TIMSS USA 8

RELEASED SCIENCE ITEMS

This book contains the released Trends in International Mathematics and Science Study (TIMSS) 2003 grade 8 science assessment items. This is not a complete set of all TIMSS 2003 assessment items because some items are kept confidential so that they may be used in subsequent cycles of TIMSS to measure trends.

How Can This Set of Released Items Be Used?

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

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

To benchmark student performance. The teacher might also compare the percent of students in the class who responded correctly to an item with the percent of students who responded correctly to the same item in other education systems or in the United States.

18679.0206

Guide to the Content and Layout of This Book

This book contains the released items from 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.

2003 Content Domains:

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

2003 Cognitive Domains:

- Factual knowledge
- Conceptual understanding
- Reasoning and analysis

Looking at *Litmus test*, the first item from TIMSS 2003, 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.
- **Scoring guide**. This form is used to assist in scoring write-in responses. In some cases, partial credit may be awarded and these items will provide guidelines for fully correct, partially correct, and incorrect responses.

Sample student responses are provided for some extended response items.

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	Main Topic	Cognitive Domain
CHEMISTRY	Acids and Bases	Conceptual Understanding

Litmus test

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

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

Item Number: S032057

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Litmus test (continued)

Item Number: S032057

Student Responses

Correct Response:

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

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

The chemicals have combined a new solution

Incorrect Response:

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

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

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

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Fanning a wood fire

Fanning can make a wood fire burn hotter because the fanning

Ⓐ makes the wood hot enough to burn

Ⓑ adds more oxygen needed for burning

Ⓒ increases the amount of wood there is to burn

Ⓓ provides the energy needed to keep the fire going

Item Number: S012003

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Reactions releasing energy

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

Ⓐ Burning coal only

Ⓑ Exploding fireworks only

Ⓒ Both burning coal and exploding fireworks

Ⓓ Neither burning coal nor exploding fireworks

Item Number: S022188

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
CHEMISTRY	Chemical Change	Conceptual Understanding

Chemical change involving elements

Which is a chemical change?

Ⓐ Element 1 is polished to form a smooth surface.

Ⓑ Element 2 is heated and evaporates.

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

Ⓓ Element 4 is separated from a mixture by filtration.

Item Number: S022198

Correct Response: C

Overall Percent Correct

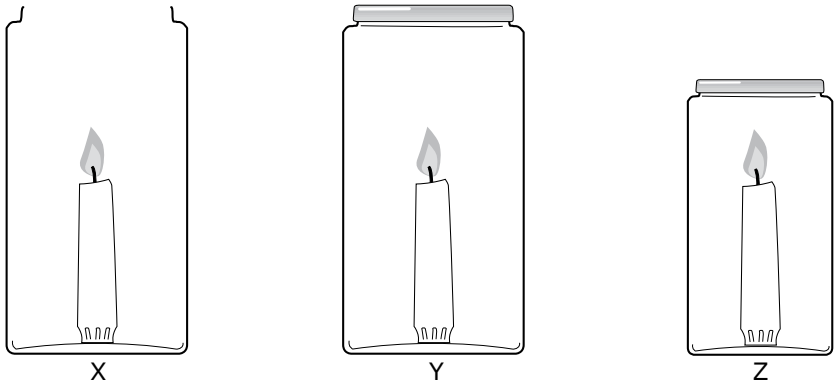
Chinese Taipei	73	▲
Singapore	60	▲
Hong Kong, SAR	52	▲
Malaysia	51	▲
Hungary	48	▲
Jordan	47	▲
Iran, Islamic Republic of	47	▲
England	46	▲
Japan	45	▲
Korea, Republic of	44	▲
Netherlands	43	▲
Palestinian Nat'l Auth.	41	▲
Armenia	40	▲
Russian Federation	39	▲
Bulgaria	39	O
Australia	39	▲
Belgium (Flemish)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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Candles burning in 3 jars



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

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

Explain your answer.

Item Number: S022191

SCORING

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

Correct Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Candles burning in 3 jars (continued)

Item Number: S022191

SCORING (continued)

Partially Correct Response

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

Incorrect Response

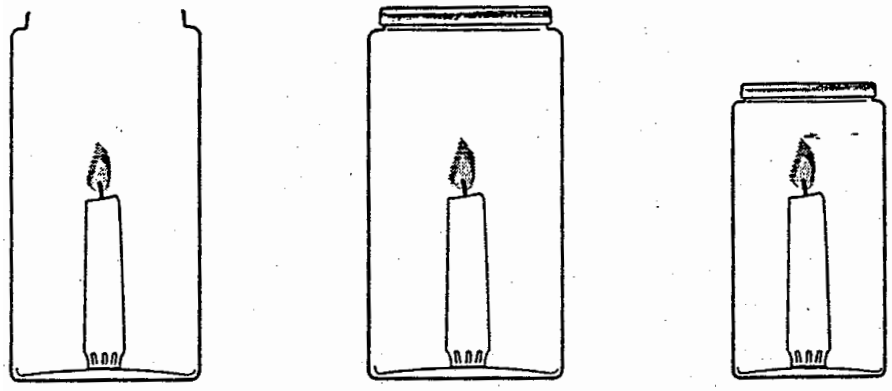
- Z with no explanation or an incorrect explanation.
  Examples: Z. This jar will have the smallest flame since it is in the smallest jar.
  Z. The smoke cannot escape, so the flame dies.
  Z. The carbon dioxide level builds up too much.
  Z. The candle wants to let off heat, so it bursts.
- X. Explanation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

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses

Correct Response:



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

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

Explain your answer.

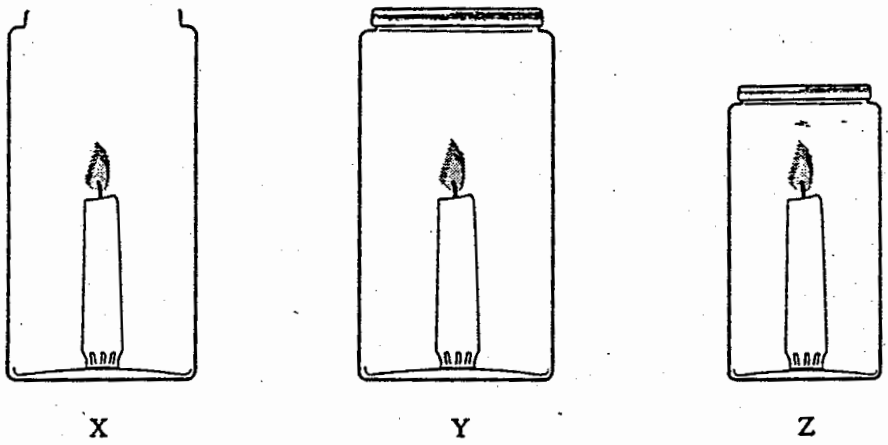
Z because fire needs oxygen to stay lit with the lid being sealed no oxygen can get in. There is a little bit of air in there for it to stay lit. Since Z is the smaller than Y, Z would go out first

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses (continued)

Partial Response:



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

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

Explain your answer.

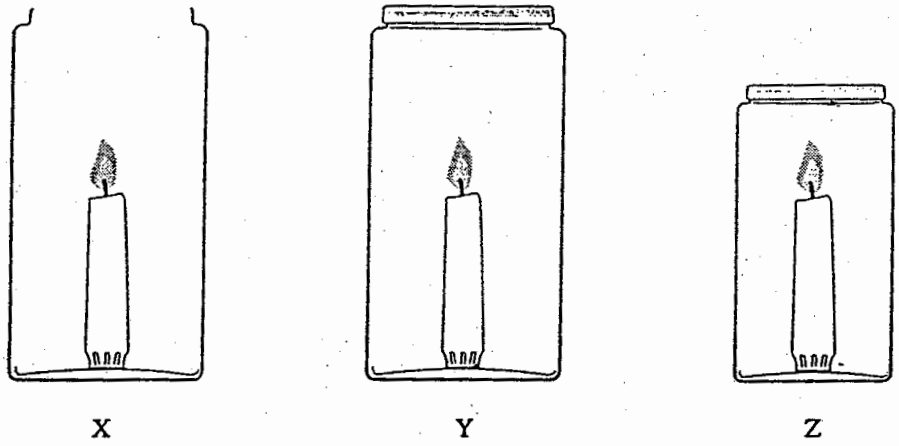
Fire needs Air to burn without it, it will go out. Since it is the smallest jar it has less air. Once the air is burned up the the fire will go out.

