



8

---

## RELEASED SCIENCE ITEMS

---

This book contains the released Trends in International Mathematics and Science Study (TIMSS) 2011 grade 8 science assessment items. This is not a complete set of all TIMSS 2011 assessment items because some items are kept confidential so that they may be used in subsequent cycles of TIMSS to measure trends.

### How Can This Set of Released Items Be Used?

**In Teacher-designed Assessments.** The items in this book present different ways of measuring students' understanding in various content and cognitive domains. A teacher may use these items to create an assessment according to the needs of the class after reviewing the items and selecting items of interest.

**For Feedback on Student Understanding.** Student responses can be scored according to the scoring information provided in the book. Items that coincide with concepts taught in class allow the teacher to gain feedback on the students' understanding of assessed concepts. For example, a teacher might decide to examine the incorrect or partially correct responses of the class. The teacher might use the items to identify particular difficulties or misconceptions experienced by individual students, which can serve as the basis for some remedial teaching or focused practice.

**To Benchmark Student Performance.** The teacher might also compare the percent of students in the class who responded correctly to an item with the percent of students who responded correctly to the same item in other education systems or in the United States.

TIMSS and PIRLS are copyrighted and are registered trademarks of IEA. Released items from TIMSS and PIRLS assessments are for non-commercial, educational, and research purposes only. Translated versions of items remain the intellectual property of IEA. Although the items are in the public domain, please print an acknowledgement of the source, including the year and name of the assessment you are using. If you publish any part of the released items from TIMSS 2011, please use the following acknowledgement:

SOURCE: TIMSS 2011 Assessment. Copyright © 2013 International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College, Chestnut Hill, MA and International Association for the Evaluation of Educational Achievement (IEA), IEA Secretariat, Amsterdam, the Netherlands.

This book contains TIMSS 2011 released items for grade 8. Each item appears on a single page, on which is provided information about the item's classification and about international student performance on the item. The items appear in the content domain order, as shown in the index on the next page.

### Information about item classification

Take a look at the first item on page 1. Across the top are three boxes which identify the item's **content domain** (the subject matter in science that the item assesses), its **main topic** (the specific topic assessed within that subject matter), and its **cognitive domain** (the cognitive or thinking process assessed). For this item, the content domain is biology, the main topic is characteristics, classification and life processes of organisms, and the cognitive domain is knowing.

Below the row of boxes and above a boxed-in area of the page is the **item label**. For this item, it is *One function of the uterus*. Below the boxed-in area is the item number, which is more commonly used to identify each item than the item label. Within the boxed-in area is the item as it appeared in student test booklets.

**Correct answers** are shown beneath each item. The correct answer for multiple-choice items is simply a letter code. For example, in the item *S032087* on page 3, the letter code C is the correct answer. The correct answers for write-in or open-ended items are explained in a scoring guide. For example, *One function of the uterus* (page 1), provides an example of a scoring guide, indicating the general nature of correct and incorrect

responses. In some cases, partial credit may be awarded and these items will provide guidelines for fully correct, partially correct, and incorrect responses. Sample student responses are provided for some of the constructed-response items for each scoring category.

### Information about international student performance

In the table along the right-hand side of the page are the **percent correct** statistics for the item. These consist of statistics on the percentage of students in each education system who could answer the question correctly. The lists of education systems are ordered in terms of this percentage. The international average is included as well.

To the right of some of the percent correct statistics are **special symbols** that indicate when an education system scored significantly higher or significantly lower than the international average. Thus, on the item *One function of the uterus* as an example, an estimated 46 percent of U.S. students could correctly answer this item; a percentage that was measurably higher than the international average, after taking into account the standard of error associated with the percent correct statistic for the United States and for the international average.



# ITEM INDEX

## Grade 8

| Content Domain   | Page  | Content Domain               | Page  |
|------------------|---|------------------------------|---|
| <b>Biology</b>   |   | <b>Chemistry (continued)</b> |   |
| S032007          | One function of the uterus .....1                                 | S052046                      | Fire put out by blanket .....70             |
| S032087          | Long-term immunity against disease.....3                          | S052136                      | List two substances that are metal.....71   |
| S032306          | Eyes react to changes .....4                                      | S052152                      | Atoms in a crushed can .....73              |
| S032315          | Antelope population graph .....7                                  | S052254                      | Water splitting rock .....74                |
| S032451          | Difference in snail shell colors.....8                            |                              |   |
| S032465          | Cells that destroy bacteria .....10                               | <b>Physics</b>               |   |
| S032514          | Growth of algae in a lake .....11                                 | S032024                      | Energy conversion in a flashlight.....75    |
| S032530Z         | Conditions for germination-DERIVED.....12                         | S032141                      | Gravity acting on parachute jumper.....76   |
| S032542          | Classification of animals .....14                                 | S032158                      | Molecules of gas when heated .....77        |
| S032611          | Purpose of cellular respiration .....15                           | S032184                      | Bulbs in series/parallel circuit.....78     |
| S032614          | Number of kidneys son has at birth.....16                         | S032238                      | Gaps between metal rail spans .....79       |
| S032640          | Exercise is important for health .....18                          | S032272                      | Water level in heated container .....80     |
| S032645          | True statement about producers .....20                            | S032279                      | Why bottle collapses in the valley .....82  |
| S032665A         | Population in countries: predict .....21                          | S032369                      | Sound from electric bell in jar .....83     |
| S032665B         | Population in countries: land use.....23                          | S032394                      | Heat conduction through copper rod.....85   |
| S032665C         | Population in countries: pollution.....25                         | S042173Z                     | Change-stay the same-DERIVED .....86        |
| S042007          | Lungs in bird/which organ in frog.....27                          | S042197                      | Strength of a magnet .....88                |
| S042017          | Function of cell part X.....28                                    | S042238A                     | Position of thermometer .....89             |
| S042022          | CO <sub>2</sub> concentration & photosynthesis .....29            | S042238B                     | One variable kept constant.....90           |
| S042024          | Process of respiration .....31                                    | S042238C                     | Conclusion from the graph .....92           |
| S042038          | Where organisms appeared on Earth .....32                         | S042272                      | Molecules of liquid when it cools.....94    |
| S042051A         | Year of highest rabbit population .....33                         | S042274                      | Speed of light through substances.....95    |
| S042051B         | Relation of rabbit-fox populations .....35                        | S042278                      | Path of light through periscope .....96     |
| S042261          | Life function of Paramecium.....37                                | S042403                      | Find out if metal 2 is a magnet.....98      |
| S042297          | Investigation of green/red peppers.....39                         | S042404                      | Liquid on outside of pitcher.....100        |
| S042298          | Importance of removing weeds.....41                               | S042407                      | Which ice block will melt first .....102    |
| S042304          | Conclusion from pulse rate-T graph.....43                         | S052165A                     | Water wheel: Energy of tank water .....104  |
| S052030          | Water travels through a plant.....44                              | S052165B                     | Water wheel: Energy before wheel.....106    |
| S052080          | Foods diabetics should avoid .....45                              | S052165C                     | Water wheel: Faster rotation .....108       |
| S052088          | Layers of rock with fossils.....46                                | S052207                      | In which liquid would object float.....110  |
| S052091          | Mayor wants to plant trees .....47                                |                              |   |
| S052093          | Genetic makeup of twins .....49                                   | <b>Earth Science</b>         |   |
|                  |   | S032060                      | Order of steps in the water cycle .....112  |
| <b>Chemistry</b> |   | S032126                      | Volcanic eruption effects.....114           |
| S032056          | Sodium bicarbonate in vinegar.....50                              | S032151                      | Major cause of tides .....116               |
| S032156          | Solubility/temperature graphs .....52                             | S032160                      | Difference between planets and moons ..117  |
| S032502          | Diagram of water molecules .....53                                | S032463                      | Soil change due to natural causes .....118  |
| S032570          | Identify if substance is metal .....54                            | S032510                      | Material that breaks down quickly.....119   |
| S032579          | Diagram for structure of matter.....56                            | S032650Z                     | Changes at high elevations-DERIVED .....120 |
| S032679          | Energy released during a reaction .....57                         | S032651A                     | Topographic map: identify X .....122        |
| S042063          | Which rod causes the bulb to light .....59                        | S032651B                     | Topographic map: river path.....123         |
| S042073          | Formula for carbon dioxide .....60                                | S032654                      | Location of jungle .....125                 |
| S042076          | Number of atoms in H <sub>2</sub> SO <sub>4</sub> molecule ....61 | S042141                      | Where active volcanoes are found.....126    |
| S042095          | Ammonia solution mixed in vinegar .....63                         | S042215                      | Diagram of an eclipse of the moon.....127   |
| S042100          | Observations for reaction .....64                                 | S042317                      | Evaporated water ending up as rain.....128  |
| S042112          | Process in which energy absorbed.....66                           | S052032                      | Evidence continents were joined.....130     |
| S042305          | Classify element/compound/mixture .....67                         | S052106                      | Advantage of terracing method.....132       |
| S042306          | Definition of a compound .....69                                  | S052297                      | Holes in volcanic rocks .....134            |

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Characteristics, Classification, and Life Processes of Organisms | Knowing          |

### One function of the uterus

The uterus (womb) is part of the reproductive system in mammals.  
Name one function of the uterus.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 72 ▲            |
| Finland                      | 64 ▲            |
| Israel                       | 63 ▲            |
| Syrian Arab Republic         | 60 ▲            |
| Slovenia                     | 59 ▲            |
| England-GBR                  | 58 ▲            |
| Korea, Rep. of               | 57 ▲            |
| Chinese Taipei-CHN           | 54 ▲            |
| Saudi Arabia                 | 53 ▲            |
| Australia                    | 52 ▲            |
| Russian Federation           | 51 ▲            |
| Lithuania                    | 50 ▲            |
| Kazakhstan                   | 50 ▲            |
| Japan                        | 49 ▲            |
| Iran, Islamic Rep.           | 47 ▲            |
| <b>United States</b>         | <b>46 ▲</b>     |
| New Zealand                  | 46 ▲            |
| United Arab Emirates         | 46 ▲            |
| Sweden                       | 45 ▲            |
| Hong Kong-CHN                | 44              |
| Jordan                       | 42              |
| Palestinian Nat'l Auth.      | 42              |
| <b>International average</b> | <b>40</b>       |
| Chile                        | 39              |
| Norway                       | 39              |
| Bahrain                      | 39              |
| Ukraine                      | 37              |
| Macedonia, Rep. of           | 37              |
| Italy                        | 37              |
| Ghana                        | 31 ▼            |
| Georgia                      | 31 ▼            |
| Oman                         | 28 ▼            |
| Qatar                        | 28 ▼            |
| Hungary                      | 27 ▼            |
| Indonesia                    | 26 ▼            |
| Turkey                       | 25 ▼            |
| Romania                      | 24 ▼            |
| Tunisia                      | 23 ▼            |
| Morocco                      | 21 ▼            |
| Thailand                     | 20 ▼            |
| Lebanon                      | 17 ▼            |
| Malaysia                     | 11 ▼            |
| Armenia                      | 3 ▼             |

Item Number: S032007

### SCORING

#### Correct Response

- States that the embryo (fetus, baby, fertilized egg, etc.) develops in the uterus (or similar).

Examples:

The uterus protects the baby while it grows.

The baby develops from the egg inside the uterus.

- Other correct

Example: The muscles in the uterus contract and push the baby out.

#### Incorrect Response

- States a reproductive organ or function but with an incorrect/inadequate connection to the function of the uterus.
- Confuses the reproductive and urinary systems.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 65 ▲ |
| Massachusetts-USA  | 58 ▲ |
| Alberta-CAN        | 55 ▲ |
| Connecticut-USA    | 53 ▲ |
| Indiana-USA        | 53 ▲ |
| Colorado-USA       | 49 ▲ |
| Quebec-CAN         | 48 ▲ |
| North Carolina-USA | 44   |
| Dubai-UAE          | 44   |
| Florida-USA        | 43   |
| Ontario-CAN        | 41   |
| Abu Dhabi-UAE      | 39   |
| California-USA     | 38   |
| Alabama-USA        | 33   |

▲ Percent higher than International average  
▼ Percent lower than International average

One function of the uterus (continued)

S032007:

## Student Responses

### Correct Response:

To hold the child while it is  
developing

### Incorrect Response:

giving birth

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--------------|------------------|
| BIOLOGY        | Human Health | Knowing          |

## Long-term immunity against disease

Which of the following can provide the human body with long-term immunity against some diseases?

- A. antibiotics
- B. vitamins
- C. vaccines
- D. red blood cells

Item Number: S032087

Correct Response:

C

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 81 ▲            |
| Sweden                       | 75 ▲            |
| Italy                        | 74 ▲            |
| Syrian Arab Republic         | 65 ▲            |
| England-GBR                  | 64 ▲            |
| Iran, Islamic Rep. of        | 62 ▲            |
| Turkey                       | 61 ▲            |
| Tunisia                      | 59 ▲            |
| Norway                       | 57 ▲            |
| Singapore                    | 56 ▲            |
| <b>United States</b>         | <b>56 ▲</b>     |
| Australia                    | 55 ▲            |
| Russian Federation           | 55 ▲            |
| Israel                       | 53 ▲            |
| Japan                        | 53 ▲            |
| Thailand                     | 50 ▲            |
| New Zealand                  | 49 ▲            |
| Hong Kong-CHN                | 49              |
| Slovenia                     | 48              |
| Macedonia, Rep. of           | 48              |
| Chinese Taipei-CHN           | 47              |
| Lebanon                      | 47              |
| Bahrain                      | 46              |
| <b>International average</b> | <b>45</b>       |
| United Arab Emirates         | 45              |
| Chile                        | 43              |
| Georgia                      | 39 ▼            |
| Qatar                        | 37 ▼            |
| Armenia                      | 36 ▼            |
| Morocco                      | 36 ▼            |
| Hungary                      | 34 ▼            |
| Romania                      | 32 ▼            |
| Kazakhstan                   | 31 ▼            |
| Palestinian Nat'l Auth.      | 31 ▼            |
| Ukraine                      | 30 ▼            |
| Saudi Arabia                 | 28 ▼            |
| Jordan                       | 24 ▼            |
| Lithuania                    | 23 ▼            |
| Oman                         | 20 ▼            |
| Malaysia                     | 15 ▼            |
| Indonesia                    | 11 ▼            |
| Ghana                        | 8 ▼             |
| Korea, Rep. of               | —               |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 71 ▲ |
| Indiana-USA        | 66 ▲ |
| Minnesota-USA      | 65 ▲ |
| North Carolina-USA | 64 ▲ |
| Alberta-CAN        | 57 ▲ |
| Colorado-USA       | 56 ▲ |
| Florida-USA        | 56 ▲ |
| Connecticut-USA    | 54 ▲ |
| Quebec-CAN         | 54 ▲ |
| Dubai-UAE          | 51 ▲ |
| Ontario-CAN        | 50 ▲ |
| California-USA     | 48   |
| Abu Dhabi-UAE      | 43   |
| Alabama-USA        | 43   |

▲ Percent higher than International average

▼ Percent lower than International average

— Not applicable

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Characteristics, Classification, and Life Processes of Organisms | Applying         |

### Eyes react to changes

Diagram 1

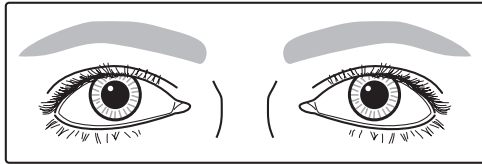
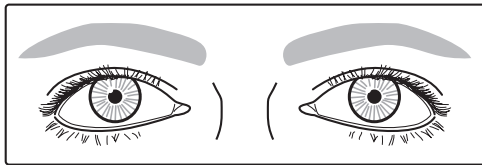


Diagram 2



Diagrams 1 and 2 illustrate the same pair of eyes that have reacted to a change in an environmental condition.

What is the environmental condition and how is it different for the eyes in Diagram 1 and Diagram 2?

Item Number: S032306

### SCORING

#### Correct Response

- Indicates LIGHT and identifies which diagram corresponds to the low/high light level.  
Diagram 1 = dim light, low light level, darkness, or similar  
Diagram 2 = bright light, high light level, or similar  
Example: There is less light in Diagram 1. The pupil has gotten larger to let in more light.
- Other fully correct

#### Partially Correct Response

- Indicates LIGHT but does not identify which diagram corresponds to low/high light level.  
Example: It is the light level. In Diagram 1, the pupils are bigger. In diagram 2 they are smaller.
- Other partially correct

#### Incorrect Response

- Indicates LIGHT but reverses the conditions in Diagrams 1 and 2.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 74 ▲            |
| Finland                      | 65 ▲            |
| Sweden                       | 63 ▲            |
| Hungary                      | 59 ▲            |
| Russian Federation           | 54 ▲            |
| Lithuania                    | 52 ▲            |
| Slovenia                     | 49 ▲            |
| New Zealand                  | 48 ▲            |
| Norway                       | 48 ▲            |
| Australia                    | 48 ▲            |
| Italy                        | 48 ▲            |
| <b>United States</b>         | <b>47 ▲</b>     |
| England-GBR                  | 46 ▲            |
| Japan                        | 45 ▲            |
| Hong Kong-CHN                | 43 ▲            |
| Chinese Taipei-CHN           | 37 ▲            |
| Ukraine                      | 35              |
| Turkey                       | 33              |
| Israel                       | 33              |
| <b>International average</b> | <b>31</b>       |
| Romania                      | 28              |
| Iran, Islamic Rep. of        | 27 ▼            |
| Singapore                    | 26 ▼            |
| Malaysia                     | 22 ▼            |
| Kazakhstan                   | 21 ▼            |
| Palestinian Nat'l Auth.      | 21 ▼            |
| United Arab Emirates         | 21 ▼            |
| Bahrain                      | 19 ▼            |
| Macedonia, Rep. of           | 19 ▼            |
| Armenia                      | 18 ▼            |
| Thailand                     | 18 ▼            |
| Chile                        | 18 ▼            |
| Tunisia                      | 17 ▼            |
| Georgia                      | 17 ▼            |
| Qatar                        | 16 ▼            |
| Syrian Arab Republic         | 16 ▼            |
| Lebanon                      | 13 ▼            |
| Oman                         | 13 ▼            |
| Jordan                       | 10 ▼            |
| Saudi Arabia                 | 7 ▼             |
| Indonesia                    | 6 ▼             |
| Morocco                      | 3 ▼             |
| Ghana                        | 2 ▼             |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 58 ▲ |
| Minnesota-USA      | 57 ▲ |
| Massachusetts-USA  | 56 ▲ |
| Colorado-USA       | 52 ▲ |
| Connecticut-USA    | 51 ▲ |
| Indiana-USA        | 47 ▲ |
| North Carolina-USA | 46 ▲ |
| Florida-USA        | 45 ▲ |
| Quebec-CAN         | 43 ▲ |
| Ontario-CAN        | 41 ▲ |
| Alabama-USA        | 37   |
| California-USA     | 37   |
| Dubai-UAE          | 33   |
| Abu Dhabi-UAE      | 17 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Eyes react to changes (continued)

S032306:

**Student Responses**

**Correct Response:**

In diagram 1 the pupils are dilated meaning it must be dark outside

**Partially Correct Response:**

The vironmental condition is the sun. If you stay in the sun a lot there will be some changes on your body including your eyes.



Eyes react to changes (continued)

S032306:

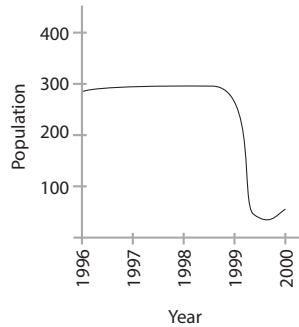
**Student Responses**

**Incorrect Response:**

diagram one would be in the sun  
Or outside with sunlight while  
diagram 2 is when you've  
been in the dark and turned  
on the lights

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Reasoning        |

Antelope population graph



The graph indicates the number of antelopes in a certain area over a period of time. Which of the following factors is most likely to have caused the sudden change in population between 1999 and 2000?

- A. global warming
- B. absence of predators
- C. depletion of the ozone layer
- D. brush fires that destroyed the food supply

Item Number: S032315

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Russian Federation           | 75 ▲            |
| Ukraine                      | 69 ▲            |
| Singapore                    | 68 ▲            |
| Finland                      | 64 ▲            |
| Malaysia                     | 64 ▲            |
| Israel                       | 63 ▲            |
| Hungary                      | 63 ▲            |
| England-GBR                  | 62 ▲            |
| Lithuania                    | 61 ▲            |
| Slovenia                     | 61 ▲            |
| <b>United States</b>         | <b>58 ▲</b>     |
| Tunisia                      | 57 ▲            |
| Chinese Taipei-CHN           | 54 ▲            |
| New Zealand                  | 54 ▲            |
| Kazakhstan                   | 54 ▲            |
| Australia                    | 54 ▲            |
| Iran, Islamic Rep. of        | 51 ▲            |
| Thailand                     | 51              |
| <b>International average</b> | <b>48</b>       |
| Indonesia                    | 47              |
| Chile                        | 46              |
| Georgia                      | 44              |
| United Arab Emirates         | 44 ▼            |
| Bahrain                      | 44              |
| Romania                      | 44 ▼            |
| Norway                       | 43 ▼            |
| Sweden                       | 42 ▼            |
| Italy                        | 42 ▼            |
| Hong Kong-CHN                | 42 ▼            |
| Saudi Arabia                 | 41 ▼            |
| Jordan                       | 40 ▼            |
| Turkey                       | 39 ▼            |
| Armenia                      | 39 ▼            |
| Morocco                      | 39 ▼            |
| Syrian Arab Republic         | 37 ▼            |
| Japan                        | 37 ▼            |
| Macedonia, Rep. of           | 35 ▼            |
| Qatar                        | 35 ▼            |
| Oman                         | 35 ▼            |
| Korea, Rep. of               | 32 ▼            |
| Ghana                        | 32 ▼            |
| Palestinian Nat'l Auth.      | 31 ▼            |
| Lebanon                      | 18 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 66 ▲ |
| Minnesota-USA      | 65 ▲ |
| Colorado-USA       | 64 ▲ |
| Indiana-USA        | 62 ▲ |
| Alberta-CAN        | 61 ▲ |
| Florida-USA        | 59 ▲ |
| North Carolina-USA | 58 ▲ |
| Connecticut-USA    | 54   |
| California-USA     | 50   |
| Quebec-CAN         | 48   |
| Alabama-USA        | 45   |
| Abu Dhabi-UAE      | 45   |
| Dubai-UAE          | 42 ▼ |
| Ontario-CAN        | 42 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                                   | Cognitive Domain |
|----------------|--|------------------|
| BIOLOGY        | Diversity, Adaptation, and Natural Selection | Applying         |

## Difference in snail shell colors

Some birds eat snails. A species of snail that lives in the forest has a dark shell. The same species of snail that lives in a field has a light-colored shell. Explain how this difference in shell colors helps the snails to survive.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Hungary                      | 79 ▲            |
| Finland                      | 79 ▲            |
| Russian Federation           | 76 ▲            |
| England-GBR                  | 76 ▲            |
| Singapore                    | 74 ▲            |
| Ukraine                      | 73 ▲            |
| Australia                    | 73 ▲            |
| <b>United States</b>         | <b>71 ▲</b>     |
| Sweden                       | 66 ▲            |
| Japan                        | 65 ▲            |
| Korea, Rep. of               | 65 ▲            |
| New Zealand                  | 65 ▲            |
| Chinese Taipei-CHN           | 62 ▲            |
| Slovenia                     | 61 ▲            |
| Hong Kong-CHN                | 61 ▲            |
| Lithuania                    | 60 ▲            |
| Norway                       | 60 ▲            |
| Israel                       | 57 ▲            |
| Thailand                     | 57 ▲            |
| Italy                        | 56 ▲            |
| Kazakhstan                   | 52 ▲            |
| Turkey                       | 50 ▲            |
| <b>International average</b> | <b>45</b>       |
| Georgia                      | 40 ▼            |
| Romania                      | 40 ▼            |
| Iran, Islamic Rep. of        | 39 ▼            |
| Chile                        | 37 ▼            |
| United Arab Emirates         | 28 ▼            |
| Armenia                      | 28 ▼            |
| Oman                         | 27 ▼            |
| Syrian Arab Republic         | 26 ▼            |
| Bahrain                      | 24 ▼            |
| Qatar                        | 22 ▼            |
| Jordan                       | 21 ▼            |
| Tunisia                      | 20 ▼            |
| Macedonia, Rep. of           | 19 ▼            |
| Indonesia                    | 16 ▼            |
| Lebanon                      | 15 ▼            |
| Malaysia                     | 15 ▼            |
| Saudi Arabia                 | 12 ▼            |
| Palestinian Nat'l Auth.      | 11 ▼            |
| Morocco                      | 3 ▼             |
| Ghana                        | 2 ▼             |

Item Number: S032451

## SCORING

## Correct Response

- Explanation refers explicitly to BOTH camouflage (blending in with surroundings, or similar) AND protection from birds, predators, enemies, etc.

Example: The snails that live in the forest have dark shells so the birds cannot see them to eat them.

- Explanation refers only to camouflage, blending in with surroundings, or similar. [Protection from predators NOT explicitly mentioned.]

Example: It helps the snail to camouflage with their surroundings.

- Other fully correct

## Partially Correct Response

- Explanation refers only to not being eaten or seen by predators. [Camouflage NOT referenced.]

Example: So the birds will not eat them.

- Other partially correct

## Incorrect Response

- Mentions only that it is dark in the forest and light in the field. [Does not explicitly refer to camouflage, protection from predators, or similar.]
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Colorado-USA       | 79 ▲ |
| Massachusetts-USA  | 78 ▲ |
| Minnesota-USA      | 77 ▲ |
| Connecticut-USA    | 76 ▲ |
| Alberta-CAN        | 75 ▲ |
| Ontario-CAN        | 74 ▲ |
| Indiana-USA        | 74 ▲ |
| North Carolina-USA | 69 ▲ |
| Florida-USA        | 66 ▲ |
| Quebec-CAN         | 65 ▲ |
| California-USA     | 64 ▲ |
| Alabama-USA        | 63 ▲ |
| Dubai-UAE          | 42   |
| Abu Dhabi-UAE      | 26 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Difference in snail shell colors (continued)

S032451:

## Student Responses

### Correct Response:

The snails are usual on grass or sand. They have to match it so that the birds will mistake it for being something else.

### Partially Correct Response:

Snails use there shells color to hide from predators

### Incorrect Response:

Because , one  
stays in sun , one  
stays in shade

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--------------|------------------|
| BIOLOGY        | Human Health | Knowing          |

## Cells that destroy bacteria

Bacteria that enter the body are destroyed by which type of cells?

- A. white blood cells
- B. red blood cells
- C. kidney cells
- D. lung cells

Item Number: S032465

Correct Response:

A

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 86 ▲            |
| Singapore                    | 84 ▲            |
| Korea, Rep. of               | 80 ▲            |
| Italy                        | 78 ▲            |
| Japan                        | 77 ▲            |
| <b>United States</b>         | <b>76 ▲</b>     |
| Sweden                       | 74 ▲            |
| Thailand                     | 73 ▲            |
| England-GBR                  | 71 ▲            |
| Iran, Islamic Rep. of        | 71 ▲            |
| Australia                    | 70 ▲            |
| Israel                       | 70 ▲            |
| Lithuania                    | 68 ▲            |
| Lebanon                      | 68 ▲            |
| Tunisia                      | 68 ▲            |
| Finland                      | 68 ▲            |
| Saudi Arabia                 | 67 ▲            |
| Kazakhstan                   | 67 ▲            |
| Hong Kong-CHN                | 66 ▲            |
| Indonesia                    | 66 ▲            |
| Hungary                      | 64              |
| New Zealand                  | 62              |
| <b>International average</b> | <b>61</b>       |
| Romania                      | 60              |
| Macedonia, Rep. of           | 60              |
| Syrian Arab Republic         | 60              |
| Russian Federation           | 59              |
| Qatar                        | 59              |
| Bahrain                      | 58              |
| United Arab Emirates         | 57 ▼            |
| Armenia                      | 55 ▼            |
| Malaysia                     | 54 ▼            |
| Norway                       | 54 ▼            |
| Palestinian Nat'l Auth.      | 52 ▼            |
| Chile                        | 48 ▼            |
| Jordan                       | 48 ▼            |
| Oman                         | 43 ▼            |
| Ukraine                      | 42 ▼            |
| Ghana                        | 40 ▼            |
| Turkey                       | 37 ▼            |
| Georgia                      | 35 ▼            |
| Morocco                      | 31 ▼            |
| Slovenia                     | 30 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Indiana-USA        | 85 ▲ |
| Minnesota-USA      | 84 ▲ |
| Massachusetts-USA  | 79 ▲ |
| Connecticut-USA    | 79 ▲ |
| North Carolina-USA | 79 ▲ |
| Florida-USA        | 78 ▲ |
| Alberta-CAN        | 77 ▲ |
| Ontario-CAN        | 77 ▲ |
| Colorado-USA       | 76 ▲ |
| Alabama-USA        | 74 ▲ |
| Dubai-UAE          | 70 ▲ |
| California-USA     | 69 ▲ |
| Quebec-CAN         | 60   |
| Abu Dhabi-UAE      | 56 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Applying         |

## Growth of algae in a lake

In a lake near a farm the growth of algae suddenly increased. This increase was most likely due to which of the following?

- A. a decrease in air temperature
- B. a decrease in water level
- C. fertilizer runoff from the farm
- D. exhaust gases from farm equipment

Item Number: S032514

Correct Response:

C

## Overall Percent Correct

| Education system        | Percent correct |
|-------------------------|-----------------|
| Finland                 | 74 ▲            |
| Chinese Taipei-CHN      | 67 ▲            |
| Georgia                 | 65 ▲            |
| Slovenia                | 64 ▲            |
| Hong Kong-CHN           | 61 ▲            |
| Romania                 | 60 ▲            |
| Sweden                  | 59 ▲            |
| Japan                   | 59 ▲            |
| Israel                  | 57 ▲            |
| Ukraine                 | 56 ▲            |
| Kazakhstan              | 55 ▲            |
| Thailand                | 54 ▲            |
| Russian Federation      | 52 ▲            |
| Norway                  | 52              |
| Singapore               | 52 ▲            |
| Lithuania               | 50              |
| Hungary                 | 50              |
| Jordan                  | 49              |
| Korea, Rep. of          | 49              |
| <b>United States</b>    | <b>48</b>       |
| International average   | 47              |
| Italy                   | 47              |
| Chile                   | 47              |
| Malaysia                | 46              |
| Tunisia                 | 46              |
| Macedonia, Rep. of      | 45              |
| Turkey                  | 43 ▼            |
| Indonesia               | 43 ▼            |
| Oman                    | 41 ▼            |
| New Zealand             | 40 ▼            |
| England-GBR             | 40 ▼            |
| Syrian Arab Republic    | 40 ▼            |
| Saudi Arabia            | 39 ▼            |
| United Arab Emirates    | 39 ▼            |
| Palestinian Nat'l Auth. | 39 ▼            |
| Bahrain                 | 36 ▼            |
| Qatar                   | 36 ▼            |
| Armenia                 | 35 ▼            |
| Iran, Islamic Rep. of   | 35 ▼            |
| Australia               | 34 ▼            |
| Morocco                 | 31 ▼            |
| Ghana                   | 30 ▼            |
| Lebanon                 | 27 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| North Carolina-USA | 72 ▲ |
| Minnesota-USA      | 63 ▲ |
| Quebec-CAN         | 60 ▲ |
| Massachusetts-USA  | 57   |
| Florida-USA        | 57   |
| Connecticut-USA    | 53   |
| Indiana-USA        | 53   |
| Colorado-USA       | 51   |
| Alberta-CAN        | 48   |
| Dubai-UAE          | 40 ▼ |
| Ontario-CAN        | 39 ▼ |
| Alabama-USA        | 39 ▼ |
| California-USA     | 38 ▼ |
| Abu Dhabi-UAE      | 36 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| <b>BIOLOGY</b> | Life Cycles, Reproduction, and Heredity | Knowing          |

## Conditions for germination-DERIVED

Many seeds can germinate in the light or in the dark.  
State two conditions necessary for germination.

1.

2.

## Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Singapore                      | 55 ▲            |
| Kazakhstan                     | 46 ▲            |
| Japan                          | 40 ▲            |
| Russian Federation             | 38 ▲            |
| Lithuania                      | 36 ▲            |
| Ukraine                        | 32 ▲            |
| Slovenia                       | 32 ▲            |
| Tunisia                        | 29 ▲            |
| England-GBR                    | 26 ▲            |
| Hong Kong-CHN                  | 26 ▲            |
| Korea, Rep. of                 | 26 ▲            |
| Georgia                        | 25 ▲            |
| Romania                        | 23              |
| Armenia                        | 23              |
| Macedonia, Rep. of             | 23              |
| Israel                         | 22              |
| Bahrain                        | 21              |
| Chinese Taipei-CHN             | 21              |
| <b>International average</b>   | <b>21</b>       |
| Turkey                         | 20              |
| Ghana                          | 20              |
| Finland                        | 20              |
| New Zealand                    | 20              |
| Sweden                         | 18              |
| Norway                         | 17              |
| Hungary                        | 16 ▼            |
| United Arab Emirates           | 15 ▼            |
| Syrian Arab Republic           | 14 ▼            |
| Malaysia                       | 14 ▼            |
| Chile                          | 13 ▼            |
| Jordan                         | 13 ▼            |
| Iran, Islamic Rep. of          | 13 ▼            |
| Morocco                        | 13 ▼            |
| Qatar                          | 12 ▼            |
| Saudi Arabia                   | 11 ▼            |
| Australia                      | 11 ▼            |
| <b>United States</b>           | <b>11 ▼</b>     |
| <i>Palestinian Nat'l Auth.</i> | 11 ▼            |
| Lebanon                        | 10 ▼            |
| Italy                          | 10 ▼            |
| Thailand                       | 7 ▼             |
| Oman                           | 7 ▼             |
| Indonesia                      | 4 ▼             |

Item Number: S032530Z

## SCORING

Note: Each of the two responses are scored separately. However, if the two responses are essentially the same, the second response should be scored as "Incorrect Response".

## Correct Response

- Water (moisture, rain) or similar.

Example: Humid conditions

- Suitable temperature (heat, warmth) or similar.

Example: Heat about 27° C

- Oxygen (air).
- Other correct

## Incorrect Response

- Soil or similar.
- Sun, sunlight, or light (no explicit mention of heat, warmth or similar).
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Dubai-UAE          | 20   |
| Quebec-CAN         | 18   |
| Alberta-CAN        | 15 ▼ |
| Connecticut-USA    | 15 ▼ |
| Abu Dhabi-UAE      | 15 ▼ |
| Massachusetts-USA  | 15 ▼ |
| Indiana-USA        | 13 ▼ |
| Colorado-USA       | 13 ▼ |
| Minnesota-USA      | 12 ▼ |
| California-USA     | 11 ▼ |
| North Carolina-USA | 11 ▼ |
| Alabama-USA        | 11 ▼ |
| Ontario-CAN        | 10 ▼ |
| Florida-USA        | 8 ▼  |

▲ Percent higher than International average  
▼ Percent lower than International average

Conditions for germination (continued)

S032530Z:

## Student Responses

### Correct Response:

1. WATER

2. AIR

### Incorrect Response:

1. underground germs

2. surface germs



| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Characteristics, Classification, and Life Processes of Organisms | Applying         |

Classification of animals

The following table shows the classification of some animals into two categories.

| Category 1 | Category 2 |
|------------|------------|
| rabbit     | frog       |
| giraffe    | spider     |
| elephant   | lion       |

Which of the following was used to classify these animals?

- A. organs used in breathing
- B. food source
- C. method of reproduction
- D. pattern of movement

Item Number: S032542

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>B</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 76 ▲            |
| Chinese Taipei-CHN           | 73 ▲            |
| Finland                      | 71 ▲            |
| Japan                        | 70 ▲            |
| Korea, Rep. of               | 68 ▲            |
| Slovenia                     | 68 ▲            |
| Hungary                      | 67 ▲            |
| Russian Federation           | 64 ▲            |
| Hong Kong-CHN                | 59 ▲            |
| Italy                        | 58 ▲            |
| Israel                       | 54              |
| Sweden                       | 53 ▲            |
| Turkey                       | 52              |
| Lithuania                    | 52              |
| Thailand                     | 52              |
| Tunisia                      | 51              |
| Ukraine                      | 51              |
| Norway                       | 51              |
| Australia                    | 50              |
| <b>International average</b> | <b>49</b>       |
| Chile                        | 49              |
| Syrian Arab Republic         | 49              |
| New Zealand                  | 49              |
| <b>United States</b>         | <b>45 ▼</b>     |
| Malaysia                     | 45 ▼            |
| England-GBR                  | 45              |
| Qatar                        | 45              |
| Lebanon                      | 45              |
| Bahrain                      | 44 ▼            |
| Romania                      | 43 ▼            |
| Morocco                      | 43 ▼            |
| United Arab Emirates         | 42 ▼            |
| Palestinian Nat'l Auth.      | 41 ▼            |
| Oman                         | 40 ▼            |
| Macedonia, Rep. of           | 37 ▼            |
| Iran, Islamic Rep. of        | 37 ▼            |
| Kazakhstan                   | 36 ▼            |
| Saudi Arabia                 | 36 ▼            |
| Jordan                       | 36 ▼            |
| Indonesia                    | 34 ▼            |
| Armenia                      | 33 ▼            |
| Georgia                      | 31 ▼            |
| Ghana                        | 28 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 57 ▲ |
| Alberta-CAN        | 55 ▲ |
| Quebec-CAN         | 52   |
| Colorado-USA       | 50   |
| Minnesota-USA      | 48   |
| Florida-USA        | 46   |
| Connecticut-USA    | 46   |
| Dubai-UAE          | 45 ▼ |
| Ontario-CAN        | 44 ▼ |
| California-USA     | 41 ▼ |
| Abu Dhabi-UAE      | 41 ▼ |
| North Carolina-USA | 40 ▼ |
| Indiana-USA        | 38 ▼ |
| Alabama-USA        | 36 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| BIOLOGY        | Cells and Their Functions | Knowing          |

Purpose of cellular respiration

Which of the following best describes the purpose of cellular respiration?

- A. to provide energy for cell activities
- B. to produce sugar for storage in cells
- C. to release oxygen for breathing
- D. to supply carbon dioxide for photosynthesis

Item Number: S032611

|                   |   |
|-------------------|---|
| Correct Response: | A |
|-------------------|---|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 66 ▲            |
| Russian Federation           | 62 ▲            |
| Singapore                    | 58 ▲            |
| Japan                        | 56 ▲            |
| Israel                       | 48 ▲            |
| Chinese Taipei-CHN           | 47 ▲            |
| Turkey                       | 46 ▲            |
| Hong Kong-CHN                | 45 ▲            |
| Lithuania                    | 43 ▲            |
| Italy                        | 42 ▲            |
| United Arab Emirates         | 40 ▲            |
| Australia                    | 39              |
| Slovenia                     | 38              |
| Saudi Arabia                 | 37              |
| Macedonia, Rep. of           | 36              |
| Ukraine                      | 36              |
| England-GBR                  | 35              |
| <b>International average</b> | <b>35</b>       |
| Chile                        | 35              |
| Malaysia                     | 34              |
| Ghana                        | 34              |
| Norway                       | 34              |
| Tunisia                      | 33              |
| Qatar                        | 33              |
| Sweden                       | 33              |
| Oman                         | 32 ▼            |
| Lebanon                      | 32              |
| Iran, Islamic Rep. of        | 32              |
| Indonesia                    | 31              |
| Bahrain                      | 31 ▼            |
| Finland                      | 30 ▼            |
| <b>United States</b>         | <b>30 ▼</b>     |
| New Zealand                  | 29 ▼            |
| Palestinian Nat'l Auth.      | 26 ▼            |
| Armenia                      | 24 ▼            |
| Morocco                      | 24 ▼            |
| Syrian Arab Republic         | 23 ▼            |
| Romania                      | 23 ▼            |
| Hungary                      | 23 ▼            |
| Georgia                      | 21 ▼            |
| Kazakhstan                   | 20 ▼            |
| Thailand                     | 19 ▼            |
| Jordan                       | 17 ▼            |

| Benchmarking education system | Percent correct |
|-------------------------------|-----------------|
| North Carolina-USA            | 43 ▲            |
| Dubai-UAE                     | 43 ▲            |
| Abu Dhabi-UAE                 | 41 ▲            |
| Massachusetts-USA             | 41              |
| Minnesota-USA                 | 39              |
| Connecticut-USA               | 36              |
| Colorado-USA                  | 34              |
| California-USA                | 34              |
| Ontario-CAN                   | 33              |
| Indiana-USA                   | 33              |
| Alabama-USA                   | 31              |
| Alberta-CAN                   | 31 ▼            |
| Florida-USA                   | 30              |
| Quebec-CAN                    | 26 ▼            |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| <b>BIOLOGY</b> | Life Cycles, Reproduction, and Heredity | Applying         |

### Number of kidneys son has at birth

Kidneys are organs found in the human body. When he was young, a man had one of his two kidneys removed because it was diseased. He now has a son.

