Annex C

PISA 2015 TEST ITEMS

Annex C1: Released items from the PISA 2015 computer-based science assessment

This annex presents example units (groups of questions related to the same stimulus information) from the PISA 2015 computer-based science assessment. One unit from the field trial (*RUNNING IN HOT WEATHER*) is presented in order to illustrate the use of computer-based simulations in the PISA 2015 assessment. Four units from the main study are also included.

Annex C2: Classification and scaling information of PISA 2015 Main Survey Items
http://dx.doi.org/10.1787/888933433242

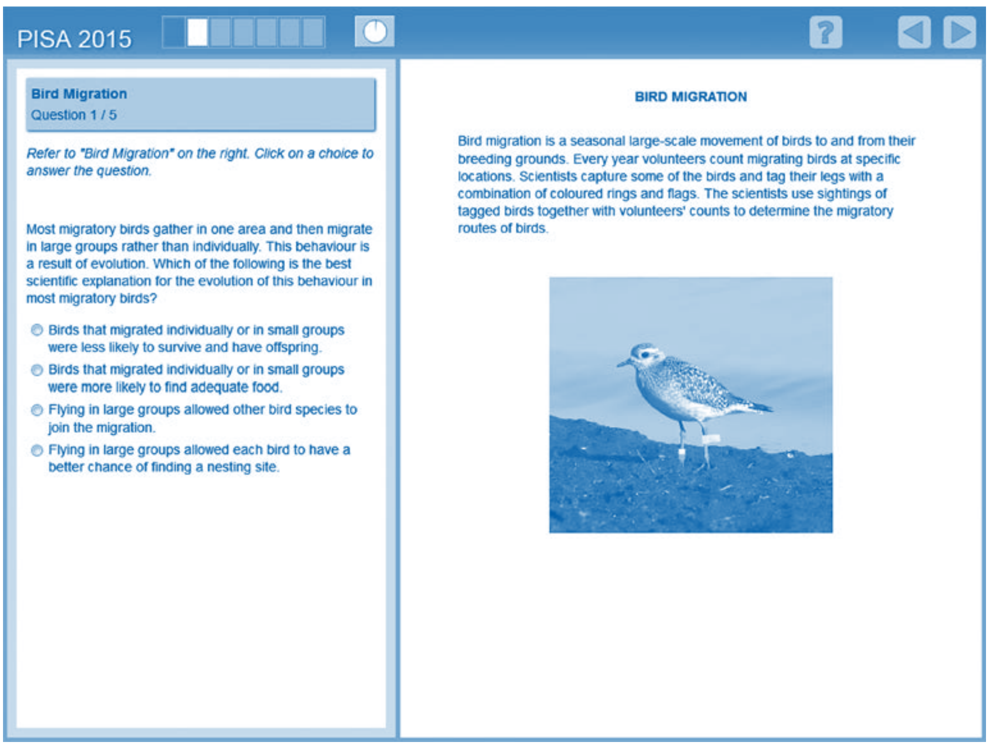
Tables C2.1, C2.2, C2.3 and C2.4 (available on line and listed in the Annex C2) present the item classification and the scaling information for the item pool for science (trend and new items), reading and mathematics.

ANNEX C1

RELEASED ITEMS FROM THE PISA 2015 COMPUTER-BASED SCIENCE ASSESSMENT

Main survey items

BIRD MIGRATION – QUESTION 1



Question Type	Simple multiple choice
Competency	Explain Phenomena Scientifically
Knowledge – System	Content – Living
Context	Global – Environmental Quality
Difficulty	501 – Level 3
Question ID	S656Q01

Scoring

Full Credit

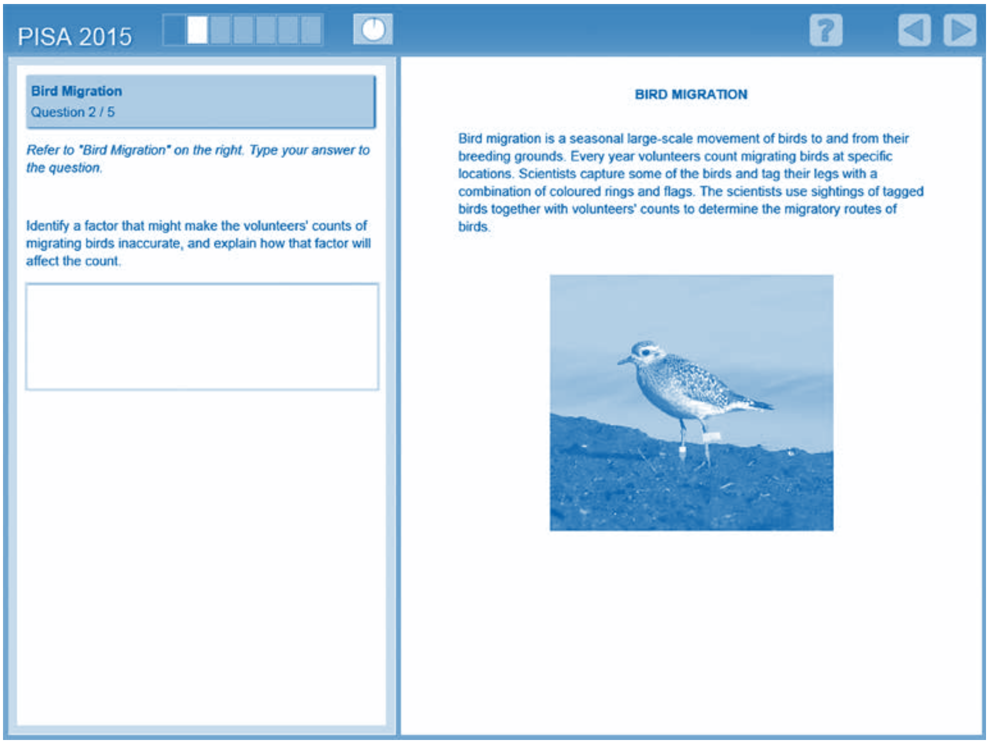
The student selects:

Birds that migrated individually or in small groups were less likely to survive and have offspring.

Comment

In question 1, students are asked to select an explanation for the specified phenomenon that birds migrate in large groups. This question, which is at the very low end of Level 3, requires that students identify an appropriate conclusion about the evolutionary benefit of this behaviour.

BIRD MIGRATION – QUESTION 2



Question Type	Human Coded
Competency	Evaluate and design scientific enquiry
Knowledge – System	Procedural – Living
Context	Global – Environmental Quality
Difficulty	630 – Level 5
Question ID	S656Q02

Scoring

Full Credit

The student identifies at least one specific factor that can affect the accuracy of counts by observers.

The observers may miss counting some birds because they fly high.

If the same birds are counted more than once, that can make the numbers too high.

For birds in a large group, volunteers can only estimate how many birds there are.

The observers might be wrong about what kind of bird they are, so the numbers of that kind of bird will be wrong.

The birds migrate at night.

Volunteers will not be everywhere the birds migrate.

