TIMSS USA 8

SCIENCE CONCEPTS & SCIENCE ITEMS

The *Science Concepts and Science Items* book contains the released TIMSS science assessment items. These are the released items from the 1995 and 2003 assessments (as distinct from the secure items, which are kept confidential so that they may be used in subsequent cycles to monitor trends).

Guide to Using the *Science Concepts and Science Items* Materials

The materials contained in this book can be used in a number of ways as a tool to assist teachers in making a formative assessment of student knowledge and skills. Some of these ways include the following:

Teacher-designed formative assessments. A teacher might, for example, decide to examine how well his or her class can understand complex information. In such a case, the first step would be to review the questions in *Science Concepts and Science Items*, selecting the ones of interest. Ready-to-use versions of these items can be found in the *Science Items* book. The teacher can print these items or present them to students on an overhead. Student responses can be scored by referring to the appropriate page in *Science Concepts and Science Items*. The teacher can also compare the overall percentage of students responding correctly to the international benchmark for that item.

Feedback on teaching. To the extent that the items coincide with concepts taught, the teacher might follow the same process to gain rapid feedback on the success of the teaching episode.

Understanding misunderstandings. Again, a teacher might decide to examine the incorrect or partially correct responses of the class for insight into any general misunderstandings, with a view to re-teaching a particular topic or skill.

Identifying individual difficulties. In the same way, the teacher might use the items to identify particular difficulties experienced by individual students, as the basis for some remedial teaching or focused practice.

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TIMSS USA 5

Guide to the Content and Layout of This Book

This book contains the released items from both TIMSS 1995 and TIMSS 2003. Due to slight revisions in terminology and released information between cycles, the format for the items in each cycle differs slightly. Each item appears on a single page and is accompanied by a number of descriptors.

1999 Content Domains:

- Earth science
- Life science
- Physics
- Chemistry
- Environmental and resource issues
- Scientific enquiry and the nature of science

2003 Content Domains:

- Chemistry
- Earth science
- Environmental science
- Life science
- Physics

1999 Cognitive Domains:

- Understanding simple information
- Understanding complex information
- Theorizing, analyzing and solving problems
- Using tools, routine procedures and science processes
- Investigating the natural world

2003 Cognitive Domains:

- Factual knowledge
- Conceptual understanding
- Reasoning and analysis

Take a look at *Layers of Earth*, the name given to the first item in this book. As specified in boxes at the top of the page, the content domain for this item is *earth science* and the cognitive domain is *understanding simple information*. Looking at *Litmus test*, the first item from TIMSS 2003 (page 75), the content domain (*chemistry*) and the cognitive domain (*conceptual understanding*) are also accompanied by the Main Topic (*acids and bases*).

International item numbers identify each item. This number appears just below the item box.

Correct answers are shown beneath each item. These correct answers take two forms:

- **Letter code**. This form is used for the correct response on multiple-choice items. *Layers of Earth* provides an example of the letter code type—the correct answer is C.

- **Scoring guide**. This form is used to assist in scoring write-in responses. *Life on other planets* (J09) further along in the *Earth Science* domain (page 11), provides an example of the scoring guide approach, 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.

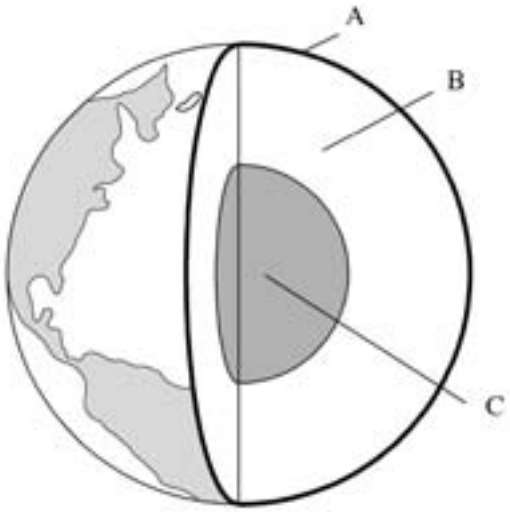
Sample student responses are provided for TIMSS 2003 extended response items. An example of an actual U.S. fourth-grade student's response is provided for each scoring category. See item S032057 on page 76.

International benchmarks are provided in a table next to each item. These consist of statistics on the percentage of students in each country who answered the question correctly. The countries are ordered in terms of this percentage. The international average is included as well, and this display also indicates which countries scored significantly higher, significantly lower, and not significantly different from this international average.

Content Domain	Cognitive Domain
Earth Science	Understanding Simple Information

Layers of Earth

The picture shows the three main layers of the Earth.



Where is it the hottest?

A. Layer A

B. Layer B

C. Layer C

D. All three layers are the same temperature.

Item Number: B01

Correct Response: C

Overall Percent Correct

Slovenia	96	▲
Slovak Republic	95	▲
Canada	94	▲
Bulgaria	94	▲
Netherlands	93	▲
Finland	93	▲
England	93	▲
United States	92	▲
Hungary	92	▲
Italy	91	▲
Czech Republic	91	▲
Russian Federation	90	▲
Australia	90	▲
New Zealand	89	▲
Japan	89	▲
Belgium (Flemish)	89	▲
Hong Kong, SAR	88	▲
Korea, Rep. of	85	▲
Chinese Taipei	84	O
Singapore	84	O
Lithuania	83	O
Latvia (LSS)	83	O
International Average	**82**	
Israel	80	O
Moldova	79	O
Jordan	79	▼
Malaysia	78	▼
Macedonia, Rep. of	77	▼
Cyprus	77	▼
Turkey	75	▼
Chile	74	▼
Iran, Islamic Rep.	72	▼
Thailand	72	▼
Romania	70	▼
Philippines	67	▼
Tunisia	67	▼
Indonesia	64	▼
South Africa	61	▼
Morocco	54	▼

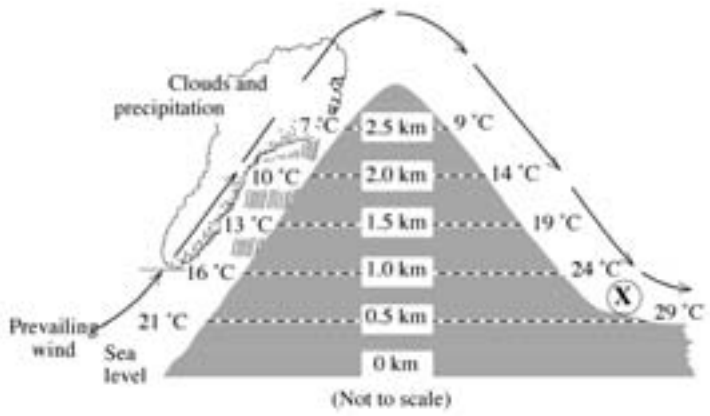
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Earth Science	Using Tools, Routine Procedures and Science Processes

Elevation diagram of wind/temperature

The diagram below shows a mountain. The prevailing wind direction and average air temperatures at different elevations on both sides of the mountain are indicated.



Which feature is probably located at the base of the mountain at location (X)?

A. a dry region

B. a jungle

C. a glacier

D. a large lake

E. a rain forest

Item Number: B05

Correct Response:	A

Overall Percent Correct

Hungary	69	▲
Slovak Republic	65	▲
Slovenia	62	▲
Netherlands	62	▲
Israel	59	▲
Latvia (LSS)	59	▲
Canada	57	▲
Finland	56	▲
Bulgaria	55	▲
Lithuania	55	▲
Korea, Rep. of	55	▲
Czech Republic	55	▲
New Zealand	54	▲
Japan	54	▲
Belgium (Flemish)	50	O
Australia	49	O
United States	49	O
Russian Federation	49	O
Turkey	47	O
International Average	**47**	
Jordan	47	O
England	44	O
Romania	44	O
Chinese Taipei	44	O
Macedonia, Rep. of	44	O
Moldova	44	O
Cyprus	43	O
Hong Kong, SAR	42	▼
Philippines	41	▼
Chile	41	▼
Italy	38	▼
Morocco	37	▼
Malaysia	37	▼
Thailand	34	▼
South Africa	32	▼
Iran, Islamic Rep.	31	▼
Singapore	30	▼
Indonesia	30	▼
Tunisia	25	▼

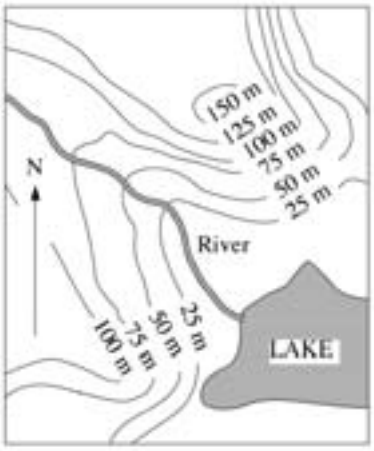
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Using Tools, Routine Procedures and Science Processes

Contour map showing river

On the diagram, hills and valleys are shown by means of contour lines. Each contour line indicates that all points on the line have the same elevation above sea level.



In which direction does the river flow?

A. Northeast

B. Southeast

C. Northwest

D. Southwest

E. It is not possible to tell from the map.

Item Number: D03

Correct Response: B

Overall Percent Correct

Chinese Taipei	61	▲
Hong Kong, SAR	61	▲
Slovenia	59	▲
Belgium (Flemish)	53	▲
Australia	53	▲
Japan	52	▲
Malaysia	51	▲
England	51	▲
Korea, Rep. of	50	▲
Russian Federation	50	▲
Netherlands	49	▲
Finland	48	▲
United States	48	▲
Canada	46	▲
Singapore	44	O
Hungary	44	▲
Slovak Republic	43	O
Bulgaria	41	O
New Zealand	41	O
Czech Republic	40	O
Lithuania	38	O
Latvia (LSS)	37	O
International Average	**37**	
Moldova	32	O
Macedonia, Rep. of	28	▼
Thailand	26	▼
Turkey	26	▼
Romania	26	▼
Israel	25	▼
Iran, Islamic Rep.	23	▼
Italy	21	▼
Cyprus	21	▼
South Africa	21	▼
Jordan	19	▼
Indonesia	18	▼
Morocco	17	▼
Philippines	16	▼
Tunisia	16	▼
Chile	14	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Earth Science	Understanding Complex Information

Oxygen equipment on mountain tops

Why do mountain climbers use oxygen equipment at the top of the world's highest mountains?

A. There is less oxygen in the air at great heights.

B. There is little nitrogen in the air at great heights.

C. There is a hole in the ozone layer.

D. There is no air at the top of very high mountains.

Item Number: F05

Correct Response:	A

Overall Percent Correct

Singapore	95	▲
Hong Kong, SAR	94	▲
Chinese Taipei	94	▲
Korea, Rep. of	93	▲
Czech Republic	92	▲
Canada	92	▲
Netherlands	91	▲
Slovak Republic	91	▲
Bulgaria	91	▲
Malaysia	90	▲
United States	90	▲
England	90	▲
Hungary	90	▲
Belgium (Flemish)	90	▲
Australia	90	▲
Finland	90	▲
New Zealand	87	▲
Slovenia	87	▲
Russian Federation	84	▲
Israel	80	O
Lithuania	80	O
International Average	**79**	
Iran, Islamic Rep.	79	O
Italy	78	O
Thailand	76	O
Macedonia, Rep. of	75	O
Chile	75	O
Japan	74	▼
Cyprus	70	▼
Romania	70	▼
Latvia (LSS)	69	▼
Indonesia	67	▼
Turkey	65	▼
Moldova	64	▼
Jordan	63	▼
Tunisia	56	▼
Philippines	48	▼
South Africa	44	▼
Morocco	39	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Understanding Simple Information

Why moon shines

The Moon produces no light, and yet it shines at night. Why is this?

A. The Moon reflects the light from the Sun.

B. The Moon rotates at very high speed.

C. The Moon is covered with a thin layer of ice.

D. The Moon has many craters.

Item Number: H03

Correct Response: A

Overall Percent Correct

Hong Kong, SAR	96	▲
Singapore	95	▲
Chinese Taipei	95	▲
Bulgaria	93	▲
Netherlands	91	▲
Japan	89	▲
England	88	▲
Malaysia	87	▲
Canada	87	▲
Belgium (Flemish)	86	▲
United States	86	▲
Finland	86	▲
Hungary	86	▲
Czech Republic	86	▲
New Zealand	84	O
Cyprus	84	O
Turkey	84	O
Australia	83	O
Latvia (LSS)	83	O
Slovak Republic	83	O
Jordan	83	O
Iran, Islamic Rep.	82	O
International Average	**81**	
Russian Federation	81	O
Korea, Rep. of	80	O
Macedonia, Rep. of	80	O
Slovenia	79	O
Thailand	78	O
Romania	78	O
Indonesia	76	▼
Italy	75	▼
Moldova	75	▼
Philippines	73	▼
Israel	72	▼
Lithuania	72	▼
Tunisia	71	▼
Morocco	64	▼
Chile	64	▼
South Africa	57	▼

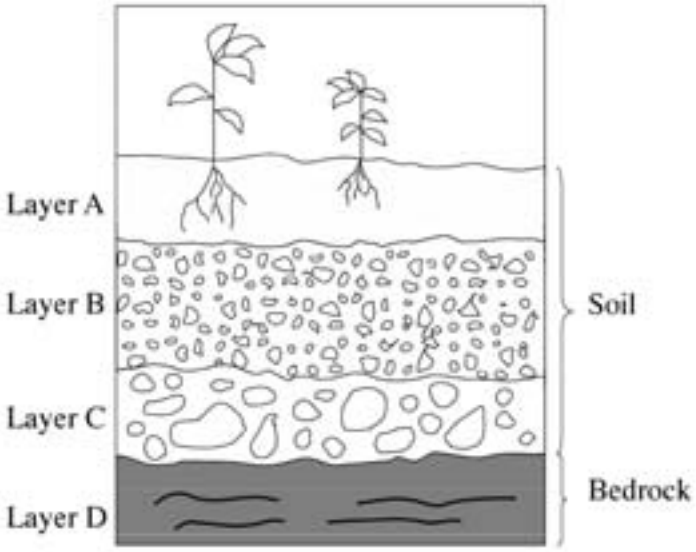
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Understanding Complex Information

Diagram of soil layers

Which layer in the diagram contains the most organic material?



A. Layer A

B. Layer B

C. Layer C

D. Layer D

Item Number: H04

Correct Response: A

Overall Percent Correct

Macedonia, Rep. of	76	▲
Russian Federation	76	▲
Slovenia	75	▲
Czech Republic	71	▲
Lithuania	67	▲
Romania	63	▲
Belgium (Flemish)	63	▲
Hungary	60	▲
Latvia (LSS)	59	▲
Slovak Republic	57	▲
Italy	53	O
Netherlands	53	O
Korea, Rep. of	53	▲
Moldova	51	O
Australia	50	O
Japan	50	O
Canada	50	O
Bulgaria	50	O
Thailand	49	O
England	48	O
International Average	**48**	
Finland	48	O
Cyprus	47	O
Chile	47	O
New Zealand	46	O
Philippines	44	O
Singapore	43	O
Tunisia	42	▼
Indonesia	41	▼
United States	40	▼
Morocco	36	▼
South Africa	35	▼
Iran, Islamic Rep.	34	▼
Jordan	32	▼
Turkey	29	▼
Chinese Taipei	28	▼
Israel	28	▼
Malaysia	22	▼
Hong Kong, SAR	15	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Understanding Simple Information

Earth's plates over millions of years

Which BEST describes the movement of the plates that make up Earth's surface over millions of years?

A. They moved for millions of years but have now stopped.

B. They stayed the same for millions of years but are now moving.

C. They have been continually moving.

D. They have never moved.

Item Number: J01

Correct Response: C

Overall Percent Correct

Hungary	93	▲
Canada	91	▲
Australia	89	▲
Slovak Republic	89	▲
Singapore	89	▲
Chinese Taipei	87	▲
Czech Republic	87	▲
England	86	▲
Hong Kong, SAR	85	▲
United States	84	▲
Korea, Rep. of	83	▲
Slovenia	82	▲
Finland	82	O
Netherlands	81	O
New Zealand	81	O
Belgium (Flemish)	81	O
Bulgaria	81	O
Latvia (LSS)	80	O
Lithuania	80	O
Russian Federation	80	O
Moldova	80	O
Japan	79	▲
Italy	77	O
Romania	75	O
Thailand	75	O
International Average	**75**	
Chile	73	O
Israel	73	O
Malaysia	68	▼
Cyprus	68	O
Macedonia, Rep. of	67	▼
Turkey	65	▼
Iran, Islamic Rep.	61	▼
Indonesia	60	▼
Jordan	56	▼
Philippines	55	▼
Tunisia	52	▼
South Africa	32	▼
Morocco	29	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Understanding Complex Information

Factor explaining seasons on Earth

Which of the following is an important factor in explaining why seasons occur on Earth?

A. Earth rotates on its axis.

B. The Sun rotates on its axis.

C. Earth's axis is tilted.

D. The Sun's axis is tilted.

Item Number: J06

Correct Response:	C

Overall Percent Correct

Japan	52	▲
Hong Kong, SAR	48	▲
England	44	▲
Italy	44	▲
Australia	41	▲
Chinese Taipei	40	▲
Canada	38	▲
New Zealand	38	▲
United States	37	▲
Finland	34	O
Bulgaria	34	O
Korea, Rep. of	30	O
Slovak Republic	30	O
Russian Federation	30	O
Slovenia	29	O
Czech Republic	28	O
Israel	28	O
Netherlands	27	O
International Average	**26**	
Lithuania	26	O
Malaysia	25	O
Cyprus	24	O
Hungary	23	O
Belgium (Flemish)	22	O
Moldova	22	O
Thailand	21	O
Turkey	18	▼
Singapore	18	▼
Morocco	18	▼
Jordan	17	▼
Romania	17	▼
South Africa	15	▼
Chile	15	▼
Iran, Islamic Rep.	13	▼
Latvia (LSS)	13	▼
Tunisia	13	▼
Philippines	13	▼
Macedonia, Rep. of	12	▼
Indonesia	7	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Theorizing, Analyzing and Solving Problems

Life on other planets

Diana and Mario were discussing what it might be like on other planets. Their science teacher gave them data about Earth and an imaginary planet Proto. The table shows these data.

	Earth	Proto
Distance from a star like the Sun	148 640 000 km	902 546 000 km
Atmospheric pressure at surface of planet	101 325 Pa	100 Pa
Atmospheric conditions • gas components	21% oxygen 0.03% carbon dioxide 78% nitrogen	5% oxygen 5% carbon dioxide 90% nitrogen
• ozone layer	yes	no
• cloud cover	yes	no

Write down one important reason why it would be difficult for humans to live on Proto if it existed. Explain your answer.

Item Number: J09

SCORING

Note: A correct response must clearly indicate the reason why a condition listed in the table makes it hard for humans to live on Proto. Responses referencing insufficient (too little, less, not enough, etc.) oxygen with or without explicitly mentioning breathing will be given credit due to the assumption of common knowledge. If more than one reason is given, assign credit corresponding to the first correct reason.

Correct Response

- States that there would be insufficient (too little, less, not enough, etc.) oxygen (to breath).
- States that the atmospheric pressure would be too low with an explanation based on low air/oxygen levels or effects of lower boiling point, etc.
- States that there is no ozone layer to protect people (against star's UV radiation).
- States that no cloud cover means no (low) water.
- States that it is too cold (due to distance from the star).
- Other correct.

Incorrect Response

- Merely repeats information in table and/or stem with no explanation.
- States that it is too hot due to no ozone layer.
- States that there is little (no) gravity (confuses atmospheric pressure with gravity).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Slovak Republic	89	▲
Singapore	86	▲
Australia	83	▲
Hungary	83	▲
Canada	82	▲
England	82	▲
Netherlands	81	▲
Latvia (LSS)	80	▲
New Zealand	80	▲
Finland	80	▲
Chinese Taipei	79	▲
Slovenia	78	▲
United States	78	▲
Belgium (Flemish)	77	▲
Korea, Rep. of	77	▲
Czech Republic	75	O
Russian Federation	73	▲
Italy	70	O
Hong Kong, SAR	70	O
Japan	69	O
Lithuania	67	O
Malaysia	67	O
International Average	**66**	
Bulgaria	65	O
Tunisia	64	O
Thailand	62	O
Israel	62	O
Jordan	59	O
Indonesia	59	O
Macedonia, Rep. of	58	O
Chile	57	▼
Cyprus	51	▼
Moldova	51	▼
Romania	48	▼
Turkey	47	▼
Iran, Islamic Rep.	45	▼
Philippines	26	▼
Morocco	25	▼
South Africa	21	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Understanding Complex Information

Atmospheric conditions in jets

Jet aircraft typically fly at altitudes of approximately 10,000 meters. Atmospheric conditions at this altitude are different from those at ground level. Write down one difference that exists and explain why it must be controlled for in order for people to survive inside jet aircraft.

Item Number: R04

SCORING

Note: A correct response must include an explanation identifying an atmospheric condition that is different at high altitudes and why it must be controlled for. Responses referencing low oxygen level (too little, less, not enough) with or without explicitly mentioning breathing will be given credit due to the assumption of prior knowledge.

Correct Response

- Refers to controlling for low oxygen level and/or little air ("thin atmosphere") in order to breath.
- Refers to controlling for low atmospheric pressure with explanation relating to the effect on humans.
- Refers to controlling for low atmospheric temperature.
- Other correct.

Incorrect Response

- Mentions pressure, temperature or oxygen with incorrect or no further explanation.
- Mentions gravity.
- Refers only to effects of wind, air currents, or turbulence, etc.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Slovak Republic	65	▲
Chinese Taipei	55	▲
Belgium (Flemish)	51	▲
Canada	50	▲
Australia	49	▲
Thailand	47	▲
Russian Federation	46	▲
Singapore	46	▲
Korea, Rep. of	45	▲
Lithuania	45	▲
New Zealand	45	▲
England	44	▲
Finland	42	O
Bulgaria	40	O
Latvia (LSS)	38	O
Slovenia	38	O
Hong Kong, SAR	35	O
Indonesia	35	O
Italy	34	O
International Average	**33**	
Hungary	33	O
Israel	32	O
Moldova	31	O
Czech Republic	29	O
Macedonia, Rep. of	28	O
Japan	28	O
Romania	27	O
Turkey	25	▼
Netherlands	24	O
Malaysia	23	▼
Iran, Islamic Rep.	23	▼
Cyprus	21	▼
Tunisia	17	▼
United States	17	▼
Jordan	17	▼
Chile	10	▼
Philippines	6	▼
South Africa	5	▼
Morocco	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Earth Science	Theorizing, Analyzing and Solving Problems

Diagram of rain from sea

Draw a diagram to show how water from the sea can fall as rain on land.

Item Number: Z02

SCORING

Note: A fully correct response must show clear evidence of the following 4 steps:

(i) Evaporation of water from the sea
(ii) Condensation (as clouds)
(iii) Transportation (from sea to land)
(iv) Precipitation.

The steps do not have to be indicated on a labeled diagram for full credit, but the drawing and/or accompanying explanatory text must be clear with respect to the direction of water flow. Steps (ii) and (iii) may be clearly indicated as two steps (e.g. formation of clouds and transportation by wind) or as a single step showing a series of clouds extending over land and sea.

Correct Response

- Response includes a diagram indicating all 4 steps (i, ii, iii and iv above) and direction of water flow.
- No diagram is shown, but response includes a complete and correct textual description of the water cycle.
- Other fully correct.

Partial Response

- As in correct response but evaporation is unclear or omitted.
- As in correct response but condensation is unclear or omitted.
- As in correct response but transportation is unclear or omitted.
- As in correct response but precipitation is unclear or omitted.
- Other partially correct.

Incorrect Response

- Response clearly indicates evaporation and/or condensation only.
- Response clearly indicates precipitation only (may also show clouds).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Belgium (Flemish)	77	▲
Singapore	76	▲
England	74	▲
Hungary	67	▲
Malaysia	66	▲
Australia	66	▲
Netherlands	65	▲
Russian Federation	64	▲
New Zealand	60	▲
Canada	58	▲
Slovenia	56	▲
Japan	54	▲
Finland	52	▲
Czech Republic	47	O
Korea, Rep. of	43	O
Chinese Taipei	43	O
Italy	42	O
Thailand	41	O
Jordan	41	O
Latvia (LSS)	41	O
International Average	**40**	
Cyprus	35	O
Slovak Republic	35	O
Chile	27	▼
Romania	26	▼
Macedonia, Rep. of	26	▼
Tunisia	25	▼
Turkey	25	▼
Lithuania	20	▼
Philippines	19	▼
Indonesia	17	▼
Moldova	14	▼
Israel	14	▼
United States	13	▼
South Africa	11	▼
Bulgaria	11	▼
Iran, Islamic Rep.	10	▼
Morocco	5	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Pulse/breathing rate after exercise

Immediately before and after running a 50 meter race, your pulse and breathing rates are taken. What changes would you expect to find?

A. no change in pulse but a decrease in breathing rate

B. an increase in pulse but no change in breathing rate

C. an increase in pulse and breathing rate

D. a decrease in pulse and breathing rate

E. no change in either

Item Number: B04

Correct Response:	C

Overall Percent Correct

Japan	98	▲
Hungary	97	▲
Singapore	96	▲
Netherlands	95	▲
Belgium (Flemish)	95	▲
England	95	▲
Slovenia	95	▲
Korea, Rep. of	95	▲
Lithuania	95	▲
Canada	94	▲
Chinese Taipei	94	▲
Finland	94	▲
Czech Republic	94	▲
Australia	94	▲
Hong Kong, SAR	93	▲
Tunisia	92	▲
Slovak Republic	92	▲
Bulgaria	92	▲
Latvia (LSS)	92	▲
United States	91	▲
New Zealand	90	▲
Malaysia	89	O
Russian Federation	89	O
Italy	89	O
Cyprus	88	O
International Average	**87**	
Thailand	87	O
Israel	86	O
Macedonia, Rep. of	86	O
Moldova	85	O
Romania	84	O
Chile	83	▼
Indonesia	83	▼
Jordan	83	▼
Turkey	79	▼
Iran, Islamic Rep.	79	▼
Philippines	59	▼
Morocco	58	▼
South Africa	36	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Sensory messages to the brain

Sensory messages are taken to the brain by

A. arteries and veins

B. arteries and hormones

C. nerves and hormones

D. muscles and veins

Item Number: D05

Correct Response:	C

Overall Percent Correct

Czech Republic	89	▲
Netherlands	83	▲
Bulgaria	82	▲
Thailand	82	▲
Latvia (LSS)	82	▲
Korea, Rep. of	80	▲
Lithuania	80	▲
Belgium (Flemish)	79	▲
Slovenia	78	▲
Slovak Republic	78	▲
Russian Federation	78	▲
Hungary	78	▲
Tunisia	76	▲
Japan	75	▲
Iran, Islamic Rep.	74	▲
England	74	▲
Chinese Taipei	72	O
Moldova	72	O
Finland	71	O
Australia	71	O
Macedonia, Rep. of	71	O
United States	71	O
Israel	70	O
International Average	**69**	
Singapore	68	O
Canada	68	O
Hong Kong, SAR	67	O
Indonesia	66	O
Italy	64	O
Jordan	64	O
Romania	64	O
New Zealand	61	▼
Malaysia	60	▼
Cyprus	53	▼
Turkey	53	▼
Philippines	45	▼
Morocco	42	▼
South Africa	36	▼
Chile	35	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Seed development from plant part

Seeds develop from which part of a plant?

A. Flower

B. Leaf

C. Root

D. Stem

Item Number: D06

Correct Response: A

Overall Percent Correct

Czech Republic	94	▲
Slovak Republic	93	▲
Latvia (LSS)	92	▲
Lithuania	89	▲
Hungary	87	▲
Russian Federation	86	▲
Romania	85	▲
Slovenia	84	▲
Japan	83	▲
Moldova	82	▲
Italy	82	▲
Singapore	82	▲
Finland	82	▲
Belgium (Flemish)	80	▲
Macedonia, Rep. of	80	▲
Indonesia	80	▲
Bulgaria	78	▲
Korea, Rep. of	77	▲
Netherlands	72	O
International Average	**71**	
Hong Kong, SAR	69	O
Thailand	69	O
Australia	68	O
Iran, Islamic Rep.	68	O
Malaysia	67	O
Jordan	67	O
New Zealand	65	▼
Tunisia	65	▼
England	63	▼
Chinese Taipei	63	▼
Canada	61	▼
Chile	57	▼
Cyprus	57	▼
United States	57	▼
Turkey	56	▼
Israel	52	▼
Philippines	39	▼
South Africa	36	▼
Morocco	34	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Characteristic of mammal

A small animal called the duckbilled platypus lives in Australia. Which characteristic of this animal shows that it is a mammal?

A. It eats other animals.

B. It feeds its young milk.

C. It makes a nest and lays eggs.

D. It has webbed feet.

Item Number: F01

Correct Response: B

Overall Percent Correct

Slovenia	89	▲
Japan	86	▲
Bulgaria	85	▲
Iran, Islamic Rep.	84	▲
Hong Kong, SAR	83	▲
Slovak Republic	81	▲
Chinese Taipei	80	▲
Latvia (LSS)	80	▲
Cyprus	80	▲
Czech Republic	79	▲
Malaysia	78	▲
Hungary	78	▲
Korea, Rep. of	77	▲
Singapore	77	▲
Russian Federation	76	O
Romania	73	O
Thailand	71	O
Finland	71	O
Belgium (Flemish)	70	O
Lithuania	70	O
Macedonia, Rep. of	70	O
International Average	**70**	
Italy	70	O
Chile	68	O
Moldova	68	O
Tunisia	67	O
Canada	66	▼
Turkey	65	▼
United States	65	▼
Indonesia	64	▼
Jordan	63	▼
Australia	63	▼
Netherlands	62	▼
Israel	60	▼
New Zealand	54	▼
England	52	▼
South Africa	46	▼
Morocco	45	▼
Philippines	30	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Interpretation of senses

Humans interpret seeing, hearing, tasting and smelling in the

A. brain

B. spinal cord

C. receptors

D. skin

Item Number: F03

Correct Response:	A

Overall Percent Correct

Bulgaria	91	▲
Hong Kong, SAR	91	▲
Singapore	86	▲
Malaysia	85	▲
United States	85	▲
Netherlands	83	▲
Russian Federation	82	▲
England	81	▲
New Zealand	81	▲
Canada	81	▲
Chinese Taipei	80	▲
Moldova	78	▲
Turkey	78	▲
Hungary	76	▲
Australia	72	▲
Finland	69	O
Lithuania	67	O
Czech Republic	67	O
International Average	**65**	
Chile	65	O
Latvia (LSS)	65	O
Macedonia, Rep. of	65	O
Romania	63	O
Indonesia	61	O
Israel	60	▼
Philippines	58	▼
Jordan	58	▼
Korea, Rep. of	55	▼
Japan	54	▼
Iran, Islamic Rep.	50	▼
Italy	44	▼
Slovenia	43	▼
Morocco	43	▼
Belgium (Flemish)	40	▼
South Africa	32	▼
Thailand	30	▼
Tunisia	24	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

NOT a function of blood

Which of these is NOT a function of the blood?

A. Digesting food

B. Protecting against disease

C. Carrying waste materials away from the cells

D. Carrying oxygen to different parts of the body

Item Number: H01

Correct Response: A

Overall Percent Correct

Thailand	90	▲
Chinese Taipei	88	▲
Czech Republic	88	▲
Hungary	85	▲
Japan	84	▲
United States	83	▲
Canada	81	▲
England	81	▲
Slovak Republic	81	▲
Finland	80	▲
Australia	80	▲
Bulgaria	79	▲
Netherlands	79	▲
Korea, Rep. of	77	▲
Belgium (Flemish)	77	▲
Italy	77	▲
Hong Kong, SAR	76	▲
Russian Federation	75	O
Singapore	74	O
Slovenia	73	O
New Zealand	72	O
International Average	**70**	
Lithuania	69	O
Chile	69	O
Romania	66	O
Macedonia, Rep. of	65	O
Israel	64	▼
Jordan	63	▼
Latvia (LSS)	58	▼
Malaysia	57	▼
Iran, Islamic Rep.	56	▼
Moldova	56	▼
Indonesia	53	▼
Turkey	51	▼
Philippines	50	▼
Tunisia	44	▼
Morocco	43	▼
South Africa	35	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Role of vitamins

What are vitamins?

A. Substances that break down food

B. Bacteria that people get when they eat some foods

C. Substances that people make from protein

D. Substances that people need in small amounts in order for their bodies to function normally

Item Number: H02

Correct Response: D

Overall Percent Correct

Latvia (LSS)	95	▲
Russian Federation	95	▲
Hungary	95	▲
Netherlands	93	▲
Korea, Rep. of	92	▲
Slovenia	90	▲
Slovak Republic	89	▲
Finland	88	▲
Bulgaria	87	▲
Belgium (Flemish)	87	▲
Malaysia	86	▲
Lithuania	86	▲
Czech Republic	84	▲
Indonesia	84	▲
England	83	▲
Italy	83	▲
Australia	83	▲
Canada	82	O
Singapore	80	O
Thailand	79	O
Chile	79	O
International Average	**78**	
United States	78	O
New Zealand	76	O
Israel	75	O
Romania	74	O
Jordan	73	▲
Macedonia, Rep. of	71	▲
Moldova	71	▲
Chinese Taipei	71	▲
Iran, Islamic Rep.	70	▲
Turkey	69	▲
Hong Kong, SAR	69	▲
Cyprus	68	▲
Philippines	68	▲
Japan	65	▲
Morocco	59	▲
Tunisia	54	▲
South Africa	35	▲

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Feature shared by all insects

What feature is shared by ALL insects?

A. External skeleton

B. Two pairs of wings

C. Jumping legs

D. Stinging mechanism

Item Number: J02

Correct Response:	A

Overall Percent Correct

Canada	81	▲
United States	78	▲
England	78	▲
New Zealand	76	▲
Netherlands	75	▲
Australia	74	▲
Japan	72	▲
Hungary	66	▲
Singapore	62	▲
Turkey	58	▲
Latvia (LSS)	58	O
Chinese Taipei	57	▲
Finland	55	O
Korea, Rep. of	54	O
Italy	53	O
Hong Kong, SAR	51	O
Russian Federation	50	O
Israel	50	O
International Average	**49**	
Slovenia	49	O
Belgium (Flemish)	46	O
Bulgaria	45	O
Malaysia	45	O
Czech Republic	43	O
South Africa	41	▼
Indonesia	39	▼
Romania	37	▼
Cyprus	36	▼
Macedonia, Rep. of	36	▼
Thailand	36	▼
Moldova	36	▼
Lithuania	32	▼
Philippines	32	▼
Chile	32	▼
Jordan	29	▼
Slovak Republic	29	▼
Iran, Islamic Rep.	25	▼
Tunisia	19	▼
Morocco	18	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Reason for protein in diet

The BEST reason for including protein in a healthy diet is because it is the main source of

A. energy for the body

B. fiber for digestion

C. raw materials for cell growth and repair

D. vitamins for fighting disease

Item Number: J07

Correct Response:	C

Overall Percent Correct

Chinese Taipei	62	▲
Finland	61	▲
Malaysia	60	▲
Belgium (Flemish)	54	▲
Hong Kong, SAR	53	▲
Slovenia	53	▲
Thailand	50	▲
Indonesia	49	▲
Czech Republic	47	▲
Singapore	45	▲
Hungary	44	▲
Slovak Republic	42	▲
Korea, Rep. of	41	▲
Russian Federation	38	O
Italy	36	O
Iran, Islamic Rep.	36	O
Cyprus	34	O
International Average	**33**	
England	33	O
Latvia (LSS)	29	O
Japan	29	O
Australia	27	O
Jordan	27	O
Bulgaria	26	O
Israel	24	▼
Chile	24	▼
Morocco	23	▼
Lithuania	22	▼
Tunisia	22	▼
Netherlands	22	▼
Canada	22	▼
New Zealand	21	▼
Moldova	20	▼
United States	20	▼
Turkey	20	▼
Romania	16	▼
Philippines	16	▼
Macedonia, Rep. of	11	▼
South Africa	11	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Large leaves on seedlings

What is the primary function of the large leaves found on seedlings growing in a forest?

A. To provide shade for the root systems

B. To get rid of excess water that is entering through the roots

C. To allow for leaf damage by insects

D. To gather as much light as possible for photosynthesis

Item Number: L02

Correct Response: D

Overall Percent Correct

Thailand	92	▲
Japan	89	▲
Korea, Rep. of	88	▲
Slovenia	84	▲
Hong Kong, SAR	83	▲
Finland	82	▲
Italy	82	▲
Singapore	81	▲
Hungary	80	▲
Slovak Republic	80	O
Lithuania	79	O
England	79	O
Russian Federation	79	▲
Malaysia	78	▲
Czech Republic	77	O
Turkey	73	O
Canada	73	O
Romania	73	O
Bulgaria	73	O
Cyprus	73	O
International Average	**72**	
Chinese Taipei	71	O
Netherlands	70	O
Chile	69	O
Belgium (Flemish)	69	O
Jordan	68	O
Australia	68	O
Macedonia, Rep. of	67	O
Iran, Islamic Rep.	66	O
Israel	66	O
Latvia (LSS)	65	O
Tunisia	65	▼
United States	63	▼
Moldova	63	▼
New Zealand	62	▼
Indonesia	62	▼
Philippines	55	▼
Morocco	42	▼
South Africa	38	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Physical characteristic of prey

Which one of the following characteristics is most likely to be found in mammals that are preyed on by other mammals for food?

A. Eyes on the sides of the head

B. Teeth that are long and pointed

C. Claws on the feet

D. Ears that cannot move

Item Number: L03

Correct Response: A

Overall Percent Correct

Belgium (Flemish)	64	▲
Japan	61	▲
Korea, Rep. of	55	▲
England	54	▲
New Zealand	50	▲
Netherlands	50	▲
Finland	48	▲
Malaysia	46	▲
Chinese Taipei	46	▲
Australia	45	▲
United States	43	O
Canada	42	O
Slovenia	40	O
Czech Republic	40	O
International Average	**37**	
Lithuania	37	O
Italy	37	O
Bulgaria	35	O
Moldova	35	O
Slovak Republic	34	O
Singapore	34	O
Russian Federation	34	O
Hong Kong, SAR	34	O
Jordan	34	O
Cyprus	33	O
Turkey	32	O
Macedonia, Rep. of	30	O
Indonesia	29	▼
Iran, Islamic Rep.	29	▼
Romania	29	O
South Africa	28	▼
Israel	27	▼
Chile	25	▼
Tunisia	24	▼
Thailand	23	▼
Hungary	22	▼
Philippines	22	▼
Morocco	16	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Wolves marking territory

When male wolves place their scent on trees, they most likely are doing this in order to

A. attract female wolves

B. attract prey

C. mark their territory against other wolves

D. mark the location of food supplies

Item Number: L05

Correct Response: C

Overall Percent Correct

Finland	92	▲
Korea, Rep. of	91	▲
Canada	89	▲
Latvia (LSS)	86	▲
Australia	84	▲
Russian Federation	84	▲
Japan	83	▲
Belgium (Flemish)	81	▲
Netherlands	80	▲
New Zealand	80	▲
Hungary	79	▲
United States	78	▲
England	75	▲
Czech Republic	74	▲
Lithuania	72	▲
Slovak Republic	71	▲
Bulgaria	71	▲
Italy	70	▲
Chile	66	▲
Thailand	65	O
Slovenia	63	O
International Average	**60**	
Hong Kong, SAR	54	O
Chinese Taipei	50	▼
Iran, Islamic Rep.	49	▼
Malaysia	46	▼
Romania	45	▼
Israel	44	▼
Singapore	44	▼
Moldova	44	▼
Macedonia, Rep. of	34	▼
Indonesia	33	▼
Jordan	33	▼
Turkey	32	▼
Philippines	31	▼
Cyprus	27	▼
South Africa	26	▼
Tunisia	19	▼
Morocco	19	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Complete food web

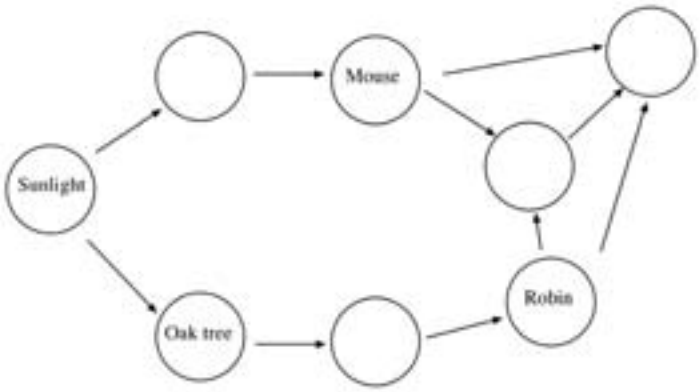
An incomplete food web has been drawn for you. Complete it by filling in each of the empty circles with the number of the correct animal or plant from the list. Remember that the arrows represent energy flow and go from the provider to the user.

1) Caterpillar

2) Corn

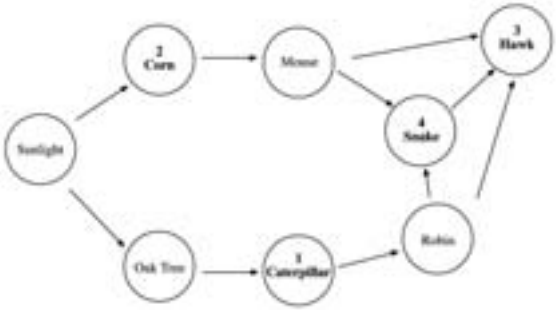
3) Hawk

4) Snake



Item Number: L08

SCORING



Note: There are two possible food webs that are accepted as correct. An alternative, but less preferred, food web with the hawk (3) and snake (4) reversed is also scored as correct.

Correct Response

- Four placed correctly: 2,1,4,3 or names of animals/plants (corn, caterpillar, snake, hawk) as shown in the diagram above.
- Same as above but with hawk and snake reversed.

Incorrect Response

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

Overall Percent Correct

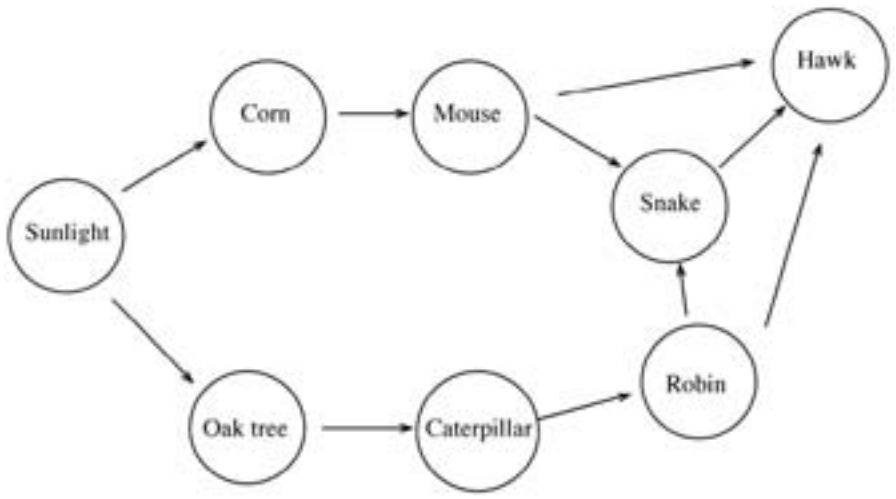
Chinese Taipei	89	▲
Singapore	89	▲
Korea, Rep. of	85	▲
Malaysia	84	▲
England	75	▲
Bulgaria	70	▲
Hungary	70	▲
Japan	68	▲
Russian Federation	67	▲
Indonesia	66	▲
Romania	65	O
Hong Kong, SAR	64	▲
Canada	63	O
Belgium (Flemish)	62	O
Czech Republic	60	O
Australia	60	O
Netherlands	58	O
Thailand	58	O
Finland	57	O
Moldova	56	O
United States	56	O
International Average	**55**	
Slovak Republic	54	O
Jordan	51	O
Latvia (LSS)	50	O
Macedonia, Rep. of	48	O
Slovenia	48	O
Italy	48	O
New Zealand	48	O
Philippines	39	▼
Lithuania	37	▼
Cyprus	37	▼
Turkey	36	▼
Tunisia	36	▼
Israel	35	▼
Iran, Islamic Rep.	35	▼
Chile	28	▼
Morocco	16	▼
South Africa	12	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Theorizing, Analyzing and Solving Problems

Food web: effect of crop failure



Look at the food web above. If the corn crop failed one year what would most likely happen to the robin population? Explain your answer.

Item Number: N02

SCORING

Note: A correct response must include a feasible explanation directly relating the predicted change in robin population to the effect of corn crop failure on prey/predator relationships indicated in the food web. Responses do not have to use the specific terms decrease, increase, and same, as long as the explanation is clear with respect to the effect on the robin population. If more than one effect is given, assign credit corresponding to the first correct explanation.

Correct Response

- Robin population may decrease. Explanation based on predators (snakes/hawks) eating more robins if mice die.
- Robin population may increase. Explanation based on predators (snakes/hawks) dying due to lack of food (mice).
- Robin population would stay the same with a feasible explanation.
- Other acceptable explanation.

Incorrect Response

- Robin population would decrease. Incorrect explanation based on robins starving if snakes die (confuses prey/predator relationship).
- Robin population would decrease. Incorrect explanation based on the robin needing corn to survive.
- Robin population would stay the same. Incorrect explanation based on the robins not needing corn to survive or not being connected to corn in the food web. (Does not consider the effect of predators.)
- Mentions only that the whole food web will be upset and/or all the animals will die.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	72	▲
Chinese Taipei	55	▲
Korea, Rep. of	54	▲
England	46	▲
Belgium (Flemish)	45	▲
Australia	44	▲
Canada	38	▲
New Zealand	38	▲
Hong Kong, SAR	36	▲
Netherlands	36	O
United States	35	▲
Malaysia	31	O
Russian Federation	30	O
Japan	28	O
Hungary	28	O
Finland	26	O
International Average	**26**	
Czech Republic	26	O
Slovenia	23	O
Turkey	23	O
Italy	22	O
Slovak Republic	21	O
Macedonia, Rep. of	21	O
Latvia (LSS)	20	O
Bulgaria	20	O
Indonesia	19	▼
Romania	19	O
Philippines	17	▼
Israel	15	▼
Lithuania	14	▼
Thailand	14	▼
Tunisia	13	▼
Cyprus	13	▼
Jordan	12	▼
Chile	11	▼
Iran, Islamic Rep.	9	▼
Moldova	8	▼
South Africa	3	▼
Morocco	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Bacteria to convert milk to yogurt

Which of the following organisms are used to convert milk to yogurt?

A. Bacteria

B. Protozoa

C. Viruses

D. Algae

Item Number: N03

Correct Response:	A

Overall Percent Correct

Japan	86	▲
Chinese Taipei	86	▲
Korea, Rep. of	75	▲
Hong Kong, SAR	73	▲
Russian Federation	73	▲
Czech Republic	71	▲
Jordan	71	▲
Iran, Islamic Rep.	67	▲
Cyprus	65	▲
Turkey	64	▲
Finland	64	▲
Bulgaria	62	O
Italy	62	O
Slovak Republic	61	O
Moldova	60	O
Latvia (LSS)	59	O
Netherlands	58	O
Lithuania	58	O
Thailand	57	O
Romania	56	O
International Average	**54**	
Slovenia	54	O
Macedonia, Rep. of	54	O
Canada	52	O
Tunisia	52	O
Hungary	47	O
England	44	▼
Australia	44	▼
New Zealand	43	▼
United States	43	▼
Morocco	42	▼
Israel	40	▼
Indonesia	37	▼
Singapore	36	▼
South Africa	35	▼
Malaysia	34	▼
Philippines	27	▼
Chile	26	▼
Belgium (Flemish)	24	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Bone meal for plant growth

Some plants grow better if bone meal (ground-up bones) is spread around their roots. What does bone meal supply to plants that makes them grow better?

A. Energy

B. Minerals

C. Vitamins

D. Carbon dioxide

E. Water

Item Number: N05

Correct Response:	B

Overall Percent Correct

Latvia (LSS)	82	▲
Thailand	81	▲
Singapore	80	▲
Lithuania	79	▲
Hungary	78	▲
Malaysia	75	▲
Russian Federation	74	▲
Finland	73	▲
Chinese Taipei	72	▲
Czech Republic	69	▲
Japan	67	▲
Slovenia	65	▲
Canada	65	▲
Italy	60	O
United States	60	O
Moldova	59	O
England	59	O
Hong Kong, SAR	58	O
Korea, Rep. of	58	O
New Zealand	58	O
Tunisia	57	O
Bulgaria	57	O
Australia	57	O
International Average	**56**	
Iran, Islamic Rep.	52	O
Belgium (Flemish)	51	O
Romania	49	O
Slovak Republic	45	▼
Turkey	44	▼
Macedonia, Rep. of	44	▼
Netherlands	43	▼
Cyprus	42	▼
Chile	41	▼
Jordan	39	▼
Indonesia	34	▼
Philippines	31	▼
Israel	30	▼
South Africa	27	▼
Morocco	19	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Simple Information

Definition of tissue

Tissues are found in living things. What is the definition of a tissue?

A. A group of cells with similar structure and function

B. A group of cells with different structure and function

C. A group of organelles contained inside a cell

D. A group of substances that make up the walls of a cell

Item Number: N06

Correct Response: A

Overall Percent Correct

Bulgaria	67	▲
Russian Federation	61	▲
Chinese Taipei	60	▲
Slovenia	57	▲
Lithuania	56	▲
Cyprus	56	▲
Korea, Rep. of	54	▲
Czech Republic	52	O
Slovak Republic	52	▲
Macedonia, Rep. of	50	▲
Jordan	49	▲
Belgium (Flemish)	47	O
Romania	47	O
United States	46	O
Netherlands	46	O
Moldova	46	O
Hungary	44	O
Canada	42	O
Israel	41	O
England	41	O
International Average	**41**	
Singapore	40	O
Italy	38	O
Australia	37	O
Hong Kong, SAR	37	O
Japan	37	O
Latvia (LSS)	36	O
New Zealand	33	▼
Iran, Islamic Rep.	30	▼
Finland	30	▼
Philippines	29	▼
Morocco	27	▼
Turkey	26	▼
Malaysia	25	▼
Thailand	24	▼
Chile	23	▼
Indonesia	22	▼
Tunisia	21	▼
South Africa	17	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Mammal/lizards living in cold regions

Which statement best explains why mammals are found in very cold regions of the world but lizards are not?

A. Both mammals and lizards are cold-blooded, but mammals have fur to keep them warm.

B. Both mammals and lizards are warm-blooded, but lizards get too cold when they shed their skin.

C. Since mammals, but not lizards, are warm blooded, their body temperature will adjust to match the external temperature.

D. Since mammals, but not lizards, are warm-blooded, they will maintain their body temperature using heat from metabolic processes.

Item Number: N08

Correct Response: D

Overall Percent Correct

Russian Federation	62	▲
Bulgaria	59	▲
Korea, Rep. of	58	▲
Japan	56	▲
Netherlands	53	▲
Canada	52	▲
Hong Kong, SAR	51	▲
Chinese Taipei	49	▲
Slovak Republic	49	O
Thailand	49	▲
United States	47	▲
Singapore	47	O
Australia	46	O
Latvia (LSS)	45	O
Lithuania	44	O
Italy	44	O
Finland	43	O
Czech Republic	41	O
International Average	**40**	
England	40	O
New Zealand	40	O
Belgium (Flemish)	39	O
Hungary	39	O
Malaysia	39	O
Romania	38	O
Cyprus	35	O
Philippines	35	O
Israel	34	O
Moldova	32	▼
Slovenia	30	▼
Chile	30	▼
Jordan	29	▼
Iran, Islamic Rep.	28	▼
Indonesia	27	▼
Macedonia, Rep. of	27	▼
Tunisia	24	▼
Turkey	23	▼
Morocco	21	▼
South Africa	15	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Theorizing, Analyzing and Solving Problems

Tree growth

Ethan hammered a nail into the trunk of a young tree. Explain why the nail was still at the same height from the ground twenty years later even though the tree had grown to a height of 22 meters.

Item Number: P03

SCORING

Note: A correct response is based on trees increasing in height as a result of growth at the tips of stems/branches (apical meristem) and trunk growth only resulting in increased diameter. Responses should be scored as correct if either of these two factors are included.

