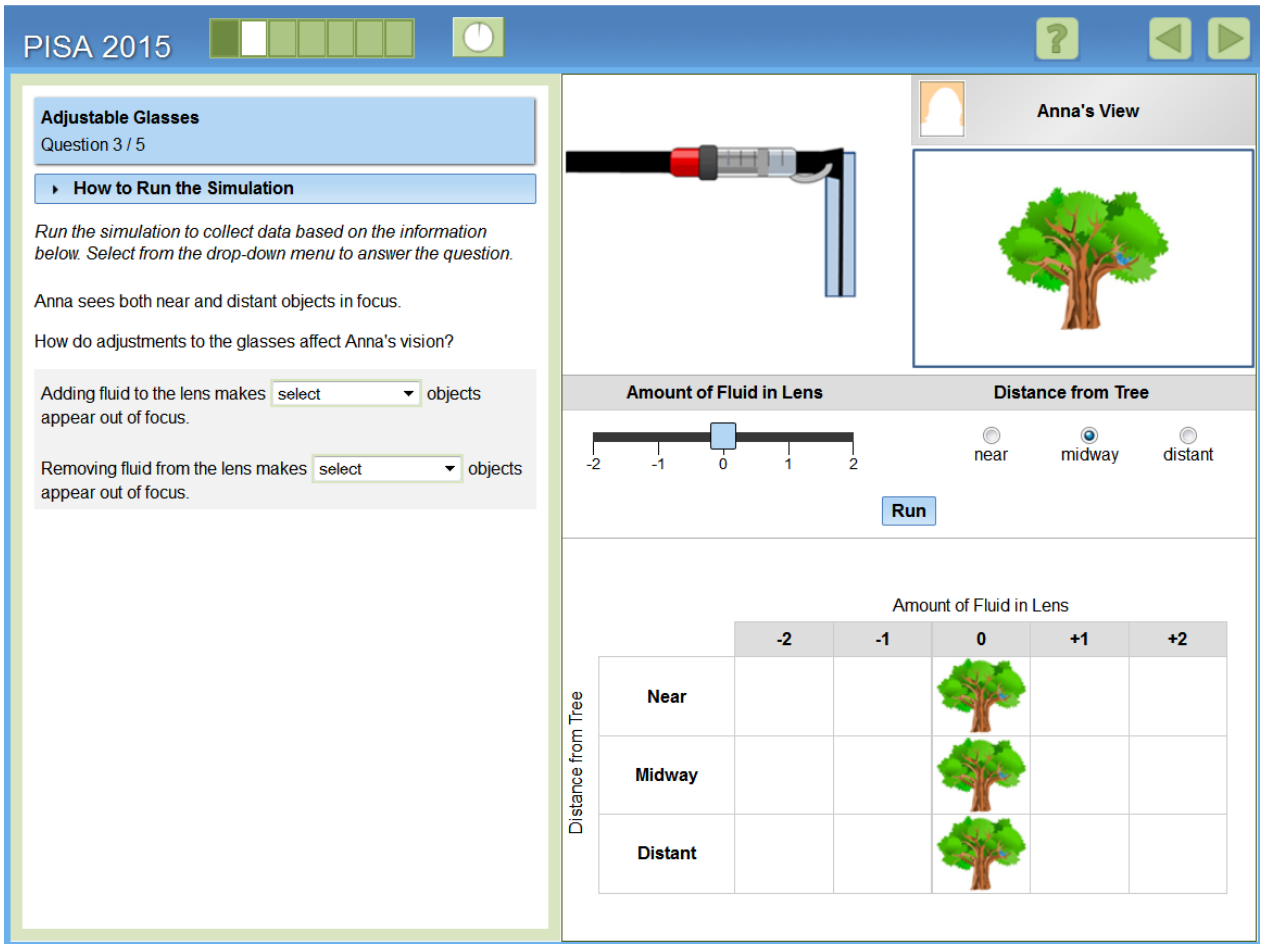


Unit 621 *Adjustable Glasses*
How to Run the Simulation

Before beginning this part of the unit, students are provided with a brief introduction to the controls in the simulation and are allowed to practice setting each control. Help messages display if students do not take the requested actions within 1 minute. If students time out by not acting at all within 2 minutes, they are shown what the simulation would look like if the controls were set as specified. As explained in the orientation, reminders about how to use the controls are available on subsequent screens by clicking on the "How to Run the Simulation" tab.



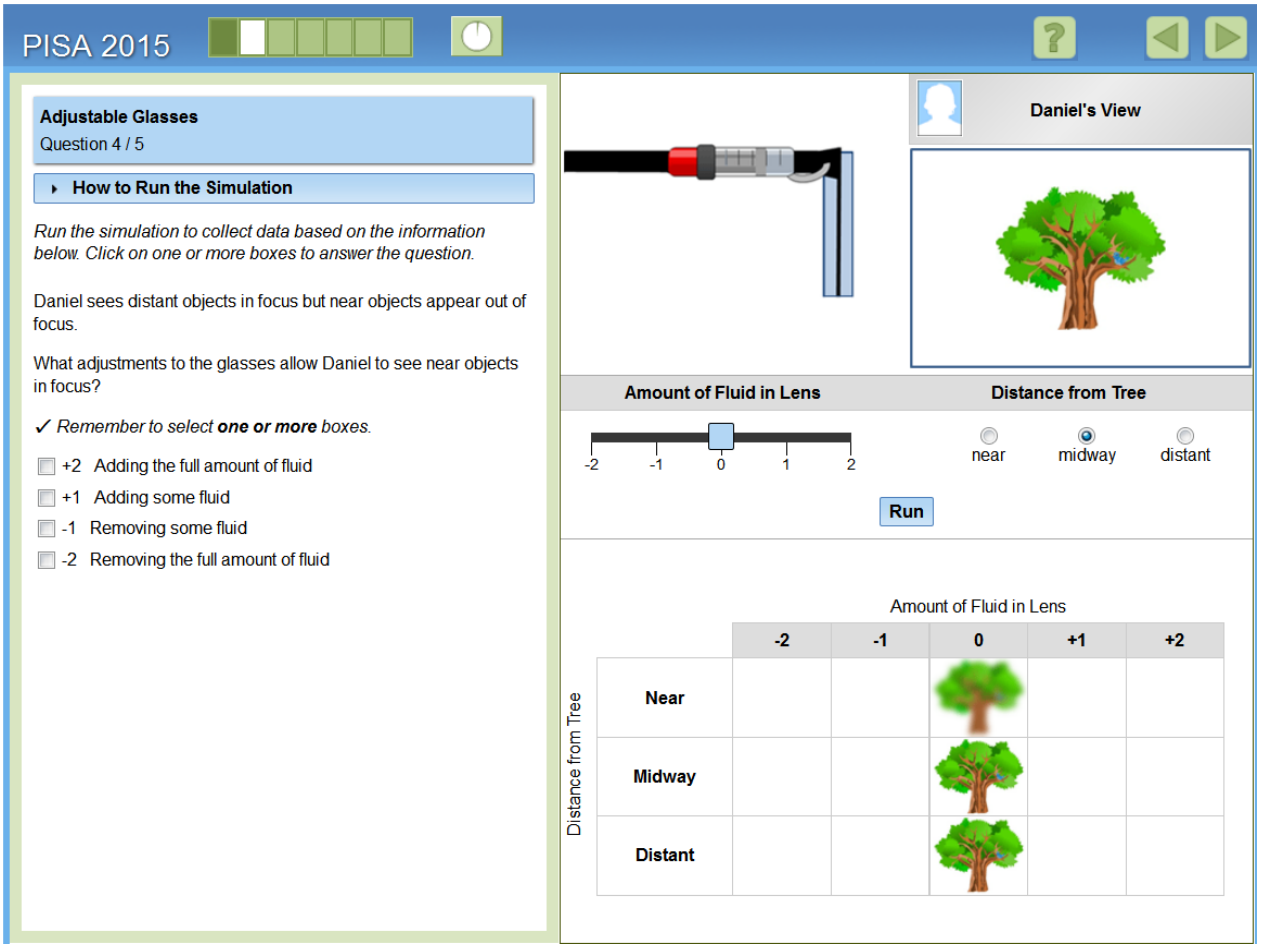
Unit 621 *Adjustable Glasses*
Released Item #3



The two drop-down menus have the same options: distant and near. Students are asked to use the simulation and the data they generate to identify that adding fluid makes *distant* objects appear out of focus for Anna and removing fluid makes *near* objects appear out of focus.