Candles burning in 3 jars (continued)

Item Number: S022191

Student Responses (continued)

Incorrect Response:



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

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

Explain your answer.

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

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

NOT a mixture

Which of the following is NOT a mixture?

Ⓐ Smoke

Ⓑ Sugar

Ⓒ Milk

Ⓓ Paint

Item Number: S022187

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Solution half as concentrated

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

Ⓐ 50 ml of water

Ⓑ 100 ml of water

Ⓒ 5 grams of salt

Ⓓ 10 grams of salt

Item Number: S032564

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Which substances are elements

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

Ⓐ oxygen, hydrogen and water

Ⓑ oxygen and hydrogen only

Ⓒ oxygen only

Ⓓ water only

Item Number: S032574

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

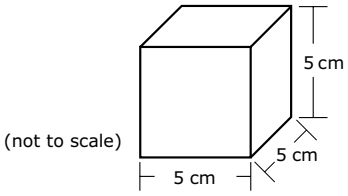
Higher ▲
Not different O
Lower ▼

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

Metal crown: density of metal block

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

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



What is the density of the block of metal?

Answer: _____ g/cm^3

Item Number: S032709

SCORING

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: density of metal block (continued)

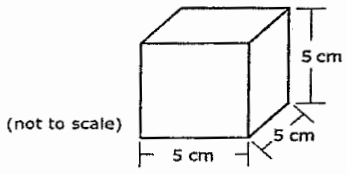
Item Number: S032709

Student Responses

Correct Response:

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

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



What is the density of the block of metal?

Answer: _____ g/cm^3

GIVEN:

$M = 2400$

$V = 5 * 5 \times 5$

$= 125\ cm^3$

FORMULA

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

Metal crown: density of metal block (continued)

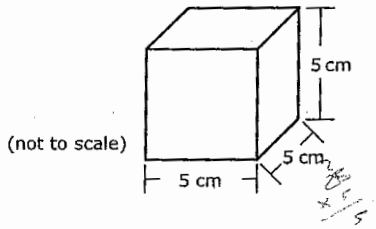
Item Number: S032709

Student Responses (continued)

Incorrect Response:

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

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



What is the density of the block of metal?

Answer: 160 g/cm^3

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

160
15|2400
-2 400
0

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

Substance type of black/white powder

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

Ⓐ a solution

Ⓑ a pure compound

Ⓒ a mixture

Ⓓ an element

Item Number: S012016

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Reaction of chlorine and sodium

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

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

Item Number: S022206

Correct Response: B

Overall Percent Correct

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

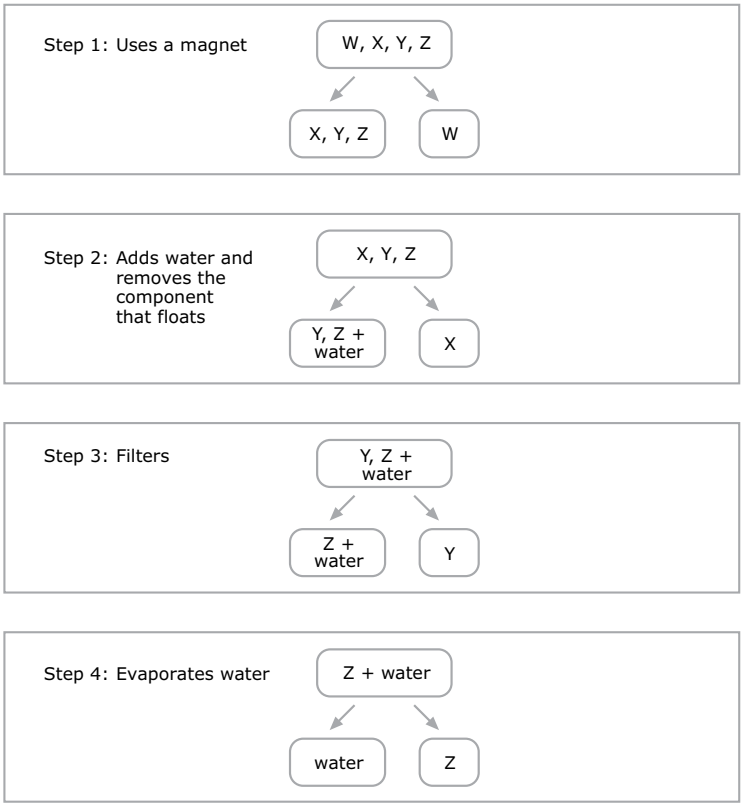
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Separation of salt/sand/iron filings mixture

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



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

Component W is: _____

Component X is: _____

Component Y is: _____

Component Z is: _____

Item Number: S032562

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032562

SCORING

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

Correct Response

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

Partially Correct Response

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

Incorrect Response

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

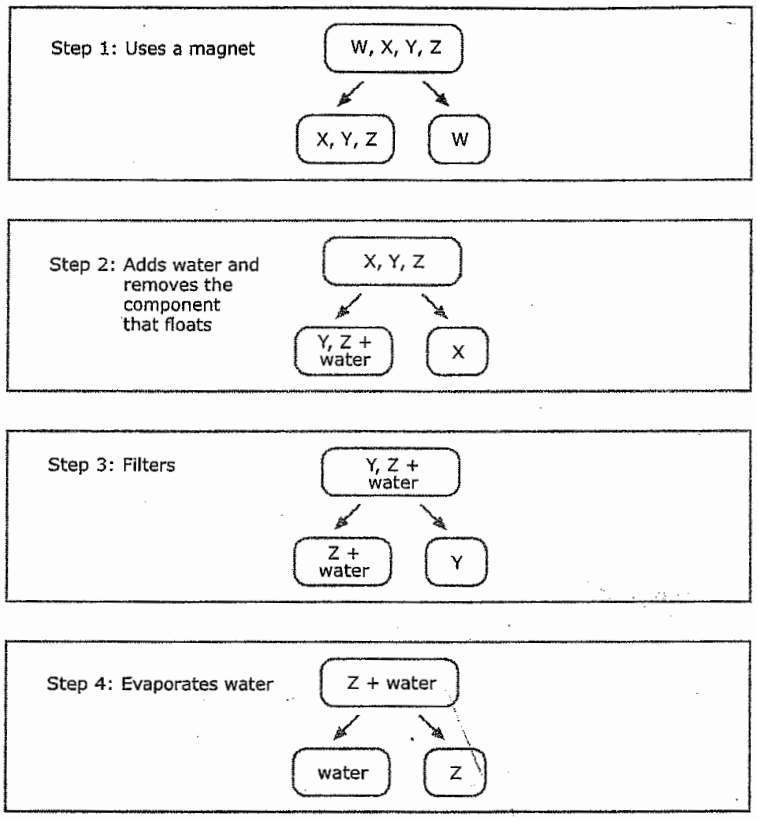
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses

Correct Response:

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



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

Component W is: iron

Component X is: sand

Component Y is: Cork

Component Z is: Salt

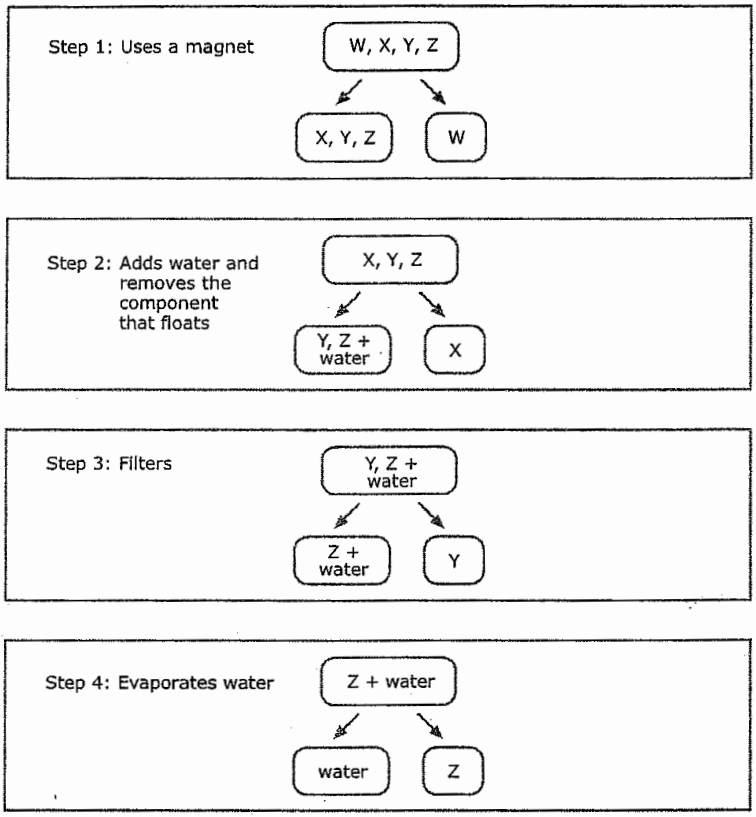
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses (continued)