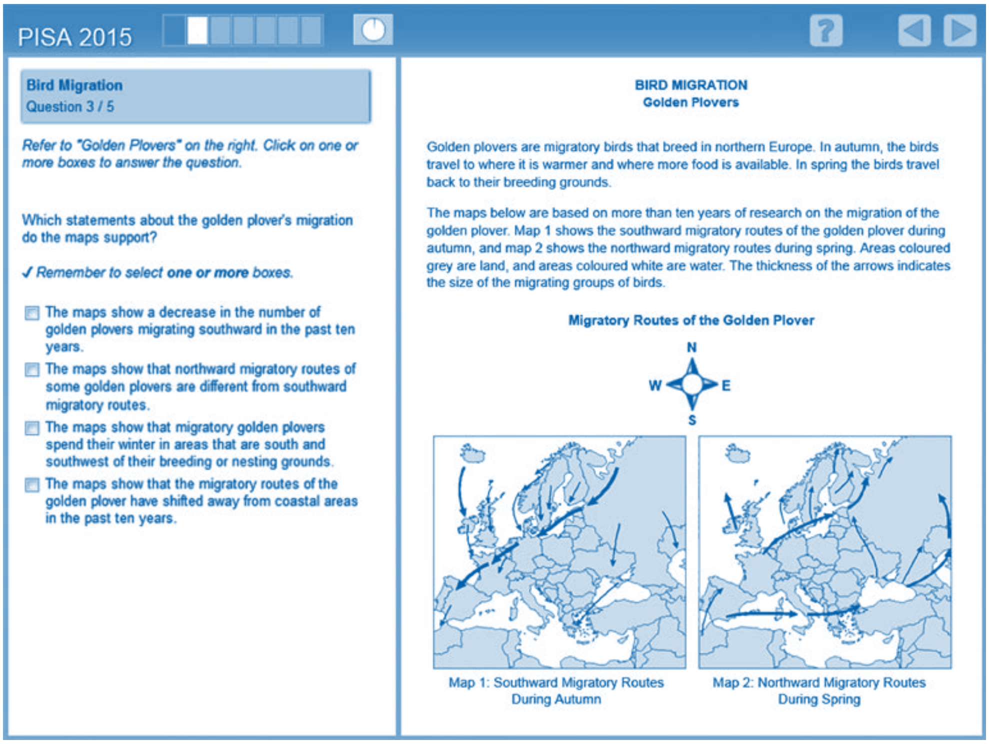
The observers can make a mistake in counting.

Clouds or rain hide some of the birds.

Comment

To correctly answer this question, students must use procedural knowledge to identify a factor that might lead to inaccurate counts of migrating birds and explain how that could affect the data collected. Being able to identify and explain potential limitations in data sets is an important aspect of scientific literacy and locates this question at the top Level.

BIRD MIGRATION – QUESTION 3



Question Type	Complex Multiple Choice
Competency	Interpret data and evidence scientifically
Knowledge – System	Procedural – Living
Context	Global – Environmental Quality
Difficulty	574 – Level 4
Question ID	S656Q04

Scoring

Full Credit

The student selects BOTH of the following 2 responses:

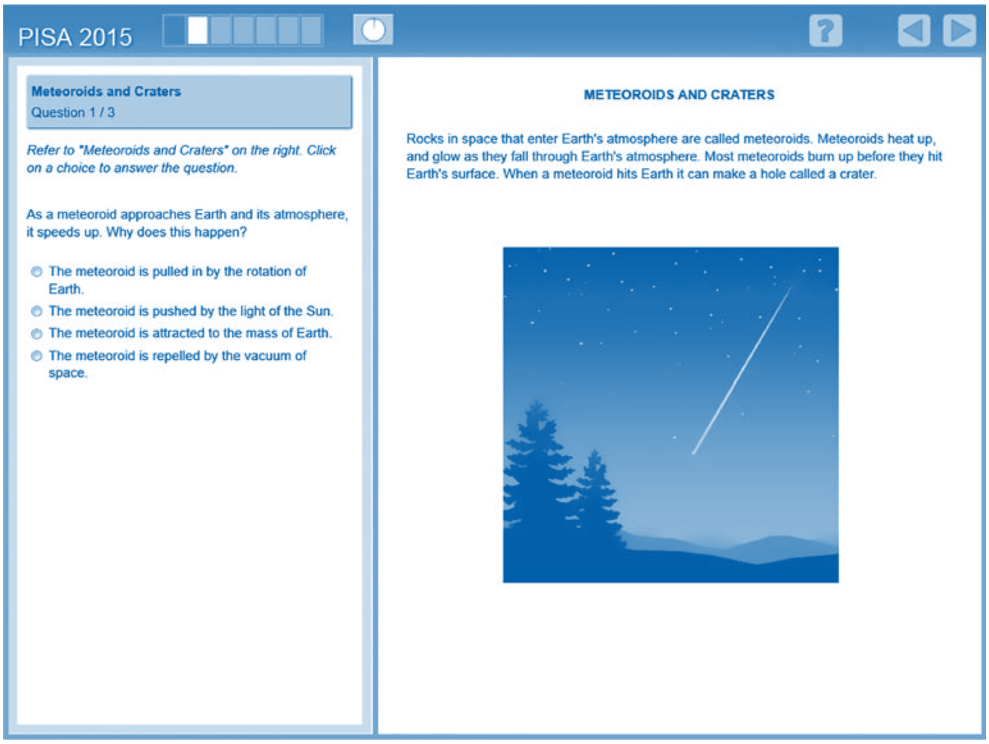
The maps show that northward migratory routes of some golden plovers are different from southward migratory routes.

The maps show that migratory golden plovers spend their winter in areas that are south and southwest of their breeding or nesting grounds.

Comment

Question 3 requires students to understand how data is represented in two maps and use that information to compare and contrast migration routes for the golden plover in the autumn and spring. This Level 4 interpretation task requires students to analyse the data and identify which of several provided conclusions are correct.

METEOROIDS AND CRATERS – QUESTION 1



Question Type	Simple Multiple Choice
Competency	Explain phenomena scientifically
Knowledge – System	Content – Physical
Context	Global – Frontiers
Difficulty	483 – Level 2
Question ID	S641Q01

Scoring

Full Credit

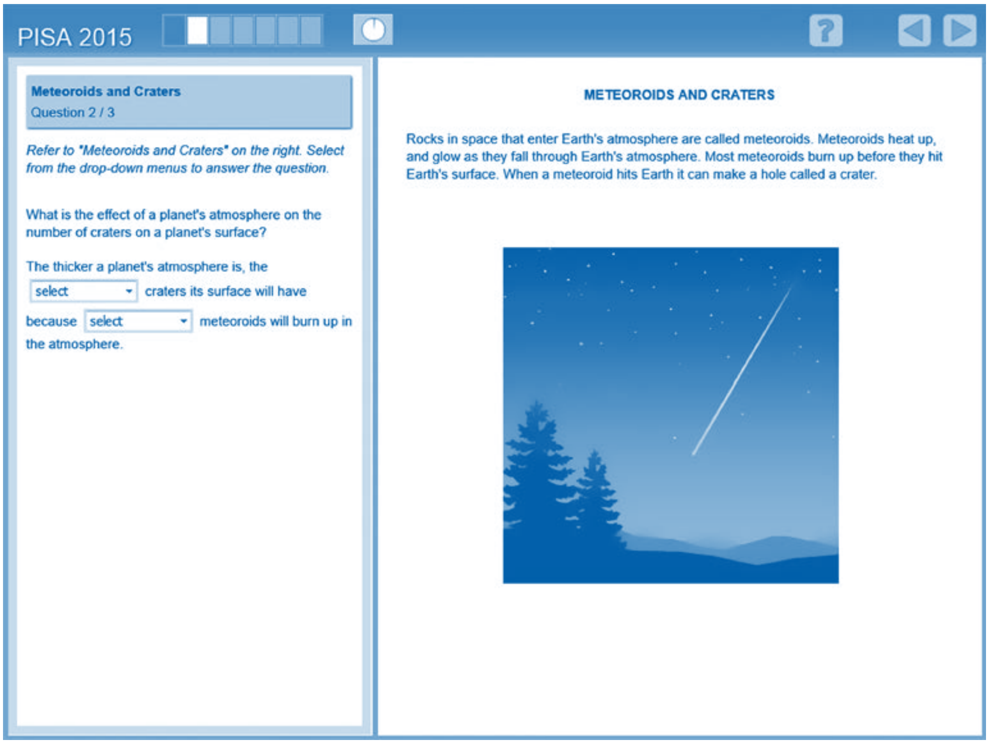
The student selects:

The meteoroid is attracted to the mass of Earth.

Comment

Question 1 requires students to apply simple scientific knowledge to select the correct explanation for why objects speed up as they approach Earth. This content question, which requires students to explain a phenomenon scientifically, is at the top of Level 2.