Item Number	CS621Q03
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Personal – Frontiers
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

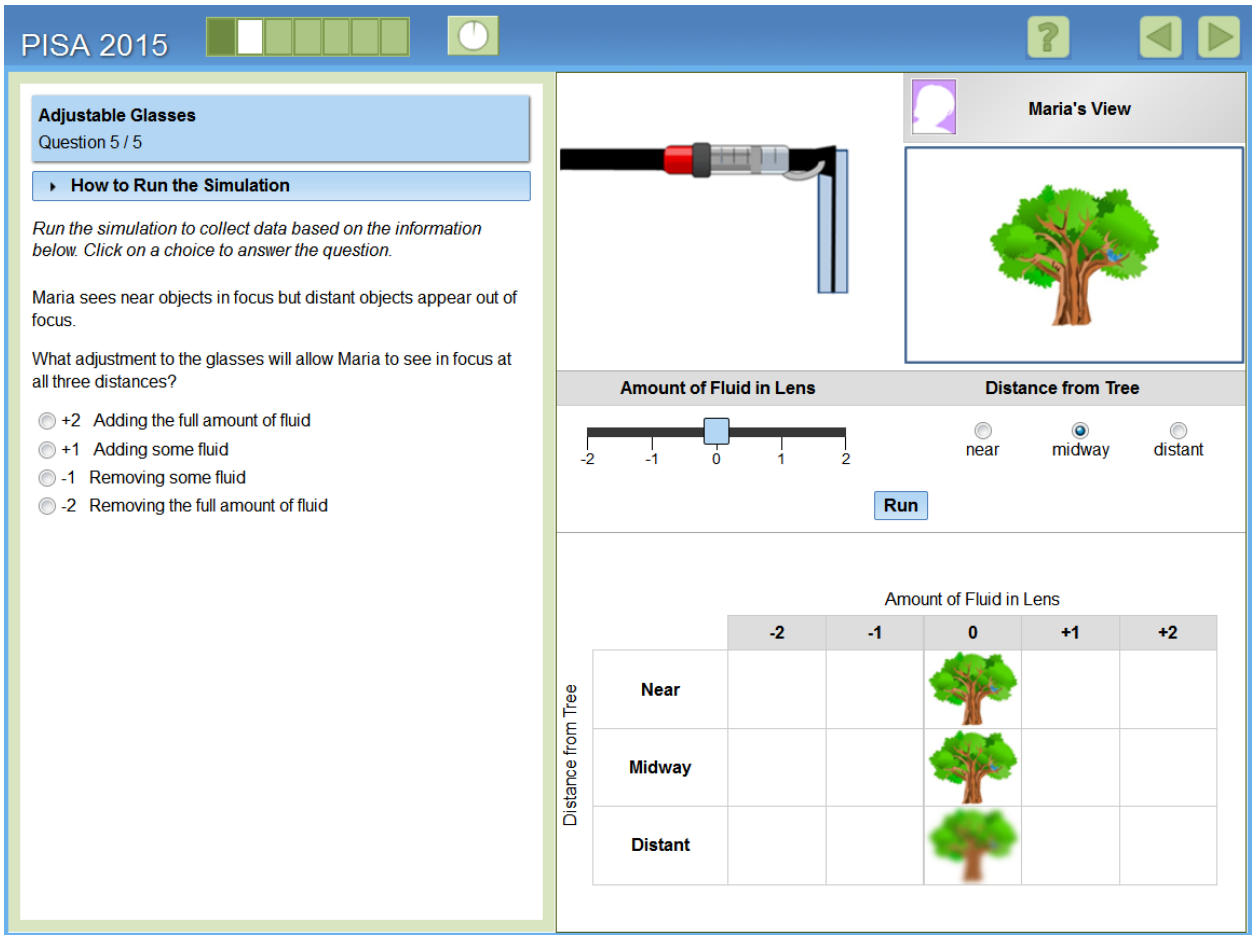
Unit 621 *Adjustable Glasses*
Released Item #4



Students are asked to use the simulation to identify the adjustments that will improve Daniel's near vision. There are two correct responses: *+2 Adding the full amount of fluid* and *+1 Adding some fluid*.

Item Number	CS621Q04
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Personal – Frontiers
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

Unit 621 *Adjustable Glasses*
Released Item #5

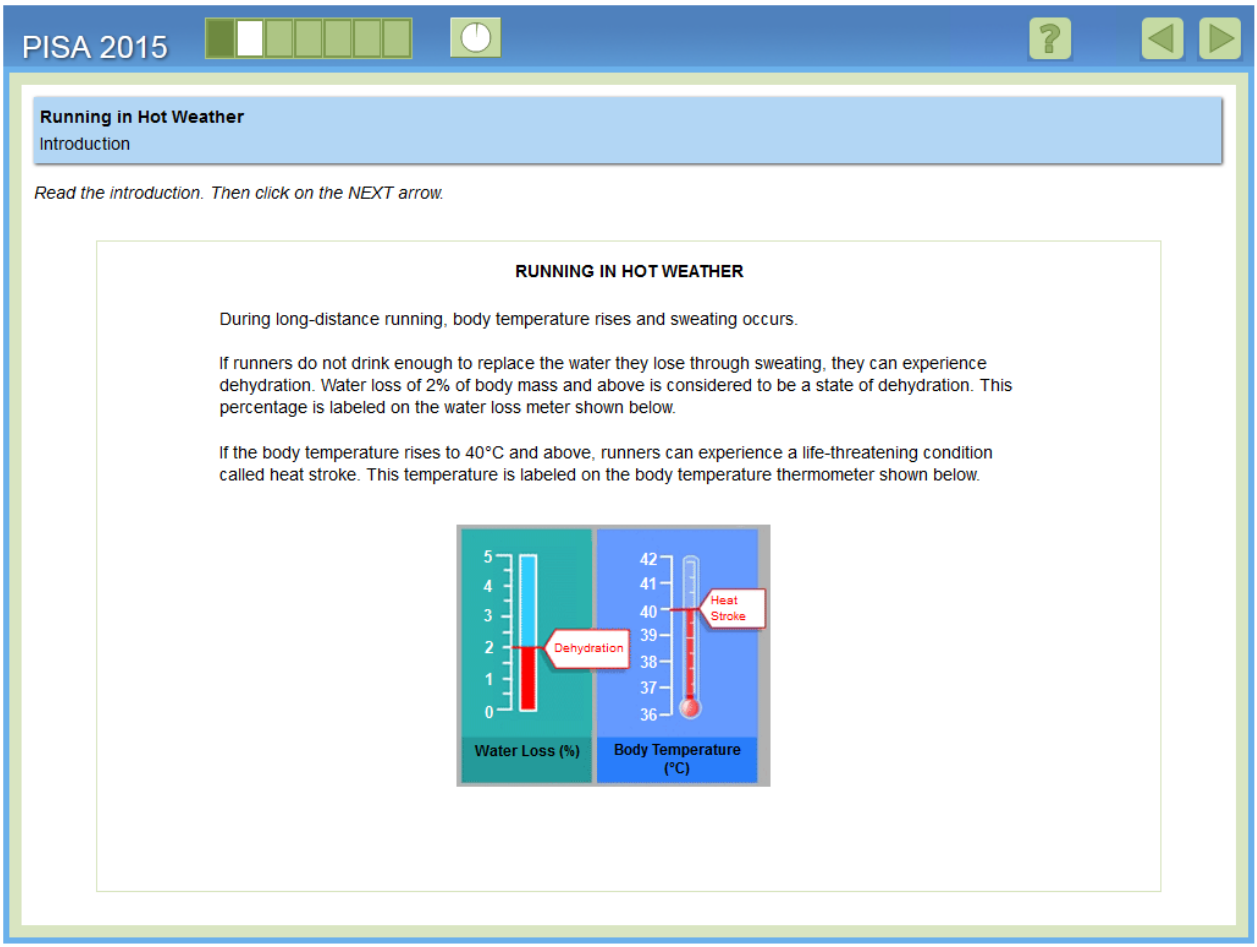


Students are asked to use the simulation and the data they generate to identify the adjustments that will improve Maria's distant vision. In this case there is one correct response: *-1 Removing some fluid*

Item Number	CS621Q05
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Personal – Frontiers
Cognitive Demand	Medium
Item Format	Simple Multiple Choice – Computer Scored