Partially Correct Response:

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



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

Component W is: water

Component X is: cork

Component Y is: sand

Component Z is: salt

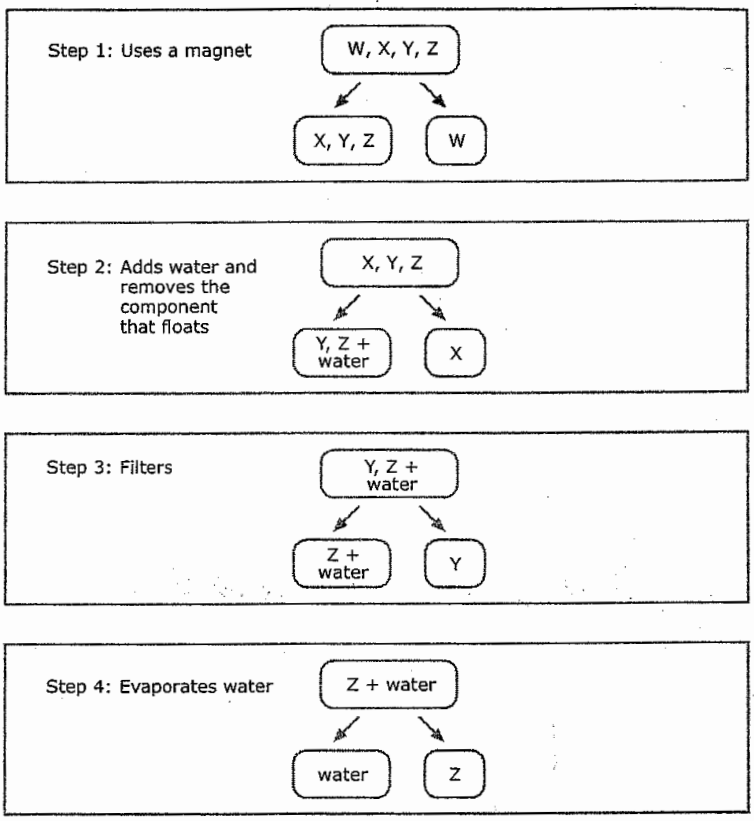
Separation of salt/sand/iron filings mixture (continued)

Item Number: S032562

Student Responses (continued)

Incorrect Response:

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



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

Component W is: Iron

Component X is: Sand

Component Y is: Salt

Component Z is: Cork

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

Metal crown: what metal block was made of

The table below lists the density for different metals.

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

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

Answer: _____

Explain your answer.

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

Item Number: S032713A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032713A

SCORING

Codes for Identifying Metal in Block

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

Correct Response

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

Incorrect Response

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

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

Item Number: S032713A

Student Responses

Correct Response:

The table below lists the density for different metals.

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

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

Answer: Gold

Explain your answer.

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

Incorrect Response:

The table below lists the density for different metals.

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

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

Answer: Clay

Explain your answer.

Because everything listed under metal they are made out Clay.

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

Metal crown: what crown was made of

The table below lists the density for different metals.

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

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

Answer: _____

Explain your answer.

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

Item Number: S032713B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: what crown was made of (continued)

Item Number: S032713B

SCORING

Codes for Reporting Composition of Crown

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

Correct Response

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

Incorrect Response

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

Metal crown: what crown was made of (continued)

Item Number: S032713B

Student Responses

Correct Response:

The table below lists the density for different metals.

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

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

he used silver and gold

Incorrect Response:

The table below lists the density for different metals.

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

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

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

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

Atoms removed from chair

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

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

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

Ⓒ There would be nothing left of the chair.

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

Item Number: S012040

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Particles in nucleus of atom

The nucleus of MOST atoms consists of

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

Item Number: S012025

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Neutral atom gains electron

What is formed when a neutral atom gains an electron?

Ⓐ A mixture

Ⓑ An ion

Ⓒ A molecule

Ⓓ A metal

Item Number: S022202

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Appearance of Jupiter and Moon

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

Item Number: S022283

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

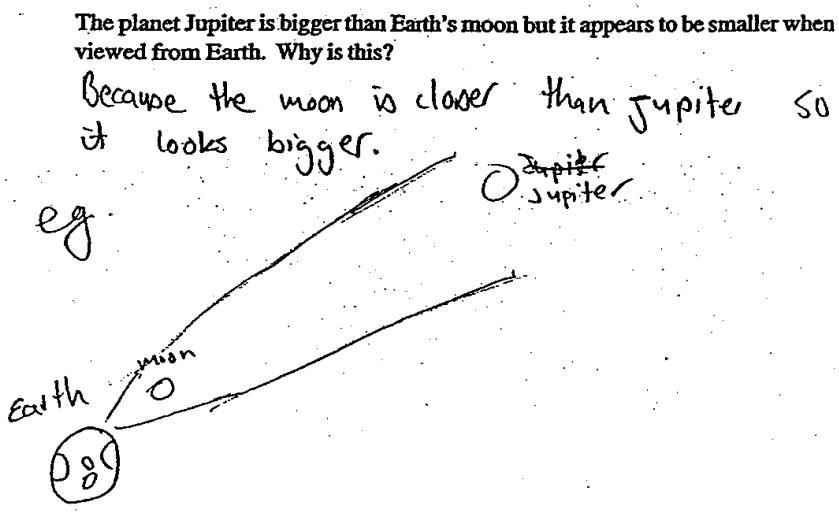
Higher	▲
Not different	O
Lower	▼

Appearance of Jupiter and Moon (continued)

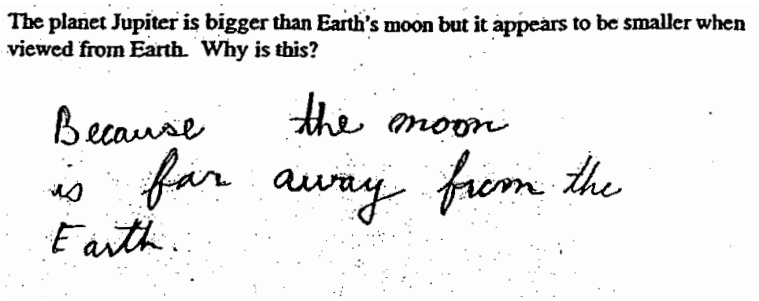
Item Number: S022283

Student Responses

Correct Response:



Incorrect Response:



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

Why the moon changes shape

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

Ⓐ The Earth turns on its axis.

Ⓑ The Moon turns on its axis.

Ⓒ The Moon orbits around the Earth.

Ⓓ Clouds cover the Moon.