Correct Response

- Mentions that trees grow in height at the tips of stems/branches. (May also mention trunk growth increasing in diameter.)
- Mentions ONLY that the trunk grows in width or diameter but not height (without mentioning growth of the stem or branches).
- Other correct.

Incorrect Response

- Mentions only that the trunk does not grow (is dead).
- Mentions that the nail stops or prevents growth.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Belgium (Flemish)	65	▲
Finland	64	▲
Canada	59	▲
Australia	57	▲
Japan	57	▲
Netherlands	56	▲
New Zealand	56	▲
Thailand	55	▲
Slovak Republic	55	▲
England	55	▲
Chinese Taipei	53	▲
Moldova	53	▲
Hungary	50	O
Singapore	49	O
Czech Republic	48	O
Russian Federation	48	O
Cyprus	47	O
Slovenia	45	O
United States	45	O
Turkey	44	O
Italy	43	O
Latvia (LSS)	42	O
International Average	**41**	
Hong Kong, SAR	40	O
Israel	38	O
Iran, Islamic Rep.	37	O
Lithuania	36	O
Romania	36	O
Malaysia	33	▼
Korea, Rep. of	33	▼
Chile	30	▼
Bulgaria	29	▼
Jordan	24	▼
Indonesia	23	▼
Tunisia	22	▼
Macedonia, Rep. of	21	▼
Philippines	9	▼
South Africa	8	▼
Morocco	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Hibernating animals

Animals hibernate to survive cold weather and poor food supplies. Which of the following occurs in animals when they hibernate?

A. Their blood stops circulating.

B. Their body temperature increases.

C. Their body fat remains constant.

D. Their rate of metabolism decreases.

Item Number: P04

Correct Response:	D

Overall Percent Correct

Lithuania	77	▲
Hungary	75	▲
Czech Republic	75	▲
Slovak Republic	74	▲
Bulgaria	72	▲
Thailand	69	▲
Finland	67	▲
Russian Federation	66	▲
Latvia (LSS)	64	▲
Indonesia	63	▲
Slovenia	54	O
Moldova	54	O
Netherlands	54	O
Singapore	53	O
Australia	51	O
Chinese Taipei	50	O
Cyprus	50	O
Iran, Islamic Rep.	50	O
Italy	50	O
Canada	50	O
Malaysia	49	O
International Average	**48**	
Belgium (Flemish)	48	O
United States	47	O
Hong Kong, SAR	47	O
Romania	46	O
Israel	44	O
New Zealand	33	▼
England	33	▼
Jordan	31	▼
Macedonia, Rep. of	30	▼
Chile	30	▼
Philippines	29	▼
Japan	28	▼
Turkey	25	▼
Tunisia	23	▼
Korea, Rep. of	22	▼
South Africa	20	▼
Morocco	16	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Digestion in stomach

What digestive substance is found in the stomach? What does it do?

Item Number: P06

SCORING

Note: To be correct, a response must name a specific digestive substance found in the stomach (enzyme, hydrochloric acid, or gastric juices) with or without a full description of its function. A general response related to "acid" will be accepted as correct, but an incorrect acid will be scored as incorrect.

Correct Response

- Names enzyme, hydrochloric acid or gastric juices with an explanation based on breaking down food (particles) or protein.
- Names enzyme, hydrochloric acid or gastric juices without a complete explanation.
- Names acid with or without a complete explanation (does not explicitly name hydrochloric acid).
- Other correct.

Incorrect Response

- Names an incorrect acid not involved in digestion in stomach (lactic acid, amino acid, sulfuric acid, etc.).
- Names a substance (or body part) not found in the stomach but involved in digestion (saliva, bile salts, bacteria, intestines, etc.).
- Mentions digesting (breaking down) food but no specific substance or body part is named.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Slovak Republic	75	▲
Czech Republic	64	▲
Hong Kong, SAR	64	▲
Slovenia	62	▲
Romania	62	▲
Moldova	60	▲
Hungary	59	▲
Latvia (LSS)	57	▲
Singapore	56	▲
Bulgaria	55	▲
Netherlands	54	O
Chinese Taipei	54	▲
Russian Federation	54	▲
Japan	53	▲
England	51	▲
Australia	49	O
Lithuania	49	O
New Zealand	49	O
United States	46	O
Belgium (Flemish)	46	O
Canada	43	O
Korea, Rep. of	42	O
Thailand	41	O
International Average	**41**	
Macedonia, Rep. of	39	O
Jordan	37	O
Italy	35	O
Finland	34	O
Malaysia	29	▼
Iran, Islamic Rep.	26	▼
Chile	24	▼
Indonesia	22	▼
Israel	19	▼
Cyprus	14	▼
Turkey	13	▼
Tunisia	6	▼
Philippines	6	▼
South Africa	4	▼
Morocco	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Understanding Complex Information

Two outcomes of introducing new species

A new species of fish was released into a lake. State two unwanted outcomes that could arise from the introduction of this new species.

1.

2.

Item Number: R03D

SCORING

Note: Each of the two outcomes are scored separately. The same score may be used twice, since they are based on general outcome categories. However, if the two outcomes are essentially the same, the second outcome should be scored as incorrect. If only one outcome is given, the second should be scored as incorrect.

Correct Response

- Mentions competition with native species (e.g. overpopulation, eating the limited food supply).
- Mentions new species introducing diseases (bacteria, parasites, etc.).
- Mentions effects of predation (new species killing off existing species or vice-versa).
- Mentions that the new species cannot survive in the lake (extinction due to inhospitable habitat).
- Mentions upsetting food web or ecological balance.
- Mentions mating with existing species.
- Other correct.

Incorrect Response

- Response too general.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Australia	74	▲
New Zealand	60	▲
Slovak Republic	58	▲
Canada	57	▲
Singapore	57	▲
Thailand	57	▲
England	56	▲
Finland	56	▲
Latvia (LSS)	53	▲
Chinese Taipei	52	▲
Belgium (Flemish)	50	▲
Moldova	48	O
Netherlands	47	O
Israel	47	O
Russian Federation	46	O
Lithuania	46	O
Hungary	44	O
Slovenia	43	O
Bulgaria	43	O
United States	42	O
International Average	**40**	
Italy	40	O
Japan	39	O
Romania	36	O
Tunisia	35	O
Cyprus	35	O
Czech Republic	34	O
Korea, Rep. of	33	▼
Malaysia	32	▼
Macedonia, Rep. of	30	▼
Hong Kong, SAR	29	▼
Chile	28	▼
Indonesia	23	▼
Iran, Islamic Rep.	22	▼
Turkey	22	▼
Jordan	21	▼
Morocco	19	▼
South Africa	8	▼
Philippines	7	▼

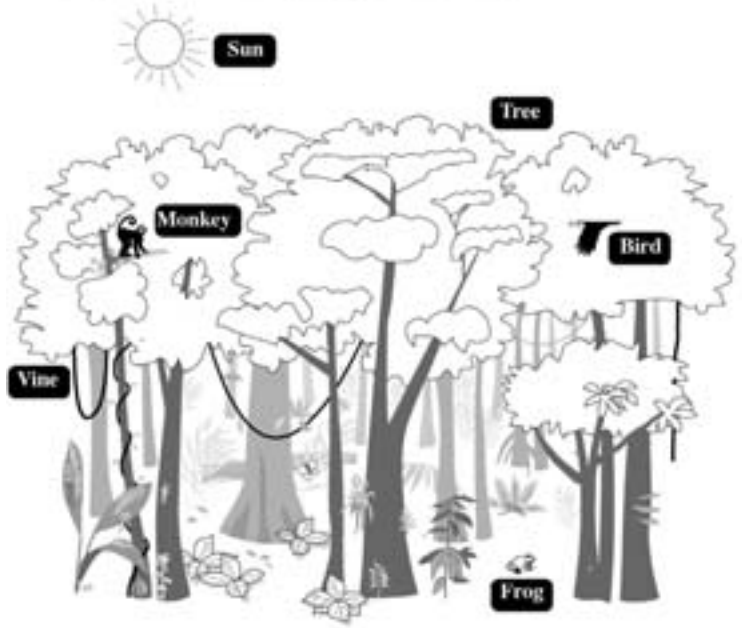
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Theorizing, Analyzing and Solving Problems

Importance of trees/sun in rain forest

In the picture of a rainforest, six objects have been labeled.



Explain why each of the following is important in maintaining the ecosystem in the rainforest.

A. The Tree

B. The Sun

Item Number: X02A

SCORING

A: Scoring for Trees

Note: If student response refers to oxygen/carbon dioxide cycle, score as correct even if other reasons are given. If more than one reason is given, assign credit corresponding to the first correct reason.

Correct Response

- Trees produce oxygen and/or use carbon dioxide.
- Trees provide food or energy.
- Trees provide a place to hide/shelter.
- Trees provide shade or protection from the Sun.
- Other correct.

Incorrect Response

- Response too vague.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	93	▲
Australia	91	▲
Canada	90	▲
England	88	▲
Chinese Taipei	87	▲
Korea, Rep. of	87	▲
Thailand	87	▲
Belgium (Flemish)	86	▲
United States	85	▲
New Zealand	83	▲
Finland	83	▲
Japan	83	▲
Hong Kong, SAR	82	▲
Slovak Republic	80	▲
Hungary	79	▲
Netherlands	79	O
Cyprus	79	▲
Malaysia	79	▲
Latvia (LSS)	79	▲
Slovenia	78	O
Tunisia	77	▲
Czech Republic	76	O
International Average	**72**	
Indonesia	72	O
Italy	71	O
Jordan	69	O
Russian Federation	64	▼
Lithuania	63	▼
Turkey	61	▼
Bulgaria	60	▼
Romania	60	▼
Israel	59	▼
Philippines	59	▼
Moldova	56	▼
Macedonia, Rep. of	49	▼
Chile	48	▼
Morocco	44	▼
Iran, Islamic Rep.	42	▼
South Africa	30	▼

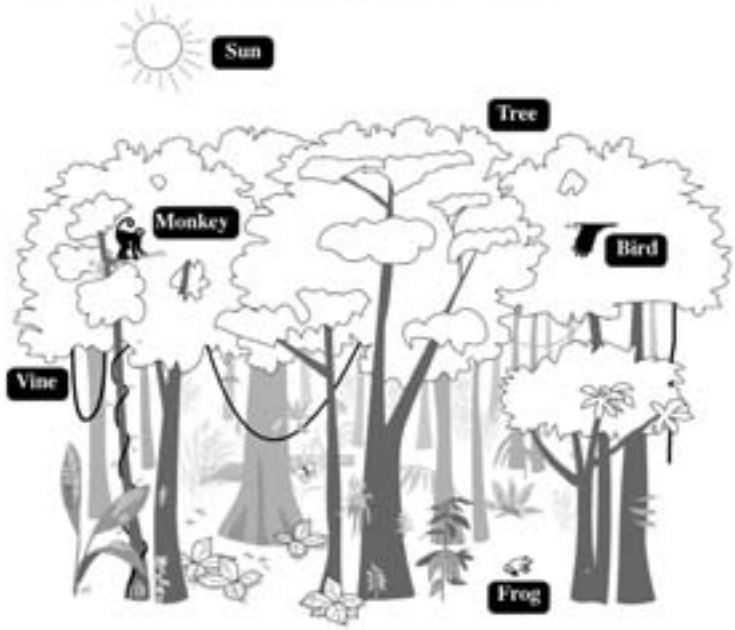
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Life Science	Theorizing, Analyzing and Solving Problems

Importance of trees/sun in rain forest

In the picture of a rainforest, six objects have been labeled.



Explain why each of the following is important in maintaining the ecosystem in the rainforest.

A. The Tree

B. The Sun

Item Number: X02B

SCORING

B: Scoring for Sun

Note: If response refers explicitly to photosynthesis, score as correct even if other reasons are given. If more than one reason is given, assign credit corresponding to the first correct reason.

Correct Response

- Sun is needed for photosynthesis (by plants).
- Sun is needed in order for chlorophyll in plants to produce food. (Does not explicitly mention photosynthesis).
- Sun provides energy and/or is needed for plant growth. (No mention of photosynthesis or chlorophyll).
- Sun provides heat (warmth) or maintains the temperature. (No mention of photosynthesis or chlorophyll).
- Sun provides light and/or enables animals to see.
- Other correct.

Incorrect Response

- Response too vague.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	91	▲
Canada	88	▲
Australia	88	▲
Korea, Rep. of	86	▲
Japan	85	▲
Thailand	84	▲
England	84	▲
Chinese Taipei	82	▲
New Zealand	82	▲
Finland	81	▲
Belgium (Flemish)	81	▲
United States	81	▲
Hong Kong, SAR	79	▲
Latvia (LSS)	79	▲
Malaysia	78	▲
Slovenia	77	▲
Netherlands	76	▲
Tunisia	69	O
Czech Republic	69	O
Jordan	68	O
International Average	**68**	
Slovak Republic	67	O
Cyprus	66	O
Indonesia	65	O
Hungary	64	O
Italy	62	O
Russian Federation	60	▼
Philippines	59	▼
Romania	57	▼
Turkey	56	▼
Lithuania	56	▼
Israel	55	▼
Moldova	55	▼
Iran, Islamic Rep.	48	▼
Bulgaria	48	▼
Chile	46	▼
Macedonia, Rep. of	44	▼
Morocco	35	▼
South Africa	28	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Simple Information

Energy released from car engine

Most of the chemical energy released when gasoline burns in a car engine is not used to move the car, but is changed into

A. electricity

B. heat

C. magnetism

D. sound

Item Number: B02

Correct Response:	B

Overall Percent Correct

Hungary	76	▲
Korea, Rep. of	74	▲
Russian Federation	72	▲
Bulgaria	71	▲
Slovenia	67	▲
England	67	▲
Finland	66	▲
Czech Republic	66	▲
Israel	65	▲
Japan	64	▲
Canada	63	▲
Netherlands	63	O
Cyprus	63	▲
Moldova	62	O
Slovak Republic	61	O
Singapore	60	O
Turkey	60	O
Romania	59	O
United States	59	O
Australia	59	O
Latvia (LSS)	59	O
New Zealand	58	O
International Average	**58**	
Jordan	56	O
Thailand	56	O
Iran, Islamic Rep.	54	O
Italy	53	O
Lithuania	52	▼
Chinese Taipei	52	▼
Philippines	51	▼
Malaysia	50	▼
Belgium (Flemish)	49	▼
Hong Kong, SAR	49	▼
Macedonia, Rep. of	48	▼
Tunisia	46	▼
Indonesia	42	▼
Morocco	40	▼
South Africa	40	▼
Chile	34	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Greatest density from mass/volume table

Which object listed in the table has the greatest density?

Object	Mass of Object	Volume of Object
W	11.0 grams	24 cubic centimeters
X	11.0 grams	12 cubic centimeters
Y	5.5 grams	4 cubic centimeters
Z	5.5 grams	11 cubic centimeters

A. W

B. X

C. Y

D. Z

Item Number: B03

Correct Response: C

Overall Percent Correct

Chinese Taipei	52	▲
Hong Kong, SAR	50	▲
Korea, Rep. of	47	▲
Finland	46	▲
Belgium (Flemish)	46	▲
Israel	44	▲
Singapore	44	▲
Japan	42	▲
Netherlands	38	▲
Hungary	36	▲
Russian Federation	35	O
Bulgaria	35	O
Slovak Republic	32	O
Slovenia	32	O
Canada	32	O
Malaysia	31	O
Latvia (LSS)	30	O
Lithuania	30	O
Czech Republic	29	O
International Average	**28**	
Australia	25	O
Romania	25	O
Macedonia, Rep. of	24	O
Moldova	23	O
United States	23	▼
Italy	23	▼
Turkey	21	▼
Cyprus	21	▼
Thailand	20	▼
Philippines	19	▼
England	19	▼
Jordan	18	▼
Iran, Islamic Rep.	17	▼
South Africa	17	▼
New Zealand	17	▼
Chile	11	▼
Tunisia	10	▼
Indonesia	8	▼
Morocco	7	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Understanding Simple Information

Color reflecting most light

The walls of a building are to be painted to reflect as much light as possible. What color should they be painted?

A. White

B. Red

C. Black

D. Pink

Item Number: B06

Correct Response: A

Overall Percent Correct

Belgium (Flemish)	94	▲
Hungary	94	▲
Slovak Republic	92	▲
Netherlands	92	▲
Singapore	91	▲
Slovenia	91	▲
Czech Republic	90	▲
Russian Federation	90	▲
Australia	89	▲
England	89	▲
Chinese Taipei	89	▲
Lithuania	88	▲
Malaysia	87	▲
Japan	87	▲
Bulgaria	86	▲
Romania	86	O
Latvia (LSS)	86	▲
Hong Kong, SAR	85	▲
Finland	85	O
Israel	85	▲
Canada	83	O
United States	83	O
International Average	**82**	
Italy	82	O
New Zealand	81	O
Philippines	80	O
Korea, Rep. of	78	▼
Indonesia	78	▼
Macedonia, Rep. of	77	▼
Cyprus	76	▼
Moldova	75	▼
Turkey	75	▼
Chile	75	▼
Iran, Islamic Rep.	73	▼
Thailand	73	▼
Tunisia	73	▼
Jordan	70	▼
South Africa	69	▼
Morocco	56	▼

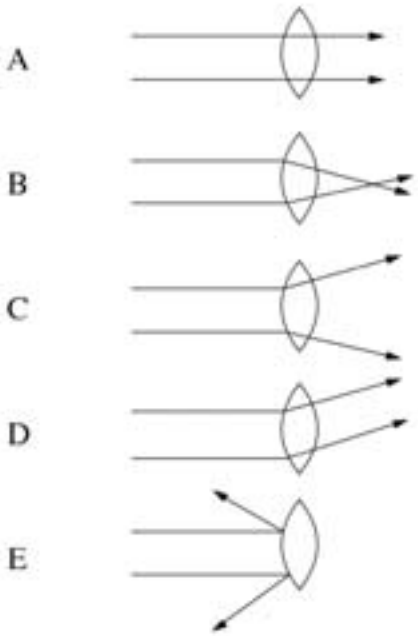
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Light rays through magnifying glass

Which diagram best shows what happens when light passes through a magnifying glass?



Item Number: D01

Correct Response: B

Overall Percent Correct

Japan	88	▲
Chinese Taipei	73	▲
Bulgaria	70	▲
Russian Federation	67	▲
Korea, Rep. of	61	▲
Singapore	54	▲
Malaysia	52	▲
Lithuania	51	▲
Finland	50	▲
Czech Republic	49	O
Slovak Republic	49	O
Moldova	48	O
Australia	48	O
Hungary	47	O
Netherlands	47	O
Canada	46	▲
Hong Kong, SAR	43	O
Romania	43	O
International Average	**42**	
Slovenia	41	O
Belgium (Flemish)	41	O
New Zealand	40	O
Thailand	40	O
Iran, Islamic Rep.	39	O
Latvia (LSS)	38	O
Chile	37	▼
Jordan	37	▼
United States	36	▼
Italy	34	▼
Morocco	31	▼
Israel	31	▼
England	29	▼
Cyprus	28	▼
Indonesia	24	▼
Turkey	23	▼
Tunisia	21	▼
Macedonia, Rep. of	20	▼
Philippines	19	▼
South Africa	14	▼

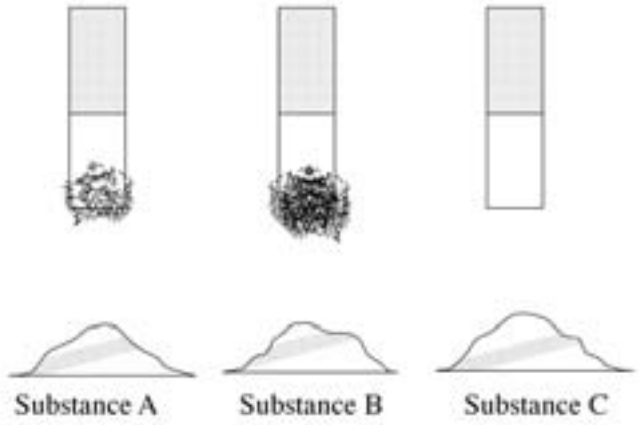
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Magnetic substances

Each of the three magnets shown has been dipped into the substance below it. Which of the substances could be coffee?



A. A only

B. B only

C. C only

D. A and B only

Item Number: D02

Correct Response: C

Overall Percent Correct

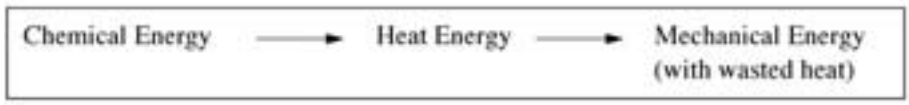
Hungary	92	▲
Czech Republic	91	▲
Bulgaria	91	▲
Korea, Rep. of	90	▲
Singapore	89	▲
England	89	▲
Slovak Republic	88	▲
Russian Federation	88	▲
Japan	85	▲
Slovenia	84	▲
Australia	83	▲
Lithuania	82	▲
Finland	82	▲
Canada	81	▲
Romania	79	▲
Macedonia, Rep. of	78	▲
Belgium (Flemish)	78	▲
Chinese Taipei	77	▲
Malaysia	75	O
Jordan	75	O
Netherlands	74	O
Hong Kong, SAR	74	O
New Zealand	73	O
Italy	73	O
United States	72	O
International Average	**72**	
Moldova	71	O
Turkey	70	O
Cyprus	69	O
Israel	67	O
Thailand	58	▼
Latvia (LSS)	58	▼
Chile	53	▼
Tunisia	53	▼
Iran, Islamic Rep.	52	▼
Indonesia	47	▼
South Africa	36	▼
Morocco	29	▼
Philippines	27	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Sequence of energy changes



The sequence of energy changes shown in the diagram explains which event?

A. A flashlight is on.

B. A candle burns.

C. Gasoline burns to power a car.

D. Electric current runs a refrigerator.

Item Number: D04

Correct Response:	C

Overall Percent Correct

Singapore	77	▲
Hungary	74	▲
Chinese Taipei	72	▲
England	71	▲
Slovak Republic	67	▲
Cyprus	67	▲
Russian Federation	67	▲
Australia	67	▲
Israel	66	▲
Hong Kong, SAR	66	▲
Italy	66	▲
Belgium (Flemish)	65	▲
Netherlands	65	▲
Iran, Islamic Rep.	65	▲
Thailand	64	▲
United States	64	▲
Bulgaria	64	O
Japan	63	▲
New Zealand	61	O
Canada	61	O
Korea, Rep. of	60	O
Slovenia	59	O
International Average	**59**	
Jordan	58	O
Romania	56	O
Tunisia	55	▼
Czech Republic	55	O
Latvia (LSS)	54	O
Moldova	53	O
Indonesia	53	▼
Malaysia	52	▼
Lithuania	51	▼
Macedonia, Rep. of	51	▼
Chile	50	▼
Morocco	48	▼
Finland	45	▼
Philippines	39	▼
Turkey	36	▼
South Africa	20	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Why light-colored clothes are cooler

On a warm sunny day, you will feel cooler wearing light-colored clothes because they

A. reflect more radiation

B. prevent sweating

C. are not as heavy as dark clothes

D. let more air in

Item Number: F02

Correct Response: A

Overall Percent Correct

Hungary	88	▲
Netherlands	88	▲
Chinese Taipei	87	▲
Belgium (Flemish)	86	▲
Czech Republic	86	▲
Slovak Republic	85	▲
Korea, Rep. of	85	▲
Hong Kong, SAR	84	▲
Singapore	83	▲
Russian Federation	83	▲
Slovenia	81	▲
Japan	79	▲
Malaysia	79	▲
Australia	77	▲
Latvia (LSS)	77	▲
Lithuania	75	▲
England	74	▲
Israel	72	▲
Bulgaria	71	O
Finland	71	▲
Canada	69	O
Macedonia, Rep. of	69	O
International Average	**65**	
United States	61	O
Italy	61	O
Romania	58	O
Iran, Islamic Rep.	58	▼
New Zealand	55	▼
Moldova	55	▼
Indonesia	52	▼
Cyprus	52	▼
Jordan	47	▼
Philippines	43	▼
Thailand	39	▼
Morocco	38	▼
Chile	37	▼
Turkey	34	▼
Tunisia	31	▼
South Africa	18	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Simple Information

Energy stored in food

People get energy from the food they eat. Where does the energy stored in food come from?

A. Fertilizer

B. The Sun

C. Vitamins

D. The soil

Item Number: H05

Correct Response: B

Overall Percent Correct

Singapore	55	▲
Iran, Islamic Rep.	53	▲
Japan	45	▲
Malaysia	44	▲
England	42	▲
Korea, Rep. of	41	▲
Hong Kong, SAR	39	▲
Finland	38	▲
Philippines	38	▲
Jordan	34	▲
Australia	33	▲
Indonesia	32	▲
Russian Federation	29	O
United States	26	O
Chinese Taipei	25	O
New Zealand	25	O
International Average	**24**	
Canada	23	O
Bulgaria	22	O
Thailand	21	O
Hungary	19	▼
Netherlands	19	▼
Czech Republic	18	▼
Macedonia, Rep. of	18	▼
Italy	18	▼
Slovak Republic	17	▼
Cyprus	16	▼
South Africa	15	▼
Latvia (LSS)	15	▼
Slovenia	14	▼
Turkey	14	▼
Moldova	14	▼
Morocco	12	▼
Chile	11	▼
Romania	11	▼
Lithuania	11	▼
Israel	11	▼
Belgium (Flemish)	9	▼
Tunisia	6	▼

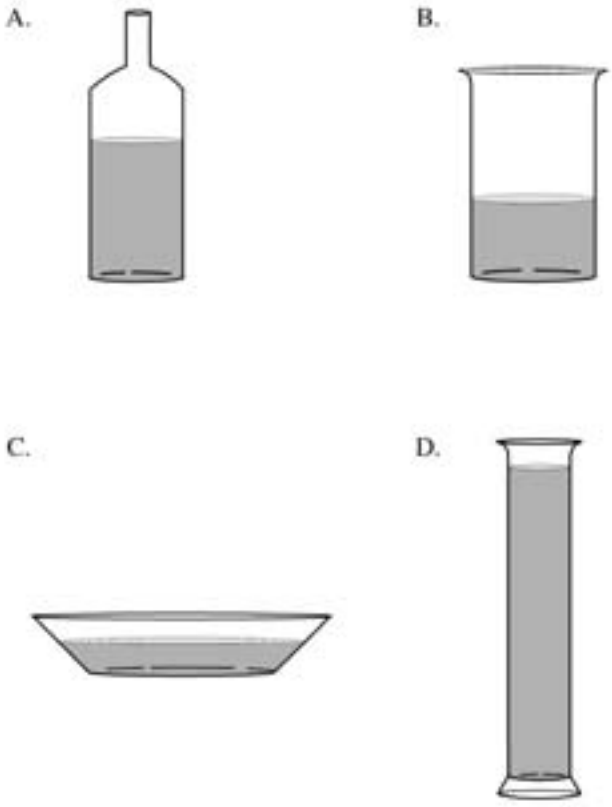
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Evaporation rate by surface area

A student put 100 mL of water in each of the open containers and let them stand in the sun for one day. Which container would probably lose the most water due to evaporation?



Item Number: J04

Correct Response: C

Overall Percent Correct

Singapore	98	▲
Hungary	95	▲
Korea, Rep. of	95	▲
Russian Federation	95	▲
Czech Republic	94	▲
Japan	94	▲
Slovak Republic	94	▲
Hong Kong, SAR	93	▲
Moldova	93	▲
Bulgaria	93	▲
Malaysia	93	▲
Chinese Taipei	93	▲
England	92	▲
Canada	91	▲
Australia	90	▲
Latvia (LSS)	90	▲
Lithuania	90	O
Israel	89	▲
Netherlands	89	O
Romania	88	O
Cyprus	88	O
New Zealand	88	O
Jordan	87	O
Finland	86	O
Thailand	85	O
International Average	**84**	
Belgium (Flemish)	84	O
United States	84	O
Slovenia	83	O
Macedonia, Rep. of	83	O
Indonesia	75	▼
Tunisia	75	▼
Turkey	74	▼
Chile	72	▼
Italy	70	▼
Iran, Islamic Rep.	69	▼
Philippines	60	▼
South Africa	53	▼
Morocco	45	▼

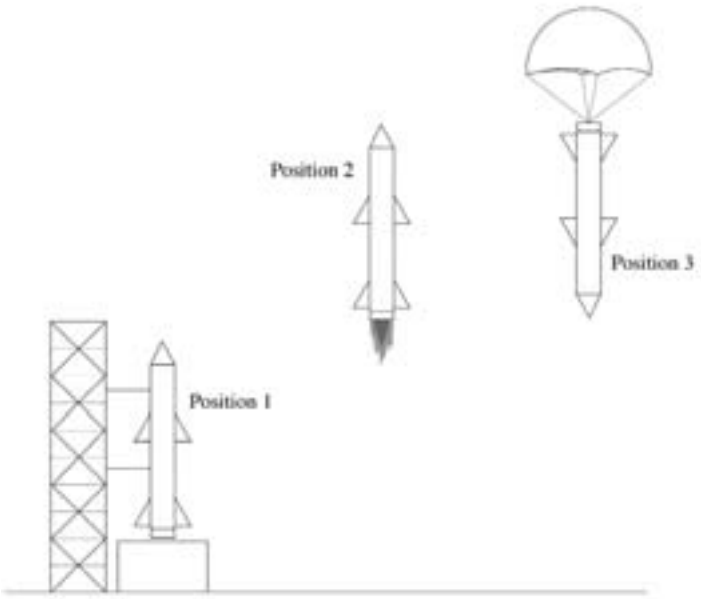
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Understanding Simple Information

Gravity acting on rocket

The drawings show a rocket being launched from Earth and then returning.



In which of the three positions does gravity act on the rocket?

A. 3 only

B. 1 and 2 only

C. 2 and 3 only

D. 1, 2 and 3

Item Number: J05

Correct Response: D

Overall Percent Correct

Slovak Republic	68	▲
Czech Republic	65	▲
Hungary	65	▲
Finland	53	▲
Singapore	49	▲
Chinese Taipei	48	▲
Lithuania	48	▲
Slovenia	46	▲
United States	46	▲
Russian Federation	46	O
Australia	45	▲
Canada	45	O
England	43	O
Moldova	42	O
Japan	40	O
New Zealand	39	O
Netherlands	39	O
International Average	**36**	
Jordan	36	O
Bulgaria	35	O
Thailand	30	O
Iran, Islamic Rep.	30	O
Cyprus	30	O
Romania	29	O
Korea, Rep. of	29	▼
Belgium (Flemish)	29	▼
Philippines	27	▼
Israel	26	▼
Italy	25	▼
Hong Kong, SAR	24	▼
Latvia (LSS)	24	▼
Chile	23	▼
Turkey	22	▼
Malaysia	21	▼
Macedonia, Rep. of	19	▼
Tunisia	19	▼
Morocco	17	▼
South Africa	15	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Understanding Simple Information

Sunscreen to protect against radiation

Sunscreen is used to protect the skin from exposure to which type of solar radiation?

A. Visible

B. X-rays

C. Infrared

D. Ultraviolet

E. Microwaves

Item Number: J08

Correct Response:	D

Overall Percent Correct

Chinese Taipei	94	▲
Singapore	91	▲
Hungary	87	▲
Thailand	86	▲
Australia	85	▲
Hong Kong, SAR	84	▲
Slovenia	84	▲
New Zealand	80	▲
Japan	79	▲
Slovak Republic	79	▲
Korea, Rep. of	77	▲
Finland	77	▲
Chile	76	▲
Czech Republic	75	▲
Netherlands	75	▲
Canada	75	▲
Indonesia	72	▲
Lithuania	70	▲
United States	69	▲
Italy	68	O
Russian Federation	65	O
Belgium (Flemish)	64	O
England	64	O
Bulgaria	62	O
International Average	**62**	
Philippines	57	O
Latvia (LSS)	54	O
Malaysia	54	▼
Romania	48	▼
Moldova	45	▼
Jordan	43	▼
Israel	39	▼
Macedonia, Rep. of	36	▼
Tunisia	33	▼
Turkey	32	▼
Cyprus	26	▼
South Africa	18	▼
Morocco	18	▼
Iran, Islamic Rep.	17	▼

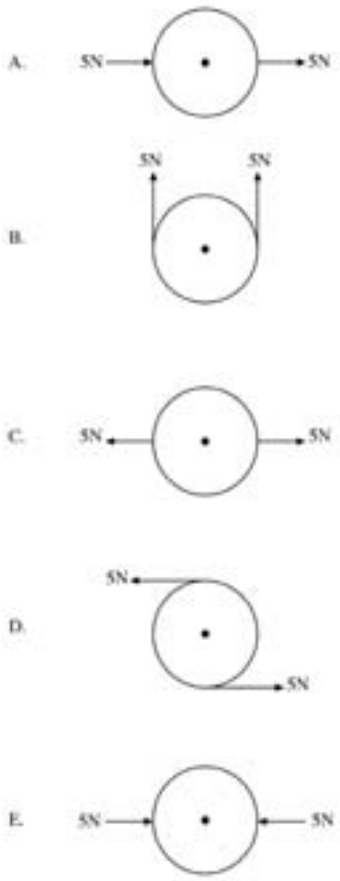
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Rotating forces on wheel

A uniform wheel is free to rotate on its axle at its center. It is acted on by two forces in the same plane. Each force has the same size, equal to 5N (Newtons). In which case will the wheel rotate?



Item Number: L01

Correct Response:	D

Overall Percent Correct

Japan	76	▲
Hungary	74	▲
Lithuania	72	▲
Latvia (LSS)	72	▲
Czech Republic	69	O
Netherlands	69	O
Finland	69	▲
Slovenia	69	O
Russian Federation	68	O
Thailand	67	O
Bulgaria	67	O
Italy	66	O
Canada	66	O
Slovak Republic	66	O
Belgium (Flemish)	64	O
Korea, Rep. of	63	O
Romania	63	O
United States	62	O
Moldova	62	O
International Average	**62**	
Hong Kong, SAR	62	O
England	61	O
Chile	60	O
Australia	60	O
Singapore	60	O
Jordan	60	O
New Zealand	59	O
Tunisia	58	O
Malaysia	58	O
Chinese Taipei	58	O
Cyprus	57	O
Turkey	57	O
Israel	57	O
Morocco	55	O
Iran, Islamic Rep.	54	▼
Macedonia, Rep. of	54	O
Indonesia	52	▼
Philippines	49	▼
South Africa	36	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Efficiency of machines

Machine A and Machine B are each used to pump water from a river. The table shows what volume of water each machine removed in one hour and how much gasoline each of them used.

	Volume of Water Removed in 1 Hour (liters)	Gasoline Used in 1 Hour (liters)
Machine A	1000	1.25
Machine B	500	0.5

a) Which machine is more efficient in converting the energy in gasoline to work?

Answer:_____

b) Explain your answer.

Item Number: L04

SCORING

Note: A correct response must identify B and include an explanation based on the concept of energy efficiency (ratio of energy output to energy input) that compares the volume of water pumped for an equivalent volume of gasoline used for the two machines. Responses based ONLY on comparing the amount of gasoline used OR the amount of water pumped by the machines without considering the ratio of water/gasoline are scored as incorrect. No credit is lost for missing/incorrect units or for minor computational errors, provided the correct conclusion and explanation are given.

Correct Response

- B. With correct explanation based on the concept of energy efficiency (B uses less gasoline than A for an equivalent volume of water pumped).

Incorrect Response

- B. It uses less gasoline (no comparison of efficiency based on volume of water pumped).
- B. Other incorrect/inadequate or no explanation.
- A. It removes more water in 1 hour (no comparison of efficiency based on gas used).
- A. Other incorrect/inadequate or no explanation.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Netherlands	58	▲
Korea, Rep. of	52	▲
Belgium (Flemish)	51	▲
Slovak Republic	50	▲
Singapore	49	▲
Australia	49	▲
Japan	46	▲
Chinese Taipei	44	▲
Canada	43	▲
New Zealand	42	▲
England	42	▲
Finland	40	O
Lithuania	38	O
Hungary	38	O
Israel	35	O
Slovenia	33	O
Russian Federation	33	O
Hong Kong, SAR	32	O
International Average	**31**	
Czech Republic	30	O
United States	30	O
Thailand	28	O
Bulgaria	28	O
Cyprus	27	O
Latvia (LSS)	26	O
Italy	23	O
Romania	22	O
Iran, Islamic Rep.	21	▼
Macedonia, Rep. of	20	▼
Malaysia	20	▼
Indonesia	20	▼
Moldova	19	▼
Jordan	19	▼
Tunisia	19	▼
Turkey	17	▼
Chile	8	▼
Morocco	7	▼
Philippines	4	▼
South Africa	3	▼

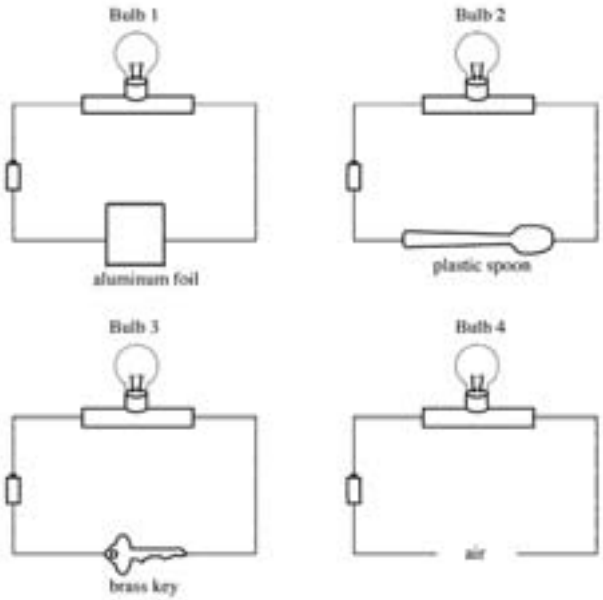
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Complete circuits

The following diagrams show a battery and a bulb connected by wires to various materials.



Which of the bulbs will light?

A. 1 only

B. 2 and 3 only

C. 1 and 3 only

D. 1, 3 and 4 only

E. 1, 2 and 3 only

Item Number: N01

Correct Response: C

Overall Percent Correct

Hong Kong, SAR	84	▲
Russian Federation	82	▲
Belgium (Flemish)	81	▲
Chinese Taipei	80	▲
Singapore	79	▲
Israel	79	▲
Korea, Rep. of	78	▲
Netherlands	78	▲
Hungary	74	▲
Australia	73	▲
Malaysia	72	▲
Czech Republic	72	O
Slovak Republic	71	O
Jordan	70	O
Cyprus	69	O
Finland	68	O
Japan	68	O
Thailand	65	O
Slovenia	65	O
England	65	O
Tunisia	65	O
United States	64	O
International Average	**64**	
New Zealand	64	O
Lithuania	63	O
Canada	60	O
Bulgaria	57	O
Romania	57	O
Italy	56	▼
Morocco	56	▼
Latvia (LSS)	56	O
Indonesia	52	▼
Chile	50	▼
Moldova	48	▼
Macedonia, Rep. of	48	▼
Turkey	46	▼
Iran, Islamic Rep.	43	▼
Philippines	42	▼
South Africa	33	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Balancing 10 and 5 liter buckets

Which picture shows the best way for the man to balance a ten-liter bucket of water and a five-liter bucket of water?

A.

B.

C.

D.

Item Number: N09

Correct Response: D

Overall Percent Correct

Japan	88	▲
Russian Federation	87	▲
Korea, Rep. of	87	▲
Finland	86	▲
Slovenia	84	▲
Chinese Taipei	84	▲
Netherlands	83	▲
Latvia (LSS)	82	▲
Czech Republic	82	▲
Hungary	81	▲
Australia	80	▲
Slovak Republic	80	▲
Thailand	78	▲
Lithuania	78	O
Canada	78	▲
Singapore	77	O
Belgium (Flemish)	77	O
New Zealand	77	O
Bulgaria	76	O
Malaysia	76	O
United States	73	O
Hong Kong, SAR	72	O
International Average	**71**	
Romania	70	O
England	70	O
Italy	69	O
Turkey	69	O
Indonesia	66	▼
Chile	63	▼
Moldova	62	▼
Macedonia, Rep. of	62	▼
Philippines	58	▼
Israel	56	▼
Tunisia	52	▼
Cyprus	50	▼
Iran, Islamic Rep.	47	▼
Morocco	34	▼
South Africa	33	▼

Country average vs. International average:

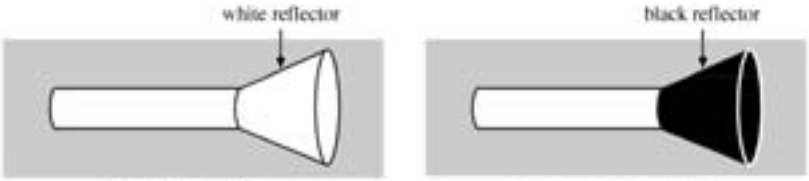
Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Flashlights with white/black reflectors

Roddy and Stephanie each make a flashlight using identical batteries and bulbs.

They then add cardboard reflectors to their flashlights as shown below. Roddy's reflector is made of white cardboard and Stephanie's reflector is made of black cardboard.



Roddy's Flashlight

Stephanie's Flashlight

The flashlights are then switched on.

a) Which flashlight shines more light on a wall two meters away? (check one)

☐ Roddy's (white reflector)

☐ Stephanie's (black reflector)

b) Explain your answer.

Item Number: N10

SCORING

Note: A correct response must identify Roddy's and include an explanation based on the relative reflectivity of the white and black cardboard. Credit is given both for responses explicitly mentioning the higher reflectance of the white cardboard and/or the higher absorptance of the black cardboard as well as responses communicating this concept using less scientific terminology.

Correct Response

- Roddy's. With correct explanation based on the higher reflectivity of the white cardboard (or lower reflectivity/higher absorption of the black cardboard). [Explicitly refers to absorption and/or reflectivity.]
- Roddy's. Explanation based on the concept of higher reflectivity but using other terminology. [Does not explicitly refer to absorption/reflection properties.]
- Other correct.

Incorrect Response

- Roddy's with an inadequate/incorrect or no explanation.
- Stephanie's. With or without explanation.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	59	▲
Singapore	58	▲
Russian Federation	57	▲
Malaysia	55	▲
England	54	▲
Hungary	52	▲
Netherlands	52	O
Belgium (Flemish)	51	▲
Japan	50	▲
Czech Republic	48	▲
Canada	47	▲
Lithuania	47	O
Australia	47	O
Slovenia	47	O
Bulgaria	45	O
United States	45	O
Finland	44	O
Korea, Rep. of	43	O
Jordan	43	O
Slovak Republic	42	O
New Zealand	41	O
Latvia (LSS)	41	O
Indonesia	40	O
Thailand	40	O
International Average	**39**	
Hong Kong, SAR	38	O
Macedonia, Rep. of	37	O
Tunisia	35	O
Italy	34	O
Turkey	32	▼
Cyprus	26	▼
Romania	25	▼
Israel	24	▼
Moldova	22	▼
Iran, Islamic Rep.	21	▼
Chile	17	▼
Morocco	16	▼
Philippines	12	▼
South Africa	11	▼

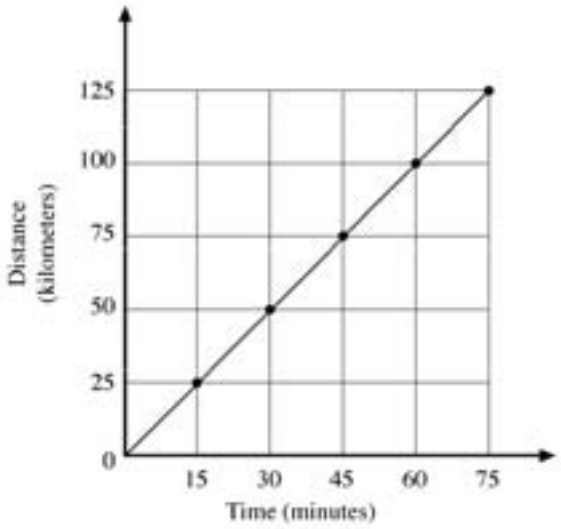
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Determination of speed from graph

The graph shows the progress made by a car traveling along a straight road.



What is the speed of the car?

A. 25 kilometers per hour

B. 50 kilometers per hour

C. 75 kilometers per hour

D. 100 kilometers per hour

Item Number: P01

Correct Response: D

Overall Percent Correct

Hong Kong, SAR	82	▲
Chinese Taipei	78	▲
Belgium (Flemish)	78	▲
Singapore	77	▲
Netherlands	75	▲
Malaysia	71	▲
Finland	71	▲
Australia	69	▲
Slovak Republic	69	▲
Canada	68	▲
Czech Republic	66	▲
Thailand	65	▲
Latvia (LSS)	62	O
Lithuania	62	O
Japan	61	O
New Zealand	60	O
Hungary	59	O
Slovenia	57	O
England	56	O
International Average	**54**	
Russian Federation	51	O
United States	50	O
Israel	49	O
Tunisia	49	O
Moldova	47	O
Italy	47	O
South Africa	47	▼
Bulgaria	47	O
Macedonia, Rep. of	44	▼
Romania	42	▼
Korea, Rep. of	41	▼
Cyprus	41	▼
Chile	37	▼
Turkey	36	▼
Morocco	34	▼
Jordan	32	▼
Iran, Islamic Rep.	30	▼
Indonesia	30	▼
Philippines	25	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Amount of light on wall and ceiling

James turns on a flashlight in his bedroom and shines it on his wall one meter away to produce a small circle of light. He then shines the flashlight on his ceiling two meters away to produce a larger circle of light.

a) Does more light reach the ceiling than the wall? (Check one)

☐ Yes

☐ No

b) Explain your answer.

Item Number: P02

SCORING

Note: A correct response is based on the same amount of light reaching both the ceiling and the wall but being more spread out (less bright) on the ceiling. Correct responses must identify NO and include an explanation that states that the light is the same or that indicates that the light is just more spread out (less bright) on the ceiling without explicitly stating same. If the explanation merely repeats information that is in the stem, it is scored as incorrect even if NO is checked. If a response indicates that there is less light on the ceiling, the explanation must include a correct reason based on more air absorption/ scattering at a greater distance to be correct. Responses that indicate less light at a greater distance without further explanation should be scored as incorrect.

Correct Response

- No. Explains that the same amount of light reaches the wall and ceiling. (May also refer to light being more spread out on the ceiling or less concentrated/focused/bright).
- No. Explains (or shows in a diagram) that light is (only) more spread out (less bright) at a greater distance. (Does not explicitly state that the light is the same.)
- No. Explains that less light reaches the ceiling because of more air absorption/scattering at a greater distance.
- No. Other correct explanation.

Incorrect Response

- No. States that less light reaches the ceiling with inadequate explanation related to distance from source. (Does not include explanation of less light due to air absorption or scattering as in third correct response).
- No. Other incorrect/inadequate or no explanation. (Includes explanations that merely paraphrase the stem).
- Yes. Explanation based on light being bigger or more spread out.
- Yes. Other incorrect/inadequate or no explanation.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	52	▲
Hong Kong, SAR	40	▲
Korea, Rep. of	36	▲
Israel	36	▲
Australia	35	▲
Canada	35	▲
Singapore	34	▲
Cyprus	34	▲
Slovak Republic	32	O
Finland	32	O
Hungary	32	▲
United States	31	▲
Macedonia, Rep. of	31	O
Latvia (LSS)	30	O
New Zealand	29	O
England	29	O
Belgium (Flemish)	28	O
Netherlands	26	O
Slovenia	25	O
International Average	**24**	
Lithuania	24	O
Czech Republic	23	O
Thailand	22	O
Iran, Islamic Rep.	22	O
Bulgaria	20	O
Moldova	20	O
Russian Federation	20	O
Italy	19	O
Japan	19	O
Turkey	18	O
Indonesia	14	▼
Romania	13	▼
Tunisia	13	▼
Chile	12	▼
Jordan	11	▼
Malaysia	8	▼
South Africa	3	▼
Philippines	3	▼
Morocco	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Understanding Complex Information

Appearance of red dress in green light

As a play begins, white stage lights shine on an actress wearing a red dress. Suddenly, the lights go off and a green light is shone on the actress. The dress looks black. Why does the dress look black?

A. The dress reflects the green part of light.

B. The dress absorbs the red part of light.

C. The dress absorbs the green part of light.

D. The dress reflects the black part of light.

Item Number: R02

Correct Response:	C

Overall Percent Correct

Singapore	63	▲
Hungary	57	▲
Japan	55	▲
Malaysia	53	▲
Korea, Rep. of	51	▲
Australia	49	▲
Netherlands	48	O
Slovenia	48	▲
United States	47	▲
Canada	45	▲
England	44	O
Chinese Taipei	44	O
Czech Republic	43	O
New Zealand	40	O
Russian Federation	39	O
Indonesia	38	O
Slovak Republic	38	O
International Average	**37**	
Belgium (Flemish)	36	O
Latvia (LSS)	35	O
Lithuania	35	O
Cyprus	35	O
Thailand	35	O
Bulgaria	35	O
Finland	35	O
Italy	35	O
Israel	33	O
Hong Kong, SAR	32	O
Chile	29	▼
Jordan	28	▼
Moldova	28	▼
Tunisia	28	▼
Macedonia, Rep. of	27	▼
Iran, Islamic Rep.	26	▼
Romania	24	▼
Philippines	23	▼
Turkey	22	▼
South Africa	20	▼
Morocco	18	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Conversion of electrical/light energy

Electrical energy is used to power a lamp. How does the amount of electrical energy used compare to amount of light energy produced?

a) The amount of electrical energy used is:
(Check one)

☐ more than the amount of light energy produced.

☐ less than the amount of light energy produced.

☐ the same as the amount of light energy produced.

b) Give a reason to support your answer.

Item Number: X01

SCORING

Note: A correct response must identify more and include a correct explanation based on electrical energy being converted to heat or a more general description of energy losses or low efficiency. Responses that include explanations based on heat, energy losses or low efficiency but with an incorrect application to the problem by checking less are scored as incorrect.

Correct Response

- MORE. With an explanation based on (much) energy being converted to heat.
- MORE. With other correct explanation of energy (power) loss or low efficiency. [Must clearly indicate that "some" energy goes elsewhere].
- MORE. Other correct explanation.

Incorrect Response

- MORE. Incorrect/inadequate or no explanation.
- SAME. Explanation is based on the concept of conservation of energy without considering energy losses.
- LESS. Explanation based on heat, energy losses or low efficiency but with an incorrect application.
- LESS. Any other incorrect or no explanation.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	21	▲
England	16	▲
Russian Federation	16	▲
Hungary	14	▲
Slovenia	13	▲
Chinese Taipei	12	▲
Hong Kong, SAR	12	▲
Belgium (Flemish)	11	▲
Macedonia, Rep. of	11	O
Iran, Islamic Rep.	10	O
Slovak Republic	10	O
Netherlands	10	O
Japan	10	O
Australia	9	O
Korea, Rep. of	8	O
Canada	8	O
Czech Republic	8	O
International Average	**8**	
Bulgaria	7	O
New Zealand	7	O
Tunisia	6	O
Turkey	6	O
Finland	6	O
Latvia (LSS)	6	O
Lithuania	5	O
Italy	5	O
Israel	5	▼
Romania	4	▼
Cyprus	4	▼
United States	4	▼
Jordan	4	▼
Moldova	4	▼
Malaysia	3	▼
Thailand	3	▼
Morocco	3	▼
Indonesia	2	▼
South Africa	2	▼
Chile	1	▼
Philippines	0	▼

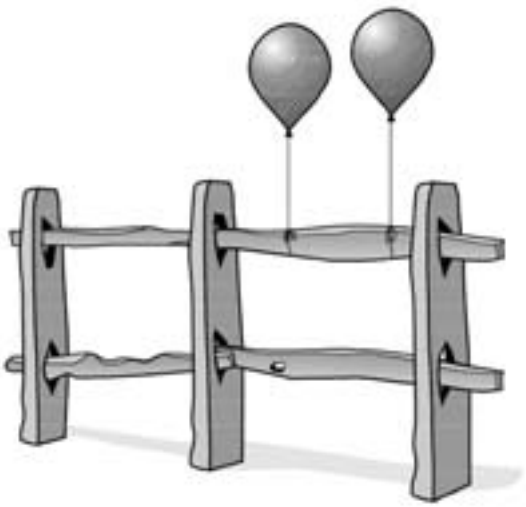
Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Physics	Theorizing, Analyzing and Solving Problems

Heat expansion of balloons

Balloons filled with helium gas are taken outside on a hot, sunny day and tied to a fence as shown in the diagram.