METEOROIDS AND CRATERS – QUESTION 2



Question Type	Complex Multiple Choice
Competency	Explain phenomena scientifically
Knowledge – System	Content – Earth & Space
Context	Global – Frontiers
Difficulty	450 – Level 2
Question ID	S641Q02

Scoring

Full Credit

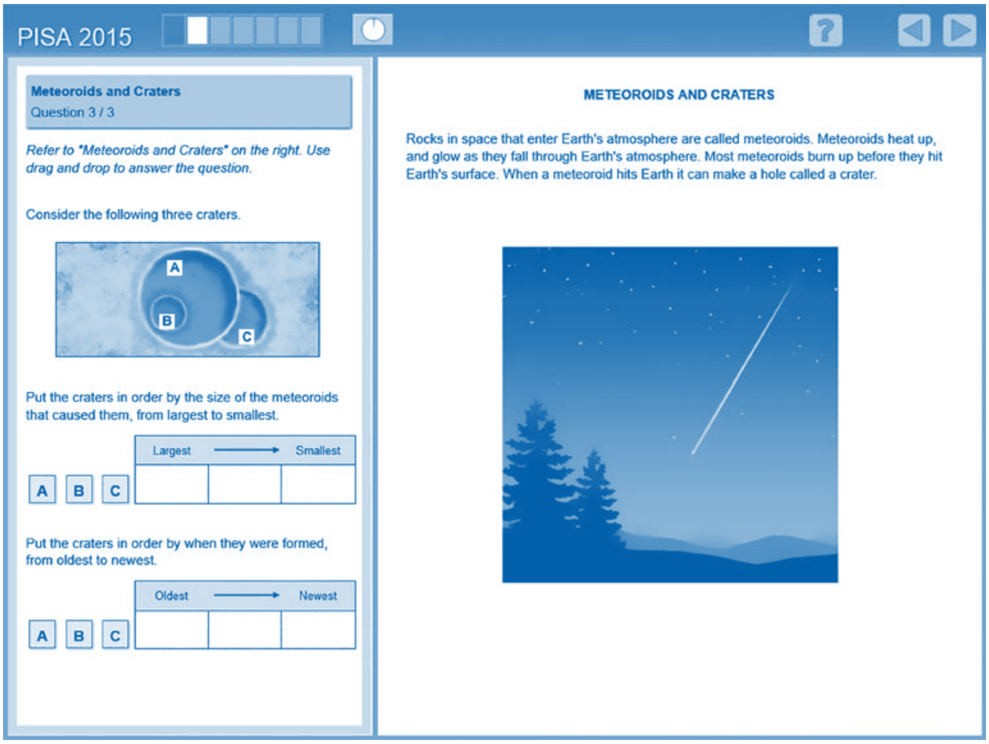
The student selects:

The thicker a planet's atmosphere is, the more/<u>fewer</u> craters its surface will have because <u>more</u>/fewer meteoroids will burn up in the atmosphere.

Comment

This Level 2 question requires students to select two responses that explain the relationship between the thickness of a planet's atmosphere, the likelihood that meteoroids will burn up in the atmosphere and, therefore, the number of craters that will be on the planet surface.

METEOROIDS AND CRATERS – QUESTIONS 3A AND 3B[1]



Question Type	Complex Multiple Choice (drag and drop)
Competency	Interpret data and evidence scientifically
Knowledge – System	Content – Earth & Space
Context	Global – Frontiers
Difficulty	3A: 299 – Level 1b
	3B: 438 – Level 2
Question ID	3A: S641Q03
	3B: S641Q04

Scoring

3A • Full Credit

The student orders the craters: A, C, B.

3B • Full Credit

The student orders the craters: C, A, B.

Comment

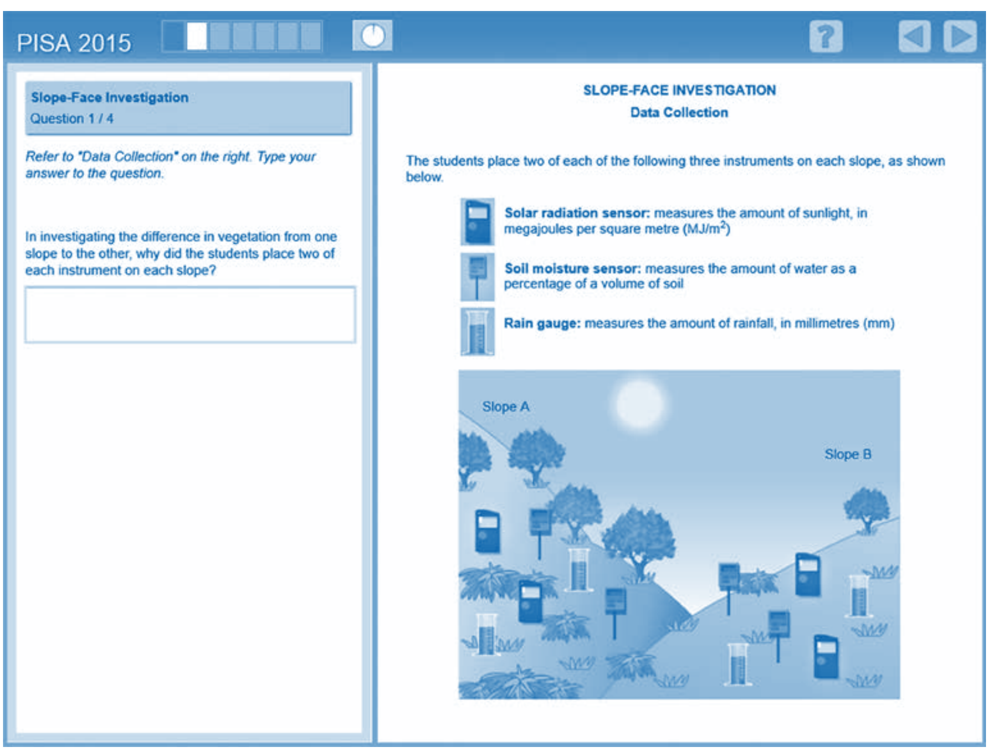
Question 3A, a basic data interpretation question, was the easiest question in the 2015 science assessment. It requires simple, everyday knowledge that a larger object would cause a larger crater and a smaller one would cause a smaller crater.

Question 3B is somewhat more difficult because students must compare the three craters shown in the image to determine when the craters were formed, from oldest to newest, based on the way they overlap in the image – e.g. crater C must have formed first because crater A overlaps C a bit and crater B must be the most recent crater because it is within A.

1. Note that these two questions are identified as Q03 and Q04 in the item codes.

SLOPE-FACE INVESTIGATION – INTRODUCTION

SLOPE-FACE INVESTIGATION – QUESTION 1



Question Type	Open Response – Human Coded
Competency	Evaluate and design scientific enquiry
Knowledge – System	Epistemic – Earth & Space
Context	Local/ National - Natural Resources
Difficulty	517 – Level 3
Question ID	S637Q01