Item Number: S032437

Correct Response: C

Overall Percent Correct

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

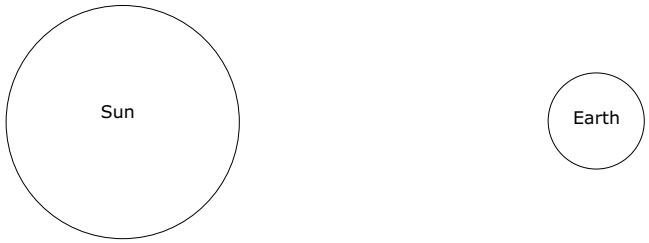
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Position of the moon during solar eclipse

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



Item Number: S032532

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

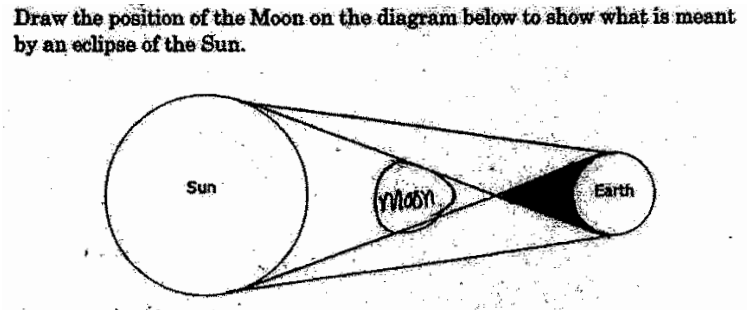
Higher	▲
Not different	O
Lower	▼

Position of the moon during solar eclipse (continued)

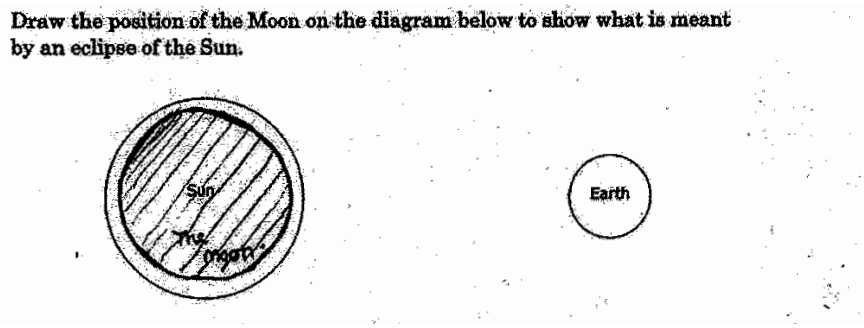
Item Number: S032532

Student Responses

Correct Response:

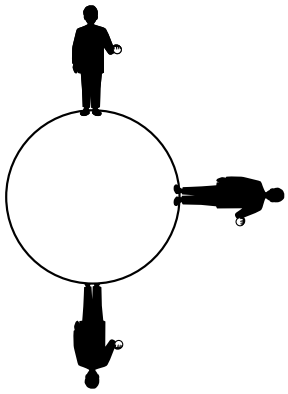


Incorrect Response:



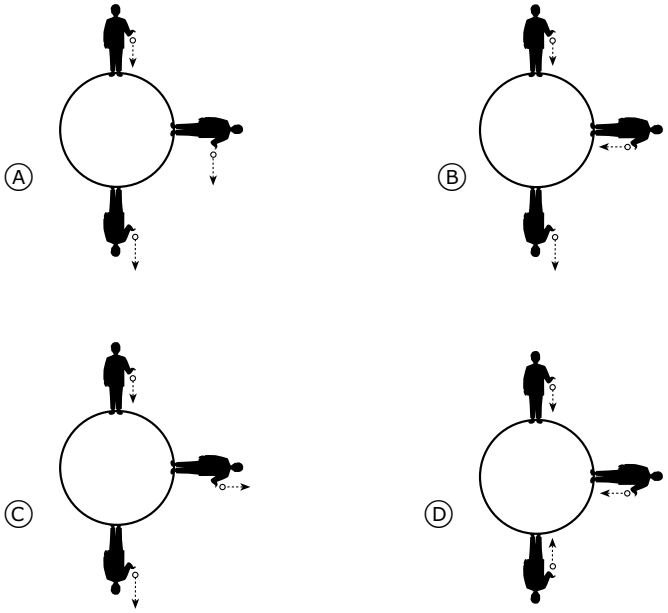
Content Domain	Main Topic	Cognitive Domain
EARTH SCIENCE	Earth in the Solar System and Universe	Conceptual Understanding

Direction dropped ball will fall



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

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



Item Number: S032714

Correct Response:	D

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Sun is an example of a star

The Sun is an example of which of the following?

Ⓐ comet
Ⓑ planet
Ⓒ galaxy
Ⓓ star

Item Number: S032150

Correct Response: D

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

The surface temperatures of Venus and Mercury

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

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

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

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

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

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

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

Item Number: S032301

Correct Response: B

Overall Percent Correct

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

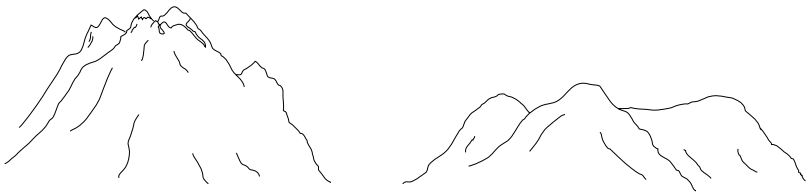
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

True statement of mountain age

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



Picture A Picture B

Which statement about these mountains is probably true?

Ⓐ The mountains in Picture A are older.

Ⓑ The mountains in Picture B are older.

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

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

Item Number: S012013

Correct Response: B

Overall Percent Correct

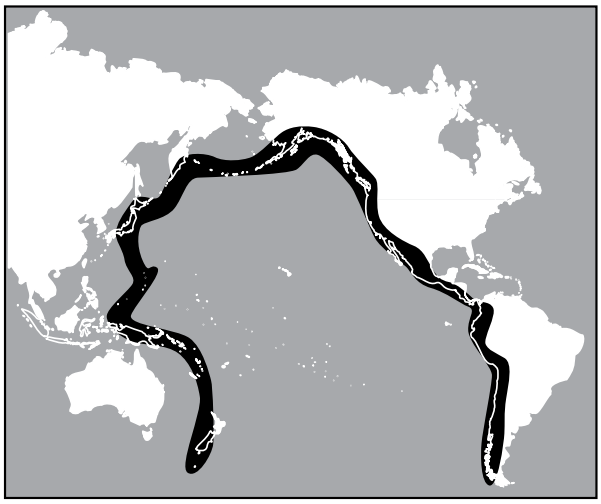
Iran, Islamic Republic of	58	▲
Italy	58	▲
Macedonia, Republic of	55	▲
Moldova, Rep. of	51	▲
Russian Federation	50	▲
Hungary	50	▲
Lithuania	47	▲
Estonia	44	▲
Latvia	44	▲
Romania	44	▲
Armenia	43	▲
Korea, Republic of	42	▲
Slovenia	42	▲
Sweden	41	▲
Belgium (Flemish)	38	▲
United States	36	▲
Bulgaria	35	▲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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Pacific Ring of Fire



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

Ⓐ It is located at the boundaries of tectonic plates.

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

Ⓒ It is located where the major ocean currents meet.

Ⓓ It is located where ocean temperature is the highest.

Item Number: S032656

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Substance NOT a fossil fuel

Which is NOT a fossil fuel?

Ⓐ Coal
Ⓑ Oil
Ⓒ Wood
Ⓓ Natural gas

Item Number: S012018

Correct Response: C

Overall Percent Correct

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

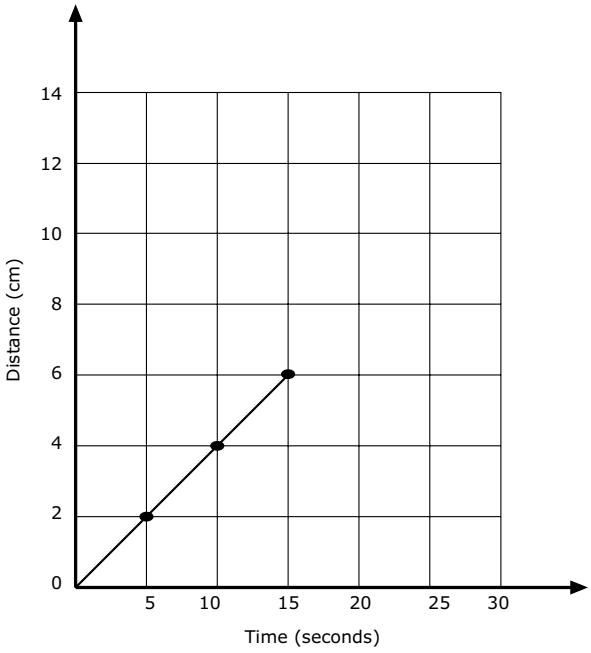
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Rock at bottom of lake/ocean

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



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

Ⓐ 4 seconds

Ⓑ 6 seconds

Ⓒ 20 seconds

Ⓓ 25 seconds

Item Number: S012041

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Fossil fuels

Fossil fuels were formed from

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

Item Number: S022074

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Time/temperature table

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

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

When did the wind become much colder?