Over a period of a few hours, the balloons increase in size. Explain why.

Item Number: Z03

SCORING

Note: A correct response is based on an increase in gas volume (or internal gas pressure) as a result of increased temperature. Credit is given for both higher-level responses relating to the increased kinetic energy of helium atoms as a function of temperature as well as more general responses relating to increased internal gas pressure and/or gas volume. An increase in temperature does not have to be explicitly mentioned in order to receive credit. Responses referring ONLY to the balloon expanding or to the effect of temperature on the balloon without further explanation of the gas behavior are scored as incorrect.

Correct Response

- Mentions explicitly that (as the gas in the balloon heats up), the helium (gas) atoms (particles, molecules) move faster (collide more frequently) causing the pressure inside the balloon to increase and/or the volume to increase (expand).
- Mentions that the pressure of the gas inside the balloon increases and/or the volume of the gas increases (expands). (No mention of gas atoms/molecules).
- Other correct.

Incorrect Response

- Mentions only that the sun heats the helium (gas) and/or causes the balloon to expand. [No reference to the pressure/volume changes in the gas.]
- Mentions pressure and/or volume with inadequate explanation.
- Mentions only the effect of heat (from Sun) on the balloon material (rubber, latex).
- Refers to (individual) atoms or molecules expanding (or growing).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Korea, Rep. of	50	▲
Finland	49	▲
Netherlands	46	▲
Singapore	46	▲
Lithuania	41	▲
Japan	37	▲
Australia	36	▲
Russian Federation	35	▲
Hungary	34	▲
New Zealand	33	▲
Thailand	33	▲
Chinese Taipei	33	▲
Czech Republic	33	O
Jordan	32	O
England	32	O
United States	31	O
Slovak Republic	30	O
Slovenia	30	O
Canada	28	O
Belgium (Flemish)	26	O
International Average	**26**	
Bulgaria	25	O
Latvia (LSS)	24	O
Italy	24	O
Macedonia, Rep. of	24	O
Malaysia	21	O
Hong Kong, SAR	19	▼
Romania	17	▼
Moldova	17	▼
Tunisia	16	▼
Turkey	15	▼
Israel	15	▼
Morocco	14	▼
Iran, Islamic Rep.	14	▼
Chile	6	▼
Cyprus	6	▼
Indonesia	5	▼
South Africa	3	▼
Philippines	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Understanding Simple Information

Best reason for painting iron surfaces

Paint applied to an iron surface prevents the iron from rusting. Which ONE of the following provides the best reason?

A. It prevents nitrogen from coming in contact with the iron.

B. It reacts chemically with the iron.

C. It prevents carbon dioxide from coming in contact with the iron.

D. It makes the surface of the iron smoother.

E. It prevents oxygen and moisture from coming in contact with the iron.

Item Number: F06

Correct Response:	E

Overall Percent Correct

Chinese Taipei	91	▲
Finland	83	▲
Russian Federation	81	▲
Hungary	81	▲
Singapore	81	▲
Netherlands	80	▲
Hong Kong, SAR	79	▲
Jordan	78	▲
England	76	▲
Bulgaria	76	▲
Iran, Islamic Rep.	76	▲
Lithuania	74	▲
Slovak Republic	73	▲
Korea, Rep. of	73	▲
Canada	72	O
Australia	72	O
Czech Republic	72	O
Romania	71	O
Thailand	70	O
Slovenia	70	O
Japan	70	O
Belgium (Flemish)	70	O
Latvia (LSS)	69	O
International Average	**67**	
New Zealand	66	O
United States	66	O
Israel	66	O
Malaysia	66	O
Italy	65	O
Macedonia, Rep. of	65	O
Chile	64	O
Cyprus	62	▼
Turkey	58	▼
Philippines	48	▼
Moldova	47	▼
Indonesia	47	▼
Tunisia	44	▼
South Africa	26	▼
Morocco	24	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Understanding Simple Information

Burning wood absorbs/releases energy

If you are burning wood, the reaction will

A. release energy

B. absorb energy

C. neither absorb nor release energy

D. sometimes release and sometimes absorb energy, depending on the kind of wood

Item Number: H06

Correct Response: A

Overall Percent Correct

Chinese Taipei	82	▲
Hungary	77	▲
Finland	75	▲
Macedonia, Rep. of	74	▲
Hong Kong, SAR	70	▲
England	68	▲
Singapore	68	▲
Iran, Islamic Rep.	66	▲
Canada	66	▲
Korea, Rep. of	65	▲
Russian Federation	65	▲
Malaysia	65	▲
United States	64	▲
Netherlands	64	O
Bulgaria	63	▲
Belgium (Flemish)	61	▲
Lithuania	61	O
Japan	59	O
Israel	58	O
Australia	58	O
Turkey	58	O
New Zealand	58	O
Slovenia	57	O
International Average	**55**	
Italy	54	O
Cyprus	54	O
Slovak Republic	54	O
Moldova	53	O
Jordan	51	O
Czech Republic	47	▼
Romania	46	▼
Thailand	43	▼
Latvia (LSS)	40	▼
Indonesia	36	▼
Chile	33	▼
Philippines	30	▼
Tunisia	25	▼
South Africa	20	▼
Morocco	17	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Understanding Complex Information

Compounds, molecules and atoms

The words *organs, tissues*, and *cells* can be used in the following sentence:

Lungs are *organs* composed of *tissues* which are made up of *cells*.

Use the words *molecules*, *atoms*, and *compounds* to complete the following sentence:

Sugars are _____ composed of _____ which are made up of _____.

Item Number: J03

SCORING

Correct Response

- Compounds - Molecules - Atoms

Incorrect Response

- Compounds - Atoms - Molecules
- Molecules - Atoms - Compounds
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

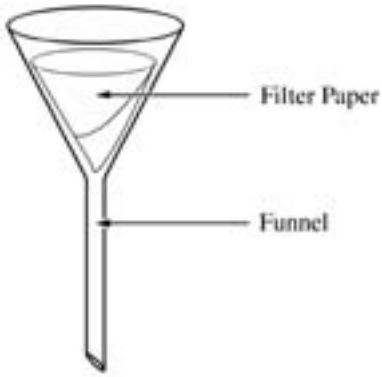
Singapore	69	▲
Bulgaria	67	▲
Slovak Republic	65	▲
Japan	63	▲
Russian Federation	61	▲
Korea, Rep. of	60	▲
Czech Republic	60	▲
Chinese Taipei	57	▲
Macedonia, Rep. of	56	▲
Italy	55	▲
Lithuania	54	O
Slovenia	54	O
Malaysia	53	▲
Australia	53	O
Latvia (LSS)	52	O
Canada	51	O
United States	51	O
England	49	O
Moldova	48	O
Iran, Islamic Rep.	46	O
Hungary	46	O
International Average	**46**	
Finland	44	O
Israel	43	O
Netherlands	42	O
Belgium (Flemish)	41	O
New Zealand	41	O
Philippines	41	O
Chile	39	▼
Hong Kong, SAR	38	▼
Jordan	36	▼
Romania	33	▼
Indonesia	30	▼
Thailand	30	▼
Cyprus	29	▼
Tunisia	27	▼
Turkey	23	▼
Morocco	15	▼
South Africa	10	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Using Tools, Routine Procedures and Science Processes

Filtration of mixtures



Filtration using the equipment shown above can be used to separate which materials?

A. A mixture of salt and pepper

B. A mixture of pepper and water

C. A mixture of oxygen and water

D. A solution of silver nitrate in water

E. A solution of sugar in water

Item Number: L06

Correct Response: B

Overall Percent Correct

Czech Republic	64	▲
Slovak Republic	62	▲
Lithuania	54	▲
Finland	54	▲
Latvia (LSS)	53	▲
Hungary	52	▲
Korea, Rep. of	51	▲
Russian Federation	50	▲
Canada	50	▲
Singapore	50	▲
Slovenia	48	▲
Netherlands	48	O
Chinese Taipei	46	▲
Romania	42	O
Japan	42	O
Malaysia	42	O
Australia	41	O
New Zealand	39	O
International Average	**39**	
United States	39	O
Cyprus	39	O
Hong Kong, SAR	38	O
Bulgaria	37	O
Moldova	34	O
England	34	O
Tunisia	34	O
Belgium (Flemish)	33	O
Israel	32	▼
Italy	30	▼
Thailand	30	▼
Philippines	29	▼
Turkey	28	▼
Macedonia, Rep. of	27	▼
South Africa	27	▼
Jordan	24	▼
Chile	21	▼
Iran, Islamic Rep.	19	▼
Indonesia	15	▼
Morocco	12	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Chemistry	Understanding Simple Information

Example of chemical reaction

Which is an example of a chemical reaction?

A. Water boiling

B. Sugar dissolving

C. Nails rusting

D. Wax melting

Item Number: N07

Correct Response: C

Overall Percent Correct

Chinese Taipei	87	▲
Japan	76	▲
Hong Kong, SAR	72	▲
England	66	▲
Singapore	64	▲
Netherlands	64	▲
Russian Federation	60	▲
Korea, Rep. of	59	▲
Iran, Islamic Rep.	58	▲
Malaysia	57	▲
Finland	56	O
Hungary	56	O
Canada	55	O
Bulgaria	54	O
Jordan	54	O
Slovenia	54	O
Australia	53	O
Romania	52	O
United States	52	O
International Average	**49**	
Belgium (Flemish)	49	O
Thailand	49	O
Italy	48	O
Latvia (LSS)	47	O
Czech Republic	47	O
Slovak Republic	47	O
New Zealand	42	O
Macedonia, Rep. of	40	▼
Cyprus	40	▼
Chile	37	▼
Lithuania	37	▼
Indonesia	35	▼
Moldova	34	▼
Turkey	32	▼
Israel	31	▼
Philippines	30	▼
Morocco	30	▼
Tunisia	23	▼
South Africa	18	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Theorizing, Analyzing and Solving Problems

Small pieces of wood burn faster

A large log of wood will burn more slowly than the same log chopped into smaller pieces. Explain why.

Item Number: R05

SCORING

Note: A correct response is based on the concept of increased surface area in the smaller pieces resulting in faster burning (reaction with oxygen). Credit is given both for higher-level responses indicating increased availability of oxygen/air or surface area in the chopped wood pieces as well as less sophisticated responses describing only that more wood is exposed to the flame and can, therefore, burn simultaneously.

Correct Response

- Mentions that there is more wood (surface area) in contact with oxygen or air in the smaller pieces. [Explicitly mentions availability to oxygen/air.]
- Mentions effect of increased surface area in the chopped wood pieces. [Explicitly mentions surface area, surface, or area. No mention of oxygen/air.]
- Mentions that when chopped, more parts of the wood are exposed to flame (ignite, catch fire) and all the small pieces can burn simultaneously. [No explicit mention of oxygen/air or surface area.]
- Other correct.

Incorrect Response

- Refers only to relative rates of burning (burning through). [Does not refer explicitly to surface area, oxygen/air, or simultaneous burning.]
- Refers only to the relative rate of ignition (catching on fire, heating up). [Does not refer explicitly to surface area, oxygen/air, or simultaneous burning.]
- Mentions only the need for oxygen/air. [Incorrect/inadequate or no connection to increased availability in chopped wood.]
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Slovak Republic	53	▲
Moldova	53	▲
Chinese Taipei	50	▲
Finland	39	▲
Russian Federation	33	O
Hungary	32	▲
Latvia (LSS)	32	O
Slovenia	31	O
Macedonia, Rep. of	31	O
Netherlands	30	O
New Zealand	30	O
England	30	O
Bulgaria	29	O
Australia	29	O
Czech Republic	29	O
Belgium (Flemish)	28	O
Korea, Rep. of	28	O
Singapore	27	O
Iran, Islamic Rep.	25	O
International Average	**24**	
Canada	23	O
Indonesia	23	O
Malaysia	21	O
Romania	21	O
Lithuania	20	O
Jordan	18	▼
United States	18	▼
Israel	17	▼
Turkey	15	▼
Hong Kong, SAR	14	▼
Italy	13	▼
Cyprus	13	▼
Thailand	13	▼
Philippines	10	▼
Chile	9	▼
Tunisia	9	▼
South Africa	7	▼
Japan	5	▼
Morocco	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Theorizing, Analyzing and Solving Problems

Galvanization of steel

A steel manufacturer uses a chemical process called 'galvanization' to protect the surface of steel beams that are used to construct high-rise buildings. It takes a crew of steel workers 8 hours to 'galvanize' a large batch of steel.

a) Why MUST the surface of the steel be protected?

b) A new 'galvanization' process is developed that shortens the procedure to 4 hours. Describe two consequences of the steel manufacturer switching to the shorter 'galvanization' process.

1.

2.

Item Number: Z01A

SCORING

A: Scoring for why steel is galvanized

Note: A correct response must explicitly reference rusting, corrosion, oxidation, or comparable term.

Correct Response

- Explicitly refers to rusting, corrosion, or oxidation.

Incorrect Response

- Mentions only the general structural properties of steel (hardness, strength, durability, etc.). [No mention of rusting, corrosion, oxidation, or equivalent].
- Mentions protection from weather, water, air, etc. [No mention of rusting, oxidation, corrosion, or equivalent.]
- Mentions only protecting the surface (repeats information in stem).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	77	▲
Singapore	66	▲
Korea, Rep. of	63	▲
England	57	▲
Finland	56	▲
Australia	56	▲
Canada	56	▲
Hong Kong, SAR	56	▲
Hungary	54	▲
Belgium (Flemish)	54	▲
Slovak Republic	48	▲
New Zealand	48	▲
United States	46	▲
Malaysia	46	▲
Jordan	44	O
Thailand	43	O
Slovenia	40	O
Czech Republic	38	O
Japan	38	O
International Average	**37**	
Bulgaria	35	O
Romania	32	O
Macedonia, Rep. of	32	O
Italy	31	O
Netherlands	31	O
Latvia (LSS)	29	▼
Russian Federation	28	▼
Indonesia	28	▼
Iran, Islamic Rep.	27	▼
Tunisia	24	▼
Israel	23	▼
Turkey	21	▼
Cyprus	20	▼
Chile	16	▼
Lithuania	16	▼
Moldova	11	▼
Philippines	10	▼
South Africa	6	▼
Morocco	3	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Chemistry	Theorizing, Analyzing and Solving Problems

Galvanization of steel

A steel manufacturer uses a chemical process called 'galvanization' to protect the surface of steel beams that are used to construct high-rise buildings. It takes a crew of steel workers 8 hours to 'galvanize' a large batch of steel.

a) Why MUST the surface of the steel be protected?

b) A new 'galvanization' process is developed that shortens the procedure to 4 hours. Describe two consequences of the steel manufacturers switching to the shorter 'galvanization' process.

1.

2.

Item Number: Z01D

SCORING

B: Scoring for new process

Correct Response

- Mentions that there is more profit (or lower cost) for the manufacturing company.
- Mentions greater efficiency/productivity or that more steel/buildings can be produced (faster).
- Mentions unemployment or lower pay for workers.
- Mentions any other worker-related consequence.
- Mentions that the new method might be inferior to the old (shorter process saves time at the expense of quality; unproven method compared to old reliable one).
- Other correct.

Incorrect Response

- Mentions only that the new process is shorter or takes 4 hours (less time). [Merely reports information given in stem.]

Overall Percent Correct

Korea, Rep. of	45	▲
Netherlands	42	▲
Singapore	41	▲
Canada	37	▲
Japan	36	▲
Thailand	35	▲
Finland	34	▲
Belgium (Flemish)	32	▲
New Zealand	31	▲
Slovak Republic	30	▲
Australia	27	▲
England	26	O
United States	26	▲
Hungary	25	O
Hong Kong, SAR	22	O
Chinese Taipei	21	O
Slovenia	21	O
Malaysia	20	O
International Average	**20**	
Bulgaria	18	O
Latvia (LSS)	17	O
Czech Republic	16	O
Jordan	15	O
Israel	13	▼
Tunisia	13	▼
Italy	12	▼
Cyprus	11	▼
Macedonia, Rep. of	11	▼
Lithuania	11	▼
Turkey	10	▼
Indonesia	9	▼
Moldova	8	▼
Chile	7	▼
Romania	7	▼
Russian Federation	5	▼
South Africa	3	▼
Philippines	3	▼
Iran, Islamic Rep.	2	▼
Morocco	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Environmental and Resource Issues	Understanding Complex Information

Area where soil is washed away

Rain and running water can wash away soil. From which area is soil most likely to be washed away?

A. A sloping area with bushes

B. A flat area with grasses

C. A flat area that is barren

D. A sloping area that is barren

Item Number: F04

Correct Response:	D

Overall Percent Correct

Chinese Taipei	92	▲
Singapore	88	▲
Slovak Republic	85	▲
Hong Kong, SAR	85	▲
Netherlands	83	▲
Korea, Rep. of	83	▲
Malaysia	81	▲
Russian Federation	80	▲
Japan	79	▲
England	78	▲
Australia	78	▲
Canada	76	▲
Cyprus	76	▲
Latvia (LSS)	75	▲
Slovenia	75	▲
Tunisia	74	▲
Czech Republic	73	O
Indonesia	73	▲
United States	73	O
New Zealand	71	O
Hungary	70	O
Thailand	69	O
Belgium (Flemish)	68	O
Finland	68	O
International Average	**68**	
Lithuania	66	O
Jordan	65	O
Romania	65	O
Israel	63	O
Italy	59	▼
Macedonia, Rep. of	55	▼
Bulgaria	52	▼
Chile	52	▼
Moldova	50	▼
Turkey	49	▼
Iran, Islamic Rep.	44	▼
Morocco	42	▼
Philippines	39	▼
South Africa	26	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Environmental and Resource Issues	Understanding Complex Information

Effectiveness of insecticides

Insecticides are used to control insect populations so that they do not destroy crops. Over time, some insecticides become less effective at killing insects, and new insecticides must be developed. What is the most likely reason insecticides become less effective over time?

A. Surviving insects have learned to include insecticides as a food source.

B. Surviving insects pass their resistance to insecticides to their Soffspring.

C. Insecticides build up in the soil.

D. Insecticides are concentrated at the bottom of the food chain.

Item Number: L07

Correct Response: B

Overall Percent Correct

Chinese Taipei	76	▲
Hong Kong, SAR	74	▲
Hungary	70	▲
Singapore	69	▲
Japan	68	▲
Australia	66	▲
United States	62	▲
Netherlands	61	▲
Canada	60	▲
Russian Federation	60	O
Finland	57	O
Slovenia	57	O
Czech Republic	57	O
England	56	O
New Zealand	56	O
Belgium (Flemish)	53	O
Lithuania	51	O
Israel	51	O
Bulgaria	50	O
Italy	50	O
Thailand	49	O
International Average	**48**	
Romania	48	O
Korea, Rep. of	47	O
Slovak Republic	45	O
Turkey	43	O
Moldova	42	O
Iran, Islamic Rep.	38	▼
Chile	38	▼
Latvia (LSS)	38	▼
Macedonia, Rep. of	37	▼
Philippines	33	▼
Jordan	32	▼
Cyprus	31	▼
Indonesia	27	▼
South Africa	25	▼
Malaysia	24	▼
Tunisia	21	▼
Morocco	20	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Cognitive Domain
Environmental and Resource Issues	Understanding Complex Information

Two reasons for famine

What are two reasons why famine (a great shortage of food) occurs?

1.

2.

Item Number: P05D

SCORING

Note: Each of the two reasons must be scored separately. The same score can be used twice. However, if the reasons described are essentially the same, or an extension of the same idea, or if only one reason is given, the second reason should be scored as incorrect.

Correct Response

- Mentions agriculturally-related factors (soil depletion, overgrazing, erosion, poor farming techniques).
- Mentions natural disasters or weather-related factors (floods, earthquakes, rain distribution, drought, temperature, sun, etc.).
- Mentions crop disease, insect infestation or other pests.
- Mentions overpopulation or consumption.
- Mentions specific social/economic/political factors.
- Mentions pollution or other contamination.
- Other correct.

Incorrect Response

- Mentions ONLY a lack or need of food (or other responses related to a general definition of famine).
- Response too vague.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	73	▲
Slovenia	72	▲
Slovak Republic	70	▲
Hong Kong, SAR	66	▲
Chinese Taipei	66	▲
Moldova	59	▲
Finland	55	▲
Australia	55	▲
Belgium (Flemish)	54	O
Canada	53	▲
Thailand	52	▲
New Zealand	48	O
Latvia (LSS)	47	O
Jordan	46	O
Czech Republic	44	O
Cyprus	43	O
International Average	**42**	
Turkey	42	O
Bulgaria	41	O
Italy	41	O
England	41	O
Malaysia	40	O
Netherlands	39	O
Korea, Rep. of	39	O
Japan	39	O
Russian Federation	38	O
Chile	37	O
United States	36	O
Indonesia	34	▼
Israel	33	▼
Iran, Islamic Rep.	33	▼
Romania	32	▼
Hungary	31	▼
Tunisia	29	▼
Lithuania	26	▼
Morocco	25	▼
Philippines	16	▼
Macedonia, Rep. of	14	▼
South Africa	8	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Environmental and Resource Issues	Understanding Simple Information

Result of global warming

What is predicted to be a result of global warming?

A. Rising ocean level

B. More severe earthquakes

C. Larger volcanic eruptions

D. Thinning ozone layer

Item Number: R06

Correct Response: A

Overall Percent Correct

Japan	67	▲
Hong Kong, SAR	59	▲
Chinese Taipei	58	▲
Lithuania	57	▲
Singapore	56	▲
Australia	52	▲
Bulgaria	49	▲
Italy	48	▲
Korea, Rep. of	47	▲
Hungary	44	▲
New Zealand	43	▲
Cyprus	42	▲
Slovak Republic	42	O
Russian Federation	38	O
South Africa	37	O
Latvia (LSS)	35	O
International Average	**33**	
England	33	O
Belgium (Flemish)	33	O
Netherlands	33	O
Czech Republic	32	O
Canada	31	O
Finland	31	O
United States	30	O
Moldova	29	O
Slovenia	28	O
Macedonia, Rep. of	25	▼
Israel	23	▼
Romania	22	▼
Morocco	22	▼
Jordan	20	▼
Malaysia	18	▼
Chile	16	▼
Philippines	16	▼
Turkey	15	▼
Thailand	13	▼
Tunisia	11	▼
Indonesia	10	▼
Iran, Islamic Rep.	9	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Scientific Inquiry and the Nature of Science	Investigating the Natural World

Evaporation of vinegar and oil

Two open bottles, one filled with vinegar and the other with olive oil, were left on a window sill in the Sun. Several days later it was observed that the bottles were no longer full. What can be concluded from this observation?

A. Vinegar evaporates faster than olive oil.

B. Olive oil evaporates faster than vinegar.

C. Both vinegar and olive oil evaporate.

D. Only liquids containing water evaporate.

E. Direct sunlight is needed for evaporation.

Item Number: N04

Overall Percent Correct

England	78	▲
Singapore	78	▲
Netherlands	76	▲
United States	76	▲
Australia	70	▲
Israel	67	▲
New Zealand	67	▲
Hungary	64	▲
Canada	64	▲
Korea, Rep. of	59	▲
Japan	50	O
Italy	49	O
Jordan	49	O
Belgium (Flemish)	49	O
Hong Kong, SAR	49	O
Czech Republic	49	O
International Average	**48**	
Malaysia	46	O
Bulgaria	45	O
Finland	45	O
Macedonia, Rep. of	44	O
Chinese Taipei	44	O
Indonesia	42	O
Iran, Islamic Rep.	42	O
Turkey	41	▼
Latvia (LSS)	41	O
Slovak Republic	40	O
Lithuania	39	O
Slovenia	39	▼
Morocco	38	▼
Philippines	38	▼
Chile	38	▼
Cyprus	36	▼
Romania	30	▼
South Africa	29	▼
Russian Federation	29	▼
Thailand	28	▼
Tunisia	27	▼
Moldova	19	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Correct Response:	C

Content Domain	Cognitive Domain
Scientific Inquiry and the Nature of Science	Understanding Simple Information

Replication of measurements

The primary reason scientists repeat the measurements they take during experiments is so that they can

A. check that the equipment is working

B. list all the results in a table

C. estimate experimental error

D. change the experimental conditions

Item Number: P07

Correct Response:	C

Overall Percent Correct

Korea, Rep. of	87	▲
Chinese Taipei	73	▲
Japan	61	▲
Thailand	60	▲
Israel	57	▲
Hong Kong, SAR	56	▲
Lithuania	52	▲
Turkey	51	▲
Slovak Republic	50	▲
Latvia (LSS)	46	O
Singapore	46	O
Czech Republic	46	O
Finland	45	O
Romania	44	O
Bulgaria	43	O
Slovenia	43	O
Russian Federation	41	O
International Average	**40**	
United States	39	O
Moldova	39	O
Tunisia	35	O
England	35	O
Jordan	34	O
Canada	34	O
Chile	33	▼
Australia	33	▼
Macedonia, Rep. of	32	▼
Hungary	31	▼
Belgium (Flemish)	31	▼
Netherlands	30	▼
New Zealand	29	▼
Indonesia	29	▼
Philippines	29	▼
Iran, Islamic Rep.	29	▼
Cyprus	28	▼
Malaysia	26	▼
Italy	24	▼
South Africa	20	▼
Morocco	11	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Scientific Inquiry and the Nature of Science	Investigating the Natural World

Bacteria/mold experiment

Alexander Fleming noticed that bacteria growing on a plate of agar did not grow next to a mold that was growing on the same plate. He wrote in his laboratory report: "The mold may be producing a substance that kills bacteria." This statement is best described as

A. an observation

B. a hypothesis

C. a generalization

D. a conclusion

Item Number: R01

Correct Response:	B

Overall Percent Correct

Chinese Taipei	80	▲
Japan	70	▲
Italy	67	▲
Israel	63	▲
Bulgaria	58	▲
Thailand	55	▲
Canada	52	▲
United States	47	▲
Hungary	42	O
Chile	42	▲
Netherlands	42	O
Morocco	41	O
Lithuania	41	O
Australia	39	O
Belgium (Flemish)	36	O
Tunisia	36	O
Cyprus	36	O
International Average	**35**	
New Zealand	32	O
Slovenia	32	O
Hong Kong, SAR	32	O
Slovak Republic	30	O
South Africa	29	▼
Singapore	28	O
Korea, Rep. of	25	▼
Iran, Islamic Rep.	25	▼
Jordan	22	▼
Macedonia, Rep. of	22	▼
England	19	▼
Malaysia	18	▼
Philippines	18	▼
Latvia (LSS)	16	▼
Romania	14	▼
Indonesia	11	▼
Finland	11	▼
Russian Federation	10	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Cognitive Domain
Scientific Inquiry and the Nature of Science	Investigating the Natural World

Heart rate experiment design

Suppose you want to investigate how long it takes for the heart rate to return to normal after exercising. What materials would you use and what procedures would you follow?

Item Number: X03

SCORING

Note: A fully correct procedure may or may not include a separate materials list in order to receive full credit. If a materials list is not included, then time measurements must be explicitly referenced within the procedure (e.g. 'time how long it takes'). Partial credit is given for responses where one of the criteria for a correct response is not completely satisfied.

Correct Response

- Describes a procedure in which: i) Somebody (or self) measures "normal" pulse or heart rate at rest (using a timer or watch). ii) Subject does an exercise (physical activity). iii) The time interval is measured from completion of exercise until pulse rate returns to "normal".
- Other fully correct.

Partial Response

- As in correct response, but no mention of beginning ('normal') pulse measurement.
- As in correct response, but no mention of measuring the time interval after exercise until pulse returns to normal.
- Other partially correct with one criterion not completely satisfied.

Incorrect Response

- No procedure given; only mentions materials.
- Describes a minimal procedure not satisfying two or more of the criteria stated in correct response.
- Refers only to how to measure the heart (pulse) rate.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	32	▲
England	31	▲
Australia	30	▲
Korea, Rep. of	30	▲
New Zealand	28	▲
Canada	26	▲
Chinese Taipei	24	▲
Belgium (Flemish)	23	▲
United States	21	▲
Hong Kong, SAR	20	▲
Netherlands	20	O
Japan	19	▲
Czech Republic	19	▲
Finland	17	▲
International Average	**12**	
Hungary	11	O
Israel	9	▼
Slovak Republic	8	▼
Slovenia	8	▼
Macedonia, Rep. of	7	▼
Latvia (LSS)	7	▼
Italy	6	▼
Cyprus	6	▼
Lithuania	6	▼
Russian Federation	6	▼
Jordan	5	▼
Indonesia	5	▼
Turkey	4	▼
Thailand	4	▼
Moldova	4	▼
Romania	3	▼
Bulgaria	3	▼
Chile	2	▼
Malaysia	2	▼
Morocco	2	▼
Tunisia	2	▼
Philippines	2	▼
Iran, Islamic Rep.	2	▼
South Africa	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Acids and Bases	Conceptual Understanding

Litmus test

A solution of hydrochloric acid (HCl) in water will turn blue litmus paper red. A solution of the base sodium hydroxide (NaOH) in water will turn red litmus paper blue. If the acid and base solutions above are mixed in the right proportion, the resulting solution will cause neither red nor blue litmus paper to change color.

Explain why the litmus paper does not change color in the mixed solution.

Item Number: S032057

SCORING

Note: To receive credit, responses must refer to neutralization or a chemical reaction that results in products that do not react with litmus paper.

Correct Response

- Explanation refers explicitly to the formation of **water** (and salt) from the neutralization reaction.
  Examples: *Hydrochloric acid and sodium hydroxide will mix together to form water and salt, which is neutral.*
  The hydrogen ions combine with the hydroxide ions to form water, so the litmus paper does not change color.
- Explanation refers explicitly to **neutralization** (or equivalent), but the specific reaction is not mentioned.
  Examples: *When you mix acid and alkali, the mixture becomes neutral and has a pH of 7.*
  The HCl neutralizes the NaOH, and the NaOH neutralizes the HCl.
  The mixed solution is neutral, so litmus paper does not react.
  Acid + base = neutral solution
  There is a neutralization reaction.
- Explanation refers to a chemical reaction taking place (implicitly or explicitly) to form products that do not react with litmus paper (or similar). [Neutralization is not explicitly mentioned.]
  Examples: *The acid and base react, and the new chemicals do not react with litmus paper.*
  The chemicals that change the litmus paper must have a chemical reaction to each other.
  Therefore they will not change the color of the paper anymore.
  They form a new solution that has different properties and doesn't react with litmus.
- Other correct.

Incorrect Response

- Mentions **only** that acid and base are "balanced", "opposites", "cancel each other", or similar.
  Examples: *The acid and base are opposites and counteract so they cancel each other out.*
  The acid tries to turn it red and the base just turns it blue again at the same time.
  Because they're balanced out and equal.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	73	▲
Hong Kong, SAR	66	▲
Japan	64	▲
Singapore	56	▲
Malaysia	50	▲
Hungary	46	▲
England	39	▲
Korea, Republic of	39	▲
Sweden	34	▲
Egypt	31	▲
Scotland	25	O
Estonia	25	O
Norway	25	O
Russian Federation	23	O
Slovak Republic	22	O
Bulgaria	21	O
International average	**21**	
Moldova, Rep. of	21	O
Jordan	20	O
Armenia	20	O
Palestinian Nat'l Auth.	20	O
Romania	18	O
United States	17	▼
Israel	16	▼
Lithuania	15	▼
Cyprus	15	▼
Macedonia, Republic of	14	▼
Slovenia	14	▼
New Zealand	13	▼
Bahrain	13	▼
Latvia	13	▼
Australia	13	▼
Italy	12	▼
Iran, Islamic Republic of	12	▼
Serbia and Montenegro	12	▼
Lebanon	9	▼
Chile	7	▼
Netherlands	7	▼
Belgium (Flemish)	5	▼
Ghana	4	▼
Morocco	4	▼
Philippines	3	▼
South Africa	3	▼
Indonesia	3	▼
Saudi Arabia	2	▼
Tunisia	2	▼
Botswana	2	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Litmus test (continued)

Item Number: S032057

Student Responses

Correct Response:

A solution of hydrochloric acid (HCl) in water will turn blue litmus paper red. A solution of the base sodium hydroxide (NaOH) in water will turn red litmus paper blue. If the acid and base solutions above are mixed in the right proportion, the resulting solution will cause neither red nor blue litmus paper to change color.

Explain why the litmus paper does not change color in the mixed solution.

The chemicals have combined a new solution

Incorrect Response:

A solution of hydrochloric acid (HCl) in water will turn blue litmus paper red. A solution of the base sodium hydroxide (NaOH) in water will turn red litmus paper blue. If the acid and base solutions above are mixed in the right proportion, the resulting solution will cause neither red nor blue litmus paper to change color.

Explain why the litmus paper does not change color in the mixed solution.

Because both acids are formed as one mean that no color will show up

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Fanning a wood fire

Fanning can make a wood fire burn hotter because the fanning

Ⓐ makes the wood hot enough to burn

Ⓑ adds more oxygen needed for burning

Ⓒ increases the amount of wood there is to burn

Ⓓ provides the energy needed to keep the fire going

Item Number: S012003

Correct Response: B

Overall Percent Correct

Japan	94	▲
Sweden	93	▲
Hungary	91	▲
Hong Kong, SAR	90	▲
Chinese Taipei	88	▲
Netherlands	87	▲
Estonia	86	▲
Norway	85	▲
New Zealand	84	▲
Australia	84	▲
England	83	▲
Italy	83	▲
Scotland	82	▲
Russian Federation	82	▲
Belgium (Flemish)	82	▲
Singapore	81	▲
United States	80	▲
Bulgaria	80	▲
Latvia	79	▲
Malaysia	78	▲
Slovak Republic	78	▲
Korea, Republic of	76	▲
Israel	76	▲
Slovenia	76	▲
Romania	73	O
Lithuania	72	O
International average	**70**	
Moldova, Rep. of	67	O
Iran, Islamic Republic of	66	O
Serbia and Montenegro	64	▼
Jordan	64	▼
Cyprus	62	▼
Macedonia, Republic of	61	▼
Chile	60	▼
Armenia	58	▼
Indonesia	57	▼
Bahrain	56	▼
Palestinian Nat'l Auth.	55	▼
Egypt	53	▼
Morocco	50	▼
Tunisia	49	▼
Lebanon	46	▼
Saudi Arabia	43	▼
Ghana	38	▼
Philippines	35	▼
Botswana	34	▼
South Africa	33	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Reactions releasing energy

Some chemical reactions absorb energy, while others release energy. Of the chemical reactions in burning coal and exploding fireworks, which will release energy?

Ⓐ Burning coal only

Ⓑ Exploding fireworks only

Ⓒ Both burning coal and exploding fireworks

Ⓓ Neither burning coal nor exploding fireworks

Item Number: S022188

Correct Response: C

Overall Percent Correct

Chinese Taipei	77	▲
Hong Kong, SAR	74	▲
Singapore	68	▲
Scotland	65	▲
United States	65	▲
Estonia	64	▲
England	62	▲
Tunisia	61	▲
Palestinian Nat'l Auth.	59	▲
Israel	59	▲
Iran, Islamic Republic of	59	▲
Malaysia	58	▲
Slovak Republic	58	▲
Australia	57	▲
Cyprus	57	▲
New Zealand	56	O
Chile	56	▲
Philippines	55	▲
Jordan	54	O
Hungary	53	O
Latvia	53	O
Russian Federation	52	O
International average	**52**	
Sweden	51	O
Slovenia	50	O
Egypt	50	O
Norway	49	O
Lithuania	49	O
Romania	47	▼
Ghana	47	▼
Belgium (Flemish)	47	▼
Lebanon	47	O
Italy	47	▼
Macedonia, Republic of	46	▼
Armenia	46	▼
Saudi Arabia	45	▼
Bahrain	44	▼
Moldova, Rep. of	44	▼
Netherlands	42	▼
Botswana	42	▼
Japan	41	▼
Indonesia	40	▼
Serbia and Montenegro	39	▼
Korea, Republic of	38	▼
South Africa	36	▼
Bulgaria	36	▼
Morocco	35	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Chemical change involving elements

Which is a chemical change?

Ⓐ Element 1 is polished to form a smooth surface.

Ⓑ Element 2 is heated and evaporates.

Ⓒ Element 3 develops a white, powdery surface after standing in air.

Ⓓ Element 4 is separated from a mixture by filtration.

Item Number: S022198

Correct Response: C

Overall Percent Correct

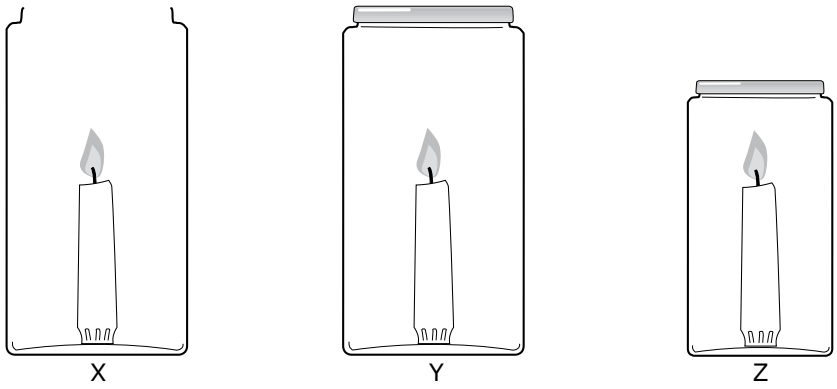
Chinese Taipei	73	▲
Singapore	60	▲
Hong Kong, SAR	52	▲
Malaysia	51	▲
Hungary	48	▲
Jordan	47	▲
Iran, Islamic Republic of	47	▲
England	46	▲
Japan	45	▲
Korea, Republic of	44	▲
Netherlands	43	▲
Palestinian Nat'l Auth.	41	▲
Armenia	40	▲
Russian Federation	39	▲
Bulgaria	39	O
Australia	39	▲
Belgium (Flemish)	38	O
Slovenia	36	O
New Zealand	34	O
Italy	34	O
International average	**34**	
Scotland	33	O
United States	33	O
Moldova, Rep. of	33	O
Estonia	32	O
Cyprus	32	O
Israel	30	▼
Tunisia	30	▼
Lebanon	30	▼
Serbia and Montenegro	30	▼
Macedonia, Republic of	30	▼
Norway	29	▼
South Africa	28	▼
Philippines	28	▼
Egypt	28	▼
Botswana	27	▼
Latvia	27	▼
Bahrain	25	▼
Romania	24	▼
Indonesia	24	▼
Saudi Arabia	22	▼
Sweden	22	▼
Slovak Republic	21	▼
Ghana	19	▼
Lithuania	19	▼
Morocco	15	▼
Chile	15	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Reasoning and Analysis

Candles burning in 3 jars



Three identical candles are placed in the three jars shown above and lit at the same time. Jars Y and Z are then sealed with lids, and Jar X is left open.

Which candle flame will go out first (X, Y, or Z)? _____

Explain your answer.

Item Number: S022191

SCORING

Note: For full credit, responses must identify **Z** and include an explanation that explicitly mentions the need for **oxygen** (for combustion or burning). Responses may also mention that the supply runs out faster in the smaller sealed jar, but it is not required for full credit. Responses referring to the need for air (explicitly or using non-scientific language) are given partial credit. Responses mentioning **only** smoke (fumes, carbon dioxide, etc.) build-up or **heat** should be scored as incorrect.

Correct Response

- Z. Explanation refers to the need for oxygen (for burning).
  Examples: Z. The flame in the smaller jar will go out first since it has the least oxygen in it.
  Z. Oxygen is needed for the candle to burn.
  Z. It has less oxygen.
- Other fully correct.

Overall Percent Correct

Netherlands	82	▲
Estonia	79	▲
Sweden	78	▲
Singapore	78	▲
Lithuania	75	▲
Hungary	72	▲
Norway	72	▲
Belgium (Flemish)	71	▲
Russian Federation	69	▲
Japan	69	▲
England	66	▲
Italy	64	▲
Hong Kong, SAR	62	▲
Slovenia	62	▲
Chinese Taipei	60	▲
Israel	58	▲
Latvia	57	▲
Australia	57	▲
Slovak Republic	55	▲
Scotland	54	▲
New Zealand	53	▲
Korea, Republic of	52	▲
United States	48	O
Serbia and Montenegro	48	O
International average	**47**	
Malaysia	45	O
Macedonia, Republic of	44	O
Lebanon	44	O
Bulgaria	43	O
Cyprus	43	▼
Romania	42	▼
Tunisia	41	▼
Jordan	38	▼
Egypt	34	▼
Chile	32	▼
Bahrain	31	▼
Armenia	30	▼
Moldova, Rep. of	29	▼
Morocco	28	▼
Palestinian Nat'l Auth.	27	▼
Saudi Arabia	23	▼
Iran, Islamic Republic of	20	▼
Indonesia	12	▼
South Africa	9	▼
Philippines	5	▼
Botswana	3	▼
Ghana	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Candles burning in 3 jars (continued)

Item Number: S022191

SCORING (continued)

Partially Correct Response

- Z. Explanation refers to lack of air (gas) explicitly or using non-scientific language (e.g. suffocation, smothering, choking, etc.). (No explicit mention of oxygen.)
  Examples: Z. The flame in the smallest jar will be suffocated first.
  Z. It does not have enough air to breath.
  Since Z is the smallest jar, it will have less air in order to burn.
  Z. It gets smothered as the carbon dioxide increases.
- Indicates both Y AND Z (Y, Z; Y or Z; Y/Z etc.). Explanation based on the need for oxygen or air.
  Examples: Y and Z. The flame needs oxygen for it to burn, and both of these jars will run out of it.
  Y, Z. The closed jars do not get any air.
  Y or Z. They do not get any oxygen.
- Other partially correct.

Incorrect Response

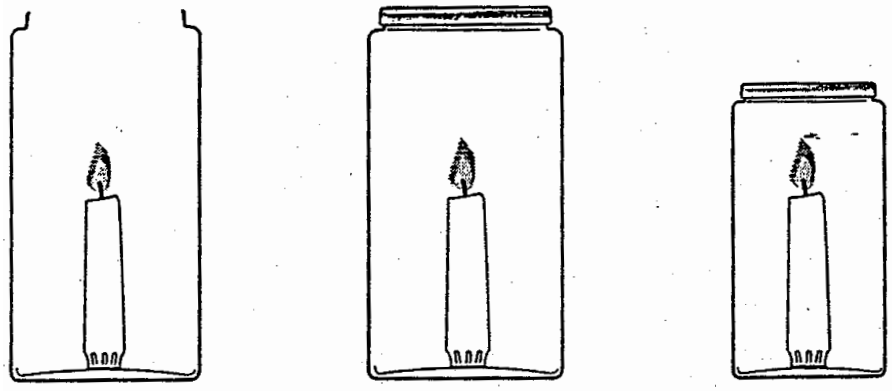
- Z with no explanation or an incorrect explanation.
  Examples: Z. This jar will have the smallest flame since it is in the smallest jar.
  Z. The smoke cannot escape, so the flame dies.
  Z. The carbon dioxide level builds up too much.
  Z. The candle wants to let off heat, so it bursts.
- X. Explanation based on the candle being blown out (or similar).
  Examples: X. A person walking past the candle might cause it to blow out.
  X. If the jar is not closed, it goes out from the wind.
- X OR Y with no explanation or any other incorrect explanation.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses

Correct Response:



Three identical candles are placed in the three jars shown above and lit at the same time. Jars Y and Z are then sealed with lids, and jar X is left open.

Which candle will go out first (X, Y, or Z)? Z

Explain your answer.

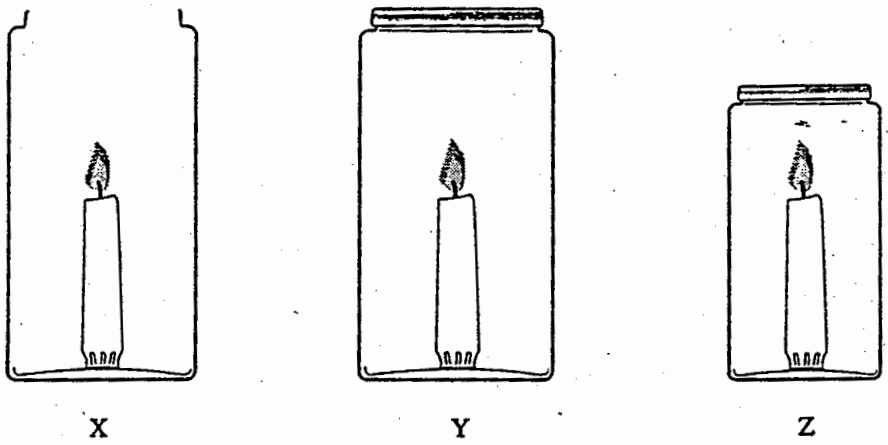
Z because fire needs oxygen to stay lit with the lid being sealed no oxygen can get in. There is a little bit of air in there for it to stay lit. Since Z is the smaller than Y, Z would go out first

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses (continued)

Partial Response:



Three identical candles are placed in the three jars shown above and lit at the same time. Jars Y and Z are then sealed with lids, and jar X is left open.

Which candle will go out first (X, Y, or Z)? Z

Explain your answer.

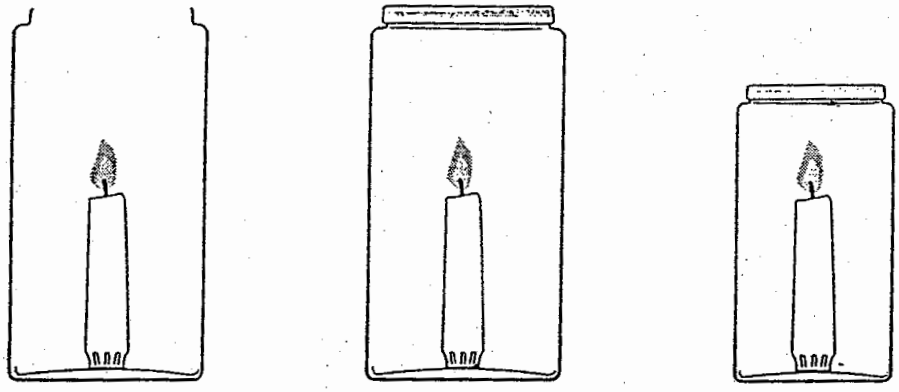
Fire needs Air to burn without it, it will go out. Since it is the smallest jar it has less air. Once the air is burned up the the fire will go out.

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses (continued)

Incorrect Response:



Three identical candles are placed in the three jars shown above and lit at the same time. Jars Y and Z are then sealed with lids, and jar X is left open.

Which candle will go out first (X, Y. or Z)? Y, Z

Explain your answer.

because they are both closed and the oxygen is trapped so then they will both go out.

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Conceptual Understanding

NOT a mixture

Which of the following is NOT a mixture?

Ⓐ Smoke

Ⓑ Sugar

Ⓒ Milk

Ⓓ Paint

Item Number: S022187

Correct Response: B

Overall Percent Correct

Chinese Taipei	64	▲
Sweden	58	▲
Estonia	57	▲
Jordan	56	▲
Netherlands	56	▲
Korea, Republic of	56	▲
Singapore	55	▲
Slovak Republic	53	▲
Hungary	51	▲
Slovenia	51	▲
Australia	50	▲
Palestinian Nat'l Auth.	50	▲
New Zealand	49	▲
Norway	49	▲
Russian Federation	48	▲
Belgium (Flemish)	48	▲
Japan	48	▲
Israel	47	▲
United States	46	▲
Lithuania	45	▲
England	45	▲
Italy	43	O
Scotland	40	O
International average	**40**	
Serbia and Montenegro	40	O
Moldova, Rep. of	40	O
Bahrain	39	O
Bulgaria	37	O
Saudi Arabia	36	▼
Latvia	35	▼
Lebanon	35	▼
Hong Kong, SAR	34	▼
Malaysia	34	▼
Armenia	33	▼
Romania	33	▼
Indonesia	30	▼
Iran, Islamic Republic of	30	▼
Macedonia, Republic of	30	▼
Tunisia	29	▼
Cyprus	28	▼
Morocco	27	▼
Chile	26	▼
Egypt	25	▼
Philippines	18	▼
Ghana	16	▼
Botswana	16	▼
South Africa	15	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Conceptual Understanding

Solution half as concentrated

David makes a solution by dissolving 10 grams of salt in 100 ml of water. He wants a solution that is half as concentrated. What should he add to the original solution to obtain a solution that is about half as concentrated?

Ⓐ 50 ml of water

Ⓑ 100 ml of water

Ⓒ 5 grams of salt

Ⓓ 10 grams of salt

Item Number: S032564

Correct Response: B

Overall Percent Correct

Latvia	55	▲
Hungary	50	▲
Estonia	50	▲
Lithuania	46	▲
Chinese Taipei	46	▲
Japan	46	▲
Hong Kong, SAR	46	▲
Russian Federation	43	▲
Sweden	42	▲
Korea, Republic of	40	▲
Belgium (Flemish)	40	▲
Moldova, Rep. of	40	▲
Singapore	40	▲
Bulgaria	38	▲
Netherlands	38	▲
Slovenia	35	▲
Australia	33	O
England	32	O
New Zealand	32	O
Serbia and Montenegro	31	O
Romania	31	O
International average	**30**	
Norway	30	O
Italy	29	O
Slovak Republic	27	O
Scotland	27	O
United States	26	▼
South Africa	25	▼
Israel	24	▼
Egypt	23	▼
Cyprus	22	▼
Bahrain	21	▼
Lebanon	21	▼
Iran, Islamic Republic of	20	▼
Macedonia, Republic of	18	▼
Malaysia	18	▼
Ghana	18	▼
Philippines	18	▼
Saudi Arabia	17	▼
Morocco	16	▼
Botswana	15	▼
Indonesia	14	▼
Chile	13	▼
Tunisia	13	▼
Armenia	12	▼
Palestinian Nat'l Auth.	0	▼
Jordan	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Conceptual Understanding

Which substances are elements

Oxygen, hydrogen, and water are substances.
Which of these substances are elements?

Ⓐ oxygen, hydrogen and water

Ⓑ oxygen and hydrogen only

Ⓒ oxygen only

Ⓓ water only

Item Number: S032574

Correct Response: B

Overall Percent Correct

Slovak Republic	76	▲
Chinese Taipei	75	▲
Estonia	73	▲
Hungary	71	▲
Singapore	67	▲
Korea, Republic of	66	▲
Serbia and Montenegro	66	▲
Slovenia	66	▲
Israel	64	▲
Japan	64	▲
Lithuania	64	▲
Latvia	64	▲
Russian Federation	62	▲
Macedonia, Republic of	60	▲
Armenia	58	▲
Sweden	57	▲
Moldova, Rep. of	55	O
New Zealand	54	O
United States	54	▲
Romania	53	O
Morocco	50	O
International average	**49**	
Bulgaria	48	O
Jordan	48	O
England	45	O
Ghana	45	O
Cyprus	45	O
Malaysia	43	▼
Australia	42	▼
Palestinian Nat'l Auth.	41	▼
Scotland	40	▼
Hong Kong, SAR	38	▼
Italy	38	▼
Egypt	37	▼
Philippines	37	▼
Botswana	37	▼
Bahrain	36	▼
Netherlands	35	▼
Iran, Islamic Republic of	33	▼
Chile	32	▼
Indonesia	32	▼
South Africa	31	▼
Norway	31	▼
Lebanon	29	▼
Saudi Arabia	28	▼
Belgium (Flemish)	27	▼
Tunisia	0	▼

Country average vs. International average:

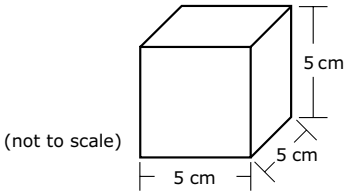
Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Conceptual Understanding

Metal crown: density of metal block

The scientists decided to compare the densities of the crown and a block of metal just like the original block. The density of a substance is the mass of a sample of the substance divided by its volume (density = mass/volume).

The scientists found the volume of the block and computed its density based on its known mass (2,400 g). The diagram below shows the dimensions of the block of metal that the scientists measured.



What is the density of the block of metal?

Answer: _____ g/cm^3

Item Number: S032709

SCORING

Correct Response

- 19.2 g/cm^3
- 19 g/cm^3 [Rounds to nearest whole unit.]