A. How many kidneys did his son have at birth? \_\_\_\_\_

B. Explain your answer.

### Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Korea, Rep. of                 | 75 ▲            |
| Singapore                      | 75 ▲            |
| <b>United States</b>           | <b>75 ▲</b>     |
| <i>Chinese Taipei-CHN</i>      | 72 ▲            |
| Slovenia                       | 71 ▲            |
| Finland                        | 71 ▲            |
| Hungary                        | 70 ▲            |
| Sweden                         | 68 ▲            |
| Japan                          | 67 ▲            |
| Russian Federation             | 67 ▲            |
| Kazakhstan                     | 67 ▲            |
| <i>Hong Kong-CHN</i>           | 66 ▲            |
| Australia                      | 65 ▲            |
| <i>England-GBR</i>             | 65 ▲            |
| Israel                         | 64 ▲            |
| Lithuania                      | 64 ▲            |
| New Zealand                    | 63 ▲            |
| Norway                         | 60 ▲            |
| Italy                          | 60 ▲            |
| Chile                          | 59 ▲            |
| Ukraine                        | 57              |
| Iran, Islamic Rep. of          | 56              |
| Romania                        | 56              |
| Turkey                         | 54              |
| <b>International average</b>   | <b>53</b>       |
| Jordan                         | 53              |
| Saudi Arabia                   | 51              |
| Thailand                       | 49              |
| Armenia                        | 45 ▼            |
| United Arab Emirates           | 41 ▼            |
| <i>Palestinian Nat'l Auth.</i> | 40 ▼            |
| Bahrain                        | 40 ▼            |
| Tunisia                        | 40 ▼            |
| Georgia                        | 39 ▼            |
| Indonesia                      | 39 ▼            |
| Syrian Arab Republic           | 36 ▼            |
| Macedonia, Rep. of             | 34 ▼            |
| Qatar                          | 32 ▼            |
| Oman                           | 32 ▼            |
| Malaysia                       | 30 ▼            |
| Lebanon                        | 24 ▼            |
| Morocco                        | 24 ▼            |
| Ghana                          | 18 ▼            |

Item Number: S032614

### SCORING

#### Correct Response

- TWO with an explanation based on the removal of a kidney not being a hereditary trait (or similar).

Examples:

Removal of his kidney is not in his genes, so it will not be passed on.

It's not hereditary.

- TWO with an explanation based on all humans (normally) having two kidneys at birth (or similar). [No explicit mention of heredity.]

Examples:

Everybody is born with two kidneys unless they have a disease.

His child would still have the normal number, which is 2.

- Other correct

#### Incorrect Response

- ONE with or without explanation.
- TWO with no explanation or an incorrect explanation.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

#### Benchmarking education system

|                           |      |
|---------------------------|------|
| <i>Indiana-USA</i>        | 81 ▲ |
| <i>Massachusetts-USA</i>  | 81 ▲ |
| <i>Minnesota-USA</i>      | 80 ▲ |
| <i>Colorado-USA</i>       | 79 ▲ |
| <i>North Carolina-USA</i> | 76 ▲ |
| <i>Florida-USA</i>        | 75 ▲ |
| <i>Connecticut-USA</i>    | 72 ▲ |
| <i>Quebec-CAN</i>         | 70 ▲ |
| <i>California-USA</i>     | 69 ▲ |
| <i>Ontario-CAN</i>        | 67 ▲ |
| <i>Alabama-USA</i>        | 66 ▲ |
| <i>Alberta-CAN</i>        | 66 ▲ |
| <i>Dubai-UAE</i>          | 45 ▼ |
| <i>Abu Dhabi-UAE</i>      | 44 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Number of kidneys son has at birth (continued)

S032614:

## Student Responses

### Correct Response:

How many kidneys did his son have at birth? 2

Explain your answer.

everyone has 2 kidneys

### Incorrect Response:

How many kidneys did his son have at birth? two

Explain your answer.

he has two because the mother makes up the child also.

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--------------|------------------|
| BIOLOGY        | Human Health | Knowing          |

## Exercise is important for health

State one reason why exercise is important for good health.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| England-GBR                  | 74 ▲            |
| Hungary                      | 73 ▲            |
| Slovenia                     | 70 ▲            |
| Hong Kong-CHN                | 69 ▲            |
| Finland                      | 68 ▲            |
| Sweden                       | 66 ▲            |
| <b>United States</b>         | <b>66 ▲</b>     |
| Australia                    | 65 ▲            |
| Kazakhstan                   | 65 ▲            |
| Jordan                       | 65 ▲            |
| Japan                        | 65 ▲            |
| Singapore                    | 64 ▲            |
| Chinese Taipei-CHN           | 62 ▲            |
| New Zealand                  | 60 ▲            |
| Norway                       | 60 ▲            |
| Italy                        | 59 ▲            |
| Israel                       | 59 ▲            |
| Bahrain                      | 58 ▲            |
| Chile                        | 58 ▲            |
| Saudi Arabia                 | 58 ▲            |
| Turkey                       | 55              |
| Korea, Rep. of               | 54              |
| United Arab Emirates         | 53              |
| Iran, Islamic Rep. of        | 53              |
| <b>International average</b> | <b>53</b>       |
| Russian Federation           | 52              |
| Syrian Arab Republic         | 52              |
| Palestinian Nat'l Auth.      | 50              |
| Qatar                        | 49              |
| Romania                      | 49 ▼            |
| Armenia                      | 47 ▼            |
| Tunisia                      | 47 ▼            |
| Lithuania                    | 46 ▼            |
| Thailand                     | 46 ▼            |
| Georgia                      | 43 ▼            |
| Oman                         | 41 ▼            |
| Indonesia                    | 40 ▼            |
| Ukraine                      | 38 ▼            |
| Malaysia                     | 36 ▼            |
| Morocco                      | 32 ▼            |
| Macedonia, Rep. of           | 28 ▼            |
| Lebanon                      | 23 ▼            |
| Ghana                        | 12 ▼            |

Item Number: S032640

## SCORING

## Correct Response

- States weight loss, preventing fat storage, lowering cholesterol, or similar.  
Example: It burns fat.
- States that exercise is beneficial for the heart, circulation, oxygen levels, or similar.  
Example: It keeps your heart in good condition so you don't have heart attacks.
- States building muscle strength/tone or similar.  
Example: It helps build muscle.
- Other correct

## Incorrect Response

- Gives only a general response related to staying healthy, fit, being strong, or similar.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 77 ▲ |
| Connecticut-USA    | 75 ▲ |
| Colorado-USA       | 74 ▲ |
| Ontario-CAN        | 72 ▲ |
| Minnesota-USA      | 71 ▲ |
| Alberta-CAN        | 71 ▲ |
| North Carolina-USA | 68 ▲ |
| Florida-USA        | 66 ▲ |
| Indiana-USA        | 66 ▲ |
| Quebec-CAN         | 63 ▲ |
| California-USA     | 62 ▲ |
| Alabama-USA        | 59   |
| Dubai-UAE          | 56   |
| Abu Dhabi-UAE      | 55   |

▲ Percent higher than International average  
▼ Percent lower than International average

Exercise is important for health (continued)

S032640:

## Student Responses

### Correct Response:

Exercise helps you maintain weight.

### Incorrect Response:

because it keeps your body in good physical shape.

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Knowing          |

## True statement about producers

Which of the following statements is true about organisms that are producers?

- A. They use energy from the sun to make food.
- B. They absorb energy from a host animal.
- C. They get energy from eating living plants.
- D. They get energy by breaking down dead plants and animals.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 82 ▲            |
| Chinese Taipei-CHN           | 76 ▲            |
| Slovenia                     | 73 ▲            |
| Macedonia, Rep. of           | 68 ▲            |
| Jordan                       | 66 ▲            |
| <b>United States</b>         | <b>66 ▲</b>     |
| Turkey                       | 63 ▲            |
| Israel                       | 62 ▲            |
| United Arab Emirates         | 59 ▲            |
| Finland                      | 59 ▲            |
| England-GBR                  | 59 ▲            |
| Korea, Rep. of               | 59 ▲            |
| Indonesia                    | 57 ▲            |
| Malaysia                     | 57 ▲            |
| Oman                         | 57 ▲            |
| Hong Kong-CHN                | 56 ▲            |
| Georgia                      | 56 ▲            |
| Lithuania                    | 55 ▲            |
| Qatar                        | 53              |
| New Zealand                  | 53              |
| Australia                    | 52              |
| Thailand                     | 50              |
| Syrian Arab Republic         | 50              |
| <b>International average</b> | <b>49</b>       |
| Chile                        | 48              |
| Norway                       | 48              |
| Russian Federation           | 44 ▼            |
| Ukraine                      | 44              |
| Ghana                        | 43 ▼            |
| Bahrain                      | 43 ▼            |
| Kazakhstan                   | 41 ▼            |
| Italy                        | 40 ▼            |
| Hungary                      | 40 ▼            |
| Palestinian Nat'l Auth.      | 38 ▼            |
| Sweden                       | 37 ▼            |
| Saudi Arabia                 | 36 ▼            |
| Armenia                      | 34 ▼            |
| Japan                        | 33 ▼            |
| Iran, Islamic Rep. of        | 30 ▼            |
| Lebanon                      | 29 ▼            |
| Romania                      | 28 ▼            |
| Morocco                      | 21 ▼            |
| Tunisia                      | 13 ▼            |

Item Number: S032645

Correct Response:

A

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 75 ▲ |
| Alberta-CAN        | 73 ▲ |
| North Carolina-USA | 72 ▲ |
| Florida-USA        | 66 ▲ |
| Connecticut-USA    | 66 ▲ |
| Minnesota-USA      | 66 ▲ |
| Indiana-USA        | 65 ▲ |
| Dubai-UAE          | 61 ▲ |
| Abu Dhabi-UAE      | 60 ▲ |
| Colorado-USA       | 59 ▲ |
| Alabama-USA        | 59 ▲ |
| Ontario-CAN        | 55 ▲ |
| California-USA     | 52   |
| Quebec-CAN         | 40 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Reasoning        |

Population in countries: predict

There are more than 6 billion people in the world who share the world's natural resources. Look at the table below. It shows some information for two fictitious countries (1 and 2).

|  | Country 1 | Country 2 |
|--|-----------|-----------|
| Population (millions)                        | 200       | 500       |
| Annual birth rate (births per 1000 people)   | 10        | 40        |
| Annual death rate (deaths per 1000 people)   | 10        | 10        |
| Area in square kilometers                    | 2,000,000 | 2,000,000 |
| Grain production (percentage of world total) | 40%       | 20%       |
| Oil consumption (percentage of world total)  | 20%       | 5%        |

A. Based on the information given in the table, predict how the population of each country will change over the next ten years. (Check one box in each row.)

|           | Population Will Increase | Population Will Decrease | Population Will Stay the Same |
|-----------|--------------------------|--------------------------|-------------------------------|
| Country 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>      |
| Country 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>      |

Item Number: S032665A

**SCORING**

**Correct Response**

- Country 1: Population will stay the same.
- Country 2: Population will increase.

**Incorrect Response**

- Country 1 correct; Country 2 incorrect
- Country 2 correct; Country 1 incorrect
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Hong Kong-CHN                | 67 ▲            |
| Finland                      | 67 ▲            |
| Chinese Taipei-CHN           | 57 ▲            |
| Japan                        | 57 ▲            |
| Singapore                    | 54 ▲            |
| Sweden                       | 53 ▲            |
| Slovenia                     | 53 ▲            |
| Israel                       | 52 ▲            |
| Korea, Rep. of               | 51 ▲            |
| England-GBR                  | 50 ▲            |
| Italy                        | 49 ▲            |
| Lithuania                    | 49 ▲            |
| Russian Federation           | 48 ▲            |
| Australia                    | 48 ▲            |
| New Zealand                  | 46 ▲            |
| Norway                       | 43 ▲            |
| Hungary                      | 41 ▲            |
| <b>United States</b>         | <b>39 ▲</b>     |
| Turkey                       | 35              |
| <b>International average</b> | <b>35</b>       |
| Ukraine                      | 33              |
| Iran, Islamic Rep. of        | 31 ▼            |
| United Arab Emirates         | 30 ▼            |
| Kazakhstan                   | 30              |
| Thailand                     | 29 ▼            |
| Bahrain                      | 28 ▼            |
| Chile                        | 28 ▼            |
| Romania                      | 27 ▼            |
| Tunisia                      | 26 ▼            |
| Armenia                      | 24 ▼            |
| Qatar                        | 24 ▼            |
| Saudi Arabia                 | 23 ▼            |
| Lebanon                      | 23 ▼            |
| Jordan                       | 23 ▼            |
| Macedonia, Rep. of           | 21 ▼            |
| Palestinian Nat'l Auth.      | 17 ▼            |
| Malaysia                     | 16 ▼            |
| Syrian Arab Republic         | 16 ▼            |
| Morocco                      | 15 ▼            |
| Oman                         | 14 ▼            |
| Georgia                      | 13 ▼            |
| Indonesia                    | 11 ▼            |
| Ghana                        | 6 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 53 ▲ |
| Ontario-CAN        | 53 ▲ |
| North Carolina-USA | 52 ▲ |
| Minnesota-USA      | 50 ▲ |
| Alberta-CAN        | 49 ▲ |
| Quebec-CAN         | 48 ▲ |
| Colorado-USA       | 48 ▲ |
| Connecticut-USA    | 45 ▲ |
| Indiana-USA        | 43 ▲ |
| Florida-USA        | 39   |
| Dubai-UAE          | 37   |
| California-USA     | 33   |
| Alabama-USA        | 31   |
| Abu Dhabi-UAE      | 30 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average



## Population in countries: predict (continued)

S032665A:

## Student Responses

## Correct Response:

- A. Based on the information given in the table, predict how the population of each country will change over the next ten years.  
(Check one box in each row.)

|           | Population<br>Will<br>Increase      | Population<br>Will<br>Decrease | Population<br>Will<br>Stay the Same |
|-----------|-------------------------------------|--------------------------------|-------------------------------------|
| Country 1 | <input type="checkbox"/>            | <input type="checkbox"/>       | <input checked="" type="checkbox"/> |
| Country 2 | <input checked="" type="checkbox"/> | <input type="checkbox"/>       | <input type="checkbox"/>            |

## Incorrect Response:

- A. Based on the information given in the table, predict how the population of each country will change over the next ten years.  
(Check one box in each row.)

|           | Population<br>Will<br>Increase | Population<br>Will<br>Decrease      | Population<br>Will<br>Stay the Same |
|-----------|--------------------------------|-------------------------------------|-------------------------------------|
| Country 1 | <input type="checkbox"/>       | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Country 2 | <input type="checkbox"/>       | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| <b>BIOLOGY</b> | Ecosystems | Reasoning        |

## Population in countries: land use

There are more than 6 billion people in the world who share the world's natural resources. Look at the table below. It shows some information for two fictitious countries (1 and 2).

|  | Country 1 | Country 2 |
|--|-----------|-----------|
| Population (millions)                        | 200       | 500       |
| Annual birth rate (births per 1000 people)   | 10        | 40        |
| Annual death rate (deaths per 1000 people)   | 10        | 10        |
| Area in square kilometers                    | 2,000,000 | 2,000,000 |
| Grain production (percentage of world total) | 40%       | 20%       |
| Oil consumption (percentage of world total)  | 20%       | 5%        |

B. Predict how the population of the two countries will affect each of the following environmental factors over the next ten years.

Land Use:

Item Number: S032665B

**SCORING****Correct Response**

- Predicts that land use in Country 2 is likely to increase (due to the increased population).
- Predicts that land use will increase with population. [Does not explicitly refer to Country 1 or Country 2.]
- Makes a prediction about land use based on the current population that is supported by data in the table.
- Other correct

**Incorrect Response**

- Makes a statement about land use that is NOT explicitly connected to either population prediction or data in the table.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 53 ▲            |
| Japan                        | 41 ▲            |
| Chinese Taipei-CHN           | 39 ▲            |
| Israel                       | 36 ▲            |
| England-GBR                  | 35 ▲            |
| Hong Kong-CHN                | 35 ▲            |
| New Zealand                  | 35 ▲            |
| Australia                    | 33 ▲            |
| Hungary                      | 31 ▲            |
| Slovenia                     | 31 ▲            |
| <b>United States</b>         | <b>29 ▲</b>     |
| Korea, Rep. of               | 28 ▲            |
| Turkey                       | 28 ▲            |
| Kazakhstan                   | 26 ▲            |
| Lithuania                    | 25 ▲            |
| Russian Federation           | 24 ▲            |
| <b>International average</b> | <b>21</b>       |
| Finland                      | 21              |
| United Arab Emirates         | 20              |
| Sweden                       | 20              |
| Thailand                     | 20              |
| Ukraine                      | 20              |
| Bahrain                      | 19              |
| Iran, Islamic Rep. of        | 19              |
| Jordan                       | 18              |
| Italy                        | 16 ▼            |
| Qatar                        | 15 ▼            |
| Palestinian Nat'l Auth.      | 15 ▼            |
| Norway                       | 14 ▼            |
| Oman                         | 12 ▼            |
| Syrian Arab Republic         | 12 ▼            |
| Macedonia, Rep. of           | 12 ▼            |
| Malaysia                     | 11 ▼            |
| Chile                        | 11 ▼            |
| Romania                      | 10 ▼            |
| Tunisia                      | 9 ▼             |
| Armenia                      | 8 ▼             |
| Indonesia                    | 8 ▼             |
| Georgia                      | 7 ▼             |
| Lebanon                      | 6 ▼             |
| Saudi Arabia                 | 5 ▼             |
| Morocco                      | 5 ▼             |
| Ghana                        | 3 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Ontario-CAN        | 47 ▲ |
| Massachusetts-USA  | 43 ▲ |
| Alberta-CAN        | 43 ▲ |
| Minnesota-USA      | 41 ▲ |
| Colorado-USA       | 36 ▲ |
| North Carolina-USA | 32 ▲ |
| Connecticut-USA    | 32 ▲ |
| Indiana-USA        | 31 ▲ |
| Florida-USA        | 30 ▲ |
| Dubai-UAE          | 28 ▲ |
| Alabama-USA        | 28 ▲ |
| Quebec-CAN         | 27 ▲ |
| California-USA     | 22   |
| Abu Dhabi-UAE      | 17   |

▲ Percent higher than International average  
▼ Percent lower than International average

Population in countries: land use (continued)

S032665B:

## Student Responses

### Correct Response:

country 1 will not affect so much  
But country 2 will need land for more  
people

### Incorrect Response:

With begin to decrease slowly

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Reasoning        |

## Population in countries: pollution

There are more than 6 billion people in the world who share the world's natural resources. Look at the table below. It shows some information for two fictitious countries (1 and 2).

|  | Country 1 | Country 2 |
|--|-----------|-----------|
| Population (millions)                        | 200       | 500       |
| Annual birth rate (births per 1000 people)   | 10        | 40        |
| Annual death rate (deaths per 1000 people)   | 10        | 10        |
| Area in square kilometers                    | 2,000,000 | 2,000,000 |
| Grain production (percentage of world total) | 40%       | 20%       |
| Oil consumption (percentage of world total)  | 20%       | 5%        |

B. Predict how the population of the two countries will affect each of the following environmental factors over the next ten years.

Pollution:

Item Number: S032665C

### SCORING

#### Correct Response

- Predicts that pollution in Country 2 may increase (due to factors related to the growing population).

Example: There will be more pollution in Country 2 as the population increases

- Predicts that pollution will increase with population. [Does not explicitly refer to Country 1 or Country 2.]

Example: Many more people means more pollution.

- Makes a prediction about pollution based on the current population that is supported by data in the table.

Example: Country 1 will pollute more because it consumes more oil than Country 2.

- Other correct

#### Incorrect Response

- Makes a statement about pollution that is NOT explicitly connected to either population prediction or data in the table.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 51 ▲            |
| Chinese Taipei-CHN           | 40 ▲            |
| England-GBR                  | 37 ▲            |
| Australia                    | 37 ▲            |
| New Zealand                  | 35 ▲            |
| Japan                        | 35 ▲            |
| Turkey                       | 34 ▲            |
| Hungary                      | 34 ▲            |
| Korea, Rep. of               | 34 ▲            |
| Hong Kong-CHN                | 32 ▲            |
| Lithuania                    | 32 ▲            |
| Israel                       | 31 ▲            |
| <b>United States</b>         | <b>30 ▲</b>     |
| Slovenia                     | 30 ▲            |
| Russian Federation           | 28 ▲            |
| Finland                      | 26              |
| Jordan                       | 26 ▲            |
| Iran, Islamic Rep. of        | 26 ▲            |
| Kazakhstan                   | 23              |
| <b>International average</b> | <b>22</b>       |
| United Arab Emirates         | 22              |
| Palestinian Nat'l Auth.      | 20              |
| Ukraine                      | 20              |
| Chile                        | 20              |
| Sweden                       | 20              |
| Thailand                     | 19 ▼            |
| Italy                        | 18 ▼            |
| Bahrain                      | 18 ▼            |
| Qatar                        | 18 ▼            |
| Tunisia                      | 17 ▼            |
| Syrian Arab Republic         | 14 ▼            |
| Norway                       | 14 ▼            |
| Oman                         | 14 ▼            |
| Romania                      | 13 ▼            |
| Armenia                      | 10 ▼            |
| Indonesia                    | 9 ▼             |
| Malaysia                     | 9 ▼             |
| Macedonia, Rep. of           | 9 ▼             |
| Georgia                      | 9 ▼             |
| Lebanon                      | 8 ▼             |
| Morocco                      | 6 ▼             |
| Ghana                        | 2 ▼             |
| Saudi Arabia                 | 2 ▼             |

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Ontario-CAN        | 46 ▲ |
| Minnesota-USA      | 43 ▲ |
| Massachusetts-USA  | 41 ▲ |
| North Carolina-USA | 39 ▲ |
| Alberta-CAN        | 38 ▲ |
| Colorado-USA       | 38 ▲ |
| Connecticut-USA    | 37 ▲ |
| Indiana-USA        | 36 ▲ |
| Quebec-CAN         | 30 ▲ |
| Florida-USA        | 29   |
| Dubai-UAE          | 28 ▲ |
| California-USA     | 24   |
| Alabama-USA        | 21   |
| Abu Dhabi-UAE      | 21   |

▲ Percent higher than International average  
▼ Percent lower than International average

Population in countries: pollution (continued)

S032665C:

## Student Responses

### Correct Response:

The more people there are the  
more pollution will be created

### Incorrect Response:

Country one will give off  
more pollution than 2 will

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Characteristics, Classification, and Life Processes of Organisms | Applying         |

## Lungs in bird/which organ in frog

Which organ in a frog has a function similar to the function of lungs in a bird?

- A. kidney
- B. skin
- C. liver
- D. heart

Item Number: S042007

**Correct Response:**

**B**

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Russian Federation           | 83 ▲            |
| Ukraine                      | 72 ▲            |
| Tunisia                      | 67 ▲            |
| Lithuania                    | 66 ▲            |
| Singapore                    | 62 ▲            |
| Finland                      | 62 ▲            |
| Chinese Taipei-CHN           | 60 ▲            |
| Korea, Rep. of               | 60 ▲            |
| Slovenia                     | 59 ▲            |
| Hungary                      | 59 ▲            |
| Syrian Arab Republic         | 52 ▲            |
| Italy                        | 51 ▲            |
| Thailand                     | 48 ▲            |
| Kazakhstan                   | 47              |
| Macedonia, Rep. of           | 46              |
| Indonesia                    | 44              |
| Lebanon                      | 43              |
| <b>International average</b> | <b>43</b>       |
| United Arab Emirates         | 42              |
| Japan                        | 42              |
| Georgia                      | 40              |
| Bahrain                      | 40 ▼            |
| Australia                    | 39 ▼            |
| Iran, Islamic Rep. of        | 38 ▼            |
| Saudi Arabia                 | 38 ▼            |
| Romania                      | 37 ▼            |
| Hong Kong-CHN                | 37 ▼            |
| Morocco                      | 36 ▼            |
| Sweden                       | 35 ▼            |
| England-GBR                  | 34 ▼            |
| Israel                       | 33 ▼            |
| Jordan                       | 33 ▼            |
| New Zealand                  | 32 ▼            |
| Palestinian Nat'l Auth.      | 32 ▼            |
| <b>United States</b>         | <b>32 ▼</b>     |
| Armenia                      | 31 ▼            |
| Qatar                        | 30 ▼            |
| Malaysia                     | 30 ▼            |
| Oman                         | 28 ▼            |
| Turkey                       | 28 ▼            |
| Norway                       | 24 ▼            |
| Chile                        | 21 ▼            |
| Ghana                        | 21 ▼            |

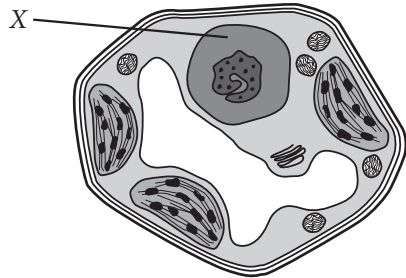
## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 47   |
| Massachusetts-USA  | 44   |
| Dubai-UAE          | 40 ▼ |
| Minnesota-USA      | 38   |
| Colorado-USA       | 37 ▼ |
| Indiana-USA        | 36 ▼ |
| Abu Dhabi-UAE      | 36 ▼ |
| North Carolina-USA | 36 ▼ |
| Ontario-CAN        | 32 ▼ |
| Connecticut-USA    | 32 ▼ |
| Florida-USA        | 30 ▼ |
| Quebec-CAN         | 30 ▼ |
| Alabama-USA        | 26 ▼ |
| California-USA     | 23 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| <b>BIOLOGY</b> | Cells and Their Functions | Applying         |

Function of cell part X



The diagram shows a plant cell.

What is the function of the part of the cell labeled X?

- A. It stores water.
- B. It makes food.
- C. It absorbs energy.
- D. It controls activities.

Item Number: S042017

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 80 ▲            |
| Lithuania                    | 51 ▲            |
| Korea, Rep. of               | 49 ▲            |
| Russian Federation           | 47 ▲            |
| Tunisia                      | 47 ▲            |
| Oman                         | 46 ▲            |
| Georgia                      | 44 ▲            |
| <b>United States</b>         | <b>44 ▲</b>     |
| United Arab Emirates         | 44 ▲            |
| Macedonia, Rep. of           | 43 ▲            |
| Italy                        | 43 ▲            |
| Slovenia                     | 42 ▲            |
| Thailand                     | 42 ▲            |
| Ukraine                      | 41 ▲            |
| Malaysia                     | 41 ▲            |
| Hungary                      | 41 ▲            |
| England-GBR                  | 39              |
| Qatar                        | 38              |
| Australia                    | 37              |
| <b>International average</b> | <b>36</b>       |
| Iran, Islamic Rep. of        | 35              |
| Israel                       | 34              |
| Turkey                       | 34              |
| New Zealand                  | 34              |
| Armenia                      | 33              |
| Bahrain                      | 33              |
| Indonesia                    | 33              |
| Chinese Taipei-CHN           | 33 ▼            |
| Jordan                       | 32              |
| Kazakhstan                   | 31              |
| Finland                      | 30 ▼            |
| Hong Kong-CHN                | 30 ▼            |
| Romania                      | 29 ▼            |
| Palestinian Nat'l Auth.      | 28 ▼            |
| Ghana                        | 28 ▼            |
| Japan                        | 28 ▼            |
| Saudi Arabia                 | 27 ▼            |
| Syrian Arab Republic         | 26 ▼            |
| Lebanon                      | 23 ▼            |
| Morocco                      | 22 ▼            |
| Sweden                       | 21 ▼            |
| Norway                       | 19 ▼            |
| Chile                        | 18 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| North Carolina-USA | 60 ▲ |
| Connecticut-USA    | 55 ▲ |
| Massachusetts-USA  | 55 ▲ |
| Alberta-CAN        | 53 ▲ |
| Indiana-USA        | 50 ▲ |
| Florida-USA        | 49 ▲ |
| Ontario-CAN        | 48 ▲ |
| Minnesota-USA      | 47 ▲ |
| Dubai-UAE          | 46 ▲ |
| Abu Dhabi-UAE      | 44 ▲ |
| Colorado-USA       | 41   |
| Quebec-CAN         | 39   |
| Alabama-USA        | 35   |
| California-USA     | 33   |

▲ Percent higher than International average  
▼ Percent lower than International average

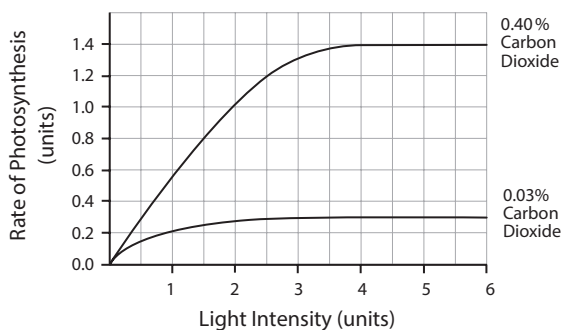
| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| BIOLOGY        | Cells and Their Functions | Reasoning        |

## CO<sub>2</sub> concentration & photosynthesis

Andrea is investigating the effects of light intensity and carbon dioxide concentration on the rate of photosynthesis.

She measured the rate of photosynthesis at different light intensities for two identical plants. The plants were placed in closed containers. One container had an initial carbon dioxide concentration of 0.40%. The other container had an initial carbon dioxide concentration of 0.03%.

She plotted her results as shown below.



Look at the graph.

A. Does an increase in carbon dioxide concentration affect the rate of photosynthesis?

(Check one box.)

- Yes  
 No

B. Explain your answer.

Item Number: S042022

### SCORING

#### Correct Response

- Yes with an explanation that refers to carbon dioxide being required for (needed for, used during) photosynthesis. The explanation may or may not include a specific reference to the graph.

Examples:

Carbon dioxide is required for photosynthesis. The higher the concentration of carbon dioxide the faster the rate of photosynthesis.

For photosynthesis to take place it needs carbon dioxide.

- Yes with an explanation that refers only to the graph (either explicitly or implicitly).

Examples:

One with 0.03 carbon dioxide is lower than the one with 0.4 carbon dioxide.

Yes, at light intensity 3, the rate of photosynthesis is 1.2 at 0.40 and 0.3 at 0.03.

#### Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 72 ▲            |
| <b>United States</b>         | <b>68 ▲</b>     |
| Japan                        | 61 ▲            |
| England-GBR                  | 60 ▲            |
| Israel                       | 52 ▲            |
| Hong Kong-CHN                | 51 ▲            |
| Korea, Rep. of               | 47 ▲            |
| New Zealand                  | 46 ▲            |
| Australia                    | 45 ▲            |
| Turkey                       | 45 ▲            |
| Chinese Taipei-CHN           | 44 ▲            |
| Tunisia                      | 44 ▲            |
| Finland                      | 42 ▲            |
| Jordan                       | 40 ▲            |
| Bahrain                      | 40 ▲            |
| Ukraine                      | 39              |
| United Arab Emirates         | 38 ▼            |
| Slovenia                     | 37              |
| Kazakhstan                   | 36              |
| Russian Federation           | 36              |
| Hungary                      | 35              |
| <b>International average</b> | <b>35</b>       |
| Lithuania                    | 34              |
| Saudi Arabia                 | 33              |
| Lebanon                      | 32              |
| Romania                      | 31 ▼            |
| Malaysia                     | 31              |
| Norway                       | 30 ▼            |
| Indonesia                    | 29 ▼            |
| Qatar                        | 28 ▼            |
| Italy                        | 27 ▼            |
| Palestinian Nat'l Auth.      | 27 ▼            |
| Oman                         | 26 ▼            |
| Thailand                     | 25 ▼            |
| Sweden                       | 25 ▼            |
| Iran, Islamic Rep. of        | 23 ▼            |
| Chile                        | 22 ▼            |
| Morocco                      | 17 ▼            |
| Georgia                      | 17 ▼            |
| Macedonia, Rep. of           | 15 ▼            |
| Armenia                      | 12 ▼            |
| Syrian Arab Republic         | 10 ▼            |
| Ghana                        | 8 ▼             |

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 77 ▲ |
| Massachusetts-USA  | 73 ▲ |
| Indiana-USA        | 71 ▲ |
| Colorado-USA       | 71 ▲ |
| Florida-USA        | 71 ▲ |
| North Carolina-USA | 69 ▲ |
| Connecticut-USA    | 69 ▲ |
| California-USA     | 65 ▲ |
| Alabama-USA        | 58 ▲ |
| Ontario-CAN        | 57 ▲ |
| Alberta-CAN        | 57 ▲ |
| Quebec-CAN         | 51 ▲ |
| Dubai-UAE          | 43 ▲ |
| Abu Dhabi-UAE      | 37   |

▲ Percent higher than International average  
▼ Percent lower than International average



CO<sub>2</sub> concentration & photosynthesis (continued)

S042022:

## Student Responses

## Correct Response:

A. Does an increase in carbon dioxide concentration affect the rate of photosynthesis?

(Check one box.)

Yes

No

B. Explain your answer.

yes because the containers with  
0.40% did more than the one with  
0.03%

## Incorrect Response:

A. Does an increase in carbon dioxide concentration affect the rate of photosynthesis?

(Check one box.)

Yes

No

B. Explain your answer.

The carbon dioxide levels may  
rise to their initial height, but  
it doesn't seem to affect the  
units of photosynthesis as shown  
in the graph.

| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| BIOLOGY        | Cells and Their Functions | Knowing          |

## Process of respiration

Which equation summarizes the process of respiration?

- A. water + carbon dioxide + energy  $\rightarrow$  sugar + oxygen  
 B. oxygen + sugar  $\rightarrow$  carbon dioxide + water + energy  
 C. carbon dioxide + oxygen + water  $\rightarrow$  sugar + energy  
 D. sugar + carbon dioxide + energy  $\rightarrow$  oxygen + water

Item Number: S042024

Correct Response:

B

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 66 ▲            |
| Russian Federation           | 59 ▲            |
| Japan                        | 52 ▲            |
| Hong Kong-CHN                | 50 ▲            |
| Kazakhstan                   | 47 ▲            |
| Slovenia                     | 47 ▲            |
| Palestinian Nat'l Auth.      | 47 ▲            |
| Syrian Arab Republic         | 45 ▲            |
| Saudi Arabia                 | 45 ▲            |
| Turkey                       | 43 ▲            |
| Armenia                      | 43              |
| England-GBR                  | 41              |
| Jordan                       | 41              |
| Israel                       | 41              |
| Chinese Taipei-CHN           | 40              |
| Finland                      | 40              |
| Macedonia, Rep. of           | 40              |
| Korea, Rep. of               | 39              |
| Georgia                      | 38              |
| Bahrain                      | 38              |
| <b>International average</b> | <b>38</b>       |
| Oman                         | 38              |
| Qatar                        | 37              |
| Italy                        | 37              |
| Romania                      | 36              |
| Ukraine                      | 36              |
| United Arab Emirates         | 35 ▼            |
| Thailand                     | 35              |
| Chile                        | 35              |
| Lithuania                    | 35              |
| Morocco                      | 34 ▼            |
| Hungary                      | 33 ▼            |
| Tunisia                      | 30 ▼            |
| Sweden                       | 30 ▼            |
| Lebanon                      | 29 ▼            |
| New Zealand                  | 28 ▼            |
| Malaysia                     | 27 ▼            |
| Ghana                        | 25 ▼            |
| Australia                    | 25 ▼            |
| Iran, Islamic Rep. of        | 25 ▼            |
| Norway                       | 23 ▼            |
| Indonesia                    | 22 ▼            |
| <b>United States</b>         | <b>22 ▼</b>     |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Dubai-UAE          | 38   |
| Quebec-CAN         | 36   |
| Abu Dhabi-UAE      | 33 ▼ |
| Massachusetts-USA  | 30 ▼ |
| North Carolina-USA | 28 ▼ |
| Alberta-CAN        | 27 ▼ |
| Connecticut-USA    | 27 ▼ |
| Minnesota-USA      | 25 ▼ |
| Florida-USA        | 25 ▼ |
| California-USA     | 25 ▼ |
| Indiana-USA        | 23 ▼ |
| Alabama-USA        | 23 ▼ |
| Ontario-CAN        | 22 ▼ |
| Colorado-USA       | 20 ▼ |

▲ Percent higher than International average  
 ▼ Percent lower than International average

| Content Domain | Main Topic                                   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Diversity, Adaptation, and Natural Selection | Knowing          |

## Where organisms appeared on Earth

Where did organisms live when they first appeared on Earth?

A. in the water

B. in the air

C. on the land

D. under the ground

Item Number: S042038

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>A</b> |
|--------------------------|----------|

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Italy                        | 86 ▲            |
| Russian Federation           | 85 ▲            |
| Chinese Taipei-CHN           | 85 ▲            |
| Korea, Rep. of               | 84 ▲            |
| Japan                        | 83 ▲            |
| Sweden                       | 82 ▲            |
| Slovenia                     | 82 ▲            |
| Norway                       | 81 ▲            |
| Finland                      | 80 ▲            |
| Lithuania                    | 74 ▲            |
| Ukraine                      | 71 ▲            |
| Hungary                      | 67 ▲            |
| Kazakhstan                   | 63 ▲            |
| Hong Kong-CHN                | 61 ▲            |
| Georgia                      | 61 ▲            |
| <b>United States</b>         | <b>56 ▲</b>     |
| Armenia                      | 56 ▲            |
| Iran, Islamic Rep. of        | 52 ▲            |
| Chile                        | 51 ▲            |
| England-GBR                  | 49              |
| Australia                    | 47              |
| <b>International average</b> | <b>46</b>       |
| New Zealand                  | 44              |
| Macedonia, Rep. of           | 43              |
| Romania                      | 40 ▼            |
| Israel                       | 36 ▼            |
| Thailand                     | 34 ▼            |
| Singapore                    | 34 ▼            |
| Malaysia                     | 27 ▼            |
| Turkey                       | 26 ▼            |
| United Arab Emirates         | 23 ▼            |
| Jordan                       | 21 ▼            |
| Indonesia                    | 19 ▼            |
| Saudi Arabia                 | 19 ▼            |
| Qatar                        | 18 ▼            |
| Ghana                        | 17 ▼            |
| Palestinian Nat'l Auth.      | 17 ▼            |
| Oman                         | 14 ▼            |
| Bahrain                      | 14 ▼            |
| Lebanon                      | 12 ▼            |
| Morocco                      | 12 ▼            |
| Syrian Arab Republic         | 11 ▼            |
| Tunisia                      | 9 ▼             |

## Benchmarking education system

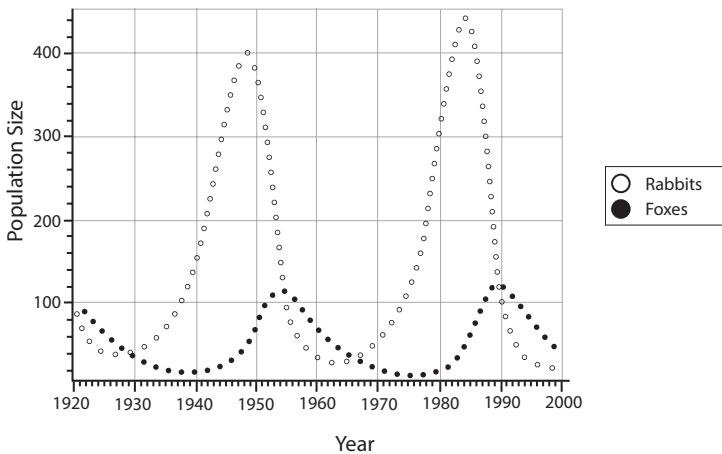
|                    |      |
|--------------------|------|
| Colorado-USA       | 72 ▲ |
| Quebec-CAN         | 71 ▲ |
| Massachusetts-USA  | 71 ▲ |
| Minnesota-USA      | 66 ▲ |
| North Carolina-USA | 65 ▲ |
| Connecticut-USA    | 61 ▲ |
| Alberta-CAN        | 59 ▲ |
| California-USA     | 59 ▲ |
| Ontario-CAN        | 57 ▲ |
| Indiana-USA        | 55 ▲ |
| Florida-USA        | 53   |
| Alabama-USA        | 48   |
| Dubai-UAE          | 35 ▼ |
| Abu Dhabi-UAE      | 19 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Applying         |

Year of highest rabbit population

A population of rabbits and foxes live in a remote area. The foxes do not have any predators. Scientists counted the number of rabbits and foxes over a long time period and plotted their results, as shown below.