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

Item Number: S012027

Correct Response: D

Overall Percent Correct

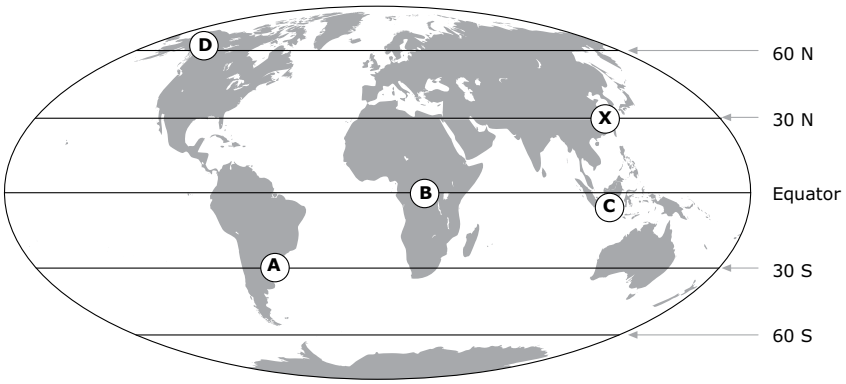
Japan	96	▲
Netherlands	93	▲
Hungary	93	▲
Australia	92	▲
Sweden	89	▲
Singapore	89	▲
Belgium (Flemish)	89	▲
England	88	▲
New Zealand	87	▲
Korea, Republic of	87	▲
Hong Kong, SAR	87	▲
Chinese Taipei	87	▲
Estonia	87	▲
Malaysia	85	▲
Slovenia	84	▲
United States	84	▲
Israel	83	▲
Italy	83	▲
Scotland	82	▲
Serbia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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Map of the world with lines of latitude



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

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

Item Number: S032652

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Stone in underground caves

Most underground caves are formed by the action of water on

Ⓐ granite
Ⓑ limestone
Ⓒ sandstone
Ⓓ shale

Item Number: S012030

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Abundance of gases in atmosphere

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

Ⓐ nitrogen, oxygen, carbon dioxide

Ⓑ nitrogen, carbon dioxide, oxygen

Ⓒ oxygen, nitrogen, carbon dioxide

Ⓓ carbon dioxide, oxygen, nitrogen

Item Number: S022275

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Changes in river shape/speed

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

Ⓐ Much the same

Ⓑ Deeper and faster

Ⓒ Slower and wider

Ⓓ Straighter

Item Number: S012006

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Increased carbon dioxide in atmosphere

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

Ⓐ A warmer climate

Ⓑ A cooler climate

Ⓒ Lower relative humidity

Ⓓ More ozone in the atmosphere

Item Number: S012017

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Main cause of acid rain

One of the main causes of acid rain is

Ⓐ Waste from nuclear power plants

Ⓑ Spills from chemical manufacturing plants

Ⓒ Gases from burning fossil fuels

Ⓓ Gases from aerosol spray cans

Item Number: S022240

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Activity to reduce air pollution in a city

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

Ⓐ turning down the volume on the television

Ⓑ using biodegradable materials

Ⓒ using public transportation instead of driving

Ⓓ recycling paper

Item Number: S032446

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Nonrenewable natural resource

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

Ⓐ Wood

Ⓑ Seawater

Ⓒ Sunlight

Ⓓ Coal

Item Number: S012042

Correct Response: D

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Renewable energy source

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

Energy Source: _____

Use:

Item Number: S032242

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

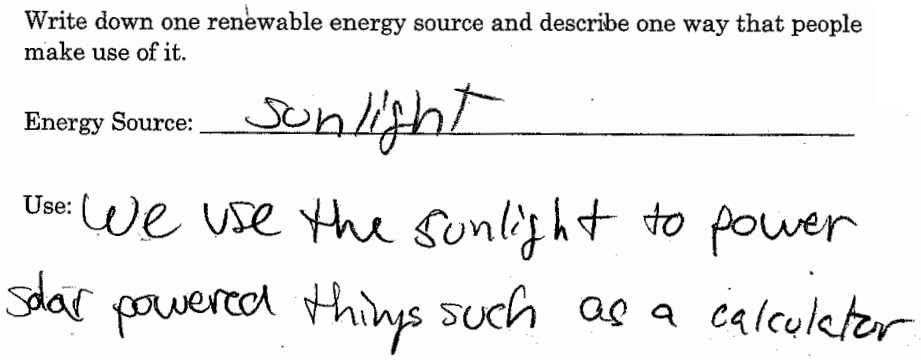
Higher	▲
Not different	O
Lower	▼

Renewable energy source (continued)

Item Number: S032242

Student Responses

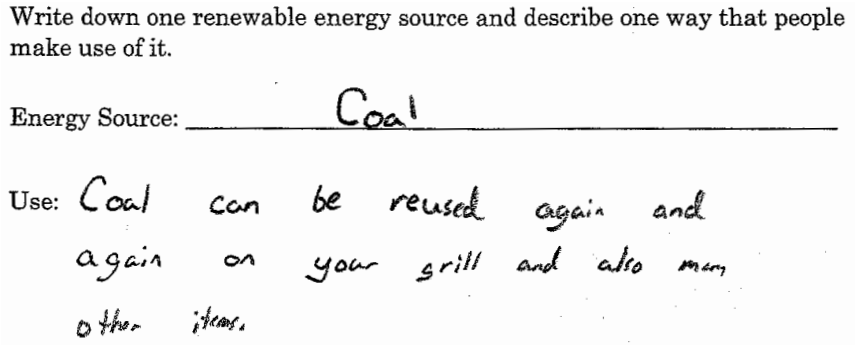
Correct Response:


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

Energy Source: sunlight

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

Incorrect Response:


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

Energy Source: Coal

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

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

Group of renewable energy sources

Which group of energy sources are ALL renewable?

Ⓐ coal, oil, and natural gas

Ⓑ solar, oil, and geothermal

Ⓒ wind, solar, and tidal

Ⓓ natural gas, solar, and tidal

Item Number: S032422

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Overgrazing by livestock

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

Ⓐ depletion of ground water

Ⓑ increased pollution

Ⓒ erosion of soil

Ⓓ acid rain

Item Number: S012005

Correct Response: C

Overall Percent Correct

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

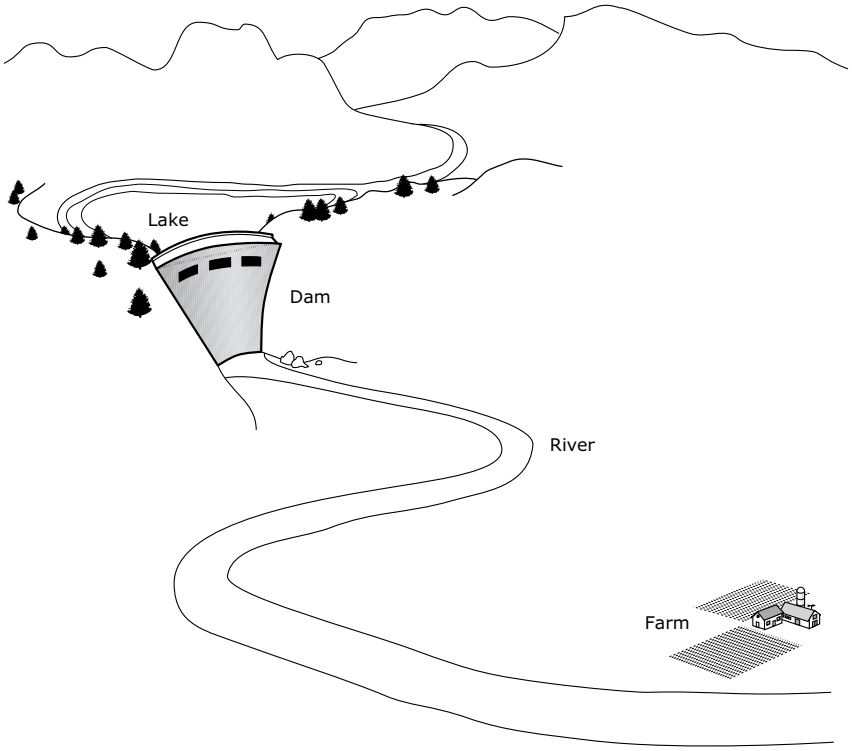
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Positive/negative effect of dam