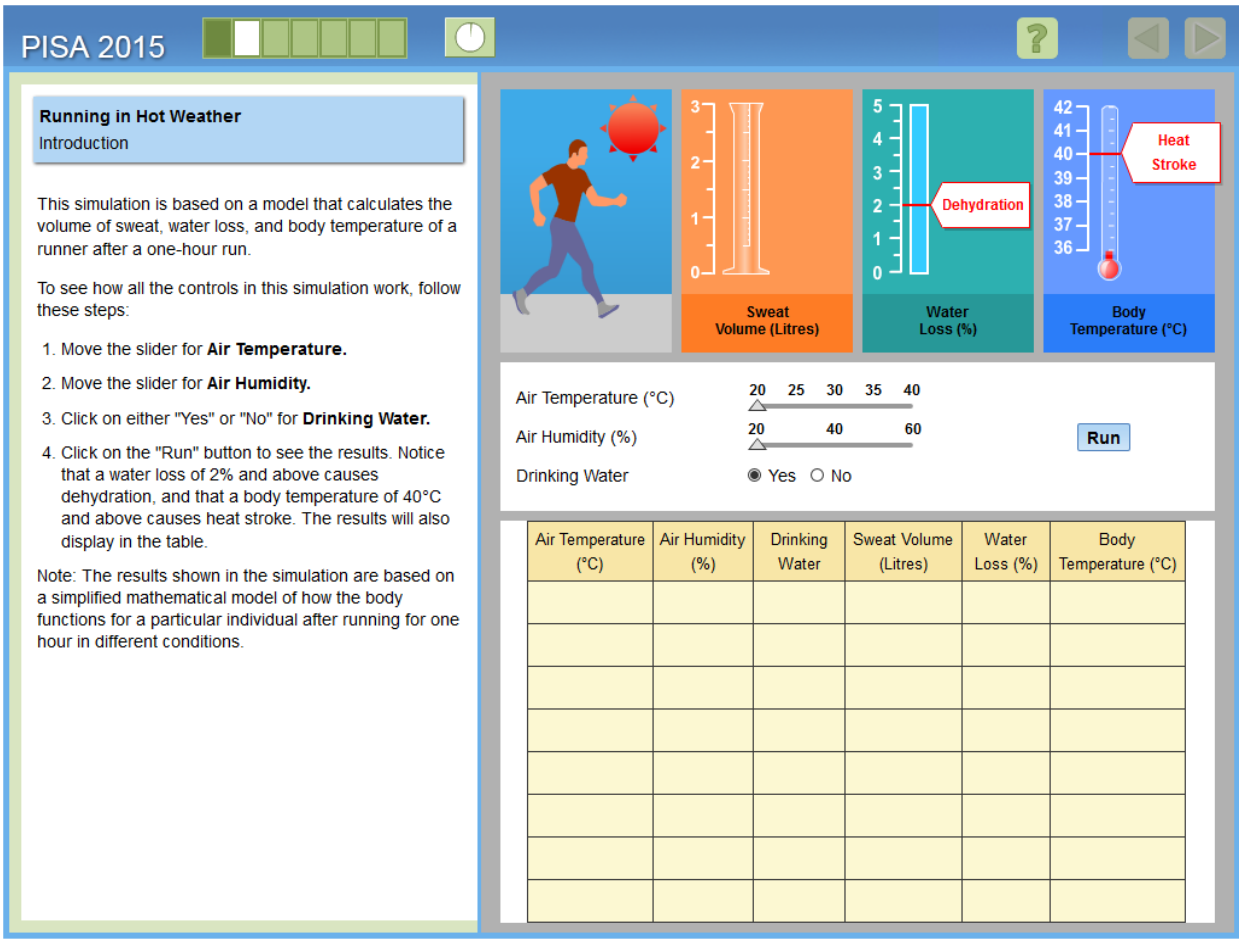
Unit 623 *Running in Hot Weather*
Unit Overview

This released unit presents a scientific enquiry related to thermoregulation using a simulation that allows students to manipulate the air temperature and air humidity levels experienced by long-distance runners, as well as whether or not the simulated runner drinks water. The student selects the air temperature, air humidity, and whether the runner is drinking water (yes/no). After running the simulation the runner's sweat volume, water loss and body temperature are displayed. When the conditions trigger dehydration or heat stroke, those health dangers are highlighted in the display.

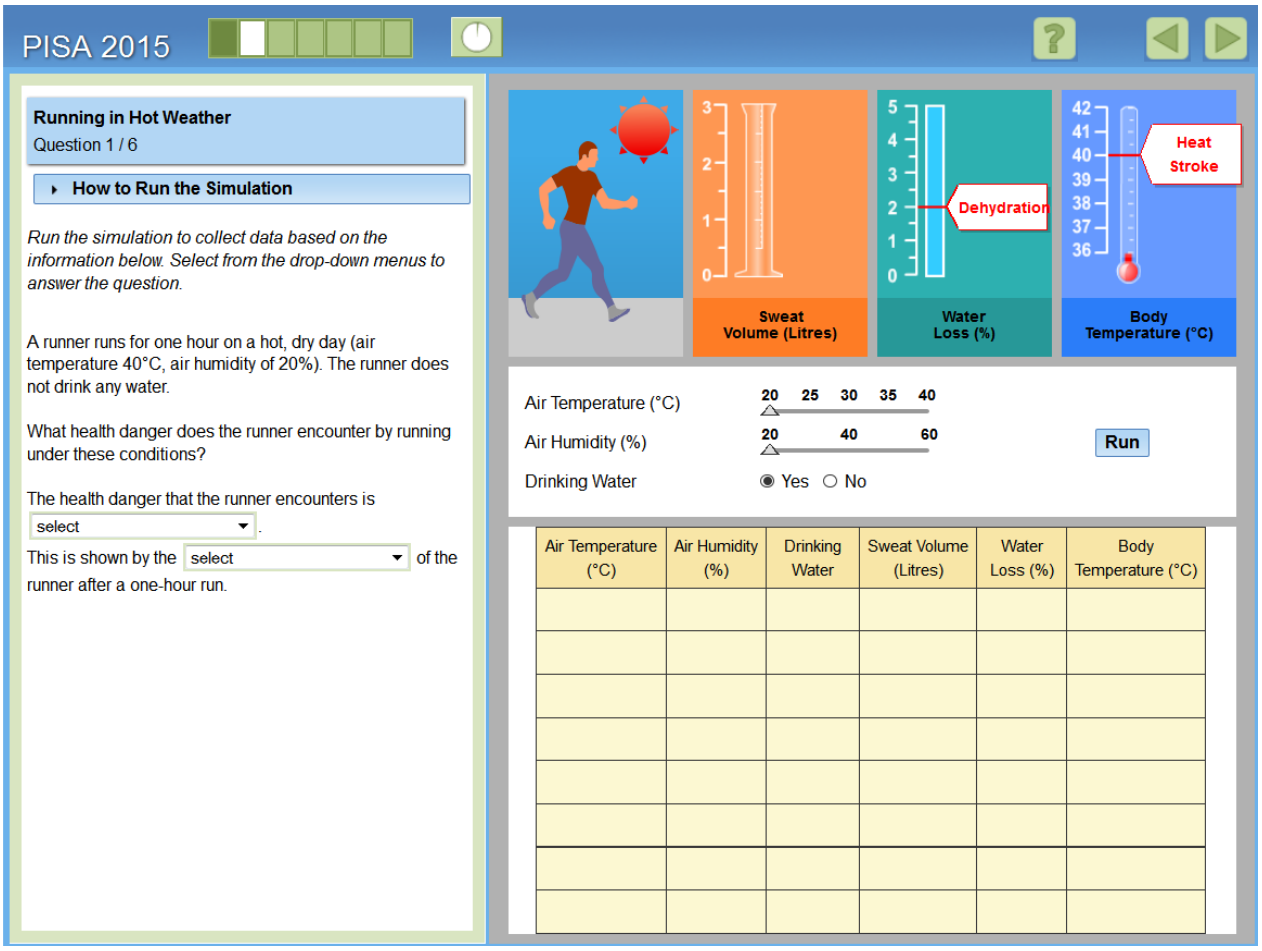


Unit 623 *Running in Hot Weather*
How to Run the Simulation

Before beginning the unit, students are provided with a brief introduction to the controls in the simulation and are allowed to practice setting each control. Help messages display if students do not take the requested actions within 1 minute. If students time out by not not acting at all within 2 minutes, they are shown what the simulation would look like if the controls were set as specified. As explained in the orientation, reminders about how to use the controls, as well as how to select or delete a row of data, are available on subsequent screens by clicking on the "How to Run the Simulation" tab.