Scoring

Full Credit

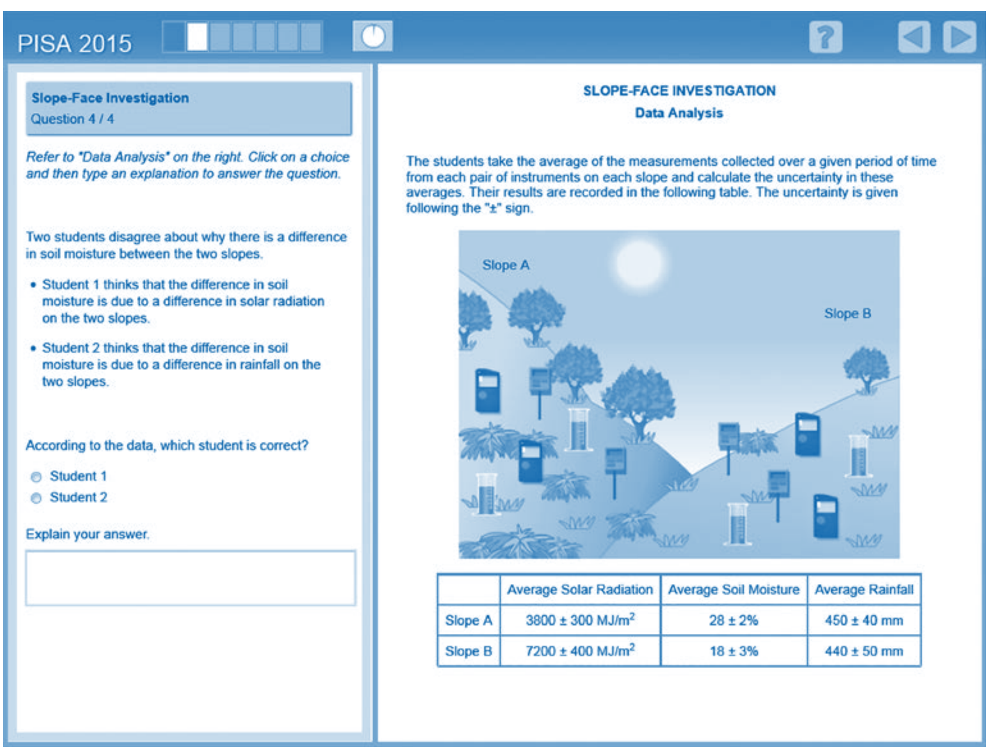
The student gives an explanation that identifies a scientific advantage of using more than one measurement instrument on each slope, e.g. correcting for variation of conditions within a slope, increasing the precision of measurement for each slope.

- So they could determine whether a difference between slopes is significant.
- Because there is likely to be variation within a slope.
- To increase the precision of the measurement for each slope.
- The data will be more accurate.
- In case one of the two malfunctions
- To compare different amounts of sun on a slope [A comparison implies that there may be variation.]

Comment

Question 1 requires students to apply epistemic knowledge to explain the design of the investigation presented in this unit. This Level 3 question allows students to demonstrate their understanding of the underlying rationale for the procedure of taking two independent measures of the phenomena being investigated. Knowledge of this rationale is the aspect of this question that assesses epistemic knowledge.

SLOPE-FACE INVESTIGATION – QUESTION 2



Question Type	Open Response – Human Coded
Competency	Interpret data and evidence scientifically
Knowledge – System	Epistemic – Earth & Space
Context	Local/ National - Natural Resources
Difficulty	589 – Level 4
Question ID	S637Q05

Scoring

Full Credit

The student selects **Student 1**

AND

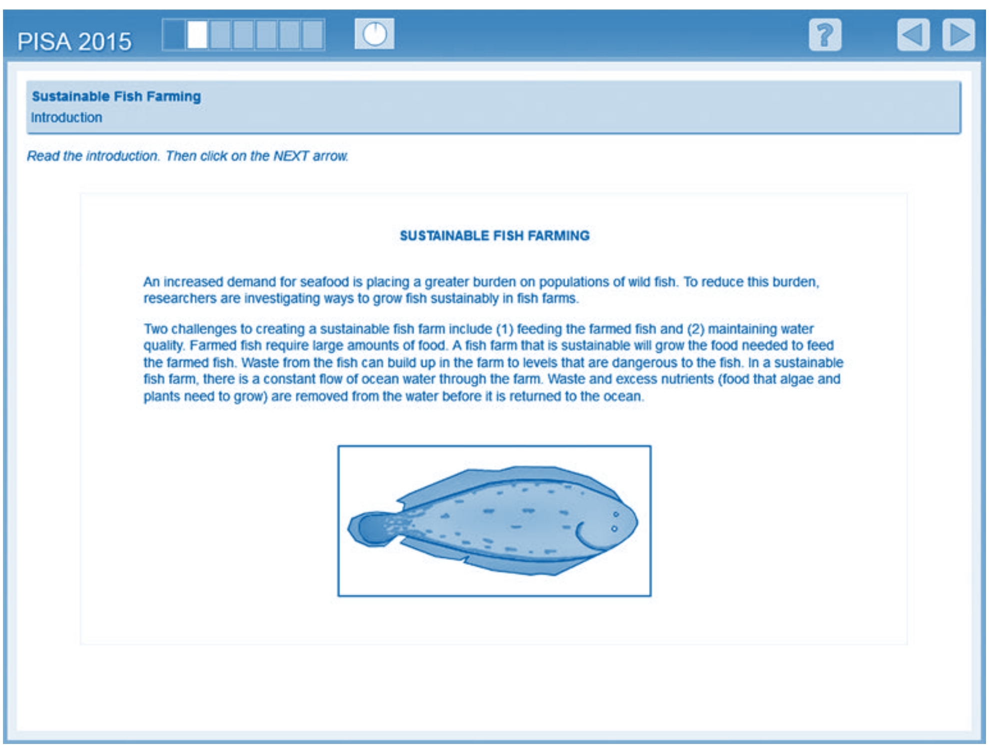
Gives an explanation that indicates that there is a difference in solar radiation between the two slopes **and/or** that rainfall does not show a difference.

- Slope B gets much more solar radiation than slope A, but the same amount of rain.
- There is no difference in the amount of rainfall the two slopes get.
- There is a big difference in how much sunlight slope A gets compared to slope B.

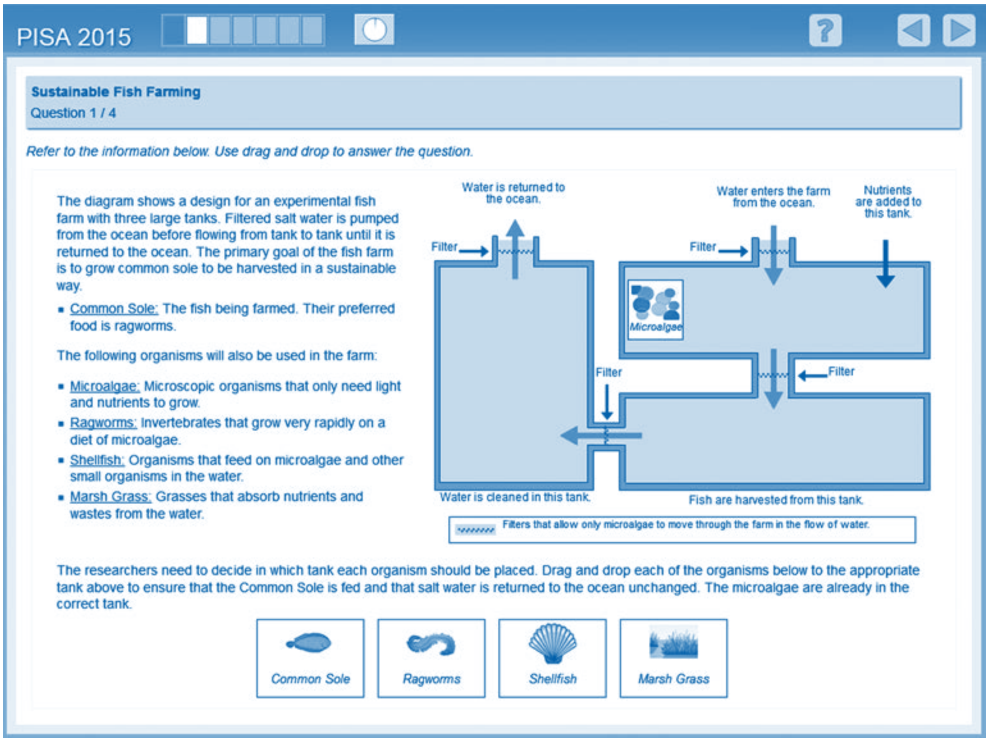
Comment

In this question, students must evaluate two claims by interpreting the provided data, which include confidence intervals around the average of measurements of solar radiation, soil moisture and rainfall. Students are asked to demonstrate an understanding of how measurement error affects the degree of confidence associated with specific scientific measurements, one major aspect of epistemic knowledge.