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



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

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

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

Item Number: S022088A

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Positive/negative effect of dam (continued)

Item Number: S022088A

SCORING

Codes for Positive Effects

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

Correct Response

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

Incorrect Response

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

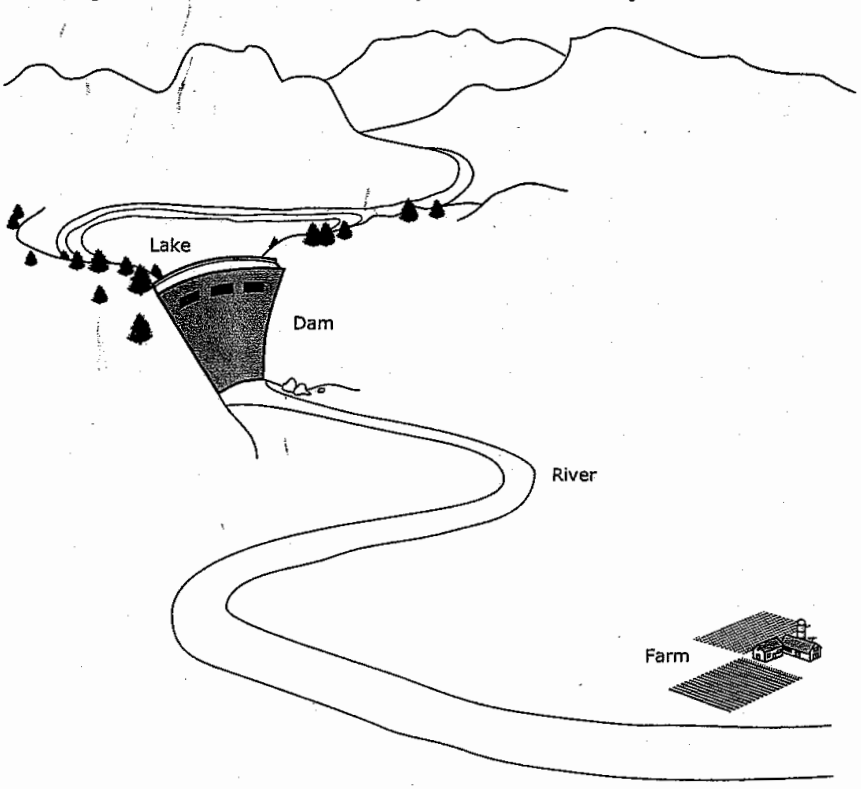
Positive/negative effect of dam (continued)

Item Number: S022088A

Student Responses

Correct Response:

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



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

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

The Dam will prevent the river from flooding the farm.

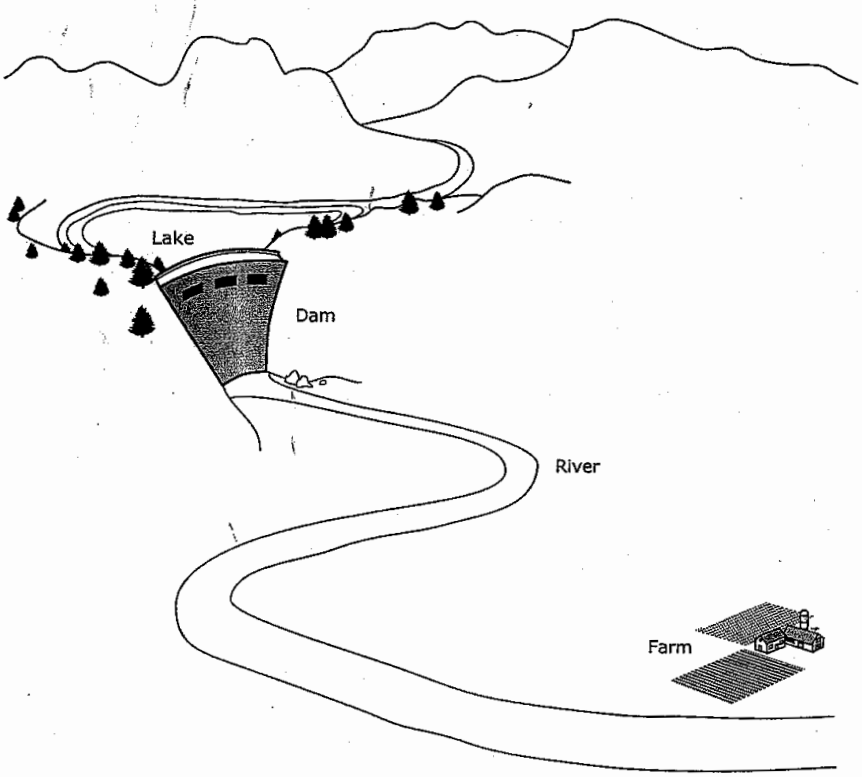
Positive/negative effect of dam (continued)

Item Number: S022088A

Student Responses (continued)

Incorrect Response:

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



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

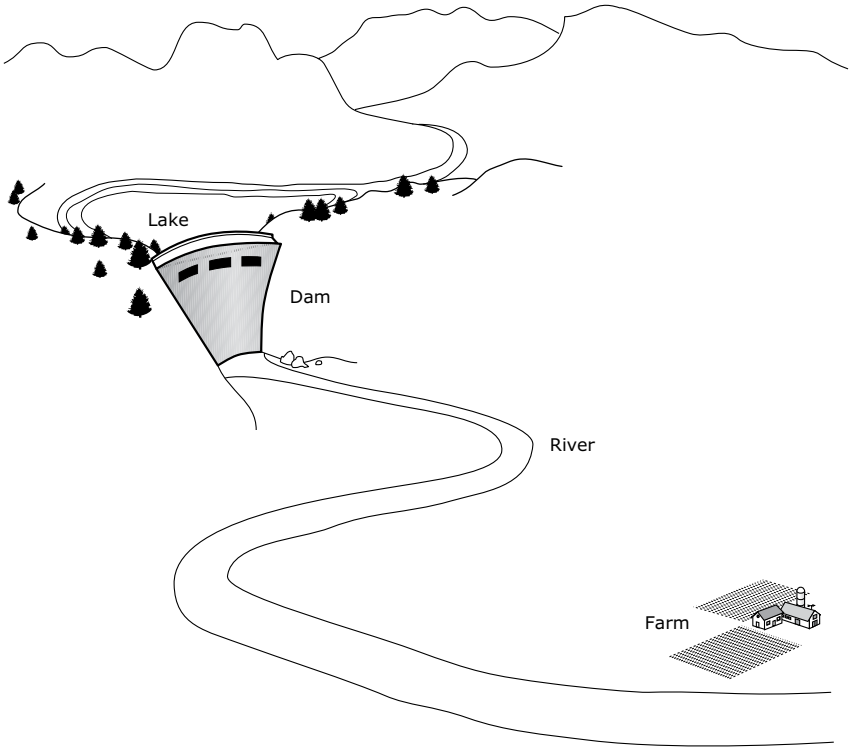
A. Describe one positive effect of the dam on farming.

theres more mousture in the ground

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

Positive/negative effect of dam

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



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

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

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

Item Number: S022088B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Positive/negative effect of dam (continued)