A. In which year was the population of rabbits at its highest?

Item Number: S042051A

**SCORING**

**Correct Response**

- 1983 - 1985

**Incorrect Response**

- States the year for foxes: 1988-1990
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 85 ▲            |
| Finland                      | 78 ▲            |
| Sweden                       | 78 ▲            |
| Slovenia                     | 76 ▲            |
| Russian Federation           | 74 ▲            |
| England-GBR                  | 73 ▲            |
| Norway                       | 72 ▲            |
| Singapore                    | 71 ▲            |
| Hungary                      | 71 ▲            |
| Australia                    | 69 ▲            |
| <b>United States</b>         | <b>69 ▲</b>     |
| New Zealand                  | 67 ▲            |
| Lithuania                    | 67 ▲            |
| Israel                       | 65 ▲            |
| Italy                        | 64 ▲            |
| Chinese Taipei-CHN           | 58 ▲            |
| Ukraine                      | 56 ▲            |
| Hong Kong-CHN                | 54 ▲            |
| Korea, Rep. of               | 51              |
| <b>International average</b> | <b>47</b>       |
| United Arab Emirates         | 44 ▼            |
| Lebanon                      | 42              |
| Tunisia                      | 41 ▼            |
| Thailand                     | 41 ▼            |
| Chile                        | 40 ▼            |
| Bahrain                      | 40 ▼            |
| Kazakhstan                   | 37 ▼            |
| Qatar                        | 36 ▼            |
| Romania                      | 35 ▼            |
| Macedonia, Rep. of           | 33 ▼            |
| Georgia                      | 31 ▼            |
| Morocco                      | 31 ▼            |
| Palestinian Nat'l Auth.      | 31 ▼            |
| Saudi Arabia                 | 31 ▼            |
| Malaysia                     | 30 ▼            |
| Jordan                       | 30 ▼            |
| Iran, Islamic Rep. of        | 29 ▼            |
| Armenia                      | 27 ▼            |
| Oman                         | 24 ▼            |
| Turkey                       | 21 ▼            |
| Syrian Arab Republic         | 13 ▼            |
| Indonesia                    | 8 ▼             |
| Ghana                        | 4 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Minnesota-USA      | 81 ▲ |
| Quebec-CAN         | 77 ▲ |
| Massachusetts-USA  | 75 ▲ |
| North Carolina-USA | 74 ▲ |
| Indiana-USA        | 72 ▲ |
| Ontario-CAN        | 71 ▲ |
| Colorado-USA       | 70 ▲ |
| Connecticut-USA    | 68 ▲ |
| Alberta-CAN        | 67 ▲ |
| Florida-USA        | 66 ▲ |
| California-USA     | 59 ▲ |
| Alabama-USA        | 57 ▲ |
| Dubai-UAE          | 53 ▲ |
| Abu Dhabi-UAE      | 43   |

▲ Percent higher than International average  
▼ Percent lower than International average

Year of highest rabbit population (continued)

S042051A:

## Student Responses

### Correct Response:

A. In which year was the population of rabbits at its highest?

1984

### Incorrect Response:

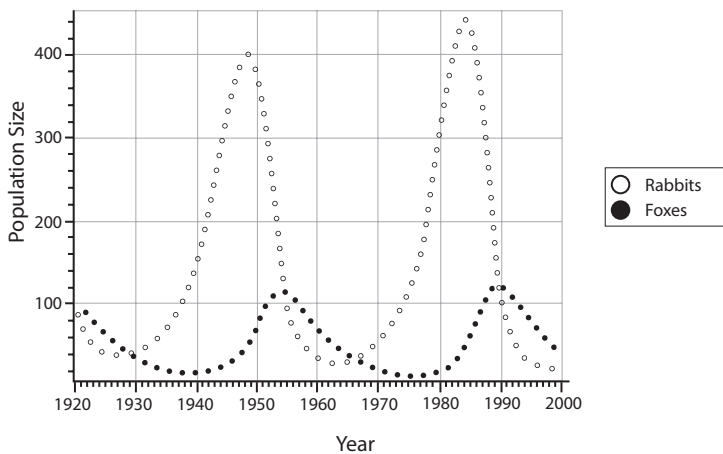
A. In which year was the population of rabbits at its highest?

1950

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Applying         |

### Relation of rabbit-fox populations

A population of rabbits and foxes live in a remote area. The foxes do not have any predators. Scientists counted the number of rabbits and foxes over a long time period and plotted their results, as shown below.



B. Describe how the changes in population size of rabbits and foxes are related.

Item Number: S042051B

### SCORING

#### Correct Response

- Describes how the changes in population are related by referring to the foxes (predators) eating the rabbits (prey).

Example: As the population of rabbits increased the foxes also increased as they have more rabbits to eat.

- Relates the graph of the fox population to that of the rabbit population without reference to predator/prey.

Example: When the rabbit population increases the fox population increases and when the rabbit population decreases the fox population decreases.

#### Incorrect Response

- States that foxes eat rabbits without describing how the changes in population size are related.
- Gives a general description that relates to both going up and down without mentioning how the changes in population size are related.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Singapore                      | 68 ▲            |
| Japan                          | 54 ▲            |
| England-GBR                    | 54 ▲            |
| Hong Kong-CHN                  | 51 ▲            |
| Finland                        | 51 ▲            |
| Korea, Rep. of                 | 48 ▲            |
| Israel                         | 46 ▲            |
| Slovenia                       | 44 ▲            |
| Australia                      | 43 ▲            |
| Chinese Taipei-CHN             | 42 ▲            |
| Sweden                         | 42 ▲            |
| <b>United States</b>           | <b>36 ▲</b>     |
| Norway                         | 35 ▲            |
| Hungary                        | 34 ▲            |
| Lithuania                      | 31 ▲            |
| Italy                          | 30              |
| New Zealand                    | 30              |
| Russian Federation             | 28              |
| United Arab Emirates           | 28              |
| Oman                           | 27              |
| <b>International average</b>   | <b>27</b>       |
| Turkey                         | 27              |
| Jordan                         | 26              |
| Ukraine                        | 25              |
| Thailand                       | 23              |
| Iran, Islamic Rep. of          | 21 ▼            |
| Qatar                          | 21 ▼            |
| Bahrain                        | 17 ▼            |
| <i>Palestinian Nat'l Auth.</i> | 17 ▼            |
| Kazakhstan                     | 17 ▼            |
| Malaysia                       | 16 ▼            |
| Syrian Arab Republic           | 16 ▼            |
| Chile                          | 13 ▼            |
| Tunisia                        | 11 ▼            |
| Armenia                        | 10 ▼            |
| Romania                        | 10 ▼            |
| Lebanon                        | 9 ▼             |
| Indonesia                      | 9 ▼             |
| Macedonia, Rep. of             | 7 ▼             |
| Georgia                        | 6 ▼             |
| Morocco                        | 4 ▼             |
| Ghana                          | 2 ▼             |
| Saudi Arabia                   | 1 ▼             |

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 54 ▲ |
| Massachusetts-USA  | 53 ▲ |
| Colorado-USA       | 50 ▲ |
| Alberta-CAN        | 48 ▲ |
| Connecticut-USA    | 48 ▲ |
| Ontario-CAN        | 46 ▲ |
| Quebec-CAN         | 39 ▲ |
| North Carolina-USA | 39 ▲ |
| Indiana-USA        | 36 ▲ |
| Florida-USA        | 33   |
| Abu Dhabi-UAE      | 30   |
| Dubai-UAE          | 30   |
| California-USA     | 22 ▼ |
| Alabama-USA        | 20 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Relation of rabbit-fox populations (continued)

S042051B:

## Student Responses

### Correct Response:

They are related by when the fox population goes up the rabbit population goes down. When the fox population goes down the rabbit population goes up.

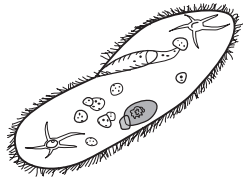
### Incorrect Response:

When rabbit population goes up. Fox population goes down

| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| BIOLOGY        | Cells and Their Functions | Knowing          |

### Life function of Paramecium

The diagram shows a single-celled organism called a *Paramecium*.



In order to survive, the *Paramecium* carries out certain life functions, such as taking in nutrients to produce energy.

State one other life function that the *Paramecium* must carry out in order to survive.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 49 ▲            |
| Israel                       | 48 ▲            |
| Russian Federation           | 46 ▲            |
| Hungary                      | 42 ▲            |
| Japan                        | 41 ▲            |
| Slovenia                     | 40 ▲            |
| Ukraine                      | 40 ▲            |
| Finland                      | 39 ▲            |
| England-GBR                  | 37 ▲            |
| Iran, Islamic Rep. of        | 36 ▲            |
| Chinese Taipei-CHN           | 35 ▲            |
| Italy                        | 33 ▲            |
| Turkey                       | 32 ▲            |
| Lithuania                    | 32 ▲            |
| Sweden                       | 30 ▲            |
| Korea, Rep. of               | 28              |
| <b>United States</b>         | <b>27</b>       |
| Armenia                      | 27              |
| Macedonia, Rep. of           | 27              |
| Kazakhstan                   | 27              |
| Australia                    | 26              |
| <b>International average</b> | <b>25</b>       |
| New Zealand                  | 24              |
| United Arab Emirates         | 24              |
| Norway                       | 24              |
| Georgia                      | 24              |
| Bahrain                      | 21 ▼            |
| Jordan                       | 18 ▼            |
| Hong Kong-CHN                | 17 ▼            |
| Syrian Arab Republic         | 16 ▼            |
| Romania                      | 16 ▼            |
| Palestinian Nat'l Auth.      | 15 ▼            |
| Thailand                     | 15 ▼            |
| Chile                        | 15 ▼            |
| Qatar                        | 15 ▼            |
| Oman                         | 15 ▼            |
| Indonesia                    | 13 ▼            |
| Saudi Arabia                 | 11 ▼            |
| Malaysia                     | 11 ▼            |
| Tunisia                      | 10 ▼            |
| Lebanon                      | 9 ▼             |
| Ghana                        | 9 ▼             |
| Morocco                      | 8 ▼             |

Item Number: S042261

### SCORING

#### Correct Response

- States one life function as noted below.
- Getting rid of waste (wastes would poison the cell)
- Reproduction (the species would die out otherwise)
- Taking in oxygen/respire (needed to produce energy)
- Responding to stimuli (moving towards food)
- Digestion (breaking down food substances)

#### Incorrect Response

- Refers to taking in water.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 44 ▲ |
| Alberta-CAN        | 36 ▲ |
| Minnesota-USA      | 36 ▲ |
| North Carolina-USA | 34 ▲ |
| Colorado-USA       | 34 ▲ |
| Connecticut-USA    | 33 ▲ |
| Ontario-CAN        | 32 ▲ |
| Quebec-CAN         | 30 ▲ |
| Indiana-USA        | 30   |
| Dubai-UAE          | 29   |
| Florida-USA        | 28   |
| Alabama-USA        | 24   |
| Abu Dhabi-UAE      | 22   |
| California-USA     | 18 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average



Life function of Paramecium (continued)

S042261:

## Student Responses

### Correct Response:

It Needs to take in Oxygen.

### Incorrect Response:

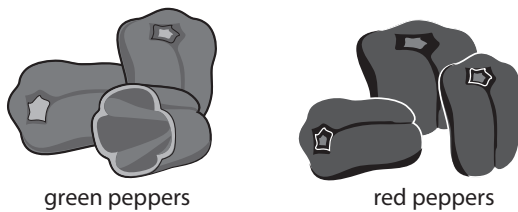
Breathing.

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| <b>BIOLOGY</b> | Life Cycles, Reproduction, and Heredity | Reasoning        |

## Investigation of green/red peppers

Kayra and Emre are studying plants. They have learned that characteristics such as the height of plants and the color of fruit are inherited.

They are looking at some green and red peppers.



Kayra thinks they are different kinds of peppers, because they are different colors.

Emre thinks that they are the same type of pepper, and red peppers are red because they have been left on the plant longer and have ripened.

Describe how you could set up an investigation to decide whether Kayra or Emre is correct.

Item Number: S042297

**SCORING****Correct Response**

- Refers to either
  - planting (seeds from) green and red peppers AND observing the color of the fruit OR
  - planting (seeds from) green peppers AND observing if the fruit turns red.
- Other fully correct

**Partially Correct Response**

- Refers to ONLY planting (seeds from) green/red peppers.

Example: You could grow seeds from each pepper.

- Other correct

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 44 ▲            |
| New Zealand                  | 37 ▲            |
| Slovenia                     | 30 ▲            |
| Turkey                       | 29 ▲            |
| Israel                       | 28 ▲            |
| <b>United States</b>         | <b>27 ▲</b>     |
| Chinese Taipei-CHN           | 26 ▲            |
| Hong Kong-CHN                | 24 ▲            |
| Sweden                       | 24 ▲            |
| Chile                        | 22 ▲            |
| Australia                    | 21 ▲            |
| Finland                      | 20 ▲            |
| Lithuania                    | 20 ▲            |
| Hungary                      | 19 ▲            |
| Russian Federation           | 16              |
| Bahrain                      | 15              |
| <b>International average</b> | <b>14</b>       |
| Japan                        | 14              |
| Romania                      | 14              |
| England-GBR                  | 14              |
| Korea, Rep. of               | 12              |
| Qatar                        | 10 ▼            |
| United Arab Emirates         | 10 ▼            |
| Georgia                      | 9 ▼             |
| Thailand                     | 9 ▼             |
| Oman                         | 9 ▼             |
| Italy                        | 9 ▼             |
| Macedonia, Rep. of           | 8 ▼             |
| Saudi Arabia                 | 8 ▼             |
| Syrian Arab Republic         | 8 ▼             |
| Norway                       | 8 ▼             |
| Tunisia                      | 8 ▼             |
| Ukraine                      | 8 ▼             |
| Morocco                      | 6 ▼             |
| Kazakhstan                   | 6 ▼             |
| Armenia                      | 6 ▼             |
| Malaysia                     | 5 ▼             |
| Jordan                       | 5 ▼             |
| Palestinian Nat'l Auth.      | 4 ▼             |
| Lebanon                      | 4 ▼             |
| Iran, Islamic Rep. of        | 2 ▼             |
| Indonesia                    | 2 ▼             |
| Ghana                        | 1 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Alberta-CAN        | 38 ▲ |
| Ontario-CAN        | 38 ▲ |
| Massachusetts-USA  | 36 ▲ |
| Minnesota-USA      | 34 ▲ |
| Colorado-USA       | 34 ▲ |
| Quebec-CAN         | 34 ▲ |
| Indiana-USA        | 32 ▲ |
| Connecticut-USA    | 31 ▲ |
| Florida-USA        | 25 ▲ |
| North Carolina-USA | 24 ▲ |
| California-USA     | 23 ▲ |
| Alabama-USA        | 18   |
| Dubai-UAE          | 14   |
| Abu Dhabi-UAE      | 9 ▼  |

▲ Percent higher than International average  
▼ Percent lower than International average

Investigation of green/red peppers (continued)

S042297:

**Student Responses**

**Correct Response:**

Plant 2 pepper plants with same  
food, water, time spent on ground and  
see if emre or Kayra is right

**Partially Correct Response:**

Plant a green one

**Incorrect Response:**

you could taste  
each one to see  
if they are the  
same or different.

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Applying         |

### Importance of removing weeds

A farmer planted a field of corn. Weeds started to grow among the seedlings.

Explain why it is important that he remove the weeds.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 75 ▲            |
| Chinese Taipei-CHN           | 74 ▲            |
| Korea, Rep. of               | 65 ▲            |
| Singapore                    | 59 ▲            |
| Hungary                      | 53 ▲            |
| Finland                      | 49 ▲            |
| Hong Kong-CHN                | 47 ▲            |
| Kazakhstan                   | 44 ▲            |
| Iran, Islamic Rep. of        | 40 ▲            |
| Lithuania                    | 37 ▲            |
| Slovenia                     | 36 ▲            |
| Russian Federation           | 35 ▲            |
| Israel                       | 35 ▲            |
| Thailand                     | 35 ▲            |
| <b>United States</b>         | <b>35 ▲</b>     |
| England-GBR                  | 31              |
| Sweden                       | 31              |
| <b>International average</b> | <b>29</b>       |
| Australia                    | 29              |
| New Zealand                  | 28              |
| Romania                      | 27              |
| Tunisia                      | 27              |
| Ukraine                      | 25              |
| Syrian Arab Republic         | 25              |
| Italy                        | 25 ▼            |
| Norway                       | 24 ▼            |
| Jordan                       | 23 ▼            |
| Malaysia                     | 21 ▼            |
| Armenia                      | 20 ▼            |
| Turkey                       | 20 ▼            |
| Palestinian Nat'l Auth.      | 20 ▼            |
| United Arab Emirates         | 17 ▼            |
| Macedonia, Rep. of           | 14 ▼            |
| Chile                        | 14 ▼            |
| Georgia                      | 14 ▼            |
| Qatar                        | 14 ▼            |
| Oman                         | 12 ▼            |
| Ghana                        | 12 ▼            |
| Bahrain                      | 10 ▼            |
| Indonesia                    | 10 ▼            |
| Lebanon                      | 7 ▼             |
| Morocco                      | 5 ▼             |
| Saudi Arabia                 | 1 ▼             |

Item Number: S042298

### SCORING

#### Correct Response

- Mentions competition for resources (nutrients, water, sunlight).

Examples:

They compete with other plants for space, water and sunlight.

The weeds will compete with the seedlings for food and water.

#### Incorrect Response

- Mentions competition for space and/or weeds reproducing (growing) rapidly.

Examples:

They would grow very quickly and take over the field.

They reproduce too rapidly.

- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 46 ▲ |
| Minnesota-USA      | 45 ▲ |
| Alberta-CAN        | 45 ▲ |
| Colorado-USA       | 38 ▲ |
| North Carolina-USA | 37 ▲ |
| Indiana-USA        | 33   |
| Connecticut-USA    | 31   |
| Ontario-CAN        | 29   |
| Florida-USA        | 29   |
| California-USA     | 27   |
| Alabama-USA        | 27   |
| Dubai-UAE          | 26 ▼ |
| Quebec-CAN         | 17 ▼ |
| Abu Dhabi-UAE      | 15 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Importance of removing weeds (continued)

S042298:

**Student Responses**

**Correct Response:**

It is important to remove the weeds because the weeds could absorb the nutrients and water that the corn needs to grow.

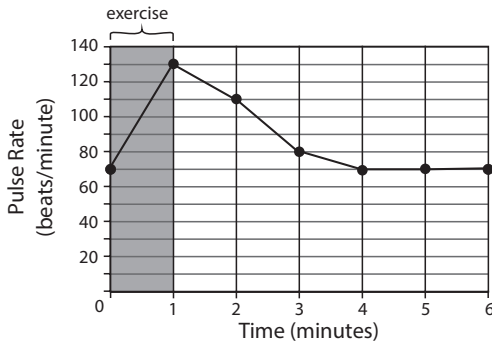
**Incorrect Response:**

Because the field is too dirty and, he never watch the field.

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Characteristics, Classification, and Life Processes of Organisms | Reasoning        |

Conclusion from pulse rate-T graph

John measures his pulse rate before he exercises. It is 70 beats per minute. He exercises for one minute and measures his pulse rate again. He then measures it every minute for several minutes. He draws a graph to show his results.



What can be concluded from his results?

- A. His pulse rate increased by 50 beats per minute.
- B. His pulse rate took less time to slow down than to increase.
- C. His pulse rate after 4 minutes was 80 beats per minute.
- D. His pulse rate returned to normal in less than 6 minutes.

Item Number: S042304

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 82 ▲            |
| Korea, Rep. of               | 80 ▲            |
| Finland                      | 80 ▲            |
| Italy                        | 79 ▲            |
| Russian Federation           | 75 ▲            |
| Singapore                    | 75 ▲            |
| Sweden                       | 75 ▲            |
| Israel                       | 74 ▲            |
| Lithuania                    | 74 ▲            |
| Norway                       | 73 ▲            |
| <b>United States</b>         | <b>73 ▲</b>     |
| Slovenia                     | 71 ▲            |
| England-GBR                  | 69 ▲            |
| Australia                    | 66 ▲            |
| Chinese Taipei-CHN           | 64 ▲            |
| New Zealand                  | 62 ▲            |
| Chile                        | 62 ▲            |
| Romania                      | 61              |
| Hong Kong-CHN                | 60              |
| Malaysia                     | 60              |
| Turkey                       | 60              |
| <b>International average</b> | <b>57</b>       |
| Ukraine                      | 56              |
| United Arab Emirates         | 54 ▼            |
| Iran, Islamic Rep. of        | 51 ▼            |
| Georgia                      | 49 ▼            |
| Tunisia                      | 49 ▼            |
| Hungary                      | 48 ▼            |
| Saudi Arabia                 | 46 ▼            |
| Bahrain                      | 46 ▼            |
| Lebanon                      | 46 ▼            |
| Indonesia                    | 46 ▼            |
| Thailand                     | 45 ▼            |
| Macedonia, Rep. of           | 45 ▼            |
| Kazakhstan                   | 44 ▼            |
| Qatar                        | 43 ▼            |
| Jordan                       | 43 ▼            |
| Armenia                      | 42 ▼            |
| Morocco                      | 42 ▼            |
| Oman                         | 42 ▼            |
| Palestinian Nat'l Auth.      | 38 ▼            |
| Syrian Arab Republic         | 32 ▼            |
| Ghana                        | 30 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 79 ▲ |
| Massachusetts-USA  | 77 ▲ |
| North Carolina-USA | 76 ▲ |
| Indiana-USA        | 76 ▲ |
| Quebec-CAN         | 76 ▲ |
| Connecticut-USA    | 75 ▲ |
| Alberta-CAN        | 73 ▲ |
| Ontario-CAN        | 71 ▲ |
| Colorado-USA       | 70 ▲ |
| Florida-USA        | 67 ▲ |
| California-USA     | 64 ▲ |
| Alabama-USA        | 60   |
| Dubai-UAE          | 57   |
| Abu Dhabi-UAE      | 55   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Reasoning        |

### Water travels through a plant

Susie has a potted plant. She sets up an experiment that shows that water travels through a plant into the air.



Which experiment would show this?

- A. Put water in a container under the pot; water will disappear from the container.
- B. Cover one of the stems of the plant with a plastic bag and water the plant; drops of water will be seen in the bag.
- C. Place a cut stem from the plant in a plastic bag; water will be seen in the bag.
- D. Place a cut stem from the plant in a glass of colored water; the plant's leaves will change color.

Item Number: S052030

**Correct Response:**

**B**

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 76 ▲            |
| Tunisia                      | 74 ▲            |
| Japan                        | 62 ▲            |
| Slovenia                     | 61 ▲            |
| Turkey                       | 58 ▲            |
| Finland                      | 57 ▲            |
| Russian Federation           | 56 ▲            |
| Israel                       | 56 ▲            |
| Singapore                    | 55 ▲            |
| Hungary                      | 53 ▲            |
| Chinese Taipei-CHN           | 52 ▲            |
| <b>United States</b>         | <b>51 ▲</b>     |
| Sweden                       | 50 ▲            |
| Italy                        | 49              |
| Australia                    | 49              |
| United Arab Emirates         | 48              |
| Thailand                     | 48              |
| Jordan                       | 48              |
| Morocco                      | 47              |
| Saudi Arabia                 | 47              |
| <b>International average</b> | <b>47</b>       |
| New Zealand                  | 46              |
| Hong Kong-CHN                | 46              |
| Lithuania                    | 44              |
| Georgia                      | 44              |
| England-GBR                  | 44              |
| Palestinian Nat'l Auth.      | 42 ▼            |
| Ukraine                      | 42              |
| Romania                      | 42 ▼            |
| Syrian Arab Republic         | 42              |
| Oman                         | 41 ▼            |
| Kazakhstan                   | 40 ▼            |
| Macedonia, Rep. of           | 40 ▼            |
| Bahrain                      | 38 ▼            |
| Qatar                        | 37 ▼            |
| Norway                       | 36 ▼            |
| Lebanon                      | 35 ▼            |
| Iran, Islamic Rep. of        | 35 ▼            |
| Armenia                      | 35 ▼            |
| Indonesia                    | 34 ▼            |
| Chile                        | 33 ▼            |
| Ghana                        | 31 ▼            |
| Malaysia                     | 29 ▼            |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 57 ▲ |
| Minnesota-USA      | 57 ▲ |
| North Carolina-USA | 57 ▲ |
| Colorado-USA       | 56 ▲ |
| Alberta-CAN        | 56 ▲ |
| Florida-USA        | 56 ▲ |
| Connecticut-USA    | 55 ▲ |
| Abu Dhabi-UAE      | 52 ▲ |
| Dubai-UAE          | 49   |
| Ontario-CAN        | 46   |
| Indiana-USA        | 45   |
| California-USA     | 45   |
| Alabama-USA        | 43   |
| Quebec-CAN         | 38 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic   | Cognitive Domain |
|----------------|--------------|------------------|
| BIOLOGY        | Human Health | Knowing          |

## Foods diabetics should avoid

John has diabetes.

Which of the following should he be careful about eating or drinking?

A. beef

B. eggs

C. milk

D. fruit juice

Item Number: S052080

|                   |   |
|-------------------|---|
| Correct Response: | D |
|-------------------|---|

## Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| <i>Chinese Taipei-CHN</i>      | 81 ▲            |
| Sweden                         | 81 ▲            |
| Russian Federation             | 80 ▲            |
| Slovenia                       | 78 ▲            |
| Israel                         | 78 ▲            |
| Korea, Rep. of                 | 76 ▲            |
| Turkey                         | 76 ▲            |
| <i>Hong Kong-CHN</i>           | 76 ▲            |
| Japan                          | 75 ▲            |
| Hungary                        | 73 ▲            |
| Finland                        | 70 ▲            |
| Lithuania                      | 67 ▲            |
| Ukraine                        | 67 ▲            |
| Iran, Islamic Rep. of          | 65 ▲            |
| Norway                         | 64              |
| New Zealand                    | 64              |
| Saudi Arabia                   | 64              |
| Bahrain                        | 63              |
| Australia                      | 63              |
| Jordan                         | 62              |
| Tunisia                        | 62              |
| <b>United States</b>           | <b>62</b>       |
| <i>England-GBR</i>             | 62              |
| <b>International average</b>   | <b>61</b>       |
| Kazakhstan                     | 60              |
| Singapore                      | 59              |
| Armenia                        | 59              |
| Syrian Arab Republic           | 58              |
| Oman                           | 57 ▼            |
| United Arab Emirates           | 57 ▼            |
| Italy                          | 57              |
| <i>Palestinian Nat'l Auth.</i> | 57 ▼            |
| Georgia                        | 56              |
| Morocco                        | 53 ▼            |
| Qatar                          | 50 ▼            |
| Romania                        | 48 ▼            |
| Thailand                       | 47 ▼            |
| Chile                          | 44 ▼            |
| Macedonia, Rep. of             | 41 ▼            |
| Ghana                          | 41 ▼            |
| Lebanon                        | 38 ▼            |
| Indonesia                      | 36 ▼            |
| Malaysia                       | 26 ▼            |

## Benchmarking education system

|                           |      |
|---------------------------|------|
| <i>Alberta-CAN</i>        | 75 ▲ |
| <i>Quebec-CAN</i>         | 74 ▲ |
| <i>Ontario-CAN</i>        | 71 ▲ |
| <i>North Carolina-USA</i> | 71 ▲ |
| <i>Minnesota-USA</i>      | 71 ▲ |
| <i>Massachusetts-USA</i>  | 70 ▲ |
| <i>Connecticut-USA</i>    | 69 ▲ |
| <i>Colorado-USA</i>       | 65   |
| <i>Indiana-USA</i>        | 61   |
| <i>Abu Dhabi-UAE</i>      | 61   |
| <i>Alabama-USA</i>        | 60   |
| <i>California-USA</i>     | 58   |
| <i>Florida-USA</i>        | 58   |
| <i>Dubai-UAE</i>          | 56 ▼ |

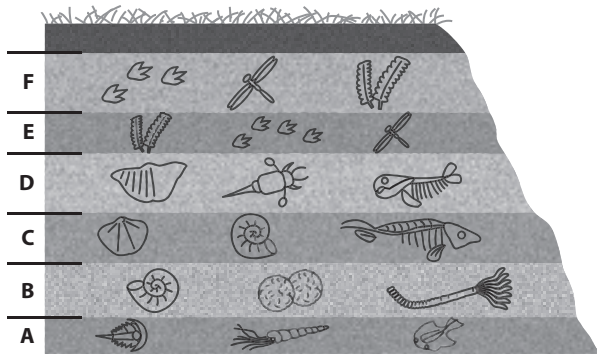
▲ Percent higher than International average  
▼ Percent lower than International average



| Content Domain | Main Topic                                   | Cognitive Domain |
|----------------|--|------------------|
| <b>BIOLOGY</b> | Diversity, Adaptation, and Natural Selection | Applying         |

Layers of rock with fossils

The diagram below shows geological layers of rock containing fossils. Layer F is the uppermost layer, while Layer A is the deepest layer.



Which statement about the age of the fossils is most likely correct?

- A. Fossils in Layer A are the oldest, because they are located in the deepest layer.
- B. Fossils in Layer C are the youngest, because they look similar to existing organisms.
- C. Fossils in Layer D are older than fossils in Layer A, because the fossils in Layer D are bigger.
- D. Fossils in Layer E are the same age as those in Layer F because they look the same.

Item Number: S052088

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>A</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Chinese Taipei-CHN             | 89 ▲            |
| Japan                          | 85 ▲            |
| Korea, Rep. of                 | 85 ▲            |
| <b>United States</b>           | <b>84 ▲</b>     |
| England-GBR                    | 84 ▲            |
| Hong Kong-CHN                  | 84 ▲            |
| Singapore                      | 83 ▲            |
| Israel                         | 79 ▲            |
| Australia                      | 79 ▲            |
| Slovenia                       | 78 ▲            |
| New Zealand                    | 76 ▲            |
| Finland                        | 75 ▲            |
| Jordan                         | 74 ▲            |
| Italy                          | 73 ▲            |
| Lithuania                      | 73 ▲            |
| Iran, Islamic Rep. of          | 70 ▲            |
| Sweden                         | 69 ▲            |
| Russian Federation             | 69 ▲            |
| Hungary                        | 69 ▲            |
| United Arab Emirates           | 68 ▲            |
| Norway                         | 67              |
| Chile                          | 65              |
| Ukraine                        | 65              |
| <b>International average</b>   | <b>64</b>       |
| Romania                        | 61              |
| Turkey                         | 59 ▼            |
| Macedonia, Rep. of             | 58 ▼            |
| Kazakhstan                     | 57 ▼            |
| Lebanon                        | 55 ▼            |
| Bahrain                        | 54 ▼            |
| Oman                           | 54 ▼            |
| Malaysia                       | 53 ▼            |
| Qatar                          | 52 ▼            |
| Georgia                        | 51 ▼            |
| <i>Palestinian Nat'l Auth.</i> | 50 ▼            |
| Syrian Arab Republic           | 50 ▼            |
| Morocco                        | 49 ▼            |
| Saudi Arabia                   | 49 ▼            |
| Tunisia                        | 47 ▼            |
| Indonesia                      | 43 ▼            |
| Armenia                        | 38 ▼            |
| Thailand                       | 37 ▼            |
| Ghana                          | 36 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Minnesota-USA      | 92 ▲ |
| Massachusetts-USA  | 90 ▲ |
| North Carolina-USA | 90 ▲ |
| Indiana-USA        | 86 ▲ |
| Florida-USA        | 86 ▲ |
| Alberta-CAN        | 83 ▲ |
| Colorado-USA       | 83 ▲ |
| Connecticut-USA    | 81 ▲ |
| Alabama-USA        | 80 ▲ |
| Quebec-CAN         | 80 ▲ |
| California-USA     | 79 ▲ |
| Ontario-CAN        | 77 ▲ |
| Dubai-UAE          | 69 ▲ |
| Abu Dhabi-UAE      | 65   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic | Cognitive Domain |
|----------------|------------|------------------|
| BIOLOGY        | Ecosystems | Reasoning        |

### Mayor wants to plant trees

The amount of carbon dioxide in the air is increasing in a large city due to the growing number of vehicles. The mayor wants to plant more trees.

A. Do you agree with the mayor's suggestion?

(Check one box.)

- Yes  
 No

B. Explain your answer.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Hong Kong-CHN                | 76 ▲            |
| Singapore                    | 73 ▲            |
| Chinese Taipei-CHN           | 70 ▲            |
| Kazakhstan                   | 69 ▲            |
| Japan                        | 67 ▲            |
| Korea, Rep. of               | 64 ▲            |
| Russian Federation           | 54 ▲            |
| Bahrain                      | 54 ▲            |
| Jordan                       | 52 ▲            |
| Thailand                     | 51 ▲            |
| England-GBR                  | 51              |
| Tunisia                      | 50              |
| Romania                      | 49              |
| United Arab Emirates         | 48              |
| Israel                       | 48              |
| Oman                         | 48              |
| Syrian Arab Republic         | 47              |
| New Zealand                  | 47              |
| Iran, Islamic Rep. of        | 46              |
| <b>International average</b> | <b>46</b>       |
| Australia                    | 45              |
| Malaysia                     | 45              |
| Slovenia                     | 43              |
| Sweden                       | 43              |
| Indonesia                    | 42              |
| Qatar                        | 42              |
| Saudi Arabia                 | 41 ▼            |
| Palestinian Nat'l Auth.      | 40 ▼            |
| Turkey                       | 40 ▼            |
| Italy                        | 39 ▼            |
| Hungary                      | 39 ▼            |
| <b>United States</b>         | <b>39 ▼</b>     |
| Finland                      | 38 ▼            |
| Norway                       | 38 ▼            |
| Georgia                      | 36 ▼            |
| Ukraine                      | 36 ▼            |
| Lebanon                      | 35 ▼            |
| Macedonia, Rep. of           | 35 ▼            |
| Armenia                      | 33 ▼            |
| Lithuania                    | 29 ▼            |
| Morocco                      | 27 ▼            |
| Chile                        | 26 ▼            |
| Ghana                        | 24 ▼            |

Item Number: S052091

### SCORING

#### Correct Response

- Yes with an explanation that trees absorb carbon dioxide (during photosynthesis).

Examples:

Yes – When trees photosynthesize they take in carbon dioxide and give out oxygen.

Yes – Trees take in carbon dioxide.

- No with a valid explanation related to reducing carbon dioxide emission.

Examples:

No – The mayor should suggest ways to cut the amount of carbon dioxide by getting people to walk or cycle.

No – I disagree with the mayor, as planting more trees won't solve the problem the same way as lessening the amount of cars on the road.

#### Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task), including the following response:

Explanation relates to oxygen only.

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Dubai-UAE          | 56 ▲ |
| Massachusetts-USA  | 55 ▲ |
| Alberta-CAN        | 54 ▲ |
| Abu Dhabi-UAE      | 50 ▲ |
| Ontario-CAN        | 50   |
| Minnesota-USA      | 46   |
| Colorado-USA       | 45   |
| Quebec-CAN         | 45   |
| Florida-USA        | 44   |
| Indiana-USA        | 41   |
| North Carolina-USA | 39 ▼ |
| Connecticut-USA    | 39 ▼ |
| California-USA     | 29 ▼ |
| Alabama-USA        | 25 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

## Mayor wants to plant trees (continued)

S052091:

## Student Responses

## Correct Response:

A. Do you agree with the mayor's suggestion?

(Check one box.)

 Yes No

B. Explain your answer.

Because the tree's would absorb the carbon dioxide.

## Incorrect Response:

A. Do you agree with the mayor's suggestion?

(Check one box.)

 Yes No

B. Explain your answer.

yes, because trees make oxygen so that we can stay alive.

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| <b>BIOLOGY</b> | Life Cycles, Reproduction, and Heredity | Applying         |

## Genetic makeup of twins

Twins are born. One is a boy and one is a girl.

Which statement is correct about their genetic makeup?

- A. The boy and the girl inherit genetic material from the father only.
- B. The boy and girl inherit genetic material from the mother only.
- C. The boy and girl inherit genetic material from both parents.
- D. The boy inherits genetic material from the father only and the girl inherits it from the mother only.

Item Number: S052093

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>C</b> |
|--------------------------|----------|

## Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Japan                          | 95 ▲            |
| Finland                        | 94 ▲            |
| Korea, Rep. of                 | 93 ▲            |
| Singapore                      | 92 ▲            |
| Slovenia                       | 91 ▲            |
| Jordan                         | 91 ▲            |
| <b>United States</b>           | <b>90 ▲</b>     |
| Israel                         | 90 ▲            |
| <i>Chinese Taipei-CHN</i>      | 89 ▲            |
| <i>England-GBR</i>             | 88 ▲            |
| <i>Hong Kong-CHN</i>           | 88 ▲            |
| Russian Federation             | 88 ▲            |
| Italy                          | 88 ▲            |
| Hungary                        | 87 ▲            |
| Armenia                        | 87 ▲            |
| Tunisia                        | 87 ▲            |
| Ukraine                        | 86              |
| United Arab Emirates           | 86 ▲            |
| Australia                      | 86              |
| Bahrain                        | 85              |
| Saudi Arabia                   | 85              |
| New Zealand                    | 85              |
| Lithuania                      | 84              |
| Turkey                         | 84              |
| <i>Palestinian Nat'l Auth.</i> | 84              |
| <b>International average</b>   | <b>83</b>       |
| Sweden                         | 83              |
| Romania                        | 83              |
| Norway                         | 82              |
| Qatar                          | 82              |
| Syrian Arab Republic           | 81              |
| Oman                           | 81 ▼            |
| Morocco                        | 80 ▼            |
| Chile                          | 80 ▼            |
| Kazakhstan                     | 79 ▼            |
| Thailand                       | 77 ▼            |
| Georgia                        | 76 ▼            |
| Lebanon                        | 76 ▼            |
| Iran, Islamic Rep. of          | 75 ▼            |
| Indonesia                      | 70 ▼            |
| Ghana                          | 69 ▼            |
| Malaysia                       | 69 ▼            |
| Macedonia, Rep. of             | 63 ▼            |

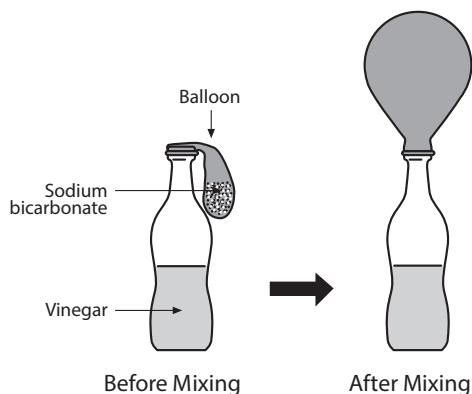
## Benchmarking education system

|                           |      |
|---------------------------|------|
| <i>Massachusetts-USA</i>  | 95 ▲ |
| <i>Minnesota-USA</i>      | 94 ▲ |
| <i>Indiana-USA</i>        | 92 ▲ |
| <i>North Carolina-USA</i> | 91 ▲ |
| <i>Connecticut-USA</i>    | 89 ▲ |
| <i>Alberta-CAN</i>        | 89 ▲ |
| <i>Colorado-USA</i>       | 89 ▲ |
| <i>Alabama-USA</i>        | 88 ▲ |
| <i>Florida-USA</i>        | 87   |
| <i>Quebec-CAN</i>         | 87 ▲ |
| <i>Ontario-CAN</i>        | 87 ▲ |
| <i>California-USA</i>     | 86   |
| <i>Abu Dhabi-UAE</i>      | 86   |
| <i>Dubai-UAE</i>          | 86   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| CHEMISTRY      | Chemical Change | Applying         |

## Sodium bicarbonate in vinegar



As shown in the diagram, the balloon inflates when the sodium bicarbonate in the balloon is mixed with the vinegar.

What causes this to happen?