Incorrect Response

- Shows the set-up for density (mass/volume) but does not compute density or makes a computational error.
- 125 [Computes volume but not density.]
- 19.3 [No work shown ; indicates density copied from table.]
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Singapore	64	▲
Hong Kong, SAR	53	▲
Japan	47	▲
Chinese Taipei	43	▲
Hungary	40	▲
Armenia	40	▲
Lithuania	39	▲
Estonia	38	▲
Korea, Republic of	33	▲
Russian Federation	33	▲
Belgium (Flemish)	31	▲
Italy	30	▲
Slovak Republic	29	▲
Latvia	28	▲
Netherlands	28	▲
England	26	O
Sweden	26	▲
United States	25	▲
Slovenia	23	O
Moldova, Rep. of	23	O
Romania	22	O
International average	**21**	
Australia	20	O
Scotland	20	O
Serbia and Montenegro	20	O
Malaysia	18	▼
Palestinian Nat'l Auth.	17	▼
New Zealand	17	O
Jordan	17	▼
Macedonia, Republic of	16	▼
Israel	16	▼
Bulgaria	11	▼
Cyprus	10	▼
Bahrain	10	▼
Norway	10	▼
Egypt	9	▼
Lebanon	9	▼
Chile	6	▼
Botswana	6	▼
Indonesia	6	▼
Philippines	5	▼
Tunisia	5	▼
Morocco	4	▼
Iran, Islamic Republic of	2	▼
South Africa	2	▼
Saudi Arabia	1	▼
Ghana	1	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: density of metal block (continued)

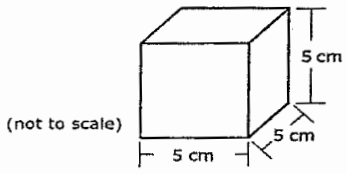
Item Number: S032709

Student Responses

Correct Response:

The scientists decided to compare the densities of the crown and a block of metal just like the original block. The density of a substance is the mass of a sample of the substance divided by its volume (density = mass/volume).

The scientists found the volume of the block and computed its density based on its known mass (2400g). The diagram below shows the dimensions of the block of metal that the scientists measured.



What is the density of the block of metal?

Answer: _____ g/cm^3

GIVEN:

$M = 2400$

$V = 5 * 5 \times 5$

$= 125\ cm^3$

FORMULA

$$D = \frac{M}{V} = \frac{2400\ g}{125\ cm^3} = 19.2\ g/cm^3$$

Metal crown: density of metal block (continued)

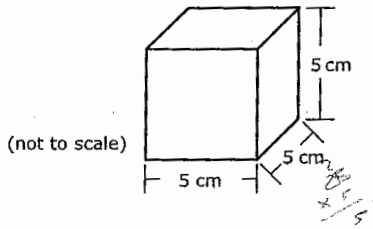
Item Number: S032709

Student Responses (continued)

Incorrect Response:

The scientists decided to compare the densities of the crown and a block of metal just like the original block. The density of a substance is the mass of a sample of the substance divided by its volume (density = mass/volume).

The scientists found the volume of the block and computed its density based on its known mass (2,400 g). The diagram below shows the dimensions of the block of metal that the scientists measured.



What is the density of the block of metal?

Answer: 160 g/cm^3

$D = \frac{m}{V} = \frac{2400\text{g}}{15}$

160
15|2400
-2 400
0

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Factual Knowledge

Substance type of black/white powder

A powder made up of both white specks and black specks is likely to be

Ⓐ a solution

Ⓑ a pure compound

Ⓒ a mixture

Ⓓ an element

Item Number: S012016

Correct Response: C

Overall Percent Correct

Lithuania	92	▲
Hungary	90	▲
Estonia	90	▲
Slovenia	88	▲
Slovak Republic	88	▲
Latvia	84	▲
Netherlands	84	▲
Sweden	84	▲
Japan	83	▲
Bulgaria	82	▲
United States	82	▲
Romania	81	▲
Singapore	80	▲
Israel	79	▲
Moldova, Rep. of	79	▲
Chinese Taipei	79	▲
Belgium (Flemish)	78	▲
England	77	▲
Australia	77	▲
Korea, Republic of	77	▲
Russian Federation	77	▲
Hong Kong, SAR	75	▲
Macedonia, Republic of	74	O
Serbia and Montenegro	74	O
Armenia	74	O
International average	**72**	
Italy	70	O
New Zealand	70	O
Malaysia	69	O
Scotland	68	O
Tunisia	67	▼
Jordan	67	▼
Palestinian Nat'l Auth.	66	▼
Norway	65	▼
Chile	65	▼
Botswana	64	▼
Egypt	63	▼
Lebanon	63	▼
Bahrain	63	▼
Morocco	60	▼
Iran, Islamic Republic of	60	▼
Saudi Arabia	59	▼
Philippines	58	▼
Cyprus	57	▼
Ghana	52	▼
Indonesia	50	▼
South Africa	48	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Classification and Composition of Matter	Factual Knowledge

Reaction of chlorine and sodium

When chlorine gas reacts with sodium metal, what type of substance is formed?

Ⓐ A mixture
Ⓑ A compound
Ⓒ An element
Ⓓ An alloy
Ⓔ A solution

Item Number: S022206

Correct Response: B

Overall Percent Correct

Bulgaria	68	▲
Cyprus	63	▲
Bahrain	60	▲
Lithuania	59	▲
Chinese Taipei	59	▲
Slovenia	59	▲
Singapore	58	▲
Japan	56	▲
Hungary	56	▲
Estonia	55	▲
Sweden	55	▲
Armenia	55	▲
Egypt	53	▲
Russian Federation	53	▲
Latvia	51	▲
Jordan	50	▲
Lebanon	50	▲
Slovak Republic	50	▲
Serbia and Montenegro	50	▲
Israel	49	▲
Korea, Republic of	49	▲
England	47	▲
Scotland	47	▲
Palestinian Nat'l Auth.	45	▲
Macedonia, Republic of	44	O
United States	42	O
International average	**41**	
Moldova, Rep. of	37	▼
Italy	36	▼
Saudi Arabia	35	▼
New Zealand	34	▼
Romania	33	▼
Chile	33	▼
Hong Kong, SAR	32	▼
Malaysia	32	▼
Australia	32	▼
Indonesia	30	▼
Tunisia	28	▼
Ghana	26	▼
Belgium (Flemish)	24	▼
Iran, Islamic Republic of	23	▼
Philippines	23	▼
South Africa	18	▼
Botswana	13	▼
Morocco	13	▼
Netherlands	13	▼
Norway	11	▼

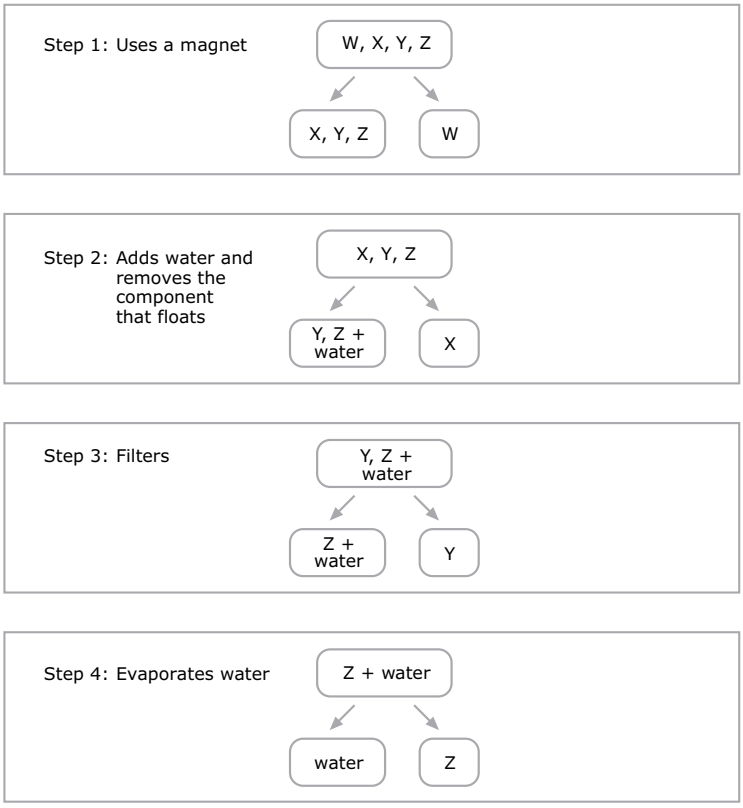
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Separation of salt/sand/iron filings mixture

Teresa is given a mixture of salt, sand, iron filings, and small pieces of cork. She separates the mixture using a 4-step procedure as shown in the diagram. The letters W, X, Y, and Z are used to stand for the four components but do not indicate which letter stands for which component.



Identify what each component is by writing *salt, sand, iron,* or *cork* in the correct spaces below

Component W is: _____

Component X is: _____

Component Y is: _____

Component Z is: _____

Item Number: S032562

Overall Percent Correct

Singapore	68	▲
Chinese Taipei	67	▲
Japan	58	▲
Hong Kong, SAR	58	▲
Estonia	56	▲
Korea, Republic of	54	▲
Hungary	51	▲
Slovak Republic	51	▲
Latvia	49	▲
England	48	▲
Scotland	48	▲
Netherlands	47	▲
Sweden	47	▲
Lithuania	47	▲
New Zealand	46	▲
Malaysia	46	▲
Russian Federation	45	▲
Australia	44	▲
Belgium (Flemish)	44	▲
Armenia	42	▲
Slovenia	41	O
Italy	39	O
United States	35	O
Jordan	35	O
Romania	35	O
International average	**34**	
Moldova, Rep. of	34	O
Israel	33	O
Norway	26	▼
Lebanon	26	▼
Chile	26	▼
Iran, Islamic Republic of	25	▼
Bahrain	23	▼
Egypt	22	▼
Bulgaria	21	▼
Palestinian Nat'l Auth.	20	▼
Serbia and Montenegro	20	▼
Cyprus	19	▼
Tunisia	15	▼
Saudi Arabia	14	▼
Macedonia, Republic of	14	▼
Indonesia	12	▼
Philippines	11	▼
South Africa	8	▼
Botswana	7	▼
Morocco	6	▼
Ghana	6	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

SCORING

Note: To receive full credit, responses must correctly identify all four components. Partial credit is given for responses that list at least two components correctly. If a component is listed more than once, none of the entries for that component will be considered as correct. For example, a response that lists Iron, Salt, Salt, Salt is incorrect.

Correct Response

- Identifies all four components correctly: W = iron; X = cork; Y = sand; Z = salt.

Partially Correct Response

- Identifies iron and cork correctly (W and X); sand and/or salt are missing or incorrect.
  Examples: Iron, Cork, Salt, Sand
  Iron, Cork, Sand, Blank
- Identifies iron and salt correctly (W and Z); cork and/or sand are missing or incorrect.
  Examples: Iron, Sand, Cork, Salt
  Iron, Blank, Blank, Salt
- Identifies sand and salt correctly (Y and Z); iron and/or cork are missing or incorrect.
  Examples: Cork, Iron, Sand, Salt
  Blank, Blank, Sand, Salt
  Water, Cork, Sand, Salt
- Other partially correct (that identifies at least two components correctly).

Incorrect Response

- Identifies only iron correctly (W), all other components are missing or incorrect.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

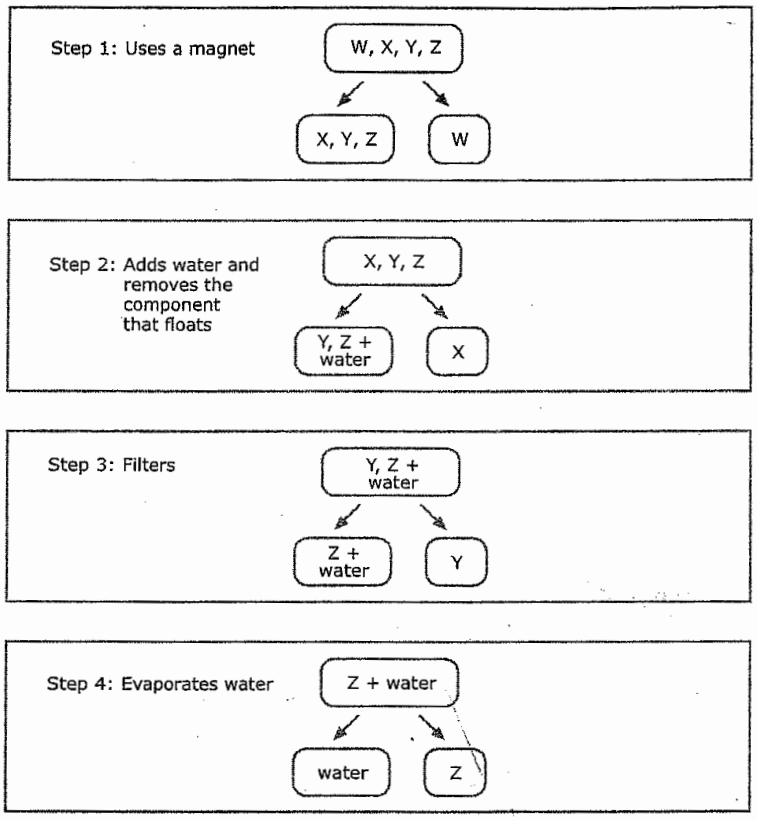
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses

Correct Response:

Teresa is given a mixture of salt, sand, iron filings, and small pieces of cork. She separates the mixture using a 4-step procedure as shown in the diagram. The letters W, X, Y, and Z are used to stand for the four components but do not indicate which letter stands for which component.



Identify what each component is by writing *salt, sand, iron,* or *cork* in the correct spaces below

Component W is: iron

Component X is: sand

Component Y is: Cork

Component Z is: Salt

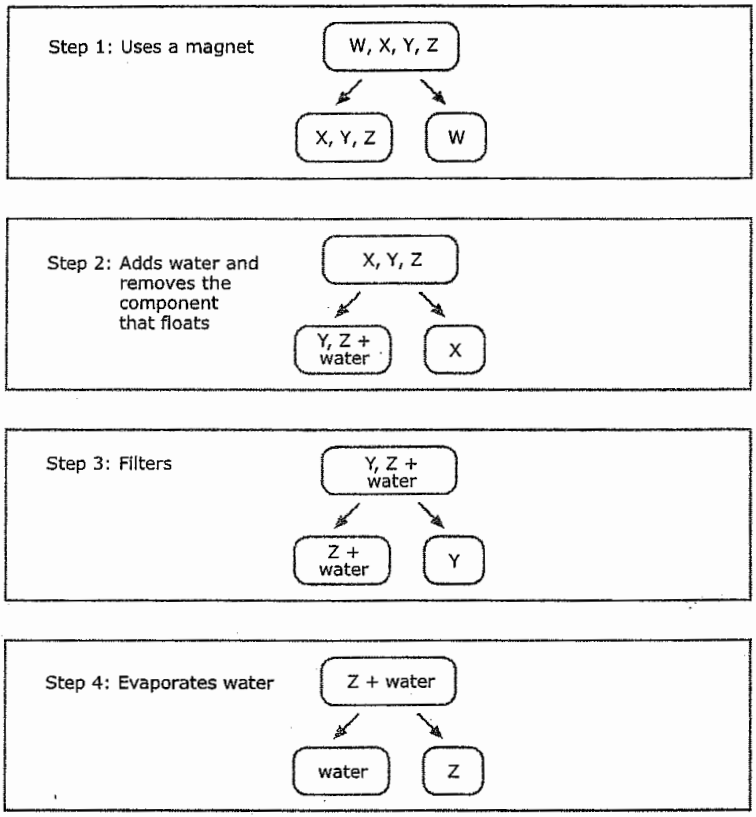
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses (continued)

Partially Correct Response:

Teresa is given a mixture of salt, sand, iron filings, and small pieces of cork. She separates the mixture using a 4-step procedure as shown in the diagram. The letters W, X, Y, and Z are used to stand for the four components but do not indicate which letter stands for which component.



Identify what each component is by writing *salt, sand, iron,* or *cork* in the correct spaces below

Component W is: water

Component X is: cork

Component Y is: sand

Component Z is: salt

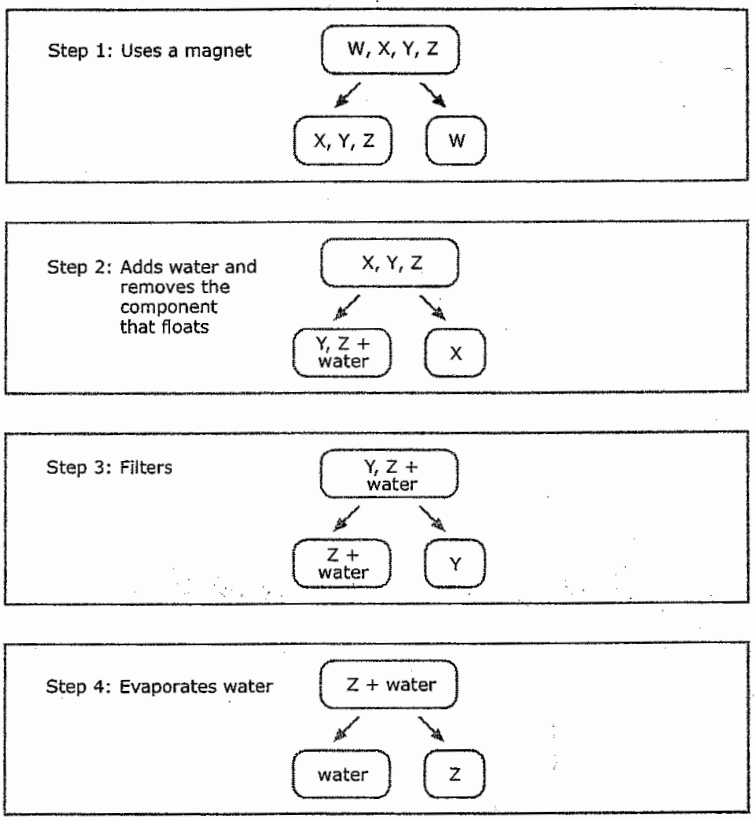
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses (continued)

Incorrect Response:

Teresa is given a mixture of salt, sand, iron filings, and small pieces of cork. She separates the mixture using a 4-step procedure as shown in the diagram. The letters W, X, Y, and Z are used to stand for the four components but do not indicate which letter stands for which component.



Identify what each component is by writing *salt, sand, iron,* or *cork* in the correct spaces below

Component W is: Iron

Component X is: Sand

Component Y is: Salt

Component Z is: Cork

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

Metal crown: what metal block was made of

The table below lists the density for different metals.

Metal	Density (g/cm^3)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

A. Look at the density you computed for the block of metal. What was the block of metal most likely made of?

Answer: _____

Explain your answer.

B. The density of the crown was found to be 12.0 g/cm^3. What would you report to the king about what metal or mixture of metals the jeweler used to make the crown?

Item Number: S032713A

Overall Percent Correct

Hungary	37	▲
Singapore	36	▲
Japan	36	▲
Chinese Taipei	29	▲
United States	28	▲
Russian Federation	27	▲
Estonia	27	▲
Lithuania	26	▲
Belgium (Flemish)	26	▲
Hong Kong, SAR	23	▲
England	23	▲
Australia	22	▲
Latvia	22	▲
Slovak Republic	21	▲
New Zealand	21	▲
Netherlands	20	▲
Sweden	18	O
Slovenia	18	O
Scotland	18	O
Korea, Republic of	18	O
Jordan	16	O
Norway	16	O
International average	**16**	
Romania	14	O
Moldova, Rep. of	13	O
Egypt	13	▼
Serbia and Montenegro	13	▼
Armenia	13	▼
Italy	12	▼
Malaysia	12	▼
Israel	11	▼
Macedonia, Republic of	11	▼
Palestinian Nat'l Auth.	11	▼
Morocco	10	▼
Bahrain	9	▼
Bulgaria	8	▼
Chile	8	▼
Cyprus	6	▼
Lebanon	6	▼
Indonesia	5	▼
Philippines	4	▼
Ghana	3	▼
Botswana	2	▼
South Africa	2	▼
Tunisia	2	▼
Iran, Islamic Republic of	1	▼
Saudi Arabia	1	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: what metal block was made of (continued)

Item Number: S032713A

SCORING

Codes for Identifying Metal in Block

Note: To receive credit, responses must identify gold AND give an explanation based on density. Responses that identify gold with no or incorrect explanation are incorrect. It is possible that a different metal or metal(s) may be identified based on an incorrect density computation in the previous question. These types of responses may scored as correct, provided the explanation is reasonable based on the computed density.

Correct Response

- GOLD with an explanation based on correct density computed in previous question (19.2 g/cm3).
  Examples: Gold. Because it had the closest density.
  Gold. The density is the same.
- Other correct.

Incorrect Response

- GOLD with no explanation or incorrect explanation that is NOT based on density.
  Examples: Gold. Because that is what crowns are always made of.
- SILVER (alone or mixed). [Confuses density of crown with density of the metal block.]
  Examples: It is mostly silver because the density is 12 and that's the closest one.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Metal crown: what metal block was made of (continued)

Item Number: S032713A

Student Responses

Correct Response:

The table below lists the density for different metals.

Metal	Density (g/cm³)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

A. Look at the density you computed for the block of metal. What was the block of metal most likely made of?

Answer: Gold

Explain your answer.

the block of metal was only 0,1 away from 19,3 which was gold so that is the closest thing to it

Incorrect Response:

The table below lists the density for different metals.

Metal	Density (g/cm³)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

A. Look at the density you computed for the block of metal. What was the block of metal most likely made of?

Answer: Clay

Explain your answer.

Because everything listed under metal they are made out Clay.

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

Metal crown: what crown was made of

The table below lists the density for different metals.

Metal	Density (g/cm^3)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

A. Look at the density you computed for the block of metal. What was the block of metal most likely made of?

Answer: _____

Explain your answer.

B. The density of the crown was found to be 12.0 g/cm^3. What would you report to the king about what metal or mixture of metals the jeweler used to make the crown?

Item Number: S032713B

Overall Percent Correct

Chinese Taipei	25	▲
Hong Kong, SAR	20	▲
Singapore	20	▲
Hungary	20	▲
Korea, Republic of	19	▲
Slovenia	18	▲
Estonia	15	▲
Norway	13	▲
Latvia	12	▲
Sweden	12	▲
Slovak Republic	12	▲
Jordan	11	▲
United States	11	▲
Netherlands	10	O
Russian Federation	10	O
Lithuania	10	O
Armenia	10	O
New Zealand	9	O
Scotland	9	O
Australia	9	O
Egypt	8	O
International average	**8**	
Romania	8	O
Malaysia	8	O
Moldova, Rep. of	8	O
Belgium (Flemish)	8	O
Macedonia, Republic of	6	▼
Cyprus	5	▼
England	5	▼
Israel	4	▼
Iran, Islamic Republic of	4	▼
Lebanon	4	▼
Indonesia	4	▼
Morocco	4	▼
Bulgaria	4	▼
Palestinian Nat'l Auth.	4	▼
Chile	3	▼
Bahrain	2	▼
South Africa	2	▼
Philippines	2	▼
Japan	1	▼
Saudi Arabia	1	▼
Tunisia	1	▼
Ghana	1	▼
Botswana	1	▼
Serbia and Montenegro	1	▼
Italy	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Metal crown: what crown was made of (continued)

Item Number: S032713B

SCORING

Codes for Reporting Composition of Crown

Note: To receive credit, responses must indicate that the crown is composed of a mixture of metals (alloy) AND identify the metals that might be included based on the density (crown density between the densities of the pure metals). Responses that indicate that the crown is made of a mixture (alloy) or is not pure gold with no further information about what other metals are included are scored as incorrect. If responses indicate that the crown is made of Palladium (not in the table but with a density of 12 g/cm3), they should be scored as correct.

Correct Response

- Reports that the crown is made of a mixture (alloy) AND names specific metal(s) that might be included (reasonable composition based on density).
  Examples: The jeweler used some silver as well as gold.
  It might have had some copper mixed in because that would lower the density and the cost.
  The jeweler most likely used all silver except for a thin coat of gold to make it look pure gold even though it wasn't.
- Other correct.

Incorrect Response

- Reports only that the crown is made of a mixture or is NOT pure gold (or similar); NO specific metals are named.
  Examples: The jeweler didn't use the block of metal that the king gave him.
  The jeweler used four more metals to make the crown.
- Reports SILVER (density closest to 12 g/cm3).
  Examples: The metal used is silver.
- Reports an incorrect mixture of metals based on additive densities.
  Examples: It's silver and aluminum (10.5 + 2.7)
  Mixture of silver and aluminum as their density adds up to 12.0 approximately.
  Copper and aluminum.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Metal crown: what crown was made of (continued)

Item Number: S032713B

Student Responses

Correct Response:

The table below lists the density for different metals.

Metal	Density (g/cm³)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

B. The density of the crown was found to be 12.0 g/cm³. What would you report to the king about what metal or mixture of metals the jeweler used to make the crown?

he used silver and gold

Incorrect Response:

The table below lists the density for different metals.

Metal	Density (g/cm³)
Platinum	21.4
Gold	19.3
Silver	10.5
Copper	8.9
Zinc	7.1
Aluminum	2.7

B. The density of the crown was found to be 12.0 g/cm³. What would you report to the king about what metal or mixture of metals the jeweler used to make the crown?

I would tell him that the man that used the crown he used Platinum, gold, copper, zinc and Aminium.

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Particulate Structure of Matter	Conceptual Understanding

Atoms removed from chair

If you took all of the atoms out of a chair, what would be left?

Ⓐ The chair would still be there, but it would weigh less.

Ⓑ The chair would be exactly the same as it was before.

Ⓒ There would be nothing left of the chair.

Ⓓ Only a pool of liquid would be left on the floor.

Item Number: S012040

Correct Response: C

Overall Percent Correct

Lithuania	78	▲
Sweden	73	▲
Singapore	69	▲
Estonia	68	▲
United States	68	▲
Hungary	67	▲
Korea, Republic of	66	▲
Japan	65	▲
England	64	▲
Armenia	64	▲
Latvia	62	▲
Slovenia	62	▲
Russian Federation	60	▲
Israel	60	▲
Slovak Republic	59	▲
Australia	59	▲
New Zealand	55	O
Scotland	55	O
Norway	54	O
Italy	53	O
Chinese Taipei	52	O
Bahrain	51	O
International average	**51**	
Romania	51	O
Palestinian Nat'l Auth.	51	O
Netherlands	50	O
Macedonia, Republic of	50	O
Bulgaria	48	O
Jordan	47	O
Hong Kong, SAR	47	O
Moldova, Rep. of	47	O
Egypt	46	▼
Chile	46	▼
Cyprus	45	▼
Serbia and Montenegro	44	▼
Lebanon	44	▼
Belgium (Flemish)	44	▼
Saudi Arabia	43	▼
Botswana	42	▼
Iran, Islamic Republic of	37	▼
South Africa	35	▼
Ghana	33	▼
Tunisia	30	▼
Malaysia	30	▼
Morocco	29	▼
Philippines	24	▼
Indonesia	13	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Particulate Structure of Matter	Factual Knowledge

Particles in nucleus of atom

The nucleus of MOST atoms consists of

Ⓐ neutrons only
Ⓑ protons and neutrons
Ⓒ protons and electrons
Ⓓ neutrons and electrons

Item Number: S012025

Correct Response: B

Overall Percent Correct

Macedonia, Republic of	79	▲
Slovak Republic	71	▲
Estonia	69	▲
Serbia and Montenegro	68	▲
Slovenia	67	▲
Armenia	66	▲
Singapore	65	▲
Chinese Taipei	63	▲
Russian Federation	62	▲
Romania	61	▲
Egypt	57	▲
United States	57	▲
Lithuania	56	▲
Lebanon	55	▲
Moldova, Rep. of	54	▲
Palestinian Nat'l Auth.	52	▲
Bulgaria	51	O
Iran, Islamic Republic of	48	O
New Zealand	48	O
International average	**47**	
Hungary	47	O
Italy	46	O
Jordan	46	O
Israel	45	O
Bahrain	45	O
Indonesia	44	O
England	43	O
Korea, Republic of	43	▼
Philippines	42	▼
Chile	42	▼
Australia	41	▼
Tunisia	40	▼
Ghana	40	▼
Cyprus	39	▼
Japan	37	▼
Latvia	36	▼
Netherlands	35	▼
Saudi Arabia	34	▼
Sweden	32	▼
Norway	32	▼
Scotland	32	▼
Morocco	31	▼
Hong Kong, SAR	31	▼
Botswana	30	▼
Malaysia	28	▼
Belgium (Flemish)	27	▼
South Africa	27	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Particulate Structure of Matter	Factual Knowledge

Neutral atom gains electron

What is formed when a neutral atom gains an electron?

Ⓐ A mixture

Ⓑ An ion

Ⓒ A molecule

Ⓓ A metal

Item Number: S022202

Correct Response: B

Overall Percent Correct

Singapore	79	▲
Bahrain	73	▲
Estonia	72	▲
Slovak Republic	71	▲
Armenia	71	▲
Lithuania	71	▲
Hungary	71	▲
Slovenia	69	▲
Lebanon	69	▲
Russian Federation	69	▲
Israel	64	▲
Serbia and Montenegro	61	▲
Egypt	61	▲
Iran, Islamic Republic of	60	▲
Sweden	60	▲
Romania	60	▲
Palestinian Nat'l Auth.	58	▲
Macedonia, Republic of	58	▲
Chile	58	▲
Jordan	58	▲
Bulgaria	56	▲
Chinese Taipei	54	▲
Hong Kong, SAR	51	O
Ghana	50	O
Latvia	49	O
Italy	49	O
Japan	48	O
International average	**47**	
United States	46	O
Moldova, Rep. of	44	O
Saudi Arabia	40	▼
England	32	▼
Australia	30	▼
Netherlands	29	▼
Philippines	28	▼
Malaysia	27	▼
Scotland	26	▼
New Zealand	24	▼
Morocco	22	▼
Belgium (Flemish)	22	▼
Cyprus	22	▼
Norway	22	▼
Korea, Republic of	21	▼
Botswana	19	▼
Tunisia	19	▼
South Africa	18	▼
Indonesia	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Conceptual Understanding

Appearance of Jupiter and Moon

The planet Jupiter is bigger than Earth's moon but it appears to be smaller when viewed from Earth. Why is this?

Item Number: S022283

SCORING

Note: A correct response is based on the relative distances of Jupiter and the Moon from Earth. An implicit comparison is correct as long as it is clear from the student response that a greater distance from Jupiter is implied. Actual distances may be used to convey the relative difference. The distances do not have to be completely accurate as long as the relative distances are correct. Responses that mention ONLY the great distance of Jupiter OR the close distance of the Moon without comparative language are also scored as correct.

Correct Response

- Refers to the greater distance of Jupiter and/or the shorter distance of the Moon (from Earth), implicitly or explicitly.
  Examples: *Jupiter is farther away from Earth than the Moon.*
  The Moon is much closer than Jupiter.
  Jupiter is farther.
  It (Jupiter) is a long distance from Earth.
  Because Jupiter is so far away.
  The Moon is so close to the Earth that it looks bigger.
- Other correct.

Incorrect Response

- Refers to distance but explanation does not clearly communicate the effect of Jupiter's or the Moon's distance on the appearance of size.
  Examples: *Because of distance.*
  Jupiter's moons are closer.
- Refers to the Moon being further, or Jupiter being closer to Earth.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

England	92	▲
Netherlands	88	▲
Estonia	86	▲
Australia	86	▲
New Zealand	86	▲
United States	85	▲
Russian Federation	84	▲
Korea, Republic of	83	▲
Norway	83	▲
Scotland	83	▲
Belgium (Flemish)	82	▲
Sweden	81	▲
Singapore	81	▲
Hungary	77	▲
Italy	76	▲
Moldova, Rep. of	76	▲
Hong Kong, SAR	76	▲
Japan	75	▲
Latvia	75	▲
Slovenia	74	▲
Armenia	72	▲
Lithuania	72	▲
Malaysia	70	▲
Chinese Taipei	67	O
Slovak Republic	66	O
Jordan	66	O
Indonesia	66	O
Israel	66	O
International average	**65**	
Palestinian Nat'l Auth.	64	O
Bulgaria	64	O
Iran, Islamic Republic of	63	O
Bahrain	62	O
Cyprus	61	O
Serbia and Montenegro	56	▼
Chile	55	▼
Tunisia	52	▼
Macedonia, Republic of	47	▼
Romania	45	▼
Egypt	42	▼
Saudi Arabia	41	▼
Morocco	40	▼
Philippines	39	▼
Lebanon	35	▼
Botswana	18	▼
South Africa	13	▼
Ghana	8	▼

Country average vs. International average:

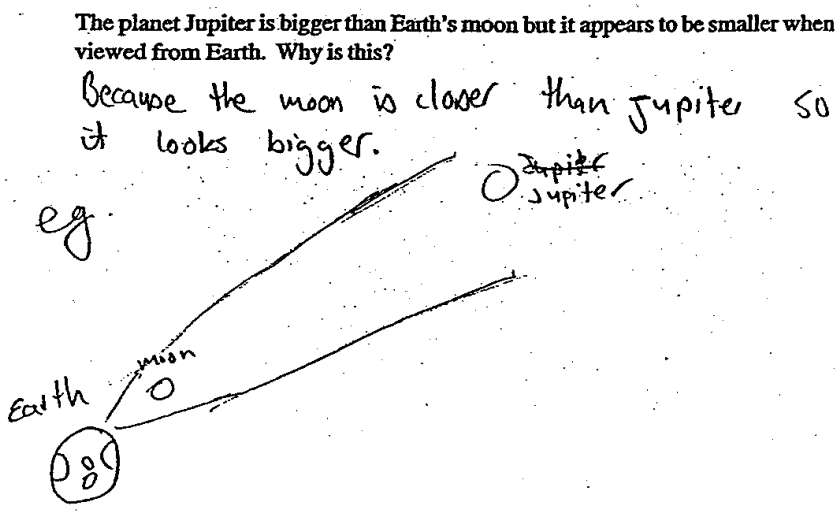
Higher	▲
Not different	O
Lower	▼

Appearance of Jupiter and Moon (continued)

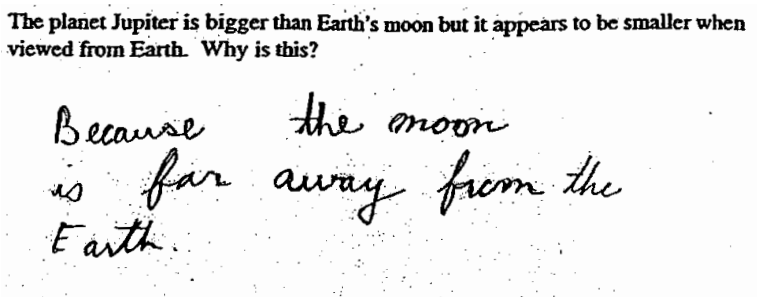
Item Number: S022283

Student Responses

Correct Response:



Incorrect Response:



Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Conceptual Understanding

Why the moon changes shape

The shape of the moon appears to change regularly during each month. Which of the following best explains why the shape of the moon appears to change?

Ⓐ The Earth turns on its axis.

Ⓑ The Moon turns on its axis.

Ⓒ The Moon orbits around the Earth.

Ⓓ Clouds cover the Moon.

Item Number: S032437

Correct Response: C

Overall Percent Correct

Hong Kong, SAR	72	▲
Malaysia	63	▲
Japan	58	▲
Singapore	58	▲
New Zealand	58	▲
Korea, Republic of	58	▲
Chinese Taipei	57	▲
Norway	56	▲
Hungary	55	▲
Estonia	54	▲
Serbia and Montenegro	54	▲
Australia	54	O
Bahrain	53	O
Sweden	53	O
Chile	53	O
Bulgaria	53	O
Scotland	53	O
Philippines	53	O
England	52	O
Egypt	52	O
United States	51	O
Armenia	51	O
Lithuania	51	O
Lebanon	50	O
International average	**50**	
Iran, Islamic Republic of	49	O
Italy	49	O
Jordan	49	O
Netherlands	48	O
Israel	47	O
Slovenia	47	O
Palestinian Nat'l Auth.	47	O
Saudi Arabia	47	O
Belgium (Flemish)	46	▼
Moldova, Rep. of	45	▼
Latvia	45	▼
Slovak Republic	45	▼
Russian Federation	45	▼
Ghana	44	▼
Cyprus	43	▼
Romania	43	▼
Macedonia, Republic of	42	▼
South Africa	41	▼
Morocco	40	▼
Botswana	39	▼
Tunisia	37	▼
Indonesia	31	▼

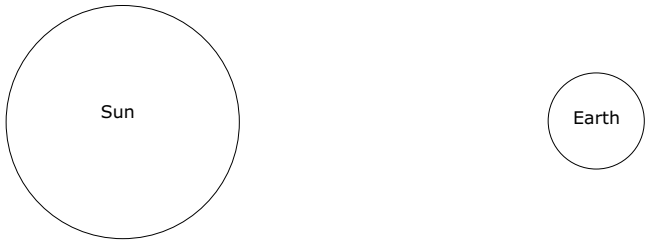
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Conceptual Understanding

Position of the moon during solar eclipse

Draw the position of the Moon on the diagram below to show what is meant by an eclipse of the Sun.



Item Number: S032532

SCORING

Note: To receive credit, the Moon should be located between the Earth and the Sun within the shaded region shown in the diagram below. Responses may also show the shadow cast by the Moon on Earth. Credit should be given for responses based on the correct position of the Moon even if incorrect shadows are shown. Because it is not explicitly required in the item, errors in the relative size or distance of the moon will not be considered.

Correct Response

- Moon is located between the Sun and Earth within the shaded region.

Incorrect Response

- Moon is drawn on the other side of Earth (lunar eclipse).
- Moon is drawn overlapping the Sun (concentric or partially "eclipsed" circles).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Armenia	93	▲
Malaysia	79	▲
Hong Kong, SAR	76	▲
Singapore	70	▲
New Zealand	69	▲
Australia	68	▲
Estonia	66	▲
United States	66	▲
England	64	▲
Netherlands	63	▲
Sweden	63	▲
Chinese Taipei	62	▲
Japan	61	▲
Iran, Islamic Republic of	61	▲
Italy	61	▲
Slovak Republic	60	▲
Latvia	60	▲
Korea, Republic of	59	▲
Hungary	59	O
Russian Federation	59	O
Jordan	58	O
Bulgaria	58	O
Serbia and Montenegro	57	O
Palestinian Nat'l Auth.	57	O
Scotland	56	O
Indonesia	56	O
Israel	55	O
Norway	54	O
International average	**53**	
Slovenia	52	O
Bahrain	52	O
Belgium (Flemish)	52	O
Romania	49	O
Saudi Arabia	46	▼
Philippines	44	▼
Cyprus	43	▼
Egypt	42	▼
Chile	41	▼
Lithuania	40	▼
Moldova, Rep. of	35	▼
Lebanon	33	▼
Macedonia, Republic of	33	▼
Tunisia	32	▼
Morocco	22	▼
Ghana	19	▼
Botswana	17	▼
South Africa	17	▼

Country average vs. International average:

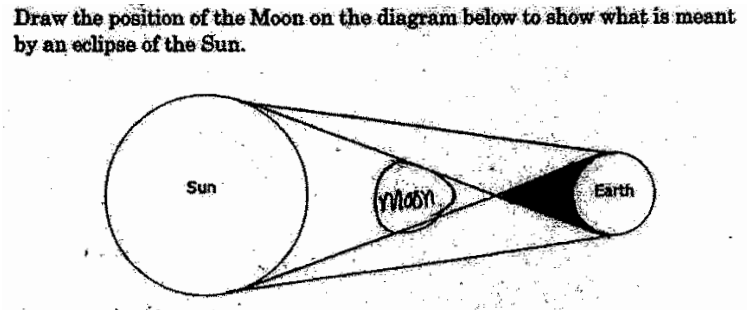
Higher	▲
Not different	O
Lower	▼

Position of the moon during solar eclipse (continued)

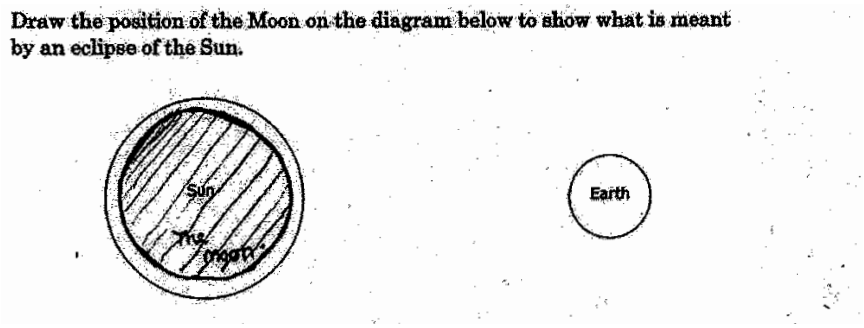
Item Number: S032532

Student Responses

Correct Response:

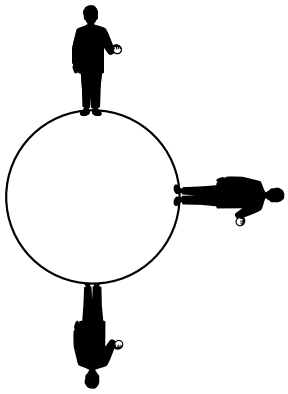


Incorrect Response:



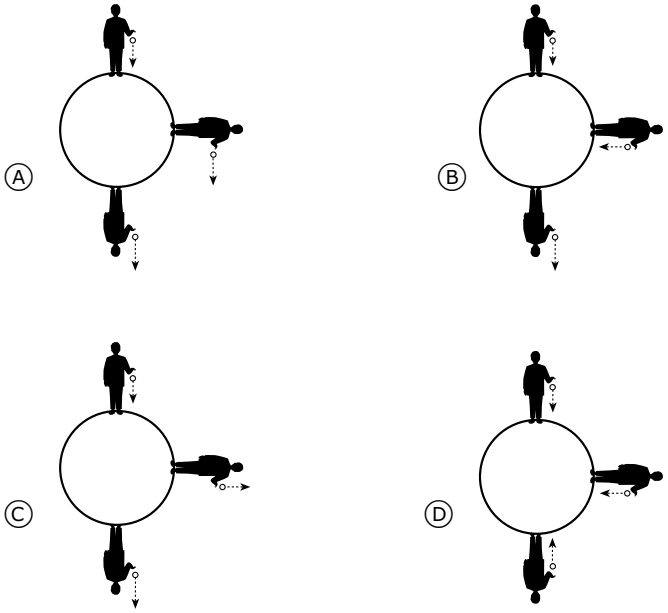
Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Conceptual Understanding

Direction dropped ball will fall



The diagram above shows a person holding a ball standing at three different places on Earth. If the person drops the ball, gravity will make it fall.

Which of the following diagrams best shows the direction the dropped ball will fall at the three different positions?



Item Number: S032714

Correct Response: D

Overall Percent Correct

Japan	92	▲
Estonia	91	▲
Korea, Republic of	90	▲
Hungary	88	▲
Sweden	87	▲
Netherlands	87	▲
Malaysia	86	▲
Chinese Taipei	86	▲
Norway	84	▲
Slovenia	83	▲
Russian Federation	82	▲
Lithuania	81	▲
New Zealand	81	▲
Hong Kong, SAR	81	▲
Latvia	80	▲
Singapore	80	▲
Slovak Republic	80	▲
Australia	79	▲
Serbia and Montenegro	78	▲
England	78	▲
Belgium (Flemish)	77	▲
United States	75	▲
Scotland	73	O
Armenia	72	O
Lebanon	72	O
Italy	71	O
International average	**70**	
Romania	70	O
Iran, Islamic Republic of	67	O
Bahrain	67	O
Jordan	66	O
Moldova, Rep. of	66	O
Israel	65	O
Philippines	65	▼
Indonesia	62	▼
Bulgaria	61	▼
Botswana	61	▼
Saudi Arabia	61	▼
Palestinian Nat'l Auth.	58	▼
Chile	58	▼
Cyprus	58	▼
Macedonia, Republic of	54	▼
Egypt	51	▼
Tunisia	47	▼
Ghana	43	▼
South Africa	40	▼
Morocco	6	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Factual Knowledge

Sun is an example of a star

The Sun is an example of which of the following?

Ⓐ comet
Ⓑ planet
Ⓒ galaxy
Ⓓ star

Item Number: S032150

Correct Response: D

Overall Percent Correct

Italy	90	▲
New Zealand	87	▲
Slovak Republic	86	▲
Sweden	86	▲
United States	84	▲
Australia	83	▲
Chile	83	▲
Bulgaria	83	▲
England	82	▲
Serbia and Montenegro	80	▲
Norway	80	▲
Scotland	79	▲
Lithuania	79	▲
Latvia	78	▲
Russian Federation	77	▲
Estonia	75	▲
Slovenia	74	▲
Belgium (Flemish)	65	▲
Netherlands	65	▲
Hong Kong, SAR	65	▲
Macedonia, Republic of	62	O
Jordan	61	O
Moldova, Rep. of	61	O
Romania	60	O
International average	**60**	
Bahrain	60	O
Philippines	59	O
Hungary	58	O
Singapore	56	▼
Malaysia	54	▼
Chinese Taipei	54	▼
Iran, Islamic Republic of	52	▼
Palestinian Nat'l Auth.	52	▼
Egypt	51	▼
Armenia	48	▼
Lebanon	47	▼
Cyprus	43	▼
Botswana	41	▼
South Africa	41	▼
Indonesia	40	▼
Japan	37	▼
Saudi Arabia	33	▼
Ghana	33	▼
Morocco	29	▼
Korea, Republic of	29	▼
Israel	26	▼
Tunisia	9	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Reasoning and Analysis

The surface temperatures of Venus and Mercury

The table shows some information about the planets Venus and Mercury.

	Average Surface Temperature (°C)	Atmospheric Composition	Mean Distance from the Sun (millions of km)	Time to Revolve Around the Sun (Number of Days)
Venus	470	Mostly Carbon Dioxide	108	225
Mercury	300	Trace amounts of gases	58	88

Which of the following best explains why the surface temperature of Venus is higher than that of Mercury?

Ⓐ There is less absorption of sunlight on Mercury because of the lack of atmospheric gases.

Ⓑ The high percentage of carbon dioxide in the atmosphere of Venus causes a greenhouse effect.

Ⓒ The longer time for Venus to revolve around the Sun allows it to absorb more heat from the Sun.

Ⓓ The Sun's rays are less direct on Mercury because it is closer to the Sun.

Item Number: S032301

Correct Response: B

Overall Percent Correct

Korea, Republic of	70	▲
Hong Kong, SAR	69	▲
Chinese Taipei	69	▲
Singapore	60	▲
United States	49	▲
Australia	48	▲
Japan	47	▲
Egypt	46	▲
Sweden	46	▲
New Zealand	45	▲
England	44	▲
Lithuania	44	▲
Estonia	43	▲
Israel	41	▲
Hungary	41	▲
Scotland	40	O
Slovenia	39	O
Latvia	38	O
Italy	38	O
Netherlands	38	O
Slovak Republic	38	O
Belgium (Flemish)	38	O
Russian Federation	37	O
International average	**36**	
Serbia and Montenegro	34	O
Norway	34	O
Iran, Islamic Republic of	33	O
Bulgaria	33	O
Malaysia	31	▼
Chile	30	▼
Cyprus	30	▼
Palestinian Nat'l Auth.	28	▼
Bahrain	28	▼
Romania	28	▼
Philippines	28	▼
Jordan	28	▼
Botswana	24	▼
Moldova, Rep. of	24	▼
Lebanon	24	▼
South Africa	23	▼
Ghana	22	▼
Tunisia	19	▼
Saudi Arabia	18	▼
Indonesia	16	▼
Morocco	16	▼
Macedonia, Republic of	15	▼
Armenia	15	▼

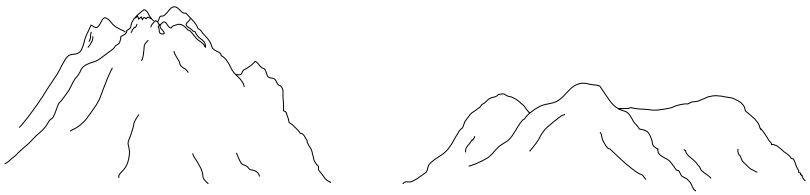
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Conceptual Understanding

True statement of mountain age

The pictures show two different mountains. The mountains in Picture A are rough and jagged. The mountains in Picture B are smooth and rounded.



Picture A Picture B

Which statement about these mountains is probably true?

Ⓐ The mountains in Picture A are older.

Ⓑ The mountains in Picture B are older.

Ⓒ The mountains are about the same age but were formed in different ways.

Ⓓ The mountains are about the same age but are in different hemispheres.

Item Number: S012013

Correct Response: B

Overall Percent Correct

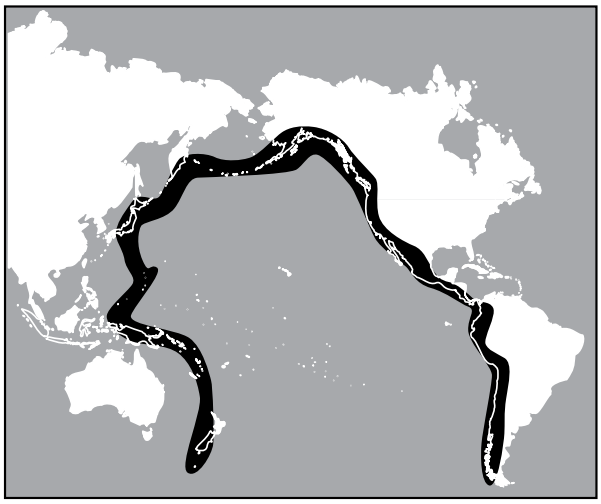
Iran, Islamic Republic of	58	▲
Italy	58	▲
Macedonia, Republic of	55	▲
Moldova, Rep. of	51	▲
Russian Federation	50	▲
Hungary	50	▲
Lithuania	47	▲
Estonia	44	▲
Latvia	44	▲
Romania	44	▲
Armenia	43	▲
Korea, Republic of	42	▲
Slovenia	42	▲
Sweden	41	▲
Belgium (Flemish)	38	▲
United States	36	▲
Bulgaria	35	▲
Morocco	34	O
Slovak Republic	33	O
Norway	32	O
International average	**30**	
England	29	O
Netherlands	28	O
Australia	27	O
Scotland	25	▼
Tunisia	24	▼
Japan	22	▼
Egypt	22	▼
Chinese Taipei	21	▼
Palestinian Nat'l Auth.	21	▼
Malaysia	21	▼
Hong Kong, SAR	20	▼
Jordan	19	▼
Lebanon	19	▼
Israel	19	▼
New Zealand	18	▼
Serbia and Montenegro	15	▼
Philippines	14	▼
South Africa	14	▼
Cyprus	13	▼
Bahrain	13	▼
Singapore	12	▼
Ghana	12	▼
Chile	11	▼
Indonesia	7	▼
Saudi Arabia	5	▼
Botswana	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Conceptual Understanding

Pacific Ring of Fire



The diagram above shows the Pacific Ring of Fire. Earthquakes and volcanic activity occur along the Ring of Fire. Which of the following best explains why?

Ⓐ It is located at the boundaries of tectonic plates.

Ⓑ It is located at the boundary of deep and shallow water.

Ⓒ It is located where the major ocean currents meet.

Ⓓ It is located where ocean temperature is the highest.

Item Number: S032656

Correct Response: A

Overall Percent Correct

Sweden	82	▲
Hong Kong, SAR	77	▲
England	77	▲
Russian Federation	76	▲
Scotland	75	▲
Lithuania	75	▲
Japan	74	▲
Latvia	71	▲
United States	71	▲
Chinese Taipei	70	▲
Italy	70	▲
Estonia	69	▲
Slovak Republic	66	▲
New Zealand	64	▲
Australia	64	▲
Netherlands	63	▲
Singapore	63	▲
Slovenia	62	▲
Korea, Republic of	62	▲
Romania	62	▲
Norway	60	▲
Bulgaria	56	▲
Cyprus	54	▲
Hungary	54	▲
Moldova, Rep. of	53	▲
Iran, Islamic Republic of	52	▲
International average	**48**	
Chile	44	▼
Israel	42	▼
Armenia	42	▼
Macedonia, Republic of	38	▼
Serbia and Montenegro	37	▼
Philippines	34	▼
Indonesia	33	▼
Belgium (Flemish)	31	▼
Jordan	20	▼
Morocco	20	▼
Malaysia	18	▼
Bahrain	17	▼
Saudi Arabia	16	▼
Tunisia	15	▼
Egypt	14	▼
Lebanon	13	▼
Ghana	11	▼
Palestinian Nat'l Auth.	11	▼
Botswana	10	▼
South Africa	10	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Factual Knowledge

Substance NOT a fossil fuel

Which is NOT a fossil fuel?