Item Number: S022088B

SCORING

Codes for Negative Effects

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

Correct Response

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

Incorrect Response

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

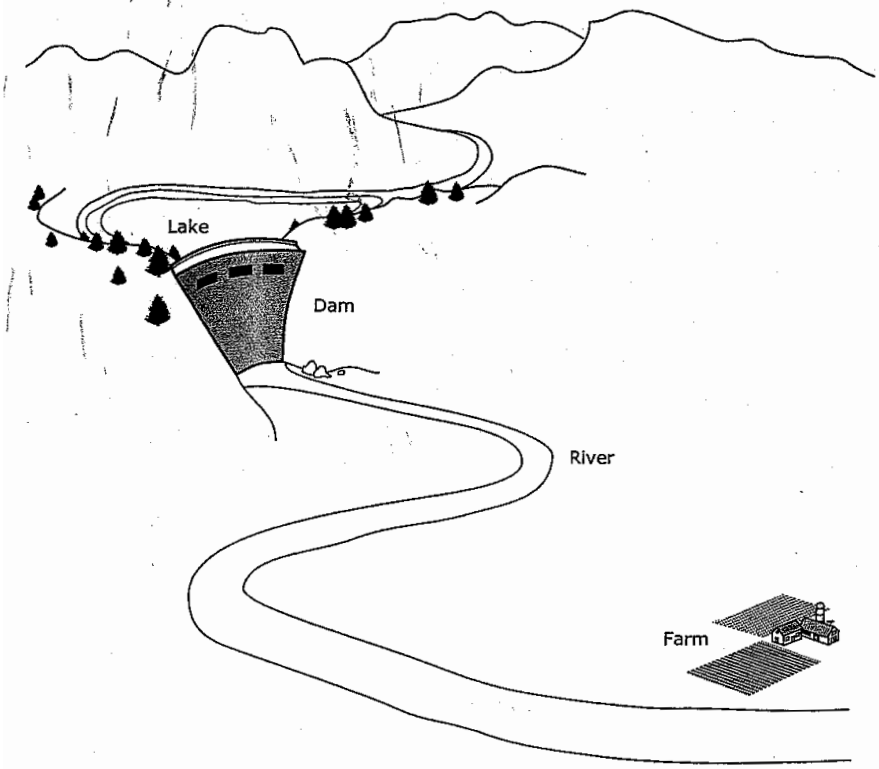
Positive/negative effect of dam (continued)

Item Number: S022088B

Student Responses

Correct Response:

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



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

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

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

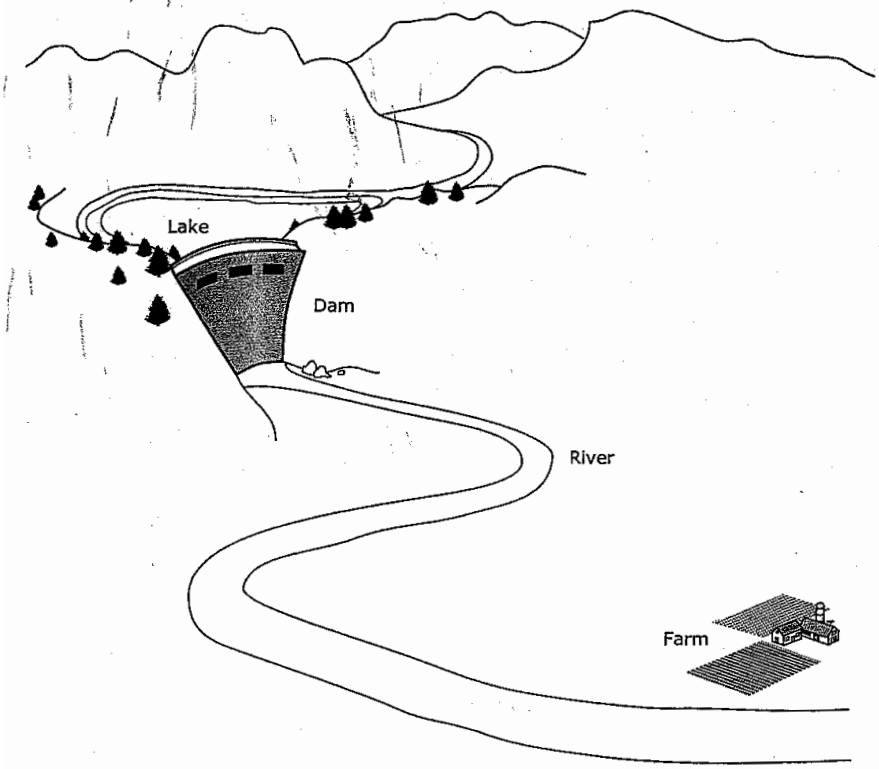
Positive/negative effect of dam (continued)

Item Number: S022088B

Student Responses (continued)

Incorrect Response:

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



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

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

It disturbs the nature of the farming and could drought.

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

Drinking water from sea water

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

Item Number: S032063

SCORING

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

Correct Response

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

Partially Correct Response

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

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

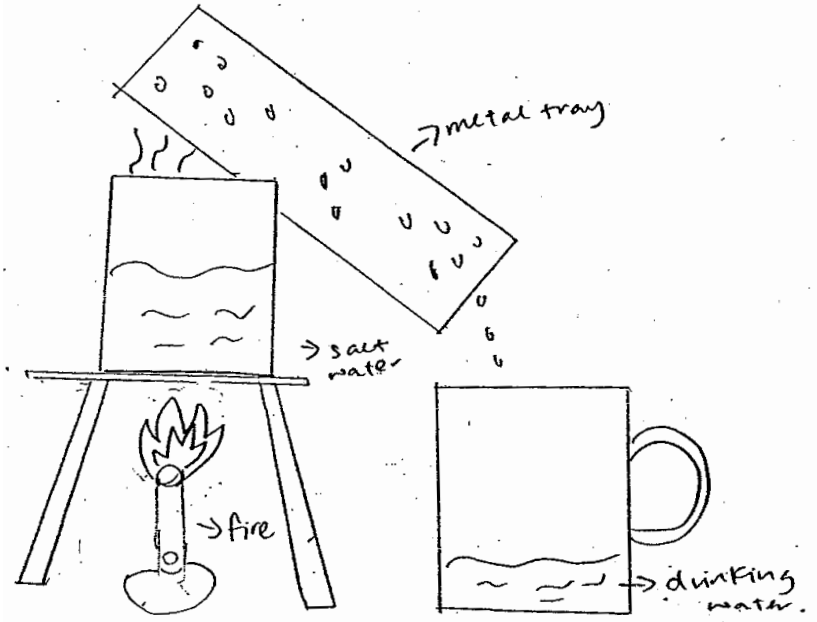
Drinking water from sea water (continued)

Item Number: S032063

Student Responses

Correct Response:

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



Partially Correct Response:

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

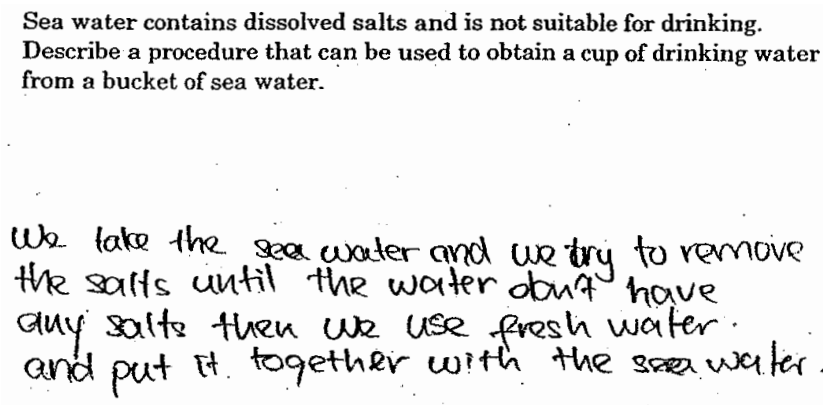
put gladwrap over the bucket and wait for the ~~salt~~ water to evaporate, onto the lunchwrap.

Drinking water from sea water (continued)

Item Number: S032063

Student Responses (continued)

Incorrect Response:



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

Main function of red blood cells

What is the main function of red blood cells?