Unit 623 *Running in Hot Weather*
Released Item #1

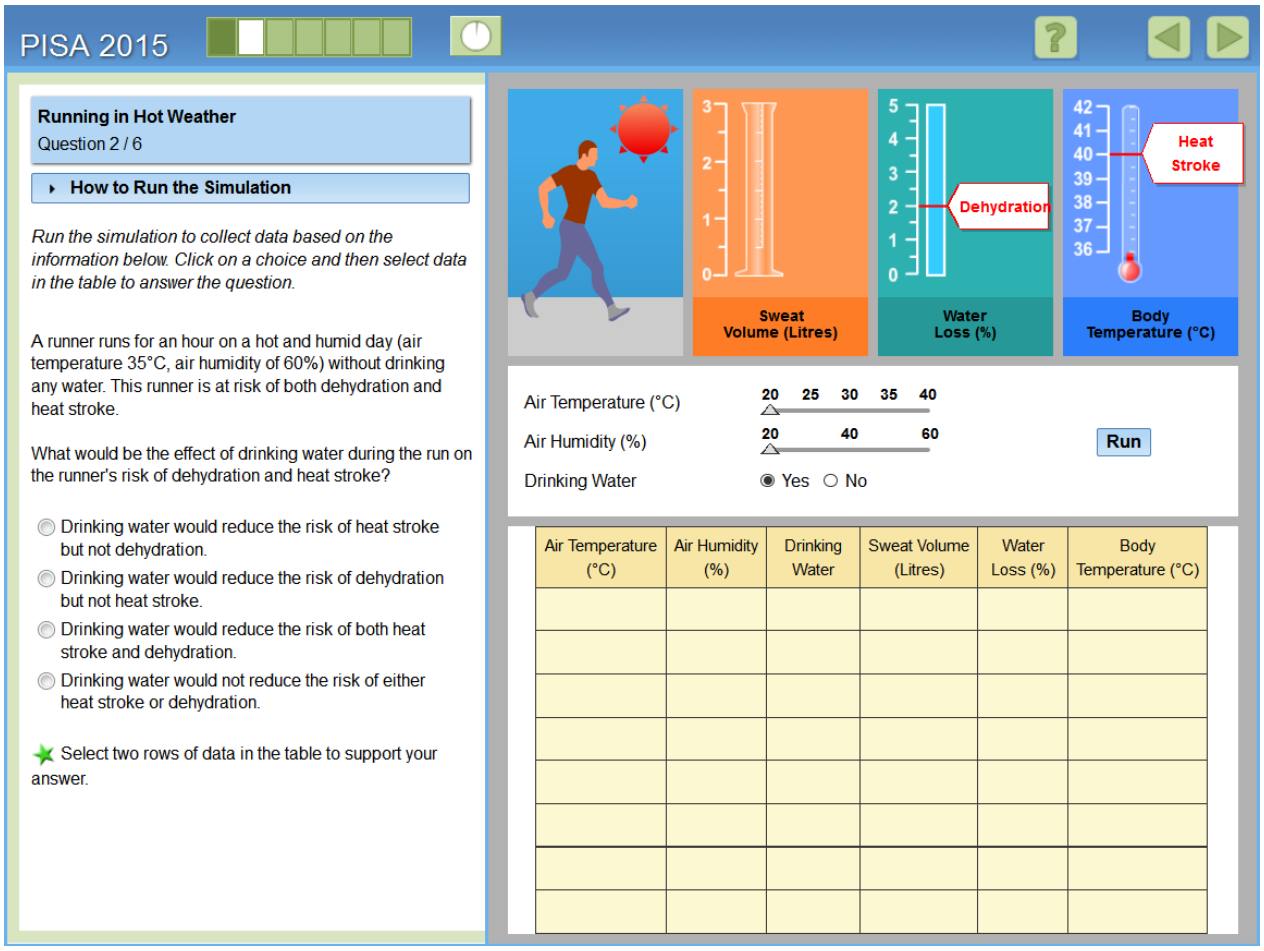


Students are asked to use the simulation to determine whether the person running under the described conditions is in danger of either dehydration or heat stroke. They are also asked to specify whether this is shown by the runner's sweat volume, water loss or body temperature. The available options in the drop-down menus are: dehydration/heat stroke and sweat volume/water loss/body temperature.

The correct response is that the health danger is *dehydration* as shown by the runner's *water loss*.

Item Number	CS623Q01
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Personal – Health and Disease
Cognitive Demand	Low
Item Format	Complex Multiple Choice – Computer Scored

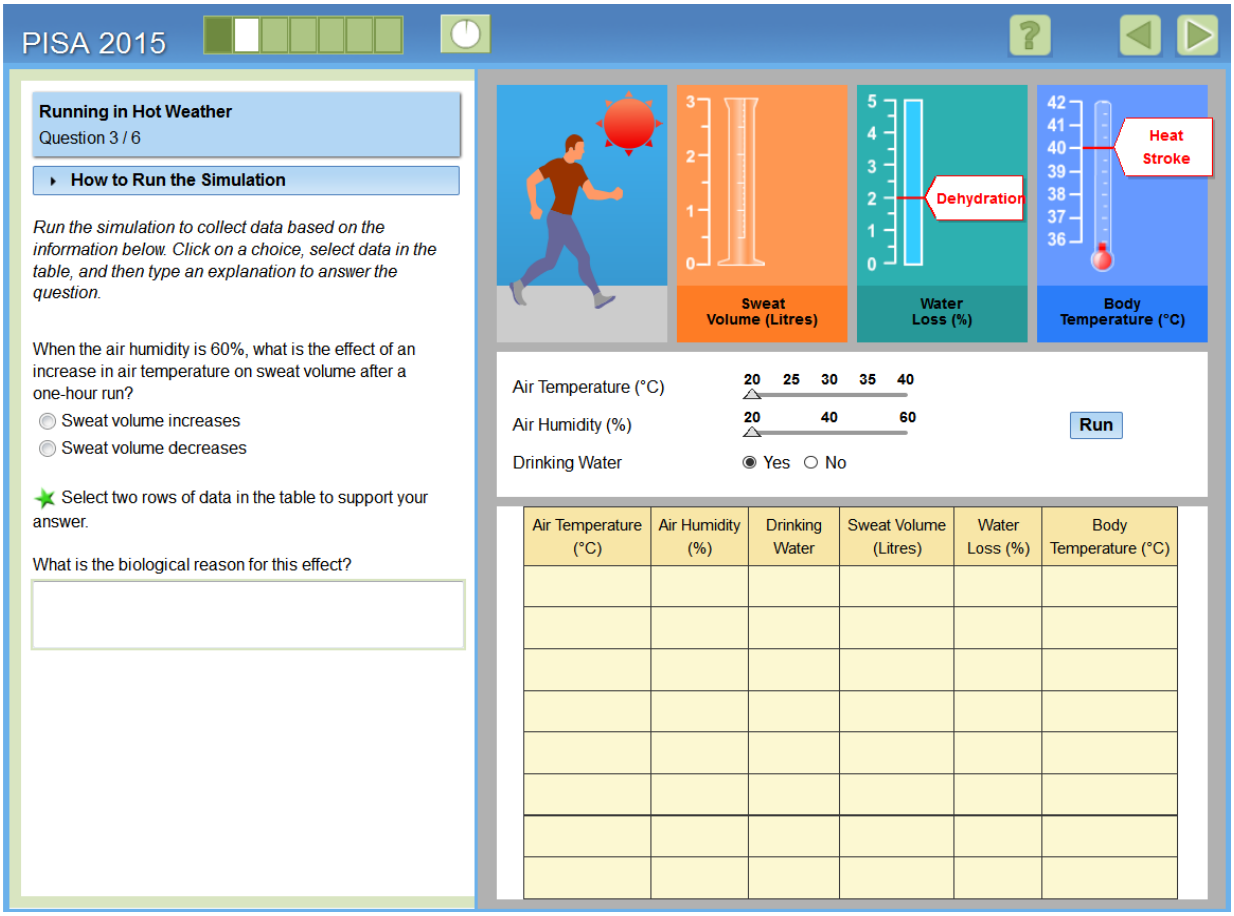
Unit 623 *Running in Hot Weather*
Released Item #2



Students are asked to run the simulation holding the air temperature and humidity constant while varying whether or not the runner drinks water. They must use the data they generate to identify that the second option is correct: *Drinking water would reduce the risk of dehydration but not heat stroke.* In support of their response, they must also select two rows of data where drinking water is set to "No" in one case and "Yes" in the other, with an air temperature of 35°C and air humidity of 60% for both rows.

Item Number	CS623Q02
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Personal – Health and Disease
Cognitive Demand	Low
Item Format	Simple Multiple Choice and Open Response - Computer Scored