SUSTAINABLE FISH FARMING – INTRODUCTION



SUSTAINABLE FISH FARMING – QUESTION 1



Question Type	Complex Multiple Choice
Competency	Explain phenomena scientifically
Knowledge – System	Content – Living
Context	Local/ National – Natural Resources
Difficulty	740 – Level 6
Question ID	CS601Q01S

Scoring

Full Credit

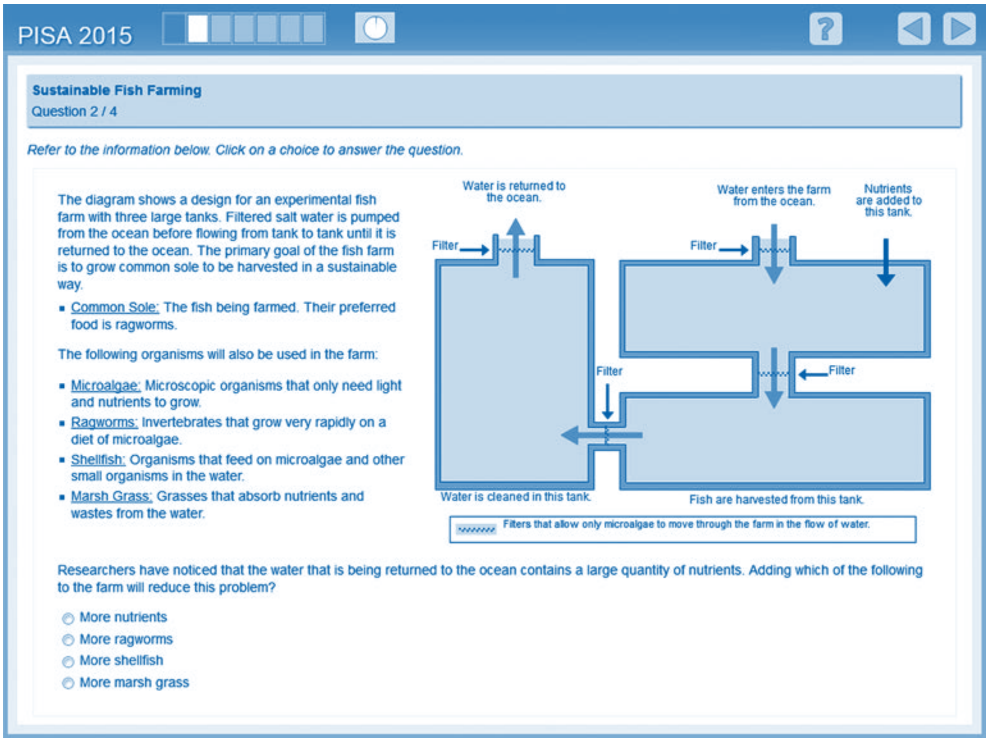
The student drags Ragworms and Common Sole into Tank 2 (bottom right) and drags.

Marsh Grass and Shellfish into Tank 3 (left).

Comment

This question requires students to understand a system and the role of several organisms within that system. In order to answer correctly, students must understand the goal of the fish farm, the function of each of the three tanks therein, and which organisms will best fulfil each function. Students must use information provided in the stimulus and the diagram, including a footnote under the diagram. An additional component that adds difficulty is the open-ended nature of the task. Any of the four organisms can be placed in any of the three tanks and there is no restriction on the number of organisms in each tank. As a result, there are multiple ways of getting this incorrect.

SUSTAINABLE FISH FARMING – QUESTION 2



Question Type	Simple Multiple Choice
Competency	Interpret data and evidence scientifically
Knowledge – System	Content – Living
Context	Local/ National – Environmental Quality
Difficulty	456 – Level 2
Question ID	CS601Q02S

Scoring

Full Credit

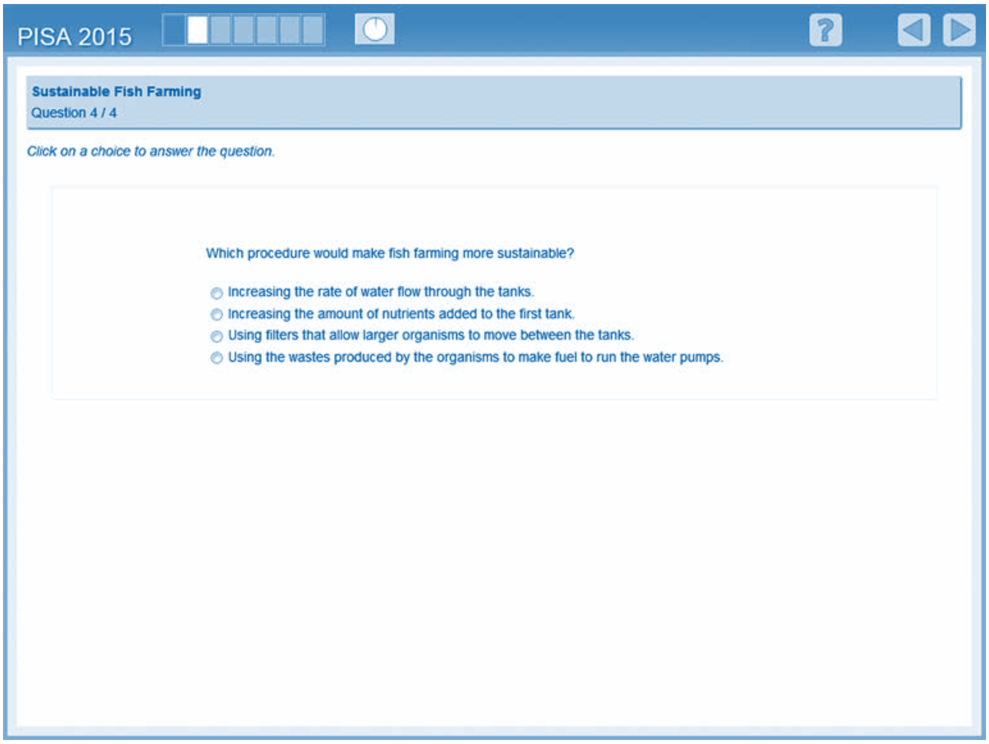
The student selects:

More marsh grass.

Comment

For question 2, which is at Level 2, students only need to identify which of the listed organisms will reduce the large number of nutrients being released to the ocean from the fish farm, based on descriptions of each organism. As the question does not require the construction of an explanation, it focuses on the ability to interpret data and evidence scientifically.

SUSTAINABLE FISH FARMING – QUESTION 3[2]



Question Type	Simple Multiple Choice
Competency	Explain phenomena scientifically
Knowledge – System	Content – Physical
Context	Local/ National – Environmental Quality
Difficulty	585 – Level 4
Question ID	CS601Q04S

Scoring

Full Credit

The student selects:

Using the wastes produced by the organisms to make fuel to run the water pumps.

Comment

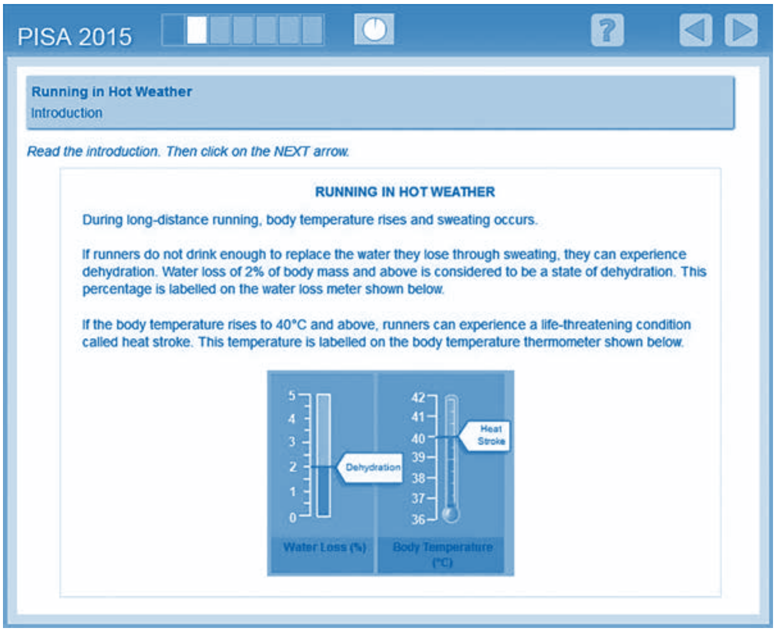
Question 3 asks students to use their understanding of the system provided in this unit and the explanation of what it means to be "sustainable" in this context in order to identify how the system could be modified to be more sustainable.