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 64 ▲            |
| Singapore                    | 62 ▲            |
| Kazakhstan                   | 61 ▲            |
| England-GBR                  | 58 ▲            |
| Russian Federation           | 57 ▲            |
| Australia                    | 55 ▲            |
| Japan                        | 52 ▲            |
| New Zealand                  | 52 ▲            |
| <b>United States</b>         | <b>51 ▲</b>     |
| Hong Kong-CHN                | 51 ▲            |
| Slovenia                     | 51 ▲            |
| Bahrain                      | 50 ▲            |
| Saudi Arabia                 | 49 ▲            |
| United Arab Emirates         | 45 ▲            |
| Hungary                      | 45 ▲            |
| Korea, Rep. of               | 42              |
| Italy                        | 41              |
| Finland                      | 39              |
| Jordan                       | 39              |
| Norway                       | 39              |
| <b>International average</b> | <b>38</b>       |
| Israel                       | 38              |
| Ukraine                      | 38              |
| Lithuania                    | 37              |
| Sweden                       | 37              |
| Romania                      | 36              |
| Iran, Islamic Rep. of        | 34 ▼            |
| Chile                        | 34 ▼            |
| Thailand                     | 33 ▼            |
| Armenia                      | 32 ▼            |
| Syrian Arab Republic         | 31 ▼            |
| Lebanon                      | 31 ▼            |
| Qatar                        | 30 ▼            |
| Turkey                       | 29 ▼            |
| Macedonia, Rep. of           | 26 ▼            |
| Palestinian Nat'l Auth.      | 26 ▼            |
| Indonesia                    | 25 ▼            |
| Malaysia                     | 23 ▼            |
| Oman                         | 22 ▼            |
| Morocco                      | 14 ▼            |
| Tunisia                      | 14 ▼            |
| Georgia                      | 13 ▼            |
| Ghana                        | 6 ▼             |

Item Number: S032056

## SCORING

## Correct Response

- States that carbon dioxide is given off (as a result of chemical reaction).

Example: Chemical reaction expels carbon dioxide which blows the balloon up.

- States that a gas is given off (as a result of chemical reaction). [Does NOT explicitly mention carbon dioxide.]

Example: When they mix the two chemicals, a gas is produced and it goes up into the balloon.

- States that a chemical reaction occurs. [Does NOT explicitly mention gas production.]

Example: Vinegar has a reaction when it is mixed with sodium bicarbonate.

- Other correct

## Incorrect Response

- Refers only to gas (air) rising into the balloon, or similar. [No mention of chemical reaction or gas production.]
- Refers to production of air, helium or some other incorrect gas.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 60 ▲ |
| Massachusetts-USA  | 60 ▲ |
| Colorado-USA       | 57 ▲ |
| Florida-USA        | 56 ▲ |
| California-USA     | 52 ▲ |
| North Carolina-USA | 51 ▲ |
| Minnesota-USA      | 50 ▲ |
| Quebec-CAN         | 50 ▲ |
| Dubai-UAE          | 49 ▲ |
| Indiana-USA        | 49 ▲ |
| Connecticut-USA    | 44 ▲ |
| Abu Dhabi-UAE      | 44 ▲ |
| Ontario-CAN        | 41   |
| Alabama-USA        | 36   |

▲ Percent higher than International average  
▼ Percent lower than International average

Sodium bicarbonate in vinegar (continued)

S032056:

## Student Responses

### Correct Response:

The chemical reaction releases a gas  
which fills up the gallon.

### Incorrect Response:

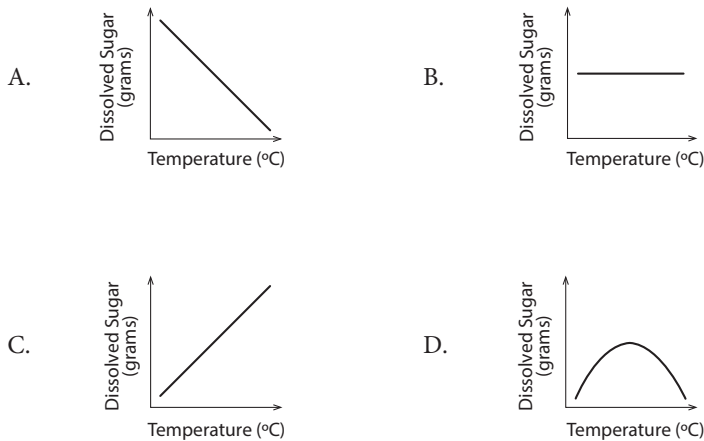
The warm air.

| Content Domain | Main Topic           | Cognitive Domain |
|----------------|----------------------|------------------|
| CHEMISTRY      | Properties of Matter | Reasoning        |

Solubility/temperature graphs

Bob did an experiment to investigate the effect of temperature on the solubility of sugar in water by measuring the amount of sugar that would dissolve in 1 liter of water at different temperatures. He then plotted his results.

Which of the following is likely to be the graph showing Bob's results?



Item Number: S032156

|                   |   |
|-------------------|---|
| Correct Response: | C |
|-------------------|---|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 82 ▲            |
| Japan                        | 77 ▲            |
| Chinese Taipei-CHN           | 76 ▲            |
| Singapore                    | 66 ▲            |
| Finland                      | 57 ▲            |
| Slovenia                     | 57 ▲            |
| England-GBR                  | 57 ▲            |
| Russian Federation           | 56 ▲            |
| Australia                    | 55 ▲            |
| Hong Kong-CHN                | 54 ▲            |
| Malaysia                     | 54 ▲            |
| <b>United States</b>         | <b>54 ▲</b>     |
| Israel                       | 54 ▲            |
| New Zealand                  | 54 ▲            |
| Hungary                      | 52 ▲            |
| Turkey                       | 52 ▲            |
| Lithuania                    | 51 ▲            |
| Bahrain                      | 48              |
| Palestinian Nat'l Auth.      | 45              |
| <b>International average</b> | <b>45</b>       |
| Jordan                       | 44              |
| Oman                         | 44              |
| Ukraine                      | 43              |
| United Arab Emirates         | 42              |
| Norway                       | 41              |
| Sweden                       | 40 ▼            |
| Qatar                        | 40              |
| Lebanon                      | 40              |
| Tunisia                      | 39 ▼            |
| Kazakhstan                   | 39 ▼            |
| Italy                        | 36 ▼            |
| Thailand                     | 36 ▼            |
| Chile                        | 34 ▼            |
| Saudi Arabia                 | 34 ▼            |
| Morocco                      | 29 ▼            |
| Romania                      | 28 ▼            |
| Georgia                      | 26 ▼            |
| Macedonia, Rep. of           | 26 ▼            |
| Armenia                      | 26 ▼            |
| Iran, Islamic Rep. of        | 25 ▼            |
| Syrian Arab Republic         | 21 ▼            |
| Indonesia                    | 21 ▼            |
| Ghana                        | 18 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 65 ▲ |
| Massachusetts-USA  | 61 ▲ |
| California-USA     | 59 ▲ |
| Colorado-USA       | 58 ▲ |
| Indiana-USA        | 58 ▲ |
| Connecticut-USA    | 58 ▲ |
| Minnesota-USA      | 57 ▲ |
| North Carolina-USA | 55 ▲ |
| Florida-USA        | 54 ▲ |
| Alabama-USA        | 48   |
| Ontario-CAN        | 47   |
| Dubai-UAE          | 47   |
| Abu Dhabi-UAE      | 43   |
| Quebec-CAN         | 42   |

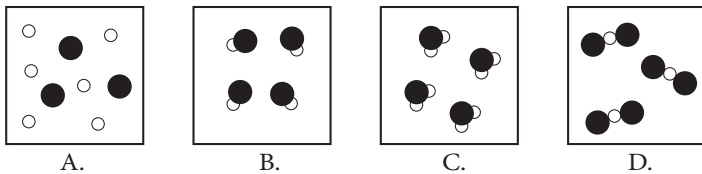
▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Applying         |

Diagram of water molecules

In the diagrams below, hydrogen atoms are represented by white circles, and oxygen atoms are represented by black circles.

Which of the diagrams best represents water?



Item Number: S032502

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>C</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 83 ▲            |
| Russian Federation           | 79 ▲            |
| Slovenia                     | 77 ▲            |
| Japan                        | 73 ▲            |
| Sweden                       | 72 ▲            |
| Chinese Taipei-CHN           | 71 ▲            |
| Lithuania                    | 65 ▲            |
| Hungary                      | 65 ▲            |
| Singapore                    | 62 ▲            |
| Turkey                       | 61 ▲            |
| Ukraine                      | 57 ▲            |
| <b>United States</b>         | <b>55 ▲</b>     |
| Iran, Islamic Rep. of        | 54 ▲            |
| Israel                       | 50 ▲            |
| Italy                        | 48              |
| Norway                       | 47              |
| Kazakhstan                   | 47              |
| <b>International average</b> | <b>46</b>       |
| Korea, Rep. of               | 45              |
| Bahrain                      | 44              |
| Australia                    | 43              |
| Malaysia                     | 43              |
| New Zealand                  | 41              |
| Armenia                      | 40 ▼            |
| Morocco                      | 40 ▼            |
| England-GBR                  | 39 ▼            |
| Romania                      | 39 ▼            |
| Syrian Arab Republic         | 39 ▼            |
| Lebanon                      | 39 ▼            |
| Chile                        | 38 ▼            |
| Saudi Arabia                 | 37 ▼            |
| Macedonia, Rep. of           | 36 ▼            |
| United Arab Emirates         | 35 ▼            |
| Qatar                        | 35 ▼            |
| Jordan                       | 32 ▼            |
| Palestinian Nat'l Auth.      | 30 ▼            |
| Georgia                      | 28 ▼            |
| Hong Kong-CHN                | 25 ▼            |
| Oman                         | 23 ▼            |
| Thailand                     | 19 ▼            |
| Indonesia                    | 18 ▼            |
| Tunisia                      | 17 ▼            |
| Ghana                        | 16 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| North Carolina-USA | 71 ▲ |
| Massachusetts-USA  | 64 ▲ |
| California-USA     | 59 ▲ |
| Indiana-USA        | 56 ▲ |
| Colorado-USA       | 54 ▲ |
| Florida-USA        | 52   |
| Minnesota-USA      | 52   |
| Connecticut-USA    | 50   |
| Alabama-USA        | 46   |
| Quebec-CAN         | 45   |
| Dubai-UAE          | 38 ▼ |
| Abu Dhabi-UAE      | 37 ▼ |
| Alberta-CAN        | 33 ▼ |
| Ontario-CAN        | 28 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average



| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Reasoning        |

## Identify if substance is metal

David is given a sample of an unknown solid substance. He wants to know if the substance is a metal. Write down one property he can observe or measure and describe how this property could be used to help identify whether the substance is a metal.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 72 ▲            |
| Slovenia                     | 69 ▲            |
| Singapore                    | 64 ▲            |
| England-GBR                  | 61 ▲            |
| Israel                       | 58 ▲            |
| Chinese Taipei-CHN           | 56 ▲            |
| Hong Kong-CHN                | 52 ▲            |
| Kazakhstan                   | 49 ▲            |
| <b>United States</b>         | <b>48 ▲</b>     |
| Russian Federation           | 48 ▲            |
| Hungary                      | 46 ▲            |
| Sweden                       | 45 ▲            |
| Jordan                       | 45 ▲            |
| Finland                      | 44 ▲            |
| Lithuania                    | 42 ▲            |
| New Zealand                  | 41 ▲            |
| Ukraine                      | 41 ▲            |
| Iran, Islamic Rep. of        | 40 ▲            |
| Australia                    | 38              |
| <b>International average</b> | <b>35</b>       |
| Norway                       | 34              |
| Palestinian Nat'l Auth.      | 32              |
| Saudi Arabia                 | 31              |
| Armenia                      | 31 ▼            |
| Korea, Rep. of               | 31 ▼            |
| Bahrain                      | 29 ▼            |
| Turkey                       | 29 ▼            |
| Qatar                        | 28 ▼            |
| United Arab Emirates         | 24 ▼            |
| Italy                        | 24 ▼            |
| Ghana                        | 23 ▼            |
| Romania                      | 22 ▼            |
| Macedonia, Rep. of           | 22 ▼            |
| Lebanon                      | 21 ▼            |
| Thailand                     | 20 ▼            |
| Malaysia                     | 18 ▼            |
| Syrian Arab Republic         | 17 ▼            |
| Georgia                      | 16 ▼            |
| Tunisia                      | 15 ▼            |
| Oman                         | 15 ▼            |
| Chile                        | 13 ▼            |
| Indonesia                    | 10 ▼            |
| Morocco                      | 7 ▼             |

Item Number: S032570

## SCORING

## Correct Response

- Response based on a characteristic property of common metals that can be measured (e.g., conductor of heat, conductor of electricity, thermal expansion, density, magnetic properties, melting point).
- Response based on physical appearance or form (e.g., shiny appearance, hardness, malleability/ductility).
- Response based on chemical reactivity of metals (e.g., tendency to undergo oxidation, reaction with acid).
- Other correct

## Incorrect Response

- Refers to a magnetic test that is incorrect; no procedure given or indicates that all metals are attracted to magnets or that NON-attraction indicates a non-metal.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 65 ▲ |
| North Carolina-USA | 56 ▲ |
| Minnesota-USA      | 50 ▲ |
| Indiana-USA        | 49 ▲ |
| Connecticut-USA    | 47 ▲ |
| Colorado-USA       | 47 ▲ |
| California-USA     | 45 ▲ |
| Alberta-CAN        | 42 ▲ |
| Dubai-UAE          | 41 ▲ |
| Florida-USA        | 41   |
| Quebec-CAN         | 39 ▲ |
| Ontario-CAN        | 35   |
| Alabama-USA        | 35   |
| Abu Dhabi-UAE      | 19 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Identify if substance is metal (continued)

S032570:

## Student Responses

### Correct Response:

He can weigh it, or feel how hard it is.  
A metal is tested by its texture, hardness,  
shape and size; so if you use hardness,  
you should have no problems.

### Incorrect Response:

if it is magnetic it is metal.

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Applying         |

Diagram for structure of matter

Which of these diagrams best represents the structure of matter, starting with the more complex particles at the top and ending with the more fundamental particles at the bottom?

A.

```

graph TD
    A[Atoms] --- B[Molecules]
    B --- C[Protons]
    B --- D[Neutrons]
    B --- E[Electrons]
            
```

B.

```

graph TD
    B[Molecules] --- A[Atoms]
    A --- C[Protons]
    A --- D[Neutrons]
    A --- E[Electrons]
            
```

C.

```

graph TD
    C[Protons] --- D[Electrons]
    D --- A[Atoms]
    D --- B[Molecules]
    D --- E[Neutrons]
            
```

D.

```

graph TD
    D[Electrons] --- E[Neutrons]
    E --- B[Molecules]
    E --- A[Atoms]
    E --- C[Protons]
            
```

Item Number: S032579

|                   |   |
|-------------------|---|
| Correct Response: | B |
|-------------------|---|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Slovenia                     | 65 ▲            |
| Singapore                    | 62 ▲            |
| Russian Federation           | 62 ▲            |
| Israel                       | 52 ▲            |
| Finland                      | 51 ▲            |
| Lithuania                    | 51 ▲            |
| Italy                        | 51 ▲            |
| Kazakhstan                   | 51 ▲            |
| Ukraine                      | 51 ▲            |
| Hungary                      | 49 ▲            |
| Iran, Islamic Rep. of        | 48 ▲            |
| <b>United States</b>         | <b>46 ▲</b>     |
| Lebanon                      | 46 ▲            |
| Armenia                      | 46 ▲            |
| Chile                        | 45              |
| Macedonia, Rep. of           | 44              |
| Turkey                       | 43              |
| Chinese Taipei-CHN           | 41              |
| Romania                      | 41              |
| <b>International average</b> | <b>41</b>       |
| Sweden                       | 39              |
| Norway                       | 39              |
| New Zealand                  | 39              |
| Tunisia                      | 39              |
| Jordan                       | 39              |
| Thailand                     | 38              |
| United Arab Emirates         | 37 ▼            |
| Oman                         | 36 ▼            |
| Georgia                      | 36              |
| Palestinian Nat'l Auth.      | 35 ▼            |
| Australia                    | 34 ▼            |
| Korea, Rep. of               | 34 ▼            |
| England-GBR                  | 33 ▼            |
| Bahrain                      | 32 ▼            |
| Malaysia                     | 32 ▼            |
| Syrian Arab Republic         | 32 ▼            |
| Saudi Arabia                 | 31 ▼            |
| Morocco                      | 31 ▼            |
| Qatar                        | 28 ▼            |
| Japan                        | 27 ▼            |
| Indonesia                    | 25 ▼            |
| Hong Kong-CHN                | 24 ▼            |
| Ghana                        | 19 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 51 ▲ |
| Connecticut-USA    | 46   |
| California-USA     | 46   |
| North Carolina-USA | 45   |
| Quebec-CAN         | 44   |
| Indiana-USA        | 43   |
| Florida-USA        | 43   |
| Colorado-USA       | 42   |
| Dubai-UAE          | 39   |
| Abu Dhabi-UAE      | 38   |
| Minnesota-USA      | 37   |
| Ontario-CAN        | 33 ▼ |
| Alabama-USA        | 32   |
| Alberta-CAN        | 30 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| CHEMISTRY      | Chemical Change | Applying         |

### Energy released during a reaction

Write down one thing you might observe that shows that energy has been released during a chemical reaction.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 49 ▲            |
| Slovenia                     | 48 ▲            |
| Chinese Taipei-CHN           | 43 ▲            |
| Singapore                    | 30 ▲            |
| Kazakhstan                   | 28 ▲            |
| New Zealand                  | 27 ▲            |
| Ukraine                      | 27 ▲            |
| Japan                        | 26 ▲            |
| Iran, Islamic Rep. of        | 24 ▲            |
| Australia                    | 24 ▲            |
| Hong Kong-CHN                | 23 ▲            |
| <b>United States</b>         | <b>22 ▲</b>     |
| Lithuania                    | 22 ▲            |
| United Arab Emirates         | 22 ▲            |
| Russian Federation           | 22              |
| Israel                       | 20              |
| England-GBR                  | 19              |
| Syrian Arab Republic         | 18              |
| <b>International average</b> | <b>18</b>       |
| Sweden                       | 17              |
| Bahrain                      | 16              |
| Hungary                      | 15              |
| Qatar                        | 15              |
| Norway                       | 14 ▼            |
| Saudi Arabia                 | 14 ▼            |
| Jordan                       | 12 ▼            |
| Armenia                      | 12 ▼            |
| Lebanon                      | 12 ▼            |
| Korea, Rep. of               | 12 ▼            |
| Chile                        | 11 ▼            |
| Romania                      | 11 ▼            |
| Macedonia, Rep. of           | 10 ▼            |
| Oman                         | 10 ▼            |
| Palestinian Nat'l Auth.      | 10 ▼            |
| Turkey                       | 9 ▼             |
| Malaysia                     | 8 ▼             |
| Italy                        | 8 ▼             |
| Morocco                      | 7 ▼             |
| Ghana                        | 6 ▼             |
| Tunisia                      | 6 ▼             |
| Thailand                     | 6 ▼             |
| Georgia                      | 4 ▼             |
| Indonesia                    | 4 ▼             |

Item Number: S032679

### SCORING

#### Correct Response

- Refers to heat or temperature increase (or similar).
- Refers to explosion or hearing sound (or similar).
- Refers to light production or seeing flames (or similar).
- Other correct

Example: If the chemical reaction causes something to move, like with a rocket blast.

#### Incorrect Response

- Refers only to steam, smoke, bubbling, gas production (or similar). [No explicit reference to heat.]
- Refers only to other evidence of change in materials that does not necessarily indicate that energy has been released (e.g., smell, color change).
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 32 ▲ |
| Minnesota-USA      | 25 ▲ |
| North Carolina-USA | 25 ▲ |
| Ontario-CAN        | 25 ▲ |
| Indiana-USA        | 24 ▲ |
| Quebec-CAN         | 24 ▲ |
| Abu Dhabi-UAE      | 23 ▲ |
| Massachusetts-USA  | 23   |
| Connecticut-USA    | 22   |
| Florida-USA        | 21   |
| Dubai-UAE          | 21   |
| California-USA     | 20   |
| Colorado-USA       | 17   |
| Alabama-USA        | 14   |

▲ Percent higher than International average  
▼ Percent lower than International average

Energy released during a reaction (continued)

S032679:

## Student Responses

### Correct Response:

When a chemical reaction releases energy, the substance will be warm or hot.

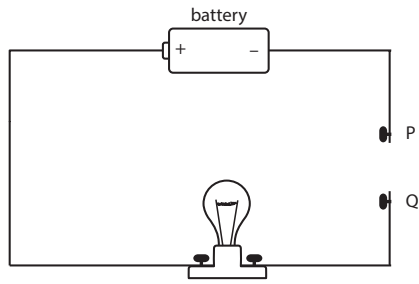
### Incorrect Response:

The chemicals start forming.

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Applying         |

Which rod causes the bulb to light

Rods made of different materials are connected between points P and Q in the circuit diagram shown below.



Which rod would cause the bulb to light?

- A. copper rod
- B. wood rod
- C. glass rod
- D. plastic rod

Item Number: S042063

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>A</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Russian Federation             | 97 ▲            |
| Hong Kong-CHN                  | 96 ▲            |
| Lithuania                      | 96 ▲            |
| Singapore                      | 96 ▲            |
| Israel                         | 95 ▲            |
| Slovenia                       | 95 ▲            |
| England-GBR                    | 95 ▲            |
| Finland                        | 94 ▲            |
| Chinese Taipei-CHN             | 94 ▲            |
| Japan                          | 94 ▲            |
| Chile                          | 94 ▲            |
| Thailand                       | 93 ▲            |
| Sweden                         | 93 ▲            |
| Indonesia                      | 92 ▲            |
| New Zealand                    | 92 ▲            |
| Turkey                         | 92 ▲            |
| Iran, Islamic Rep. of          | 91 ▲            |
| Italy                          | 91              |
| Morocco                        | 91 ▲            |
| <b>United States</b>           | <b>90</b>       |
| Australia                      | 89              |
| Tunisia                        | 88              |
| Korea, Rep. of                 | 88              |
| Jordan                         | 88              |
| <b>International average</b>   | <b>88</b>       |
| <i>Palestinian Nat'l Auth.</i> | 87              |
| Norway                         | 87              |
| Romania                        | 87              |
| Syrian Arab Republic           | 87              |
| Hungary                        | 87              |
| Ukraine                        | 86              |
| United Arab Emirates           | 84 ▼            |
| Malaysia                       | 84 ▼            |
| Bahrain                        | 83 ▼            |
| Macedonia, Rep. of             | 83 ▼            |
| Qatar                          | 80 ▼            |
| Saudi Arabia                   | 80 ▼            |
| Kazakhstan                     | 80 ▼            |
| Georgia                        | 80 ▼            |
| Armenia                        | 79 ▼            |
| Lebanon                        | 78 ▼            |
| Oman                           | 73 ▼            |
| Ghana                          | 69 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Alberta-CAN        | 95 ▲ |
| Indiana-USA        | 95 ▲ |
| Minnesota-USA      | 93 ▲ |
| Massachusetts-USA  | 93 ▲ |
| North Carolina-USA | 93 ▲ |
| Connecticut-USA    | 92 ▲ |
| Florida-USA        | 90   |
| Ontario-CAN        | 90   |
| Quebec-CAN         | 90   |
| Colorado-USA       | 90   |
| Dubai-UAE          | 90   |
| Alabama-USA        | 87   |
| California-USA     | 85   |
| Abu Dhabi-UAE      | 83 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Knowing          |

## Formula for carbon dioxide

What is the chemical formula for carbon dioxide?

- A. CO
- B. CO<sub>2</sub>
- C. C
- D. O<sub>2</sub>

Item Number: S042073

Correct Response:

**B**

## Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Japan                          | 99 ▲            |
| Chinese Taipei-CHN             | 98 ▲            |
| Lebanon                        | 97 ▲            |
| Slovenia                       | 96 ▲            |
| Romania                        | 94 ▲            |
| Hungary                        | 93 ▲            |
| England-GBR                    | 92 ▲            |
| Russian Federation             | 92 ▲            |
| Armenia                        | 91 ▲            |
| Singapore                      | 91 ▲            |
| Korea, Rep. of                 | 90 ▲            |
| Italy                          | 90 ▲            |
| Hong Kong-CHN                  | 89 ▲            |
| Indonesia                      | 89 ▲            |
| Ukraine                        | 88 ▲            |
| Kazakhstan                     | 88 ▲            |
| Macedonia, Rep. of             | 88 ▲            |
| Qatar                          | 87              |
| Syrian Arab Republic           | 87              |
| Israel                         | 86              |
| Oman                           | 86              |
| Jordan                         | 86              |
| <b>United States</b>           | <b>86</b>       |
| Lithuania                      | 85              |
| <b>International average</b>   | <b>85</b>       |
| <i>Palestinian Nat'l Auth.</i> | 85              |
| Australia                      | 84              |
| Norway                         | 84              |
| New Zealand                    | 84              |
| Turkey                         | 83              |
| United Arab Emirates           | 83              |
| Morocco                        | 82 ▼            |
| Sweden                         | 81 ▼            |
| Finland                        | 81 ▼            |
| Chile                          | 80 ▼            |
| Ghana                          | 79 ▼            |
| Bahrain                        | 79 ▼            |
| Saudi Arabia                   | 75 ▼            |
| Tunisia                        | 73 ▼            |
| Thailand                       | 73 ▼            |
| Georgia                        | 68 ▼            |
| Malaysia                       | 67 ▼            |
| Iran, Islamic Rep. of          | 59 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 93 ▲ |
| Minnesota-USA      | 93 ▲ |
| Colorado-USA       | 90 ▲ |
| Dubai-UAE          | 90 ▲ |
| Florida-USA        | 89 ▲ |
| Massachusetts-USA  | 89   |
| North Carolina-USA | 88   |
| Connecticut-USA    | 87   |
| Ontario-CAN        | 85   |
| Abu Dhabi-UAE      | 84   |
| Indiana-USA        | 84   |
| Quebec-CAN         | 84   |
| Alabama-USA        | 81   |
| California-USA     | 79   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Knowing          |

Number of atoms in H<sub>2</sub>SO<sub>4</sub> molecule

Complete the table below to show the number of atoms of each element in a molecule of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>).

| Element  | Number of Atoms |
|----------|-----------------|
| Hydrogen |                 |
| Sulfur   |                 |
| Oxygen   |                 |

Item Number: S042076

**SCORING****Correct Response**

- Completes the table as shown below:

| Element  | Number of Atoms |
|----------|-----------------|
| Hydrogen | 2               |
| Sulfur   | 1               |
| Oxygen   | 4               |

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 69 ▲            |
| Russian Federation           | 64 ▲            |
| Slovenia                     | 58 ▲            |
| Japan                        | 53 ▲            |
| Ukraine                      | 50 ▲            |
| Lebanon                      | 49 ▲            |
| <b>United States</b>         | <b>48 ▲</b>     |
| Kazakhstan                   | 47 ▲            |
| Macedonia, Rep. of           | 47 ▲            |
| Lithuania                    | 47 ▲            |
| Armenia                      | 46 ▲            |
| Chinese Taipei-CHN           | 44 ▲            |
| Romania                      | 43 ▲            |
| England-GBR                  | 41 ▲            |
| Iran, Islamic Rep. of        | 38 ▲            |
| Finland                      | 37              |
| Italy                        | 36              |
| Israel                       | 34              |
| <b>International average</b> | <b>33</b>       |
| Oman                         | 32              |
| United Arab Emirates         | 32              |
| Hungary                      | 31              |
| Turkey                       | 31              |
| New Zealand                  | 31              |
| Sweden                       | 30              |
| Chile                        | 30              |
| Australia                    | 27 ▼            |
| Norway                       | 27 ▼            |
| Korea, Rep. of               | 26 ▼            |
| Qatar                        | 25 ▼            |
| Jordan                       | 24 ▼            |
| Palestinian Nat'l Auth.      | 23 ▼            |
| Syrian Arab Republic         | 23 ▼            |
| Thailand                     | 21 ▼            |
| Hong Kong-CHN                | 21 ▼            |
| Bahrain                      | 21 ▼            |
| Morocco                      | 19 ▼            |
| Malaysia                     | 18 ▼            |
| Georgia                      | 11 ▼            |
| Saudi Arabia                 | 10 ▼            |
| Ghana                        | 8 ▼             |
| Indonesia                    | 7 ▼             |
| Tunisia                      | 2 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 68 ▲ |
| California-USA     | 57 ▲ |
| North Carolina-USA | 53 ▲ |
| Colorado-USA       | 53 ▲ |
| Indiana-USA        | 49 ▲ |
| Minnesota-USA      | 41 ▲ |
| Quebec-CAN         | 41 ▲ |
| Connecticut-USA    | 40 ▲ |
| Dubai-UAE          | 38 ▲ |
| Alabama-USA        | 38   |
| Florida-USA        | 34   |
| Abu Dhabi-UAE      | 33   |
| Alberta-CAN        | 12 ▼ |
| Ontario-CAN        | 12 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average



Number of atoms in H<sub>2</sub>SO<sub>4</sub> molecule (continued)

S042076:

**Student Responses****Correct Response:**

| Element  | Number of Atoms |
|----------|-----------------|
| Hydrogen | 2               |
| Sulfur   | 1               |
| Oxygen   | 4               |

**Incorrect Response:**

| Element  | Number of Atoms |
|----------|-----------------|
| Hydrogen | 2               |
| Sulfur   | 0               |
| Oxygen   | 4               |

| Content Domain | Main Topic           | Cognitive Domain |
|----------------|----------------------|------------------|
| CHEMISTRY      | Properties of Matter | Knowing          |

## Ammonia solution mixed in vinegar

Robert put two drops of an indicator into vinegar, and the color turned red. He then added drops of ammonia solution until the color disappeared.

What process occurred?

- A. rusting
- B. melting
- C. evaporation
- D. neutralization

Item Number: S042095

Correct Response:

D

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 91 ▲            |
| Finland                      | 90 ▲            |
| Singapore                    | 89 ▲            |
| Hong Kong-CHN                | 88 ▲            |
| Russian Federation           | 87 ▲            |
| Ukraine                      | 81 ▲            |
| Norway                       | 80 ▲            |
| England-GBR                  | 79 ▲            |
| Iran, Islamic Rep. of        | 77 ▲            |
| Hungary                      | 77 ▲            |
| <b>United States</b>         | <b>74 ▲</b>     |
| Jordan                       | 73 ▲            |
| Japan                        | 73 ▲            |
| Australia                    | 72 ▲            |
| Sweden                       | 70 ▲            |
| Turkey                       | 69              |
| Armenia                      | 68              |
| Italy                        | 68              |
| New Zealand                  | 68              |
| United Arab Emirates         | 67              |
| <b>International average</b> | <b>67</b>       |
| Slovenia                     | 65              |
| Lithuania                    | 65              |
| Bahrain                      | 65              |
| Korea, Rep. of               | 63              |
| Malaysia                     | 63              |
| Romania                      | 62              |
| Chile                        | 62 ▼            |
| Qatar                        | 61 ▼            |
| Kazakhstan                   | 61 ▼            |
| Israel                       | 60 ▼            |
| Oman                         | 59 ▼            |
| Syrian Arab Republic         | 58 ▼            |
| Indonesia                    | 58 ▼            |
| Tunisia                      | 58 ▼            |
| Thailand                     | 57 ▼            |
| Saudi Arabia                 | 54 ▼            |
| Georgia                      | 54 ▼            |
| Morocco                      | 51 ▼            |
| Lebanon                      | 48 ▼            |
| Palestinian Nat'l Auth.      | 48 ▼            |
| Macedonia, Rep. of           | 47 ▼            |
| Ghana                        | 34 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| North Carolina-USA | 81 ▲ |
| Minnesota-USA      | 79 ▲ |
| Massachusetts-USA  | 78 ▲ |
| Indiana-USA        | 78 ▲ |
| Alberta-CAN        | 75 ▲ |
| Florida-USA        | 74 ▲ |
| Connecticut-USA    | 72 ▲ |
| California-USA     | 72   |
| Colorado-USA       | 71   |
| Dubai-UAE          | 71 ▲ |
| Abu Dhabi-UAE      | 70   |
| Ontario-CAN        | 69   |
| Alabama-USA        | 63   |
| Quebec-CAN         | 54 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| CHEMISTRY      | Chemical Change | Knowing          |

## Observations for reaction

Ahmet put some powder into a test tube. He then added liquid to the powder and shook the test tube. A chemical reaction took place.

Describe two things he might observe as the chemical reaction took place.

1.

2.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| England-GBR                  | 59 ▲            |
| New Zealand                  | 50 ▲            |
| <b>United States</b>         | <b>46 ▲</b>     |
| Chinese Taipei-CHN           | 44 ▲            |
| Russian Federation           | 44 ▲            |
| Singapore                    | 44 ▲            |
| Australia                    | 42 ▲            |
| United Arab Emirates         | 37 ▲            |
| Finland                      | 36 ▲            |
| Hong Kong-CHN                | 35 ▲            |
| Norway                       | 32 ▲            |
| Japan                        | 30 ▲            |
| Saudi Arabia                 | 30 ▲            |
| Syrian Arab Republic         | 30 ▲            |
| Slovenia                     | 30 ▲            |
| Jordan                       | 28 ▲            |
| Ukraine                      | 27              |
| <b>International average</b> | <b>24</b>       |
| Bahrain                      | 23              |
| Israel                       | 23              |
| Korea, Rep. of               | 23              |
| Lebanon                      | 22              |
| Qatar                        | 22              |
| Lithuania                    | 21              |
| Palestinian Nat'l Auth.      | 21              |
| Sweden                       | 18 ▼            |
| Tunisia                      | 18 ▼            |
| Kazakhstan                   | 17 ▼            |
| Romania                      | 17 ▼            |
| Oman                         | 17 ▼            |
| Iran, Islamic Rep. of        | 17 ▼            |
| Hungary                      | 15 ▼            |
| Armenia                      | 14 ▼            |
| Malaysia                     | 10 ▼            |
| Italy                        | 9 ▼             |
| Turkey                       | 8 ▼             |
| Thailand                     | 8 ▼             |
| Chile                        | 7 ▼             |
| Indonesia                    | 6 ▼             |
| Macedonia, Rep. of           | 5 ▼             |
| Morocco                      | 4 ▼             |
| Georgia                      | 3 ▼             |
| Ghana                        | 1 ▼             |

Item Number: S042100

## SCORING

## Correct Response

- Describes two different observations as listed below.

Appearance of a new color (color change)

Seeing gas production (bubbling, foaming)

Hearing a noise (fizzing)

Smelling a gas

Changing temperature (increase or decrease)

A precipitate forming

Light being emitted

An explosion taking place

## Partially Correct Response

- Describes one observation as listed above.

## Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task).

## Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 53 ▲ |
| Massachusetts-USA  | 52 ▲ |
| Indiana-USA        | 51 ▲ |
| Colorado-USA       | 51 ▲ |
| North Carolina-USA | 47 ▲ |
| Quebec-CAN         | 44 ▲ |
| California-USA     | 44 ▲ |
| Florida-USA        | 42 ▲ |
| Dubai-UAE          | 39 ▲ |
| Abu Dhabi-UAE      | 39 ▲ |
| Alabama-USA        | 38 ▲ |
| Connecticut-USA    | 37 ▲ |
| Alberta-CAN        | 37 ▲ |
| Ontario-CAN        | 32 ▲ |

▲ Percent higher than International average  
▼ Percent lower than International average

## Observations for reaction (continued)

S042100:

**Student Responses****Correct Response:**

Describe two things he might observe as the chemical reaction took place.

1. That the powder and the liquid could explode.
2. The reaction could make a horrible smell, if the powder might change colors.

**Partially Correct Response:**

Describe two things he might observe as the chemical reaction took place.

1. The powder dissolved.
2. The liquid thickened.

**Incorrect Response:**

Describe two things he might observe as the chemical reaction took place.

1. The color
2. What the reaction was if it was gas, metal or liquid

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| CHEMISTRY      | Chemical Change | Knowing          |

Process in which energy absorbed

During which chemical process is energy absorbed?

A. iron nails rusting

B. candles burning

C. vegetables rotting

D. plants photosynthesizing

Item Number: S042112

|                   |   |
|-------------------|---|
| Correct Response: | D |
|-------------------|---|

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Hong Kong-CHN                | 83 ▲            |
| Korea, Rep. of               | 79 ▲            |
| Chile                        | 77 ▲            |
| England-GBR                  | 75 ▲            |
| Chinese Taipei-CHN           | 75 ▲            |
| <b>United States</b>         | <b>74 ▲</b>     |
| Australia                    | 71 ▲            |
| New Zealand                  | 70 ▲            |
| Singapore                    | 70 ▲            |
| Sweden                       | 69 ▲            |
| Italy                        | 67 ▲            |
| Israel                       | 65 ▲            |
| Finland                      | 62              |
| United Arab Emirates         | 62 ▲            |
| Japan                        | 61              |
| Palestinian Nat'l Auth.      | 60              |
| Jordan                       | 60              |
| Syrian Arab Republic         | 60              |
| Armenia                      | 59              |
| Thailand                     | 59              |
| Hungary                      | 59              |
| Ukraine                      | 58              |
| <b>International average</b> | <b>58</b>       |
| Russian Federation           | 57              |
| Turkey                       | 56              |
| Bahrain                      | 56              |
| Oman                         | 55              |
| Lithuania                    | 54              |
| Qatar                        | 52 ▼            |
| Norway                       | 51 ▼            |
| Tunisia                      | 51 ▼            |
| Romania                      | 51 ▼            |
| Saudi Arabia                 | 49 ▼            |
| Macedonia, Rep. of           | 48 ▼            |
| Georgia                      | 48 ▼            |
| Kazakhstan                   | 46 ▼            |
| Morocco                      | 45 ▼            |
| Ghana                        | 45 ▼            |
| Slovenia                     | 43 ▼            |
| Malaysia                     | 42 ▼            |
| Indonesia                    | 42 ▼            |
| Iran, Islamic Rep. of        | 41 ▼            |
| Lebanon                      | 40 ▼            |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 78 ▲ |
| Indiana-USA        | 78 ▲ |
| Massachusetts-USA  | 77 ▲ |
| Alberta-CAN        | 76 ▲ |
| Ontario-CAN        | 76 ▲ |
| North Carolina-USA | 74 ▲ |
| Florida-USA        | 73 ▲ |
| Connecticut-USA    | 70 ▲ |
| California-USA     | 68 ▲ |
| Colorado-USA       | 67 ▲ |
| Alabama-USA        | 66 ▲ |
| Dubai-UAE          | 65 ▲ |
| Quebec-CAN         | 65 ▲ |
| Abu Dhabi-UAE      | 61   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain   | Main Topic                               | Cognitive Domain |
|------------------|--|------------------|
| <b>CHEMISTRY</b> | Classification and Composition of Matter | Applying         |

## Classify element/compound/mixture

The table below shows some elements, compounds, and mixtures.

Classify them by putting an X in the appropriate column beside each one.

|           | Element | Compound | Mixture |
|-----------|---------|----------|---------|
| Air       |         |          |         |
| Sugar     |         |          |         |
| Salt      |         |          |         |
| Gold      |         |          |         |
| Sea water |         |          |         |
| Helium    |         |          |         |

Item Number: S042305

**SCORING****Correct Response**

- Classifies all 6 correctly.

|           | Element | Compound | Mixture |
|-----------|---------|----------|---------|
| Air       |         |          | X       |
| Sugar     |         | X        |         |
| Salt      |         | X        |         |
| Gold      | X       |          |         |
| Sea Water |         |          | X       |
| Helium    | X       |          |         |

**Partially Correct Response**

- Classifies 4 or 5 correctly.