Ⓐ Coal

Ⓑ Oil

Ⓒ Wood

Ⓓ Natural gas

Item Number: S012018

Correct Response: C

Overall Percent Correct

Lithuania	87	▲
Chinese Taipei	87	▲
Malaysia	86	▲
Bahrain	83	▲
Bulgaria	83	▲
Singapore	82	▲
Jordan	77	▲
Netherlands	76	▲
Estonia	74	▲
Belgium (Flemish)	72	▲
Armenia	71	▲
Korea, Republic of	71	▲
United States	70	▲
Russian Federation	69	▲
Slovak Republic	68	▲
Japan	67	▲
Hong Kong, SAR	67	▲
Palestinian Nat'l Auth.	67	▲
Indonesia	67	▲
Moldova, Rep. of	65	O
England	64	O
Scotland	64	O
Serbia and Montenegro	63	O
Italy	62	O
International average	**62**	
Slovenia	61	O
Botswana	61	O
Egypt	60	O
Romania	59	O
Tunisia	58	O
Australia	57	O
Philippines	57	▼
Latvia	56	▼
Lebanon	55	▼
Chile	55	▼
Sweden	54	▼
New Zealand	53	▼
Saudi Arabia	52	▼
Israel	52	▼
Iran, Islamic Republic of	52	▼
Morocco	46	▼
Macedonia, Republic of	39	▼
Norway	36	▼
Ghana	36	▼
Cyprus	35	▼
South Africa	33	▼
Hungary	25	▼

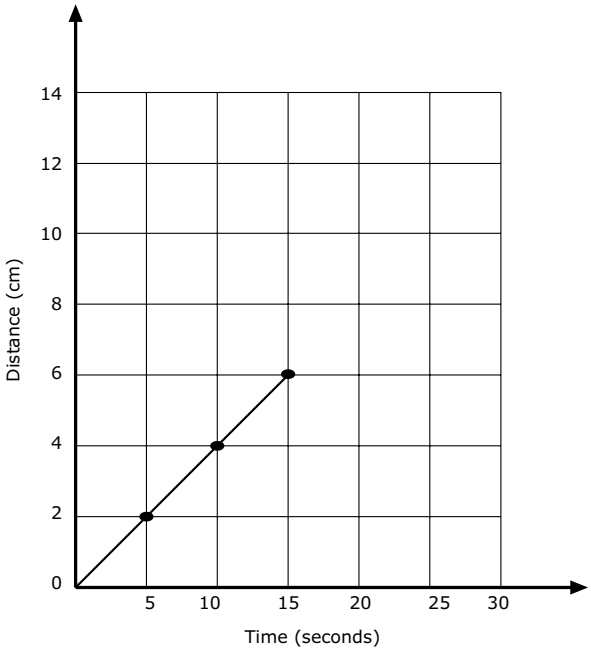
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Factual Knowledge

Rock at bottom of lake/ocean

The graph shows the progress made by a beetle moving along a straight line.



If the beetle keeps moving at the same speed, how long will it take to travel 10 cm?

Ⓐ 4 seconds

Ⓑ 6 seconds

Ⓒ 20 seconds

Ⓓ 25 seconds

Item Number: S012041

Correct Response: C

Overall Percent Correct

Lithuania	89	▲
Hungary	88	▲
Korea, Republic of	85	▲
Hong Kong, SAR	85	▲
Estonia	85	▲
Chinese Taipei	80	▲
Iran, Islamic Republic of	80	▲
Tunisia	74	▲
Japan	74	▲
England	71	▲
Latvia	70	▲
Armenia	70	▲
Morocco	68	▲
Israel	65	▲
Singapore	65	▲
Russian Federation	65	▲
Jordan	65	▲
Bahrain	64	▲
United States	60	▲
Palestinian Nat'l Auth.	57	O
Italy	56	O
International average	**54**	
Philippines	52	O
Australia	52	O
Moldova, Rep. of	52	O
Saudi Arabia	51	O
Egypt	50	O
Slovenia	47	▼
Serbia and Montenegro	44	▼
Scotland	44	▼
Netherlands	43	▼
Romania	43	▼
Cyprus	41	▼
Malaysia	41	▼
Lebanon	40	▼
Bulgaria	39	▼
New Zealand	37	▼
Botswana	36	▼
Sweden	34	▼
Ghana	34	▼
Slovak Republic	31	▼
Norway	28	▼
Indonesia	27	▼
Belgium (Flemish)	26	▼
Macedonia, Republic of	22	▼
South Africa	22	▼
Chile	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Factual Knowledge

Fossil fuels

Fossil fuels were formed from

Ⓐ volcanoes
Ⓑ the remains of living things
Ⓒ gases in the atmosphere
Ⓓ water trapped inside rocks

Item Number: S022074

Correct Response: B

Overall Percent Correct

Jordan	82	▲
Singapore	81	▲
Chinese Taipei	79	▲
Hong Kong, SAR	77	▲
England	71	▲
Indonesia	69	▲
Iran, Islamic Republic of	67	▲
Serbia and Montenegro	66	▲
United States	65	▲
Estonia	64	▲
Botswana	61	▲
Macedonia, Republic of	59	▲
Italy	57	▲
Hungary	57	▲
Sweden	57	▲
Scotland	56	O
Lithuania	56	▲
Korea, Republic of	56	▲
Slovenia	54	O
Bulgaria	53	O
Romania	53	O
Norway	52	O
International average	**52**	
Armenia	51	O
Japan	51	O
Netherlands	51	O
Egypt	50	O
Palestinian Nat'l Auth.	49	O
Slovak Republic	48	O
New Zealand	46	O
Australia	46	▼
Israel	45	▼
Malaysia	45	▼
Belgium (Flemish)	45	▼
Latvia	44	▼
Russian Federation	43	▼
Moldova, Rep. of	43	▼
Lebanon	42	▼
Philippines	41	▼
Bahrain	39	▼
Chile	35	▼
Saudi Arabia	26	▼
Tunisia	22	▼
South Africa	22	▼
Cyprus	21	▼
Ghana	19	▼
Morocco	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Reasoning and Analysis

Time/temperature table

The table gives the temperature at a certain place at different times of the day for three days.

	6 a.m.	9 a.m.	12 noon	3 p.m.	6 p.m.
Monday	15˚C	17˚C	20˚C	21˚C	19˚C
Tuesday	15˚C	15˚C	15˚C	5˚C	4˚C
Wednesday	8˚C	10˚C	14˚C	14˚C	13˚C

When did the wind become much colder?

Ⓐ Monday morning
Ⓑ Monday afternoon
Ⓒ Tuesday morning
Ⓓ Tuesday afternoon
Ⓔ Wednesday afternoon

Item Number: S012027

Correct Response: D

Overall Percent Correct

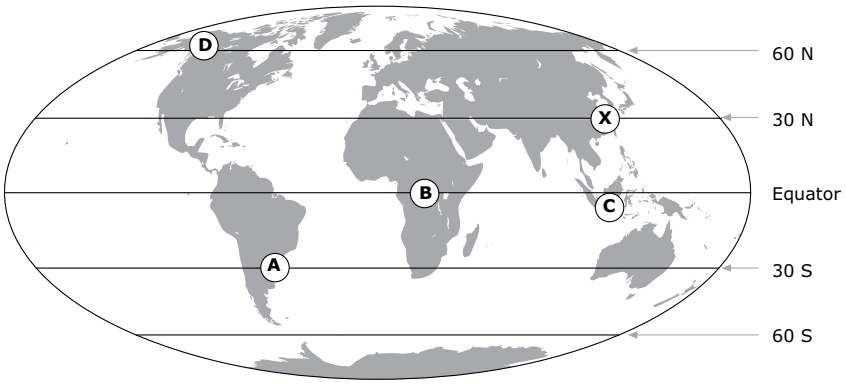
Japan	96	▲
Netherlands	93	▲
Hungary	93	▲
Australia	92	▲
Sweden	89	▲
Singapore	89	▲
Belgium (Flemish)	89	▲
England	88	▲
New Zealand	87	▲
Korea, Republic of	87	▲
Hong Kong, SAR	87	▲
Chinese Taipei	87	▲
Estonia	87	▲
Malaysia	85	▲
Slovenia	84	▲
United States	84	▲
Israel	83	▲
Italy	83	▲
Scotland	82	▲
Serbia and Montenegro	82	▲
Latvia	82	▲
Bulgaria	79	▲
Slovak Republic	79	▲
Cyprus	76	▲
Lithuania	76	O
Chile	76	O
Norway	75	O
Macedonia, Republic of	75	O
International average	**73**	
Romania	71	O
Jordan	69	O
Tunisia	69	▼
Moldova, Rep. of	68	O
Russian Federation	68	▼
Morocco	65	▼
Bahrain	63	▼
Palestinian Nat'l Auth.	60	▼
Lebanon	57	▼
Iran, Islamic Republic of	56	▼
Indonesia	44	▼
Egypt	43	▼
Armenia	39	▼
Saudi Arabia	36	▼
Botswana	35	▼
Philippines	33	▼
South Africa	26	▼
Ghana	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth Processes, Cycles and History	Reasoning and Analysis

Map of the world with lines of latitude



The diagram above shows a map of the world with the lines of latitude marked. Which of the following places marked on the map is most likely to have an average yearly temperature similar to location **X**?

Ⓐ location A
Ⓑ location B
Ⓒ location C
Ⓓ location D

Item Number: S032652

Correct Response: A

Overall Percent Correct

Estonia	73	▲
Netherlands	70	▲
Hungary	68	▲
Malaysia	67	▲
Chinese Taipei	65	▲
Korea, Republic of	64	▲
Slovak Republic	64	▲
Singapore	63	▲
Sweden	61	▲
Slovenia	58	▲
Italy	57	▲
Australia	55	▲
Latvia	53	▲
England	53	O
Moldova, Rep. of	53	O
United States	51	▲
Serbia and Montenegro	51	O
Hong Kong, SAR	51	O
Japan	49	O
Belgium (Flemish)	49	O
New Zealand	49	O
Macedonia, Republic of	49	O
Israel	48	O
Bulgaria	48	O
Indonesia	48	O
International average	**48**	
Russian Federation	46	O
Romania	45	O
Jordan	45	O
Iran, Islamic Republic of	44	▼
Scotland	44	O
Bahrain	43	▼
Norway	42	▼
Cyprus	42	▼
Lithuania	42	▼
Chile	41	▼
Palestinian Nat'l Auth.	39	▼
Philippines	39	▼
Armenia	37	▼
Saudi Arabia	35	▼
Egypt	35	▼
Lebanon	34	▼
Morocco	30	▼
Ghana	26	▼
Botswana	25	▼
South Africa	21	▼
Tunisia	20	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth's Structure and Physical Features	Factual Knowledge

Stone in underground caves

Most underground caves are formed by the action of water on

Ⓐ granite
Ⓑ limestone
Ⓒ sandstone
Ⓓ shale

Item Number: S012030

Correct Response: B

Overall Percent Correct

Slovenia	91	▲
Slovak Republic	85	▲
Hungary	85	▲
Korea, Republic of	78	▲
Chinese Taipei	75	▲
Serbia and Montenegro	74	▲
Cyprus	63	▲
Netherlands	62	▲
Belgium (Flemish)	59	▲
Bulgaria	58	▲
Romania	58	▲
Italy	57	▲
Sweden	56	▲
Malaysia	55	▲
England	53	▲
Macedonia, Republic of	53	▲
Lebanon	52	▲
Singapore	47	O
Israel	46	O
International average	**46**	
Norway	45	O
United States	45	O
Estonia	44	O
Australia	41	▼
Bahrain	40	▼
Russian Federation	40	▼
New Zealand	40	▼
Morocco	40	▼
Scotland	38	▼
Philippines	37	▼
Chile	36	▼
Ghana	36	▼
Moldova, Rep. of	35	▼
Botswana	35	▼
Jordan	32	▼
Iran, Islamic Republic of	31	▼
Armenia	30	▼
Egypt	30	▼
Lithuania	29	▼
Indonesia	28	▼
Japan	26	▼
Hong Kong, SAR	25	▼
South Africa	24	▼
Latvia	24	▼
Saudi Arabia	17	▼
Tunisia	6	▼
Palestinian Nat'l Auth.	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth's Structure and Physical Features	Factual Knowledge

Abundance of gases in atmosphere

Three gases found in Earth's atmosphere are carbon dioxide, nitrogen, and oxygen. What is their order of abundance from greatest to least?

Ⓐ nitrogen, oxygen, carbon dioxide

Ⓑ nitrogen, carbon dioxide, oxygen

Ⓒ oxygen, nitrogen, carbon dioxide

Ⓓ carbon dioxide, oxygen, nitrogen

Item Number: S022275

Correct Response: A

Overall Percent Correct

Chinese Taipei	56	▲
Hong Kong, SAR	56	▲
Japan	49	▲
Armenia	44	▲
Estonia	44	▲
Slovak Republic	43	▲
Palestinian Nat'l Auth.	43	▲
Hungary	40	▲
Singapore	39	▲
Bulgaria	38	▲
Korea, Republic of	36	▲
Malaysia	34	▲
Romania	32	O
Macedonia, Republic of	31	O
Russian Federation	31	O
Slovenia	30	O
Israel	30	O
Scotland	29	O
Philippines	29	O
Egypt	28	O
Serbia and Montenegro	28	O
International average	**28**	
England	27	O
Lithuania	27	O
Latvia	26	O
Indonesia	26	O
Italy	23	▼
Ghana	23	▼
Moldova, Rep. of	22	▼
Saudi Arabia	22	▼
Jordan	21	▼
Lebanon	21	▼
United States	21	▼
Netherlands	21	▼
Norway	20	▼
New Zealand	20	▼
Bahrain	19	▼
Australia	19	▼
Sweden	18	▼
Botswana	18	▼
Cyprus	17	▼
Morocco	16	▼
South Africa	15	▼
Iran, Islamic Republic of	13	▼
Belgium (Flemish)	12	▼
Chile	11	▼
Tunisia	6	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Changes in river shape/speed

A small, fast-moving river is in a V-shaped valley on the slope of a mountain. If you follow the river to where it passes through a plain, what will the river most likely look like compared with how it looked on the mountain?

Ⓐ Much the same

Ⓑ Deeper and faster

Ⓒ Slower and wider

Ⓓ Straighter

Item Number: S012006

Correct Response: C

Overall Percent Correct

Japan	84	▲
Russian Federation	79	▲
Estonia	79	▲
Netherlands	74	▲
Chinese Taipei	73	▲
Slovenia	73	▲
Slovak Republic	71	▲
Hungary	71	▲
Belgium (Flemish)	68	▲
Sweden	66	▲
Latvia	65	▲
Norway	65	▲
Israel	63	▲
Singapore	62	▲
Romania	62	▲
Korea, Republic of	61	▲
Iran, Islamic Republic of	59	▲
Australia	58	▲
Italy	58	▲
Malaysia	57	▲
United States	57	▲
England	57	▲
Bulgaria	56	O
Serbia and Montenegro	52	O
Scotland	52	O
International average	**52**	
Indonesia	52	O
New Zealand	50	O
Moldova, Rep. of	50	O
Lithuania	50	O
Armenia	49	O
Hong Kong, SAR	48	▼
Macedonia, Republic of	46	▼
Chile	44	▼
Cyprus	37	▼
Morocco	37	▼
Jordan	36	▼
Tunisia	36	▼
Philippines	33	▼
Botswana	31	▼
Palestinian Nat'l Auth.	27	▼
South Africa	26	▼
Lebanon	26	▼
Ghana	25	▼
Bahrain	22	▼
Egypt	22	▼
Saudi Arabia	15	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Changes in Environment	Factual Knowledge

Increased carbon dioxide in atmosphere

The burning of fossil fuels has increased the carbon dioxide content of the atmosphere. What is a possible effect that the increased amount of carbon dioxide is likely to have on our planet?

Ⓐ A warmer climate

Ⓑ A cooler climate

Ⓒ Lower relative humidity

Ⓓ More ozone in the atmosphere

Item Number: S012017

Correct Response: A

Overall Percent Correct

Singapore	83	▲
Japan	80	▲
Hong Kong, SAR	72	▲
Netherlands	71	▲
Malaysia	67	▲
Sweden	66	▲
Korea, Republic of	65	▲
England	65	▲
Australia	64	▲
Norway	62	▲
Chinese Taipei	62	▲
Scotland	62	▲
Estonia	58	▲
United States	56	▲
New Zealand	56	▲
Hungary	56	▲
Indonesia	52	▲
Israel	51	▲
Italy	48	O
Latvia	47	O
Moldova, Rep. of	46	O
Belgium (Flemish)	45	O
International average	**45**	
Iran, Islamic Republic of	45	O
Slovenia	44	O
Russian Federation	43	O
Bulgaria	43	O
Slovak Republic	43	O
Cyprus	42	O
Chile	40	▼
Romania	40	▼
Macedonia, Republic of	35	▼
Armenia	35	▼
Lithuania	34	▼
Philippines	32	▼
Morocco	32	▼
Serbia and Montenegro	30	▼
Botswana	27	▼
South Africa	23	▼
Lebanon	21	▼
Jordan	21	▼
Ghana	21	▼
Bahrain	18	▼
Egypt	17	▼
Tunisia	17	▼
Palestinian Nat'l Auth.	15	▼
Saudi Arabia	11	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Changes in Environment	Factual Knowledge

Main cause of acid rain

One of the main causes of acid rain is

Ⓐ Waste from nuclear power plants

Ⓑ Spills from chemical manufacturing plants

Ⓒ Gases from burning fossil fuels

Ⓓ Gases from aerosol spray cans

Item Number: S022240

Correct Response: C

Overall Percent Correct

Chinese Taipei	67	▲
Singapore	61	▲
Hong Kong, SAR	56	▲
Malaysia	51	▲
Lithuania	49	▲
Slovenia	47	▲
England	46	▲
Korea, Republic of	40	▲
Bulgaria	40	▲
Tunisia	39	▲
Scotland	39	▲
Japan	38	▲
Jordan	38	▲
Cyprus	37	▲
Egypt	36	O
Botswana	35	O
Australia	35	O
United States	35	O
Armenia	34	O
Estonia	34	O
International average	**33**	
Latvia	32	O
Slovak Republic	32	O
Indonesia	31	O
Palestinian Nat'l Auth.	30	O
Hungary	29	O
South Africa	29	▼
Sweden	28	▼
New Zealand	27	▼
Saudi Arabia	27	▼
Philippines	27	▼
Serbia and Montenegro	26	▼
Ghana	26	▼
Iran, Islamic Republic of	26	▼
Romania	25	▼
Netherlands	25	▼
Bahrain	25	▼
Chile	23	▼
Russian Federation	23	▼
Lebanon	23	▼
Israel	23	▼
Italy	20	▼
Moldova, Rep. of	19	▼
Belgium (Flemish)	19	▼
Norway	17	▼
Macedonia, Republic of	13	▼
Morocco	12	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Changes in Environment	Factual Knowledge

Activity to reduce air pollution in a city

Which of these daily activities can most directly help reduce air pollution in a city?

Ⓐ turning down the volume on the television

Ⓑ using biodegradable materials

Ⓒ using public transportation instead of driving

Ⓓ recycling paper

Item Number: S032446

Correct Response: C

Overall Percent Correct

Korea, Republic of	91	▲
Hong Kong, SAR	84	▲
Sweden	84	▲
Singapore	81	▲
Chinese Taipei	79	▲
Belgium (Flemish)	78	▲
Netherlands	78	▲
New Zealand	76	▲
Hungary	75	▲
England	75	▲
Scotland	73	▲
Australia	72	▲
Norway	68	▲
Iran, Islamic Republic of	67	▲
Italy	67	▲
United States	63	▲
Cyprus	61	▲
Japan	58	O
Bahrain	57	O
Slovenia	56	O
Lithuania	56	O
Jordan	56	O
International average	**55**	
Moldova, Rep. of	55	O
Russian Federation	53	O
Malaysia	53	O
Estonia	52	O
Latvia	51	O
Palestinian Nat'l Auth.	50	▼
Lebanon	49	▼
Slovak Republic	47	▼
Israel	46	▼
Saudi Arabia	44	▼
Chile	43	▼
Armenia	42	▼
Philippines	42	▼
Morocco	41	▼
Romania	38	▼
Macedonia, Republic of	38	▼
Serbia and Montenegro	36	▼
Tunisia	33	▼
Indonesia	31	▼
Bulgaria	25	▼
South Africa	24	▼
Ghana	24	▼
Botswana	20	▼
Egypt	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Conceptual Understanding

Nonrenewable natural resource

Oil is an example of a natural resource that is not renewable. Which is another example of a nonrenewable resource?

Ⓐ Wood

Ⓑ Seawater

Ⓒ Sunlight

Ⓓ Coal

Item Number: S012042

Correct Response: D

Overall Percent Correct

Singapore	86	▲
Hong Kong, SAR	80	▲
Chinese Taipei	79	▲
England	69	▲
Korea, Republic of	69	▲
Scotland	68	▲
Jordan	65	▲
Italy	61	▲
Palestinian Nat'l Auth.	60	▲
Lebanon	60	▲
Bulgaria	59	▲
Estonia	59	▲
United States	59	▲
Slovenia	58	▲
Lithuania	58	▲
Romania	57	▲
Indonesia	56	▲
Moldova, Rep. of	56	O
Netherlands	56	O
Egypt	55	O
Australia	55	O
Hungary	55	O
Saudi Arabia	55	O
New Zealand	53	O
International average	**52**	
Botswana	52	O
Slovak Republic	52	O
Russian Federation	51	O
Malaysia	51	O
Bahrain	50	O
Norway	49	O
Belgium (Flemish)	48	▼
Serbia and Montenegro	46	▼
Cyprus	45	▼
Israel	45	▼
Tunisia	43	▼
Armenia	41	▼
Latvia	41	▼
Japan	39	▼
Morocco	39	▼
Macedonia, Republic of	37	▼
Chile	36	▼
Philippines	35	▼
Sweden	35	▼
South Africa	33	▼
Ghana	28	▼
Iran, Islamic Republic of	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Conceptual Understanding

Renewable energy source

Write down one renewable energy source and describe one way that people make use of it.

Energy Source: _____

Use:

Item Number: S032242

SCORING

Note: For credit, responses must name a renewable energy source or device and a use that indicates how the energy from the source/device is applied. Credit is NOT given for responses that name a renewable source/device with no or inadequate description of its use.

Correct Response

- **Sun or sunlight** (solar energy) with a correct description of its use.
  Examples: Sun. It is used to heat water by solar panels.
  Sunlight. It keeps us warm.
- **Wind** (windmills) with a correct description of its use.
  Examples: Windmills. Are for grinding corns or for pumping water.
  Wind turbines to generate electricity.
- **Water** (waves, tides, water wheels, etc.) with a correct description of its use.
  Examples: Tidal barrage. To generate electricity.
  Water. To generate electricity.
- Other correct.
  Examples: Food. To give the body energy.
  Wood. It is used in wood stoves for cooking.

Incorrect Response

- Names any fossil fuel (e.g., coal, oil, gasoline).
  Examples: Gas. You can use it for heating.
- Names a renewable energy source/device with no or inadequate description of use.
  Examples: Water. You can heat, freeze and melt it.
  Sunlight.
  Windmill.
- Names "light" (without connection to the Sun) with or without a correct description of use.
  Examples: Light energy. It help us to see.
  Light.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task)
  Examples: Electricity. Used for cooking.
  Batteries. To power a torch.

Overall Percent Correct

Hong Kong, SAR	64	▲
Singapore	47	▲
England	43	▲
Italy	41	▲
Jordan	40	▲
Slovak Republic	38	▲
Chinese Taipei	36	▲
Estonia	35	▲
Slovenia	35	▲
Palestinian Nat'l Auth.	34	▲
Hungary	34	▲
New Zealand	32	▲
Scotland	29	O
United States	29	▲
Sweden	29	O
Israel	27	O
Lebanon	27	O
Netherlands	27	O
Iran, Islamic Republic of	27	O
Australia	27	O
Latvia	26	O
Malaysia	26	O
Lithuania	26	O
International average	**25**	
Russian Federation	25	O
Romania	24	O
Macedonia, Republic of	23	O
Belgium (Flemish)	23	O
Norway	22	O
Bahrain	22	▼
Cyprus	21	▼
Korea, Republic of	21	▼
Serbia and Montenegro	20	▼
Bulgaria	19	▼
Philippines	19	▼
Egypt	18	▼
Indonesia	17	▼
Chile	17	▼
Botswana	15	▼
Tunisia	14	▼
Armenia	13	▼
Saudi Arabia	12	▼
Ghana	9	▼
Japan	9	▼
South Africa	7	▼
Morocco	4	▼
Moldova, Rep. of	2	▼

Country average vs. International average:

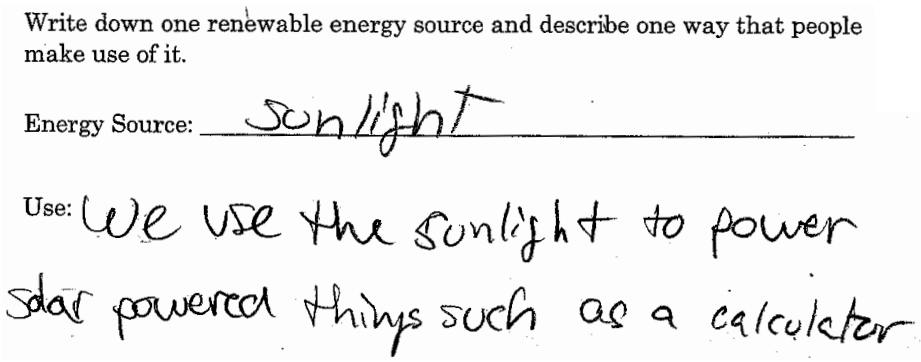
Higher	▲
Not different	O
Lower	▼

Renewable energy source (continued)

Item Number: S032242

Student Responses

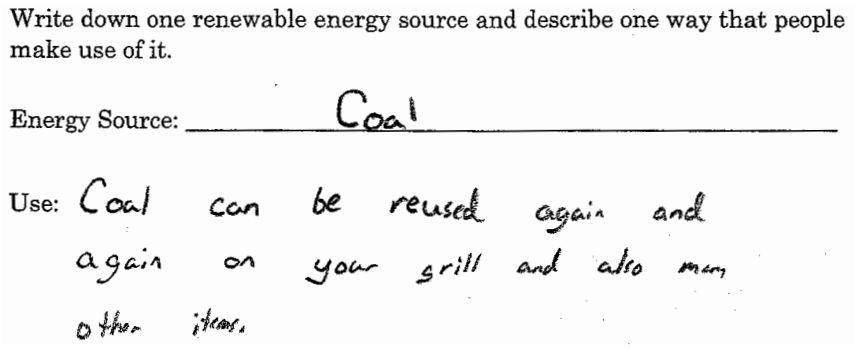
Correct Response:


Write down one renewable energy source and describe one way that people make use of it.

Energy Source: sunlight

Use: We use the sunlight to power solar powered things such as a calculator

Incorrect Response:


Write down one renewable energy source and describe one way that people make use of it.

Energy Source: Coal

Use: Coal can be reused again and again on your grill and also many other items.

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Conceptual Understanding

Group of renewable energy sources

Which group of energy sources are ALL renewable?

Ⓐ coal, oil, and natural gas

Ⓑ solar, oil, and geothermal

Ⓒ wind, solar, and tidal

Ⓓ natural gas, solar, and tidal

Item Number: S032422

Correct Response: C

Overall Percent Correct

Hong Kong, SAR	84	▲
Korea, Republic of	77	▲
Lithuania	76	▲
Singapore	76	▲
Hungary	74	▲
Chinese Taipei	74	▲
Estonia	73	▲
Italy	70	▲
England	70	▲
Slovenia	68	▲
Scotland	68	▲
Japan	66	▲
Russian Federation	63	▲
Malaysia	63	▲
Slovak Republic	62	▲
Sweden	61	▲
Latvia	60	▲
Netherlands	60	O
Jordan	59	▲
United States	56	O
Belgium (Flemish)	55	O
Armenia	55	O
New Zealand	55	O
International average	**53**	
Cyprus	53	O
Australia	52	O
Bahrain	52	O
Norway	50	O
Romania	50	O
Palestinian Nat'l Auth.	49	O
Serbia and Montenegro	49	O
Lebanon	47	▼
Egypt	45	▼
Bulgaria	45	▼
Indonesia	45	▼
Israel	44	▼
Moldova, Rep. of	43	▼
Macedonia, Republic of	43	▼
Iran, Islamic Republic of	40	▼
Chile	40	▼
Tunisia	30	▼
Philippines	28	▼
Botswana	27	▼
Morocco	26	▼
South Africa	21	▼
Saudi Arabia	18	▼
Ghana	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Factual Knowledge

Overgrazing by livestock

Overgrazing of land by livestock contributes to a major problem. That problem is

Ⓐ depletion of ground water

Ⓑ increased pollution

Ⓒ erosion of soil

Ⓓ acid rain

Item Number: S012005

Correct Response: C

Overall Percent Correct

Chinese Taipei	88	▲
Botswana	80	▲
Malaysia	79	▲
Australia	74	▲
Netherlands	72	▲
Estonia	71	▲
Singapore	70	▲
Hong Kong, SAR	68	▲
Russian Federation	67	▲
United States	65	▲
Hungary	64	▲
Romania	63	▲
Japan	63	▲
Indonesia	63	▲
Ghana	63	▲
Jordan	63	▲
Latvia	61	▲
Belgium (Flemish)	60	▲
England	60	O
Italy	59	O
Palestinian Nat'l Auth.	59	O
Morocco	57	O
Slovenia	57	O
Scotland	57	O
International average	**56**	
Norway	56	O
Iran, Islamic Republic of	56	O
Bulgaria	54	O
Armenia	54	O
New Zealand	54	O
Tunisia	52	▼
Slovak Republic	52	O
Serbia and Montenegro	51	▼
Bahrain	48	▼
Macedonia, Republic of	48	▼
Cyprus	47	▼
Sweden	46	▼
Chile	46	▼
Philippines	45	▼
Lithuania	45	▼
Moldova, Rep. of	42	▼
South Africa	36	▼
Egypt	34	▼
Saudi Arabia	33	▼
Israel	32	▼
Lebanon	17	▼
Korea, Republic of	0	▼

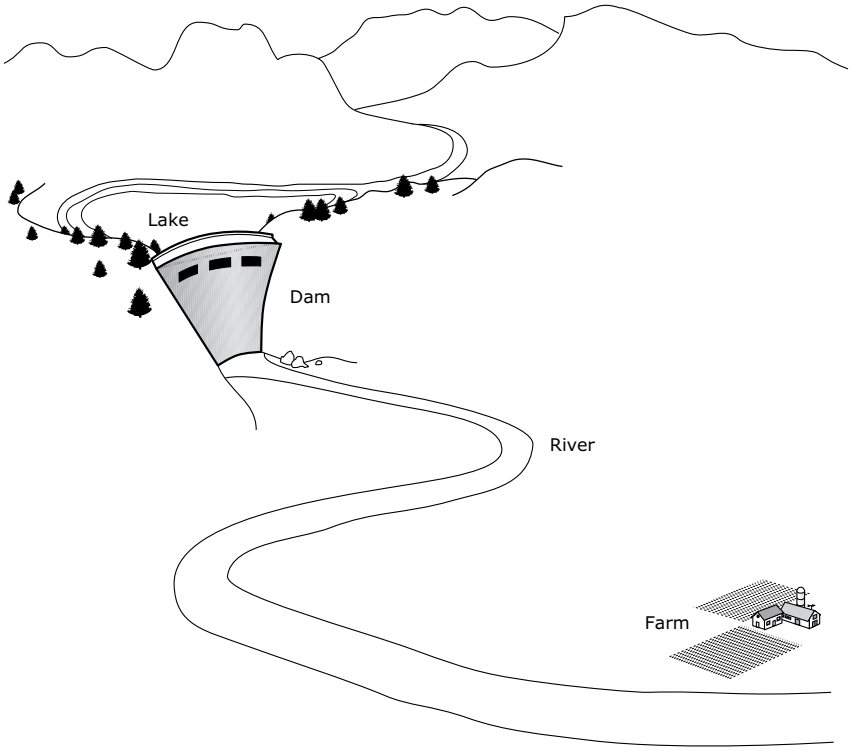
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Reasoning and Analysis

Positive/negative effect of dam

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

A. Describe one positive effect of the dam on farming.

B. Describe one negative effect of the dam on farming.

Item Number: S022088A

Overall Percent Correct

Chinese Taipei	87	▲
Korea, Republic of	83	▲
Netherlands	82	▲
Belgium (Flemish)	79	▲
Hong Kong, SAR	78	▲
United States	77	▲
Japan	77	▲
Australia	75	▲
Iran, Islamic Republic of	74	▲
Estonia	74	▲
Singapore	72	▲
Slovenia	72	▲
Latvia	72	▲
Slovak Republic	72	▲
Malaysia	71	▲
New Zealand	71	▲
England	70	▲
Italy	67	▲
Norway	67	▲
Lithuania	65	▲
Romania	64	O
Jordan	63	O
Israel	61	O
Indonesia	61	O
International average	**60**	
Macedonia, Republic of	59	O
Cyprus	59	O
Hungary	58	O
Serbia and Montenegro	57	O
Scotland	57	O
Sweden	56	O
Bulgaria	55	O
Russian Federation	55	▼
Tunisia	53	▼
Egypt	51	▼
Palestinian Nat'l Auth.	49	▼
Moldova, Rep. of	49	▼
Philippines	48	▼
Armenia	46	▼
Saudi Arabia	45	▼
Bahrain	44	▼
Botswana	39	▼
Morocco	38	▼
Chile	36	▼
Lebanon	28	▼
Ghana	20	▼
South Africa	11	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Positive/negative effect of dam (continued)

Item Number: S022088A

SCORING

Codes for Positive Effects

Note: For credit, responses must clearly indicate a positive effect of the dam related to farming in the valley.

Correct Response

- Mentions that the dam prevents flooding.
  Examples: Without the dam, a big storm could cause a flood.
  There is no chance of flooding.
  It slows down the river so it does not overflow and ruin the crops.
- Mentions that the dam controls the water supply.
  Examples: It stores water for the summer.
  The dam releases just the right amount of water.
  It brings more water closer to the farm.
  It would be easier to irrigate.
- Mentions a soil-related benefit of the dam.
  Examples: More top soil.
  Controls erosion.
  The ground will be more fertile because of the large supply of water.
- Mentions the dam as a source of power.
  Examples: The farmer will have a good power supply.
  The farm can use the hydroelectric power for energy.
- Other correct.

Incorrect Response

- Mentions a positive effect but does not clearly address the issue of farming or the effect of the dam.
  Examples: It provides better drinking water.
  Water is good for the crops.
  It makes the river small for swimming and fishing.
- Gives a negative effect.
  Examples: It might prevent the farm from getting enough water.
  The water could become too high and overflow.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task)

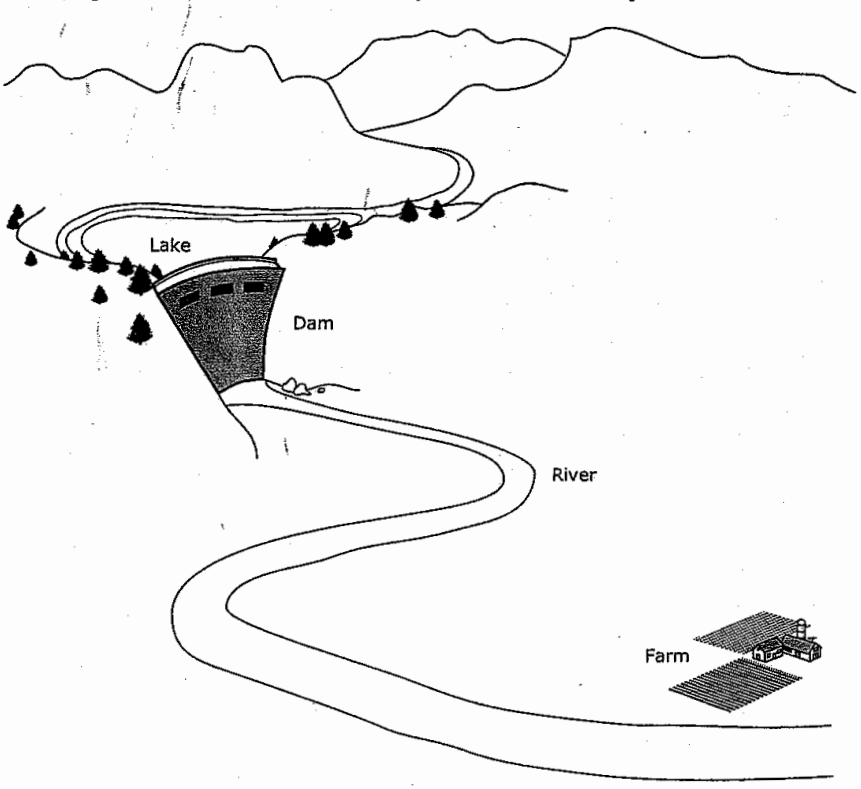
Positive/negative effect of dam (continued)

Item Number: S022088A

Student Responses

Correct Response:

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

A. Describe one positive effect of the dam on farming.

The Dam will prevent the river from flooding the farm.

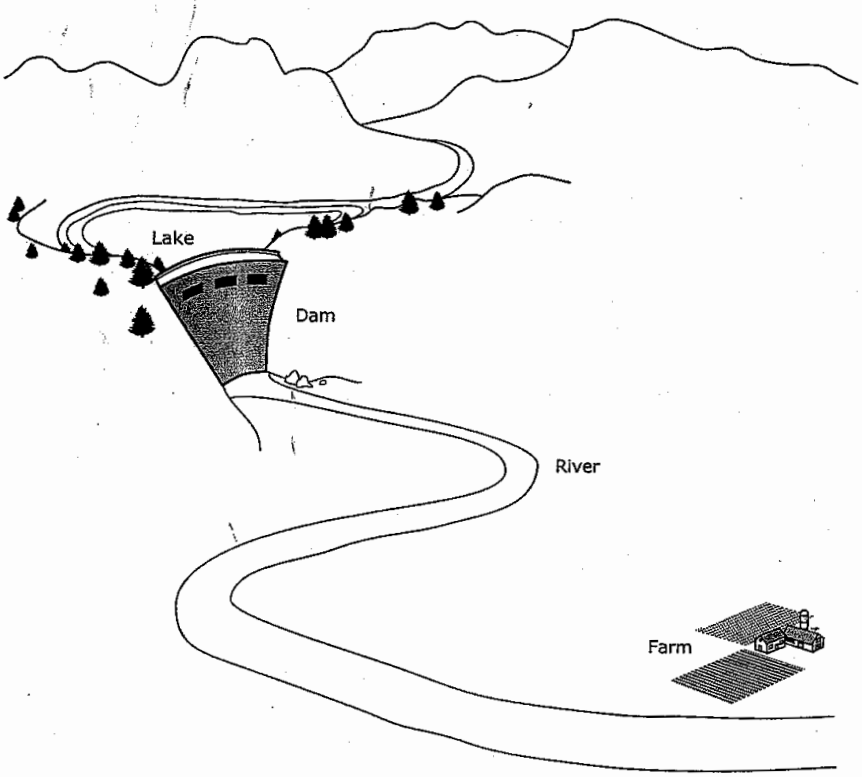
Positive/negative effect of dam (continued)

Item Number: S022088A

Student Responses (continued)

Incorrect Response:

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

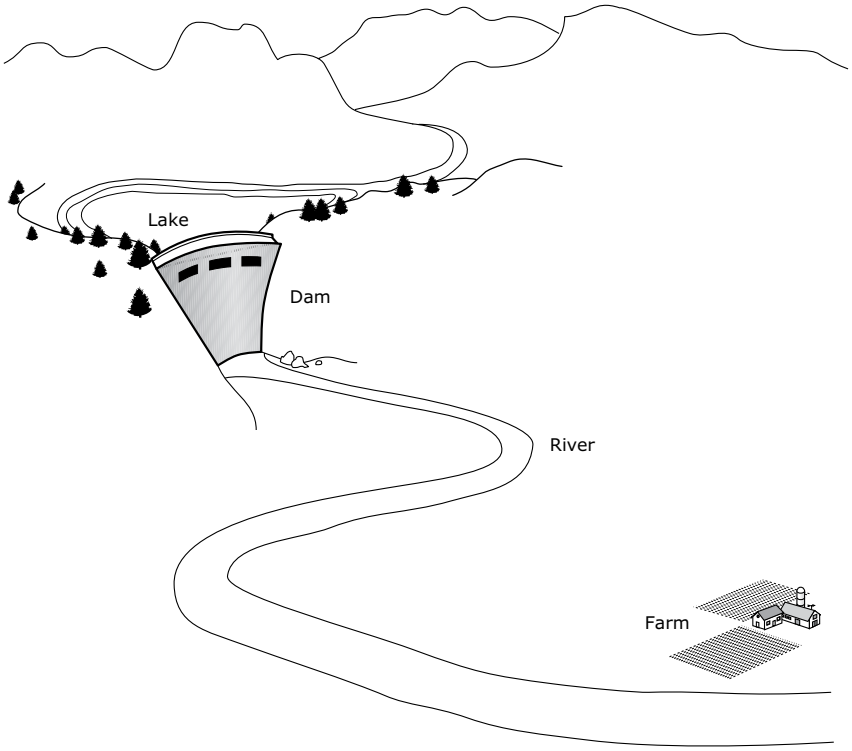
A. Describe one positive effect of the dam on farming.

theres more mousture in the ground

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Reasoning and Analysis

Positive/negative effect of dam

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

A. Describe one positive effect of the dam on farming.

B. Describe one negative effect of the dam on farming.

Item Number: S022088B

Overall Percent Correct

Chinese Taipei	68	▲
Slovak Republic	64	▲
Netherlands	63	▲
Romania	62	▲
Estonia	61	▲
United States	59	▲
Belgium (Flemish)	57	▲
Latvia	57	▲
Hong Kong, SAR	57	▲
Israel	56	▲
New Zealand	55	▲
Slovenia	55	▲
Jordan	55	▲
Russian Federation	54	▲
Indonesia	53	▲
Norway	52	▲
Australia	51	▲
Iran, Islamic Republic of	50	▲
Bulgaria	50	▲
Lithuania	49	▲
Singapore	46	O
England	46	O
Malaysia	45	O
Bahrain	44	O
Italy	44	O
International average	**44**	
Korea, Republic of	41	O
Palestinian Nat'l Auth.	40	▼
Armenia	39	▼
Scotland	38	▼
Japan	38	▼
Macedonia, Republic of	38	▼
Sweden	38	▼
Philippines	37	▼
Hungary	37	▼
Saudi Arabia	35	▼
Tunisia	35	▼
Moldova, Rep. of	35	▼
Serbia and Montenegro	32	▼
Chile	30	▼
Cyprus	29	▼
Egypt	26	▼
Lebanon	24	▼
Morocco	21	▼
Botswana	19	▼
Ghana	13	▼
South Africa	11	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Positive/negative effect of dam (continued)

Item Number: S022088B

SCORING

Codes for Negative Effects

Note: For credit, responses must clearly indicate a negative effect of the dam related to farming in the valley.

Correct Response

- Mentions the dam breaking (resulting in flooding).
  Examples: If the dam breaks it could flood the valley and the crops.
  If there is a leak, the whole dam could flood and destroy everything.
- Mentions the river drying up or decreasing water supply.
  Examples: No or less irrigation because the dam does not let the water flow through.
  The fields could dry out from too little water.
  It slows the river too much and the farm will not have enough water.
- Mentions a soil-related problem of the dam.
  Examples: Nutrients not replenished by flooding.
  The rich nutrients from the water are not coming over the fields.
- Mentions upsetting the ecological balance.
  Examples: The dam could alter the ecology of the farm.
  The dam might interfere with the farm's ecosystem.
- Other correct.

Incorrect Response

- Mentions a negative effect but it does not clearly address the issue of farming or the effect of the dam.
  Examples: It bursts.
  It is now going to be a tourist attraction.
  Flooding. [Does not mention how the dam causes this.]
  A lot of fish will die because their habitat has been changed.
  The fish cannot swim upstream.
- Response indicates a misconception of how dams function (controlled release of water).
  Examples: The lake could overflow the top of the dam.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

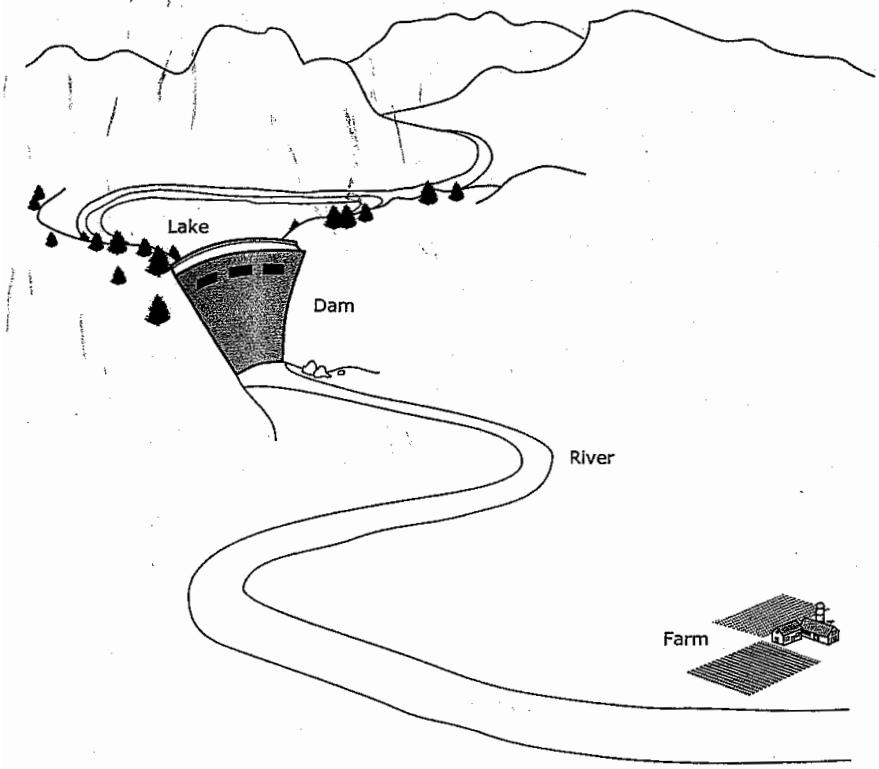
Positive/negative effect of dam (continued)

Item Number: S022088B

Student Responses

Correct Response:

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

B. Describe one negative effect of the dam on farming.

It would slow down the water pressur and the minirals from up the river wouldn't be eroded to give the farm soil minirals.

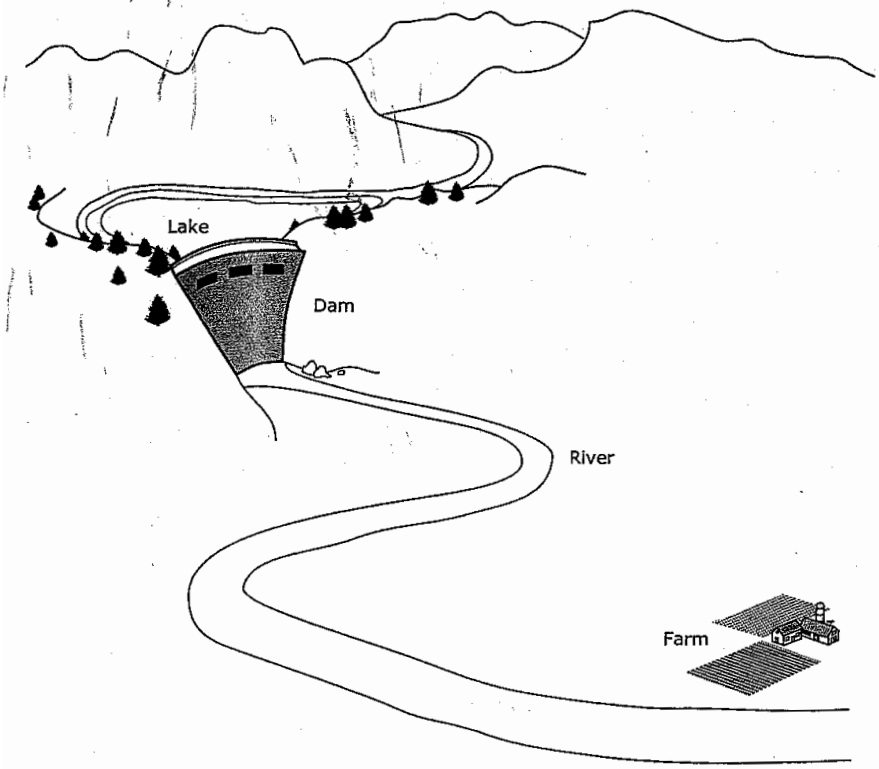
Positive/negative effect of dam (continued)

Item Number: S022088B

Student Responses (continued)

Incorrect Response:

The diagram shows a farm in a valley where a dam has just been built.



The presence of the dam can have both positive and negative effects on farming in the valley.

B. Describe one negative effect of the dam on farming.

It disturbs the nature of the farming and could drought.

Content Domain	Main Topic	Cognitive Domain
ENVIRONMENTAL SCIENCE	Use and Conservation of Natural Resources	Reasoning and Analysis

Drinking water from sea water

Sea water contains dissolved salts and is not suitable for drinking. Describe a procedure that can be used to obtain a cup of drinking water from a bucket of sea water.

Item Number: S032063

SCORING

Note: For full credit, responses must give a procedure that clearly indicates the method used to separate water from salt and collect the pure water. The most common procedure is the distillation method, but other correct procedures such as the freezing method or reverse osmosis method are possible. Partial credit should be given for responses that address at least the separation portion of the procedure. Responses that are based on boiling or filtering without indicating how separation of water and salt occurs are scored as incorrect.

Correct Response

- Describes a correct procedure that includes the following basic steps (may use diagrams):
  i) Boiling/evaporation to separate water from salt
  ii) Collecting the distilled water (condensation)
  Examples: Heat the salt water, catch the steam on a tray, drip it into a cup and the salt will be left in the bucket and drinking water in the cup.
  Boil the sea water taking the steam up to a tube and letting steam turn back into water.
- Other fully correct.

Partially Correct Response

Describes boiling/evaporation step to separate water from salt; condensation step is omitted.
Examples: Maybe if you boiled the salt water the salt would separate from the water.
Take the salt water and boil it and the steam will create great drinking water.

- States 'distillation' or similar but no description of the process is given.
  Examples: The best way is to use a distillation apparatus.
  Distill it.
- Other partially correct.