2. In the PISA 2015 main survey, this is the third question in this unit. In the field trial, another question appeared before this question, which explains why the question id identifies this as "Q04".

Field trial items

RUNNING IN HOT WEATHER – INTRODUCTION

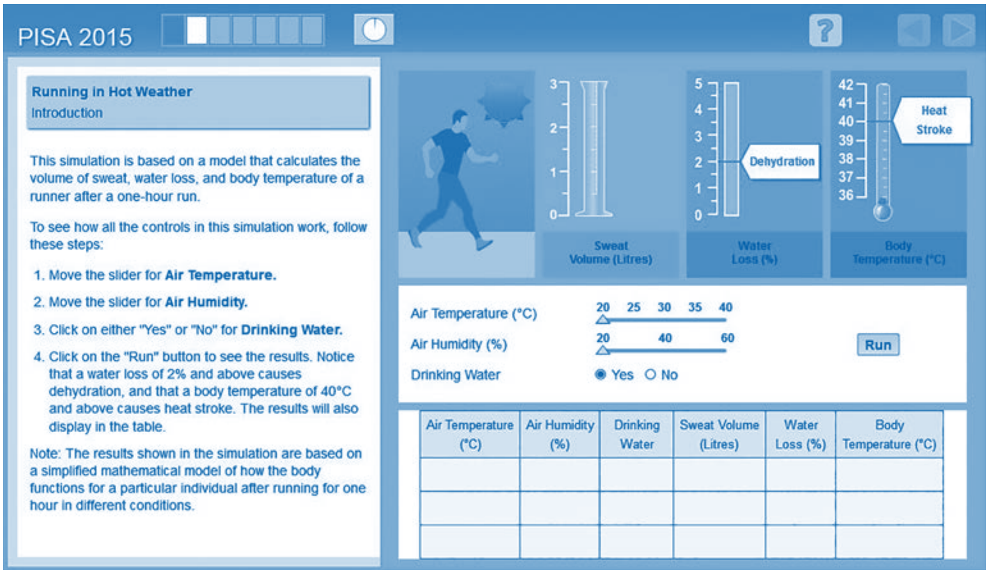
This unit presents a scientific enquiry about thermoregulation in the context of long-distance runners training in a location where weather conditions are sometimes hot and/or humid. The simulation allows students to manipulate the air temperature and air humidity levels, as well as whether or not the simulated runner drinks water.



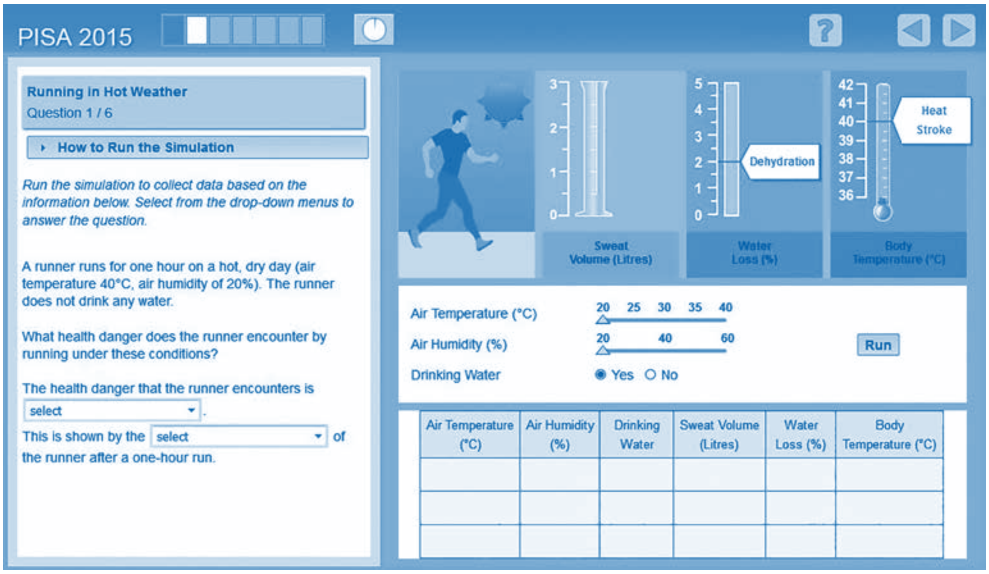
For each trial, data associated with the selected variables are displayed, including: air temperature, air humidity, drinking water (yes/no), sweat volume, water loss and body temperature. The runner's sweat volume, water loss and body temperature are also displayed on the top panel in the simulation panel. When the conditions trigger dehydration or heat stroke those health dangers are highlighted with red flags.

RUNNING IN HOT WEATHER – PRACTICE

Before beginning the unit, students are introduced to the simulation controls and asked to practice setting each control. Help messages are displayed if students do not perform the requested actions within 1 minute. If students time-out by not acting within 2 minutes, they are shown what the simulation would look like if the controls were set as specified in the provided instructions. As explained in the orientation that students take before beginning the Science section, reminders about how to use the controls, as well as how to select or delete a row of data are available on each question screen by clicking on the "How to Run the Simulation" tab in the left pane.



RUNNING IN HOT WEATHER – QUESTION 1



Students are asked to use the simulation and the data they generate to identify whether the person running under the specified 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.

Question Type	Complex Multiple Choice
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Procedural - Living
Context	Personal – Health and Disease
Difficulty	497 – Level 3

Scoring

Full Credit

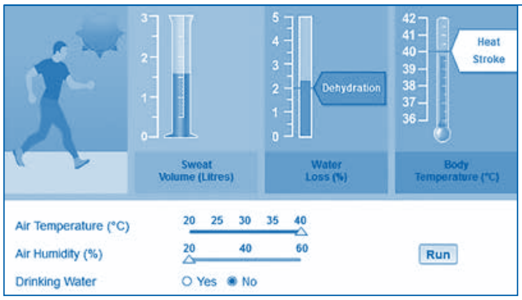
The student selects:

The health danger that the runner encounters is (<u>dehydration</u>/heat stroke).[3]

This is shown by the (sweat volume/<u>water loss</u>/body temperature) of the runner after a one-hour run.