**Incorrect Response**

- Classifies 2 or 3 correctly.
- Classifies 1 correctly.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 33 ▲            |
| Singapore                    | 29 ▲            |
| Slovenia                     | 28 ▲            |
| Russian Federation           | 27 ▲            |
| Kazakhstan                   | 25 ▲            |
| Israel                       | 18 ▲            |
| Hungary                      | 17 ▲            |
| Qatar                        | 17 ▲            |
| Finland                      | 16 ▲            |
| Macedonia, Rep. of           | 15 ▲            |
| Palestinian Nat'l Auth.      | 15 ▲            |
| England-GBR                  | 15              |
| Ukraine                      | 15              |
| Turkey                       | 13              |
| United Arab Emirates         | 12              |
| <b>International average</b> | <b>11</b>       |
| New Zealand                  | 11              |
| Lithuania                    | 11              |
| <b>United States</b>         | <b>10</b>       |
| Ghana                        | 10              |
| Japan                        | 10              |
| Lebanon                      | 10              |
| Romania                      | 9               |
| Bahrain                      | 9 ▼             |
| Korea, Rep. of               | 9 ▼             |
| Australia                    | 8 ▼             |
| Hong Kong-CHN                | 8 ▼             |
| Oman                         | 7 ▼             |
| Malaysia                     | 7 ▼             |
| Iran, Islamic Rep. of        | 6 ▼             |
| Sweden                       | 6 ▼             |
| Norway                       | 6 ▼             |
| Chile                        | 6 ▼             |
| Thailand                     | 6 ▼             |
| Jordan                       | 5 ▼             |
| Italy                        | 3 ▼             |
| Georgia                      | 3 ▼             |
| Morocco                      | 3 ▼             |
| Syrian Arab Republic         | 3 ▼             |
| Saudi Arabia                 | 3 ▼             |
| Tunisia                      | 2 ▼             |
| Indonesia                    | 2 ▼             |
| Armenia                      | 1 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 20 ▲ |
| Dubai-UAE          | 16 ▲ |
| North Carolina-USA | 12   |
| Colorado-USA       | 12   |
| California-USA     | 11   |
| Abu Dhabi-UAE      | 11   |
| Florida-USA        | 11   |
| Indiana-USA        | 10   |
| Minnesota-USA      | 10   |
| Connecticut-USA    | 9    |
| Alberta-CAN        | 5 ▼  |
| Alabama-USA        | 5 ▼  |
| Quebec-CAN         | 5 ▼  |
| Ontario-CAN        | 3 ▼  |

▲ Percent higher than International average  
▼ Percent lower than International average

## Classify element/compound/mixture (continued)

S042305:

## Student Responses

## Correct Response:

The table below shows some elements, compounds, and mixtures.

Classify them by putting an X in the appropriate column beside each one.

|           | Element | Compound | Mixture |
|-----------|---------|----------|---------|
| Air       |         |          | X       |
| Sugar     |         | X        |         |
| Salt      |         | X        |         |
| Gold      | X       |          |         |
| Sea water |         |          | X       |
| Helium    | X       |          |         |

## Incorrect Response:

The table below shows some elements, compounds, and mixtures.

Classify them by putting an X in the appropriate column beside each one.

|           | Element | Compound | Mixture |
|-----------|---------|----------|---------|
| Air       |         | X        |         |
| Sugar     |         |          | X       |
| Salt      |         |          | X       |
| Gold      | X       |          |         |
| Sea water |         |          | X       |
| Helium    | X       |          |         |

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Knowing          |

## Definition of a compound

Which of the following defines a compound?

- A. different substances mixed together
- B. atoms and molecules mixed together
- C. atoms of different elements combined together
- D. atoms of the same element combined together

Item Number: S042306

Correct Response:

C

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 66 ▲            |
| Chinese Taipei-CHN           | 65 ▲            |
| Russian Federation           | 59 ▲            |
| Israel                       | 56 ▲            |
| Japan                        | 55 ▲            |
| Ukraine                      | 54 ▲            |
| Turkey                       | 53 ▲            |
| Palestinian Nat'l Auth.      | 53 ▲            |
| Bahrain                      | 52 ▲            |
| Hungary                      | 50 ▲            |
| England-GBR                  | 49 ▲            |
| United Arab Emirates         | 49 ▲            |
| Finland                      | 48 ▲            |
| Hong Kong-CHN                | 48 ▲            |
| New Zealand                  | 48 ▲            |
| Jordan                       | 47 ▲            |
| <b>United States</b>         | <b>46 ▲</b>     |
| Slovenia                     | 46 ▲            |
| Korea, Rep. of               | 45              |
| Saudi Arabia                 | 45              |
| Oman                         | 42              |
| <b>International average</b> | <b>42</b>       |
| Qatar                        | 41              |
| Australia                    | 39              |
| Sweden                       | 38 ▼            |
| Syrian Arab Republic         | 37              |
| Chile                        | 37 ▼            |
| Morocco                      | 37 ▼            |
| Norway                       | 36 ▼            |
| Italy                        | 36 ▼            |
| Lebanon                      | 35 ▼            |
| Ghana                        | 34 ▼            |
| Malaysia                     | 33 ▼            |
| Iran, Islamic Rep. of        | 32 ▼            |
| Romania                      | 31 ▼            |
| Armenia                      | 30 ▼            |
| Thailand                     | 27 ▼            |
| Tunisia                      | 25 ▼            |
| Kazakhstan                   | 22 ▼            |
| Macedonia, Rep. of           | 21 ▼            |
| Georgia                      | 20 ▼            |
| Indonesia                    | 18 ▼            |
| Lithuania                    | —               |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 58 ▲ |
| Florida-USA        | 51 ▲ |
| Dubai-UAE          | 51 ▲ |
| North Carolina-USA | 50 ▲ |
| California-USA     | 48 ▲ |
| Abu Dhabi-UAE      | 48 ▲ |
| Colorado-USA       | 46   |
| Indiana-USA        | 46   |
| Connecticut-USA    | 45   |
| Minnesota-USA      | 45   |
| Alabama-USA        | 45   |
| Quebec-CAN         | 34 ▼ |
| Ontario-CAN        | 34 ▼ |
| Alberta-CAN        | 30 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average  
— Not applicable



| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| CHEMISTRY      | Chemical Change | Knowing          |

## Fire put out by blanket

Why can a small fire be put out by placing a heavy blanket over it?

- A. This lowers the temperature.
- B. This make the flames smaller.
- C. This absorbs the burning substance.
- D. This keeps oxygen from reaching the fire.

Item Number: S052046

Correct Response:

D

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 98 ▲            |
| Korea, Rep. of               | 97 ▲            |
| Slovenia                     | 96 ▲            |
| Chinese Taipei-CHN           | 95 ▲            |
| Sweden                       | 94 ▲            |
| Norway                       | 94 ▲            |
| Hong Kong-CHN                | 93 ▲            |
| Russian Federation           | 93 ▲            |
| Hungary                      | 92 ▲            |
| Japan                        | 91 ▲            |
| Lithuania                    | 90 ▲            |
| Ukraine                      | 90 ▲            |
| Israel                       | 89 ▲            |
| Australia                    | 89 ▲            |
| New Zealand                  | 88 ▲            |
| Italy                        | 88 ▲            |
| England-GBR                  | 88 ▲            |
| Iran, Islamic Rep. of        | 87 ▲            |
| Singapore                    | 87 ▲            |
| <b>United States</b>         | <b>85 ▲</b>     |
| Armenia                      | 82 ▲            |
| Chile                        | 82 ▲            |
| Romania                      | 80              |
| Kazakhstan                   | 78              |
| <b>International average</b> | <b>78</b>       |
| Jordan                       | 78              |
| Syrian Arab Republic         | 75              |
| Tunisia                      | 75 ▼            |
| Palestinian Nat'l Auth.      | 73 ▼            |
| Saudi Arabia                 | 72 ▼            |
| Bahrain                      | 69 ▼            |
| Turkey                       | 69 ▼            |
| Georgia                      | 69 ▼            |
| Malaysia                     | 67 ▼            |
| United Arab Emirates         | 66 ▼            |
| Qatar                        | 66 ▼            |
| Lebanon                      | 61 ▼            |
| Oman                         | 58 ▼            |
| Macedonia, Rep. of           | 56 ▼            |
| Thailand                     | 55 ▼            |
| Morocco                      | 49 ▼            |
| Ghana                        | 48 ▼            |
| Indonesia                    | 32 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 94 ▲ |
| Quebec-CAN         | 94 ▲ |
| Minnesota-USA      | 90 ▲ |
| Ontario-CAN        | 89 ▲ |
| Massachusetts-USA  | 89 ▲ |
| Indiana-USA        | 88 ▲ |
| Colorado-USA       | 87 ▲ |
| Connecticut-USA    | 86 ▲ |
| North Carolina-USA | 83   |
| Florida-USA        | 82   |
| Alabama-USA        | 82   |
| California-USA     | 79   |
| Dubai-UAE          | 73 ▼ |
| Abu Dhabi-UAE      | 65 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Reasoning        |

List two substances that are metal

Some physical properties of five different substances (A, B, C, D, and E) are outlined in the table below. Two of the substances are metal.

|   | Substance A | Substance B | Substance C | Substance D | Substance E |
|---|-------------|-------------|-------------|-------------|-------------|
| Physical state at room temperature (20°C) | solid       | solid       | liquid      | liquid      | gas         |
| Appearance/color                          | shiny grey  | white       | silver      | colorless   | colorless   |
| Conducts electricity                      | yes         | no          | yes         | yes         | no          |

List the two substances (A, B, C, D, or E) that are metal.

- 
- 

Item Number: S052136

## SCORING

### Correct Response

- Lists substances A and C.

### Incorrect Response

- Lists substance A with an incorrect or no other substance listed.
- Lists substance C with an incorrect or no other substance listed.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task), including the following response:
  - Shiny grey
  - Silver

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 76 ▲            |
| Singapore                    | 75 ▲            |
| Chinese Taipei-CHN           | 71 ▲            |
| Hong Kong-CHN                | 67 ▲            |
| Israel                       | 65 ▲            |
| Slovenia                     | 64 ▲            |
| Korea, Rep. of               | 61 ▲            |
| Hungary                      | 61 ▲            |
| England-GBR                  | 60 ▲            |
| Sweden                       | 58 ▲            |
| Finland                      | 58 ▲            |
| <b>United States</b>         | <b>57 ▲</b>     |
| Australia                    | 57 ▲            |
| New Zealand                  | 55 ▲            |
| Italy                        | 55 ▲            |
| Turkey                       | 54 ▲            |
| Russian Federation           | 53 ▲            |
| Ukraine                      | 46              |
| Kazakhstan                   | 45              |
| Lithuania                    | 45              |
| Norway                       | 44              |
| <b>International average</b> | <b>44</b>       |
| Lebanon                      | 40              |
| Thailand                     | 40              |
| Iran, Islamic Rep. of        | 39 ▼            |
| Chile                        | 39 ▼            |
| United Arab Emirates         | 37 ▼            |
| Qatar                        | 34 ▼            |
| Romania                      | 33 ▼            |
| Jordan                       | 33 ▼            |
| Malaysia                     | 32 ▼            |
| Bahrain                      | 31 ▼            |
| Macedonia, Rep. of           | 28 ▼            |
| Tunisia                      | 28 ▼            |
| Palestinian Nat'l Auth.      | 27 ▼            |
| Oman                         | 26 ▼            |
| Saudi Arabia                 | 26 ▼            |
| Armenia                      | 25 ▼            |
| Morocco                      | 23 ▼            |
| Syrian Arab Republic         | 21 ▼            |
| Indonesia                    | 18 ▼            |
| Ghana                        | 17 ▼            |
| Georgia                      | 15 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 64 ▲ |
| Colorado-USA       | 62 ▲ |
| Connecticut-USA    | 61 ▲ |
| North Carolina-USA | 59 ▲ |
| Florida-USA        | 59 ▲ |
| Alberta-CAN        | 58 ▲ |
| Ontario-CAN        | 58 ▲ |
| Indiana-USA        | 56 ▲ |
| Minnesota-USA      | 55 ▲ |
| Quebec-CAN         | 55 ▲ |
| California-USA     | 54 ▲ |
| Alabama-USA        | 54 ▲ |
| Dubai-UAE          | 53 ▲ |
| Abu Dhabi-UAE      | 33 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

List two substances that are metal (continued)

S052136:

## Student Responses

### Correct Response:

List the two substances (A, B, C, D, or E) that are metal.

1. A
2. C

### Incorrect Response:

List the two substances (A, B, C, D, or E) that are metal.

1. Substance A
2. Substance B

| Content Domain | Main Topic                               | Cognitive Domain |
|----------------|--|------------------|
| CHEMISTRY      | Classification and Composition of Matter | Applying         |

## Atoms in a crushed can

A car tire runs over a can and crushes it completely.

Which statement is true for the atoms in the structure of the can?

- A. The atoms are broken.
- B. The atoms are flattened.
- C. The atoms remain the same.
- D. The atoms are changed into different atoms.

Item Number: S052152

Correct Response:

C

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Israel                       | 66 ▲            |
| Korea, Rep. of               | 65 ▲            |
| Chinese Taipei-CHN           | 65 ▲            |
| Singapore                    | 61 ▲            |
| Sweden                       | 58 ▲            |
| Finland                      | 56 ▲            |
| Russian Federation           | 55 ▲            |
| <b>United States</b>         | <b>53 ▲</b>     |
| Japan                        | 49 ▲            |
| Hungary                      | 47 ▲            |
| Lithuania                    | 47 ▲            |
| Iran, Islamic Rep. of        | 46 ▲            |
| Norway                       | 45 ▲            |
| Armenia                      | 43 ▲            |
| Slovenia                     | 43 ▲            |
| Turkey                       | 41 ▲            |
| Hong Kong-CHN                | 41              |
| England-GBR                  | 41              |
| New Zealand                  | 41              |
| Kazakhstan                   | 40              |
| Chile                        | 38              |
| Australia                    | 38              |
| Romania                      | 37              |
| Ukraine                      | 37              |
| <b>International average</b> | <b>37</b>       |
| Macedonia, Rep. of           | 36              |
| Lebanon                      | 32 ▼            |
| Italy                        | 30 ▼            |
| Thailand                     | 28 ▼            |
| Georgia                      | 27 ▼            |
| United Arab Emirates         | 27 ▼            |
| Bahrain                      | 27 ▼            |
| Syrian Arab Republic         | 24 ▼            |
| Ghana                        | 23 ▼            |
| Saudi Arabia                 | 21 ▼            |
| Jordan                       | 20 ▼            |
| Morocco                      | 20 ▼            |
| Qatar                        | 20 ▼            |
| Oman                         | 20 ▼            |
| Palestinian Nat'l Auth.      | 19 ▼            |
| Malaysia                     | 15 ▼            |
| Indonesia                    | 11 ▼            |
| Tunisia                      | 9 ▼             |

## Benchmarking education system

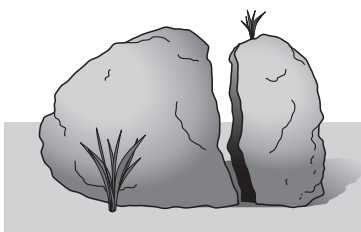
|                    |      |
|--------------------|------|
| Massachusetts-USA  | 64 ▲ |
| Indiana-USA        | 59 ▲ |
| Florida-USA        | 59 ▲ |
| Minnesota-USA      | 56 ▲ |
| Quebec-CAN         | 54 ▲ |
| Colorado-USA       | 54 ▲ |
| California-USA     | 52 ▲ |
| North Carolina-USA | 51 ▲ |
| Connecticut-USA    | 49 ▲ |
| Alberta-CAN        | 45 ▲ |
| Ontario-CAN        | 44 ▲ |
| Alabama-USA        | 42   |
| Dubai-UAE          | 35   |
| Abu Dhabi-UAE      | 26 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic           | Cognitive Domain |
|----------------|----------------------|------------------|
| CHEMISTRY      | Properties of Matter | Reasoning        |

## Water splitting rock

Scientists think that the rocks in the picture were once a single rock.



Which property of water had the **most** effect on splitting the rock into two pieces?

- A. Water expanding when it freezes.
- B. Water boiling at 100°C.
- C. Water having a density less than rock.
- D. Water dissolving many substances.

Item Number: S052254

Correct Response:

A

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 77 ▲            |
| Finland                      | 74 ▲            |
| England-GBR                  | 69 ▲            |
| Hungary                      | 68 ▲            |
| Iran, Islamic Rep. of        | 67 ▲            |
| Lithuania                    | 65 ▲            |
| Sweden                       | 63 ▲            |
| Norway                       | 61 ▲            |
| <b>United States</b>         | <b>58 ▲</b>     |
| Singapore                    | 56 ▲            |
| Macedonia, Rep. of           | 50 ▲            |
| Slovenia                     | 50 ▲            |
| Russian Federation           | 50 ▲            |
| Italy                        | 49 ▲            |
| Ukraine                      | 43              |
| Romania                      | 42 ▼            |
| Australia                    | 42              |
| <b>International average</b> | <b>38</b>       |
| New Zealand                  | 38              |
| Syrian Arab Republic         | 35              |
| Georgia                      | 35              |
| United Arab Emirates         | 34 ▼            |
| Chinese Taipei-CHN           | 34 ▼            |
| Kazakhstan                   | 32 ▼            |
| Armenia                      | 32 ▼            |
| Jordan                       | 29 ▼            |
| Saudi Arabia                 | 26 ▼            |
| Qatar                        | 25 ▼            |
| Malaysia                     | 25 ▼            |
| Japan                        | 25 ▼            |
| Turkey                       | 24 ▼            |
| Bahrain                      | 24 ▼            |
| Lebanon                      | 24 ▼            |
| Ghana                        | 23 ▼            |
| Palestinian Nat'l Auth.      | 22 ▼            |
| Oman                         | 22 ▼            |
| Morocco                      | 21 ▼            |
| Hong Kong-CHN                | 20 ▼            |
| Thailand                     | 20 ▼            |
| Chile                        | 16 ▼            |
| Israel                       | 13 ▼            |
| Tunisia                      | 12 ▼            |
| Indonesia                    | 10 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 75 ▲ |
| Minnesota-USA      | 69 ▲ |
| Connecticut-USA    | 67 ▲ |
| North Carolina-USA | 66 ▲ |
| Alberta-CAN        | 66 ▲ |
| Florida-USA        | 63 ▲ |
| Indiana-USA        | 56 ▲ |
| Colorado-USA       | 54 ▲ |
| Ontario-CAN        | 53 ▲ |
| California-USA     | 46 ▲ |
| Alabama-USA        | 44   |
| Quebec-CAN         | 42 ▲ |
| Dubai-UAE          | 40   |
| Abu Dhabi-UAE      | 33 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

Energy conversion in a flashlight

Which of the following energy conversions takes place in a battery-operated flashlight?

A. electrical → mechanical → light

B. chemical → mechanical → light

C. chemical → electrical → light

D. nuclear → electrical → light

Item Number: S032024

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>C</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 82 ▲            |
| Hong Kong-CHN                | 79 ▲            |
| Japan                        | 55 ▲            |
| England-GBR                  | 51 ▲            |
| New Zealand                  | 51 ▲            |
| Israel                       | 49 ▲            |
| Malaysia                     | 44 ▲            |
| Australia                    | 41 ▲            |
| Norway                       | 40 ▲            |
| Italy                        | 39              |
| Indonesia                    | 38              |
| <b>United States</b>         | <b>38</b>       |
| Qatar                        | 37              |
| Ghana                        | 37              |
| Saudi Arabia                 | 36              |
| Bahrain                      | 36              |
| Lebanon                      | 35              |
| Chinese Taipei-CHN           | 35              |
| <b>International average</b> | <b>35</b>       |
| Iran, Islamic Rep. of        | 35              |
| United Arab Emirates         | 34              |
| Russian Federation           | 33              |
| Tunisia                      | 33              |
| Turkey                       | 33              |
| Palestinian Nat'l Auth.      | 32              |
| Finland                      | 31              |
| Oman                         | 31 ▼            |
| Sweden                       | 29 ▼            |
| Chile                        | 29 ▼            |
| Armenia                      | 27 ▼            |
| Slovenia                     | 25 ▼            |
| Jordan                       | 25 ▼            |
| Kazakhstan                   | 24 ▼            |
| Hungary                      | 24 ▼            |
| Syrian Arab Republic         | 23 ▼            |
| Thailand                     | 22 ▼            |
| Lithuania                    | 21 ▼            |
| Romania                      | 20 ▼            |
| Macedonia, Rep. of           | 20 ▼            |
| Ukraine                      | 20 ▼            |
| Morocco                      | 20 ▼            |
| Georgia                      | 18 ▼            |
| Korea, Rep. of               | —               |

| Benchmarking education system | Percent correct |
|-------------------------------|-----------------|
| Florida-USA                   | 45 ▲            |
| Dubai-UAE                     | 42 ▲            |
| Minnesota-USA                 | 41 ▲            |
| Alberta-CAN                   | 38              |
| Colorado-USA                  | 35              |
| Massachusetts-USA             | 34              |
| Indiana-USA                   | 32              |
| Alabama-USA                   | 32              |
| Connecticut-USA               | 31              |
| Abu Dhabi-UAE                 | 31              |
| Ontario-CAN                   | 30 ▼            |
| North Carolina-USA            | 28 ▼            |
| California-USA                | 26 ▼            |
| Quebec-CAN                    | 22 ▼            |

▲ Percent higher than International average  
 ▼ Percent lower than International average  
 — Not applicable

| Content Domain | Main Topic        | Cognitive Domain |
|----------------|-------------------|------------------|
| PHYSICS        | Forces and Motion | Applying         |

Gravity acting on parachute jumper

The figure shows a parachute jumper in four positions.

1. In the aircraft before the jump

2. In freefall immediately after jumping before parachute opens

3. Falling to the ground after the parachute opens

4. On the ground just after landing

In which of the positions does the force of gravity act on the jumper?

A. Position 2 only.

B. Positions 2 and 3 only.

C. Positions 1, 2 and 3 only.

D. Positions 1, 2, 3, and 4.

Item Number: S032141

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 63 ▲            |
| Finland                      | 59 ▲            |
| Israel                       | 54 ▲            |
| Japan                        | 49 ▲            |
| Sweden                       | 49 ▲            |
| Slovenia                     | 47 ▲            |
| Singapore                    | 45 ▲            |
| Hungary                      | 45 ▲            |
| England-GBR                  | 43 ▲            |
| Lithuania                    | 42 ▲            |
| Ukraine                      | 40 ▲            |
| Russian Federation           | 38 ▲            |
| <b>United States</b>         | <b>37 ▲</b>     |
| Hong Kong-CHN                | 36 ▲            |
| Chinese Taipei-CHN           | 35              |
| Turkey                       | 34              |
| Palestinian Nat'l Auth.      | 34              |
| Norway                       | 32              |
| <b>International average</b> | <b>32</b>       |
| Jordan                       | 30              |
| Armenia                      | 30              |
| Australia                    | 30              |
| New Zealand                  | 29              |
| United Arab Emirates         | 28 ▼            |
| Italy                        | 26 ▼            |
| Qatar                        | 26 ▼            |
| Lebanon                      | 26 ▼            |
| Bahrain                      | 25 ▼            |
| Syrian Arab Republic         | 25 ▼            |
| Ghana                        | 22 ▼            |
| Kazakhstan                   | 22 ▼            |
| Oman                         | 22 ▼            |
| Thailand                     | 22 ▼            |
| Iran, Islamic Rep. of        | 22 ▼            |
| Romania                      | 22 ▼            |
| Saudi Arabia                 | 20 ▼            |
| Macedonia, Rep. of           | 20 ▼            |
| Georgia                      | 20 ▼            |
| Chile                        | 19 ▼            |
| Morocco                      | 16 ▼            |
| Malaysia                     | 16 ▼            |
| Tunisia                      | 16 ▼            |
| Indonesia                    | 13 ▼            |

| Benchmarking education system | Percent correct |
|-------------------------------|-----------------|
| Connecticut-USA               | 51 ▲            |
| Minnesota-USA                 | 49 ▲            |
| Alberta-CAN                   | 44 ▲            |
| Massachusetts-USA             | 43 ▲            |
| Ontario-CAN                   | 43 ▲            |
| Florida-USA                   | 42 ▲            |
| Indiana-USA                   | 38              |
| North Carolina-USA            | 38              |
| Colorado-USA                  | 36              |
| Quebec-CAN                    | 33              |
| California-USA                | 33              |
| Alabama-USA                   | 32              |
| Dubai-UAE                     | 27 ▼            |
| Abu Dhabi-UAE                 | 26 ▼            |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

## Molecules of gas when heated

A gas is heated and its temperature increases.  
What happens to the gas molecules?

- A. They get bigger.
- B. They move faster.
- C. They move slower.
- D. They increase in number.

Item Number: S032158

Correct Response:

B

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 86 ▲            |
| Israel                       | 81 ▲            |
| Russian Federation           | 80 ▲            |
| Singapore                    | 79 ▲            |
| Norway                       | 75 ▲            |
| <b>United States</b>         | <b>75 ▲</b>     |
| Finland                      | 73 ▲            |
| Turkey                       | 72 ▲            |
| Hungary                      | 71 ▲            |
| Saudi Arabia                 | 71 ▲            |
| Sweden                       | 69 ▲            |
| Slovenia                     | 69 ▲            |
| England-GBR                  | 67 ▲            |
| Chinese Taipei-CHN           | 67 ▲            |
| Chile                        | 66 ▲            |
| Ukraine                      | 66 ▲            |
| New Zealand                  | 65 ▲            |
| Kazakhstan                   | 65              |
| Australia                    | 64              |
| Italy                        | 62              |
| Iran, Islamic Rep. of        | 61              |
| Bahrain                      | 61              |
| <b>International average</b> | <b>60</b>       |
| Armenia                      | 59              |
| Hong Kong-CHN                | 59              |
| Malaysia                     | 58              |
| United Arab Emirates         | 58              |
| Oman                         | 58              |
| Lithuania                    | 57              |
| Georgia                      | 55              |
| Macedonia, Rep. of           | 54 ▼            |
| Palestinian Nat'l Auth.      | 52 ▼            |
| Qatar                        | 52 ▼            |
| Jordan                       | 51 ▼            |
| Japan                        | 45 ▼            |
| Indonesia                    | 45 ▼            |
| Ghana                        | 44 ▼            |
| Morocco                      | 40 ▼            |
| Lebanon                      | 39 ▼            |
| Romania                      | 38 ▼            |
| Tunisia                      | 38 ▼            |
| Syrian Arab Republic         | 37 ▼            |
| Thailand                     | 33 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 89 ▲ |
| Alberta-CAN        | 86 ▲ |
| Florida-USA        | 82 ▲ |
| Indiana-USA        | 80 ▲ |
| Colorado-USA       | 78 ▲ |
| Ontario-CAN        | 77 ▲ |
| Minnesota-USA      | 76 ▲ |
| Connecticut-USA    | 72 ▲ |
| California-USA     | 67 ▲ |
| North Carolina-USA | 67 ▲ |
| Alabama-USA        | 64   |
| Quebec-CAN         | 62   |
| Dubai-UAE          | 61   |
| Abu Dhabi-UAE      | 60   |

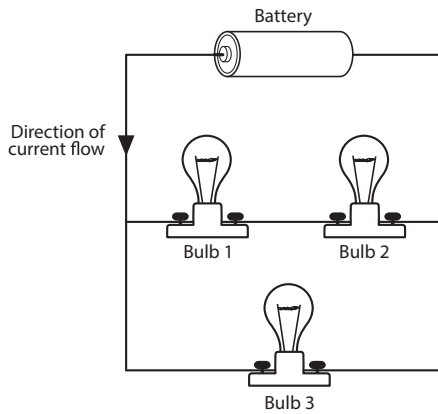
▲ Percent higher than International average  
▼ Percent lower than International average



| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| PHYSICS        | Electricity and Magnetism | Applying         |

Bulbs in series/parallel circuit

Three identical light bulbs are connected to a battery as shown in the diagram. The arrow indicates the direction of the current flow.



Which statement is true?

- A. The current in Bulb 1 is greater than the current in Bulb 2.
- B. The current in Bulb 1 is greater than the current in Bulb 3.
- C. The current in Bulb 2 is the same as the current in Bulb 3.
- D. The current in Bulb 2 is the same as the current in Bulb 1.

Item Number: S032184

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 71 ▲            |
| Singapore                    | 68 ▲            |
| Japan                        | 62 ▲            |
| Russian Federation           | 54 ▲            |
| Hungary                      | 52 ▲            |
| United Arab Emirates         | 49 ▲            |
| Israel                       | 49 ▲            |
| Hong Kong-CHN                | 49 ▲            |
| Romania                      | 48 ▲            |
| Malaysia                     | 47 ▲            |
| Lebanon                      | 47              |
| Armenia                      | 47              |
| Turkey                       | 46 ▲            |
| Tunisia                      | 46              |
| Iran, Islamic Rep. of        | 45              |
| England-GBR                  | 45              |
| Kazakhstan                   | 45              |
| Macedonia, Rep. of           | 44              |
| Italy                        | 43              |
| Bahrain                      | 43              |
| <b>International average</b> | <b>43</b>       |
| Australia                    | 41              |
| Saudi Arabia                 | 41              |
| <b>United States</b>         | <b>40 ▼</b>     |
| Sweden                       | 40              |
| Chile                        | 40              |
| Oman                         | 40              |
| Palestinian Nat'l Auth.      | 40              |
| Jordan                       | 39              |
| Finland                      | 38 ▼            |
| New Zealand                  | 37 ▼            |
| Syrian Arab Republic         | 37 ▼            |
| Qatar                        | 37 ▼            |
| Indonesia                    | 36 ▼            |
| Slovenia                     | 35 ▼            |
| Ukraine                      | 35 ▼            |
| Lithuania                    | 34 ▼            |
| Ghana                        | 32 ▼            |
| Georgia                      | 31 ▼            |
| Norway                       | 31 ▼            |
| Thailand                     | 8 ▼             |
| Chinese Taipei-CHN           | —               |
| Morocco                      | —               |

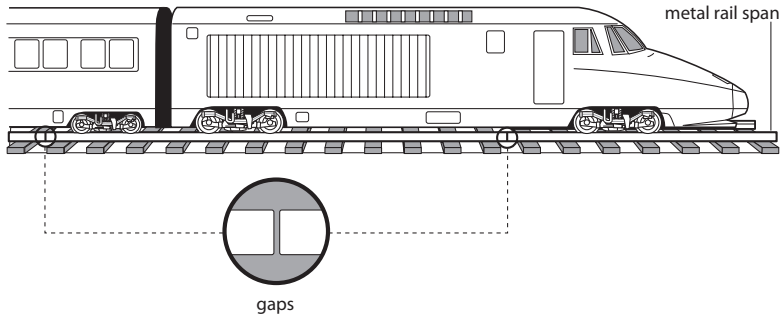
Benchmarking education system

|                    |      |
|--------------------|------|
| Abu Dhabi-UAE      | 52 ▲ |
| Indiana-USA        | 51 ▲ |
| Dubai-UAE          | 49 ▲ |
| Florida-USA        | 46   |
| Alabama-USA        | 45   |
| California-USA     | 42   |
| North Carolina-USA | 40   |
| Ontario-CAN        | 39   |
| Connecticut-USA    | 38   |
| Colorado-USA       | 36   |
| Quebec-CAN         | 36 ▼ |
| Alberta-CAN        | 32 ▼ |
| Massachusetts-USA  | —    |
| Minnesota-USA      | —    |

▲ Percent higher than International average  
 ▼ Percent lower than International average  
 — Not applicable

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Applying         |

Gaps between metal rail spans



Which of the following best explains why some railroad tracks are laid down with gaps between the metal rail spans?

- To allow for the metal tracks to expand on hot days.
- To allow for the metal tracks to expand on cold days.
- To allow for cooling of the tracks by air in the gaps.
- To allow for vibration of the tracks due to the train.

Item Number: S032238

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>A</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 87 ▲            |
| Singapore                    | 81 ▲            |
| Hong Kong-CHN                | 76 ▲            |
| Korea, Rep. of               | 62 ▲            |
| Lithuania                    | 61 ▲            |
| Australia                    | 60 ▲            |
| Hungary                      | 59 ▲            |
| Malaysia                     | 55 ▲            |
| Finland                      | 55 ▲            |
| Japan                        | 53 ▲            |
| Turkey                       | 52 ▲            |
| Syrian Arab Republic         | 50 ▲            |
| New Zealand                  | 46 ▲            |
| Palestinian Nat'l Auth.      | 44              |
| Russian Federation           | 44              |
| Sweden                       | 43              |
| Indonesia                    | 43              |
| Oman                         | 43              |
| Italy                        | 42              |
| <b>International average</b> | <b>41</b>       |
| Qatar                        | 40              |
| Romania                      | 40              |
| <b>United States</b>         | <b>39</b>       |
| Bahrain                      | 38              |
| Saudi Arabia                 | 38              |
| Iran, Islamic Rep. of        | 37 ▼            |
| England-GBR                  | 37              |
| Norway                       | 35 ▼            |
| Jordan                       | 33 ▼            |
| Tunisia                      | 32 ▼            |
| United Arab Emirates         | 31 ▼            |
| Macedonia, Rep. of           | 30 ▼            |
| Ukraine                      | 29 ▼            |
| Israel                       | 28 ▼            |
| Georgia                      | 27 ▼            |
| Slovenia                     | 27 ▼            |
| Thailand                     | 26 ▼            |
| Kazakhstan                   | 22 ▼            |
| Morocco                      | 21 ▼            |
| Ghana                        | 20 ▼            |
| Armenia                      | 18 ▼            |
| Lebanon                      | 18 ▼            |
| Chile                        | 11 ▼            |

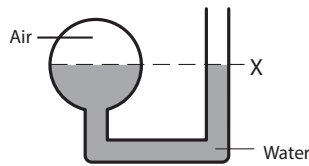
| Benchmarking education system | Percent correct |
|-------------------------------|-----------------|
| Alberta-CAN                   | 60 ▲            |
| Minnesota-USA                 | 49 ▲            |
| Massachusetts-USA             | 47              |
| Indiana-USA                   | 43              |
| Ontario-CAN                   | 42              |
| Florida-USA                   | 41              |
| Connecticut-USA               | 40              |
| North Carolina-USA            | 38              |
| Abu Dhabi-UAE                 | 37              |
| Colorado-USA                  | 34 ▼            |
| Alabama-USA                   | 32              |
| Dubai-UAE                     | 30 ▼            |
| California-USA                | 27 ▼            |
| Quebec-CAN                    | 19 ▼            |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Reasoning        |

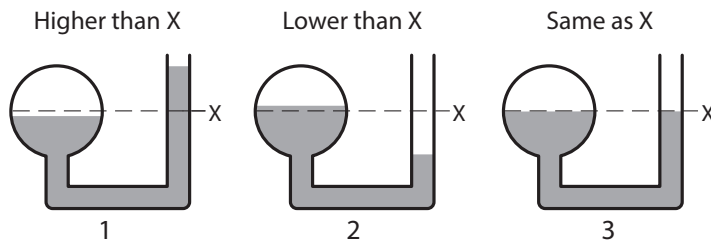
Water level in heated container

The figure shows a glass tube open at one end and connected to a closed glass sphere at the other end. The equipment is partly filled with water, as shown, so that there is air above the water in the sphere. The water in the tube reaches level X.



The air in the glass sphere is then heated by a hair dryer.

A. What will be the water level in the open glass tube after the sphere is heated? (Circle 1, 2 or 3 below.)



B. Explain your answer.

Item Number: S032272

SCORING

Correct Response

- HIGHER (1) with a correct explanation that refers to air expanding when heated or an increase in volume or pressure (or similar).

Examples:

When the sphere is heated, the air expands and pushes the water up the tube.  
The pressure will make the water rise.

- Other correct

Incorrect Response

- HIGHER (1) with no explanation or an incorrect explanation.
- LOWER (2) with no explanation or an incorrect explanation.
- SAME (3) with no explanation or an incorrect explanation.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 45 ▲            |
| Russian Federation           | 29 ▲            |
| Korea, Rep. of               | 28 ▲            |
| Kazakhstan                   | 25 ▲            |
| Chinese Taipei-CHN           | 24 ▲            |
| Japan                        | 23 ▲            |
| Hong Kong-CHN                | 22 ▲            |
| Israel                       | 18 ▲            |
| Slovenia                     | 18 ▲            |
| Hungary                      | 17 ▲            |
| Iran, Islamic Rep. of        | 17 ▲            |
| Finland                      | 15              |
| Armenia                      | 14              |
| Sweden                       | 14              |
| Australia                    | 13              |
| Norway                       | 13              |
| <b>International average</b> | <b>13</b>       |
| Bahrain                      | 13              |
| Chile                        | 12              |
| Lithuania                    | 12              |
| Turkey                       | 11              |
| New Zealand                  | 11              |
| Ukraine                      | 11              |
| Romania                      | 11 ▼            |
| <b>United States</b>         | <b>11 ▼</b>     |
| England-GBR                  | 10              |
| Malaysia                     | 9 ▼             |
| Macedonia, Rep. of           | 8 ▼             |
| Syrian Arab Republic         | 8 ▼             |
| Thailand                     | 8 ▼             |
| Indonesia                    | 8 ▼             |
| Jordan                       | 8 ▼             |
| Tunisia                      | 8 ▼             |
| Italy                        | 8 ▼             |
| Palestinian Nat'l Auth.      | 8 ▼             |
| Oman                         | 7 ▼             |
| Lebanon                      | 7 ▼             |
| Georgia                      | 7 ▼             |
| Qatar                        | 7 ▼             |
| United Arab Emirates         | 7 ▼             |
| Saudi Arabia                 | 6 ▼             |
| Morocco                      | 4 ▼             |
| Ghana                        | 1 ▼             |

Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 26 ▲ |
| Ontario-CAN        | 24 ▲ |
| Massachusetts-USA  | 16   |
| Quebec-CAN         | 15   |
| Colorado-USA       | 14   |
| Connecticut-USA    | 14   |
| Minnesota-USA      | 14   |
| Florida-USA        | 13   |
| Indiana-USA        | 12   |
| North Carolina-USA | 8 ▼  |
| Abu Dhabi-UAE      | 8 ▼  |
| Dubai-UAE          | 8 ▼  |
| California-USA     | 6 ▼  |
| Alabama-USA        | 6 ▼  |

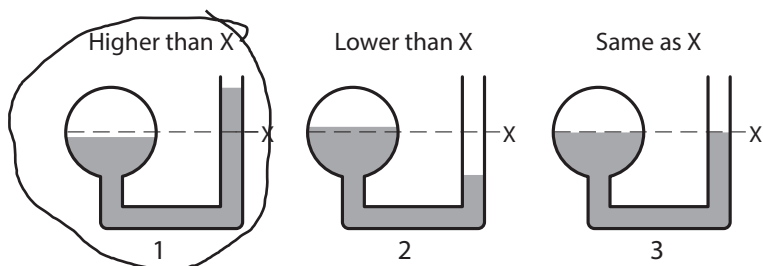
▲ Percent higher than International average  
▼ Percent lower than International average

Water level in heated container (continued)

S032272:

Student Responses

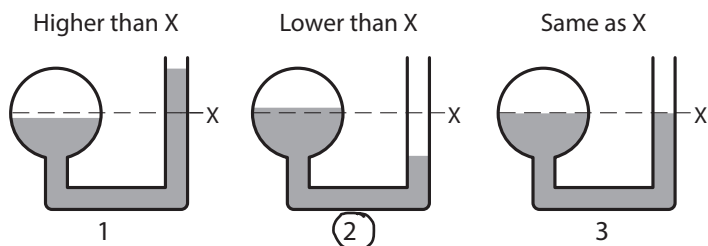
Correct Response:



B. Explain your answer.

air expands as it is heated

Incorrect Response:



B. Explain your answer.

The heat will make water rise in the sphere.

| Content Domain | Main Topic        | Cognitive Domain |
|----------------|-------------------|------------------|
| PHYSICS        | Forces and Motion | Applying         |

### Why bottle collapses in the valley

A man climbed to the top of a very high mountain. While on the mountain top, he drank all the water in his plastic water bottle and then put the cover back on. When he returned to camp in the valley, he discovered that the empty bottle had collapsed.

Which of the following best explains why this happened?

- A. The temperature is lower in the valley than on the mountain top.
- B. The temperature is higher in the valley than on the mountain top.
- C. Air pressure in the valley is lower than on the mountain top.
- D. Air pressure in the valley is higher than on the mountain top.