Incorrect Response

- Mentions boiling but with no or incorrect indication of separation included. [May also mention filtering or other processes.]
  Examples: You can boil it.
- Mentions filtering to separate salt. [Response not based on boiling.]
  Examples: Make it go through a filter.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Singapore	35	▲
Korea, Republic of	22	▲
Estonia	21	▲
Hong Kong, SAR	20	▲
Egypt	20	▲
Japan	19	▲
New Zealand	16	▲
Netherlands	15	▲
Australia	15	▲
England	14	▲
Jordan	13	▲
Iran, Islamic Republic of	12	▲
Lithuania	12	O
Latvia	11	O
Russian Federation	11	O
Slovak Republic	11	O
Israel	11	O
Scotland	10	O
Hungary	10	O
Palestinian Nat'l Auth.	10	O
Bahrain	10	O
Sweden	10	O
International average	**10**	
Armenia	9	O
Slovenia	8	O
Norway	8	O
Chinese Taipei	7	▼
Italy	7	▼
Macedonia, Republic of	7	▼
Saudi Arabia	7	O
United States	6	▼
Bulgaria	6	▼
Morocco	6	▼
Cyprus	5	▼
Romania	5	▼
Malaysia	5	▼
Belgium (Flemish)	4	▼
Lebanon	3	▼
South Africa	3	▼
Chile	3	▼
Serbia and Montenegro	3	▼
Tunisia	2	▼
Ghana	2	▼
Indonesia	2	▼
Philippines	1	▼
Botswana	1	▼
Moldova, Rep. of	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

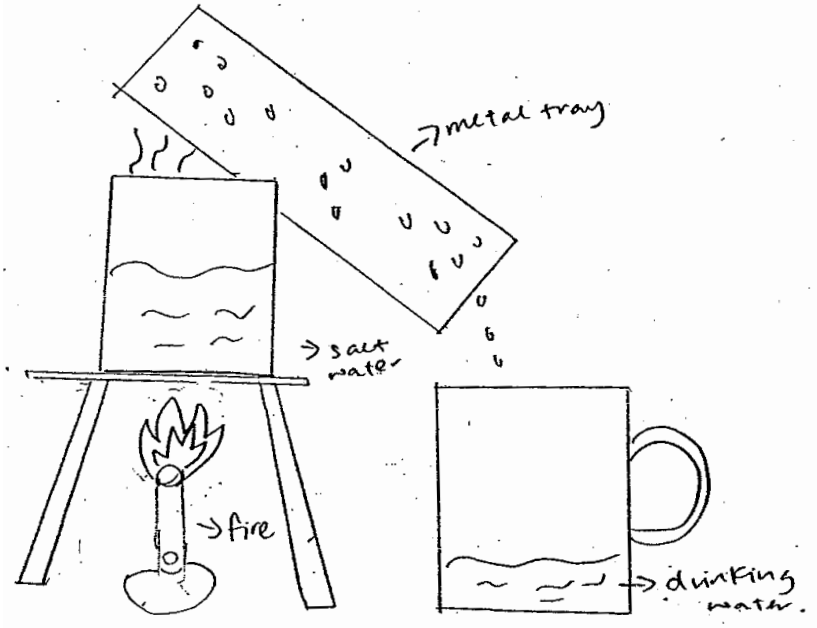
Drinking water from sea water (continued)

Item Number: S032063

Student Responses

Correct Response:

Sea water contains dissolved salts and is not suitable for drinking. Describe a procedure that can be used to obtain a cup of drinking water from a bucket of sea water.



Partially Correct Response:

Sea water contains dissolved salts and is not suitable for drinking. Describe a procedure that can be used to obtain a cup of drinking water from a bucket of sea water.

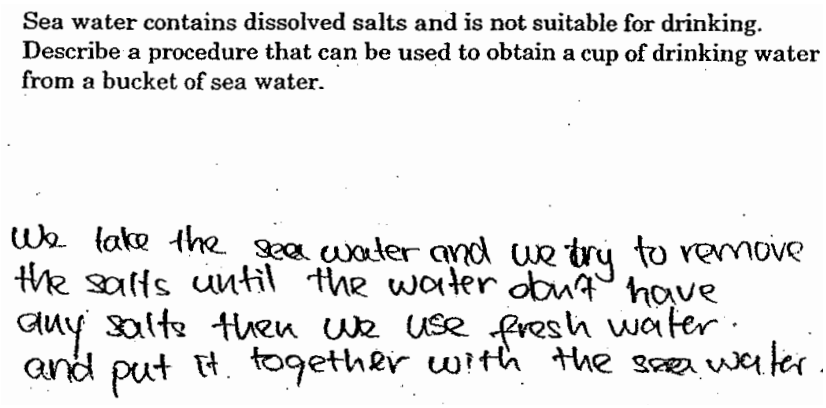
put gladwrap over the bucket and wait for the ~~salt~~ water to evaporate, onto the lunchwrap.

Drinking water from sea water (continued)

Item Number: S032063

Student Responses (continued)

Incorrect Response:


Sea water contains dissolved salts and is not suitable for drinking. Describe a procedure that can be used to obtain a cup of drinking water from a bucket of sea water.

We take the sea water and we try to remove the salts until the water don't have any salts then we use fresh water and put it together with the sea water.

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Cells and Their Functions	Factual Knowledge

Main function of red blood cells

What is the main function of red blood cells?

Ⓐ To fight disease in the body

Ⓑ To carry oxygen to all parts of the body

Ⓒ To remove carbon monoxide from all parts of the body

Ⓓ To produce materials which cause the blood to clot

Item Number: S012038

Correct Response: B

Overall Percent Correct

Singapore	90	▲
England	84	▲
Japan	84	▲
Italy	82	▲
Chinese Taipei	81	▲
Malaysia	77	▲
United States	75	▲
Sweden	75	▲
Australia	74	▲
Netherlands	73	▲
Scotland	70	▲
New Zealand	69	▲
Slovak Republic	69	▲
Hungary	66	▲
Lebanon	66	▲
Indonesia	64	▲
Jordan	64	O
Korea, Republic of	62	O
Israel	61	O
Belgium (Flemish)	60	O
Slovenia	60	O
International average	**60**	
Hong Kong, SAR	59	O
Norway	58	O
Armenia	57	O
Morocco	56	O
Saudi Arabia	56	O
Tunisia	54	▼
Lithuania	54	▼
Bahrain	53	▼
Philippines	53	▼
Estonia	53	▼
Serbia and Montenegro	53	▼
Bulgaria	52	▼
Russian Federation	52	▼
Macedonia, Republic of	52	▼
Cyprus	50	▼
Palestinian Nat'l Auth.	50	▼
Iran, Islamic Republic of	49	▼
Romania	48	▼
Botswana	46	▼
Egypt	45	▼
Moldova, Rep. of	39	▼
Latvia	39	▼
Ghana	36	▼
South Africa	34	▼
Chile	33	▼

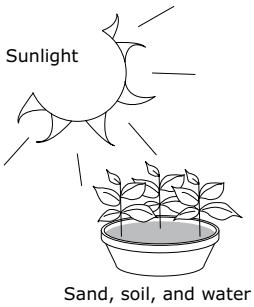
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

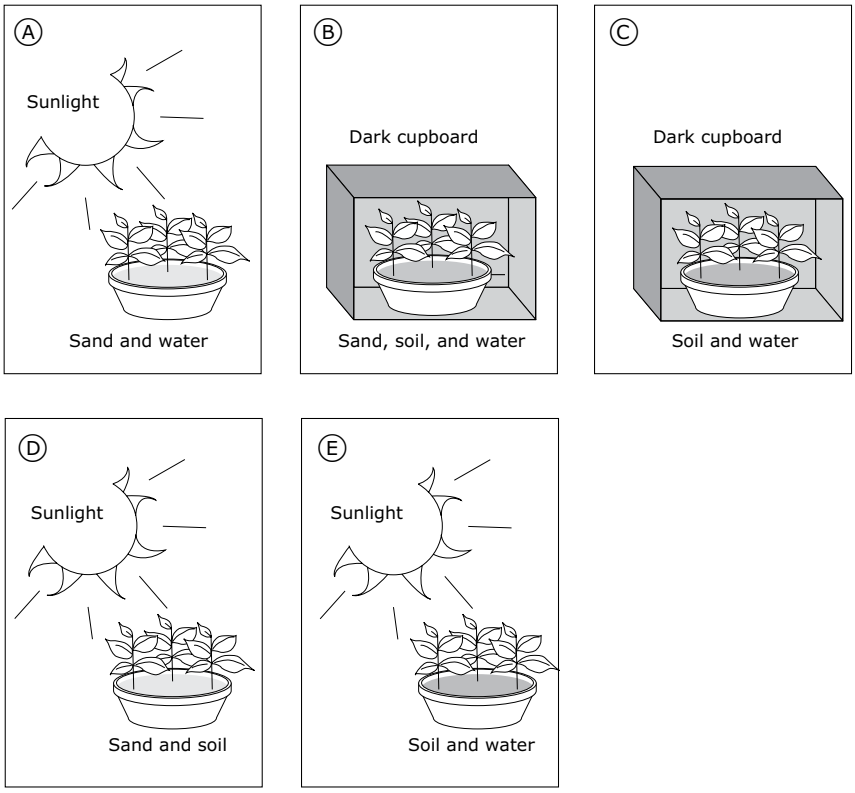
Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Development and Life Cycle of Organisms	Reasoning and Analysis

Plant growth experiment

A girl has an idea that green plants need sand in the soil for healthy growth. In order to test her idea she uses two pots of plants. She sets up one pot of plants as shown below.



Which ONE of the following should she use for the second pot of plants?



Item Number: S022235

Correct Response: E

Overall Percent Correct

Sweden	81	▲
Hungary	76	▲
Hong Kong, SAR	76	▲
Singapore	76	▲
Japan	74	▲
Armenia	73	▲
Estonia	72	▲
Chinese Taipei	72	▲
Norway	72	▲
United States	70	▲
Moldova, Rep. of	68	▲
Romania	67	▲
Australia	67	▲
Scotland	66	▲
Jordan	65	▲
Bulgaria	65	▲
England	65	▲
Russian Federation	65	▲
Italy	64	▲
Chile	64	▲
Israel	63	▲
Saudi Arabia	62	O
New Zealand	62	O
Serbia and Montenegro	62	O
Korea, Republic of	60	O
Netherlands	60	O
Bahrain	60	O
International average	**59**	
Palestinian Nat'l Auth.	58	O
Slovenia	57	O
Slovak Republic	57	O
Lithuania	57	O
Cyprus	56	O
Egypt	55	O
Malaysia	55	O
Morocco	47	▼
Philippines	44	▼
Botswana	44	▼
Lebanon	42	▼
Tunisia	41	▼
Indonesia	39	▼
Latvia	39	▼
Belgium (Flemish)	36	▼
South Africa	34	▼
Ghana	29	▼
Iran, Islamic Republic of	14	▼
Macedonia, Republic of	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Diversity, Adaptation, and Natural Selection	Conceptual Understanding

Fossils in sedimentary rock

The fossils that are found in the oldest layers of sedimentary rock were formed from which types of organisms?

Ⓐ only organisms that lived in the sea

Ⓑ only organisms that lived on land

Ⓒ only organisms that lived in the air

Ⓓ organisms that lived on the land, in the sea and in the air

Item Number: S032083

Correct Response: A

Overall Percent Correct

Japan	79	▲
Korea, Republic of	63	▲
Slovenia	55	▲
Sweden	53	▲
Hungary	49	▲
Hong Kong, SAR	47	▲
Slovak Republic	45	▲
Bulgaria	41	▲
Italy	37	▲
Iran, Islamic Republic of	35	▲
Norway	34	▲
Malaysia	33	▲
Netherlands	32	O
Chinese Taipei	32	▲
Israel	31	O
England	30	O
United States	29	O
Serbia and Montenegro	28	O
International average	**28**	
Lithuania	27	O
Scotland	27	O
Estonia	27	O
Morocco	26	O
Australia	25	O
Belgium (Flemish)	25	▼
Russian Federation	24	▼
Singapore	24	▼
Romania	23	▼
New Zealand	20	▼
Cyprus	19	▼
Moldova, Rep. of	19	▼
Armenia	19	▼
Botswana	17	▼
Lebanon	17	▼
Latvia	17	▼
Egypt	17	▼
Macedonia, Republic of	16	▼
Philippines	15	▼
Bahrain	14	▼
Tunisia	12	▼
Saudi Arabia	12	▼
South Africa	11	▼
Chile	11	▼
Indonesia	10	▼
Ghana	8	▼
Palestinian Nat'l Auth.	0	▼
Jordan	0	▼

Country average vs. International average:

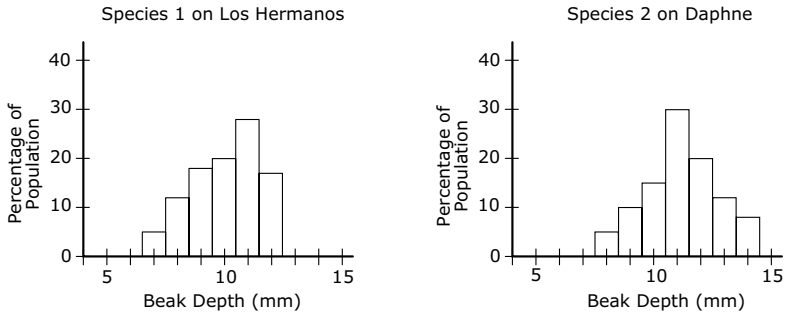
Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
A. LIFE SCIENCE	**Diversity, Adaptation and Natural Selection**	**Reasoning and Analysis**
B. LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Conceptual Understanding

Galapagos Islands: compare beak depths of Species 1 and 2

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



A. How do the beak depths of Species 1 and Species 2 compare?

B. A wide variety of seeds exist on the islands, and both Species 1 and Species 2 eat seeds. Based on the beak depths of the two finch species, what would you conclude about the size of seeds that each species eats?

Item Number: S032706A

Overall Percent Correct

Japan	66	▲
Korea, Republic of	65	▲
Slovenia	56	▲
Belgium (Flemish)	55	▲
Hong Kong, SAR	54	▲
Malaysia	46	▲
Chinese Taipei	46	▲
Singapore	46	▲
United States	45	▲
Latvia	45	▲
Russian Federation	44	▲
New Zealand	43	▲
Estonia	42	▲
Hungary	42	▲
Armenia	41	▲
Australia	41	▲
Sweden	39	▲
Scotland	39	▲
England	39	▲
Lithuania	36	▲
Italy	35	O
Netherlands	34	O
Norway	31	O
International average	**30**	
Romania	29	O
Chile	26	O
Moldova, Rep. of	26	O
Slovak Republic	23	▼
Indonesia	22	▼
Bulgaria	21	▼
Egypt	21	▼
Israel	19	▼
Jordan	19	▼
Iran, Islamic Republic of	18	▼
Macedonia, Republic of	17	▼
Cyprus	17	▼
Morocco	16	▼
Bahrain	14	▼
Serbia and Montenegro	13	▼
Palestinian Nat'l Auth.	12	▼
Tunisia	10	▼
South Africa	6	▼
Saudi Arabia	6	▼
Philippines	4	▼
Botswana	4	▼
Ghana	3	▼
Lebanon	3	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Galapagos Islands: compare beak depths of Species 1 and 2 (continued)

Item Number: S032706A

SCORING

Note: Credit will be given for responses that are consistent with the information in the graphs. This includes responses that are based on similarities, differences, or both. Responses that indicate that the two species are 'similar' must refer to specific information from the graphs, such as the range, average, most frequent beak size (mode), etc., in order to receive credit. Responses that state only that the two species are the 'same' or 'similar' with no supporting information are incorrect.

Correct Response

- Gives a description based on **similarities** that is supported with information in the graphs.
  Examples: Both are similar in average beak size.
  They are similar because they both have most finches in the 11mm beak range.
- Gives description based on **differences** that is supported with information in the graphs.
  Examples: Species 1 is a little bit shorter than Species 2.
  Species 2 has more that are big.
  Species 2 has a wider range of depth than of Species 1.
- Give a description that includes **both** similarities and differences.
  Examples: Both species have the greatest amount of birds with 11mm beak depths, but Species 1 does not have birds with beak depths bigger than 13mm.
- Other correct.

Incorrect Response

- States only that the two species are the 'same' or 'similar' without supporting information from the graphs.
  Examples: They are nearly the same.
- States that one species is larger or smaller than the other, but does not identify which.
  Examples: One of them is a bit different on beak depth.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Galapagos Islands: compare beak depths of Species 1 and 2 (continued)

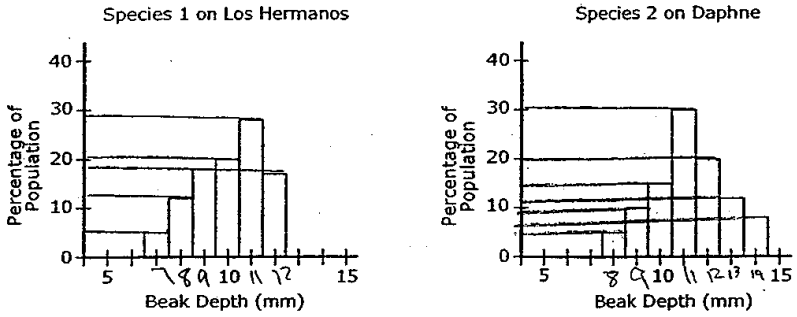
Item Number: S032706A

Student Responses

Correct Response:

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



A. How do the beak depths of Species 1 and Species 2 compare?

Species 2 birds have deeper beaks, and very few birds with beaks under 10mm. Species 1 birds generally have smaller beaks.

Galapagos Islands: compare beak depths of Species 1 and 2 (continued)

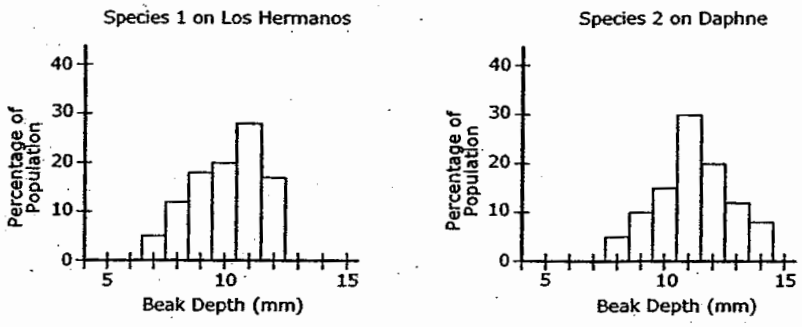
Item Number: S032706A

Student Responses (continued)

Incorrect Response:

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



A. How do the beak depths of Species 1 and Species 2 compare?

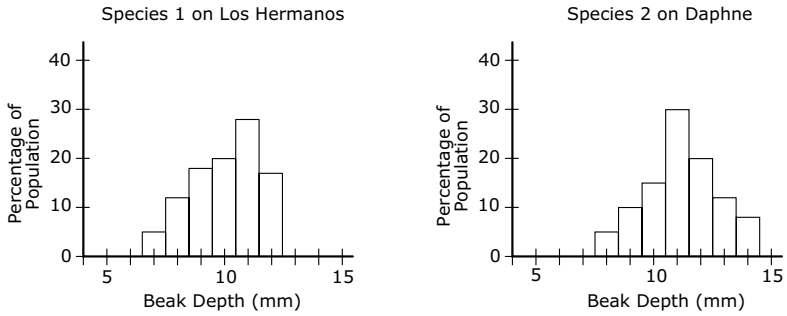
the beak depth is pretty close in graph 1 and 2

Content Domain	Main Topic	Cognitive Domain
A. LIFE SCIENCE	Diversity, Adaptation and Natural Selection	Reasoning and Analysis
B. LIFE SCIENCE	**Structure, Function and Life Processes in Organisms**	**Conceptual Understanding**

Galapagos Islands: size of seeds each species eats

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



A. How do the beak depths of Species 1 and Species 2 compare?

B. A wide variety of seeds exist on the islands, and both Species 1 and Species 2 eat seeds. Based on the beak depths of the two finch species, what would you conclude about the size of seeds that each species eats?

Item Number: S032706B

Overall Percent Correct

Korea, Republic of	59	▲
Japan	51	▲
Estonia	51	▲
Belgium (Flemish)	48	▲
Chinese Taipei	47	▲
Latvia	45	▲
Hong Kong, SAR	45	▲
Singapore	45	▲
England	42	▲
Slovenia	42	▲
Armenia	42	▲
United States	40	▲
Lithuania	39	▲
Malaysia	39	▲
Hungary	37	▲
Netherlands	36	▲
Scotland	34	▲
Australia	33	O
Russian Federation	32	O
New Zealand	32	O
Slovak Republic	31	O
Sweden	29	O
Norway	29	O
Italy	27	O
International average	**27**	
Moldova, Rep. of	26	O
Romania	25	O
Jordan	21	▼
Chile	20	▼
Bahrain	18	▼
Israel	17	▼
Cyprus	15	▼
Egypt	15	▼
Bulgaria	15	▼
Palestinian Nat'l Auth.	14	▼
Macedonia, Republic of	14	▼
Iran, Islamic Republic of	12	▼
Indonesia	12	▼
Tunisia	10	▼
Serbia and Montenegro	10	▼
Morocco	8	▼
Lebanon	7	▼
Botswana	6	▼
Saudi Arabia	4	▼
South Africa	4	▼
Philippines	2	▼
Ghana	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: size of seeds each species eats (continued)

Item Number: S032706B

SCORING

Note: The response to Part B must be consistent with the comparison of beak sizes given in Part A in order to receive credit. Correct responses can refer explicitly to comparisons of the two "species" or more generally to a comparison of "birds" of different sizes within or across species. It is possible that a correct conclusion may be drawn based on an incorrect response to Part A.

Correct Response

- States that the two species eat the same (similar) types of seeds.
  [Response to A indicates that the two species have the same or similar size beaks.]
- States that Species 2 eats larger seeds than Species 1.
  [Response to A indicates that Species 2 is larger.]
- States only that birds (finches) with larger beaks eat larger seeds (or similar).
  [No explicit comparison of the two species.]
- Other correct.

Incorrect Response

- States that the two species eat the same (similar) types of seeds, but this conclusion is inconsistent with the response given in Part A.
- States that one species eats larger seeds than the other, but this conclusion is inconsistent with the response given in Part A.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Galapagos Islands: size of seeds each species eats (continued)

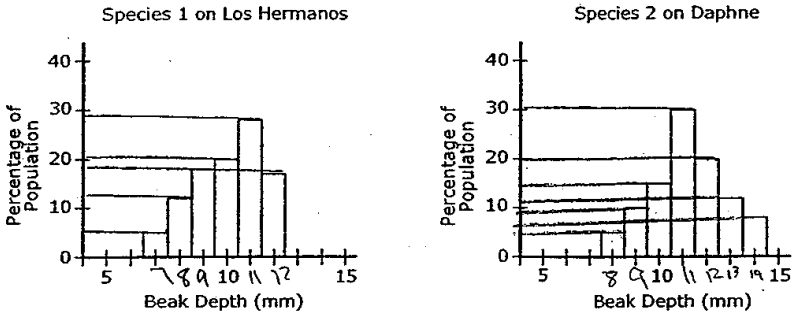
Item Number: S032706B

Student Responses

Correct Response:

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



B. A wide variety of seeds exist on the islands, and both Species 1 and Species 2 eat seeds. Based on the beak depths of the two finch species, what would you conclude about the size of seeds that each species eats?

Species 1 would eat the smaller seeds, because they are smaller birds. Species 2 would likely eat larger seeds.

Galapagos Islands: size of seeds each species eats (continued)

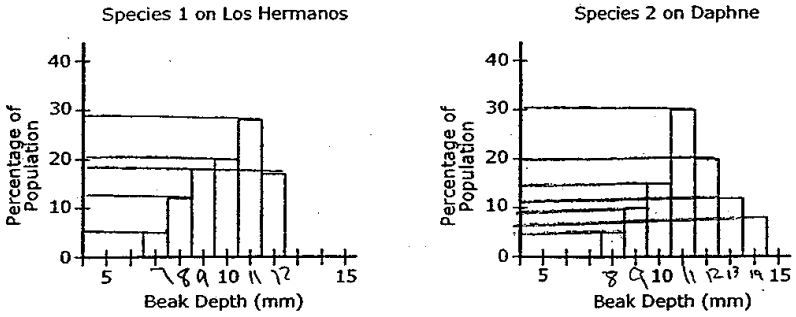
Item Number: S032706B

Student Responses (continued)

Incorrect Response:

The Galapagos Islands contain a number of different species of finches (birds) that are thought to have developed from one species. Some species of finches eat certain types of seeds depending on their beak depth. The diagram below shows the head of one species of finch and its beak depth.

Some of the islands have only one species living on them, while other islands have more than one species. Species 1 lives on Los Hermanos Island. Species 2 lives on Daphne Island. The two graphs below show the percentage of the population with different beak depths for each of the two species.



B. A wide variety of seeds exist on the islands, and both Species 1 and Species 2 eat seeds. Based on the beak depths of the two finch species, what would you conclude about the size of seeds that each species eats?

I will check in each species 1 and 2 how much they eat each day.

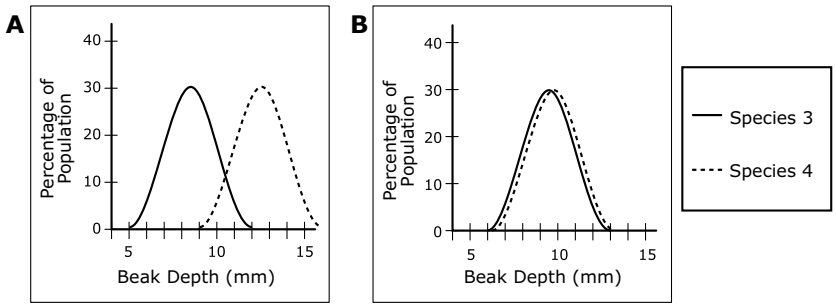
Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Diversity, Adaptation and Natural Selection	Reasoning and Analysis

Galapagos Islands: graphs of beak depths for Species 3 and 4

Two other species (Species 3 and Species 4) live on Santa Maria Island, which also has a range of seed types.

Which of the following graphs shows a range of beak depths for Species 3 and Species 4 that would best insure the survival of both species on Santa Maria Island?

(Circle the letter by the correct graph.)



Explain why this range of beak depths would be best.

Item Number: S032707

SCORING

Correct Response

Note: For credit, responses must identify A with an explanation based on reduced competition for food as a result of beak size differences. Credit is NOT given for responses that identify A with a minimal explanation that indicates a correct interpretation of the graph but refers only to differences in beak size.

Correct Response

- **A** with an explanation that relates the difference in beak size to reduced competition (or similar).
  Examples: With the different sized beaks they would not have to share food.
  One species will eat the small seeds and one will eat the large seeds.
  There would be no competition between the two species if they ate different seeds.
  They each have their own food source.
- Other correct.

Incorrect Response

- **A** with a minimal explanation that refers only to the difference in beak size. [Does not explicitly mention competition for seeds or similar.]
  Examples: Because they are different sizes.
  Because Species 3 has a smaller beak size.
- **A** with no explanation or an incorrect explanation.
  Examples: Because their beaks look sharper.
  Because both species have a large beak to the percentage of population.
  It's like the other graphs.
- **B** with no explanation or an incorrect explanation.
  Examples: Bigger beak depths so they could eat more seeds.
  Both are nearly equal and are a more normal size.
  It's better if they are the same size because they eat the same seeds.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Singapore	37	▲
Chinese Taipei	36	▲
Korea, Republic of	26	▲
Hong Kong, SAR	26	▲
Scotland	26	▲
Estonia	25	▲
Australia	25	▲
Sweden	23	▲
United States	23	▲
New Zealand	22	▲
Belgium (Flemish)	21	▲
Lithuania	21	▲
England	21	▲
Norway	15	▲
Slovenia	14	O
Japan	13	O
Slovak Republic	12	O
Latvia	12	O
Italy	11	O
International average	**11**	
Russian Federation	9	O
Netherlands	9	O
Hungary	8	O
Israel	8	▼
Romania	8	O
Malaysia	4	▼
Chile	4	▼
Serbia and Montenegro	4	▼
Palestinian Nat'l Auth.	3	▼
Jordan	3	▼
Bulgaria	3	▼
Bahrain	2	▼
South Africa	2	▼
Egypt	2	▼
Armenia	2	▼
Moldova, Rep. of	2	▼
Macedonia, Republic of	2	▼
Indonesia	1	▼
Philippines	1	▼
Botswana	1	▼
Iran, Islamic Republic of	1	▼
Morocco	1	▼
Lebanon	1	▼
Cyprus	1	▼
Saudi Arabia	1	▼
Tunisia	1	▼
Ghana	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: graphs of beak depths for Species 3 and 4 (continued)

Item Number: S032707

Student Responses

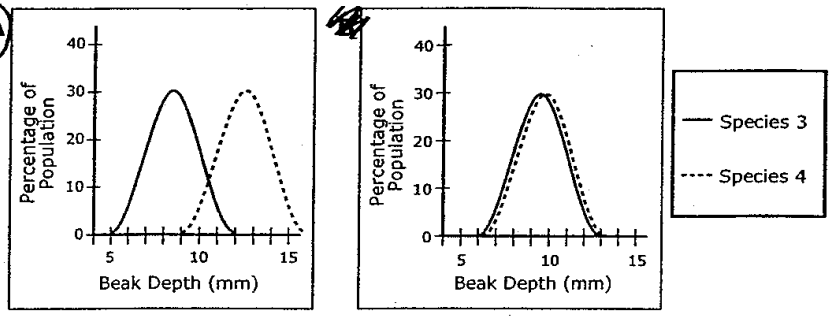
Correct Response:

Two other species (Species 3 and Species 4) live on Santa Maria Island, which also has a range of seed types.

Which of the following graphs shows a range of beak depths for Species 3 and Species 4 that would best insure the survival of both species on Santa Maria Island?

(Circle the letter by the correct graph.)

A



Explain why this range of beak depths would be best.

It is best if the 2 types of birds eat different sized food so they don't have to fight each other for food and can live in peaceful coexistance and not kill each other off fighting for food

Galapagos Islands: graphs of beak depths for Species 3 and 4 (continued)

Item Number: S032707

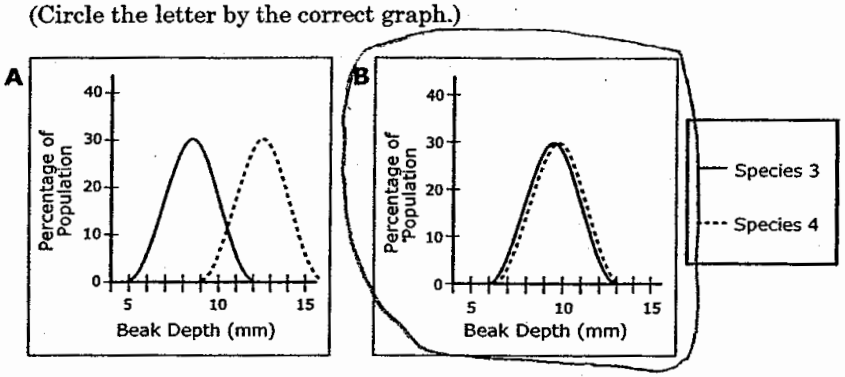
Student Responses (continued)

Incorrect Response:

Two other species (Species 3 and Species 4) live on Santa Maria Island, which also has a range of seed types.

Which of the following graphs shows a range of beak depths for Species 3 and Species 4 that would best insure the survival of both species on Santa Maria Island?

(Circle the letter by the correct graph.)



Explain why this range of beak depths would be best.

They would be good for picking seeds.

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: plants/animals inhabited island first

Which organisms that live on land most likely inhabited the Galapagos Islands first?

(Check one box.)

☐ Land plants

☐ Land animals

Explain your answer.

Item Number: S032704

SCORING

Note: Credit is given for responses that check PLANTS and give an explanation that refers explicitly to **photosynthesis** or plants making their own food as well those that refer only to the survival or mode of transportation of plants/animals. Responses that check ANIMALS may also receive credit with a reasonable explanation based on transportation and the availability of alternative food sources, e.g., fish.

Correct Response

- **PLANTS** with an explanation based plants being able to make their own food (**photosynthesis**).
  Examples: Plants can photosynthesize.
  Because plant make their own food using light, water and chlorophyll.
- **PLANTS** with an explanation based only on survival OR mode of transportation of plants/animals. [Photosynthesis or making food not explicitly mentioned.]
  Examples: They could survive there first because plants only need water and air.
  Without plants there would not be animals.
  First the plants arrived. Then the animals can come and survive by eating the plants.
  Seeds could just be carried by the wind. Animals would have to swim a long distance.
  Seeds from South America blew to the islands.
- **ANIMALS** with a reasonable explanation based on transportation **AND** availability of alternative food sources (may be implicit based on the specific type of animal named).
  Examples: Birds could fly over to the island to nest and survive by eating fish from the sea.
  Seals can swim there and live on the rocky shore. [Assumes seals eat fish.]
- Other correct.

Incorrect Response

- **PLANTS** with no explanation or an incorrect explanation. [May include a correct statement that does not apply to the situation.]
  Examples: They just grew from the ground.
  Because plants grow faster and live longer.
  They are living organisms.
  Plants were on Earth before animals.
- **ANIMALS** with no explanation or an incorrect explanation.
  Examples: Birds could just eat the seeds in the ground.
  They are everywhere.
  There will be a surplus of food.
  Animals can move but plants cannot.
  Animals migrate.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Estonia	62	▲
Armenia	55	▲
Singapore	49	▲
New Zealand	49	▲
Japan	48	▲
Latvia	48	▲
Lithuania	48	▲
United States	48	▲
Sweden	46	▲
Norway	44	▲
Hungary	44	▲
Australia	44	▲
Russian Federation	43	▲
Belgium (Flemish)	42	▲
Netherlands	42	▲
England	42	▲
Slovak Republic	41	▲
Korea, Republic of	40	▲
Hong Kong, SAR	40	▲
Scotland	38	▲
Chinese Taipei	38	▲
Malaysia	35	O
Slovenia	33	O
International average	**31**	
Jordan	30	O
Moldova, Rep. of	29	O
Israel	25	▼
Chile	23	▼
Cyprus	22	▼
Romania	22	▼
Palestinian Nat'l Auth.	21	▼
Italy	21	▼
Serbia and Montenegro	20	▼
Macedonia, Republic of	19	▼
Bulgaria	18	▼
Bahrain	16	▼
Lebanon	16	▼
Iran, Islamic Republic of	15	▼
Indonesia	14	▼
Egypt	12	▼
Tunisia	10	▼
Morocco	10	▼
South Africa	9	▼
Botswana	7	▼
Philippines	6	▼
Saudi Arabia	1	▼
Ghana	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: plants/animals inhabited island first (continued)

Item Number: S032704

Student Responses

Correct Response:

Which organisms that live on land most likely inhabited the Galapagos Islands first?

(Check one box.)

☑ Land plants

☐ Land animals

Explain your answer. Without land plants the earth would not be able to have land Animals

Incorrect Response:

Which organisms that live on land most likely inhabited the Galapagos Islands first?

(Check one box.)

☐ Land plants

■ Land animals

Explain your answer. It does because it gets use to the living.

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: effect of cats

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

A. One effect of **cats**:

B. One effect of **goats**:

Item Number: S032705A

SCORING

Correct Response

- Refers to cats preying upon other organisms, or similar (resulting in a reduction in population).
  Examples: They will eat the birds and other animals.
  The cats help them by eating the rats and mice.
  Their prey could become extinct.
- Other correct.
  Examples: They might pass on diseases to other animals.

Incorrect Response

- Refers **only** to an effect on the cat with no explicit effect on other organisms.
  Examples: They cannot survive on the island.
  Cats might reproduce and get out of control.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).
  Examples: The cats might eat all the plants.

Overall Percent Correct

Australia	68	▲
New Zealand	66	▲
Estonia	59	▲
Chinese Taipei	58	▲
Armenia	56	▲
Singapore	54	▲
Slovak Republic	52	▲
Lithuania	49	▲
Netherlands	47	▲
Russian Federation	46	▲
Hungary	46	▲
Belgium (Flemish)	46	▲
Latvia	45	▲
United States	45	▲
Hong Kong, SAR	45	▲
England	45	▲
Romania	43	▲
Norway	42	O
Sweden	41	O
Scotland	41	O
Korea, Republic of	40	O
Japan	40	O
Jordan	39	O
International average	**36**	
Palestinian Nat'l Auth.	36	O
Malaysia	35	O
Slovenia	33	O
Serbia and Montenegro	33	O
Chile	30	▼
Israel	29	▼
Cyprus	28	▼
Egypt	27	▼
Tunisia	27	▼
Bulgaria	26	▼
Moldova, Rep. of	26	▼
Italy	24	▼
Bahrain	23	▼
Iran, Islamic Republic of	22	▼
Botswana	21	▼
Indonesia	20	▼
Lebanon	16	▼
South Africa	14	▼
Morocco	12	▼
Saudi Arabia	9	▼
Macedonia, Republic of	8	▼
Philippines	8	▼
Ghana	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: effect of cats (continued)

Item Number: S032705A

Student Responses

Correct Response:

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

A. One effect of **cats**:

Cats could [illegible] scare away some of the smaller animals already settled there.

Incorrect Response:

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

A. One effect of **cats**: lion & Tiger

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: effect of goats

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

A. One effect of **cats**:

B. One effect of **goats**:

Item Number: S032705B

SCORING

Correct Response

- Refers **only** to the goats eating plants (resulting in a reduction of the amount of plant life on the island).
  Examples: The goats will eat all the grass on the island.
  It could lead to erosion if the goats clear the land by eating all the plants.
  Large pieces of grass will disappear as the goats eat it.
- Refers to an effect of the goat on other animals (e.g., competition for food/habitat, as a food source for predators, etc.). [Note: may also refer to the goats eating plants.]
  Examples: The animals that eat goats would have more food.
  They might become a source of food.
  The goats will eat up the plants and the populations that depend on plants will decrease.
- Other correct.

Incorrect Response

- Refers **only** to an effect on the goat with no explicit effect on other organisms.
  Examples: Goats would have more babies.
  They would die because they don't have any food.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).
  Examples: Goats might eat the cats.

Overall Percent Correct

Singapore	74	▲
Australia	74	▲
Chinese Taipei	73	▲
Korea, Republic of	70	▲
Hong Kong, SAR	69	▲
Estonia	69	▲
New Zealand	68	▲
Malaysia	63	▲
England	62	▲
United States	60	▲
Hungary	58	▲
Russian Federation	58	▲
Netherlands	58	▲
Scotland	57	▲
Armenia	57	▲
Japan	54	▲
Slovak Republic	53	▲
Lithuania	51	▲
Sweden	48	O
Latvia	48	O
Jordan	48	O
Belgium (Flemish)	47	O
Palestinian Nat'l Auth.	45	O
Romania	45	O
International average	**45**	
Norway	44	O
Chile	41	O
Israel	38	▼
Egypt	37	▼
Slovenia	37	▼
Serbia and Montenegro	37	▼
Italy	36	▼
Indonesia	34	▼
Tunisia	33	▼
Bulgaria	32	▼
Bahrain	32	▼
Botswana	31	▼
Cyprus	27	▼
Macedonia, Republic of	25	▼
Philippines	24	▼
Moldova, Rep. of	22	▼
Lebanon	22	▼
Iran, Islamic Republic of	20	▼
Morocco	15	▼
Saudi Arabia	11	▼
South Africa	8	▼
Ghana	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: effect of goats (continued)

Item Number: S032705B

Student Responses

Correct Response:

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

B. One effect of **goats**:

Goats could eat all the vegetation, causing the other animals to not have food.

Incorrect Response:

When settlers came to live on the Galapagos Islands, they brought with them a number of new animals such as cats and goats. Write down one effect the introduction of cats and goats could have on the animals and plants already living on the islands.

B. One effect of **goats**: horse + cow

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Factual Knowledge

Elements that make up animals and plants

Animals and plants are made up of a number of different chemical elements. What happens to all of these elements when animals and plants die?

Ⓐ They die with the animal or plant.

Ⓑ They evaporate into the atmosphere.

Ⓒ They are recycled back into the environment.

Ⓓ They change into different elements.

Item Number: S032682

Correct Response: C

Overall Percent Correct

Chinese Taipei	70	▲
Estonia	70	▲
Hungary	69	▲
Singapore	63	▲
Sweden	61	▲
United States	60	▲
Tunisia	55	▲
Australia	54	▲
Philippines	53	▲
New Zealand	52	▲
Japan	51	▲
Korea, Republic of	48	▲
Hong Kong, SAR	46	▲
England	45	▲
Romania	44	▲
Israel	44	▲
Italy	44	▲
Norway	42	O
Slovenia	40	O
Slovak Republic	40	O
Morocco	38	O
Netherlands	38	O
International average	**38**	
Macedonia, Republic of	36	O
Bulgaria	36	O
Scotland	34	O
Iran, Islamic Republic of	33	▼
Russian Federation	32	▼
Malaysia	32	▼
Chile	30	▼
Botswana	29	▼
Egypt	28	▼
Palestinian Nat'l Auth.	25	▼
Armenia	25	▼
Moldova, Rep. of	24	▼
Latvia	24	▼
Belgium (Flemish)	24	▼
Saudi Arabia	22	▼
Cyprus	22	▼
Indonesia	21	▼
South Africa	21	▼
Jordan	21	▼
Lithuania	20	▼
Lebanon	20	▼
Ghana	17	▼
Serbia and Montenegro	15	▼
Bahrain	14	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Reasoning and Analysis

Community of mice, snakes and wheat plants

The diagram above shows a community consisting of mice, snakes and wheat plants.

What would happen to this community if people killed the snakes?

Item Number: S032202

SCORING

Note: For full credit, responses must include an explicit statement of the effect on BOTH the mice population and the wheat plants. Partial credit is given for responses that refer to one but not both of these.

Correct Response

- States that mice (population) will increase AND wheat plants will decrease.
  Examples: The population of mice would increase because there are no snakes. The increase in mice would then cause the amount of wheat plants to decrease.
  Then we would get more mice and less wheat plants.
- States that the mice would eat more (all) of the wheat plants AND that the mice (population) will decrease as the wheat decreases. [May also refer to the initial increase in population of mice.]
  Examples: Mice would eat all the plants, then the plants would die out, then the mice would not have anything to eat so then they would die.
  Mice would become overpopulated and eat all the wheat. Then all the mice would starve because there is no food left.
- Other fully correct.

Partially Correct Response

- States **only** that the mice will increase. [No explicit mention of the effect on wheat.]
  Examples: The number of mice would increase because there are no snakes to eat them.
  There would be lots of mice.
- States only that the mice will eat more (all) of the wheat plants (or similar). [No explicit mention of the effect on mice.]
  Examples: If people killed the snakes the mice would destroy all the wheat plants.
- Other partially correct.

Incorrect Response

- Refers to an effect on the whole community (ecosystem) but too vague to interpret.
  Examples: The whole community will be affected.
  The ecosystem would be unbalanced.
  Everything dies.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Singapore	78	▲
Malaysia	68	▲
England	57	▲
Chinese Taipei	55	▲
Estonia	52	▲
Australia	50	▲
Sweden	48	▲
Hungary	48	▲
Belgium (Flemish)	46	▲
Netherlands	45	▲
United States	44	▲
Scotland	42	▲
Slovak Republic	41	▲
Lithuania	41	▲
Iran, Islamic Republic of	40	▲
Jordan	39	▲
Russian Federation	38	▲
Korea, Republic of	38	▲
Hong Kong, SAR	37	O
Romania	37	O
New Zealand	35	O
Egypt	34	O
Armenia	34	O
International average	**33**	
Slovenia	33	O
Latvia	32	O
Serbia and Montenegro	32	O
Macedonia, Republic of	32	O
Japan	31	O
Norway	31	O
Indonesia	30	O
Israel	30	▼
Italy	27	▼
Moldova, Rep. of	26	▼
Tunisia	26	▼
Saudi Arabia	24	▼
Bulgaria	22	▼
Cyprus	18	▼
Chile	16	▼
Bahrain	16	▼
Palestinian Nat'l Auth.	16	▼
Morocco	16	▼
Philippines	16	▼
Lebanon	9	▼
Botswana	6	▼
South Africa	6	▼
Ghana	3	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Community of mice, snakes and wheat plants (continued)

Item Number: S032202

Student Responses

Correct Response:

The diagram above shows a community consisting of mice, snakes and wheat plants.

What would happen to this community if people killed the snakes?

The mice would become overpopulated and eat all the wheat plants.

Partially Correct Response:

The diagram above shows a community consisting of mice, snakes and wheat plants.

What would happen to this community if people killed the snakes?

If they killed the snakes, then the snakes wouldn't be able to eat the mice. Then the mice would eat up the wheat plants.

Community of mice, snakes and wheat plants (continued)

Item Number: S032202

Student Responses (continued)

Incorrect Response:

The diagram above shows a community consisting of mice, snakes and wheat plants.

What would happen to this community if people killed the snakes?

It wouldn't be a community anymore because who would eat the mice!

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Human Health	Factual Knowledge

Leafy vegetables important for human health

Eating leafy vegetables is important for human health. This is because leafy vegetables are a good source of which of the following?

Ⓐ protein
Ⓑ carbohydrates
Ⓒ minerals
Ⓓ fat

Item Number: S032637

Correct Response: C

Overall Percent Correct

Korea, Republic of	65	▲
Japan	65	▲
Slovenia	63	▲
Israel	62	▲
Chinese Taipei	59	▲
Estonia	58	▲
Hungary	57	▲
England	55	▲
Netherlands	53	▲
Singapore	52	▲
United States	48	▲
Macedonia, Republic of	46	▲
Belgium (Flemish)	46	▲
Italy	45	▲
New Zealand	44	▲
Latvia	42	▲
Malaysia	41	▲
Hong Kong, SAR	41	O
Bulgaria	41	O
Australia	40	O
Lithuania	40	O
International average	**38**	
Scotland	37	O
Romania	34	O
Egypt	34	O
Serbia and Montenegro	34	▼
Morocco	33	O
Sweden	33	▼
Moldova, Rep. of	32	▼
Norway	32	▼
Bahrain	30	▼
Palestinian Nat'l Auth.	29	▼
Philippines	28	▼
Lebanon	28	▼
Iran, Islamic Republic of	28	▼
Tunisia	28	▼
Russian Federation	28	▼
Jordan	25	▼
Chile	24	▼
Armenia	24	▼
Slovak Republic	24	▼
Botswana	23	▼
Saudi Arabia	20	▼
South Africa	20	▼
Ghana	19	▼
Indonesia	17	▼
Cyprus	9	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Human Health	Reasoning and Analysis

Transmission of cold in classroom

Scott went to school with a cold. Several days later, half of his classmates also had colds. What is one likely reason some classmates had colds but others did not?

Item Number: S022154

SCORING

Note: To receive credit, responses must include some reference to transmission of 'germs' (viruses, bacteria, etc.), either explicitly or through a description of a method of transmission (sneezing/coughing, direct physical contact, etc.), or to defense mechanisms (immunity, resistance, etc.). A response that includes only a general reference to proximity without any description of a method of transmission will be scored as incorrect.

Correct Response

- Refers explicitly to transmission of 'germs' (viruses, bacteria, etc.) from Salil to some classmates (or not to others).
  Examples: Some students were hanging around Salil with him sneezing his germs onto them.
  The ones exposed to the virus caught it.
- Refers to some students having better defense mechanisms (immunity, resistance).
  Examples: Some of the students have just got over a cold.
  Some students' immunity was low because they went outside in the cold.
- Refers to a specific method of transmission involving physical contact or exposure without mentioning germs explicitly (e.g. sneezing/coughing, shaking hands, drinking from same glass, breathing same air).
  Examples: He sneezed on the ones that got it.
  They touched something Salil touched.
- Other correct.

Incorrect Response

- Includes ONLY a general or vague response relating to proximity or "catching the cold" from Salil. [No explicit description of a method of transmission is given.]
  Examples: Some of his classmates did not like him so probably were not near him a lot.
  The ones who were his friends got it.
  The kids who sat by him caught the cold.
  Some caught it from Salil.
  Salil gave it to some of the class.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	84	▲
Slovak Republic	78	▲
Hungary	75	▲
Singapore	73	▲
Romania	71	▲
Slovenia	70	▲
Estonia	69	▲
Hong Kong, SAR	68	▲
Latvia	68	▲
Palestinian Nat'l Auth.	68	▲
Belgium (Flemish)	67	▲
Lithuania	66	▲
Armenia	66	▲
Netherlands	65	▲
Norway	65	▲
Moldova, Rep. of	64	▲
Sweden	63	▲
Jordan	63	▲
United States	61	▲
Italy	60	▲
Korea, Republic of	57	▲
Iran, Islamic Republic of	57	O
Israel	56	O
Russian Federation	54	O
Bahrain	54	O
Egypt	54	O
Serbia and Montenegro	54	O
New Zealand	54	O
Bulgaria	53	O
Macedonia, Republic of	53	O
International average	**53**	
England	50	O
Chile	48	▼
Scotland	47	▼
Australia	46	▼
Malaysia	43	▼
Japan	43	▼
Indonesia	39	▼
Cyprus	37	▼
Saudi Arabia	37	▼
Philippines	34	▼
Morocco	31	▼
Lebanon	24	▼
Tunisia	18	▼
South Africa	13	▼
Botswana	10	▼
Ghana	6	▼

Country average vs. International average:

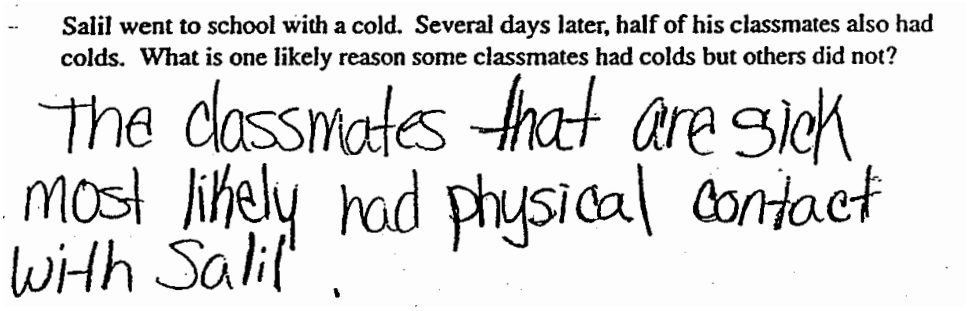
Higher	▲
Not different	O
Lower	▼

Transmission of cold in classroom (continued)

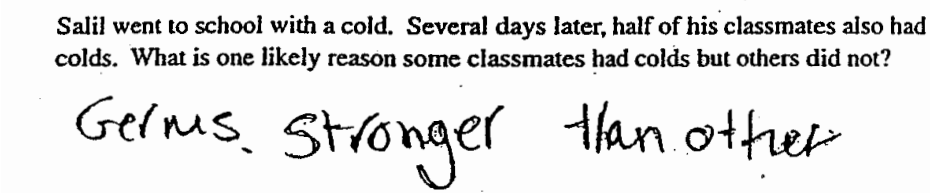
Item Number: S022154

Student Responses

Correct Response:



Incorrect Response:



Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Reproduction and Heredity	Conceptual Understanding

Son inherits traits

A son can inherit traits

Ⓐ only from his father

Ⓑ only from his mother

Ⓒ from both his father and his mother

Ⓓ from either his father or his mother, but not from both

Item Number: S012026

Correct Response: C

Overall Percent Correct

Netherlands	94	▲
United States	93	▲
Latvia	92	▲
Belgium (Flemish)	92	▲
Chinese Taipei	91	▲
England	91	▲
Hungary	91	▲
Norway	90	▲
Sweden	90	▲
Korea, Republic of	90	▲
Russian Federation	90	▲
Lithuania	89	▲
Romania	88	▲
Chile	87	▲
Slovak Republic	87	▲
Italy	87	▲
Hong Kong, SAR	86	▲
Scotland	86	▲
Israel	85	▲
Estonia	85	▲
Slovenia	85	▲
Bulgaria	83	▲
Moldova, Rep. of	83	▲
Cyprus	82	▲
Armenia	82	▲
Macedonia, Republic of	81	▲
Singapore	79	O
Australia	77	O
International average	**76**	
Serbia and Montenegro	75	O
New Zealand	73	O
Iran, Islamic Republic of	69	▼
Egypt	68	▼
Japan	65	▼
Lebanon	65	▼
Bahrain	64	▼
Morocco	63	▼
Philippines	60	▼
Jordan	60	▼
Tunisia	60	▼
Palestinian Nat'l Auth.	57	▼
Saudi Arabia	52	▼
South Africa	51	▼
Ghana	48	▼
Malaysia	47	▼
Indonesia	44	▼
Botswana	43	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Reproduction and Heredity	Conceptual Understanding

Traits transferred from generations

Traits are transferred from generation to generation through the

Ⓐ sperm only
Ⓑ egg only
Ⓒ sperm and the egg
Ⓓ testes

Item Number: S012039

Correct Response: C

Overall Percent Correct

Chinese Taipei	97	▲
Hong Kong, SAR	97	▲
Korea, Republic of	91	▲
Hungary	88	▲
England	88	▲
Sweden	87	▲
Netherlands	86	▲
Singapore	86	▲
United States	86	▲
Israel	85	▲
Scotland	83	▲
Estonia	83	▲
Belgium (Flemish)	83	▲
Chile	83	▲
Romania	80	▲
Slovak Republic	79	▲
Italy	79	▲
Malaysia	79	▲
Norway	78	▲
Latvia	77	▲
Bulgaria	76	O
Philippines	76	O
Japan	76	O
Slovenia	76	O
Bahrain	75	O
Russian Federation	74	O
International average	**74**	
Australia	73	O
Lithuania	72	O
Egypt	71	O
Armenia	71	O
New Zealand	70	O
Moldova, Rep. of	68	▼
Macedonia, Republic of	68	▼
Serbia and Montenegro	67	▼
Indonesia	67	▼
Morocco	66	▼
Tunisia	64	▼
Cyprus	63	▼
Palestinian Nat'l Auth.	62	▼
Jordan	57	▼
Botswana	57	▼
Saudi Arabia	52	▼
South Africa	52	▼
Iran, Islamic Republic of	50	▼
Ghana	50	▼
Lebanon	37	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Reproduction and Heredity	Conceptual Understanding

Biological control of insect population

Why would male insects be treated to prevent sperm production?

