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.

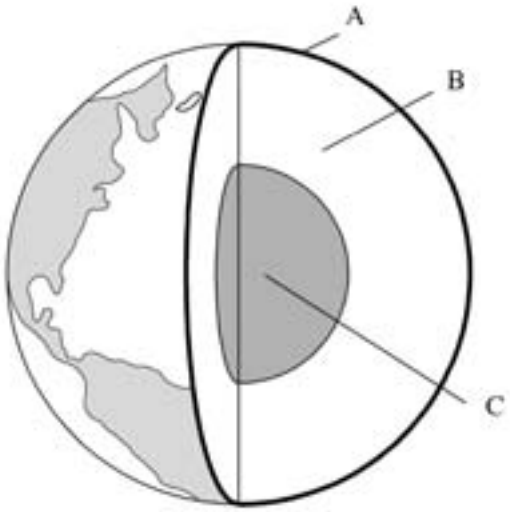
Sample student responses are provided for TIMSS 2003 extended response items. An example of an actual U.S. fourth-grade student's response is provided for each scoring category. See item S032057 on page 76.

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	▼

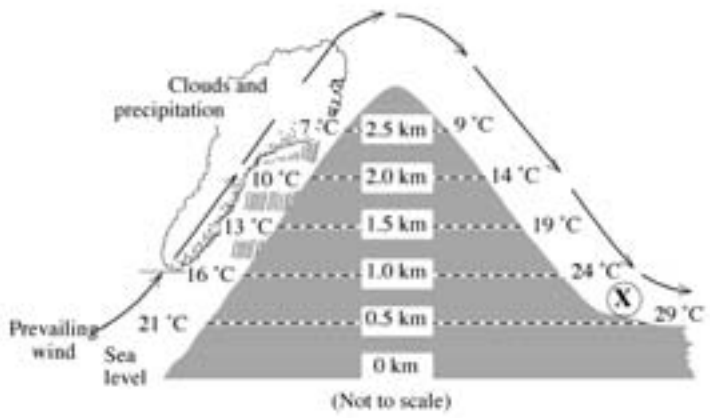
Country average vs. International average:

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	▼

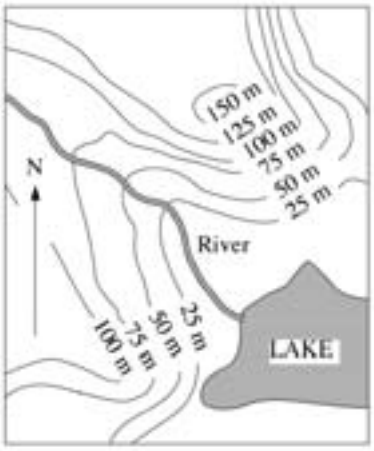
Country average vs. International average:

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	▼

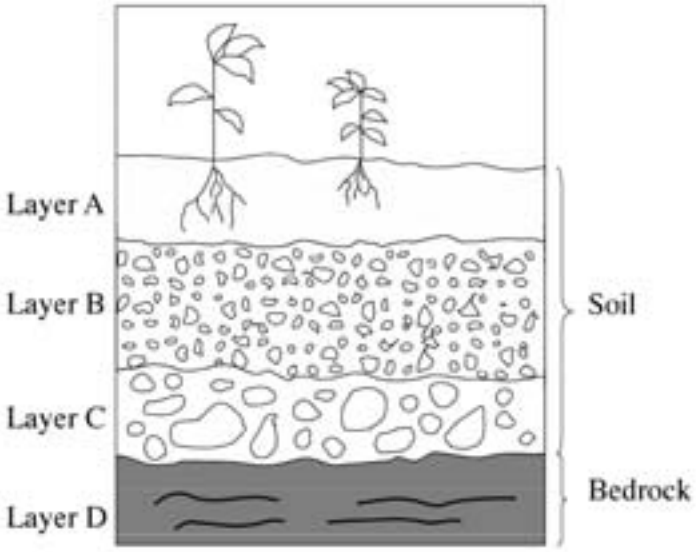
Country average vs. International average:

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

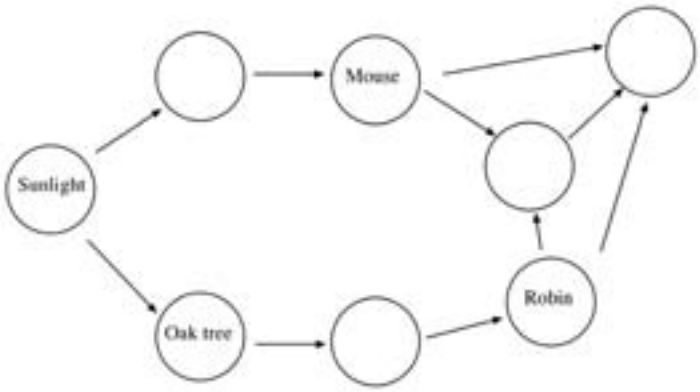
An incomplete food web has been drawn for you. Complete it by filling in each of the empty circles with the number of the correct animal or plant from the list. Remember that the arrows represent energy flow and go from the provider to the user.

1) Caterpillar

2) Corn

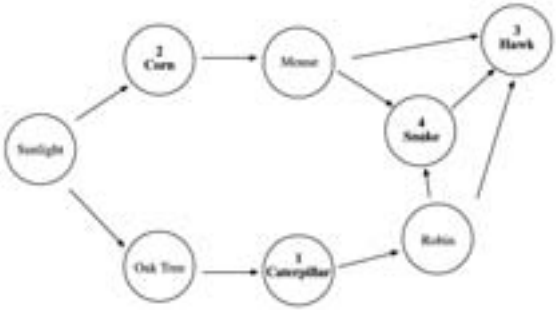
3) Hawk

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

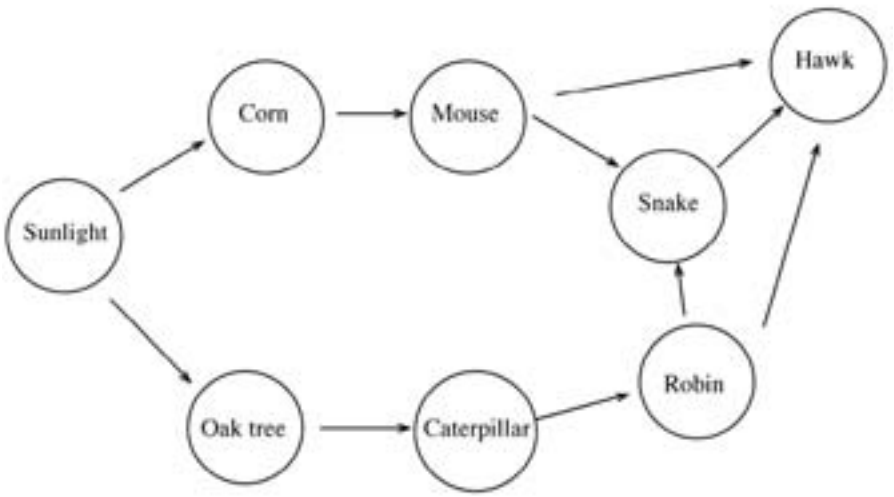
Chinese Taipei	89	▲
Singapore	89	▲
Korea, Rep. of	85	▲
Malaysia	84	▲
England	75	▲
Bulgaria	70	▲
Hungary	70	▲
Japan	68	▲
Russian Federation	67	▲
Indonesia	66	▲
Romania	65	O
Hong Kong, SAR	64	▲
Canada	63	O
Belgium (Flemish)	62	O
Czech Republic	60	O
Australia	60	O
Netherlands	58	O
Thailand	58	O
Finland	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	▼

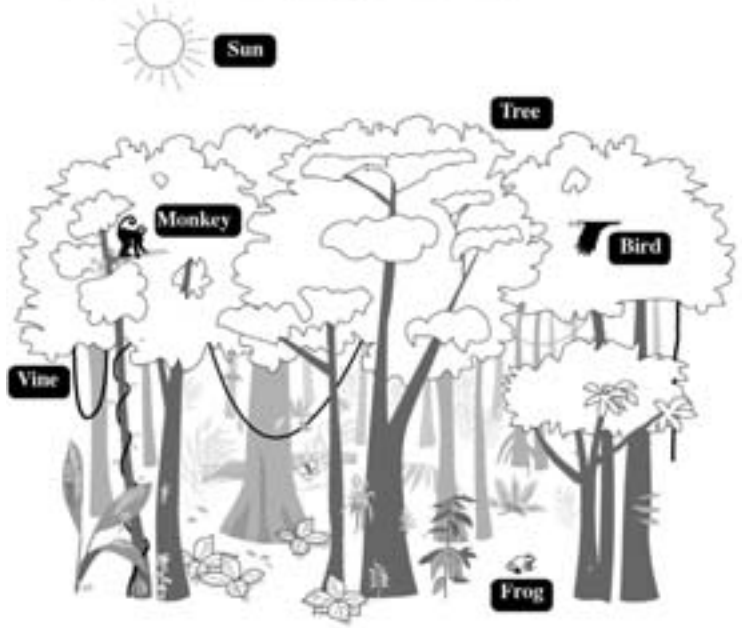
Country average vs. International average:

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	▼

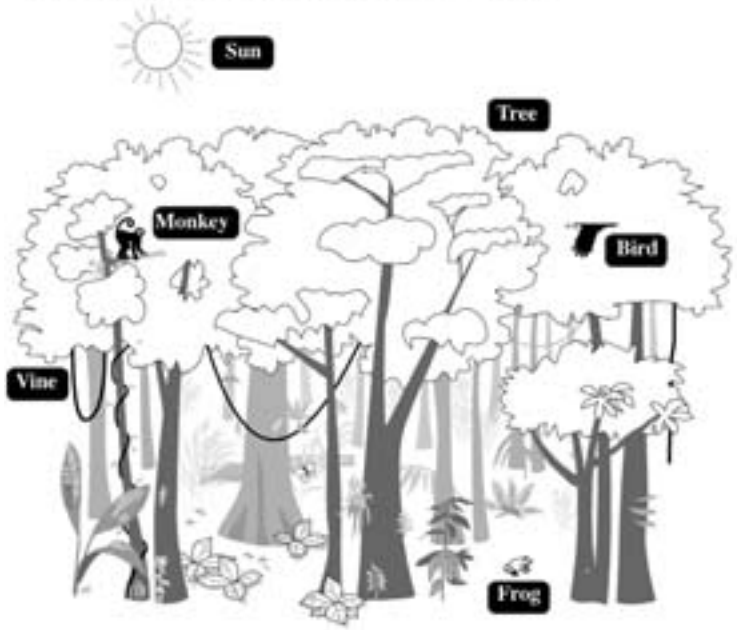
Country average vs. International average:

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	▼

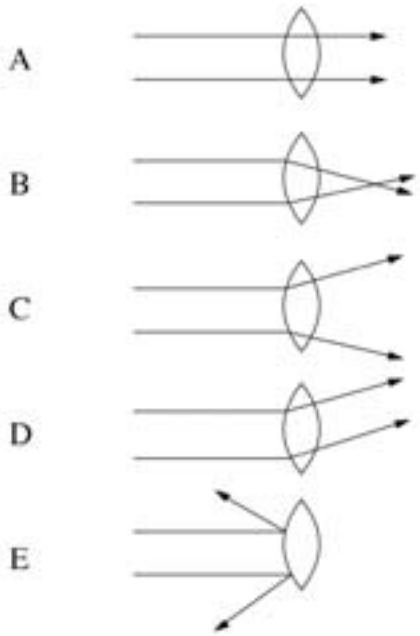
Country average vs. International average:

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	▼

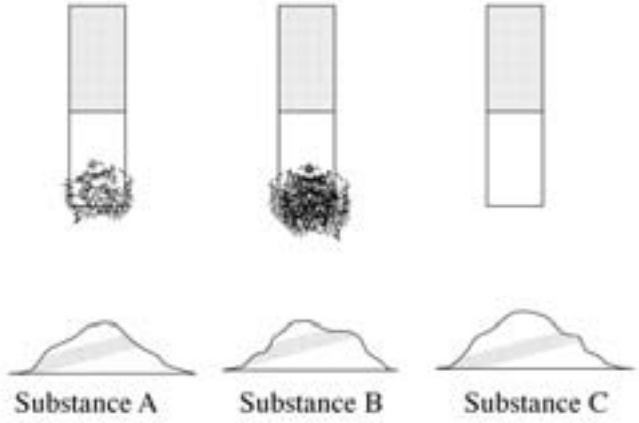
Country average vs. International average:

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

Chemical Energy → Heat Energy → Mechanical Energy (with wasted heat)