Unit 623 *Running in Hot Weather*
Released Item #3



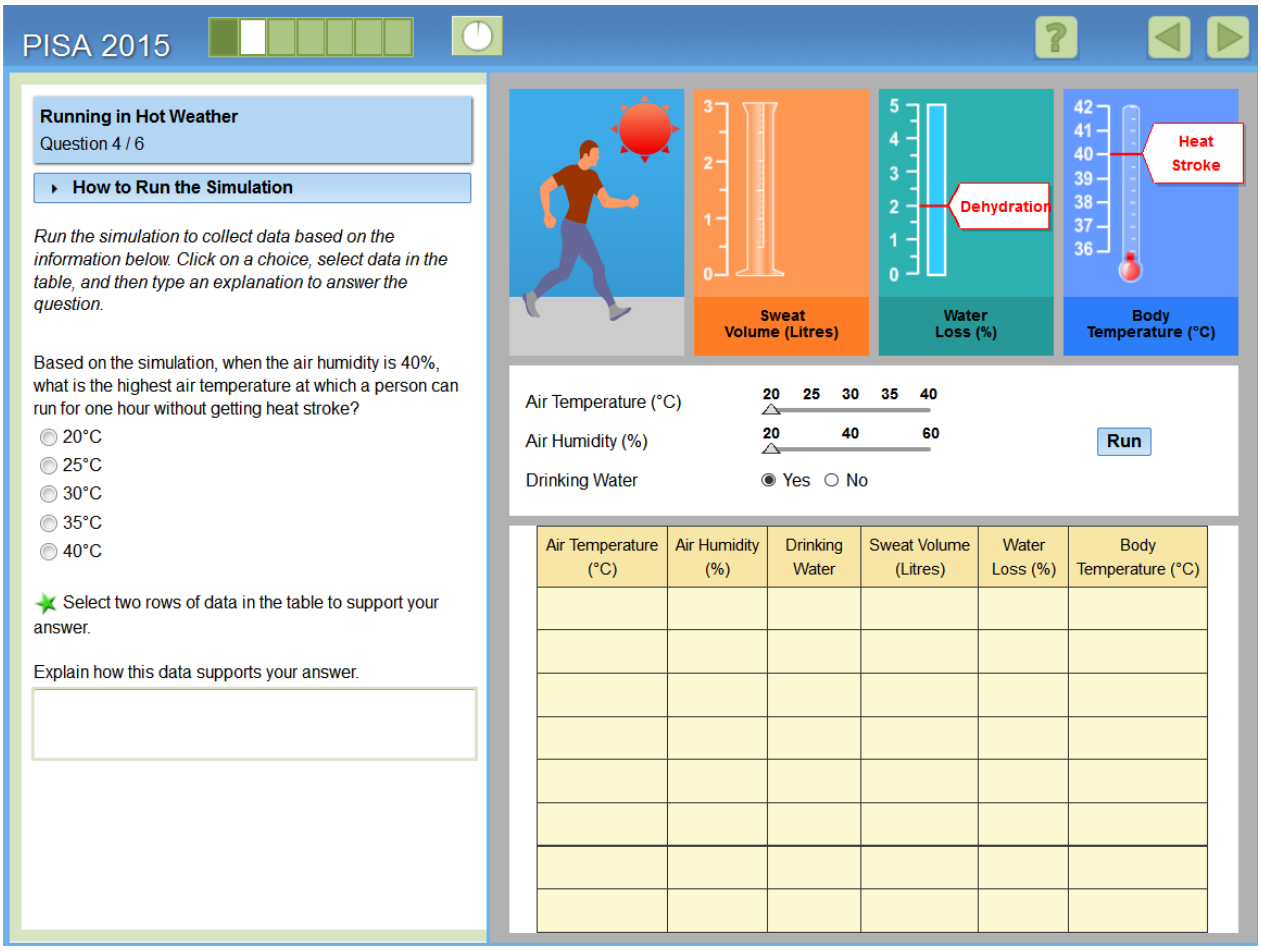
This item includes two separately coded questions: CS623Q03 includes the multiple-choice question and selection of data to support that answer; CS623Q04. asks students to explain the reason that sweat volume increases under the specified conditions. Unlike the previous questions, only humidity is specified. Students must investigate how varying air temperatures impact sweat volume.

The correct response for CS623Q03 is that *sweat volume increases* when air temperature increases at 60% humidity and the selected rows of data must include one row with a temperature set to a lower number and one to a higher number, with both at a 60% humidity level (e.g., 20°C at 60% and 25°C at 60% or 35°C at 60% and 40°C at 60%)

For CS623Q04, students must explain that sweating is a mechanism used by the body to lower body temperature as the biological reason for this increase in sweat volume at higher temperatures.

Item Number	CS623Q03 and CS623Q04
Competency	Q03: Evaluate and Design Scientific Enquiry Q04: Explain Phenomena Scientifically
Knowledge – System	Q03: Procedural Q04: Content – Living
Context	Personal – Health and Disease
Cognitive Demand	Medium
Item Format	Q03: Simple Multiple Choice and Open Response – Computer Scored Q04: Open Response – Human Coded

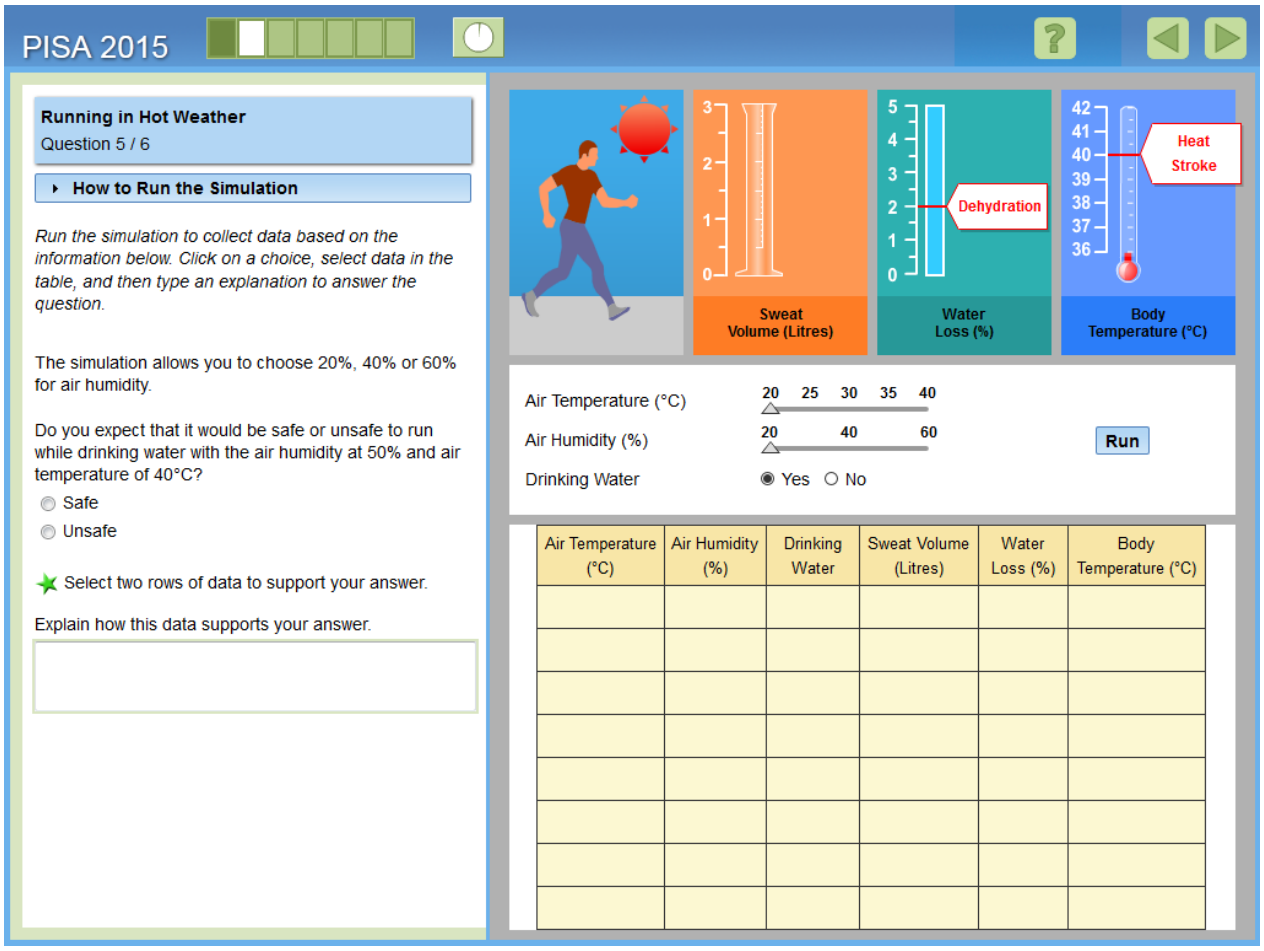
Unit 623 *Running in Hot Weather*
Released Item #4



Students are asked to use the simulation to identify the highest temperature at which a person can run without getting heat stroke when the humidity is 40%. The correct response is *35°C* and students must select the following two rows of data to support their response: 35°C air temperature - 40% humidity and 40°C air temperature - 40% humidity. They must further explain how the selected rows of data support their answer by indicating that at 40% humidity moving the air temperature up from 35°C to 40°C causes heat stroke.