Ⓐ To increase the number of female insects

Ⓑ To reduce the total population of insects

Ⓒ To produce new species of insects

Ⓓ To prevent insects from mating

Item Number: S022117

Correct Response: B

Overall Percent Correct

United States	71	▲
Australia	69	▲
Singapore	68	▲
England	67	▲
New Zealand	66	▲
Scotland	65	▲
Belgium (Flemish)	62	▲
Sweden	60	▲
Israel	59	▲
Slovak Republic	58	▲
Malaysia	57	▲
Netherlands	57	▲
Japan	54	▲
Korea, Republic of	53	▲
Hong Kong, SAR	52	▲
Bulgaria	52	▲
Hungary	50	▲
Lithuania	49	▲
Estonia	47	O
Norway	47	O
Botswana	46	O
Serbia and Montenegro	46	O
Chile	45	O
International average	**44**	
Italy	44	O
Chinese Taipei	44	O
Bahrain	42	O
Indonesia	42	O
Jordan	41	▼
Latvia	40	▼
Romania	39	▼
Slovenia	38	▼
Cyprus	37	▼
Macedonia, Republic of	34	▼
Philippines	33	▼
Russian Federation	32	▼
Palestinian Nat'l Auth.	31	▼
Armenia	29	▼
Ghana	28	▼
Egypt	27	▼
Iran, Islamic Republic of	27	▼
Moldova, Rep. of	25	▼
Tunisia	25	▼
Morocco	23	▼
South Africa	21	▼
Lebanon	19	▼
Saudi Arabia	17	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Reproduction and Heredity	Factual Knowledge

Fertilization in animals

Which of the following takes place during fertilization in animals?

Ⓐ production of sperm and egg

Ⓑ joining of sperm and egg

Ⓒ division of egg

Ⓓ development of embryo

Item Number: S032008

Correct Response: B

Overall Percent Correct

Hong Kong, SAR	88	▲
Lithuania	87	▲
Chinese Taipei	86	▲
Estonia	85	▲
Japan	85	▲
Korea, Republic of	83	▲
Belgium (Flemish)	82	▲
Hungary	78	▲
England	77	▲
Netherlands	75	▲
Latvia	75	▲
Russian Federation	74	▲
Israel	73	▲
Sweden	72	▲
Morocco	69	▲
Slovak Republic	69	▲
Bulgaria	68	▲
United States	67	▲
Scotland	67	▲
Tunisia	67	▲
Slovenia	66	▲
Australia	65	▲
Singapore	64	▲
Malaysia	63	O
International average	**60**	
Norway	60	O
Cyprus	57	O
New Zealand	56	O
Jordan	56	O
Italy	55	▼
Bahrain	54	▼
Serbia and Montenegro	53	▼
Palestinian Nat'l Auth.	50	▼
Indonesia	48	▼
Chile	47	▼
Macedonia, Republic of	47	▼
Egypt	47	▼
Armenia	46	▼
Romania	44	▼
Saudi Arabia	40	▼
South Africa	39	▼
Moldova, Rep. of	38	▼
Botswana	37	▼
Lebanon	37	▼
Philippines	31	▼
Iran, Islamic Republic of	22	▼
Ghana	19	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Conceptual Understanding

Bodily process to prevent overheating

What processes take place in the human body that prevent it from overheating during exercise?

Item Number: S022152

SCORING

Note: If perspiration or sweating is mentioned, score as correct, even if other correct responses such as increased blood flow to the skin are also included.

Correct Response

- Refers to perspiration (sweating) AND the cooling effect of evaporation.
  Examples: When people sweat, it evaporates to cool them down.
  Sweating. When the sweat evaporates, it cools the skin.
  Perspiration cools you down when it evaporates.
- Refers to perspiration (sweating), without explicitly mentioning the cooling effect of evaporation.
  Examples: The body sweats.
  Perspiration keeps you from overheating.
  The perspiration cools you off and you don't stay hot.
- Refers to increased blood flow to the skin.
  Examples: The blood rushes to your face and cools you down.
- Other correct.

Incorrect Response

- Refers only to drinking water to cool down.
- Refers to an effect of exercise but does not specifically address overheating and/or cooling.
  Examples: The blood pumps faster.
  Breathing increases.
  Your body is working hard and using up more food energy.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Japan	86	▲
Korea, Republic of	85	▲
Australia	72	▲
United States	72	▲
New Zealand	69	▲
Scotland	69	▲
Estonia	67	▲
England	66	▲
Belgium (Flemish)	63	▲
Lithuania	61	▲
Latvia	61	▲
Netherlands	61	▲
Hong Kong, SAR	60	▲
Israel	59	▲
Italy	55	▲
Hungary	55	▲
Russian Federation	55	▲
Bulgaria	50	▲
Slovenia	48	▲
Singapore	48	▲
Sweden	47	O
Slovak Republic	45	O
Armenia	45	O
Moldova, Rep. of	44	O
International average	**44**	
Malaysia	42	O
Romania	42	O
Serbia and Montenegro	41	O
Norway	41	O
Chinese Taipei	39	▼
Chile	37	▼
Bahrain	35	▼
Iran, Islamic Republic of	32	▼
Saudi Arabia	31	▼
Macedonia, Republic of	29	▼
Jordan	29	▼
Palestinian Nat'l Auth.	24	▼
Egypt	20	▼
Indonesia	19	▼
Tunisia	18	▼
Philippines	18	▼
Botswana	17	▼
Cyprus	15	▼
South Africa	9	▼
Lebanon	7	▼
Morocco	6	▼
Ghana	6	▼

Country average vs. International average:

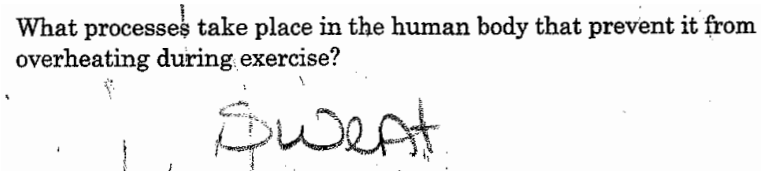
Higher	▲
Not different	O
Lower	▼

Bodily process to prevent overheating (continued)

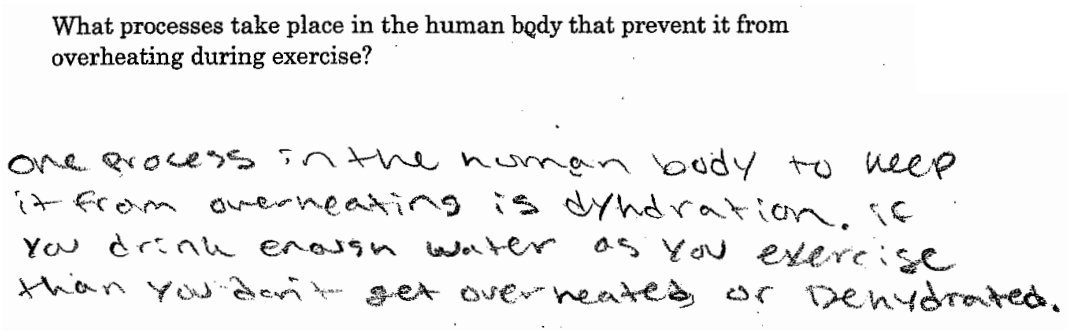
Item Number: S022152

Student Responses

Correct Response:



Incorrect Response:



Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Conceptual Understanding

Advantage of having two ears

What is the advantage of having two ears to hear with rather than one ear?

Item Number: S022160

SCORING

Note: Credit is given for both higher-level responses referencing locating the source of sound as well as less sophisticated responses referencing hearing sounds from both sides and retaining hearing if one ear does not function.

Correct Response

- Mentions being able to locate the position, direction and/or distance of the source of sound.
  Examples: By having two ears, you can actually tell where a sound came from.
  With two ears you could hear which direction a noise is coming from.
  With two ears you can judge the distance the sound is away from you.
  With two ears you can tell if the sound is near or far.
- Mentions hearing sounds from both sides (direction) with no mention of locating the source.
  Examples: You can hear on both sides of you.
  You can hear sounds from all around, not just one side.
  With two ears you can hear from more than one way.
- Mentions that if hearing is lost in one ear, the other may still function.
  Examples: In the result of being deaf in one ear, you have another one that is used.
  If you lost the hearing in one ear, the other one might still work.
- Other correct.

Incorrect Response

- Gives only a general or vague response relating to how well one can hear.
  Examples: You hear better.
  You can hear half as much with one ear.
  Two ears lets you hear a lot more.
  The volume is greater.
- Mentions only that hearing is uneven/unbalanced with one ear.
  Examples: If you had one ear, the sound would be uneven.
  Your hearing would be out of balance.
  You hearing gets balanced better with two ears.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Sweden	70	▲
Netherlands	70	▲
New Zealand	64	▲
Australia	64	▲
England	62	▲
Belgium (Flemish)	61	▲
United States	58	▲
Scotland	56	▲
Hungary	55	▲
Slovenia	53	▲
Norway	52	▲
Lithuania	50	▲
Latvia	48	▲
Israel	41	▲
Estonia	41	▲
Singapore	40	▲
Jordan	37	O
Egypt	36	O
Korea, Republic of	35	O
International average	**34**	
Malaysia	33	O
Italy	32	O
Hong Kong, SAR	32	O
Chinese Taipei	30	▼
Palestinian Nat'l Auth.	30	▼
Macedonia, Republic of	29	▼
Cyprus	28	▼
Botswana	28	▼
Japan	27	▼
Bahrain	25	▼
Romania	25	▼
Russian Federation	23	▼
Chile	22	▼
Morocco	22	▼
Saudi Arabia	21	▼
Slovak Republic	21	▼
Armenia	20	▼
Serbia and Montenegro	20	▼
Moldova, Rep. of	19	▼
Iran, Islamic Republic of	19	▼
Bulgaria	16	▼
Philippines	15	▼
Lebanon	12	▼
South Africa	9	▼
Ghana	8	▼
Tunisia	7	▼
Indonesia	6	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

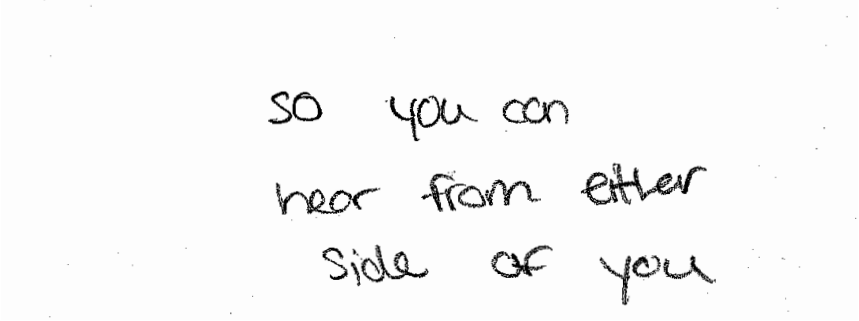
Advantage of having two ears (continued)

Item Number: S022160

Student Responses

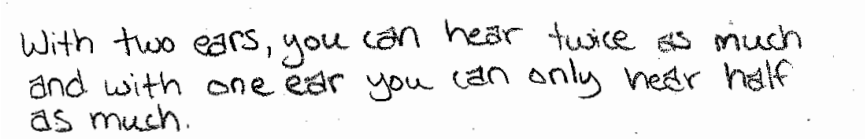
Correct Response:

What is the advantage of having two ears to hear with rather than one ear?



Incorrect Response:

What is the advantage of having two ears to hear with rather than one ear?



Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Factual Knowledge

Organ NOT in abdomen

Which of the following organs is NOT situated in the abdomen?

Ⓐ liver
Ⓑ kidney
Ⓒ stomach
Ⓓ bladder
Ⓔ heart

Item Number: S012001

Correct Response: E

Overall Percent Correct

Chinese Taipei	94	▲
Hungary	83	▲
Netherlands	83	▲
Sweden	82	▲
Belgium (Flemish)	80	▲
Slovak Republic	78	▲
Bulgaria	77	▲
Macedonia, Republic of	77	▲
Lithuania	77	▲
Russian Federation	77	▲
Armenia	76	▲
Hong Kong, SAR	75	▲
Serbia and Montenegro	75	▲
Australia	74	▲
Latvia	74	▲
United States	73	▲
Estonia	71	▲
Romania	69	▲
Singapore	68	▲
Israel	67	▲
Cyprus	67	▲
England	67	▲
Chile	66	▲
New Zealand	65	▲
Scotland	63	O
International average	**60**	
Saudi Arabia	59	O
Bahrain	58	O
Japan	58	O
Korea, Republic of	52	▼
Jordan	51	▼
Norway	50	▼
Slovenia	48	▼
Egypt	48	▼
Indonesia	47	▼
Morocco	46	▼
Italy	45	▼
Philippines	45	▼
Tunisia	45	▼
Iran, Islamic Republic of	43	▼
Palestinian Nat'l Auth.	42	▼
Moldova, Rep. of	32	▼
Botswana	30	▼
Lebanon	26	▼
South Africa	26	▼
Malaysia	23	▼
Ghana	12	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Factual Knowledge

Message from eyes to brain

When a person sees something, what carries the message from the eyes to the brain?

Ⓐ arteries
Ⓑ glands
Ⓒ muscles
Ⓓ nerves
Ⓔ veins

Item Number: S012014

Correct Response: D

Overall Percent Correct

Chinese Taipei	94	▲
Japan	93	▲
Hong Kong, SAR	93	▲
Korea, Republic of	92	▲
Netherlands	91	▲
Slovak Republic	87	▲
Belgium (Flemish)	86	▲
Hungary	86	▲
Singapore	85	▲
Lithuania	83	▲
Indonesia	81	▲
Russian Federation	81	▲
Sweden	81	▲
Slovenia	81	▲
England	81	▲
Australia	81	▲
Iran, Islamic Republic of	81	▲
United States	80	▲
New Zealand	80	▲
Macedonia, Republic of	79	▲
Estonia	79	▲
Bulgaria	79	▲
Serbia and Montenegro	79	▲
Malaysia	79	▲
Italy	78	▲
Moldova, Rep. of	78	▲
Latvia	75	O
Scotland	74	O
Saudi Arabia	74	O
Jordan	72	O
International average	**72**	
Bahrain	70	O
Romania	70	O
Israel	69	O
Armenia	67	▼
Tunisia	67	▼
Palestinian Nat'l Auth.	63	▼
Norway	59	▼
Philippines	58	▼
Egypt	57	▼
Botswana	56	▼
Cyprus	49	▼
Morocco	46	▼
Lebanon	44	▼
Chile	36	▼
South Africa	29	▼
Ghana	17	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Factual Knowledge

Absorbtion of food into the blood stream

In humans, where does the absorption of food into the blood stream mainly take place?

Ⓐ stomach

Ⓑ mouth

Ⓒ large intestines

Ⓓ small intestines

Item Number: S032386

Correct Response: D

Overall Percent Correct

Singapore	71	▲
Japan	58	▲
Armenia	44	▲
Jordan	43	▲
Malaysia	42	▲
Slovenia	38	▲
Hong Kong, SAR	37	▲
Sweden	35	▲
Moldova, Rep. of	34	▲
Chinese Taipei	33	▲
Saudi Arabia	33	▲
Egypt	33	▲
Morocco	31	O
Belgium (Flemish)	30	O
Philippines	29	O
New Zealand	29	O
Korea, Republic of	29	O
Bahrain	29	O
Slovak Republic	28	O
International average	**28**	
Palestinian Nat'l Auth.	28	O
Netherlands	27	O
Australia	27	O
United States	27	O
Russian Federation	26	O
Ghana	26	O
Romania	25	O
Lithuania	25	O
Hungary	25	O
Lebanon	25	O
England	25	O
Indonesia	25	O
Botswana	23	▼
Italy	23	▼
Macedonia, Republic of	23	▼
Bulgaria	22	▼
Chile	22	▼
Tunisia	21	▼
Scotland	20	▼
Serbia and Montenegro	19	▼
Estonia	18	▼
Latvia	18	▼
Norway	18	▼
Israel	18	▼
Cyprus	17	▼
Iran, Islamic Republic of	13	▼
South Africa	10	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Factual Knowledge

Fish organ like human lung

Which of the following organs in fish has the same function as the human lung?

Ⓐ kidney

Ⓑ heart

Ⓒ gill

Ⓓ skin

Item Number: S032607

Correct Response: C

Overall Percent Correct

Italy	91	▲
Korea, Republic of	90	▲
Hungary	85	▲
Russian Federation	84	▲
Netherlands	83	▲
Iran, Islamic Republic of	82	▲
Chinese Taipei	80	▲
Belgium (Flemish)	78	▲
Moldova, Rep. of	77	▲
Sweden	76	▲
Bahrain	76	▲
Bulgaria	76	▲
Hong Kong, SAR	75	▲
Slovenia	74	▲
Estonia	74	▲
Romania	72	▲
Slovak Republic	71	▲
Japan	68	▲
Morocco	68	▲
Israel	64	O
Jordan	64	O
England	64	O
International average	**63**	
Serbia and Montenegro	63	O
Saudi Arabia	63	O
Singapore	62	O
Lithuania	62	O
Egypt	62	O
Macedonia, Republic of	62	O
Malaysia	62	O
Australia	61	O
Latvia	61	O
Chile	60	O
United States	60	▼
Scotland	59	▼
Armenia	58	O
Palestinian Nat'l Auth.	56	▼
Norway	55	▼
Indonesia	54	▼
New Zealand	49	▼
Lebanon	45	▼
Tunisia	40	▼
Philippines	37	▼
South Africa	35	▼
Cyprus	25	▼
Botswana	23	▼
Ghana	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Structure, Function and Life Processes in Organisms	Reasoning and Analysis

How glasses/contact lenses work

Briefly explain how eyeglasses and contact lenses help some people to see more clearly.

Item Number: S022161

SCORING

Note: Credit is given for higher-level responses that demonstrate knowledge of vision by describing how lenses modify the way light enters the eye and hits the **retina** or back of the eye (as well as less sophisticated responses based on helping eyes to focus, to see objects at different distances or to magnification.

Correct Response

- Mentions that glasses/contact lenses bend (refract) or focus light rays onto the **retina** (or back of the eye). [May use a diagram to show this.]
  Examples: The glasses focus the light onto the retina.
- Mentions the curvature (shape) of lenses (concave/convex) and/or bending of light by lenses. [Based primarily on the properties of lenses with no explicit mention of the focusing of light on the retina or back of eye.]
  Examples: You can focus better because glasses bend the light into your eye.
- Mentions that glasses/contact lenses help the eyes focus and/or allow (near-sighted/far-sighted) people to see images at a distance or close up.
  Examples: Some people can see close up but need glasses in order to see things far away.
  Far-sighted people can only read with glasses that correct their close-up vision.
  Eyeglasses can help your eyes to focus more clearly on things.
- Mentions that glasses/contact lenses magnify or enlarge (images).
  Examples: They magnify.
  The magnification in the glasses make things more clear and bigger.
  The lenses make things look bigger.
- Other correct.

Incorrect Response

- Gives only a vague reference to glasses/contact lenses helping people see more clearly or containing prescriptions (chemicals, special type/shape/thickness of glass, etc.) without further explanation of vision or how lenses work.
  Examples: They make you see more clearly.
  If you are near sighted, you need glasses to help you see.
  Contacts help vision because of the prescription injected into them.
  Lenses are prescribed to fix eye problems.
  The lenses in glasses are made thick so you can see better.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

New Zealand	68	▲
Jordan	64	▲
Estonia	56	▲
England	56	▲
Bahrain	55	▲
Australia	55	▲
Armenia	54	▲
Moldova, Rep. of	53	▲
Latvia	52	▲
Korea, Republic of	52	▲
Russian Federation	51	▲
Palestinian Nat'l Auth.	50	▲
Netherlands	50	▲
Sweden	49	▲
Lithuania	48	▲
Hungary	48	▲
United States	48	▲
Scotland	48	▲
Norway	47	▲
Hong Kong, SAR	46	▲
Slovak Republic	44	▲
Singapore	44	▲
Chile	42	O
Israel	42	O
Slovenia	41	O
Egypt	39	O
International average	**39**	
Romania	37	O
Bulgaria	37	O
Malaysia	35	O
Belgium (Flemish)	34	▼
Japan	34	▼
Macedonia, Republic of	33	▼
Iran, Islamic Republic of	32	▼
Serbia and Montenegro	30	▼
Italy	30	▼
Chinese Taipei	28	▼
Indonesia	26	▼
Saudi Arabia	19	▼
Tunisia	18	▼
Cyprus	17	▼
Morocco	15	▼
Philippines	14	▼
Botswana	12	▼
South Africa	9	▼
Lebanon	6	▼
Ghana	5	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

How glasses/contact lenses work (continued)

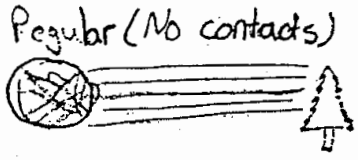
Item Number: S022161

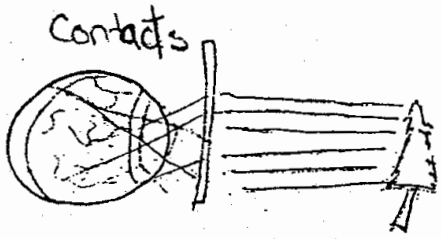
Student Responses

Correct Response:

Briefly explain how eyeglasses and contact lenses help some people to see more clearly.

Eyeglasses and contact lenses bend the light rays so the hit the retina at the right angle to make them see clearly.





S02216

Incorrect Response:

Briefly explain how eyeglasses and contact lenses help some people to see more clearly.

Glasses and contacts have Perscriptions in them of what your eyesite percentage is, (Because you go to the eye-doctor to get tested.)

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Types, Characteristics and Classification of Living Things	Conceptual Understanding

Characteristics of animal groups

A person sorted some animals into the two groups listed on the table. Which characteristic of animals was used for the sorting?

Ⓐ Legs
Ⓑ Eyes
Ⓒ Nervous system
Ⓓ Skin

Group 1	Group 2
Humans	Snakes
Dogs	Worms
Flies	Fish

Item Number: S012028

Correct Response: A

Overall Percent Correct

Korea, Republic of	79	▲
Japan	76	▲
Australia	70	▲
New Zealand	68	▲
Chinese Taipei	66	▲
England	66	▲
Scotland	64	▲
Malaysia	63	▲
Hong Kong, SAR	62	▲
Estonia	62	▲
Slovak Republic	62	▲
United States	62	▲
Norway	60	▲
Singapore	59	▲
Netherlands	58	▲
Israel	57	▲
Latvia	56	▲
Sweden	54	▲
Belgium (Flemish)	53	▲
Hungary	49	▲
Russian Federation	48	O
Italy	47	O
Slovenia	46	O
International average	**45**	
Armenia	43	O
Cyprus	42	O
Moldova, Rep. of	41	O
Lithuania	40	▼
Bahrain	37	▼
Bulgaria	36	▼
Serbia and Montenegro	35	▼
Romania	33	▼
Macedonia, Republic of	32	▼
Palestinian Nat'l Auth.	31	▼
Tunisia	31	▼
Chile	31	▼
Saudi Arabia	26	▼
Morocco	25	▼
Egypt	25	▼
Jordan	24	▼
Indonesia	24	▼
Botswana	23	▼
Philippines	23	▼
Iran, Islamic Republic of	23	▼
South Africa	19	▼
Lebanon	19	▼
Ghana	11	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Types, Characteristics and Classification of Living Things	Conceptual Understanding

Cats most closely related to which animal

Cats are most closely related to which of the following animals?

Ⓐ crocodiles
Ⓑ whales
Ⓒ frogs
Ⓓ penguins

Item Number: S032595

Correct Response: B

Overall Percent Correct

Japan	65	▲
Russian Federation	47	▲
Malaysia	46	▲
Singapore	43	▲
Bulgaria	42	▲
Moldova, Rep. of	41	▲
Chinese Taipei	40	▲
Italy	39	▲
Armenia	36	▲
Estonia	35	▲
Latvia	35	▲
Lithuania	33	▲
Hungary	32	▲
Slovenia	31	▲
Israel	31	▲
Hong Kong, SAR	28	O
Romania	27	O
Macedonia, Republic of	26	O
International average	**26**	
United States	25	O
Serbia and Montenegro	25	O
Korea, Republic of	25	O
England	25	O
Slovak Republic	24	O
Australia	22	▼
Botswana	22	▼
Iran, Islamic Republic of	21	▼
Philippines	20	▼
Belgium (Flemish)	20	▼
Lebanon	19	▼
New Zealand	18	▼
Chile	18	▼
Scotland	18	▼
Jordan	18	▼
Egypt	17	▼
Netherlands	17	▼
Bahrain	16	▼
Ghana	15	▼
South Africa	15	▼
Cyprus	15	▼
Saudi Arabia	15	▼
Palestinian Nat'l Auth.	14	▼
Sweden	13	▼
Norway	13	▼
Indonesia	8	▼
Morocco	0	▼
Tunisia	0	▼

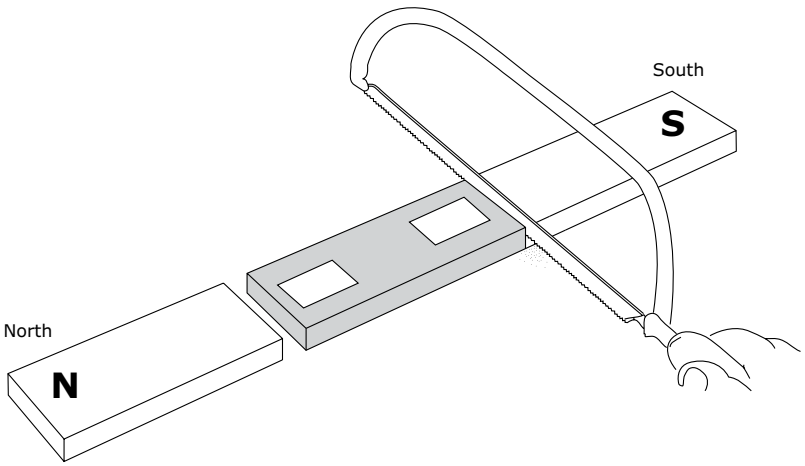
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Electricity and Magnetism	Conceptual Understanding

Poles on cut magnet

The diagram shows a bar magnet which is cut into three pieces with a hacksaw.



Write an "N" or an "S" in each box on the diagram to show the polarity of each end of the center piece.

Item Number: S022035

SCORING

Note: To receive credit, the polarity of BOTH ends of the center piece must be indicated. Answer is correct if polarity is indicated correctly (N-S), but letters are shown above, below, or outside the boxes, as long as the polarity of both ends of the center piece is clear.

Correct Response

- N-S

Incorrect Response

- S-N
- Pole of cut ends of outer pieces are indicated (S - N) instead of poles on center piece.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Japan	64	▲
Singapore	62	▲
Macedonia, Republic of	62	▲
Korea, Republic of	59	▲
Bahrain	58	▲
Sweden	58	▲
Lithuania	56	▲
Belgium (Flemish)	55	▲
Cyprus	53	▲
Russian Federation	52	▲
New Zealand	51	▲
Australia	51	▲
United States	51	▲
Estonia	51	▲
Serbia and Montenegro	51	▲
Israel	51	▲
Netherlands	49	O
Bulgaria	48	O
Italy	48	O
Morocco	47	O
Scotland	47	O
Moldova, Rep. of	46	O
Romania	46	O
England	46	O
Latvia	45	O
Slovenia	45	O
International average	**44**	
Chinese Taipei	44	O
Slovak Republic	43	O
Hungary	43	O
Malaysia	43	O
Norway	41	O
Hong Kong, SAR	40	▼
Botswana	39	▼
Jordan	38	▼
Saudi Arabia	37	▼
Lebanon	36	▼
Chile	35	▼
Philippines	34	▼
Tunisia	33	▼
Indonesia	32	▼
Iran, Islamic Republic of	32	▼
Egypt	30	▼
Palestinian Nat'l Auth.	27	▼
Armenia	25	▼
Ghana	19	▼
South Africa	17	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

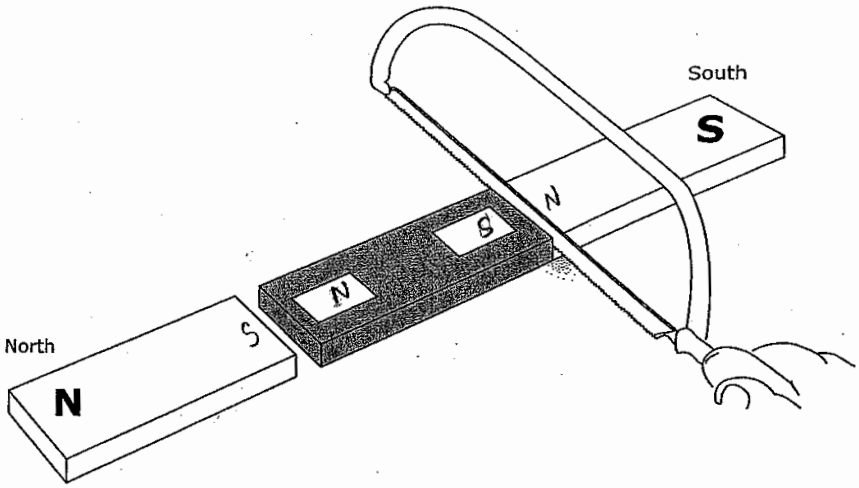
Poles on cut magnet (continued)

Item Number: S022035

Student Responses

Correct Response:

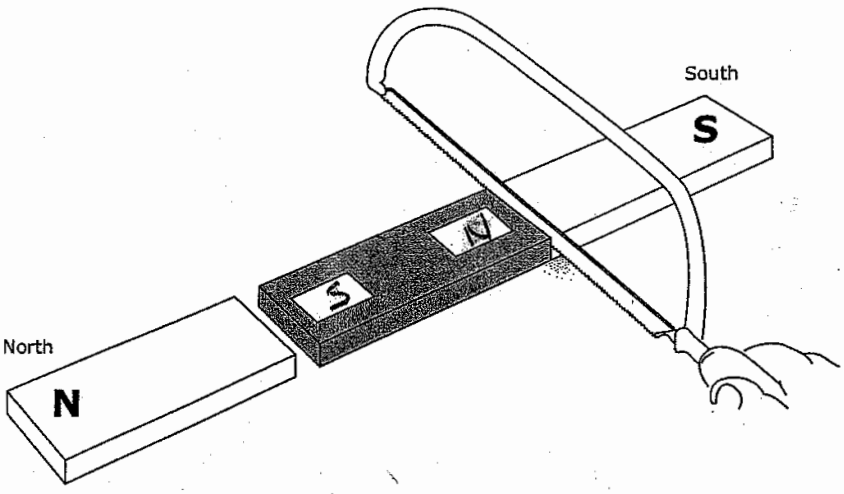
The diagram shows a bar magnet which is cut into three pieces with a hacksaw.



Write an "N" or an "S" in each box on the diagram to show the polarity of each end of the center piece.

Incorrect Response:

The diagram shows a bar magnet which is cut into three pieces with a hacksaw.

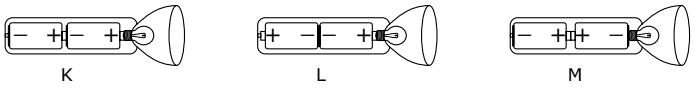


Write an "N" or an "S" in each box on the diagram to show the polarity of each end of the center piece.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Electricity and Magnetism	Factual Knowledge

Diagram of batteries in a flashlight

The diagrams show a flashlight and three ways to put batteries in it.



In order to make the flashlight work, which way must the batteries be placed?

Ⓐ Only as in K

Ⓑ Only as in L

Ⓒ Only as in M

Ⓓ None of these ways would work.

Item Number: S012037

Correct Response: A

Overall Percent Correct

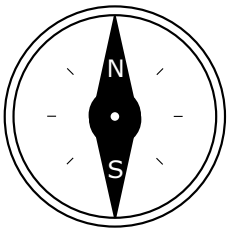
Singapore	97	▲
England	95	▲
Korea, Republic of	93	▲
Japan	93	▲
Hong Kong, SAR	93	▲
Russian Federation	93	▲
Slovak Republic	93	▲
Estonia	93	▲
Chinese Taipei	92	▲
Malaysia	91	▲
Romania	91	▲
Latvia	91	▲
Hungary	91	▲
Bulgaria	91	▲
Bahrain	90	▲
Lithuania	90	▲
Moldova, Rep. of	90	▲
Sweden	89	▲
United States	89	▲
Armenia	88	▲
New Zealand	88	O
Slovenia	87	▲
Lebanon	86	O
Netherlands	86	O
Australia	85	O
Belgium (Flemish)	85	O
Cyprus	85	O
International average	**85**	
Scotland	84	O
Indonesia	84	O
Serbia and Montenegro	84	O
Macedonia, Republic of	84	O
Italy	83	O
Iran, Islamic Republic of	83	O
Chile	82	O
Israel	82	O
Norway	81	▼
Botswana	81	▼
Morocco	81	O
Jordan	78	▼
Saudi Arabia	78	▼
Palestinian Nat'l Auth.	78	▼
Philippines	77	▼
Egypt	67	▼
Tunisia	59	▼
Ghana	55	▼
South Africa	52	▼

Country average vs. International average:

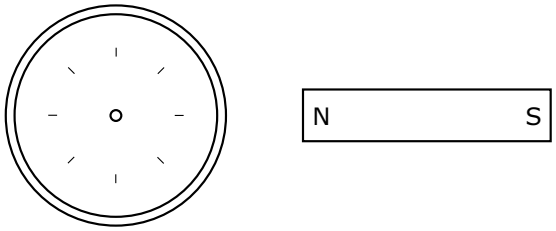
Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Electricity and Magnetism	Reasoning and Analysis

Compass placed next to a magnet/draw



The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

B. Explain your answer using your knowledge of magnets.

Item Number: S032625A

SCORING

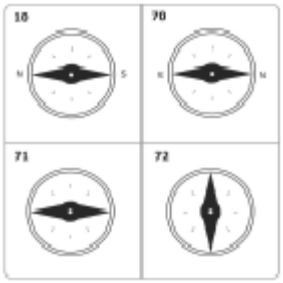
Correct Response

- Draws a "horizontal" needle with N to the left and S to the right. [See diagram below.]

Note: Credit should be given even if one label is missing (N to the left OR S to the right shown).

Incorrect Response

- Draws a "horizontal" needle with poles reversed (N to the right and/or S to the left). [See diagram below.]
- Draws a "horizontal" needle with no poles indicated. [See diagram below.]
- Draws a "vertical" needle with or without poles indicated. [See diagram below.]
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).



Overall Percent Correct

Japan	88	▲
Korea, Republic of	87	▲
Chinese Taipei	86	▲
Singapore	76	▲
Slovak Republic	74	▲
Hungary	67	▲
England	65	▲
Hong Kong, SAR	61	▲
Malaysia	58	▲
Bulgaria	57	▲
Bahrain	56	▲
Armenia	54	▲
Sweden	52	▲
Australia	50	▲
Russian Federation	48	▲
Romania	45	▲
Serbia and Montenegro	45	▲
United States	45	▲
Netherlands	44	O
Iran, Islamic Republic of	43	O
Scotland	41	O
International average	**40**	
Jordan	38	O
Moldova, Rep. of	37	O
Italy	33	▼
Macedonia, Republic of	33	▼
Palestinian Nat'l Auth.	33	▼
Lebanon	31	▼
New Zealand	31	▼
Norway	30	▼
Estonia	29	▼
Morocco	28	▼
Israel	27	▼
Indonesia	26	▼
Egypt	26	▼
Slovenia	25	▼
Belgium (Flemish)	25	▼
Tunisia	24	▼
Latvia	23	▼
Lithuania	21	▼
Cyprus	20	▼
Philippines	17	▼
Saudi Arabia	16	▼
Chile	15	▼
Botswana	14	▼
South Africa	5	▼
Ghana	2	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

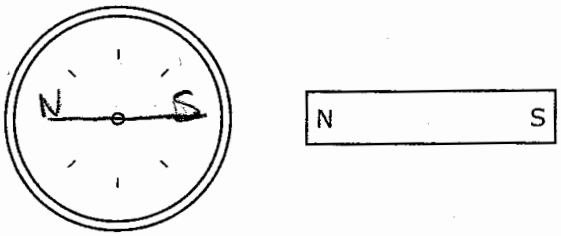
Compass placed next to a magnet/draw (continued)

Item Number: S032625A

Student Responses

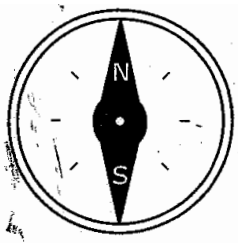
Correct Response:

The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.

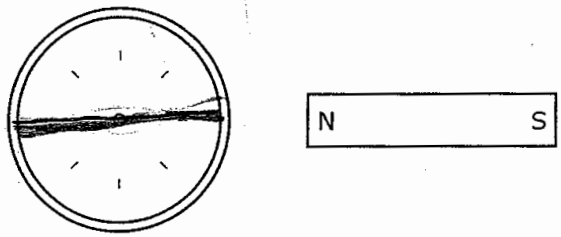


A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

Incorrect Response:



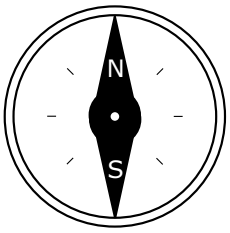
The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



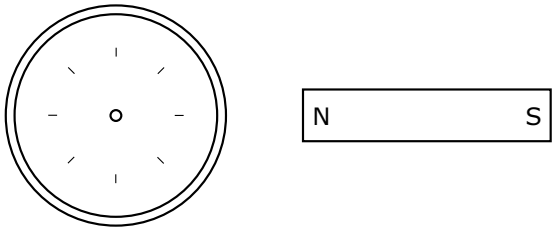
A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Electricity and Magnetism	Reasoning and Analysis

Compass placed next to a magnet/explain



The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

B. Explain your answer using your knowledge of magnets.

Item Number: S032625B

Scoring for Explanation

Correct Response

- Explains that opposite poles attract (N toward S, etc.) or like poles repel (or similar).
  Examples: The south point of the compass is attracted to the north pole of the magnet.
  North and south attract together.
  The magnets which have different poles attract one another.
  The N pole on the magnet will attract the S pole on the compass.
  Opposites attract and likes repel.
  The magnet pushes the N pole of the compass away.
- Other correct.

Incorrect Response

- Refers to magnetic attraction/repulsion but with an incorrect application.
  Examples: Because the same pole will be attracted.
  The magnet is closer to the compass and will have a stronger attraction to the N end.
  The needle of the compass is metal, so it is attracted to the magnet and turns.
  It attracts the needle to North and South poles.
- Explains that the compass needle always points North, or similar.
  Examples: The needle of North always goes to the magnetic North.
  North always goes toward North.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Korea, Republic of	81	▲
Japan	77	▲
Chinese Taipei	70	▲
Singapore	67	▲
Hungary	59	▲
England	59	▲
Slovak Republic	56	▲
Hong Kong, SAR	47	▲
Armenia	45	▲
Bahrain	43	▲
Malaysia	43	▲
Bulgaria	42	▲
Australia	41	▲
Iran, Islamic Republic of	40	▲
Sweden	39	▲
United States	37	▲
Serbia and Montenegro	37	▲
Romania	33	O
Netherlands	31	O
Jordan	30	O
Palestinian Nat'l Auth.	30	O
International average	**29**	
Russian Federation	29	O
Moldova, Rep. of	28	O
Scotland	28	O
Macedonia, Republic of	21	▼
Italy	20	▼
Indonesia	20	▼
Egypt	17	▼
New Zealand	17	▼
Israel	16	▼
Lebanon	16	▼
Morocco	14	▼
Estonia	13	▼
Norway	13	▼
Botswana	11	▼
Belgium (Flemish)	11	▼
Slovenia	10	▼
Saudi Arabia	9	▼
Tunisia	9	▼
Philippines	8	▼
Latvia	8	▼
Chile	5	▼
Lithuania	5	▼
South Africa	4	▼
Cyprus	4	▼
Ghana	2	▼

Country average vs. International average:

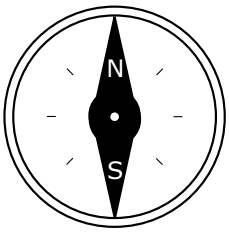
Higher ▲
Not different O
Lower ▼

Compass placed next to a magnet/explain (continued)

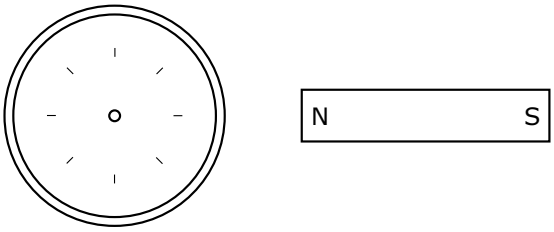
Item Number: S032625B

Student Responses

Correct Response:



The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



B. Explain your answer using your knowledge of magnets.

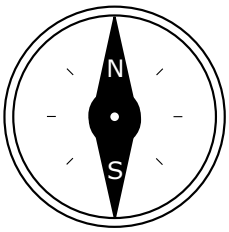
opposites attract and the north side of the magnet is facing the compass so the needle with south on it will point to the magnet

Compass placed next to a magnet/explain (continued)

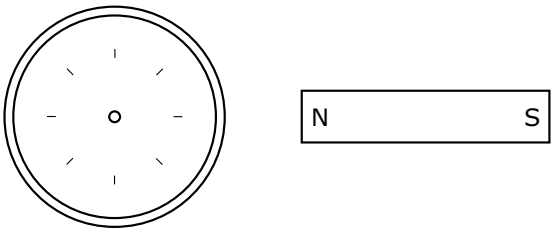
Item Number: S032625B

Student Responses (continued)

Incorrect Response:



The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



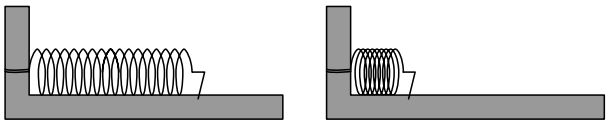
B. Explain your answer using your knowledge of magnets.

As the magnet contects the magnet moves the opposite way.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Energy Types, Sources and Conversions	Conceptual Understanding

Stored energy in two springs

Spring 1 and Spring 2 were the same. Then, Spring 1 was pushed together a little and clamped in place. Spring 2 was pushed together a lot and clamped.



1 2

Which spring has more stored energy?

Ⓐ Spring 1

Ⓑ Spring 2

Ⓒ Spring 2

Ⓓ You cannot tell unless you know what the springs are made of.

Item Number: S012002

Correct Response: B

Overall Percent Correct

Singapore	84	▲
England	84	▲
Korea, Republic of	84	▲
United States	83	▲
New Zealand	83	▲
Japan	81	▲
Netherlands	79	▲
Australia	78	▲
Scotland	78	▲
Estonia	77	▲
Hungary	75	▲
Italy	75	▲
Norway	74	▲
Lithuania	74	▲
Russian Federation	73	▲
Belgium (Flemish)	71	▲
Sweden	71	▲
Israel	70	▲
Hong Kong, SAR	69	▲
Slovenia	68	▲
Malaysia	67	▲
Latvia	64	O
Chinese Taipei	64	O
Lebanon	63	O
Jordan	63	O
International average	**62**	
Bulgaria	61	O
Armenia	60	O
Chile	59	O
Cyprus	58	O
Indonesia	57	▼
Iran, Islamic Republic of	56	▼
Macedonia, Republic of	56	▼
Serbia and Montenegro	55	▼
Botswana	52	▼
Palestinian Nat'l Auth.	50	▼
Philippines	48	▼
Slovak Republic	47	▼
Morocco	46	▼
Romania	39	▼
South Africa	39	▼
Egypt	39	▼
Moldova, Rep. of	38	▼
Saudi Arabia	37	▼
Ghana	36	▼
Bahrain	35	▼
Tunisia	28	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Energy Types, Sources and Conversions	Conceptual Understanding

Nail pulled out of a wooden board

When a nail is pulled out of a wooden board, the nail becomes warm. Explain why.

Item Number: S032131

SCORING

Correct Response

- Explanation refers to friction (implicitly or explicitly).
  Examples: Because it is rubbed against the wood.
  Nail resists when you pull it out.
  Because of the force on the nail to pull it out.
  Because of friction.
  There is friction between the nail and the wooden board.
- Explanation refers to energy change.
  Examples: There is more energy in the nail after the transition.
  Because energy is used to get it out.
  Kinetic energy changes to heat energy when you pull it out.
- Other correct.

Incorrect Response

- Explanation refers only to the nail or the action taken with inadequate connection to friction or energy.
  Examples: It is hard to get it out.
  You must pull hard.
  Because it was in the wood for too long.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Chinese Taipei	84	▲
Hungary	84	▲
Slovak Republic	78	▲
England	75	▲
Hong Kong, SAR	74	▲
Japan	74	▲
United States	73	▲
Russian Federation	72	▲
Lithuania	72	▲
Netherlands	71	▲
Australia	71	▲
Korea, Republic of	70	▲
Latvia	68	▲
Singapore	67	▲
Estonia	66	▲
Scotland	66	▲
Armenia	66	▲
Belgium (Flemish)	64	▲
Romania	64	▲
Malaysia	63	▲
Moldova, Rep. of	62	▲
Bulgaria	61	▲
New Zealand	57	O
Slovenia	54	O
International average	**52**	
Iran, Islamic Republic of	52	O
Sweden	51	O
Israel	48	O
Norway	47	▼
Jordan	44	▼
Cyprus	44	▼
Serbia and Montenegro	44	▼
Macedonia, Republic of	41	▼
Palestinian Nat'l Auth.	40	▼
Italy	40	▼
Chile	40	▼
Indonesia	39	▼
Bahrain	33	▼
Morocco	27	▼
Tunisia	27	▼
Saudi Arabia	26	▼
Philippines	24	▼
Lebanon	22	▼
Egypt	20	▼
Botswana	11	▼
South Africa	11	▼
Ghana	5	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Nail pulled out of a wooden board (continued)

Item Number: S032131

Student Responses

Correct Response:

When a nail is pulled out of a wooden board, the nail becomes warm. Explain why.

The nail becomes warm because of the energy that was in it as it was pulled out.

Incorrect Response:

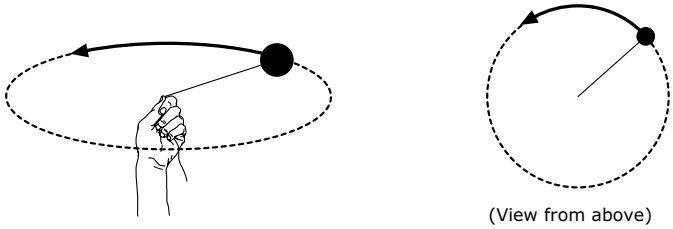
When a nail is pulled out of a wooden board, the nail becomes warm. Explain why.

Because the inside of the board is warmer than it is on the outside

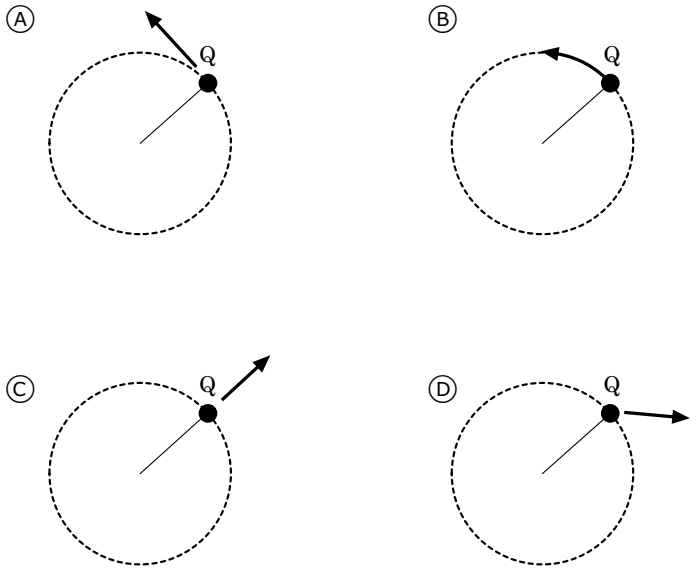
Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Conceptual Understanding

Path of ball released from orbit

The diagram on the left shows a ball on the end of a string being whirled in a circle. The diagram on the right shows the whirling ball as viewed from above.



After several whirls, the string is released when the ball is at Q. Which of these diagrams shows the direction in which the ball will fly the instant the string is released?



Item Number: S022040

Correct Response: A

Overall Percent Correct

Korea, Republic of	87	▲
Netherlands	82	▲
Estonia	80	▲
Singapore	79	▲
Australia	77	▲
Japan	77	▲
Hungary	77	▲
Scotland	77	▲
New Zealand	77	▲
Belgium (Flemish)	76	▲
United States	76	▲
Lithuania	75	▲
Malaysia	75	▲
Sweden	74	▲
England	74	▲
Russian Federation	74	▲
Slovak Republic	72	▲
Norway	72	▲
Latvia	71	▲
Slovenia	70	▲
Hong Kong, SAR	69	▲
Chinese Taipei	68	▲
Italy	61	O
Bulgaria	60	O
Serbia and Montenegro	60	O
International average	**60**	
Cyprus	59	O
Israel	58	O
Romania	58	O
Chile	58	O
Armenia	58	O
Macedonia, Republic of	54	▼
Moldova, Rep. of	52	▼
Iran, Islamic Republic of	48	▼
Jordan	47	▼
Indonesia	47	▼
Bahrain	44	▼
Philippines	42	▼
Saudi Arabia	38	▼
Palestinian Nat'l Auth.	36	▼
Morocco	33	▼
Tunisia	31	▼
Egypt	30	▼
Lebanon	30	▼
Botswana	30	▼
South Africa	22	▼
Ghana	22	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Conceptual Understanding

Why helium balloon moves upward

A balloon filled with helium gas is set free and starts to move upward.
Which of the following best explains why the helium balloon moves upward?

Ⓐ The density of helium is less than the density of air.

Ⓑ The air resistance lifts the balloon up.

Ⓒ There is no gravity acting on helium balloons.

Ⓓ The wind blows the balloon upward.

Item Number: S032281

Correct Response: A

Overall Percent Correct

Korea, Republic of	89	▲
Hungary	88	▲
Slovak Republic	86	▲
Chinese Taipei	86	▲
Estonia	83	▲
Singapore	81	▲
Slovenia	79	▲
Sweden	77	▲
Russian Federation	75	▲
Japan	74	▲
United States	72	▲
Hong Kong, SAR	71	▲
Malaysia	69	▲
Lithuania	69	▲
Norway	69	▲
Scotland	69	▲
Latvia	69	▲
New Zealand	67	▲
England	66	▲
Australia	66	▲
Serbia and Montenegro	65	▲
Romania	65	▲
Italy	61	O
Bulgaria	60	O
International average	**58**	
Netherlands	58	O
Jordan	56	O
Moldova, Rep. of	56	O
Armenia	56	O
Israel	54	▼
Chile	52	▼
Macedonia, Republic of	52	▼
Palestinian Nat'l Auth.	50	▼
Philippines	49	▼
Belgium (Flemish)	49	▼
Lebanon	47	▼
Egypt	45	▼
Bahrain	43	▼
Iran, Islamic Republic of	38	▼
Cyprus	35	▼
Saudi Arabia	33	▼
Indonesia	32	▼
Ghana	28	▼
Botswana	25	▼
South Africa	21	▼
Tunisia	21	▼
Morocco	19	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Conceptual Understanding

Metal crown: why scientists repeated measurement

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

A. Why did the scientists measure the volume five times?

B. The scientists reported to the king that the density of the crown was 12.0 g/cm^3. Show how the scientists used their results to obtain this value for the density.