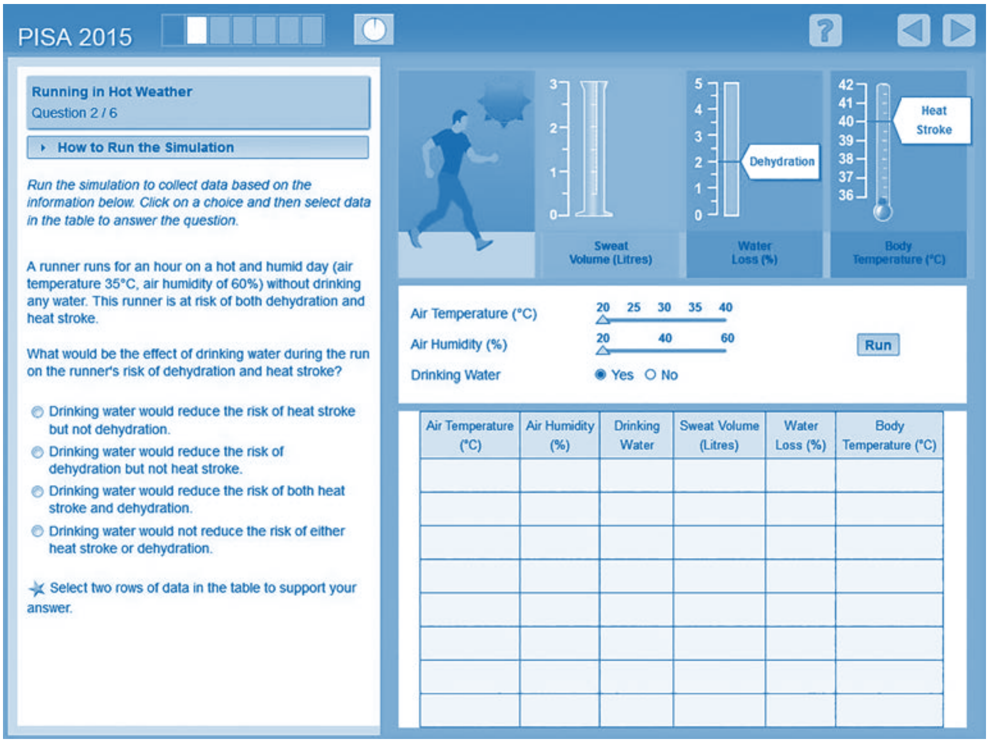
Comment

In this question, students are provided with the specific values for each of the variables in the simulation. They must set the controls as specified and run the simulation once. A red flag is displayed indicating that, under these conditions, the runner would suffer from water loss leading to dehydration. This is the easiest question in the unit, requiring students to carry out a straightforward procedure, identify the flagged condition in the display as shown below, and interpret the display to correctly identify water loss as the cause of the runner's dehydration.



3. Note that underlining indicates the correct response.

RUNNING IN HOT WEATHER – QUESTION 2



Question Type	Simple Multiple Choice/Open Response
Competency	Interpret Data and Evidence Scientifically
Knowledge – System	Content – Living
Context	Personal – Health and Disease
Difficulty	580 – Level 4

Scoring

Full Credit

The student selects:

Drinking water would reduce the risk of dehydration but not heat stroke AND selects the following two rows in the data table:

- Air temperature set to 35° C, 60% air humidity and "No" for drinking water AND
- Air temperature set to 35° C, 60% air humidity and "Yes" for drinking water

Partial Credit

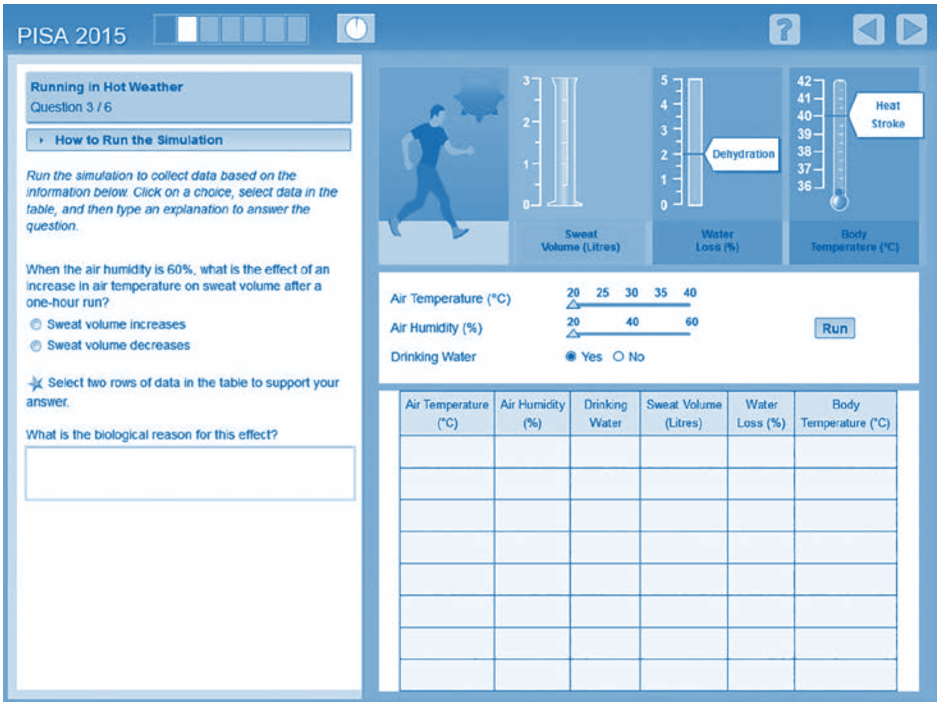
The student selects:

Drinking water would reduce the risk of dehydration but not heat stroke AND selects incorrect or incomplete data.

Comment

In question 2, students are asked to run the simulation holding the air temperature and humidity constant using specified values, and they must manipulate the variable of whether or not the runner drinks water. The simulation shows that running under the specified conditions without drinking water leads to both dehydration and heat stroke. In contrast, drinking water reduces the risk of dehydration but not the risk of heat stroke. Students must run the simulation twice in order to collect the data that supports their answer. Because students must manipulate one variable and compare the outcomes of two trials, this question is more difficult than the first question in the unit.

RUNNING IN HOT WEATHER – QUESTIONS 3A AND 3B



3A	Question Type	Multiple Choice and Open Response (select data) – Computer Scored
	Competency	Evaluate and Design Scientific Enquiry
	Knowledge – System	Procedural – Living
	Context	Personal – Health and Disease
	Difficulty	531 – Level 3

3B	Question Type	Open Response – Human Coded
	Competency	Explain Phenomena Scientifically
	Knowledge – System	Content – Living
	Context	Personal – Health and Disease
	Difficulty	641 – Level 5

Scoring

3A • Full Credit

The student selects:

Sweat volume increases

AND

The two selected rows must have air humidity of 60% and two different air temperatures selected (one lower and one higher – such as 20°C in one row and 25°C in the second or 35°C in one row and 40°C in the second, etc.) In addition, drinking water must have the same setting (either "Yes" or "No") in both of the selected rows.

3B • Full Credit

The student's response indicates or implies the function of sweat in cooling the body and/or regulating body temperature.

Sweat evaporates to cool the body when temperatures are high.

Increasing sweat levels in high temperatures keeps the body from getting too hot.

Sweat helps maintain body temperature at a safe level.

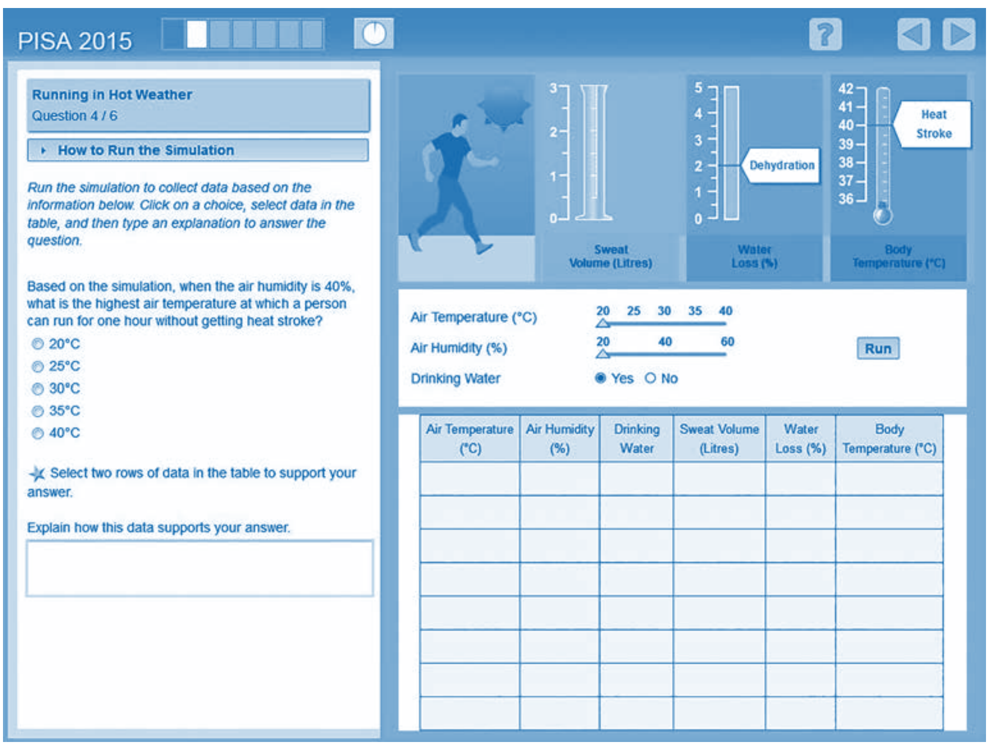
Comment

This set includes two separately coded questions: 3A is a multiple-choice question and also requires the selection of data to support that answer; 3B asks students to explain the reason that sweat volume increases under the specified conditions.