Item Number	CS623Q05
Competency	Evaluate and Design Scientific Enquiry
Knowledge – System	Procedural
Context	Personal – Health and Disease
Cognitive Demand	Medium
Item Format	Open Response – Human Coded

Unit 623 *Running in Hot Weather*
Released Item #5[3]



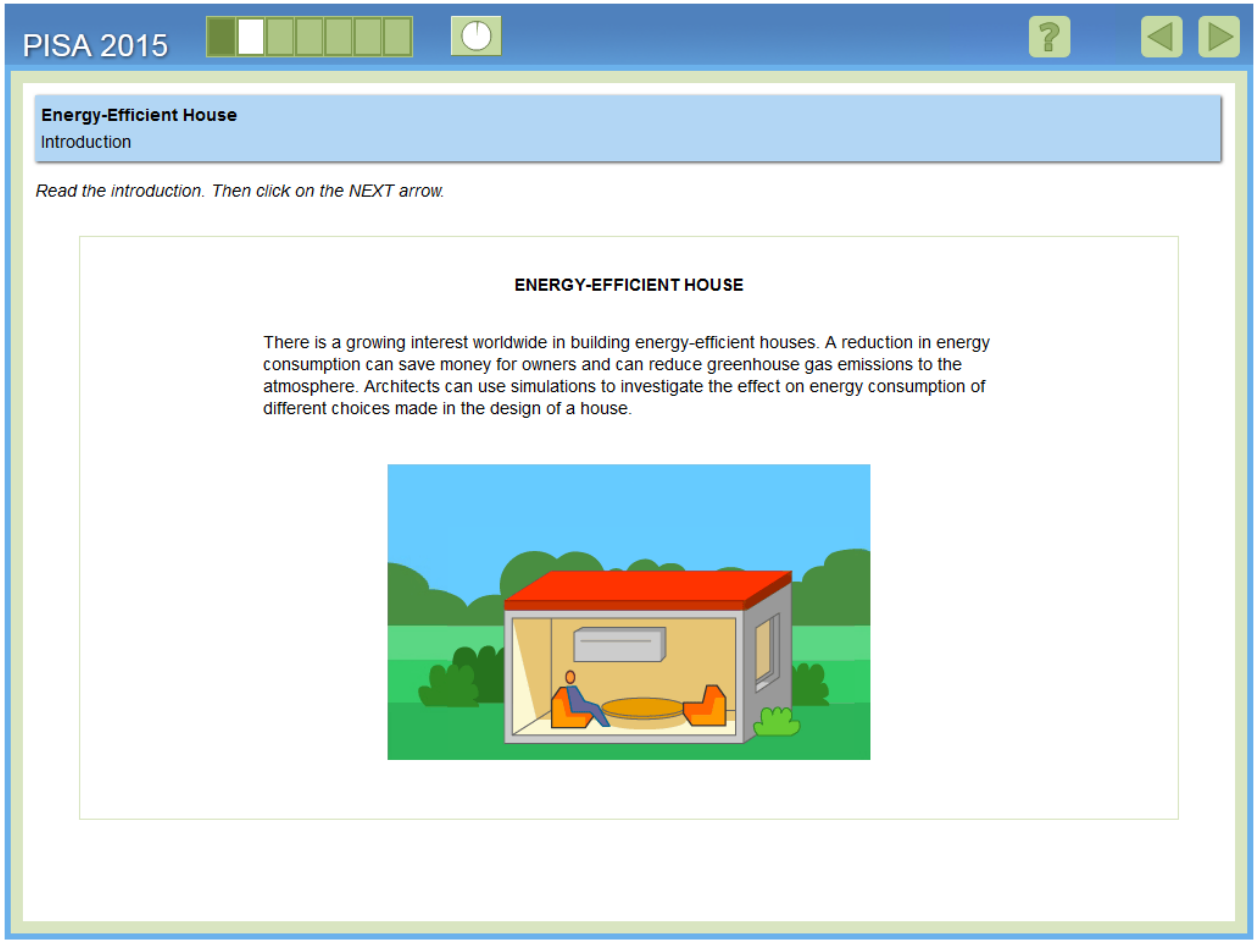
Students use the simulation to develop a hypothesis about the safety of running at 40°C at 50% humidity (a humidity value that cannot be set on the slider). By testing the humidity levels below and above 50% at 40°C, students can conclude that it would be *unsafe* to run at 40°C, even while drinking water. To support this response, they must select one row with 40% humidity at 40°C with drinking water set to "Yes" and a second with 60% humidity at 40°C with drinking water set to "Yes". The explanation must indicate that, given that the runner would suffer from heat stroke at both 40% and 60% humidity at 40°C while drinking water; there is a risk of heat stroke at 50% humidity under those same conditions.

Item Number	CS623Q06
Competency	Evaluate and Design Scientific Enquiry
Knowledge – System	Procedural
Context	Personal – Health and Disease
Cognitive Demand	High
Item Format	Open Response – Human Coded

[3] Note that the last item in this unit, CS623Q08, is not included among the released items.

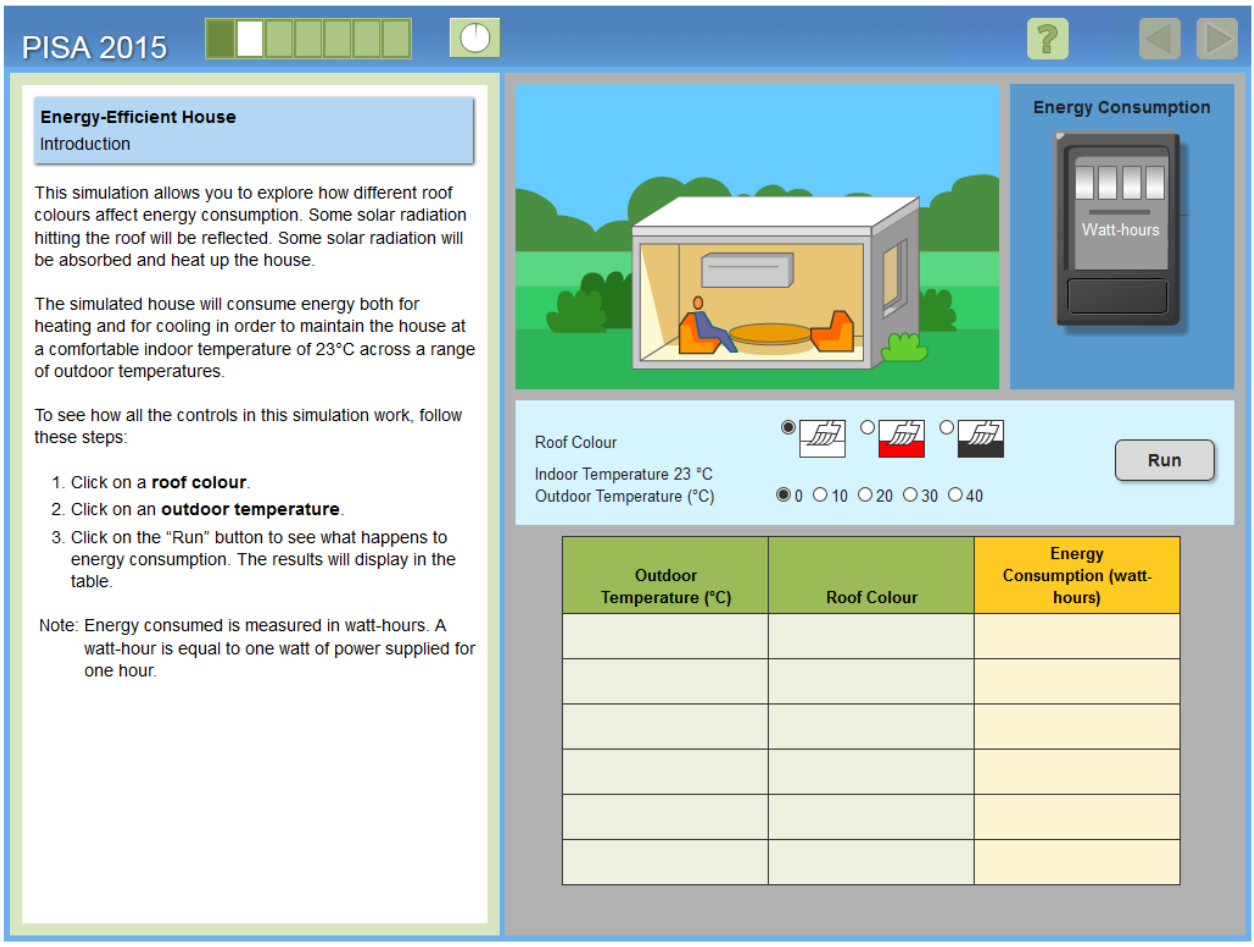
Unit 633 *Energy-Efficient House*
Unit Overview

This released unit focuses on how different roof colours affect energy consumption. The simulation allows students to investigate the effect of roof colour on the amount of energy needed to heat or cool a house to a constant temperature of 23°C. For each trial, the student selects a roof colour and outside temperature. After pressing "Run," the simulation displays energy consumption at the selected colour and temperature.