Item Number: S032712A

Overall Percent Correct

Chinese Taipei	76	▲
Korea, Republic of	67	▲
Estonia	60	▲
Singapore	58	▲
Hong Kong, SAR	56	▲
Japan	53	▲
Malaysia	53	▲
Lithuania	53	▲
Belgium (Flemish)	47	▲
United States	47	▲
Australia	44	▲
Jordan	44	▲
Slovenia	42	▲
Sweden	42	▲
Scotland	41	▲
New Zealand	40	▲
Palestinian Nat'l Auth.	38	▲
Slovak Republic	34	O
England	34	O
Netherlands	33	O
Israel	33	O
International average	**30**	
Moldova, Rep. of	30	O
Latvia	29	O
Egypt	29	O
Russian Federation	26	▼
Serbia and Montenegro	23	▼
Norway	22	▼
Hungary	22	▼
Cyprus	21	▼
Morocco	21	▼
Tunisia	19	▼
Iran, Islamic Republic of	18	▼
Bahrain	17	▼
Macedonia, Republic of	15	▼
Indonesia	15	▼
Italy	15	▼
Romania	14	▼
Bulgaria	13	▼
Armenia	11	▼
Botswana	10	▼
Philippines	8	▼
Chile	6	▼
Lebanon	6	▼
South Africa	6	▼
Ghana	5	▼
Saudi Arabia	1	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: why scientists repeated measurement (continued)

Item Number: S032712A

SCORING

Why Scientists Repeat Measurements

Correct Response

- Refers to accuracy, precision, reliability, experimental uncertainty, estimation of measurement error (or similar).

  Examples: Because there is experimental error. So measuring it 5 times you can calculate the average to know how much error there is.

  Each time they measure the volume it is close but not exactly the same. So, it's better to measure it a few times to be sure.

  They want a more exact answer.

  To get an accurate measure of the volume.

  It's more reliable.

- Refers only to computing an average or mean value (or median or range).

  Examples: To find the average volume.

  To work out the mean.

- Other correct.

Incorrect Response

- Refers only to 'mistakes' or changes in the measurements (or similar); no explicit mention of accuracy, precision, experimental uncertainty, etc.

  Examples: In case mistakes happen.

  To make sure it wasn't changing.

  To make sure the answer was right and he did not make a mistake.

  To make sure they did it right.

  To check if it was correct.

- Refers only to a 'fair test' or similar; no explicit mention of computation of average, accuracy, precision, experimental uncertainty, etc.

  Examples: To make sure it was a fair test.

  To ensure a fair test.

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

Metal crown: why scientists repeated measurement (continued)

Item Number: S032712A

Student Responses

Correct Response:

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

A. Why did the scientists measure the volume five times?

To test more than once to see if their answers are close to the other answers.

Incorrect Response:

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

A. Why did the scientists measure the volume five times?

To see if they got a different answer, or they might of used s different object to measure,

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Conceptual Understanding

Metal crown: determination of average/median value

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

A. Why did the scientists measure the volume five times?

B. The scientists reported to the king that the density of the crown was 12.0 g/cm^3. Show how the scientists used their results to obtain this value for the density.

Item Number: S032712B

SCORING

Correct Response

- Shows (or describes) a correct method for computing the average (mean) value.
  Examples: (11.88+12.00+11.94+12.12+12.06) = 60. 60/5=12.0
  (202+200+201+198+199)/5 = 200. 2400/200=12.0
  They added together all of the densities and then divided by 5 to get the average.
- Shows (or describes) a correct method for determining the median value.
  Examples: 202, 201, 200, 198, 199. 200 is the median volume, so 2400/200 is the median density (12).
  12 is the middle value when placed in order (12.12, 12.06, 12.00, 11.94, 11.88).
- Other correct

Incorrect Response

- States that it is the average, mean or median value with no or incorrect work shown.
- Shows a computation of density (mass/volume). [No determination of average or median included.]
  Examples: They did mass divided by volume.
  2400g/200cc = 12 g/cc
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	47	▲
Japan	44	▲
Estonia	36	▲
Lithuania	31	▲
United States	29	▲
Netherlands	29	▲
Chinese Taipei	28	▲
Scotland	26	▲
Sweden	24	▲
Hong Kong, SAR	24	▲
Australia	23	▲
England	22	▲
Latvia	22	▲
New Zealand	21	▲
Malaysia	20	▲
Belgium (Flemish)	20	▲
Korea, Republic of	15	O
Norway	14	O
Slovenia	14	O
International average	**14**	
Israel	13	O
Moldova, Rep. of	13	O
Hungary	12	▼
Serbia and Montenegro	11	▼
Slovak Republic	10	▼
Russian Federation	10	O
Cyprus	9	▼
Bulgaria	9	▼
Romania	7	▼
Jordan	7	▼
Macedonia, Republic of	7	▼
Armenia	6	▼
Italy	6	▼
Lebanon	6	▼
Indonesia	4	▼
Tunisia	4	▼
Philippines	4	▼
Egypt	4	▼
Bahrain	3	▼
Palestinian Nat'l Auth.	3	▼
Chile	3	▼
Morocco	3	▼
Botswana	2	▼
Iran, Islamic Republic of	2	▼
South Africa	1	▼
Ghana	1	▼
Saudi Arabia	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: determination of average/median value (continued)

Item Number: S032712B

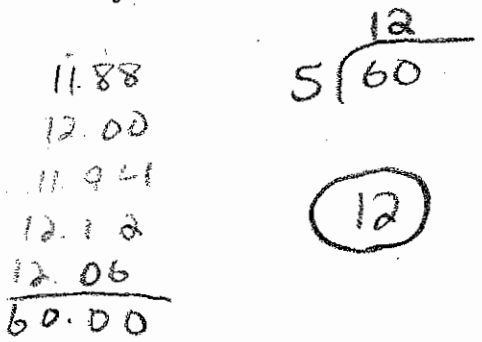
Student Responses

Correct Response:

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

B. The scientists reported to the king that the density of the crown was 12.0 g/cm^3. Show how the scientists used their results to obtain this value for the density.



Metal crown: determination of average/median value (continued)

Item Number: S032712B

Student Responses

Incorrect Response:

The scientists measured the volume of the crown five times. They computed the density for each volume measurement. Their results are shown in the table below.

Trial	Volume of Crown (cm^3)	Density of Crown (g/cm^3)
1	202	11.88
2	200	12.00
3	201	11.94
4	198	12.12
5	199	12.06

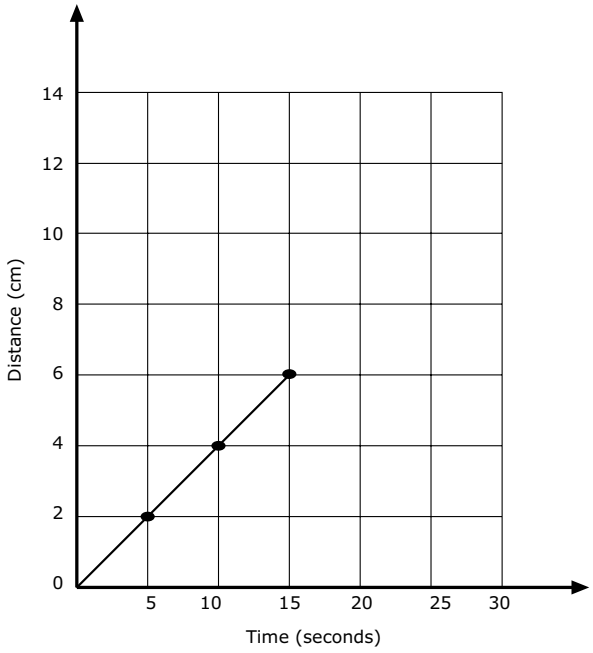
B. The scientists reported to the king that the density of the crown was 12.0 g/cm^3. Show how the scientists used their results to obtain this value for the density.

He took the average and used that.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Reasoning and Analysis

Extrapolation of distance/time graph

The graph shows the progress made by a beetle moving along a straight line.



If the beetle keeps moving at the same speed, how long will it take to travel 10 cm?

Ⓐ 4 seconds

Ⓑ 6 seconds

Ⓒ 20 seconds

Ⓓ 25 seconds

Item Number: S022041

Correct Response: D

Overall Percent Correct

Netherlands	91	▲
Singapore	90	▲
Korea, Republic of	90	▲
Japan	89	▲
Malaysia	89	▲
Belgium (Flemish)	89	▲
Scotland	88	▲
Australia	87	▲
United States	87	▲
Hungary	86	▲
England	85	▲
Sweden	84	▲
Hong Kong, SAR	84	▲
Lithuania	83	▲
New Zealand	82	▲
Estonia	82	▲
Chinese Taipei	80	▲
Slovenia	80	▲
Latvia	79	▲
Israel	79	▲
Russian Federation	79	▲
Norway	75	▲
Italy	74	O
Chile	73	O
Moldova, Rep. of	73	O
Bulgaria	71	O
International average	**71**	
Lebanon	70	O
Cyprus	68	O
Slovak Republic	68	O
Romania	67	O
Botswana	64	▼
Macedonia, Republic of	64	▼
Morocco	61	▼
Indonesia	61	▼
Bahrain	58	▼
Iran, Islamic Republic of	56	▼
Armenia	56	▼
Serbia and Montenegro	55	▼
Tunisia	55	▼
Jordan	54	▼
Philippines	52	▼
Egypt	51	▼
Palestinian Nat'l Auth.	44	▼
Saudi Arabia	40	▼
South Africa	35	▼
Ghana	32	▼

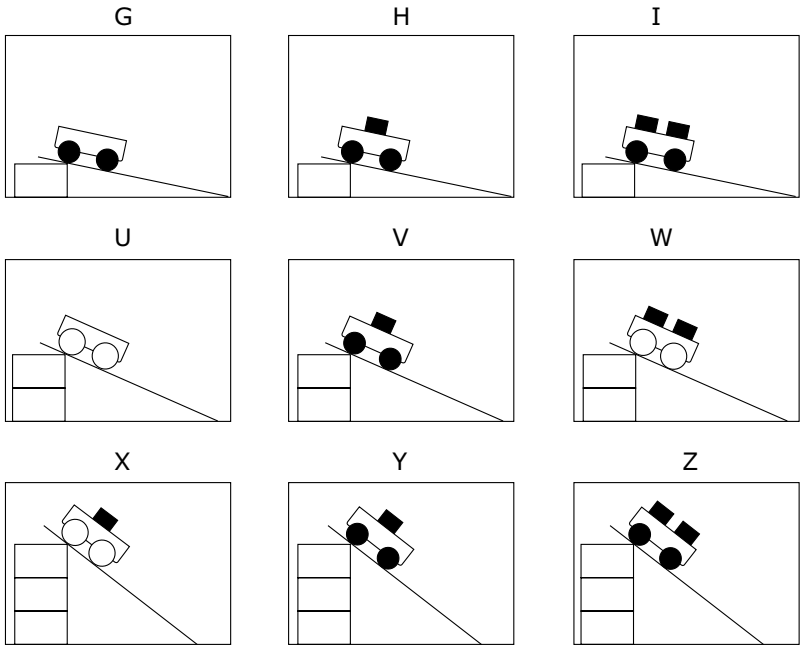
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Reasoning and Analysis

Controlled experiment with cart

The diagrams show nine different trials Michael carried out using carts with wheels of two different sizes and different numbers of blocks of equal mass. He used the same ramp for all trials, starting the carts from different heights.



He wants to test this idea: The higher the ramp is placed, the faster the cart will travel at the bottom of the ramp. Which three trials should he compare?

Ⓐ G, H and I
Ⓑ I, W and Z
Ⓒ I, V and X
Ⓓ U, W and X
Ⓔ H, V and Y

Item Number: S022222

Correct Response: E

Overall Percent Correct

Singapore	79	▲
Japan	78	▲
Korea, Republic of	75	▲
Hong Kong, SAR	66	▲
England	65	▲
Chinese Taipei	63	▲
Netherlands	59	▲
Malaysia	58	▲
Australia	58	▲
Scotland	58	▲
United States	57	▲
Hungary	56	▲
Lithuania	54	▲
New Zealand	54	▲
Estonia	51	▲
Sweden	48	▲
Belgium (Flemish)	48	▲
Russian Federation	47	O
Slovenia	45	O
Armenia	45	O
Italy	44	O
International average	**43**	
Slovak Republic	43	O
Latvia	42	O
Norway	41	O
Israel	41	O
Serbia and Montenegro	39	▼
Bahrain	37	▼
Romania	36	▼
Bulgaria	36	▼
Jordan	35	▼
Cyprus	34	▼
Chile	33	▼
Saudi Arabia	32	▼
Macedonia, Republic of	31	▼
Lebanon	31	▼
Iran, Islamic Republic of	31	▼
Moldova, Rep. of	30	▼
Philippines	30	▼
Palestinian Nat'l Auth.	25	▼
Indonesia	25	▼
Egypt	23	▼
Botswana	23	▼
Tunisia	23	▼
Morocco	22	▼
South Africa	18	▼
Ghana	18	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Reasoning and Analysis

Data trend of masses on spring

The table below shows the results of an experiment to investigate how the length of a spring changes as different masses are hung from it.

Mass (grams)	Length of Spring (cm)
0	5
10	7
20	9
30	11
40	12
50	13
60	13

Describe how the length of the spring changed as different masses were hung from it.

Item Number: S022286

Overall Percent Correct

Singapore	75	▲
Hungary	73	▲
Slovak Republic	71	▲
Korea, Republic of	68	▲
Chinese Taipei	67	▲
Estonia	66	▲
New Zealand	65	▲
Armenia	65	▲
Chile	62	▲
Italy	60	▲
Japan	56	▲
Norway	56	▲
Australia	55	▲
Hong Kong, SAR	55	▲
Serbia and Montenegro	53	▲
Lithuania	52	▲
Sweden	50	▲
Slovenia	49	▲
Latvia	47	O
Iran, Islamic Republic of	46	▲
United States	45	O
Netherlands	45	O
Russian Federation	43	O
Bulgaria	42	O
International average	**42**	
Israel	41	O
Moldova, Rep. of	40	O
Belgium (Flemish)	39	O
Jordan	37	▼
Macedonia, Republic of	36	▼
Romania	36	▼
Palestinian Nat'l Auth.	35	▼
Scotland	34	▼
Malaysia	33	▼
Egypt	33	▼
England	30	▼
Philippines	29	▼
Saudi Arabia	27	▼
Cyprus	26	▼
Lebanon	20	▼
Indonesia	17	▼
Morocco	17	▼
Bahrain	13	▼
Tunisia	12	▼
Botswana	7	▼
South Africa	6	▼
Ghana	2	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Data trend of masses on spring (continued)

Item Number: S022286

SCORING

Note: To receive credit, responses must address two basic regions in the table to describe the trend in spring length as a function of the mass added:

(i) initially, the spring increases in length (at a constant rate) as more mass is added.

(ii) after a point (40 grams), the spring length starts to level off and then remains constant as more mass is added.

Responses may be quantitative or qualitative in nature. [No credit is lost for using wrong or no units in describing length or mass.]

Correct Response

- Response includes both regions (i) and (ii).
  Examples: At low mass, it grew 2 for every 10 grams. Then it changed by 1 at 40g. Then at 50g, it did not grow any more.
  It increases by 2's until 30, increases by 1's until 50, and increases by 0 at 60.
  The length increased steadily up to 40g, and then it increased just a little bit more until it was 13cm at 50 and 60 grams.
  At first it got longer every time you added a mass, but then after a while, it did not get any longer.
- Other correct.

Incorrect Response

- Includes only region (i). Response references only an increase in length as more mass is added but discussion of leveling off is inadequate or missing.
  Examples: The length increased as more mass was added.
  The spring length got 2cm longer with each mass.
  It increased by 2cm each time until 40 grams.
- Refers only to leveling off of spring length or decreasing increments at higher masses. [Description of change in region (i) is inadequate or missing.]
  Examples: It stretches but only up to 13 cm.
  After 50 grams it did not change.
  It stretches less at higher masses.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Data trend of masses on spring (continued)

Item Number: S022286

Student Responses

Correct Response:

The table below shows the results of an experiment to investigate how the length of a spring changes as different masses are hung from it.

Mass (grams)	Length of Spring (cm)
0	5
10	7
20	9
30	11
40	12
50	13
60	13

Describe how the length of the spring changed as different masses were hung from it.

The length increased by 2 until it reached a mass of 30 grams it than increased by 1 and than sustained after a mass of 50.

Data trend of masses on spring (continued)

Item Number: S022286

Student Responses (continued)

Incorrect Response:

The table below shows the results of an experiment to investigate how the length of a spring changes as different masses are hung from it.

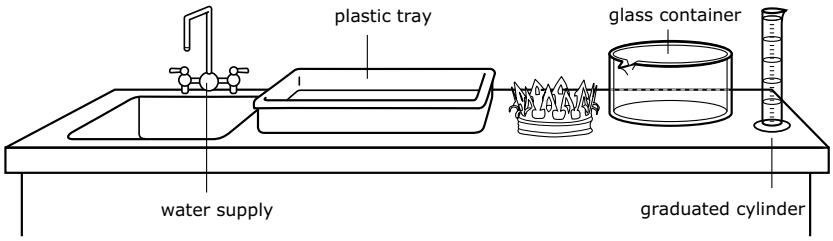
Mass (grams)	Length of Spring (cm)
0	5
10	7
20	9
30	11
40	12
50	13
60	13

Describe how the length of the spring changed as different masses were hung from it. it got longer as you hung heavier things from it.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Forces and Motion	Reasoning and Analysis

Metal crown: procedure to find volume of crown

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Item Number: S032711

Overall Percent Correct

Singapore	38	▲
Japan	36	▲
Hong Kong, SAR	33	▲
Korea, Republic of	33	▲
Chinese Taipei	32	▲
Jordan	27	▲
Russian Federation	25	▲
Estonia	21	▲
Lithuania	20	▲
Slovak Republic	20	▲
Sweden	19	▲
Slovenia	19	▲
United States	17	▲
Belgium (Flemish)	16	▲
New Zealand	16	O
Hungary	15	O
Israel	15	O
Australia	14	O
International average	**13**	
Romania	13	O
Latvia	13	O
Netherlands	13	O
Italy	12	O
Malaysia	11	O
Cyprus	11	O
Bulgaria	11	O
Serbia and Montenegro	10	▼
Norway	9	▼
Saudi Arabia	9	▼
Scotland	8	▼
Macedonia, Republic of	8	▼
England	8	▼
Bahrain	8	▼
Palestinian Nat'l Auth.	7	▼
Egypt	5	▼
Armenia	5	▼
Indonesia	5	▼
Lebanon	5	▼
Iran, Islamic Republic of	4	▼
Botswana	4	▼
Philippines	3	▼
South Africa	2	▼
Chile	2	▼
Ghana	2	▼
Tunisia	1	▼
Morocco	0	▼
Moldova, Rep. of	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

SCORING

Note: For full credit, responses must describe or diagram a procedure based on displacement and clearly identify how the volume of the crown is determined. Partial credit is given for procedures or diagrams that demonstrate knowledge of displacement without a complete description of the steps/measurements to be made. Responses may also implicitly refer to other materials not indicated in the diagram (e.g., ruler, marker, etc.). Because it is not totally clear from the diagram what the relative size of the crown, beaker, and tray are, credit is given for procedures that use any of these materials for displacement even if the actual procedure might not be completely successful.

Correct Response

- Describes or diagrams a procedure based on displacement of water using measured water level differences:

  i) Adding water to the beaker (sink or tray) and marking the water level.

  ii) Placing the crown in the beaker (sink or tray) and marking the new water level.

  iii) Measuring the volume difference before/after adding the crown using the graduated cylinder
- Describes or diagrams a procedure based on displacement of water using measured overflow:

  i) Filling the beaker (or tray) with water.

  ii) Placing the crown in the beaker (or tray) and collecting the overflow.

  iii) Measuring the volume of the overflow using the graduated cylinder
- Other fully correct.

Partially Correct Response

- Describes or diagrams a partial procedure that includes displacement of water but with inadequate or no description of the steps/measurements to determine the volume.

  Examples: Put some water in the beaker and add the crown. Measure how much the level of water went up.

  Add the crown to the beaker filled with water. See how much overflowed.
- Other partially correct.

Incorrect Response

- Mentions putting the crown in the beaker (sink or tray) of water with no explicit mention that the water level will rise/overflow and no or incorrect procedure given for measuring the volume.

  Examples: Fill the beaker to the top with water and add the crown. You can get the volume that way.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

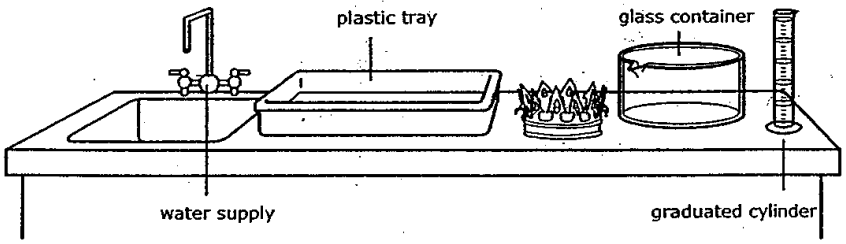
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

Student Responses

Correct Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

① Fill glass container to the very rim with water
② Place graduated cylinder under the spout
③ Place the crown carefully into the glass container
④ Measure how much water fell into the cylinder.
⑤ However much water spilled into the cylinder is the volume of the crown,
⑥ Convert mL into cm^3

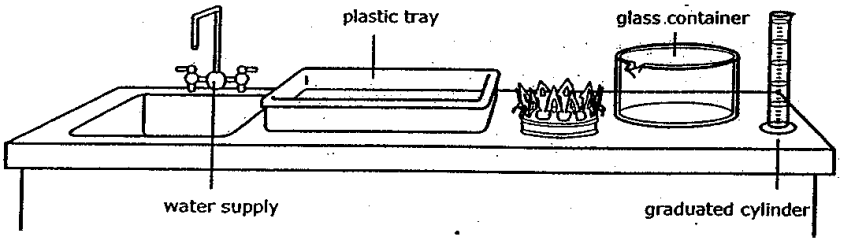
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

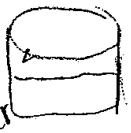
Student Responses (continued)

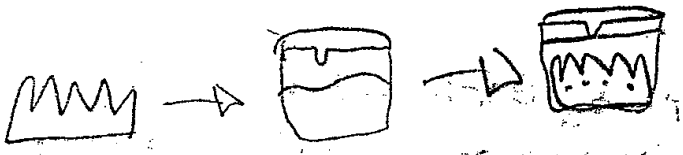
Partially Correct Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Put water in glass container →  → mesaure it



Take away that number from the one without the crown & get the answer.

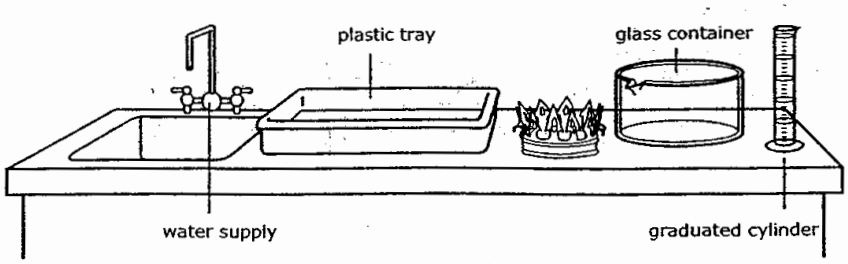
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

Student Responses (continued)

Incorrect Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



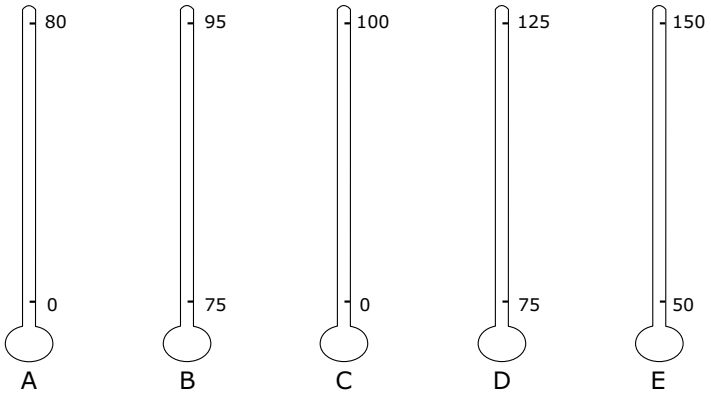
Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Put the crown into the plastic tray then weigh it.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Heat and Temperature	Reasoning and Analysis

Thermometer scale for boiling water

At different altitudes, the boiling point of water ranges from about 80° C to 100° C. Which of the Celsius thermometers shown below would give the most accurate measurement of the boiling point of water at different altitudes?



Ⓐ Thermometer A
Ⓑ Thermometer B
Ⓒ Thermometer C
Ⓓ Thermometer D
Ⓔ Thermometer E

Item Number: S022225

Correct Response: D

Overall Percent Correct

Hong Kong, SAR	38	▲
Korea, Republic of	33	▲
Netherlands	33	▲
Slovak Republic	33	▲
Estonia	31	▲
Chinese Taipei	30	▲
Japan	29	▲
Belgium (Flemish)	27	▲
Israel	27	▲
Lithuania	26	▲
United States	26	▲
Singapore	25	▲
Hungary	24	▲
Russian Federation	23	▲
Sweden	22	O
Slovenia	22	O
New Zealand	22	O
Australia	22	O
Latvia	22	O
Palestinian Nat'l Auth.	21	O
Egypt	21	O
Jordan	20	O
England	20	O
International average	**20**	
Bulgaria	20	O
Scotland	19	O
Cyprus	17	O
Romania	16	▼
Italy	16	▼
Serbia and Montenegro	16	▼
Bahrain	16	▼
Norway	16	▼
Macedonia, Republic of	15	▼
South Africa	14	▼
Tunisia	13	▼
Moldova, Rep. of	13	▼
Philippines	13	▼
Lebanon	12	▼
Indonesia	11	▼
Iran, Islamic Republic of	10	▼
Armenia	9	▼
Chile	9	▼
Ghana	8	▼
Botswana	8	▼
Malaysia	6	▼
Morocco	0	▼
Saudi Arabia	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Seeing person in a dark room

A person in a dark room looking through a window can clearly see a person outside in the daylight. But a person outside cannot see the person inside. Why does this happen?

Ⓐ There is not enough light being reflected off the person in the room.

Ⓑ Light rays cannot pass through a window twice.

Ⓒ Outside light does not pass through windows.

Ⓓ Sunlight is not as intense as other sources of light.

Item Number: S012004

Correct Response: A

Overall Percent Correct

Singapore	87	▲
England	83	▲
Scotland	81	▲
New Zealand	81	▲
Sweden	80	▲
United States	79	▲
Lithuania	79	▲
Chinese Taipei	79	▲
Netherlands	79	▲
Korea, Republic of	78	▲
Australia	76	▲
Estonia	76	▲
Norway	75	▲
Israel	75	▲
Hong Kong, SAR	73	▲
Latvia	72	▲
Belgium (Flemish)	71	▲
Slovenia	70	▲
Romania	69	O
Hungary	69	O
Serbia and Montenegro	69	O
Indonesia	68	O
Italy	68	O
Moldova, Rep. of	68	O
Iran, Islamic Republic of	66	O
Bahrain	66	O
International average	**66**	
Philippines	66	O
Jordan	65	O
Cyprus	62	▼
Chile	61	▼
Japan	61	▼
Saudi Arabia	60	▼
Tunisia	60	▼
Macedonia, Republic of	59	▼
Slovak Republic	59	▼
Botswana	58	▼
Morocco	57	▼
Palestinian Nat'l Auth.	57	▼
Russian Federation	52	▼
Bulgaria	50	▼
Egypt	50	▼
Malaysia	47	▼
Ghana	44	▼
Armenia	42	▼
South Africa	42	▼
Lebanon	35	▼

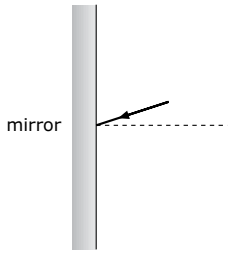
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

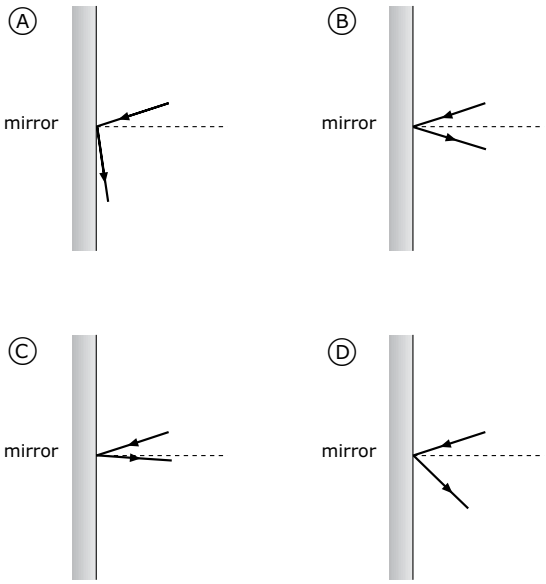
Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Angle of reflected light ray

A ray of light strikes a mirror as shown.



Which picture best shows the direction of the reflected light?



Item Number: S022058

Correct Response: B

Overall Percent Correct

Estonia	83	▲
England	83	▲
Korea, Republic of	81	▲
Netherlands	81	▲
Japan	80	▲
Singapore	79	▲
Armenia	76	▲
New Zealand	76	▲
Chinese Taipei	75	▲
Latvia	74	▲
Malaysia	72	▲
Cyprus	72	▲
Sweden	71	▲
Lithuania	71	▲
Hong Kong, SAR	68	▲
Belgium (Flemish)	67	▲
Scotland	67	O
Australia	66	O
Bulgaria	66	O
Hungary	66	O
International average	**63**	
Slovenia	63	O
Serbia and Montenegro	62	O
Iran, Islamic Republic of	62	O
Slovak Republic	62	O
Israel	61	O
Russian Federation	61	O
Macedonia, Republic of	61	O
Indonesia	61	O
Palestinian Nat'l Auth.	60	O
Romania	59	O
United States	59	▼
Jordan	59	▼
Moldova, Rep. of	58	▼
Lebanon	57	▼
Norway	57	▼
Italy	57	▼
Egypt	54	▼
Bahrain	54	▼
Morocco	51	▼
Philippines	51	▼
Saudi Arabia	49	▼
Chile	45	▼
Tunisia	44	▼
Ghana	41	▼
Botswana	38	▼
South Africa	33	▼

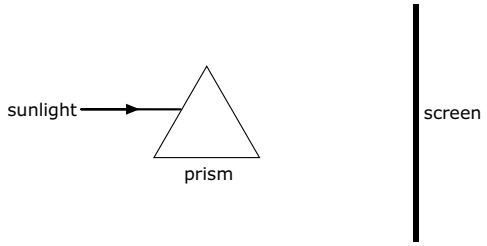
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Sunlight through a glass prism

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

Item Number: S032375

SCORING

Note: For full credit, responses must explicitly indicate that different colors are seen on the screen, either by textual description or by drawing on the diagram. A completely correct or complete sequence of colors is not required for full credit. Partial credit will be given for responses that show or describe refraction even if the appearance of the light beams on the screen is not fully described.

Correct Response

- Describes or draws the visible color spectrum.
  Examples: A spectrum of seven colors which is red, orange, yellow, green, blue, indigo, violet.
- Refers to a spectrum, rainbow, colors, etc. (no color spectrum shown)
  Examples: I will see many colors on it like the rainbow.
  All the colors of the color spectrum.
  There will be seven colors.
- Other fully correct.

Partially Correct Response

- Describes or draws multiple refracted rays but with no explicit connection to color.
  Examples: There will be a lot of rays coming out the other side of the prism.
  The light will spread out across that side of the prism and be seen on most of the screen.
- Describes or draws only the refraction (bending) of light beam (no mention of color dispersion).
  Examples: The light inside the prism will bend.
  The sunlight would go through at an angle.
- Other partially correct.

Incorrect Response

- Describes or draws a shadow or image of the prism (or similar).
  Examples: The prism will make a shadow on the screen.
- Refers only to seeing sunlight or light on the screen. [No mention of color dispersion or refraction.]
  Examples: Sunlight hitting the screen.
  The screen will be bright because there is light falling on it.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Korea, Republic of	74	▲
Singapore	65	▲
Malaysia	53	▲
Hong Kong, SAR	49	▲
United States	49	▲
England	47	▲
Netherlands	45	▲
New Zealand	43	▲
Chinese Taipei	38	▲
Jordan	36	▲
Bahrain	34	▲
Armenia	33	▲
Palestinian Nat'l Auth.	33	▲
Lithuania	32	▲
Iran, Islamic Republic of	31	▲
Scotland	28	O
Sweden	25	O
Egypt	24	O
Hungary	24	O
Italy	24	O
International average	**23**	
Australia	22	O
Estonia	20	O
Romania	18	▼
Israel	17	▼
Latvia	17	▼
Belgium (Flemish)	15	▼
Norway	15	▼
Slovenia	15	▼
Saudi Arabia	14	▼
Chile	11	▼
Russian Federation	11	▼
Philippines	10	▼
Japan	10	▼
Indonesia	9	▼
Lebanon	7	▼
Bulgaria	7	▼
Macedonia, Republic of	7	▼
Slovak Republic	6	▼
Botswana	5	▼
Cyprus	4	▼
South Africa	3	▼
Moldova, Rep. of	2	▼
Serbia and Montenegro	2	▼
Ghana	1	▼
Morocco	1	▼
Tunisia	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

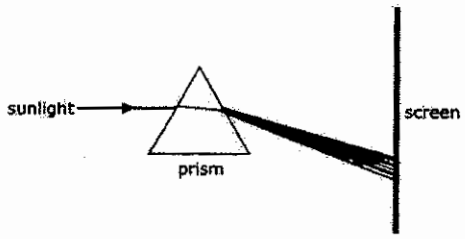
Sunlight through a glass prism (continued)

Item Number: S032375

Student Responses

Correct Response:

The diagram shows a ray of sunlight entering a glass prism.

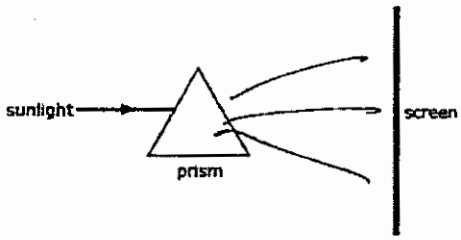


Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

Seven different colours namely red, orange, yellow, green blue, indigo and violet will be seen.

Partially Correct Response:

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

You will see many different light rays

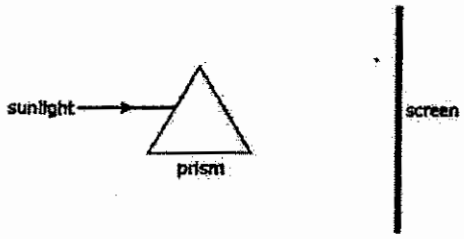
Sunlight through a glass prism (continued)

Item Number: S032375

Student Responses (continued)

Incorrect Response:

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

There will be a reflection of one side of the prism

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Lightning seen before thunder heard

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

Explain why she saw lightning before she heard thunder.

Item Number: S032626

SCORING

Correct Response

- Refers to light traveling faster than sound (or similar).
  Examples: Speed of light is faster than speed of sound.
  Light travels quicker than sound.
  It takes more time for sound to reach her than light.
- Other correct.

Incorrect Response

- Refers only to lightning being closer or thunder being further away (explicitly or implicitly).
  Examples: Thunder has a longer way to go.
  Thunder is striking from kilometers away.
- Refers to lightning occurring first, causing thunder, or similar.
  [No explicit mention of the relative speed of light/sound to travel.]
  Examples: Lightning is so quick, thunder only happens afterward.
  The noise occurs later.
  Thunder occurs from lightning.
  Thunder is the echo of lightning.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	88	▲
England	74	▲
Chinese Taipei	70	▲
Japan	65	▲
Hong Kong, SAR	62	▲
Lithuania	61	▲
Sweden	59	▲
Botswana	54	▲
Hungary	54	▲
Norway	54	▲
Estonia	53	▲
Latvia	52	▲
Netherlands	52	▲
Australia	51	▲
Korea, Republic of	47	▲
Malaysia	47	▲
Israel	46	O
United States	46	▲
Bahrain	45	O
Saudi Arabia	45	O
Romania	44	O
Slovenia	44	O
Bulgaria	43	O
New Zealand	43	O
Scotland	43	O
Belgium (Flemish)	42	O
International average	**42**	
Italy	41	O
Slovak Republic	41	O
Macedonia, Republic of	41	O
Egypt	40	O
Jordan	39	O
Serbia and Montenegro	37	▼
Russian Federation	36	▼
Cyprus	35	▼
Moldova, Rep. of	35	▼
Lebanon	32	▼
Palestinian Nat'l Auth.	31	▼
Armenia	26	▼
Chile	19	▼
Indonesia	19	▼
Iran, Islamic Republic of	15	▼
Philippines	13	▼
Morocco	12	▼
Tunisia	8	▼
South Africa	4	▼
Ghana	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Lightning seen before thunder heard (continued)

Item Number: S032626

Student Responses

Correct Response:

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

Explain why she saw lightning before she heard thunder.

Light travels faster than sound. So the lightning was moving faster than the thunder even though the were part of the same thing.

Incorrect Response:

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

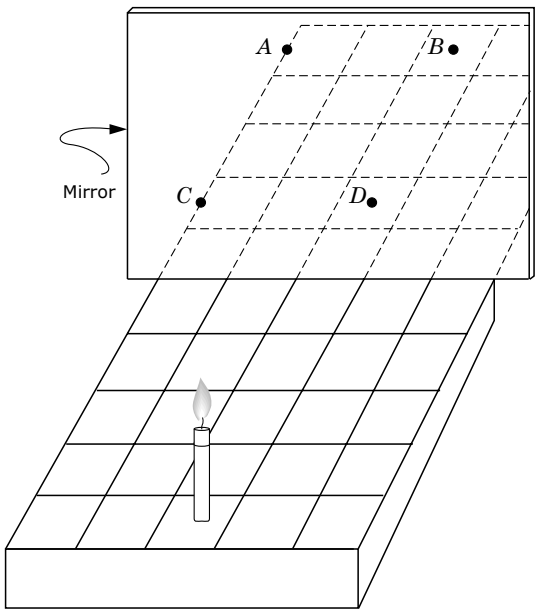
Explain why she saw lightning before she heard thunder.

She saw lightning first because, the lightning is close

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Candle position reflected on grid

A candle is placed on a ruled grid in front of a mirror, as shown. At what point will the reflection of the candle appear to be?



Ⓐ Point A
Ⓑ Point B
Ⓒ Point C
Ⓓ Point D

Item Number: S012015

Correct Response: B

Overall Percent Correct

Belgium (Flemish)	89	▲
Singapore	88	▲
Netherlands	87	▲
New Zealand	86	▲
England	86	▲
Scotland	83	▲
Hungary	80	▲
Hong Kong, SAR	80	▲
Estonia	80	▲
Australia	80	▲
Slovak Republic	77	▲
Korea, Republic of	77	▲
Chinese Taipei	77	▲
Japan	75	▲
Bahrain	74	▲
Malaysia	73	▲
United States	73	▲
Slovenia	72	▲
Russian Federation	71	▲
Norway	70	▲
Latvia	69	▲
Lithuania	68	▲
Cyprus	65	O
Armenia	65	O
International average	**64**	
Italy	64	O
Israel	63	O
Chile	63	O
Indonesia	60	▼
Sweden	60	▼
Serbia and Montenegro	59	▼
Moldova, Rep. of	56	▼
Palestinian Nat'l Auth.	55	▼
Bulgaria	54	▼
Romania	53	▼
Macedonia, Republic of	53	▼
Egypt	53	▼
Iran, Islamic Republic of	52	▼
Lebanon	51	▼
Saudi Arabia	48	▼
Morocco	46	▼
Jordan	45	▼
Tunisia	43	▼
Botswana	42	▼
Philippines	41	▼
Ghana	28	▼
South Africa	25	▼

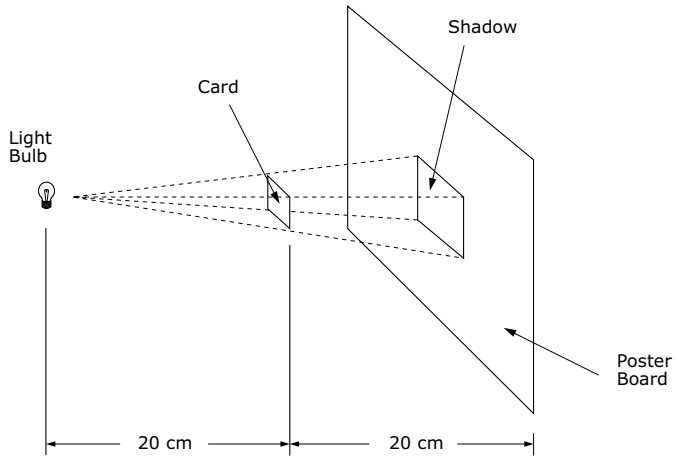
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Shadow size from distance diagram

A tiny light bulb is held 20 centimeters to the left of a square card, which is in turn held 20 centimeters to the left of a poster board, as shown. The shadow of the card on the poster board has a side of 10 centimeters.



If the poster board is moved 40 cm further to the right so that it is 80 cm from the light, what will be the new side of the card's shadow on the poster board?

Ⓐ 5 cm
Ⓑ 10 cm
Ⓒ 15 cm
Ⓓ 20 cm

Item Number: S012029

Correct Response: D

Overall Percent Correct

Korea, Republic of	79	▲
Sweden	69	▲
Belgium (Flemish)	69	▲
Estonia	68	▲
Chinese Taipei	68	▲
Japan	67	▲
Russian Federation	67	▲
Singapore	66	▲
Netherlands	64	▲
Lithuania	63	O
Lebanon	63	O
Malaysia	63	▲
Scotland	63	O
Romania	62	O
Hungary	61	O
United States	61	O
Latvia	61	O
Hong Kong, SAR	61	O
Slovenia	61	O
Botswana	60	O
Armenia	60	O
Israel	60	O
England	60	O
International average	**59**	
Italy	59	O
Moldova, Rep. of	59	O
Macedonia, Republic of	58	O
Australia	58	O
Serbia and Montenegro	58	O
Bahrain	58	O
New Zealand	57	O
Iran, Islamic Republic of	57	O
Philippines	57	O
Norway	57	O
Bulgaria	56	O
Morocco	56	O
Jordan	56	O
Palestinian Nat'l Auth.	56	▼
Cyprus	55	▼
Tunisia	53	▼
Slovak Republic	53	▼
South Africa	51	▼
Indonesia	50	▼
Saudi Arabia	49	▼
Egypt	48	▼
Chile	47	▼
Ghana	47	▼

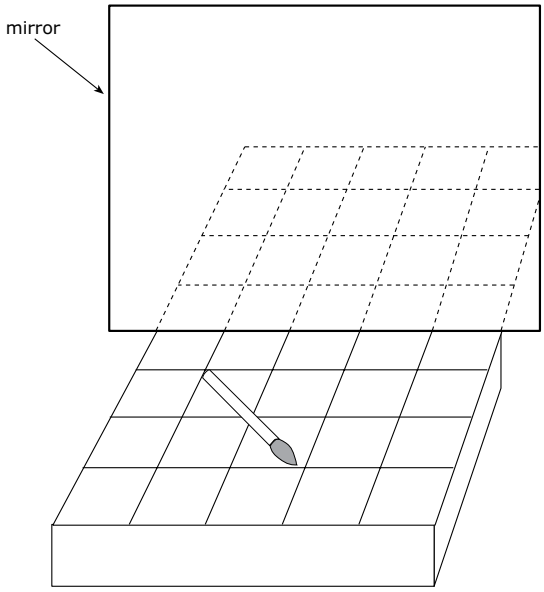
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Brush reflected in mirror at angle

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Item Number: S022279

Overall Percent Correct

New Zealand	75	▲
Netherlands	72	▲
Belgium (Flemish)	71	▲
England	71	▲
Scotland	70	▲
Estonia	67	▲
Japan	66	▲
Australia	61	▲
Hungary	61	▲
Hong Kong, SAR	60	▲
Singapore	59	▲
Latvia	59	▲
Lithuania	58	▲
Russian Federation	56	▲
Armenia	54	▲
Norway	53	▲
Slovenia	53	▲
Slovak Republic	52	▲
Chinese Taipei	52	▲
Sweden	51	▲
Malaysia	51	▲
Moldova, Rep. of	51	▲
United States	51	▲
Korea, Republic of	46	O
Serbia and Montenegro	45	O
Bahrain	44	O
International average	**44**	
Italy	42	O
Romania	41	O
Bulgaria	37	▼
Israel	36	▼
Chile	35	▼
Indonesia	35	▼
Macedonia, Republic of	35	▼
Iran, Islamic Republic of	32	▼
Cyprus	31	▼
Tunisia	26	▼
Philippines	24	▼
Morocco	23	▼
Egypt	22	▼
Palestinian Nat'l Auth.	22	▼
Saudi Arabia	21	▼
Lebanon	21	▼
Jordan	20	▼
Botswana	17	▼
South Africa	8	▼
Ghana	4	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Brush reflected in mirror at angle (continued)

Item Number: S022279

SCORING

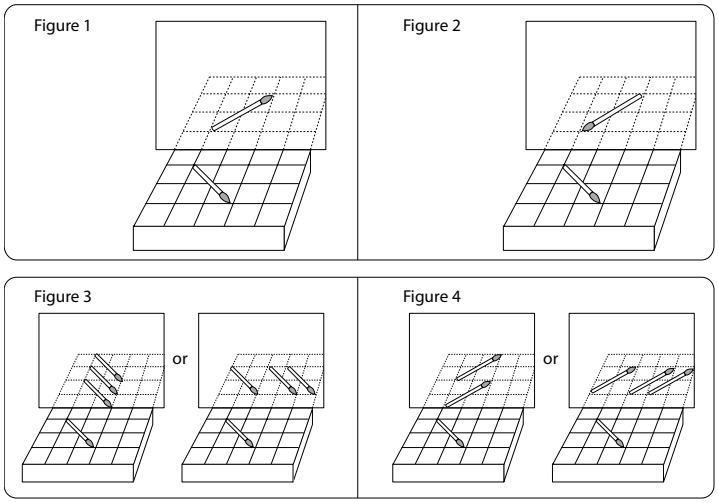
Note: A brush on the borderline of the correct squares should be accepted as correct. Credit is given for a brush in the correct squares even if the hairs are not clearly shown. Only if the hairs are clearly shown in the wrong direction is the answer incorrect.

Correct Response

- Correct placement: angle, grid position, and direction (hairs to the right). (See Figure 1.)

Incorrect Response

- Correct angle and placement, but image flipped with hairs clearly turned to the left. (See Figure 2.)
- Image parallel to original (hairs to the right or left). (See Figure 3; other rows/columns are possible).
- Correct angle but image translated (hairs to the right or left). (See Figure 4; other rows/columns are possible).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).



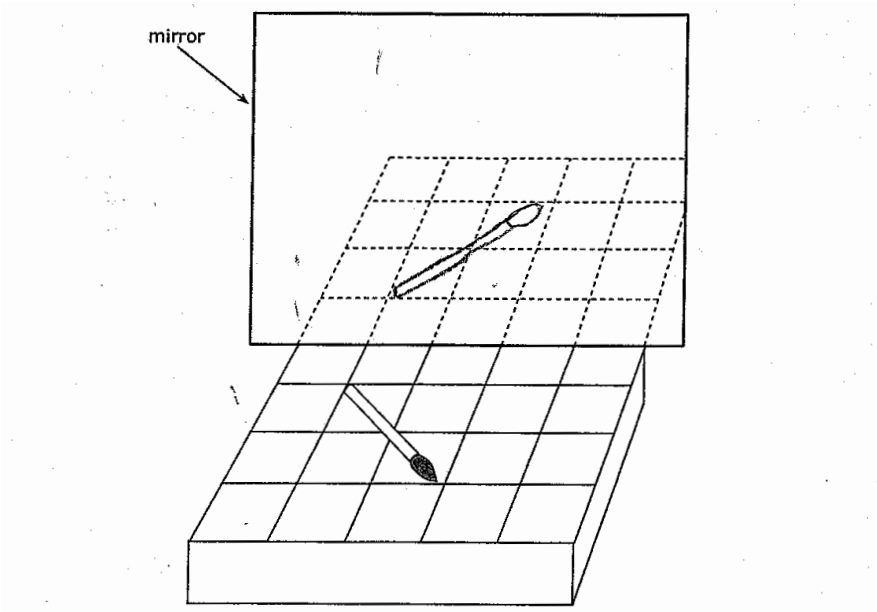
Brush reflected in mirror at angle (continued)

Item Number: S022279

Student Responses

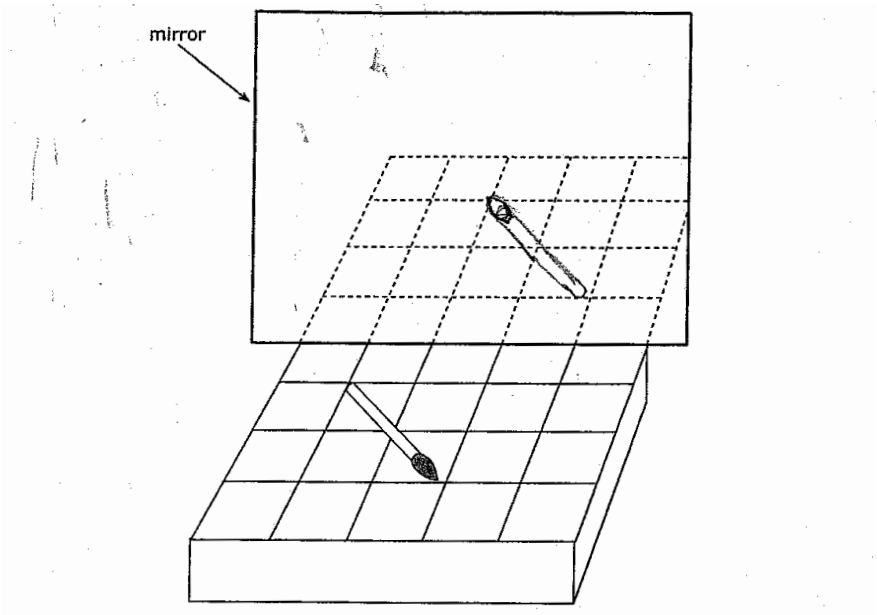
Correct Response:

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Incorrect Response:

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Content Domain	Main Topic	Cognitive Domain
PHYSICS	Physical States and Changes in Matter	Factual Knowledge

Wet towel dries in the sun

A wet towel will dry when it is left in the Sun. Which process occurs to make this happen?

Ⓐ melting

Ⓑ boiling

Ⓒ condensation

Ⓓ evaporation

Item Number: S032055

Correct Response: D

Overall Percent Correct

Chinese Taipei	98	▲
Singapore	95	▲
Hungary	95	▲
Estonia	94	▲
Slovak Republic	94	▲
Hong Kong, SAR	94	▲
Japan	94	▲
Russian Federation	94	▲
Korea, Republic of	93	▲
Tunisia	91	▲
Lithuania	91	▲
Slovenia	90	▲
England	89	▲
Moldova, Rep. of	89	▲
New Zealand	88	▲
Australia	88	▲
Latvia	88	▲
Netherlands	88	▲
Malaysia	87	▲
Bulgaria	87	▲
Scotland	87	O
Jordan	86	O
Romania	86	O
Armenia	86	O
Belgium (Flemish)	85	O
United States	85	O
Israel	85	O
Serbia and Montenegro	85	O
Bahrain	84	O
Norway	84	O
International average	**83**	
Iran, Islamic Republic of	83	O
Morocco	83	O
Sweden	82	O
Saudi Arabia	82	O
Italy	81	O
Palestinian Nat'l Auth.	78	▼
Macedonia, Republic of	78	▼
Cyprus	77	▼
Indonesia	77	▼
Chile	76	▼
Lebanon	76	▼
Philippines	69	▼
Botswana	67	▼
Egypt	59	▼
South Africa	51	▼
Ghana	39	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Item Index 1999

Item Index 2003

Item Index 2003