Item Number: S032279

|                   |   |
|-------------------|---|
| Correct Response: | D |
|-------------------|---|

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 57 ▲            |
| Hong Kong-CHN                | 50 ▲            |
| Slovenia                     | 48 ▲            |
| Russian Federation           | 44 ▲            |
| Chinese Taipei-CHN           | 42 ▲            |
| Turkey                       | 41 ▲            |
| Korea, Rep. of               | 40 ▲            |
| <b>United States</b>         | <b>38</b> ▲     |
| Israel                       | 37 ▲            |
| Sweden                       | 37 ▲            |
| England-GBR                  | 36              |
| Lithuania                    | 36              |
| Italy                        | 36              |
| Malaysia                     | 35              |
| New Zealand                  | 35              |
| Palestinian Nat'l Auth.      | 35              |
| Australia                    | 34              |
| Hungary                      | 34              |
| Singapore                    | 34              |
| Norway                       | 33              |
| Thailand                     | 33              |
| <b>International average</b> | <b>33</b>       |
| Bahrain                      | 32              |
| Armenia                      | 31              |
| Iran, Islamic Rep. of        | 30              |
| Jordan                       | 30              |
| Finland                      | 30              |
| Ukraine                      | 30              |
| Kazakhstan                   | 29              |
| Tunisia                      | 29 ▼            |
| Qatar                        | 28 ▼            |
| Georgia                      | 28              |
| United Arab Emirates         | 28 ▼            |
| Chile                        | 28 ▼            |
| Syrian Arab Republic         | 28 ▼            |
| Indonesia                    | 25 ▼            |
| Oman                         | 24 ▼            |
| Saudi Arabia                 | 24 ▼            |
| Ghana                        | 23 ▼            |
| Lebanon                      | 22 ▼            |
| Macedonia, Rep. of           | 22 ▼            |
| Romania                      | 21 ▼            |
| Morocco                      | 21 ▼            |

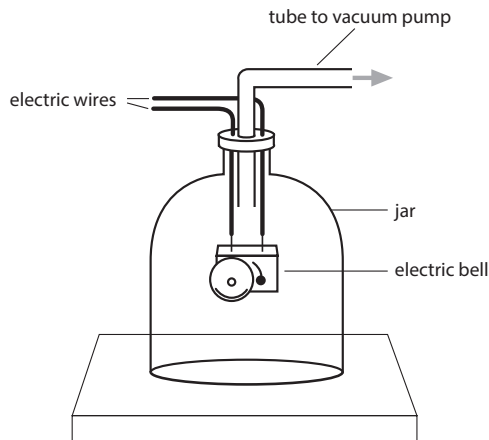
### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 46 ▲ |
| Massachusetts-USA  | 39 ▲ |
| Connecticut-USA    | 39 ▲ |
| Florida-USA        | 39 ▲ |
| North Carolina-USA | 38   |
| Indiana-USA        | 36   |
| Alberta-CAN        | 35   |
| Colorado-USA       | 33   |
| California-USA     | 33   |
| Ontario-CAN        | 32   |
| Alabama-USA        | 32   |
| Dubai-UAE          | 31   |
| Quebec-CAN         | 31   |
| Abu Dhabi-UAE      | 29   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| PHYSICS        | Light and Sound | Applying         |

## Sound from electric bell in jar



The diagram shows an electric bell inside a jar. The electric bell is switched on and a ringing sound is heard. The air is then pumped out of the jar.

What will happen to the sound of the bell when the air is pumped out of the jar? Explain your answer.

Item Number: S032369

### SCORING

#### Correct Response

- Refers to sound fading AND explains that sound needs a medium to travel through (or similar).  
Example: The sound will die out because if there is no air, then it cannot transfer the sound.
- Other fully correct

#### Partially Correct Response

- Refers to sound fading (or similar) with NO further explanation.
- Refers to sound fading with a minimal explanation that refers only to the vacuum or lack of air. [Does not explicitly refer to sound needing a medium to travel through.]
- Other partially correct

#### Incorrect Response

- Refers to sound disappearing (or similar) with an incorrect explanation that reflects a misconception about the production/transmission of sound.
- Refers to sound being louder, clearer (or similar) with or without further explanation.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 60 ▲            |
| Japan                        | 58 ▲            |
| Hong Kong-CHN                | 44 ▲            |
| Korea, Rep. of               | 40 ▲            |
| Jordan                       | 35 ▲            |
| Turkey                       | 33 ▲            |
| Lithuania                    | 33 ▲            |
| Finland                      | 32 ▲            |
| Hungary                      | 32 ▲            |
| Slovenia                     | 32 ▲            |
| England-GBR                  | 29 ▲            |
| Russian Federation           | 28 ▲            |
| Singapore                    | 27 ▲            |
| Palestinian Nat'l Auth.      | 27 ▲            |
| Iran, Islamic Rep. of        | 26 ▲            |
| Oman                         | 24              |
| Syrian Arab Republic         | 23              |
| Ukraine                      | 23              |
| Armenia                      | 22              |
| <b>International average</b> | <b>22</b>       |
| Kazakhstan                   | 22              |
| Sweden                       | 21              |
| Israel                       | 19              |
| <b>United States</b>         | <b>18 ▼</b>     |
| Australia                    | 17 ▼            |
| Italy                        | 17 ▼            |
| Bahrain                      | 16 ▼            |
| New Zealand                  | 16 ▼            |
| Macedonia, Rep. of           | 16 ▼            |
| Georgia                      | 15 ▼            |
| Qatar                        | 14 ▼            |
| Malaysia                     | 14 ▼            |
| Tunisia                      | 13 ▼            |
| Norway                       | 12 ▼            |
| United Arab Emirates         | 12 ▼            |
| Thailand                     | 10 ▼            |
| Lebanon                      | 10 ▼            |
| Saudi Arabia                 | 10 ▼            |
| Romania                      | 7 ▼             |
| Indonesia                    | 6 ▼             |
| Morocco                      | 4 ▼             |
| Ghana                        | 4 ▼             |
| Chile                        | 3 ▼             |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Florida-USA        | 27   |
| Colorado-USA       | 23   |
| Massachusetts-USA  | 21   |
| Minnesota-USA      | 20   |
| Dubai-UAE          | 20   |
| Connecticut-USA    | 19   |
| North Carolina-USA | 16 ▼ |
| Indiana-USA        | 16 ▼ |
| Quebec-CAN         | 14 ▼ |
| Alabama-USA        | 13 ▼ |
| Ontario-CAN        | 11 ▼ |
| Alberta-CAN        | 9 ▼  |
| Abu Dhabi-UAE      | 8 ▼  |
| California-USA     | 6 ▼  |

▲ Percent higher than International average  
▼ Percent lower than International average

Sound from electric bell in jar (continued)

S032369:

## Student Responses

### Correct Response:

less and less particles will be in the ~~jar~~ jar  
causing the sound to dip and eventually stop  
A vacume is formed in the jar so the particles  
can't vibrate and carry sound

### Partially Correct Response:

It will become silent.

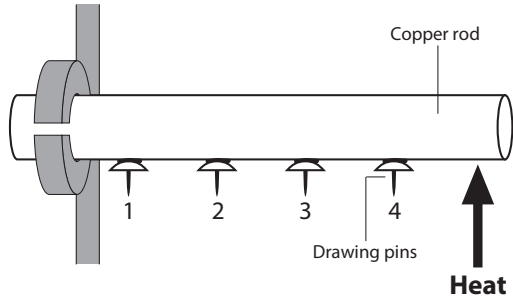
### Incorrect Response:

The Bell will stop because the  
air gives pressure to a bell to move

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Applying         |

Heat conduction through copper rod

A student attaches four drawing pins to a copper rod using candle wax as shown in the diagram. The rod is then heated continuously at one end and the pins fall off in the order 4, 3, 2, 1.



By which process does heat reach the pins?

- A. expansion
- B. radiation
- C. conduction
- D. convection

Item Number: S032394

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>C</b> |
|--------------------------|----------|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 91 ▲            |
| Russian Federation           | 91 ▲            |
| Ukraine                      | 79 ▲            |
| Kazakhstan                   | 77 ▲            |
| Japan                        | 72 ▲            |
| Singapore                    | 72 ▲            |
| Korea, Rep. of               | 70 ▲            |
| Hong Kong-CHN                | 69 ▲            |
| Armenia                      | 66 ▲            |
| Sweden                       | 66 ▲            |
| Hungary                      | 63 ▲            |
| Romania                      | 62 ▲            |
| Jordan                       | 61 ▲            |
| Macedonia, Rep. of           | 59 ▲            |
| Oman                         | 55              |
| Palestinian Nat'l Auth.      | 54              |
| Israel                       | 53              |
| <b>International average</b> | <b>52</b>       |
| Iran, Islamic Rep. of        | 51              |
| England-GBR                  | 51              |
| Lithuania                    | 51              |
| Finland                      | 51              |
| Chile                        | 49 ▼            |
| United Arab Emirates         | 49 ▼            |
| Italy                        | 48              |
| Slovenia                     | 48              |
| Saudi Arabia                 | 47 ▼            |
| Turkey                       | 46 ▼            |
| Qatar                        | 45 ▼            |
| Malaysia                     | 43 ▼            |
| New Zealand                  | 43 ▼            |
| <b>United States</b>         | <b>41 ▼</b>     |
| Australia                    | 41 ▼            |
| Bahrain                      | 40 ▼            |
| Thailand                     | 40 ▼            |
| Ghana                        | 40 ▼            |
| Georgia                      | 38 ▼            |
| Indonesia                    | 32 ▼            |
| Lebanon                      | 31 ▼            |
| Norway                       | 30 ▼            |
| Syrian Arab Republic         | 25 ▼            |
| Morocco                      | 22 ▼            |
| Tunisia                      | 15 ▼            |

Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 55   |
| Quebec-CAN         | 54   |
| Dubai-UAE          | 54   |
| Florida-USA        | 53   |
| Minnesota-USA      | 48   |
| Abu Dhabi-UAE      | 47   |
| Indiana-USA        | 42 ▼ |
| Alberta-CAN        | 42 ▼ |
| California-USA     | 42 ▼ |
| Connecticut-USA    | 40 ▼ |
| Colorado-USA       | 40 ▼ |
| North Carolina-USA | 40 ▼ |
| Alabama-USA        | 33 ▼ |
| Ontario-CAN        | 32 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average



| Content Domain | Main Topic                            | Cognitive Domain |
|----------------|---------------------------------------|------------------|
| PHYSICS        | Physical States and Changes in Matter | Applying         |

## Change-stay the same-DERIVED

As a liquid changes into a gas, which characteristics or properties change and which stay the same?

In each row of the table below, put an X in the appropriate column.

|                    | Changes | Stays the Same |
|--------------------|---------|----------------|
| Density            |         |                |
| Mass               |         |                |
| Volume             |         |                |
| Size of molecules  |         |                |
| Speed of molecules |         |                |

Item Number: S042173Z

## SCORING

## Correct Response

- Places the X's correctly as shown below:

|                    | Changes | Stays the Same |
|--------------------|---------|----------------|
| Density            | X       |                |
| Mass               |         | X              |
| Volume             | X       |                |
| Size of Molecules  |         | X              |
| Speed of Molecules | X       |                |

## Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Israel                       | 65 ▲            |
| Korea, Rep. of               | 54 ▲            |
| Japan                        | 53 ▲            |
| Singapore                    | 49 ▲            |
| Chinese Taipei-CHN           | 49 ▲            |
| Ukraine                      | 45 ▲            |
| Slovenia                     | 43 ▲            |
| Russian Federation           | 43 ▲            |
| Hong Kong-CHN                | 40 ▲            |
| Turkey                       | 40 ▲            |
| Kazakhstan                   | 40 ▲            |
| Finland                      | 38              |
| England-GBR                  | 37              |
| Iran, Islamic Rep. of        | 36              |
| <b>United States</b>         | <b>35</b>       |
| Chile                        | 35              |
| Norway                       | 35              |
| New Zealand                  | 34              |
| <b>International average</b> | <b>34</b>       |
| Saudi Arabia                 | 34              |
| United Arab Emirates         | 33              |
| Sweden                       | 32              |
| Bahrain                      | 32              |
| Armenia                      | 31              |
| Italy                        | 31              |
| Palestinian Nat'l Auth.      | 30              |
| Hungary                      | 30              |
| Lithuania                    | 30              |
| Jordan                       | 29 ▼            |
| Oman                         | 29 ▼            |
| Qatar                        | 28 ▼            |
| Australia                    | 28 ▼            |
| Tunisia                      | 26 ▼            |
| Syrian Arab Republic         | 26 ▼            |
| Macedonia, Rep. of           | 25 ▼            |
| Georgia                      | 24 ▼            |
| Malaysia                     | 23 ▼            |
| Romania                      | 22 ▼            |
| Lebanon                      | 22 ▼            |
| Indonesia                    | 18 ▼            |
| Thailand                     | 17 ▼            |
| Ghana                        | 9 ▼             |
| Morocco                      | —               |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 54 ▲ |
| Florida-USA        | 44 ▲ |
| California-USA     | 43 ▲ |
| Colorado-USA       | 42 ▲ |
| Alberta-CAN        | 42 ▲ |
| Minnesota-USA      | 39   |
| Abu Dhabi-UAE      | 38   |
| Indiana-USA        | 38   |
| Connecticut-USA    | 37   |
| Ontario-CAN        | 36   |
| Dubai-UAE          | 32   |
| North Carolina-USA | 31   |
| Quebec-CAN         | 26 ▼ |
| Alabama-USA        | 25 ▼ |

▲ Percent higher than International average

▼ Percent lower than International average

— Not applicable

## Change-stay the same (continued)

S042173Z:

## Student Responses

## Correct Response:

|                    | Changes | Stays the Same |
|--------------------|---------|----------------|
| Density            | X       |                |
| Mass               |         | X              |
| Volume             | X       |                |
| Size of molecules  |         | X              |
| Speed of molecules | X       |                |

## Incorrect Response:

|                    | Changes | Stays the Same |
|--------------------|---------|----------------|
| Density            | X       |                |
| Mass               |         | X              |
| Volume             |         | X              |
| Size of molecules  |         | X              |
| Speed of molecules | X       |                |

| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| PHYSICS        | Electricity and Magnetism | Reasoning        |

### Strength of a magnet

A student sets up an investigation to test the strength of magnets. He has several magnets of different sizes, shapes, and masses. He uses the magnets to lift metal paper clips.

How is the strength of a magnet defined in the investigation?

- A. by the mass of the magnet lifting the metal paper clips
- B. by the size of the magnet lifting the metal paper clips
- C. by the number of metal paper clips lifted by the magnet
- D. by the time the metal paper clips stay on the magnet

Item Number: S042197

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>C</b> |
|--------------------------|----------|

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 80 ▲            |
| Slovenia                     | 68 ▲            |
| Korea, Rep. of               | 68 ▲            |
| England-GBR                  | 65 ▲            |
| Japan                        | 63 ▲            |
| Chinese Taipei-CHN           | 60 ▲            |
| Australia                    | 58 ▲            |
| <b>United States</b>         | <b>57 ▲</b>     |
| Russian Federation           | 55 ▲            |
| Ukraine                      | 54 ▲            |
| New Zealand                  | 54 ▲            |
| Malaysia                     | 50 ▲            |
| Hong Kong-CHN                | 49 ▲            |
| Qatar                        | 42              |
| Sweden                       | 42              |
| Finland                      | 42              |
| Bahrain                      | 42              |
| <b>International average</b> | <b>42</b>       |
| Hungary                      | 41              |
| United Arab Emirates         | 38 ▼            |
| Chile                        | 38 ▼            |
| Iran, Islamic Rep. of        | 38              |
| Tunisia                      | 37 ▼            |
| Jordan                       | 37 ▼            |
| Oman                         | 35 ▼            |
| Italy                        | 35 ▼            |
| Israel                       | 35 ▼            |
| Syrian Arab Republic         | 34 ▼            |
| Armenia                      | 33 ▼            |
| Norway                       | 33 ▼            |
| Palestinian Nat'l Auth.      | 33 ▼            |
| Lithuania                    | 33 ▼            |
| Turkey                       | 32 ▼            |
| Thailand                     | 32 ▼            |
| Romania                      | 31 ▼            |
| Saudi Arabia                 | 29 ▼            |
| Macedonia, Rep. of           | 29 ▼            |
| Kazakhstan                   | 29 ▼            |
| Lebanon                      | 28 ▼            |
| Morocco                      | 27 ▼            |
| Georgia                      | 24 ▼            |
| Ghana                        | 23 ▼            |
| Indonesia                    | 17 ▼            |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 67 ▲ |
| Indiana-USA        | 62 ▲ |
| Massachusetts-USA  | 62 ▲ |
| Florida-USA        | 61 ▲ |
| Minnesota-USA      | 61 ▲ |
| Connecticut-USA    | 61 ▲ |
| Colorado-USA       | 60 ▲ |
| North Carolina-USA | 55 ▲ |
| Ontario-CAN        | 54 ▲ |
| Alabama-USA        | 49 ▲ |
| California-USA     | 49 ▲ |
| Dubai-UAE          | 45   |
| Quebec-CAN         | 42   |
| Abu Dhabi-UAE      | 36 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

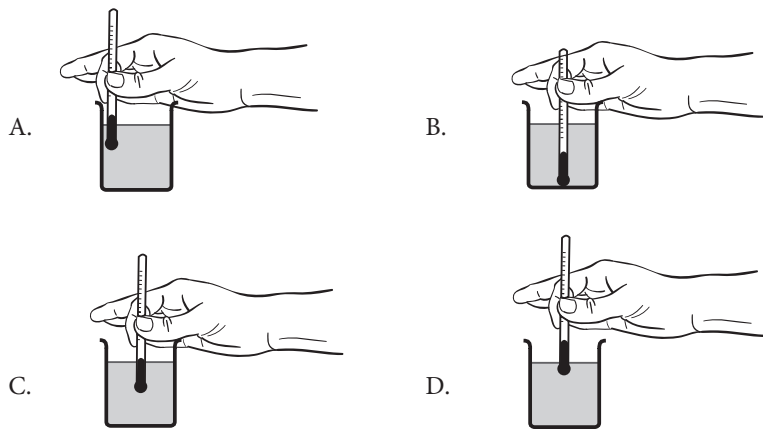
| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

Position of thermometer

Two kinds of heat sources are usually available in the science lab; an electric hot plate and a Bunsen burner. Jack planned an investigation to test which of these sources heats water faster.

He poured 200 mL of water into each of two identical beakers and recorded the initial temperature of the water in each beaker.

A. Where should Jack place the thermometer to accurately take his readings during his investigation?



Item Number: S042238A

|                   |   |
|-------------------|---|
| Correct Response: | C |
|-------------------|---|

Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Hong Kong-CHN                | 71 ▲            |
| Japan                        | 64 ▲            |
| Korea, Rep. of               | 60 ▲            |
| Chinese Taipei-CHN           | 59 ▲            |
| Finland                      | 58 ▲            |
| New Zealand                  | 58 ▲            |
| Norway                       | 57 ▲            |
| Australia                    | 57 ▲            |
| Russian Federation           | 53 ▲            |
| Singapore                    | 53 ▲            |
| Slovenia                     | 52 ▲            |
| Sweden                       | 52 ▲            |
| Hungary                      | 51 ▲            |
| <b>United States</b>         | <b>48 ▲</b>     |
| England-GBR                  | 48 ▲            |
| Thailand                     | 43              |
| Italy                        | 43              |
| Palestinian Nat'l Auth.      | 43              |
| Lithuania                    | 43              |
| <b>International average</b> | <b>41</b>       |
| Ukraine                      | 40              |
| Malaysia                     | 38              |
| Israel                       | 36 ▼            |
| Romania                      | 35 ▼            |
| Oman                         | 35 ▼            |
| Turkey                       | 35 ▼            |
| United Arab Emirates         | 34 ▼            |
| Qatar                        | 33 ▼            |
| Morocco                      | 32 ▼            |
| Bahrain                      | 32 ▼            |
| Lebanon                      | 31 ▼            |
| Kazakhstan                   | 31 ▼            |
| Jordan                       | 31 ▼            |
| Macedonia, Rep. of           | 31 ▼            |
| Chile                        | 31 ▼            |
| Iran, Islamic Rep. of        | 28 ▼            |
| Saudi Arabia                 | 28 ▼            |
| Syrian Arab Republic         | 28 ▼            |
| Tunisia                      | 25 ▼            |
| Georgia                      | 23 ▼            |
| Armenia                      | 23 ▼            |
| Indonesia                    | 22 ▼            |
| Ghana                        | 13 ▼            |

Benchmarking education system

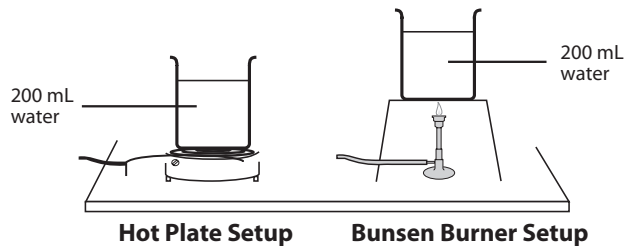
|                    |      |
|--------------------|------|
| Quebec-CAN         | 66 ▲ |
| Colorado-USA       | 60 ▲ |
| Alberta-CAN        | 59 ▲ |
| Minnesota-USA      | 58 ▲ |
| Ontario-CAN        | 53 ▲ |
| Massachusetts-USA  | 53 ▲ |
| North Carolina-USA | 52 ▲ |
| Florida-USA        | 51 ▲ |
| Indiana-USA        | 51 ▲ |
| Connecticut-USA    | 50 ▲ |
| Alabama-USA        | 43   |
| California-USA     | 42   |
| Dubai-UAE          | 42   |
| Abu Dhabi-UAE      | 32 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| <b>PHYSICS</b> | Energy Transformations, Heat, and Temperature | Reasoning        |

### One variable kept constant

Jack then placed one beaker on a hot plate and the other over a Bunsen burner, as shown below.



He recorded the temperature of the water in each set up every two minutes for ten minutes.

B. List one variable that Jack controlled in his investigation.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 65 ▲            |
| Singapore                    | 60 ▲            |
| England-GBR                  | 49 ▲            |
| Slovenia                     | 43 ▲            |
| Turkey                       | 43 ▲            |
| New Zealand                  | 41 ▲            |
| <b>United States</b>         | <b>39 ▲</b>     |
| Australia                    | 38 ▲            |
| Ukraine                      | 32 ▲            |
| Chinese Taipei-CHN           | 29 ▲            |
| Israel                       | 29 ▲            |
| Hong Kong-CHN                | 29 ▲            |
| Thailand                     | 26 ▲            |
| Jordan                       | 23              |
| Russian Federation           | 22              |
| <b>International average</b> | <b>21</b>       |
| Syrian Arab Republic         | 20              |
| Lithuania                    | 20              |
| Oman                         | 19              |
| Malaysia                     | 19              |
| Hungary                      | 18 ▼            |
| United Arab Emirates         | 17 ▼            |
| Georgia                      | 16 ▼            |
| Romania                      | 14 ▼            |
| Bahrain                      | 13 ▼            |
| Korea, Rep. of               | 11 ▼            |
| Armenia                      | 10 ▼            |
| Iran, Islamic Rep. of        | 10 ▼            |
| Qatar                        | 9 ▼             |
| Norway                       | 9 ▼             |
| Kazakhstan                   | 8 ▼             |
| Palestinian Nat'l Auth.      | 8 ▼             |
| Morocco                      | 8 ▼             |
| Lebanon                      | 8 ▼             |
| Ghana                        | 7 ▼             |
| Tunisia                      | 7 ▼             |
| Finland                      | 6 ▼             |
| Chile                        | 5 ▼             |
| Macedonia, Rep. of           | 5 ▼             |
| Indonesia                    | 5 ▼             |
| Italy                        | 4 ▼             |
| Saudi Arabia                 | 3 ▼             |
| Sweden                       | —               |

Item Number: S042238B

### SCORING

#### Correct Response

- Lists one variable as shown below.
  - The beakers (same, same shape, same size, same materials)
  - The water (same volume, from the same place)
  - The thermometer (same type, same position for taking readings)
  - Location of the experiment (same place, same room)

#### Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

Examples:

- The initial temperature.
- Checking the temperature.
- Timing.

### Benchmarking education system

|                    |      |
|--------------------|------|
| Connecticut-USA    | 57 ▲ |
| Colorado-USA       | 54 ▲ |
| Alberta-CAN        | 54 ▲ |
| Minnesota-USA      | 51 ▲ |
| Florida-USA        | 48 ▲ |
| Massachusetts-USA  | 45 ▲ |
| Indiana-USA        | 36 ▲ |
| North Carolina-USA | 35 ▲ |
| Ontario-CAN        | 30 ▲ |
| California-USA     | 27 ▲ |
| Dubai-UAE          | 24   |
| Alabama-USA        | 20   |
| Abu Dhabi-UAE      | 18   |
| Quebec-CAN         | 9 ▼  |

▲ Percent higher than International average

▼ Percent lower than International average

— Not applicable

One variable kept constant (continued)

S042238B:

## Student Responses

### Correct Response:

The amount of water

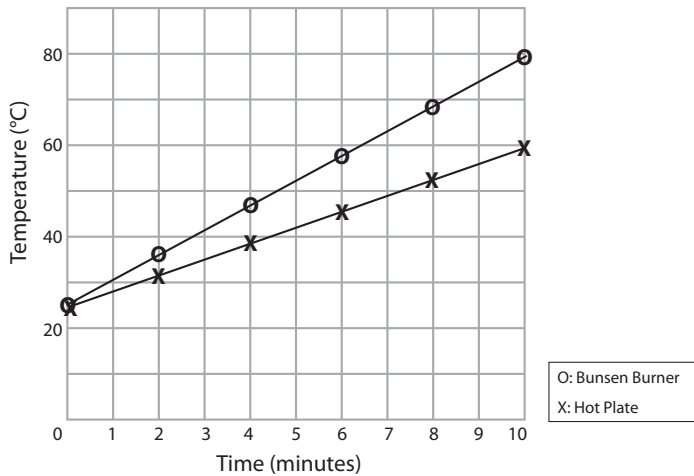
### Incorrect Response:

Time

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Reasoning        |

Conclusion from the graph

C. Jack used his results to draw a graph as shown below.



Use the information in the graph to explain which heat source heated the water faster.

Item Number: S042238C

**SCORING**

**Correct Response**

- States that the Bunsen Burner heated the water faster than the hot plate.

Examples:

The bunsen burner heated faster because the temperature of the water after 10 minutes was higher than the temperature of the water being heated by the hot plate.

The bunsen burner heats up water at a faster rate than the hot plate.

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 91 ▲            |
| Korea, Rep. of               | 90 ▲            |
| Finland                      | 90 ▲            |
| Australia                    | 88 ▲            |
| <b>United States</b>         | <b>87 ▲</b>     |
| England-GBR                  | 86 ▲            |
| Japan                        | 86 ▲            |
| New Zealand                  | 85 ▲            |
| Chinese Taipei-CHN           | 85 ▲            |
| Hungary                      | 85 ▲            |
| Lithuania                    | 84 ▲            |
| Hong Kong-CHN                | 82 ▲            |
| Norway                       | 80 ▲            |
| Sweden                       | 77 ▲            |
| Israel                       | 77 ▲            |
| Italy                        | 74 ▲            |
| Russian Federation           | 71 ▲            |
| Turkey                       | 70 ▲            |
| Chile                        | 67 ▲            |
| Ukraine                      | 66 ▼            |
| United Arab Emirates         | 66 ▲            |
| Iran, Islamic Rep. of        | 65 ▼            |
| <b>International average</b> | <b>62</b>       |
| Tunisia                      | 58 ▼            |
| Malaysia                     | 57 ▼            |
| Jordan                       | 57 ▼            |
| Bahrain                      | 56 ▼            |
| Oman                         | 52 ▼            |
| Kazakhstan                   | 50 ▼            |
| Lebanon                      | 49 ▼            |
| Thailand                     | 49 ▼            |
| Saudi Arabia                 | 49 ▼            |
| Qatar                        | 49 ▼            |
| Palestinian Nat'l Auth.      | 47 ▼            |
| Georgia                      | 38 ▼            |
| Romania                      | 36 ▼            |
| Macedonia, Rep. of           | 35 ▼            |
| Morocco                      | 35 ▼            |
| Syrian Arab Republic         | 30 ▼            |
| Indonesia                    | 30 ▼            |
| Armenia                      | 26 ▼            |
| Ghana                        | 17 ▼            |
| Slovenia                     | 12 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Minnesota-USA      | 93 ▲ |
| Massachusetts-USA  | 92 ▲ |
| Indiana-USA        | 90 ▲ |
| Colorado-USA       | 90 ▲ |
| North Carolina-USA | 88 ▲ |
| Florida-USA        | 86 ▲ |
| Connecticut-USA    | 86 ▲ |
| California-USA     | 84 ▲ |
| Ontario-CAN        | 83 ▲ |
| Alberta-CAN        | 81 ▲ |
| Alabama-USA        | 81 ▲ |
| Dubai-UAE          | 74 ▲ |
| Abu Dhabi-UAE      | 65 ▼ |
| Quebec-CAN         | 43 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Conclusion from the graph (continued)

S042238C:

## Student Responses

### Correct Response:

The bunsen burner heated the water faster  
On the graph the bunsen burner line is  
increasing more quickly than the hot plate.  
The end result showed the bunsen burner  
had a higher temperature at the end of the  
10 minutes.

### Incorrect Response:

Hot plate, time is better for  
same temperature



| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

## Molecules of liquid when it cools

What happens to the molecules of a liquid when the liquid cools?

- A. They slow down.
- B. They speed up.
- C. They decrease in number.
- D. They decrease in size.

Item Number: S042272

Correct Response:

A

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 82 ▲            |
| Slovenia                     | 80 ▲            |
| Russian Federation           | 77 ▲            |
| Israel                       | 75 ▲            |
| Singapore                    | 73 ▲            |
| Finland                      | 73 ▲            |
| <b>United States</b>         | <b>73 ▲</b>     |
| Sweden                       | 72 ▲            |
| Kazakhstan                   | 71 ▲            |
| New Zealand                  | 70 ▲            |
| Hungary                      | 70 ▲            |
| Norway                       | 68 ▲            |
| Bahrain                      | 67 ▲            |
| Ukraine                      | 67 ▲            |
| England-GBR                  | 65 ▲            |
| Turkey                       | 63 ▲            |
| Saudi Arabia                 | 63 ▲            |
| Australia                    | 62 ▲            |
| United Arab Emirates         | 60              |
| Iran, Islamic Rep. of        | 60              |
| Armenia                      | 59              |
| Romania                      | 59              |
| Lithuania                    | 59              |
| <b>International average</b> | <b>58</b>       |
| Georgia                      | 56              |
| Italy                        | 56              |
| Chinese Taipei-CHN           | 56              |
| Malaysia                     | 53 ▼            |
| Hong Kong-CHN                | 52 ▼            |
| Chile                        | 51 ▼            |
| Oman                         | 50 ▼            |
| Japan                        | 50 ▼            |
| Macedonia, Rep. of           | 49 ▼            |
| Qatar                        | 47 ▼            |
| Jordan                       | 46 ▼            |
| Thailand                     | 41 ▼            |
| Palestinian Nat'l Auth.      | 40 ▼            |
| Syrian Arab Republic         | 37 ▼            |
| Lebanon                      | 37 ▼            |
| Indonesia                    | 35 ▼            |
| Morocco                      | 33 ▼            |
| Tunisia                      | 32 ▼            |
| Ghana                        | 31 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 86 ▲ |
| Massachusetts-USA  | 86 ▲ |
| Ontario-CAN        | 83 ▲ |
| Florida-USA        | 81 ▲ |
| Indiana-USA        | 79 ▲ |
| Minnesota-USA      | 79 ▲ |
| Colorado-USA       | 76 ▲ |
| Connecticut-USA    | 75 ▲ |
| North Carolina-USA | 71 ▲ |
| California-USA     | 71 ▲ |
| Alabama-USA        | 65 ▲ |
| Quebec-CAN         | 65 ▲ |
| Abu Dhabi-UAE      | 61   |
| Dubai-UAE          | 59   |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| PHYSICS        | Light and Sound | Knowing          |

## Speed of light through substances

Light travels fastest through which of the following?

- A. air
- B. glass
- C. water
- D. a vacuum

Item Number: S042274

**Correct Response:**

**D**

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 64 ▲            |
| Chinese Taipei-CHN           | 59 ▲            |
| Singapore                    | 54 ▲            |
| Japan                        | 53 ▲            |
| Palestinian Nat'l Auth.      | 52 ▲            |
| Turkey                       | 50 ▲            |
| Jordan                       | 48 ▲            |
| Oman                         | 48 ▲            |
| Saudi Arabia                 | 47 ▲            |
| Finland                      | 44 ▲            |
| Italy                        | 44 ▲            |
| Tunisia                      | 41 ▲            |
| Hungary                      | 40 ▲            |
| Morocco                      | 40 ▲            |
| Israel                       | 40 ▲            |
| Bahrain                      | 38 ▲            |
| Indonesia                    | 36              |
| Sweden                       | 34              |
| Russian Federation           | 33              |
| <b>International average</b> | <b>33</b>       |
| Hong Kong-CHN                | 31              |
| Qatar                        | 31              |
| United Arab Emirates         | 30              |
| Lebanon                      | 30              |
| Syrian Arab Republic         | 29              |
| Chile                        | 28 ▼            |
| Thailand                     | 28 ▼            |
| Ukraine                      | 27 ▼            |
| Iran, Islamic Rep. of        | 26 ▼            |
| Kazakhstan                   | 25 ▼            |
| Armenia                      | 25 ▼            |
| Ghana                        | 24 ▼            |
| Romania                      | 24 ▼            |
| England-GBR                  | 21 ▼            |
| Macedonia, Rep. of           | 19 ▼            |
| New Zealand                  | 18 ▼            |
| Norway                       | 17 ▼            |
| Australia                    | 16 ▼            |
| Malaysia                     | 15 ▼            |
| Slovenia                     | 14 ▼            |
| <b>United States</b>         | <b>13 ▼</b>     |
| Lithuania                    | 12 ▼            |
| Georgia                      | 11 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Quebec-CAN         | 34   |
| Abu Dhabi-UAE      | 33   |
| Dubai-UAE          | 24 ▼ |
| Florida-USA        | 22 ▼ |
| Connecticut-USA    | 18 ▼ |
| California-USA     | 13 ▼ |
| Alberta-CAN        | 13 ▼ |
| Colorado-USA       | 13 ▼ |
| Minnesota-USA      | 12 ▼ |
| Massachusetts-USA  | 12 ▼ |
| Indiana-USA        | 11 ▼ |
| Alabama-USA        | 10 ▼ |
| North Carolina-USA | 9 ▼  |
| Ontario-CAN        | 9 ▼  |

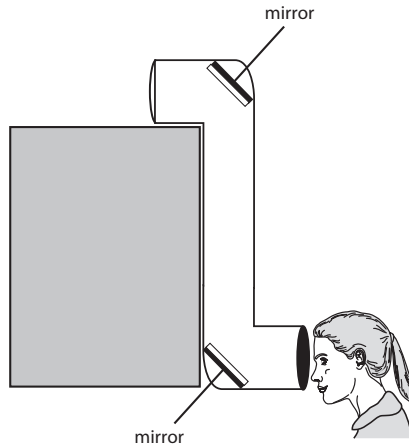
▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic      | Cognitive Domain |
|----------------|-----------------|------------------|
| PHYSICS        | Light and Sound | Applying         |

### Path of light through periscope

The diagram below shows a periscope. Mary is using it to look over a wall.

Draw the path the light ray would take through the periscope. Show the direction of the light ray with arrows.



### Overall Percent Correct

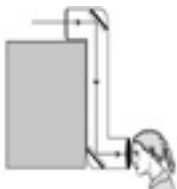
| Education system               | Percent correct |
|--------------------------------|-----------------|
| Kazakhstan                     | 57 ▲            |
| Finland                        | 53 ▲            |
| Singapore                      | 53 ▲            |
| Hungary                        | 50 ▲            |
| Hong Kong-CHN                  | 49 ▲            |
| Slovenia                       | 47 ▲            |
| Russian Federation             | 46 ▲            |
| England-GBR                    | 42 ▲            |
| Chinese Taipei-CHN             | 41 ▲            |
| Sweden                         | 40 ▲            |
| Australia                      | 39 ▲            |
| Lithuania                      | 39 ▲            |
| Iran, Islamic Rep. of          | 38 ▲            |
| Thailand                       | 37 ▲            |
| New Zealand                    | 36 ▲            |
| Italy                          | 34              |
| Romania                        | 34              |
| <b>United States</b>           | <b>34 ▲</b>     |
| Japan                          | 33              |
| Korea, Rep. of                 | 32              |
| Norway                         | 32              |
| <b>International average</b>   | <b>30</b>       |
| Israel                         | 29              |
| Armenia                        | 26 ▼            |
| Tunisia                        | 26 ▼            |
| Ukraine                        | 25 ▼            |
| Macedonia, Rep. of             | 24 ▼            |
| Qatar                          | 23 ▼            |
| Syrian Arab Republic           | 23 ▼            |
| Malaysia                       | 22 ▼            |
| Chile                          | 22 ▼            |
| United Arab Emirates           | 22 ▼            |
| Bahrain                        | 19 ▼            |
| Lebanon                        | 19 ▼            |
| Turkey                         | 19 ▼            |
| Georgia                        | 19 ▼            |
| Oman                           | 19 ▼            |
| <i>Palestinian Nat'l Auth.</i> | 18 ▼            |
| Saudi Arabia                   | 17 ▼            |
| Morocco                        | 16 ▼            |
| Jordan                         | 12 ▼            |
| Indonesia                      | 11 ▼            |
| Ghana                          | 5 ▼             |

Item Number: S042278

### SCORING

#### Correct Response

- Draws a correct path of the light ray with arrows showing the direction as shown below.



#### Incorrect Response

- Draws a correct path of the light ray, but arrows are missing.
- Draws a correct path of the light ray, but the direction is reversed.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Benchmarking education system

|                    |      |
|--------------------|------|
| Minnesota-USA      | 49 ▲ |
| Alberta-CAN        | 44 ▲ |
| Indiana-USA        | 43 ▲ |
| Massachusetts-USA  | 41 ▲ |
| Quebec-CAN         | 40 ▲ |
| Ontario-CAN        | 39 ▲ |
| Colorado-USA       | 37 ▲ |
| Connecticut-USA    | 36 ▲ |
| Florida-USA        | 33   |
| North Carolina-USA | 31   |
| Dubai-UAE          | 31   |
| California-USA     | 29   |
| Alabama-USA        | 26 ▼ |
| Abu Dhabi-UAE      | 20 ▼ |

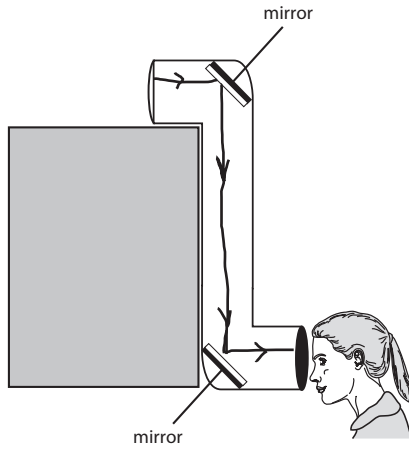
▲ Percent higher than International average  
▼ Percent lower than International average

## Path of light through periscope (continued)

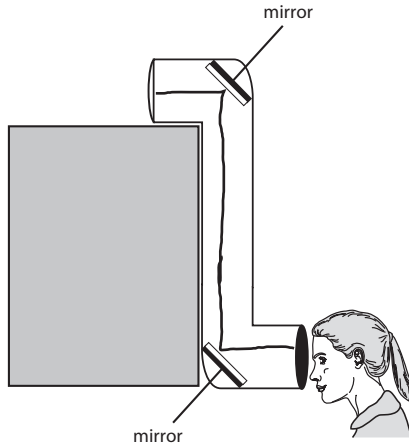
S042278:

### Student Responses

#### Correct Response:

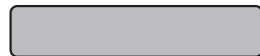


#### Incorrect Response:



| Content Domain | Main Topic                | Cognitive Domain |
|----------------|---------------------------|------------------|
| PHYSICS        | Electricity and Magnetism | Reasoning        |

Find out if metal 2 is a magnet



Metal bar 1



Metal bar 2

Ray has two metal bars. He knows Metal bar 1 is a magnet.

A. How could he use Metal bar 1 to find out if Metal bar 2 is a magnet?

B. What would he observe if Metal bar 2 is a magnet?

Item Number: S042403

### SCORING

#### Correct Response

- Refers to metals repelling each other. May or may not include attraction.

Examples:

Put one end of Metal 1 to both ends of Metal 2; If the metals repel, then Metal 2 is a magnet.

When either one of the ends goes near metal 2 it repels.