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	▼

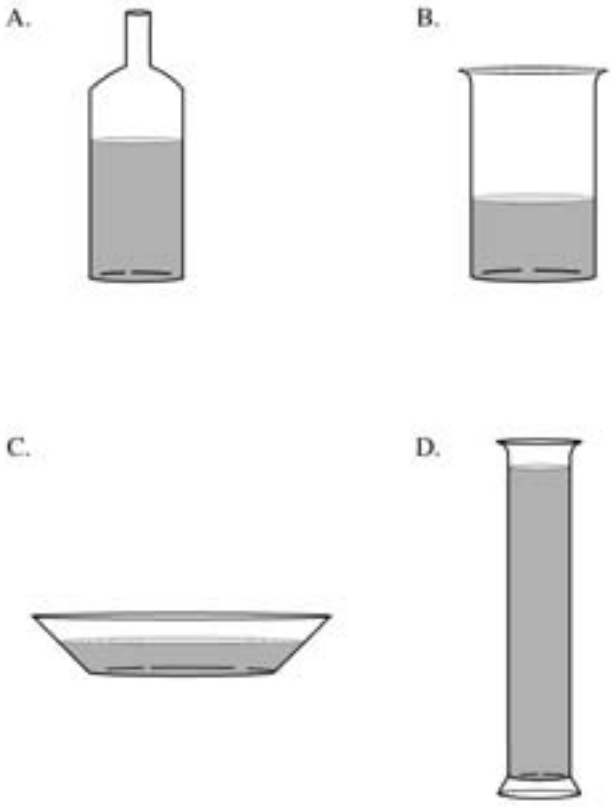
Country average vs. International average:

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	▼

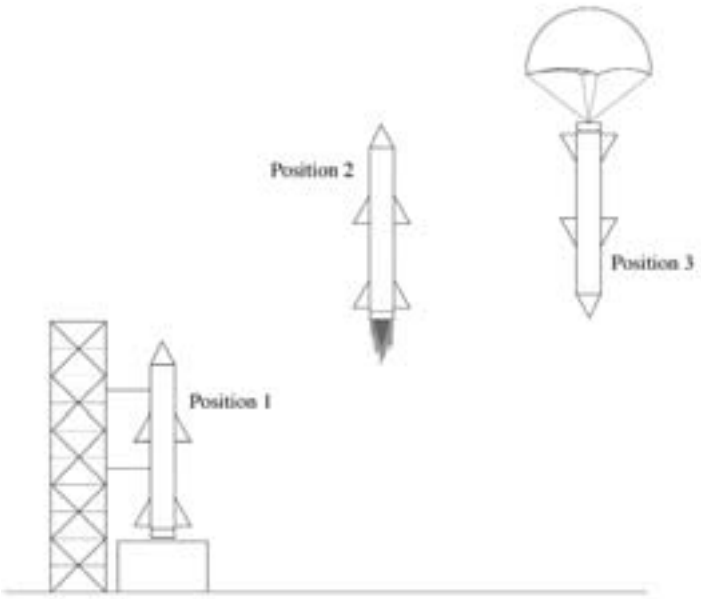
Country average vs. International average:

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	▼

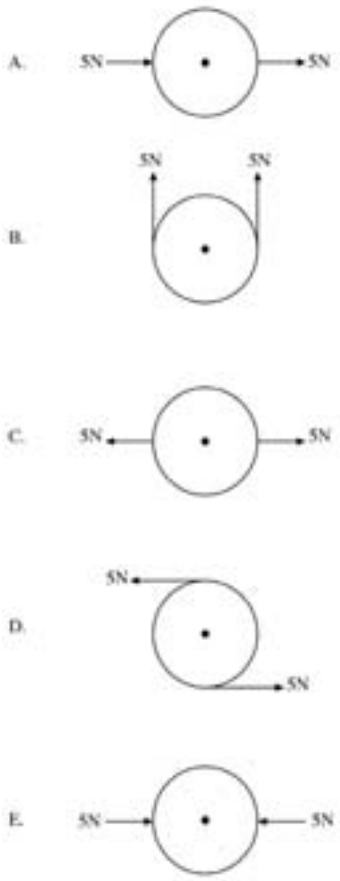
Country average vs. International average:

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	▼

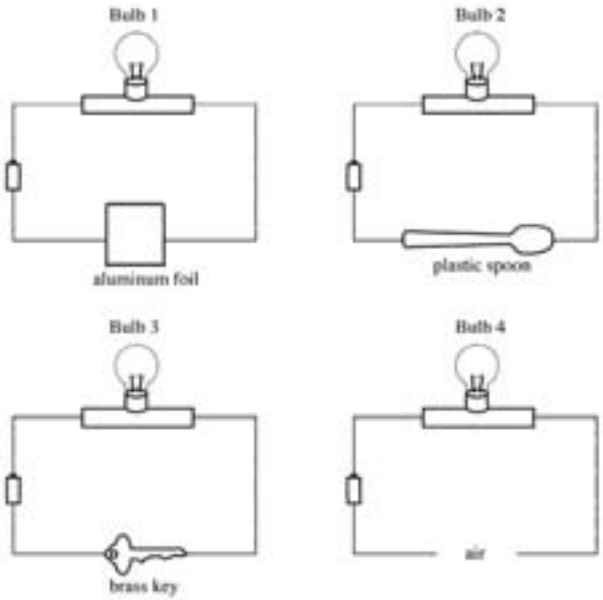
Country average vs. International average:

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:

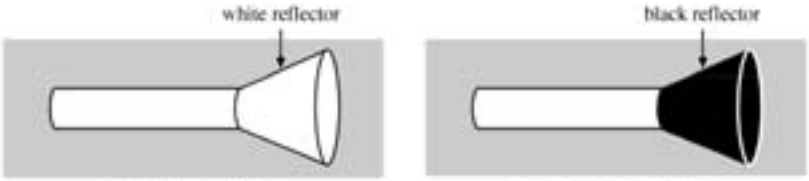
Higher ▲
Not different O
Lower ▼

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	▼

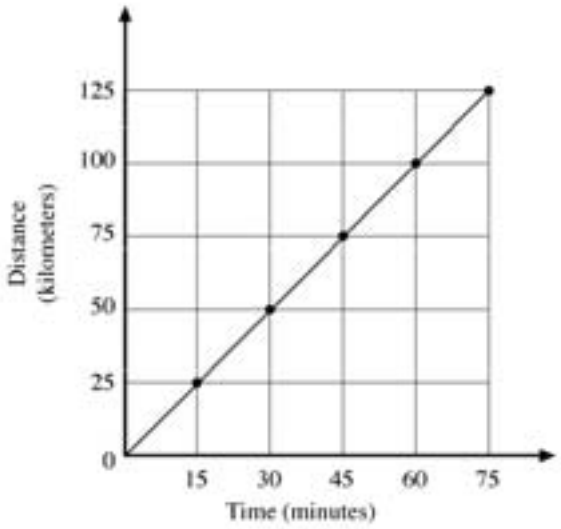
Country average vs. International average:

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	▼

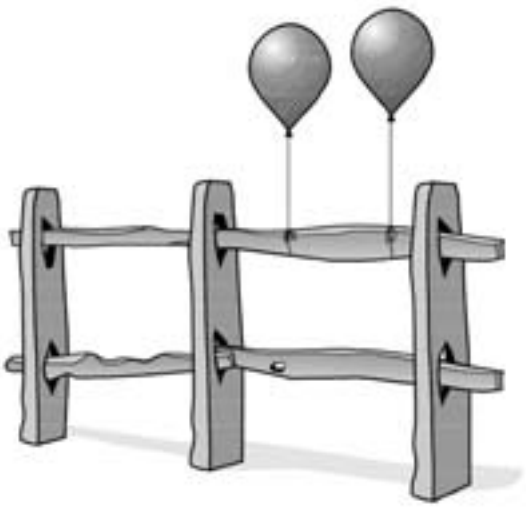
Country average vs. International average:

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

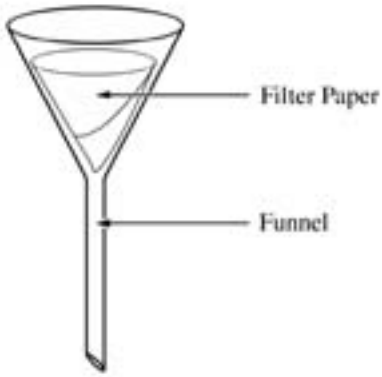
Singapore	69	▲
Bulgaria	67	▲
Slovak Republic	65	▲
Japan	63	▲
Russian Federation	61	▲
Korea, Rep. of	60	▲
Czech Republic	60	▲
Chinese Taipei	57	▲
Macedonia, Rep. of	56	▲
Italy	55	▲
Lithuania	54	O
Slovenia	54	O
Malaysia	53	▲
Australia	53	O
Latvia (LSS)	52	O
Canada	51	O
United States	51	O
England	49	O
Moldova	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

Correct Response: C

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 ▼

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	▼