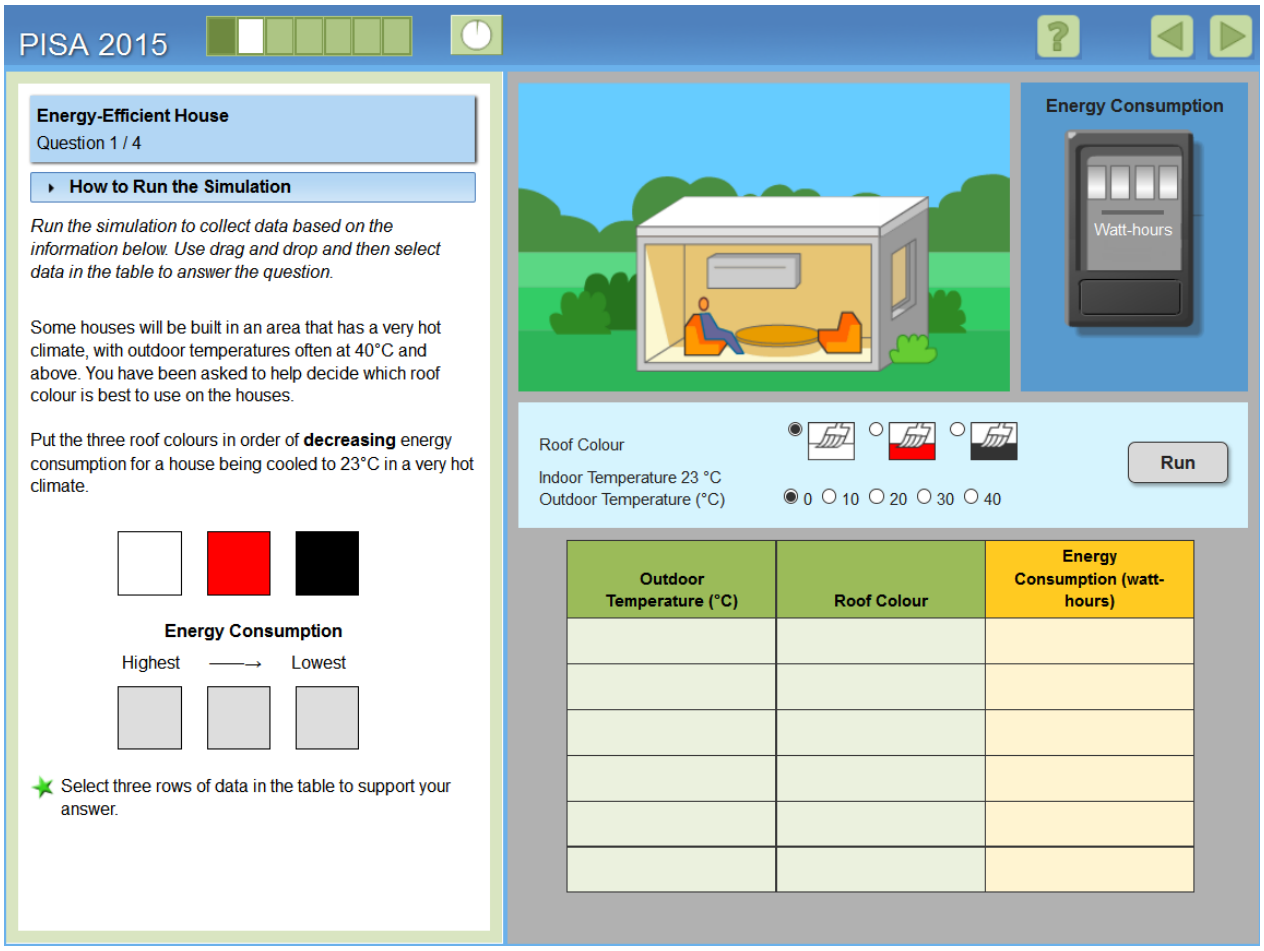


Unit 633 *Energy-Efficient House*
How to Run the Simulation

Before beginning the unit, students are provided with a brief introduction to the controls in the simulation and are allowed to practice setting each control. Help messages display if students do not take the requested actions within 1 minute. If students time out by not acting at all within 2 minutes, they are shown what the simulation would look like if the controls were set as specified. As explained in the orientation, reminders about how to use the controls, as well as how to select or delete a row of data, are available on subsequent screens by clicking on the "How to Run the Simulation" tab.



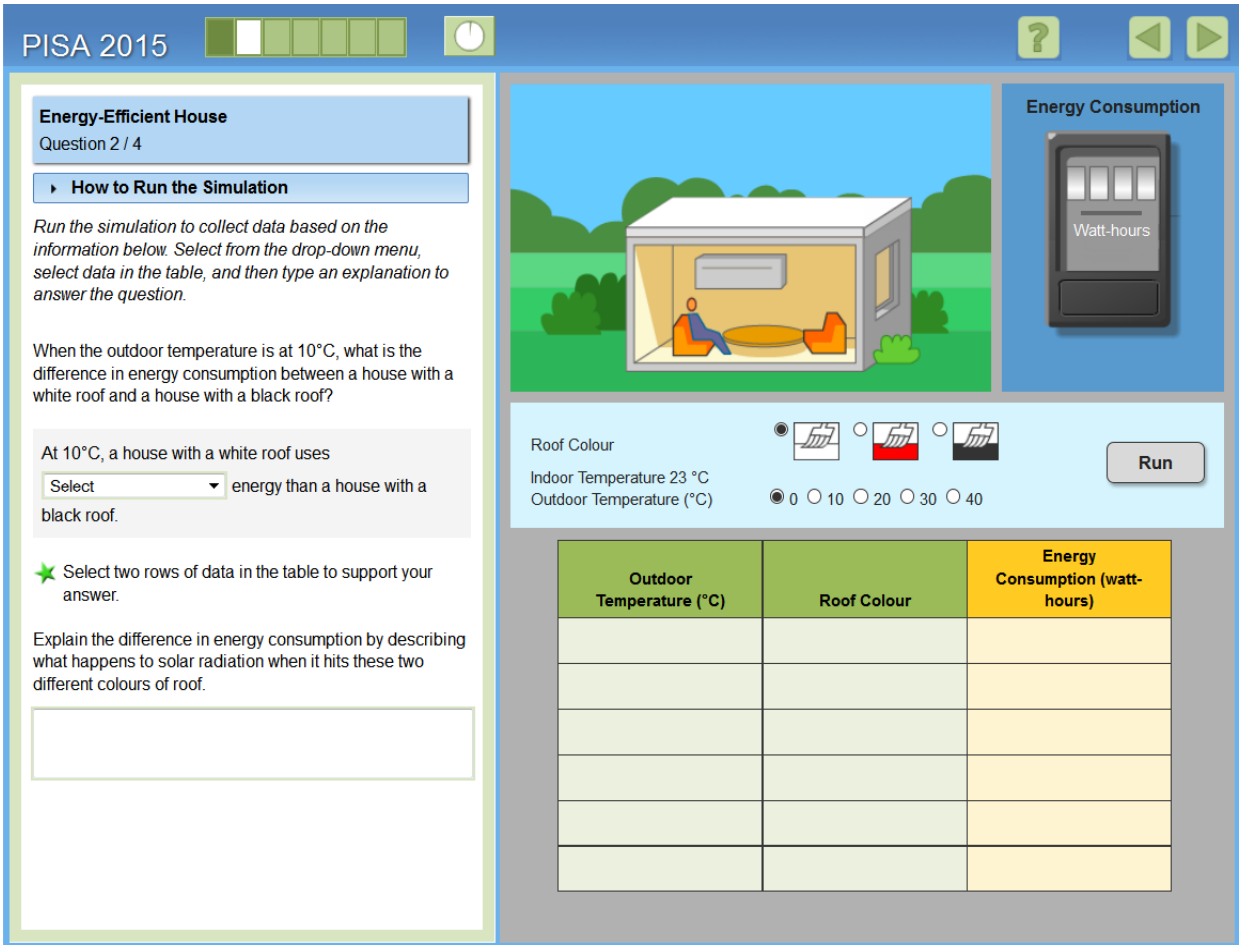
Unit 633 *Energy-Efficient House*
Released Item #1



Students are asked to select an outside temperature of 40°C and use the simulation results to put the roof colours in order from highest to lowest in terms of energy consumption as well as identify the data that support their selections. The correct response is: *black* (highest energy consumption at this temperature), *red* (middle), *white* (lowest) and the 3 supporting rows of data include ones with the outdoor temperature set to a constant 40°C and each of three roof colours selected (red, black and white).