In 3A, one variable is defined – the humidity level – and students must run the simulation using at least two different temperatures to show the impact of an increase in temperature on sweat volume. Students must identify at least two rows of data in the data table that supports their answer. This question falls at Level 3.

Question 3B is the most difficult question in the unit at Level 5. It requires students to draw on their knowledge of biology (content knowledge) to explain that sweating cools the body at higher temperatures.

RUNNING IN HOT WEATHER – QUESTION 4



Question Type	Open Response – Human Coded
Competency	Evaluate and Design Scientific Enquiry
Knowledge – System	Procedural – Living
Context	Personal – Health and Disease
Difficulty	592 – Level 4

Scoring

Full Credit

The student selects *35°C*

AND

The two rows selected have 40% humidity at 35°C air temperature and 40% humidity at 40°C air temperature

AND

The student gives an explanation that indicates or implies that with humidity at 40%, 35°C is the highest air temperature that is safe from heat stroke, since moving the air temperature up from 35°C to 40°C puts the runner into heat stroke.

As the outdoor temperature goes up from 35° to 40°C, the body temperature goes above 40°, putting the runner in heat stroke.

At 40% humidity, running in 40°C air temperature leads to heat stroke, but at 35°C the runner's body temperature remains just below the level of heat stroke.

When the air temperature is increased, 40°C is the first time the runner gets heat stroke.

When humidity is 40%, the runner only gets heat stroke at 40°C. The other highest temperature is 35°C.

40°C heat stroke, not 35°C. [Minimum response]

Partial Credit

The student selects ***35°C***

AND

The two rows selected have 40% humidity at 35°C air temperature and 40% humidity at 40°C air temperature

AND

The student's explanation is missing, unclear or incorrect.

OR

The student selects ***35°C***

AND

Correct rows are not selected

AND

The student gives a correct explanation.

OR

The student selects ***40°C***

AND

The two rows selected have 40% humidity at 35°C air temperature and 40% humidity at 40°C air temperature

AND

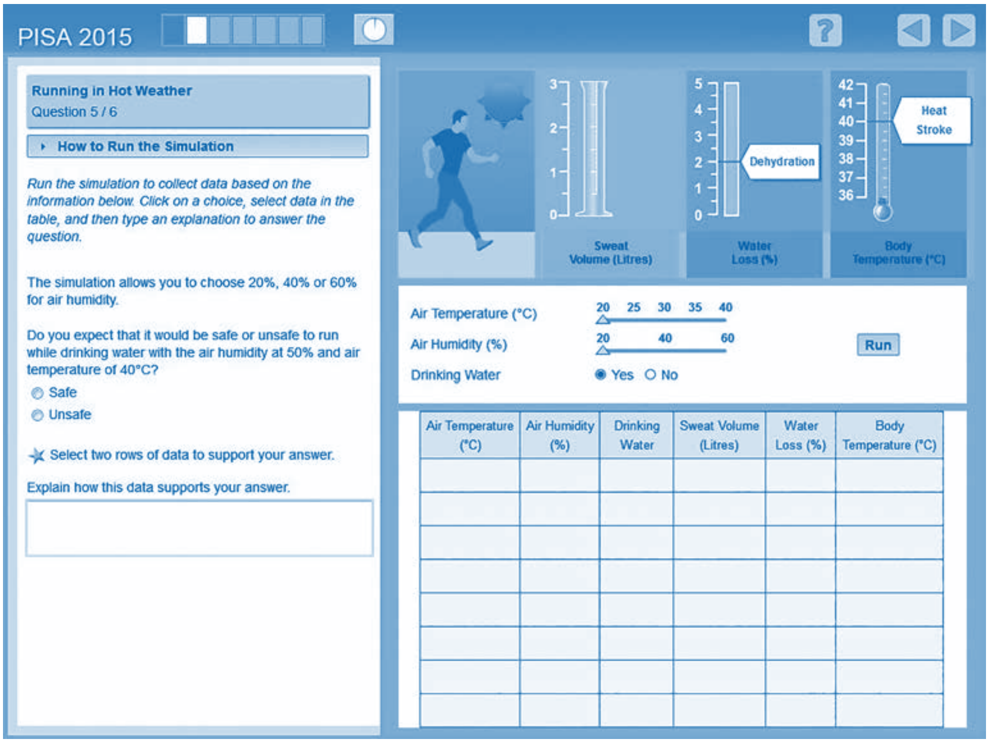
The student gives an explanation that indicates or implies that with humidity at 40%, 35°C is the highest air temperature that is safe from heat stroke.

Note: This last combination is given credit because students might simply interpret the question as: "What is the lowest temperature that is *unsafe*?"

Comment

In this question, one variable is defined. With a set air humidity of 40%, students must run at least two trials in order to determine the highest temperature at which a person can run without getting heat stroke. They must draw on procedural knowledge to explain how the data they have collected supports their answer by indicating that at 40% humidity, an air temperature higher than 35°C results in heat stroke.

RUNNING IN HOT WEATHER – QUESTION 5



Question Type	Open Response – Human Coded
Competency	Evaluate and Design Scientific Enquiry
Knowledge – System	Procedural
Context	Personal – Health and Disease
Difficulty	598 – Level 4

Scoring

Full Credit

The student selects *Unsafe*

AND

The two rows selected have:

- 40% humidity at 40°C with Drinking Water = Yes, and
- 60% humidity at 40°C with Drinking Water = Yes

AND

The student gives an explanation that indicates that with the runner suffering from heat stroke at both 40% and 60% humidity, there is a risk of heat stroke at 50% humidity in the same conditions.

With a temperature of 40°C and the drinking water, the runner will experience heat stroke at both 40% and 60% humidity, so the runner will probably experience heat stroke between those two levels of humidity, at 50%.

50% is halfway between 40% and 60%, and both those levels involve heat stroke, so 50% probably does as well.

40% is unsafe, so higher than that will be worse. [Minimum response. With a correct selection of data, this response can be read as explaining how the data supports a selection of unsafe for 50%.]

Partial Credit

The student selects ***Unsafe***

AND

The two rows selected have

40% humidity at 40°C with Drinking Water=Yes and

60% humidity at 40°C with Drinking Water=Yes

AND

The student's explanation is missing, unclear or incorrect.

OR

The student selects ***Unsafe***

AND

Correct rows are **not** selected

AND

The student gives a correct explanation referring to results from the simulation.

Comment

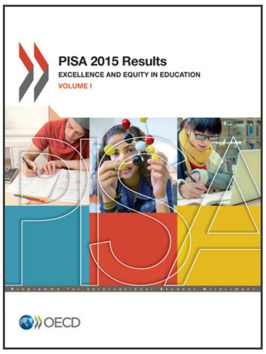
This question requires students to extrapolate beyond the data that can be directly collected through the simulation. They must develop a hypothesis about the safety of running at 40°C at 50% air humidity, where only 40% and 60% humidity levels are available in the simulation tools. The correct response is that it would be unsafe, and students must select one row with a humidity level at 40% and one at 60% with temperature and drinking water set as specified in the question in both rows. 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, it is likely that heat stroke would also occur at 50% humidity.

ANNEX C2

CLASSIFICATION AND SCALING INFORMATION OF PISA 2015 MAIN SURVEY ITEMS

All tables in Annex C2 are available on line: http://dx.doi.org/10.1787/888933433242

Table C2.1	PISA 2015 Main Survey item classification: Science trend items
Table C2.2	PISA 2015 Main Survey item classification: Science new items
Table C2.3	PISA 2015 Main Survey item classification: Reading items
Table C2.4	PISA 2015 Main Survey item classification: Mathematics items



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