#### Incorrect Response

- Refers to attraction only.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 59 ▲            |
| Korea, Rep. of               | 57 ▲            |
| Finland                      | 54 ▲            |
| Hungary                      | 51 ▲            |
| Russian Federation           | 48 ▲            |
| Sweden                       | 45 ▲            |
| Slovenia                     | 40 ▲            |
| Japan                        | 39 ▲            |
| Norway                       | 38 ▲            |
| Australia                    | 38 ▲            |
| Turkey                       | 37 ▲            |
| Lithuania                    | 34 ▲            |
| Ukraine                      | 33              |
| Chinese Taipei-CHN           | 33 ▲            |
| Romania                      | 32              |
| Kazakhstan                   | 32              |
| <b>United States</b>         | <b>31 ▲</b>     |
| Iran, Islamic Rep. of        | 30              |
| New Zealand                  | 30              |
| Israel                       | 30              |
| Italy                        | 29              |
| Chile                        | 29              |
| <b>International average</b> | <b>28</b>       |
| Hong Kong-CHN                | 28              |
| England-GBR                  | 27              |
| United Arab Emirates         | 27              |
| Jordan                       | 23 ▼            |
| Bahrain                      | 21 ▼            |
| Palestinian Nat'l Auth.      | 21 ▼            |
| Armenia                      | 20 ▼            |
| Malaysia                     | 19 ▼            |
| Qatar                        | 18 ▼            |
| Tunisia                      | 16 ▼            |
| Syrian Arab Republic         | 16 ▼            |
| Macedonia, Rep. of           | 15 ▼            |
| Thailand                     | 13 ▼            |
| Lebanon                      | 12 ▼            |
| Oman                         | 12 ▼            |
| Georgia                      | 9 ▼             |
| Indonesia                    | 9 ▼             |
| Morocco                      | 7 ▼             |
| Saudi Arabia                 | 6 ▼             |
| Ghana                        | 3 ▼             |

### Benchmarking education system

|                    |      |
|--------------------|------|
| Colorado-USA       | 43 ▲ |
| Minnesota-USA      | 40 ▲ |
| Ontario-CAN        | 39 ▲ |
| Massachusetts-USA  | 37 ▲ |
| Indiana-USA        | 36 ▲ |
| Alberta-CAN        | 35 ▲ |
| Connecticut-USA    | 34 ▲ |
| Quebec-CAN         | 34 ▲ |
| Florida-USA        | 33   |
| Dubai-UAE          | 31   |
| Abu Dhabi-UAE      | 29   |
| North Carolina-USA | 27   |
| Alabama-USA        | 25   |
| California-USA     | 24   |

▲ Percent higher than International average  
▼ Percent lower than International average

## Find out if metal 2 is a magnet (continued)

S042403:

## Student Responses

## Correct Response:

A. How could he use Metal bar 1 to find out if Metal bar 2 is a magnet?

Ray could hold bar 1 near bar 2 if bar 2 is attracted to bar one and sticks to it, or if bar 1 repels bar 2, they're both magnets

B. What would he observe if Metal bar 2 is a magnet?

Bar 2 would either be attracted and move towards and stick to bar 1, or be repelled and move away from bar 1

## Incorrect Response:

A. How could he use Metal bar 1 to find out if Metal bar 2 is a magnet?

He could see if they stick together

B. What would he observe if Metal bar 2 is a magnet?

the type of metal.

| Content Domain | Main Topic                            | Cognitive Domain |
|----------------|---------------------------------------|------------------|
| PHYSICS        | Physical States and Changes in Matter | Applying         |

## Liquid on outside of pitcher



Diagram 1



Diagram 2

Ice-cold water was placed in a glass pitcher on a hot day (Diagram 1). Soon afterwards, liquid appeared on the outside of the pitcher (Diagram 2).

Describe the process that caused the liquid to appear on the outside of the pitcher.

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 35 ▲            |
| Chinese Taipei-CHN           | 30 ▲            |
| Singapore                    | 22 ▲            |
| Saudi Arabia                 | 15 ▲            |
| Kazakhstan                   | 14 ▲            |
| Israel                       | 13 ▲            |
| Hong Kong-CHN                | 13 ▲            |
| Hungary                      | 12 ▲            |
| England-GBR                  | 12 ▲            |
| Korea, Rep. of               | 11 ▲            |
| Sweden                       | 11 ▲            |
| Iran, Islamic Rep. of        | 10 ▲            |
| Slovenia                     | 8               |
| <b>International average</b> | <b>7</b>        |
| Norway                       | 7               |
| Bahrain                      | 7               |
| Australia                    | 7               |
| Finland                      | 7               |
| Qatar                        | 6               |
| Russian Federation           | 6               |
| Jordan                       | 5 ▼             |
| United Arab Emirates         | 5 ▼             |
| New Zealand                  | 5 ▼             |
| Romania                      | 5 ▼             |
| Palestinian Nat'l Auth.      | 4 ▼             |
| Armenia                      | 4 ▼             |
| Turkey                       | 4 ▼             |
| Oman                         | 4 ▼             |
| Macedonia, Rep. of           | 3 ▼             |
| Italy                        | 3 ▼             |
| Lebanon                      | 3 ▼             |
| <b>United States</b>         | <b>2 ▼</b>      |
| Malaysia                     | 2 ▼             |
| Georgia                      | 2 ▼             |
| Indonesia                    | 2 ▼             |
| Ukraine                      | 2 ▼             |
| Lithuania                    | 2 ▼             |
| Syrian Arab Republic         | 2 ▼             |
| Chile                        | 1 ▼             |
| Thailand                     | 1 ▼             |
| Morocco                      | 1 ▼             |
| Ghana                        | 1 ▼             |
| Tunisia                      | # ▼             |

Item Number: S042404

## SCORING

## Correct Response

- Describes the process of condensation by referring to water vapor (in the air) condensing on the cool outside surface of the pitcher.

Example: It came from the water vapor condensing on the cool surface of a glass pitcher.

## Partially Correct Response

- Describes the process of condensation by referring to water vapor (in the air) condensing without mentioning the coolness of the pitcher.

Example: The liquid came from water vapor condensing.

- States condensation without referring to water vapor.

Example: Condensation.

## Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |     |
|--------------------|-----|
| Ontario-CAN        | 10  |
| Quebec-CAN         | 9   |
| Alberta-CAN        | 7   |
| Abu Dhabi-UAE      | 7   |
| Massachusetts-USA  | 6   |
| Dubai-UAE          | 5   |
| Minnesota-USA      | 5 ▼ |
| Connecticut-USA    | 4 ▼ |
| Colorado-USA       | 4 ▼ |
| North Carolina-USA | 2 ▼ |
| Florida-USA        | 2 ▼ |
| Alabama-USA        | 2 ▼ |
| Indiana-USA        | 1 ▼ |
| California-USA     | 1 ▼ |

▲ Percent higher than International average

▼ Percent lower than International average

# Rounds to zero

Liquid on outside of pitcher (continued)

S042404:

## Student Responses

### Correct Response:

The water begins to evaporate because of the hot sun, the newly formed water vapor then condenses on the cool surface of the pitcher.

### Partially Correct Response:

the water cooled the glass causing water vapor from the air to condense on the glass

### Incorrect Response:

The hot sun made the pitcher "sweat" causing it to bring out water.



| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Applying         |

Which ice block will melt first

The pictures below show two ice blocks. Block 2 is wrapped in newspaper.



Ice Block 1



Ice Block 2 wrapped in newspaper

A. Which ice block will melt first?

(Check one box.)

- Block 1  
 Block 2

B. Explain your answer.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 60 ▲            |
| Singapore                    | 53 ▲            |
| Japan                        | 51 ▲            |
| Ukraine                      | 49 ▲            |
| Chile                        | 45 ▲            |
| Tunisia                      | 43 ▲            |
| Korea, Rep. of               | 43 ▲            |
| Slovenia                     | 43 ▲            |
| Hong Kong-CHN                | 42 ▲            |
| Australia                    | 41 ▲            |
| Iran, Islamic Rep. of        | 39 ▲            |
| Thailand                     | 39              |
| Romania                      | 39              |
| Kazakhstan                   | 38              |
| Bahrain                      | 38              |
| Hungary                      | 38              |
| England-GBR                  | 38              |
| Russian Federation           | 37              |
| Indonesia                    | 37              |
| Jordan                       | 36              |
| Turkey                       | 36              |
| <b>International average</b> | <b>35</b>       |
| New Zealand                  | 34              |
| Malaysia                     | 34              |
| Israel                       | 34              |
| Sweden                       | 33              |
| Syrian Arab Republic         | 33              |
| Qatar                        | 32              |
| <b>United States</b>         | <b>31 ▼</b>     |
| Finland                      | 31              |
| Oman                         | 31 ▼            |
| Lithuania                    | 30 ▼            |
| United Arab Emirates         | 30 ▼            |
| Norway                       | 29 ▼            |
| Palestinian Nat'l Auth.      | 28 ▼            |
| Italy                        | 28 ▼            |
| Saudi Arabia                 | 28 ▼            |
| Ghana                        | 24 ▼            |
| Armenia                      | 24 ▼            |
| Georgia                      | 22 ▼            |
| Lebanon                      | 20 ▼            |
| Macedonia, Rep. of           | 18 ▼            |
| Morocco                      | 17 ▼            |

Item Number: S042407

### SCORING

#### Correct Response

- Block 1 with an explanation referring to heat OR surrounding air (hot air, sun) reaching ice block 1 more easily than ice block 2.

Examples:

Block 1 gains heat from the surrounding air. Block 2 does not gain much heat as it is wrapped in newspaper.

The newspaper helps to block some of the heat.

#### Incorrect Response

- Block 2 with an explanation referring explicitly or implicitly to the newspaper making the ice block warmer.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 59 ▲ |
| Ontario-CAN        | 49 ▲ |
| Quebec-CAN         | 46 ▲ |
| Minnesota-USA      | 36   |
| Massachusetts-USA  | 34   |
| Florida-USA        | 34   |
| Abu Dhabi-UAE      | 31   |
| Colorado-USA       | 31   |
| Dubai-UAE          | 30 ▼ |
| California-USA     | 28 ▼ |
| North Carolina-USA | 28 ▼ |
| Connecticut-USA    | 28 ▼ |
| Indiana-USA        | 28 ▼ |
| Alabama-USA        | 20 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

## Which ice block will melt first (continued)

S042407:

## Student Responses

## Correct Response:

The pictures below show two ice blocks. Block 2 is wrapped in newspaper.



Ice Block 1



Ice Block 2 wrapped in newspaper

A. Which ice block will melt first?

(Check one box.)

Block 1

Block 2

B. Explain your answer.

Newspaper is an insulator trapping  
the frigidness so ice cube 2  
remains solid longer.

## Incorrect Response:

The pictures below show two ice blocks. Block 2 is wrapped in newspaper.



Ice Block 1



Ice Block 2 wrapped in newspaper

A. Which ice block will melt first?

(Check one box.)

Block 1

Block 2

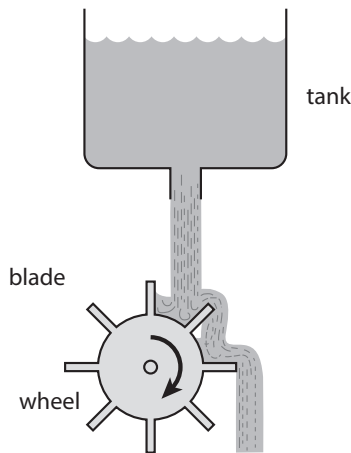
B. Explain your answer.

The paper will make it  
warmer in side  
& the ice melt faster

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

Water wheel: Energy of tank water

The diagram shows water flowing from a tank and rotating a wheel.



A. What kind of energy does the water have when it is in the tank?

Item Number: S052165A

**SCORING**

**Correct Response**

- (Gravitational) potential energy or gravitational energy or stored energy

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 64 ▲            |
| Hong Kong-CHN                | 38 ▲            |
| Israel                       | 35 ▲            |
| Saudi Arabia                 | 33 ▲            |
| Iran, Islamic Rep. of        | 33 ▲            |
| <b>United States</b>         | <b>32 ▲</b>     |
| New Zealand                  | 27 ▲            |
| Russian Federation           | 26 ▲            |
| Slovenia                     | 24 ▲            |
| Ukraine                      | 24 ▲            |
| Kazakhstan                   | 23 ▲            |
| Australia                    | 22 ▲            |
| Armenia                      | 22 ▲            |
| Ghana                        | 19              |
| Italy                        | 19              |
| Turkey                       | 18              |
| Lebanon                      | 18              |
| England-GBR                  | 17              |
| <b>International average</b> | <b>17</b>       |
| Macedonia, Rep. of           | 15              |
| Bahrain                      | 15              |
| Malaysia                     | 14              |
| Palestinian Nat'l Auth.      | 14              |
| Lithuania                    | 14 ▼            |
| Finland                      | 13              |
| Qatar                        | 13 ▼            |
| Romania                      | 13 ▼            |
| United Arab Emirates         | 10 ▼            |
| Sweden                       | 10 ▼            |
| Jordan                       | 9 ▼             |
| Indonesia                    | 8 ▼             |
| Japan                        | 8 ▼             |
| Korea, Rep. of               | 7 ▼             |
| Norway                       | 7 ▼             |
| Syrian Arab Republic         | 7 ▼             |
| Oman                         | 6 ▼             |
| Thailand                     | 5 ▼             |
| Georgia                      | 5 ▼             |
| Hungary                      | 4 ▼             |
| Chile                        | 2 ▼             |
| Tunisia                      | 1 ▼             |
| Chinese Taipei-CHN           | 1 ▼             |
| Morocco                      | # ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Florida-USA        | 60 ▲ |
| Colorado-USA       | 48 ▲ |
| Massachusetts-USA  | 47 ▲ |
| Connecticut-USA    | 40 ▲ |
| Alabama-USA        | 32 ▲ |
| Indiana-USA        | 30 ▲ |
| Minnesota-USA      | 21   |
| North Carolina-USA | 18   |
| Alberta-CAN        | 16   |
| Dubai-UAE          | 14   |
| Abu Dhabi-UAE      | 11 ▼ |
| Ontario-CAN        | 11 ▼ |
| California-USA     | 5 ▼  |
| Quebec-CAN         | 2 ▼  |

▲ Percent higher than International average

▼ Percent lower than International average

# Rounds to zero

Water wheel: Energy of tank water (continued)

S052165A:

## Student Responses

**Correct Response:**

Potential

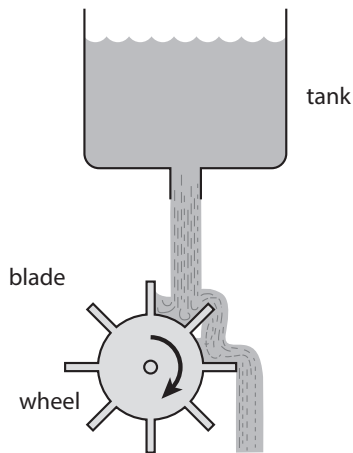
**Incorrect Response:**

fast energy.

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Knowing          |

Water wheel: Energy before wheel

The diagram shows water flowing from a tank and rotating a wheel.



B. What kind of energy does the water have just before it hits the wheel?

Item Number: S052165B

**SCORING**

**Correct Response**

- Kinetic energy (with or without (gravitational) potential energy, or gravitational energy, or stored energy)

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 66 ▲            |
| Hong Kong-CHN                | 60 ▲            |
| Israel                       | 47 ▲            |
| Saudi Arabia                 | 42 ▲            |
| England-GBR                  | 39 ▲            |
| <b>United States</b>         | <b>37 ▲</b>     |
| Finland                      | 37 ▲            |
| Italy                        | 34 ▲            |
| Ukraine                      | 31 ▲            |
| Malaysia                     | 31 ▲            |
| New Zealand                  | 31 ▲            |
| Oman                         | 31 ▲            |
| Slovenia                     | 29 ▲            |
| Russian Federation           | 29 ▲            |
| Turkey                       | 28 ▲            |
| Bahrain                      | 27              |
| Australia                    | 27              |
| Palestinian Nat'l Auth.      | 27              |
| Iran, Islamic Rep. of        | 25              |
| Kazakhstan                   | 25              |
| <b>International average</b> | <b>24</b>       |
| Armenia                      | 22              |
| Qatar                        | 21              |
| Tunisia                      | 21              |
| Sweden                       | 21              |
| Ghana                        | 20 ▼            |
| Jordan                       | 19 ▼            |
| Lebanon                      | 18 ▼            |
| United Arab Emirates         | 18 ▼            |
| Macedonia, Rep. of           | 16 ▼            |
| Korea, Rep. of               | 15 ▼            |
| Syrian Arab Republic         | 15 ▼            |
| Romania                      | 13 ▼            |
| Lithuania                    | 13 ▼            |
| Japan                        | 13 ▼            |
| Indonesia                    | 12 ▼            |
| Hungary                      | 11 ▼            |
| Norway                       | 9 ▼             |
| Thailand                     | 9 ▼             |
| Chile                        | 8 ▼             |
| Georgia                      | 4 ▼             |
| Morocco                      | 1 ▼             |
| Chinese Taipei-CHN           | 1 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Florida-USA        | 63 ▲ |
| Massachusetts-USA  | 54 ▲ |
| Colorado-USA       | 52 ▲ |
| Connecticut-USA    | 41 ▲ |
| Indiana-USA        | 39 ▲ |
| Alabama-USA        | 37 ▲ |
| North Carolina-USA | 27   |
| Minnesota-USA      | 26   |
| Alberta-CAN        | 23   |
| Dubai-UAE          | 22   |
| Abu Dhabi-UAE      | 20   |
| Ontario-CAN        | 15 ▼ |
| California-USA     | 10 ▼ |
| Quebec-CAN         | 4 ▼  |

▲ Percent higher than International average  
▼ Percent lower than International average

Water wheel: Energy before wheel (continued)

S052165B:

## Student Responses

### Correct Response:

*Kinetic*

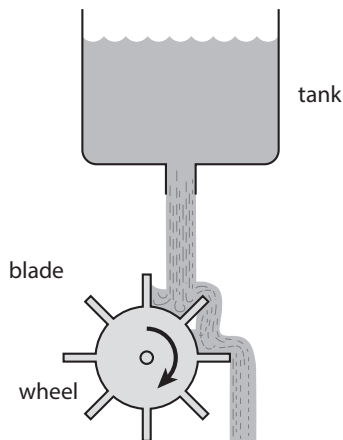
### Incorrect Response:

*Falling energy.  
(dropping)*

| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| PHYSICS        | Energy Transformations, Heat, and Temperature | Reasoning        |

Water wheel: Faster rotation

The diagram shows water flowing from a tank and rotating a wheel.



C. Write one change to the system that will make the wheel rotate faster.

Item Number: S052165C

**SCORING**

**Correct Response**

- Gives a reason related to increasing the flow of water from the list of acceptable responses below.
  - Put more water in the tank
  - Use a taller water tank
  - Make the outlet wider/bigger
  - Make another outlet
  - Increase the distance between the wheel and the tank
  - Make the wheel smaller
  - Make the blades wider/bigger/longer
  - Increase the number of blades

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task), including responses that do not include how to change the system.

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 67 ▲            |
| Japan                        | 58 ▲            |
| Hong Kong-CHN                | 46 ▲            |
| Korea, Rep. of               | 44 ▲            |
| Israel                       | 44 ▲            |
| Chinese Taipei-CHN           | 44 ▲            |
| England-GBR                  | 42 ▲            |
| Finland                      | 41 ▲            |
| Iran, Islamic Rep. of        | 40 ▲            |
| Turkey                       | 37 ▲            |
| Russian Federation           | 37 ▲            |
| Australia                    | 36 ▲            |
| Slovenia                     | 35 ▲            |
| Hungary                      | 34 ▲            |
| Norway                       | 31              |
| Ukraine                      | 31              |
| Lithuania                    | 31              |
| New Zealand                  | 29              |
| <b>United States</b>         | <b>28</b>       |
| <b>International average</b> | <b>27</b>       |
| Sweden                       | 26              |
| Syrian Arab Republic         | 25              |
| Romania                      | 25              |
| Italy                        | 23 ▼            |
| Oman                         | 23 ▼            |
| Kazakhstan                   | 20 ▼            |
| Tunisia                      | 20 ▼            |
| Palestinian Nat'l Auth.      | 20 ▼            |
| Bahrain                      | 18 ▼            |
| Jordan                       | 18 ▼            |
| United Arab Emirates         | 18 ▼            |
| Saudi Arabia                 | 17 ▼            |
| Macedonia, Rep. of           | 17 ▼            |
| Qatar                        | 17 ▼            |
| Malaysia                     | 16 ▼            |
| Armenia                      | 16 ▼            |
| Georgia                      | 13 ▼            |
| Chile                        | 12 ▼            |
| Lebanon                      | 11 ▼            |
| Thailand                     | 10 ▼            |
| Indonesia                    | 9 ▼             |
| Morocco                      | 5 ▼             |
| Ghana                        | 3 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 37 ▲ |
| Minnesota-USA      | 35 ▲ |
| Alberta-CAN        | 35 ▲ |
| Colorado-USA       | 33   |
| Connecticut-USA    | 33   |
| Ontario-CAN        | 32 ▲ |
| Quebec-CAN         | 31   |
| Indiana-USA        | 25   |
| Florida-USA        | 25   |
| Dubai-UAE          | 24   |
| North Carolina-USA | 23   |
| Alabama-USA        | 17 ▼ |
| California-USA     | 17 ▼ |
| Abu Dhabi-UAE      | 17 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Water wheel: Faster rotation (continued)

S052165C:

## Student Responses

### Correct Response:

more water coming out at  
once ; a bigger opening

### Incorrect Response:

Changing the speed and temperature of the  
Water.



| Content Domain | Main Topic        | Cognitive Domain |
|----------------|-------------------|------------------|
| PHYSICS        | Forces and Motion | Knowing          |

In which liquid would object float

An object has a density of  $1.1 \text{ g/cm}^3$ .

A. In which liquid would this object float?

(Check one box.)

Liquid X:  $1.3 \text{ g/cm}^3$

Liquid Y:  $0.9 \text{ g/cm}^3$

B. Explain your answer.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 62 ▲            |
| Singapore                    | 61 ▲            |
| Slovenia                     | 58 ▲            |
| Chinese Taipei-CHN           | 52 ▲            |
| Hungary                      | 48 ▲            |
| Russian Federation           | 47 ▲            |
| Hong Kong-CHN                | 45 ▲            |
| Finland                      | 44 ▲            |
| <b>United States</b>         | <b>43 ▲</b>     |
| Japan                        | 39 ▲            |
| Turkey                       | 38 ▲            |
| Israel                       | 36 ▲            |
| Ukraine                      | 36              |
| Romania                      | 35              |
| Kazakhstan                   | 35              |
| Lithuania                    | 35              |
| Thailand                     | 33              |
| Jordan                       | 32              |
| <b>International average</b> | <b>31</b>       |
| United Arab Emirates         | 30              |
| Tunisia                      | 30              |
| England-GBR                  | 29              |
| Australia                    | 28              |
| Oman                         | 28 ▼            |
| Italy                        | 28              |
| Sweden                       | 27 ▼            |
| Armenia                      | 26 ▼            |
| New Zealand                  | 25 ▼            |
| Lebanon                      | 24 ▼            |
| Palestinian Nat'l Auth.      | 23 ▼            |
| Malaysia                     | 23 ▼            |
| Norway                       | 23 ▼            |
| Georgia                      | 22 ▼            |
| Bahrain                      | 21 ▼            |
| Iran, Islamic Rep. of        | 21 ▼            |
| Chile                        | 19 ▼            |
| Qatar                        | 17 ▼            |
| Saudi Arabia                 | 16 ▼            |
| Morocco                      | 15 ▼            |
| Syrian Arab Republic         | 15 ▼            |
| Macedonia, Rep. of           | 12 ▼            |
| Ghana                        | 9 ▼             |
| Indonesia                    | 9 ▼             |

Item Number: S052207

### SCORING

#### Correct Response

- Liquid X with an explanation that refers to the object being less dense.

Examples:

Liquid X – The density of the object is lower than the density of liquid X, so it can float in liquid X.

Liquid X – In order for the object to float, it must have a lower density than the liquid.

#### Incorrect Response

- Liquid X with an explanation that refers to the object/liquid being heavier or lighter.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 66 ▲ |
| Colorado-USA       | 53 ▲ |
| Connecticut-USA    | 52 ▲ |
| Minnesota-USA      | 51 ▲ |
| Alberta-CAN        | 50 ▲ |
| North Carolina-USA | 49 ▲ |
| California-USA     | 48 ▲ |
| Ontario-CAN        | 45 ▲ |
| Indiana-USA        | 45 ▲ |
| Florida-USA        | 43 ▲ |
| Quebec-CAN         | 35   |
| Dubai-UAE          | 35 ▲ |
| Alabama-USA        | 33   |
| Abu Dhabi-UAE      | 29   |

▲ Percent higher than International average  
▼ Percent lower than International average

In which liquid would object float (continued)

S052207:

## Student Responses

### Correct Response:

A. In which liquid would this object float?

(Check one box.)

Liquid X:  $1.3 \text{ g/cm}^3$

Liquid Y:  $0.9 \text{ g/cm}^3$

B. Explain your answer.

The object has to be less dense than the liquid.

### Incorrect Response:

A. In which liquid would this object float?

(Check one box.)

Liquid X:  $1.3 \text{ g/cm}^3$

Liquid Y:  $0.9 \text{ g/cm}^3$

B. Explain your answer.

Because the liquid is lighter than the object.

| Content Domain       | Main Topic                             | Cognitive Domain |
|----------------------|--|------------------|
| <b>EARTH SCIENCE</b> | Earth's Processes, Cycles, and History | Applying         |

## Order of steps in the water cycle

The following five statements describe processes involved in the water cycle. Water evaporation from the sea is identified as a first step in the water cycle.

Number the other statements 2 through 5 in the order in which these processes take place.

- \_\_\_\_\_ Water vapor rises in warm air.
- \_\_\_\_\_ Water travels along a river to the sea.
- 1   Water evaporates from the sea.
- \_\_\_\_\_ Water vapor is cooled and forms clouds.
- \_\_\_\_\_ Clouds move and water falls on land as rain.

Item Number: S032060

**SCORING****Correct Response**

- 2, 5, 1, 3, 4

**Incorrect Response**

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 92 ▲            |
| Hong Kong-CHN                | 85 ▲            |
| Singapore                    | 83 ▲            |
| Chinese Taipei-CHN           | 82 ▲            |
| Korea, Rep. of               | 81 ▲            |
| Russian Federation           | 79 ▲            |
| England-GBR                  | 79 ▲            |
| Israel                       | 79 ▲            |
| Sweden                       | 78 ▲            |
| Lithuania                    | 76 ▲            |
| Slovenia                     | 76 ▲            |
| Hungary                      | 74 ▲            |
| New Zealand                  | 72 ▲            |
| Australia                    | 71 ▲            |
| Italy                        | 71 ▲            |
| <b>United States</b>         | <b>71 ▲</b>     |
| Japan                        | 71 ▲            |
| Ukraine                      | 69 ▲            |
| Norway                       | 67              |
| Chile                        | 66              |
| <b>International average</b> | <b>63</b>       |
| Tunisia                      | 62              |
| United Arab Emirates         | 62              |
| Thailand                     | 61              |
| Oman                         | 60              |
| Bahrain                      | 59 ▼            |
| Iran, Islamic Rep. of        | 58 ▼            |
| Jordan                       | 57 ▼            |
| Romania                      | 56 ▼            |
| Saudi Arabia                 | 56 ▼            |
| Kazakhstan                   | 55 ▼            |
| Georgia                      | 54 ▼            |
| Turkey                       | 54 ▼            |
| Lebanon                      | 50 ▼            |
| Malaysia                     | 49 ▼            |
| Armenia                      | 47 ▼            |
| Syrian Arab Republic         | 46 ▼            |
| Palestinian Nat'l Auth.      | 45 ▼            |
| Indonesia                    | 45 ▼            |
| Qatar                        | 45 ▼            |
| Morocco                      | 44 ▼            |
| Macedonia, Rep. of           | 37 ▼            |
| Ghana                        | 14 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Quebec-CAN         | 80 ▲ |
| Minnesota-USA      | 79 ▲ |
| Alberta-CAN        | 77 ▲ |
| Ontario-CAN        | 76 ▲ |
| Massachusetts-USA  | 76 ▲ |
| North Carolina-USA | 76 ▲ |
| Colorado-USA       | 75 ▲ |
| Indiana-USA        | 74 ▲ |
| Florida-USA        | 73 ▲ |
| Dubai-UAE          | 68 ▲ |
| Connecticut-USA    | 67   |
| California-USA     | 62   |
| Abu Dhabi-UAE      | 60   |
| Alabama-USA        | 58   |

▲ Percent higher than International average  
▼ Percent lower than International average

Order of steps in the water cycle (continued)

S032060:

**Student Responses**

**Correct Response:**

- 2   Water vapor rises in warm air.
- 5   Water travels along a river to the sea.
- 1   Water evaporates from the sea.
- 3   Water vapor is cooled and forms clouds.
- 4   Clouds move and water falls on land as rain.

**Incorrect Response:**

- 4   Water vapor rises in warm air.
- 2   Water travels along a river to the sea.
- 1   Water evaporates from the sea.
- 3   Water vapor is cooled and forms clouds.
- 5   Clouds move and water falls on land as rain.

| Content Domain       | Main Topic                             | Cognitive Domain |
|----------------------|--|------------------|
| <b>EARTH SCIENCE</b> | Earth's Processes, Cycles, and History | Knowing          |

### Volcanic eruption effects

State one way that a volcanic eruption can affect the environment.

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 81 ▲            |
| Slovenia                     | 78 ▲            |
| Sweden                       | 76 ▲            |
| Finland                      | 71 ▲            |
| New Zealand                  | 70 ▲            |
| Lithuania                    | 70 ▲            |
| England-GBR                  | 67 ▲            |
| Russian Federation           | 63 ▲            |
| Japan                        | 63 ▲            |
| Australia                    | 63 ▲            |
| <b>United States</b>         | <b>62 ▲</b>     |
| Chile                        | 62 ▲            |
| Korea, Rep. of               | 58 ▲            |
| Kazakhstan                   | 58 ▲            |
| Romania                      | 57 ▲            |
| Chinese Taipei-CHN           | 55 ▲            |
| Hong Kong-CHN                | 54 ▲            |
| Hungary                      | 54 ▲            |
| Norway                       | 49              |
| Turkey                       | 49              |
| Israel                       | 49              |
| Ukraine                      | 49              |
| <b>International average</b> | <b>48</b>       |
| Thailand                     | 47              |
| Indonesia                    | 45              |
| Saudi Arabia                 | 45              |
| United Arab Emirates         | 42 ▼            |
| Italy                        | 41 ▼            |
| Iran, Islamic Rep. of        | 37 ▼            |
| Georgia                      | 34 ▼            |
| Armenia                      | 32 ▼            |
| Bahrain                      | 32 ▼            |
| Jordan                       | 32 ▼            |
| Qatar                        | 32 ▼            |
| Malaysia                     | 32 ▼            |
| Macedonia, Rep. of           | 31 ▼            |
| Palestinian Nat'l Auth.      | 31 ▼            |
| Lebanon                      | 28 ▼            |
| Tunisia                      | 28 ▼            |
| Syrian Arab Republic         | 27 ▼            |
| Oman                         | 26 ▼            |
| Morocco                      | 19 ▼            |
| Ghana                        | 9 ▼             |

Item Number: S032126

### SCORING

#### Correct Response

- States a negative environmental effect due to volcanic eruptions such as pollution (due to release of gases, smoke, ash, etc.) or destruction of habitats or plant/animal life (due to lava flow, burning or similar).

Example: Burns away essential plant life.

- States a positive environmental effect such as making land fertile, creating new habitats, and allowing for different life forms.

Example: It can make the land surrounding the volcano more fertile.

- Other correct

#### Incorrect Response

- Gives only a general statement of destruction or the nature of volcanic eruptions with inadequate description of how the environment is affected.

Example: It can destroy everything.

- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 70 ▲ |
| Ontario-CAN        | 67 ▲ |
| Colorado-USA       | 67 ▲ |
| Connecticut-USA    | 65 ▲ |
| Minnesota-USA      | 65 ▲ |
| Florida-USA        | 64 ▲ |
| Alberta-CAN        | 61 ▲ |
| Indiana-USA        | 59 ▲ |
| California-USA     | 58 ▲ |
| North Carolina-USA | 57 ▲ |
| Quebec-CAN         | 56 ▲ |
| Dubai-UAE          | 51   |
| Alabama-USA        | 46   |
| Abu Dhabi-UAE      | 39 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

Volcanic eruption effects (continued)

S032126:

**Student Responses**

**Correct Response:**

the ash can give minerals to the  
soil

**Incorrect Response:**

Smoke/gases

| Content Domain | Main Topic                                 | Cognitive Domain |
|----------------|--|------------------|
| EARTH SCIENCE  | Earth in the Solar System and the Universe | Knowing          |

## Major cause of tides

Which of the following is the major cause of tides?

- A. heating of the oceans by the Sun
- B. gravitational pull of the Moon
- C. earthquakes on the ocean floor
- D. changes in wind direction

Item Number: S032151

Correct Response:

**B**

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 78 ▲            |
| Slovenia                     | 76 ▲            |
| New Zealand                  | 66 ▲            |
| <b>United States</b>         | <b>61 ▲</b>     |
| Norway                       | 59 ▲            |
| Sweden                       | 58 ▲            |
| Italy                        | 57 ▲            |
| Australia                    | 57 ▲            |
| Russian Federation           | 56 ▲            |
| Korea, Rep. of               | 55 ▲            |
| Chinese Taipei-CHN           | 54 ▲            |
| Iran, Islamic Rep. of        | 53 ▲            |
| Lithuania                    | 53 ▲            |
| Oman                         | 52 ▲            |
| England-GBR                  | 52 ▲            |
| Syrian Arab Republic         | 50 ▲            |
| United Arab Emirates         | 50 ▲            |
| Hong Kong-CHN                | 45              |
| Japan                        | 44              |
| Jordan                       | 44              |
| <b>International average</b> | <b>43</b>       |
| Ukraine                      | 42              |
| Singapore                    | 42              |
| Thailand                     | 41              |
| Armenia                      | 40              |
| Chile                        | 39              |
| Bahrain                      | 39              |
| Qatar                        | 38 ▼            |
| Saudi Arabia                 | 37 ▼            |
| Israel                       | 37 ▼            |
| Turkey                       | 35 ▼            |
| Hungary                      | 35 ▼            |
| Kazakhstan                   | 34 ▼            |
| Macedonia, Rep. of           | 32 ▼            |
| Indonesia                    | 29 ▼            |
| Georgia                      | 25 ▼            |
| Romania                      | 25 ▼            |
| Palestinian Nat'l Auth.      | 23 ▼            |
| Morocco                      | 18 ▼            |
| Ghana                        | 16 ▼            |
| Malaysia                     | 16 ▼            |
| Tunisia                      | 15 ▼            |
| Lebanon                      | 13 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 79 ▲ |
| Connecticut-USA    | 75 ▲ |
| Florida-USA        | 70 ▲ |
| Minnesota-USA      | 66 ▲ |
| Colorado-USA       | 66 ▲ |
| North Carolina-USA | 61 ▲ |
| Indiana-USA        | 57 ▲ |
| Alberta-CAN        | 54 ▲ |
| Quebec-CAN         | 51 ▲ |
| Abu Dhabi-UAE      | 51 ▲ |
| California-USA     | 50 ▲ |
| Dubai-UAE          | 49 ▲ |
| Alabama-USA        | 44   |
| Ontario-CAN        | 38 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain       | Main Topic                                 | Cognitive Domain |
|----------------------|--|------------------|
| <b>EARTH SCIENCE</b> | Earth in the Solar System and the Universe | Knowing          |

## Difference between planets and moons

What is the main difference between planets and moons in our solar system?

- A. All planets can support life; moons cannot.
- B. All planets have atmospheres; moons do not.
- C. All planets orbit the Sun; all moons orbit planets.
- D. All planets are larger than all moons.

Item Number: S032160

**Correct Response:**

**C**

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 88 ▲            |
| Finland                      | 81 ▲            |
| Hong Kong-CHN                | 79 ▲            |
| Singapore                    | 78 ▲            |
| England-GBR                  | 76 ▲            |
| Russian Federation           | 75 ▲            |
| Slovenia                     | 75 ▲            |
| Sweden                       | 74 ▲            |
| Kazakhstan                   | 73 ▲            |
| Norway                       | 73 ▲            |
| Chinese Taipei-CHN           | 71 ▲            |
| New Zealand                  | 70 ▲            |
| Australia                    | 70 ▲            |
| <b>United States</b>         | <b>70 ▲</b>     |
| Lithuania                    | 69 ▲            |
| Italy                        | 67 ▲            |
| Turkey                       | 66 ▲            |
| Hungary                      | 64              |
| Ukraine                      | 64              |
| Chile                        | 63              |
| Israel                       | 62              |
| <b>International average</b> | <b>62</b>       |
| Macedonia, Rep. of           | 60              |
| Romania                      | 59              |
| United Arab Emirates         | 59              |
| Bahrain                      | 58              |
| Qatar                        | 58 ▼            |
| Armenia                      | 57 ▼            |
| Palestinian Nat'l Auth.      | 54 ▼            |
| Syrian Arab Republic         | 53 ▼            |
| Malaysia                     | 53 ▼            |
| Japan                        | 52 ▼            |
| Iran, Islamic Rep. of        | 52 ▼            |
| Saudi Arabia                 | 52 ▼            |
| Morocco                      | 52 ▼            |
| Thailand                     | 51 ▼            |
| Tunisia                      | 49 ▼            |
| Jordan                       | 49 ▼            |
| Georgia                      | 49 ▼            |
| Oman                         | 46 ▼            |
| Lebanon                      | 44 ▼            |
| Indonesia                    | 39 ▼            |
| Ghana                        | 36 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 77 ▲ |
| Minnesota-USA      | 75 ▲ |
| Florida-USA        | 73 ▲ |
| North Carolina-USA | 72 ▲ |
| Indiana-USA        | 72 ▲ |
| Alberta-CAN        | 72 ▲ |
| Colorado-USA       | 71 ▲ |
| Connecticut-USA    | 71 ▲ |
| Alabama-USA        | 69 ▲ |
| Quebec-CAN         | 69 ▲ |
| Ontario-CAN        | 66 ▲ |
| California-USA     | 66   |
| Dubai-UAE          | 63   |
| Abu Dhabi-UAE      | 60   |

▲ Percent higher than International average  
▼ Percent lower than International average



| Content Domain | Main Topic                                    | Cognitive Domain |
|----------------|---|------------------|
| EARTH SCIENCE  | Earth's Resources, Their Use and Conservation | Knowing          |

## Soil change due to natural causes

Soils change both through natural processes and as a result of human activity. Which of the following soil changes is due only to natural causes?

- A. degradation of nutrients due to pesticides
- B. formation of deserts due to tree felling
- C. flooding due to dam construction
- D. removal of nutrients due to heavy rains

Item Number: S032463

Correct Response:

D

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Chinese Taipei-CHN           | 85 ▲            |
| Finland                      | 80 ▲            |
| Japan                        | 80 ▲            |
| Russian Federation           | 77 ▲            |
| Korea, Rep. of               | 77 ▲            |
| Hong Kong-CHN                | 74 ▲            |
| Hungary                      | 73 ▲            |
| Singapore                    | 69 ▲            |
| Turkey                       | 67 ▲            |
| Israel                       | 67 ▲            |
| Ukraine                      | 67 ▲            |
| Italy                        | 66 ▲            |
| Chile                        | 66 ▲            |
| Australia                    | 64 ▲            |
| <b>United States</b>         | <b>63 ▲</b>     |
| England-GBR                  | 62 ▲            |
| Thailand                     | 61 ▲            |
| Iran, Islamic Rep. of        | 60 ▲            |
| Lithuania                    | 59              |
| <b>International average</b> | <b>55</b>       |
| Georgia                      | 55              |
| New Zealand                  | 54              |
| Kazakhstan                   | 54              |
| Sweden                       | 52              |
| Bahrain                      | 51              |
| Armenia                      | 50 ▼            |
| United Arab Emirates         | 50 ▼            |
| Romania                      | 49 ▼            |
| Slovenia                     | 49 ▼            |
| Indonesia                    | 48 ▼            |
| Palestinian Nat'l Auth.      | 43 ▼            |
| Syrian Arab Republic         | 43 ▼            |
| Qatar                        | 41 ▼            |
| Saudi Arabia                 | 39 ▼            |
| Malaysia                     | 39 ▼            |
| Tunisia                      | 38 ▼            |
| Ghana                        | 38 ▼            |
| Macedonia, Rep. of           | 38 ▼            |
| Norway                       | 35 ▼            |
| Oman                         | 35 ▼            |
| Lebanon                      | 34 ▼            |
| Jordan                       | 34 ▼            |
| Morocco                      | 28 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| North Carolina-USA | 75 ▲ |
| Quebec-CAN         | 74 ▲ |
| Massachusetts-USA  | 72 ▲ |
| Minnesota-USA      | 71 ▲ |
| Alberta-CAN        | 68 ▲ |
| Indiana-USA        | 65 ▲ |
| Ontario-CAN        | 65 ▲ |
| Florida-USA        | 65 ▲ |
| Connecticut-USA    | 63 ▲ |
| Colorado-USA       | 63 ▲ |
| Dubai-UAE          | 57   |
| California-USA     | 55   |
| Alabama-USA        | 49 ▼ |
| Abu Dhabi-UAE      | 45 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain       | Main Topic                                    | Cognitive Domain |
|----------------------|---|------------------|
| <b>EARTH SCIENCE</b> | Earth's Resources, Their Use and Conservation | Knowing          |

## Material that breaks down quickly

The following waste materials are buried in a landfill.  
Which will break down most quickly?