Item Number	CS633Q01
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Local/National – Natural Resources
Cognitive Demand	Low
Item Format	Open Response – Computer Scored

Unit 633 *Energy-Efficient House*
Released Item #2

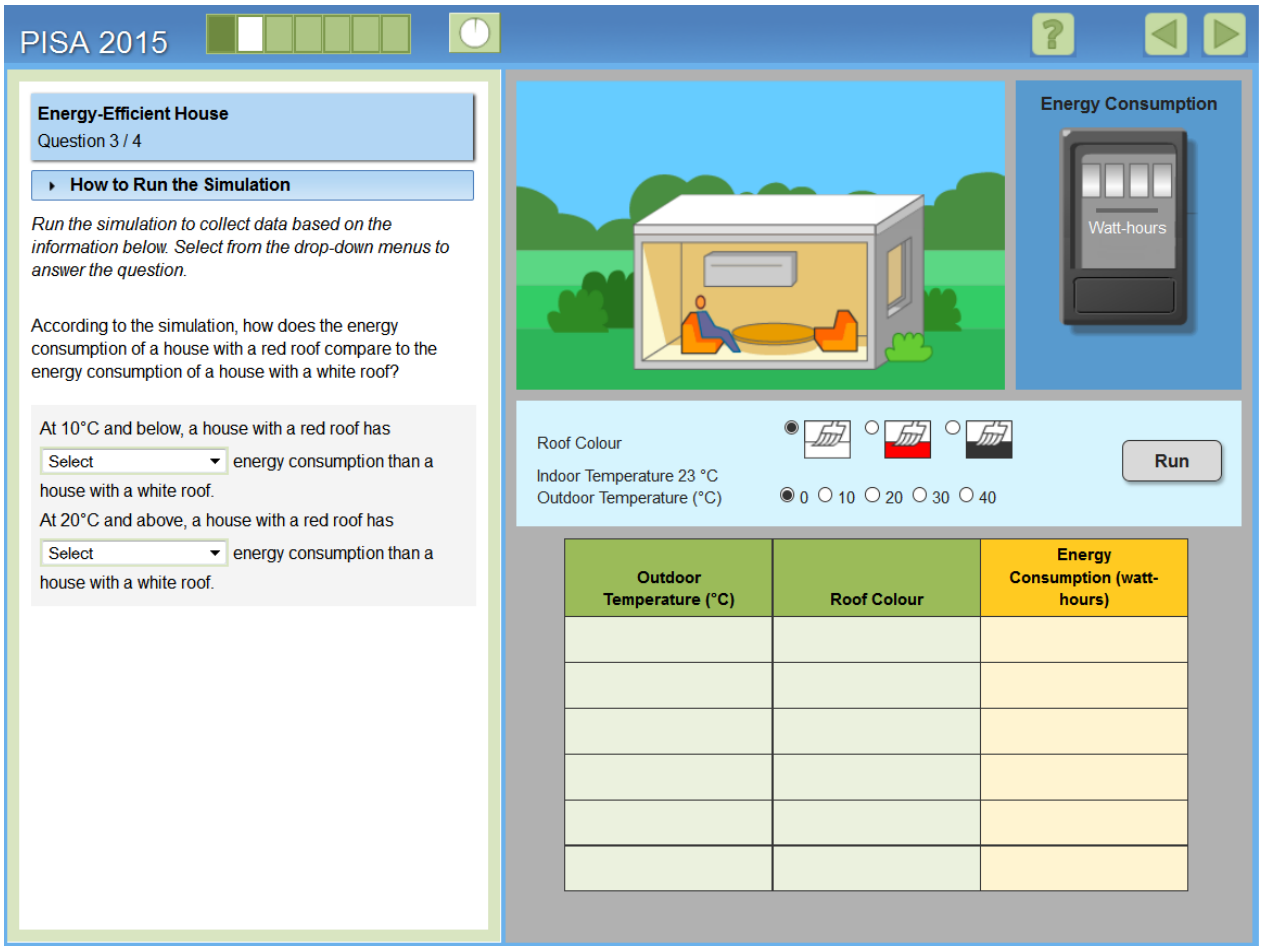


Students are asked to use the simulation to compare the energy consumption of a house with a white roof versus one with a black roof at at 10°C. This item includes two separate coded questions: CS633Q02 includes the multiple-choice question and the selection of data to support that answer; CS633Q03 asks students to explain the how roof colour affects the reflection and absorption of solar radiation.

CS633Q02 includes both a drop-down selection and data selection. The white roof uses *more* energy than the black roof to heat the house to 23°C when the outdoor temperature is 10°C. The supporting data include two rows with the outdoor temperature of 10°C – one with a white roof selected and the other with a black roof selected.
To explain this phenomenon in CS633Q03, students must indicate or imply that sunlight is a source of energy, or heat, and that the black roof absorbs more solar radiation than the white roof.

Item Number	CS633Q02 and CS633Q03
Competency	Q02: Interpret Data and Evidence Scientifically Q03: Explain Phenomena Scientifically
Knowledge – System	Q02: Procedural Q03: Content – Physical
Context	Local/National – Natural Resources
Cognitive Demand	Medium
Item Format	Q02: Open Response – Computer Scored Q03: Open Response – Human Coded

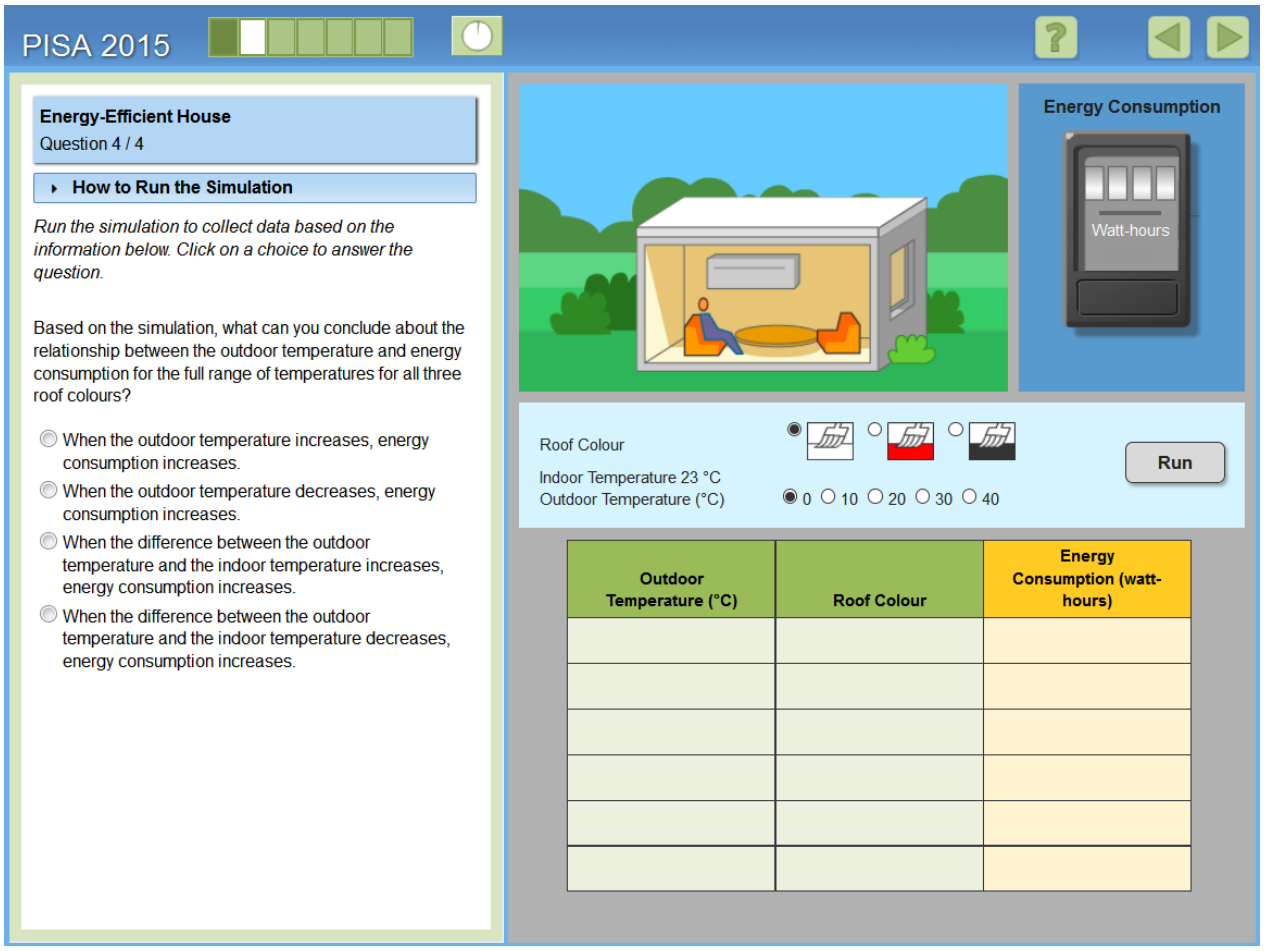
Unit 633 *Energy-Efficient House*
Released Item #3



Students are asked to run the simulation to compare the energy consumption of a house with a red roof versus one with a white roof first at 10°C and then at 20°C. Students should determine that a house with a red roof has *lower* energy consumption than one with a white roof at temperatures of 10°C or below, but *higher* energy consumption at temperatures of 20°C or above.

Item Number	CS633Q04
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural
Context	Local/National – Natural Resources
Cognitive Demand	Medium
Item Format	Complex Multiple Choice – Computer Scored

Unit 633 *Energy-Efficient House*
Released Item #4



Students are asked to select a statement about the relationship between outdoor temperature and energy consumption that is supported by the simulation. The correct response is the third option: *When the difference between the outdoor temperature and the indoor temperature increases, energy consumption increases.*

Item Number	CS633Q05
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Physical
Context	Local/National – Natural Resources
Cognitive Demand	High
Item Format	Simple Multiple Choice – Computer Scored