- A. steel
- B. plastic
- C. glass
- D. paper

Item Number: S032510

**Correct Response:**

**D**

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 91 ▲            |
| Slovenia                     | 90 ▲            |
| Lithuania                    | 88 ▲            |
| Chinese Taipei-CHN           | 87 ▲            |
| Hungary                      | 87 ▲            |
| Hong Kong-CHN                | 84 ▲            |
| Thailand                     | 83 ▲            |
| Sweden                       | 82 ▲            |
| Korea, Rep. of               | 81 ▲            |
| Romania                      | 80 ▲            |
| Indonesia                    | 79 ▲            |
| Russian Federation           | 79 ▲            |
| Singapore                    | 79 ▲            |
| Ukraine                      | 77 ▲            |
| New Zealand                  | 75 ▲            |
| Japan                        | 75 ▲            |
| Australia                    | 75 ▲            |
| <b>United States</b>         | <b>74 ▲</b>     |
| England-GBR                  | 73 ▲            |
| Armenia                      | 73 ▲            |
| Italy                        | 72 ▲            |
| Kazakhstan                   | 72              |
| Macedonia, Rep. of           | 71              |
| Georgia                      | 70              |
| Norway                       | 70              |
| Chile                        | 69              |
| <b>International average</b> | <b>68</b>       |
| Israel                       | 67              |
| Turkey                       | 66              |
| Syrian Arab Republic         | 64              |
| Malaysia                     | 61 ▼            |
| Tunisia                      | 60 ▼            |
| Jordan                       | 58 ▼            |
| Iran, Islamic Rep. of        | 57 ▼            |
| United Arab Emirates         | 50 ▼            |
| Palestinian Nat'l Auth.      | 49 ▼            |
| Bahrain                      | 46 ▼            |
| Saudi Arabia                 | 46 ▼            |
| Lebanon                      | 45 ▼            |
| Oman                         | 44 ▼            |
| Morocco                      | 43 ▼            |
| Qatar                        | 42 ▼            |
| Ghana                        | 32 ▼            |

## Benchmarking education system

|                    |      |
|--------------------|------|
| Alberta-CAN        | 82 ▲ |
| Massachusetts-USA  | 82 ▲ |
| Minnesota-USA      | 79 ▲ |
| Colorado-USA       | 79 ▲ |
| North Carolina-USA | 78 ▲ |
| Florida-USA        | 78 ▲ |
| Indiana-USA        | 77 ▲ |
| Connecticut-USA    | 76 ▲ |
| Ontario-CAN        | 75 ▲ |
| Quebec-CAN         | 73 ▲ |
| Alabama-USA        | 71   |
| California-USA     | 61 ▼ |
| Dubai-UAE          | 51 ▼ |
| Abu Dhabi-UAE      | 49 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| EARTH SCIENCE  | Earth's Structure and Physical Features | Applying         |

Changes at high elevations-DERIVED

Tamora is preparing to climb one of the highest mountains on Earth. She knows that the atmospheric conditions will change the higher up the mountain she climbs.

In the table below, write down two atmospheric conditions that will change as Tamora climbs the mountain. State what Tamora needs to bring in order to survive these two conditions at high elevations.

|    | Change in Atmospheric Condition | What Tamora Needs to Bring |
|----|---------------------------------|----------------------------|
| 1. |                                 |                            |
| 2. |                                 |                            |

Item Number: S032650Z

**SCORING**

Note: Each of the two responses are scored separately. However, if the two responses are essentially the same, the second response should be scored as "Incorrect Response".

**Correct Response**

- Indicates that the temperature will decrease (or similar).  
Example: The temperature will be colder. [More clothes.]
- Indicates that there will be less oxygen (air) or lower atmospheric pressure (or similar).  
Example: Air will get thinner. [Oxygen mask.]
- Indicates increased precipitation (snow, rain) or clouds (or similar).  
Example: It will get icy. [Bring ice shoes.]
- Other correct

**Incorrect Response**

- Mentions a type of equipment, but does not clearly indicate how the atmospheric condition changes.
- Mentions that the atmospheric pressure increases with or without listing oxygen equipment.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task).

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 61 ▲            |
| Japan                        | 60 ▲            |
| New Zealand                  | 59 ▲            |
| Finland                      | 59 ▲            |
| England-GBR                  | 56 ▲            |
| Australia                    | 56 ▲            |
| Hungary                      | 55 ▲            |
| Korea, Rep. of               | 53 ▲            |
| Chinese Taipei-CHN           | 50 ▲            |
| Slovenia                     | 49 ▲            |
| Lithuania                    | 48 ▲            |
| Israel                       | 46 ▲            |
| <b>United States</b>         | <b>42 ▲</b>     |
| Hong Kong-CHN                | 40 ▲            |
| Norway                       | 40 ▲            |
| Sweden                       | 39 ▲            |
| Saudi Arabia                 | 37 ▲            |
| <b>International average</b> | <b>33</b>       |
| Romania                      | 32              |
| Russian Federation           | 32              |
| Jordan                       | 31              |
| Palestinian Nat'l Auth.      | 31              |
| United Arab Emirates         | 30 ▼            |
| Italy                        | 30              |
| Tunisia                      | 29 ▼            |
| Kazakhstan                   | 27 ▼            |
| Qatar                        | 26 ▼            |
| Syrian Arab Republic         | 22 ▼            |
| Chile                        | 22 ▼            |
| Bahrain                      | 22 ▼            |
| Macedonia, Rep. of           | 21 ▼            |
| Morocco                      | 20 ▼            |
| Turkey                       | 20 ▼            |
| Oman                         | 20 ▼            |
| Iran, Islamic Rep. of        | 19 ▼            |
| Ukraine                      | 18 ▼            |
| Armenia                      | 15 ▼            |
| Thailand                     | 14 ▼            |
| Malaysia                     | 11 ▼            |
| Indonesia                    | 11 ▼            |
| Georgia                      | 10 ▼            |
| Lebanon                      | 9 ▼             |
| Ghana                        | 3 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 60 ▲ |
| Minnesota-USA      | 57 ▲ |
| Quebec-CAN         | 56 ▲ |
| Alberta-CAN        | 53 ▲ |
| North Carolina-USA | 52 ▲ |
| Indiana-USA        | 51 ▲ |
| Connecticut-USA    | 50 ▲ |
| Colorado-USA       | 49 ▲ |
| Ontario-CAN        | 48 ▲ |
| Florida-USA        | 42 ▲ |
| Dubai-UAE          | 39 ▲ |
| Abu Dhabi-UAE      | 31   |
| California-USA     | 30   |
| Alabama-USA        | 29   |

▲ Percent higher than International average  
▼ Percent lower than International average

## Changes at high elevations (continued)

S032650Z:

## Student Responses

## Correct Response:

|    | Change in Atmospheric Condition                           | What Tamora Needs to Bring        |
|----|---|-----------------------------------|
| 1. | The air will become less Dense making it harder to breath | Oxygen tanks to so she can breath |
| 2. | It will get much colder the higher she goes               | the warm wheather Proof clothing  |

## Incorrect Response:

|    | Change in Atmospheric Condition                                  | What Tamora Needs to Bring                |
|----|--|---|
| 1. | The higher she goes the atmospheric condition in cooler the top. | Something she can use to stay to the top. |
| 2. |  |   |

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| EARTH SCIENCE  | Earth's Structure and Physical Features | Applying         |

Topographic map: identify X

**Tiger Island**

The diagram above shows a topographic map of Tiger Island. The lines on the map are contour lines that connect points at the same elevation. The elevations shown are in meters.

A. What geographical feature is found at point **X**? \_\_\_\_\_

Item Number: S032651A

**SCORING**

**Correct Response**

- Identifies X as a mountain, hill, peak, summit, highest point, volcano, or similar.

**Incorrect Response**

- Identifies X as a crater, valley, hole, or similar (misinterpretation that contour lines indicate decreasing elevation).
- Identifies X as a water feature.
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Finland                      | 84 ▲            |
| Chinese Taipei-CHN           | 81 ▲            |
| Slovenia                     | 70 ▲            |
| Singapore                    | 68 ▲            |
| Russian Federation           | 67 ▲            |
| Hungary                      | 66 ▲            |
| Hong Kong-CHN                | 64 ▲            |
| Norway                       | 61 ▲            |
| Australia                    | 61 ▲            |
| Lithuania                    | 60 ▲            |
| Korea, Rep. of               | 60 ▲            |
| <b>United States</b>         | <b>59 ▲</b>     |
| Ukraine                      | 57 ▲            |
| England-GBR                  | 56 ▲            |
| Italy                        | 54 ▲            |
| Japan                        | 52 ▲            |
| Israel                       | 47 ▲            |
| New Zealand                  | 45 ▲            |
| Sweden                       | 43 ▲            |
| <b>International average</b> | <b>38</b>       |
| Kazakhstan                   | 35              |
| Iran, Islamic Rep. of        | 31 ▼            |
| Turkey                       | 31 ▼            |
| Romania                      | 30 ▼            |
| Macedonia, Rep. of           | 28 ▼            |
| Malaysia                     | 27 ▼            |
| Georgia                      | 25 ▼            |
| United Arab Emirates         | 23 ▼            |
| Thailand                     | 22 ▼            |
| Chile                        | 22 ▼            |
| Saudi Arabia                 | 22 ▼            |
| Jordan                       | 21 ▼            |
| Bahrain                      | 21 ▼            |
| Armenia                      | 20 ▼            |
| Qatar                        | 18 ▼            |
| Syrian Arab Republic         | 17 ▼            |
| Palestinian Nat'l Auth.      | 15 ▼            |
| Lebanon                      | 11 ▼            |
| Morocco                      | 10 ▼            |
| Tunisia                      | 10 ▼            |
| Indonesia                    | 9 ▼             |
| Oman                         | 9 ▼             |
| Ghana                        | 4 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 82 ▲ |
| Minnesota-USA      | 70 ▲ |
| Colorado-USA       | 65 ▲ |
| North Carolina-USA | 63 ▲ |
| Indiana-USA        | 61 ▲ |
| Connecticut-USA    | 60 ▲ |
| Alberta-CAN        | 58 ▲ |
| Quebec-CAN         | 57 ▲ |
| Florida-USA        | 51 ▲ |
| Ontario-CAN        | 50 ▲ |
| California-USA     | 45 ▲ |
| Alabama-USA        | 38   |
| Dubai-UAE          | 30 ▼ |
| Abu Dhabi-UAE      | 23 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                              | Cognitive Domain |
|----------------|---|------------------|
| EARTH SCIENCE  | Earth's Structure and Physical Features | Reasoning        |

Topographic map: river path

**Tiger Island**

The diagram above shows a topographic map of Tiger Island. The lines on the map are contour lines that connect points at the same elevation. The elevations shown are in meters.

B. Think about the source of rivers and how they flow. Now draw the path of a river between point X and Cub Bay. Use an arrow to indicate on the map which direction the river will flow.

Item Number: S032651B

**SCORING**

**Correct Response**

- Draws a correct path WITH arrow(s) indicating correct direction (see diagram below). [Path runs from point X downhill to Cub Bay and between the smaller hill(s). Includes arrow(s) that indicates direction of flow from mountain to the sea.]
- Draws a correct path (as described in first bullet) but OPPOSITE direction of arrow is shown (from sea to mountain).
- Draws a correct path (as described in first bullet) but NO arrow is shown.
- Other correct

**Incorrect Response**

- Draws a direct path that goes over the next smaller hill with or without arrow(s) (see diagram below).
- Draws a path that circles around hill(s) by following contour lines with or without arrow(s) (see diagram below).
- Other incorrect (including crossed out, erased, stray marks, illegible, or off task)

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Japan                        | 47 ▲            |
| Slovenia                     | 46 ▲            |
| Chinese Taipei-CHN           | 40 ▲            |
| Finland                      | 38 ▲            |
| Korea, Rep. of               | 37 ▲            |
| Russian Federation           | 35 ▲            |
| Hong Kong-CHN                | 30 ▲            |
| Australia                    | 30 ▲            |
| Singapore                    | 30 ▲            |
| Sweden                       | 29 ▲            |
| Iran, Islamic Rep. of        | 25 ▲            |
| Norway                       | 25 ▲            |
| Hungary                      | 24 ▲            |
| Lithuania                    | 24 ▲            |
| Ukraine                      | 24 ▲            |
| Kazakhstan                   | 23 ▲            |
| England-GBR                  | 21              |
| Italy                        | 21              |
| <b>United States</b>         | <b>21</b>       |
| New Zealand                  | 20              |
| <b>International average</b> | <b>19</b>       |
| Malaysia                     | 18              |
| Romania                      | 17              |
| Israel                       | 14 ▼            |
| Jordan                       | 13 ▼            |
| Macedonia, Rep. of           | 13 ▼            |
| Tunisia                      | 12 ▼            |
| Chile                        | 12 ▼            |
| Bahrain                      | 11 ▼            |
| Qatar                        | 10 ▼            |
| United Arab Emirates         | 9 ▼             |
| Turkey                       | 9 ▼             |
| Morocco                      | 9 ▼             |
| Georgia                      | 8 ▼             |
| Palestinian Nat'l Auth.      | 8 ▼             |
| Oman                         | 7 ▼             |
| Armenia                      | 7 ▼             |
| Syrian Arab Republic         | 7 ▼             |
| Lebanon                      | 6 ▼             |
| Indonesia                    | 5 ▼             |
| Thailand                     | 2 ▼             |
| Ghana                        | 1 ▼             |
| Saudi Arabia                 | 1 ▼             |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 37 ▲ |
| Alberta-CAN        | 35 ▲ |
| Ontario-CAN        | 26 ▲ |
| Minnesota-USA      | 25 ▲ |
| Quebec-CAN         | 25 ▲ |
| Colorado-USA       | 23   |
| North Carolina-USA | 21   |
| Connecticut-USA    | 20   |
| California-USA     | 20   |
| Indiana-USA        | 17   |
| Florida-USA        | 14   |
| Alabama-USA        | 13 ▼ |
| Dubai-UAE          | 11 ▼ |
| Abu Dhabi-UAE      | 10 ▼ |

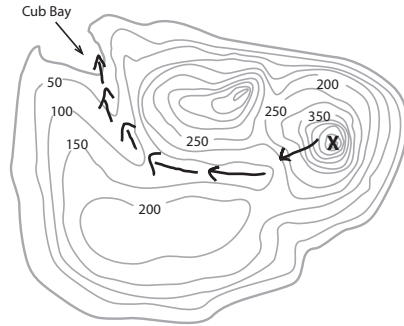
▲ Percent higher than International average  
▼ Percent lower than International average

Topographic map: river path (continued)

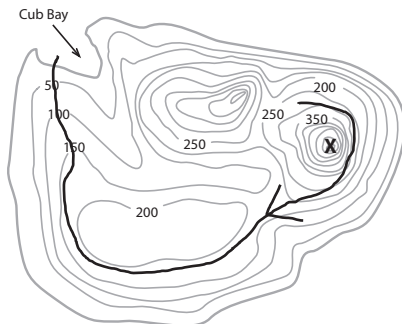
S032651B:

Student Responses

Correct Response:



Incorrect Response:



| Content Domain | Main Topic                             | Cognitive Domain |
|----------------|--|------------------|
| EARTH SCIENCE  | Earth's Processes, Cycles, and History | Reasoning        |

Location of jungle

The diagram above shows the prevailing wind direction, precipitation, and average air temperatures at different elevations on both sides of a mountain. In which location are you most likely to find a jungle?

A. location 1  
 B. location 2  
 C. location 3  
 D. location 4

Item Number: S032654

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>A</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Slovenia                     | 71 ▲            |
| Finland                      | 70 ▲            |
| Russian Federation           | 65 ▲            |
| Hungary                      | 65 ▲            |
| Chinese Taipei-CHN           | 64 ▲            |
| Hong Kong-CHN                | 64 ▲            |
| Lithuania                    | 62 ▲            |
| Iran, Islamic Rep. of        | 59 ▲            |
| Sweden                       | 58 ▲            |
| Ukraine                      | 57 ▲            |
| Singapore                    | 56 ▲            |
| <b>United States</b>         | <b>56 ▲</b>     |
| Japan                        | 56 ▲            |
| Korea, Rep. of               | 55 ▲            |
| Turkey                       | 55 ▲            |
| Australia                    | 53 ▲            |
| Norway                       | 53 ▲            |
| United Arab Emirates         | 51 ▲            |
| New Zealand                  | 50              |
| Italy                        | 49              |
| Israel                       | 49              |
| England-GBR                  | 48              |
| <b>International average</b> | <b>47</b>       |
| Macedonia, Rep. of           | 46              |
| Oman                         | 45              |
| Qatar                        | 45              |
| Chile                        | 44              |
| Tunisia                      | 43              |
| Saudi Arabia                 | 43              |
| Jordan                       | 41 ▼            |
| Malaysia                     | 38 ▼            |
| Thailand                     | 37 ▼            |
| Romania                      | 36 ▼            |
| Bahrain                      | 34 ▼            |
| Palestinian Nat'l Auth.      | 33 ▼            |
| Armenia                      | 33 ▼            |
| Georgia                      | 30 ▼            |
| Indonesia                    | 29 ▼            |
| Lebanon                      | 27 ▼            |
| Morocco                      | 25 ▼            |
| Syrian Arab Republic         | 25 ▼            |
| Kazakhstan                   | 24 ▼            |
| Ghana                        | 22 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 66 ▲ |
| Minnesota-USA      | 64 ▲ |
| Colorado-USA       | 63 ▲ |
| Florida-USA        | 57 ▲ |
| Alberta-CAN        | 56 ▲ |
| Connecticut-USA    | 55 ▲ |
| Indiana-USA        | 54 ▲ |
| Ontario-CAN        | 54 ▲ |
| North Carolina-USA | 53   |
| Dubai-UAE          | 51   |
| Abu Dhabi-UAE      | 51   |
| California-USA     | 51   |
| Quebec-CAN         | 48   |
| Alabama-USA        | 46   |

▲ Percent higher than International average  
 ▼ Percent lower than International average



| Content Domain | Main Topic                             | Cognitive Domain |
|----------------|--|------------------|
| EARTH SCIENCE  | Earth's Processes, Cycles, and History | Knowing          |

Where active volcanoes are found

Where are active volcanoes most likely to be found?

- A. where rivers form
- B. where tectonic plates meet
- C. where oceans are deepest
- D. where land and water meet

Item Number: S042141

Correct Response:

**B**

### Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Finland                        | 93 ▲            |
| Hong Kong-CHN                  | 89 ▲            |
| Lithuania                      | 87 ▲            |
| Russian Federation             | 85 ▲            |
| Slovenia                       | 85 ▲            |
| England-GBR                    | 84 ▲            |
| Chinese Taipei-CHN             | 81 ▲            |
| Sweden                         | 80 ▲            |
| Ukraine                        | 80 ▲            |
| Australia                      | 79 ▲            |
| Italy                          | 78 ▲            |
| Korea, Rep. of                 | 78 ▲            |
| <b>United States</b>           | <b>77 ▲</b>     |
| Romania                        | 74 ▲            |
| New Zealand                    | 74 ▲            |
| Kazakhstan                     | 73 ▲            |
| Singapore                      | 73 ▲            |
| Norway                         | 72 ▲            |
| Israel                         | 72 ▲            |
| Chile                          | 71 ▲            |
| Armenia                        | 70 ▲            |
| Bahrain                        | 70 ▲            |
| Japan                          | 69              |
| Morocco                        | 69 ▼            |
| United Arab Emirates           | 67              |
| Hungary                        | 67              |
| <b>International average</b>   | <b>65</b>       |
| Thailand                       | 64              |
| Oman                           | 61 ▼            |
| Macedonia, Rep. of             | 60 ▼            |
| Iran, Islamic Rep. of          | 58 ▼            |
| Tunisia                        | 53 ▼            |
| Qatar                          | 51 ▼            |
| Saudi Arabia                   | 50 ▼            |
| <i>Palestinian Nat'l Auth.</i> | 47 ▼            |
| Indonesia                      | 46 ▼            |
| Syrian Arab Republic           | 44 ▼            |
| Georgia                        | 44 ▼            |
| Jordan                         | 43 ▼            |
| Turkey                         | 42 ▼            |
| Malaysia                       | 36 ▼            |
| Lebanon                        | 32 ▼            |
| Ghana                          | 21 ▼            |

### Benchmarking education system

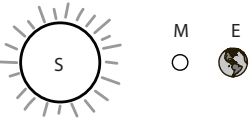
|                    |      |
|--------------------|------|
| Quebec-CAN         | 88 ▲ |
| Minnesota-USA      | 87 ▲ |
| Massachusetts-USA  | 86 ▲ |
| North Carolina-USA | 85 ▲ |
| Colorado-USA       | 84 ▲ |
| Indiana-USA        | 84 ▲ |
| Alberta-CAN        | 82 ▲ |
| Connecticut-USA    | 79 ▲ |
| Florida-USA        | 75 ▲ |
| Ontario-CAN        | 69   |
| Alabama-USA        | 68   |
| California-USA     | 67   |
| Dubai-UAE          | 67   |
| Abu Dhabi-UAE      | 66   |

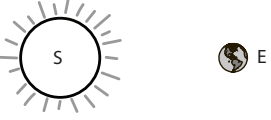
▲ Percent higher than International average  
▼ Percent lower than International average

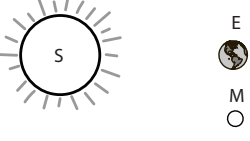
| Content Domain | Main Topic                                 | Cognitive Domain |
|----------------|--|------------------|
| EARTH SCIENCE  | Earth in the Solar System and the Universe | Applying         |


Diagram of an eclipse of the moon

Which diagram shows the position of the Sun (S), moon (M), and Earth (E) during an eclipse of the moon? (Not drawn to scale)

A. 

B. 

C. 

D. 

Item Number: S042215

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>D</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Iran, Islamic Rep. of        | 53 ▲            |
| Palestinian Nat'l Auth.      | 50 ▲            |
| Finland                      | 49 ▲            |
| Armenia                      | 46 ▲            |
| Korea, Rep. of               | 44 ▲            |
| Norway                       | 44 ▲            |
| Ukraine                      | 43 ▲            |
| Saudi Arabia                 | 43 ▲            |
| Hungary                      | 42 ▲            |
| Slovenia                     | 42 ▲            |
| Bahrain                      | 40 ▲            |
| Macedonia, Rep. of           | 40              |
| Japan                        | 39              |
| Chinese Taipei-CHN           | 38              |
| Hong Kong-CHN                | 38              |
| Oman                         | 38 ▲            |
| Malaysia                     | 37              |
| <b>International average</b> | <b>35</b>       |
| Lithuania                    | 34              |
| Sweden                       | 34              |
| Israel                       | 34              |
| Kazakhstan                   | 33              |
| Syrian Arab Republic         | 33              |
| Indonesia                    | 32              |
| Italy                        | 32              |
| Russian Federation           | 32              |
| Thailand                     | 31 ▼            |
| Georgia                      | 31              |
| Morocco                      | 31 ▼            |
| Qatar                        | 31              |
| United Arab Emirates         | 30 ▼            |
| Lebanon                      | 30              |
| Turkey                       | 30 ▼            |
| Singapore                    | 30 ▼            |
| Jordan                       | 29 ▼            |
| Romania                      | 29 ▼            |
| <b>United States</b>         | <b>28 ▼</b>     |
| Tunisia                      | 26 ▼            |
| England-GBR                  | 26 ▼            |
| New Zealand                  | 25 ▼            |
| Australia                    | 23 ▼            |
| Chile                        | 19 ▼            |
| Ghana                        | 17 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Connecticut-USA    | 40   |
| Quebec-CAN         | 40 ▲ |
| Massachusetts-USA  | 37   |
| Florida-USA        | 35   |
| Minnesota-USA      | 32   |
| Colorado-USA       | 30   |
| California-USA     | 30   |
| Abu Dhabi-UAE      | 30 ▼ |
| North Carolina-USA | 29   |
| Dubai-UAE          | 28 ▼ |
| Alberta-CAN        | 27 ▼ |
| Indiana-USA        | 27 ▼ |
| Alabama-USA        | 25 ▼ |
| Ontario-CAN        | 22 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average

| Content Domain | Main Topic                             | Cognitive Domain |
|----------------|--|------------------|
| EARTH SCIENCE  | Earth's Processes, Cycles, and History | Applying         |

## Evaporated water ending up as rain

How does water that has evaporated from the sea end up as rain on land many miles away?

## Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 70 ▲            |
| Finland                      | 66 ▲            |
| Japan                        | 65 ▲            |
| Hong Kong-CHN                | 63 ▲            |
| Iran, Islamic Rep. of        | 62 ▲            |
| Russian Federation           | 61 ▲            |
| Australia                    | 61 ▲            |
| Korea, Rep. of               | 59 ▲            |
| Norway                       | 57 ▲            |
| England-GBR                  | 57 ▲            |
| Israel                       | 56 ▲            |
| <b>United States</b>         | <b>56 ▲</b>     |
| Chinese Taipei-CHN           | 55 ▲            |
| Sweden                       | 55 ▲            |
| Lithuania                    | 51 ▲            |
| Hungary                      | 48 ▲            |
| New Zealand                  | 48 ▲            |
| Oman                         | 47 ▲            |
| Slovenia                     | 47 ▲            |
| Italy                        | 47 ▲            |
| United Arab Emirates         | 45 ▲            |
| Jordan                       | 45              |
| Turkey                       | 44              |
| Chile                        | 44              |
| Ukraine                      | 42              |
| <b>International average</b> | <b>42</b>       |
| Bahrain                      | 39              |
| Qatar                        | 34 ▼            |
| Kazakhstan                   | 32 ▼            |
| Thailand                     | 31 ▼            |
| Syrian Arab Republic         | 29 ▼            |
| Tunisia                      | 27 ▼            |
| Saudi Arabia                 | 24 ▼            |
| Palestinian Nat'l Auth.      | 23 ▼            |
| Romania                      | 23 ▼            |
| Georgia                      | 22 ▼            |
| Indonesia                    | 21 ▼            |
| Morocco                      | 20 ▼            |
| Macedonia, Rep. of           | 19 ▼            |
| Lebanon                      | 18 ▼            |
| Armenia                      | 16 ▼            |
| Malaysia                     | 16 ▼            |
| Ghana                        | 9 ▼             |

Item Number: S042317

## SCORING

## Correct Response

- Mentions two OR three of the factors indicated below.
  - Clouds form (condensation)
  - The clouds move to land (blown by the wind)
  - Rain falls from clouds (because drops become too heavy/temperature drops).

Example: That's because there will be condensation and the clouds form. The clouds move to land and when temperatures drop the water in the clouds condenses and fall as rain.

## Partially Correct Response

- Mentions only one factor indicated above.

Example: Water vapor condenses into clouds. (a)

## Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 69 ▲ |
| Minnesota-USA      | 68 ▲ |
| Colorado-USA       | 67 ▲ |
| Indiana-USA        | 58 ▲ |
| Alberta-CAN        | 57 ▲ |
| North Carolina-USA | 56 ▲ |
| Ontario-CAN        | 56 ▲ |
| Florida-USA        | 54 ▲ |
| Connecticut-USA    | 54 ▲ |
| California-USA     | 50 ▲ |
| Quebec-CAN         | 48 ▲ |
| Abu Dhabi-UAE      | 47 ▲ |
| Dubai-UAE          | 47 ▲ |
| Alabama-USA        | 41   |

▲ Percent higher than International average  
▼ Percent lower than International average

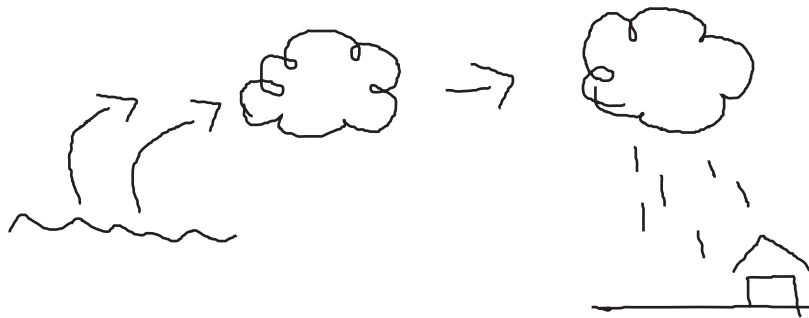
## Evaporated water ending up as rain (continued)

S042317:

## Student Responses

## Correct Response:

The water vapor condenses in the air, forming clouds. Once the process of condensation ceases, it falls onto land as precipitation.



## Incorrect Response:

because clouds can travel far

| Content Domain       | Main Topic                             | Cognitive Domain |
|----------------------|--|------------------|
| <b>EARTH SCIENCE</b> | Earth's Processes, Cycles, and History | Reasoning        |

## Evidence continents were joined

Two continents are separated by water.

Geologists are looking for evidence that the two continents were once joined.

What fossil evidence would support this idea?

## Overall Percent Correct

| Education system               | Percent correct |
|--------------------------------|-----------------|
| Iran, Islamic Rep. of          | 48 ▲            |
| Japan                          | 43 ▲            |
| Italy                          | 38 ▲            |
| <b>United States</b>           | <b>37 ▲</b>     |
| Israel                         | 34 ▲            |
| <i>Chinese Taipei-CHN</i>      | 32 ▲            |
| Russian Federation             | 31 ▲            |
| Slovenia                       | 29 ▲            |
| Korea, Rep. of                 | 28 ▲            |
| <i>England-GBR</i>             | 28 ▲            |
| New Zealand                    | 27 ▲            |
| Australia                      | 27 ▲            |
| Sweden                         | 24 ▲            |
| Lithuania                      | 23 ▲            |
| Singapore                      | 22 ▲            |
| Romania                        | 21              |
| Kazakhstan                     | 20              |
| Ukraine                        | 20              |
| Norway                         | 20              |
| <i>Hong Kong-CHN</i>           | 19              |
| <b>International average</b>   | <b>18</b>       |
| Finland                        | 18              |
| Jordan                         | 17              |
| Chile                          | 15 ▼            |
| United Arab Emirates           | 15 ▼            |
| Syrian Arab Republic           | 13 ▼            |
| Hungary                        | 12 ▼            |
| Oman                           | 10 ▼            |
| Macedonia, Rep. of             | 9 ▼             |
| Turkey                         | 8 ▼             |
| Armenia                        | 8 ▼             |
| Georgia                        | 8 ▼             |
| Thailand                       | 8 ▼             |
| <i>Palestinian Nat'l Auth.</i> | 7 ▼             |
| Qatar                          | 6 ▼             |
| Indonesia                      | 5 ▼             |
| Morocco                        | 5 ▼             |
| Malaysia                       | 5 ▼             |
| Bahrain                        | 5 ▼             |
| Lebanon                        | 3 ▼             |
| Saudi Arabia                   | 3 ▼             |
| Tunisia                        | 2 ▼             |
| Ghana                          | —               |

Item Number: S052032

## SCORING

## Correct Response

- Explains that fossils from identical (land) organisms (that cannot fly or swim) can be found on both continents.

Examples:

The same species of extinct animals are found on the two continents.

If the same fossilized animals are found on both continents.

## Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

## Benchmarking education system

|                           |      |
|---------------------------|------|
| <i>Massachusetts-USA</i>  | 58 ▲ |
| <i>Minnesota-USA</i>      | 53 ▲ |
| <i>North Carolina-USA</i> | 46 ▲ |
| <i>Alberta-CAN</i>        | 46 ▲ |
| <i>Colorado-USA</i>       | 44 ▲ |
| <i>Indiana-USA</i>        | 41 ▲ |
| <i>Connecticut-USA</i>    | 38 ▲ |
| <i>Florida-USA</i>        | 35 ▲ |
| <i>California-USA</i>     | 32 ▲ |
| <i>Ontario-CAN</i>        | 29 ▲ |
| <i>Quebec-CAN</i>         | 21   |
| <i>Alabama-USA</i>        | 19   |
| <i>Dubai-UAE</i>          | 16   |
| <i>Abu Dhabi-UAE</i>      | 15   |

▲ Percent higher than International average

▼ Percent lower than International average

— Not applicable

Evidence continents were joined (continued)

S052032:

## Student Responses

### Correct Response:

the same fossils being found on  
different continents.

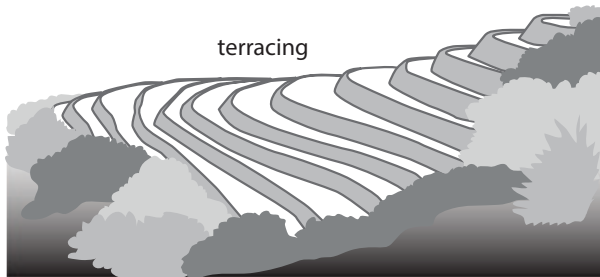
### Incorrect Response:

dirt

| Content Domain       | Main Topic                                    | Cognitive Domain |
|----------------------|---|------------------|
| <b>EARTH SCIENCE</b> | Earth's Resources, Their Use and Conservation | Applying         |

### Advantage of terracing method

The diagram below shows a field on a slope that is being farmed using the terracing method.



Write one advantage of using the method of farming shown in the diagram.

Item Number: S052106

### SCORING

#### Correct Response

- Writes one advantage of using the terracing method from the list of acceptable responses below.

Allows farming to be done on a slope (utilize more land)  
 Run-off slowed down (prevents crops from washing away)  
 Prevents soil erosion (landslides, rock slides)  
 Able to grow different crops  
 Retains water so crops are healthier/need less watering  
 Examples:  
 You can farm in steep places.  
 Helps to avoid the washing away of crops on hills.

#### Incorrect Response

- Incorrect (including crossed out, erased, stray marks, illegible, or off task)

### Overall Percent Correct

| Education system             | Percent correct |
|------------------------------|-----------------|
| Singapore                    | 56 ▲            |
| Chinese Taipei-CHN           | 52 ▲            |
| Slovenia                     | 51 ▲            |
| Japan                        | 49 ▲            |
| Korea, Rep. of               | 41 ▲            |
| Turkey                       | 40 ▲            |
| Italy                        | 38 ▲            |
| Hong Kong-CHN                | 37 ▲            |
| Malaysia                     | 34 ▲            |
| Hungary                      | 33 ▲            |
| Russian Federation           | 32 ▲            |
| <b>United States</b>         | <b>32 ▲</b>     |
| Indonesia                    | 31 ▲            |
| England-GBR                  | 30 ▲            |
| Romania                      | 30 ▲            |
| Thailand                     | 30 ▲            |
| Israel                       | 27              |
| Palestinian Nat'l Auth.      | 27              |
| Australia                    | 27              |
| <b>International average</b> | <b>26</b>       |
| Syrian Arab Republic         | 24              |
| Kazakhstan                   | 22              |
| Jordan                       | 22              |
| Norway                       | 22              |
| Tunisia                      | 22 ▼            |
| Finland                      | 21 ▼            |
| Lithuania                    | 20 ▼            |
| United Arab Emirates         | 20 ▼            |
| New Zealand                  | 17 ▼            |
| Iran, Islamic Rep. of        | 17 ▼            |
| Ukraine                      | 17 ▼            |
| Armenia                      | 16 ▼            |
| Oman                         | 16 ▼            |
| Morocco                      | 14 ▼            |
| Saudi Arabia                 | 14 ▼            |
| Bahrain                      | 14 ▼            |
| Lebanon                      | 13 ▼            |
| Qatar                        | 13 ▼            |
| Georgia                      | 13 ▼            |
| Macedonia, Rep. of           | 11 ▼            |
| Sweden                       | 11 ▼            |
| Chile                        | 10 ▼            |
| Ghana                        | 8 ▼             |

#### Benchmarking education system

|                    |      |
|--------------------|------|
| Massachusetts-USA  | 42 ▲ |
| Minnesota-USA      | 40 ▲ |
| Connecticut-USA    | 34 ▲ |
| Colorado-USA       | 34 ▲ |
| Florida-USA        | 33 ▲ |
| Indiana-USA        | 32   |
| North Carolina-USA | 32 ▲ |
| Alberta-CAN        | 31 ▲ |
| California-USA     | 30   |
| Dubai-UAE          | 28   |
| Quebec-CAN         | 24   |
| Alabama-USA        | 23   |
| Ontario-CAN        | 23   |
| Abu Dhabi-UAE      | 17 ▼ |

▲ Percent higher than International average  
 ▼ Percent lower than International average

Advantage of terracing method (continued)

S052106:

## Student Responses

### Correct Response:

You get a selection of plants and rain  
So you can grow different plants on  
each row.

### Incorrect Response:

You can walk up instead of straight?



| Content Domain       | Main Topic                             | Cognitive Domain |
|----------------------|--|------------------|
| <b>EARTH SCIENCE</b> | Earth's Processes, Cycles, and History | Knowing          |

Holes in volcanic rocks

Some volcanic rocks have many holes in them.



How were the holes made?

- A. Insects dug into the rock when it was soft.
- B. Gas bubbles were trapped in the rock when it cooled.
- C. Rain dropped on the rock when it was soft.
- D. Small stones fell out of the rock when it cooled.

Item Number: S052297

|                          |          |
|--------------------------|----------|
| <b>Correct Response:</b> | <b>B</b> |
|--------------------------|----------|

**Overall Percent Correct**

| Education system             | Percent correct |
|------------------------------|-----------------|
| Korea, Rep. of               | 90 ▲            |
| Australia                    | 84 ▲            |
| New Zealand                  | 84 ▲            |
| <b>United States</b>         | <b>81 ▲</b>     |
| England-GBR                  | 80 ▲            |
| Japan                        | 77 ▲            |
| Singapore                    | 76 ▲            |
| Russian Federation           | 75 ▲            |
| Norway                       | 75 ▲            |
| Slovenia                     | 72 ▲            |
| Hungary                      | 71 ▲            |
| Italy                        | 68 ▲            |
| Finland                      | 68 ▲            |
| Hong Kong-CHN                | 64 ▲            |
| Sweden                       | 64 ▲            |
| Thailand                     | 64 ▲            |
| Ukraine                      | 61              |
| Georgia                      | 60              |
| Romania                      | 60              |
| <b>International average</b> | <b>57</b>       |
| Israel                       | 57              |
| Kazakhstan                   | 57              |
| Lithuania                    | 54              |
| United Arab Emirates         | 52 ▼            |
| Chinese Taipei-CHN           | 50 ▼            |
| Chile                        | 49 ▼            |
| Qatar                        | 48 ▼            |
| Armenia                      | 47 ▼            |
| Lebanon                      | 46 ▼            |
| Turkey                       | 46 ▼            |
| Bahrain                      | 46 ▼            |
| Morocco                      | 46 ▼            |
| Oman                         | 45 ▼            |
| Syrian Arab Republic         | 45 ▼            |
| Iran, Islamic Rep. of        | 45 ▼            |
| Malaysia                     | 42 ▼            |
| Tunisia                      | 40 ▼            |
| Indonesia                    | 40 ▼            |
| Jordan                       | 39 ▼            |
| Saudi Arabia                 | 39 ▼            |
| Palestinian Nat'l Auth.      | 38 ▼            |
| Macedonia, Rep. of           | 35 ▼            |
| Ghana                        | 25 ▼            |

**Benchmarking education system**

|                    |      |
|--------------------|------|
| Minnesota-USA      | 91 ▲ |
| Colorado-USA       | 89 ▲ |
| Alberta-CAN        | 88 ▲ |
| Massachusetts-USA  | 88 ▲ |
| Ontario-CAN        | 85 ▲ |
| Quebec-CAN         | 84 ▲ |
| Indiana-USA        | 83 ▲ |
| Connecticut-USA    | 79 ▲ |
| California-USA     | 79 ▲ |
| Florida-USA        | 78 ▲ |
| North Carolina-USA | 78 ▲ |
| Alabama-USA        | 74 ▲ |
| Dubai-UAE          | 58   |
| Abu Dhabi-UAE      | 49 ▼ |

▲ Percent higher than International average  
▼ Percent lower than International average