Ⓐ To fight disease in the body

Ⓑ To carry oxygen to all parts of the body

Ⓒ To remove carbon monoxide from all parts of the body

Ⓓ To produce materials which cause the blood to clot

Item Number: S012038

Correct Response: B

Overall Percent Correct

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

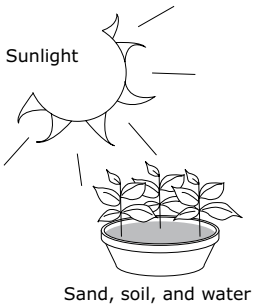
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

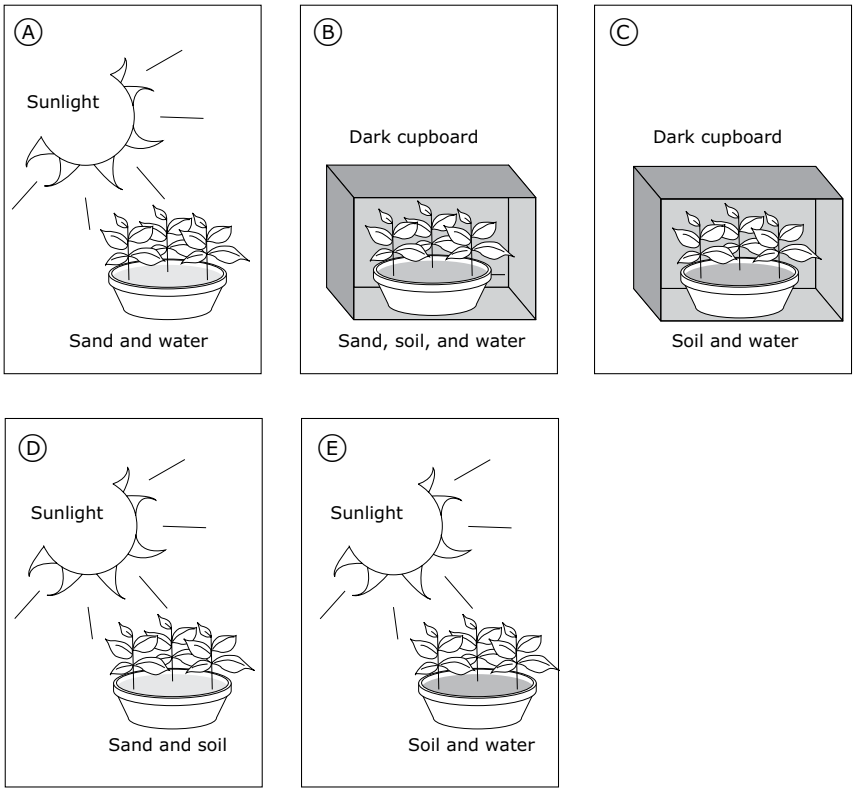
Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Development and Life Cycle of Organisms	Reasoning and Analysis

Plant growth experiment

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



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



Item Number: S022235

Correct Response: E

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Fossils in sedimentary rock

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

Ⓐ only organisms that lived in the sea

Ⓑ only organisms that lived on land

Ⓒ only organisms that lived in the air

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

Item Number: S032083

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

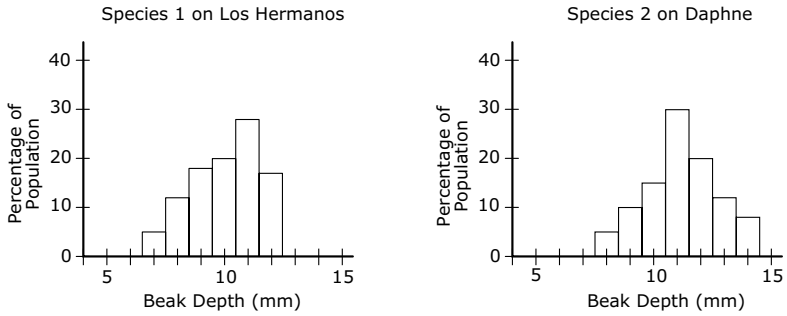
Higher ▲
Not different O
Lower ▼

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

Galapagos Islands: compare beak depths of Species 1 and 2

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

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



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

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

Item Number: S032706A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032706A

SCORING

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

Correct Response

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

Incorrect Response

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

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

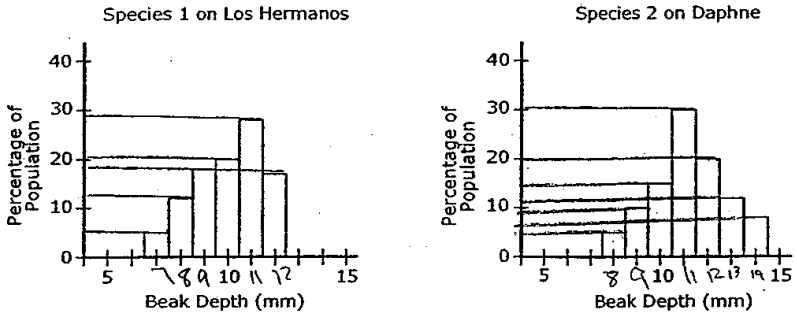
Item Number: S032706A

Student Responses

Correct Response:

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

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



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

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

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

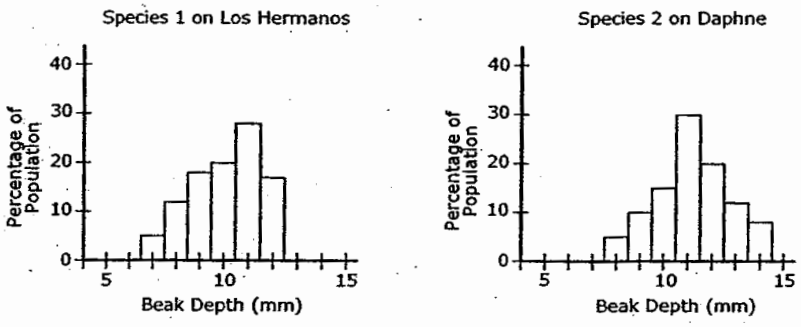
Item Number: S032706A

Student Responses (continued)

Incorrect Response:

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

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



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

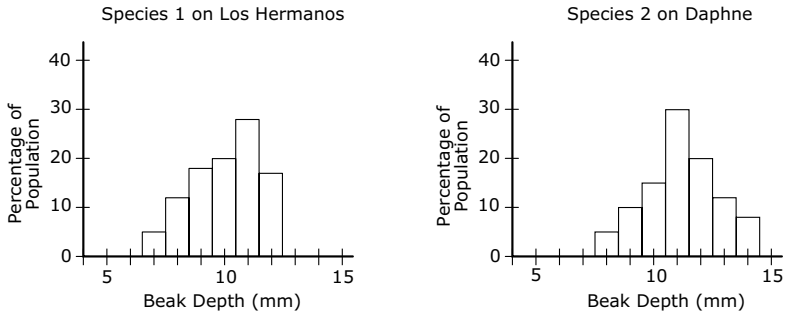
the beak depth is pretty close in graph 1 and 2

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

Galapagos Islands: size of seeds each species eats

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

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



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

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

Item Number: S032706B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032706B

SCORING

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

Correct Response

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

Incorrect Response

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

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

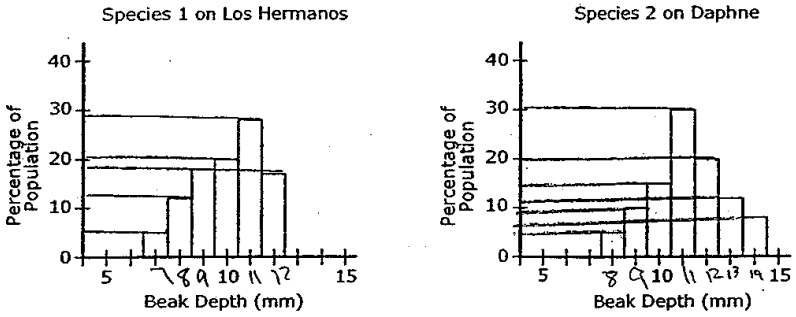
Item Number: S032706B

Student Responses

Correct Response:

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

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



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

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

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

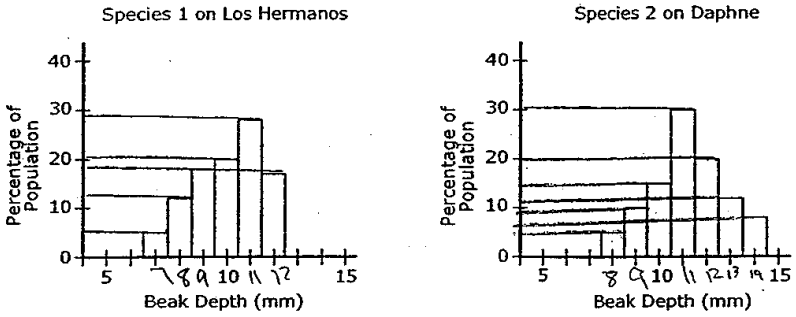
Item Number: S032706B

Student Responses (continued)

Incorrect Response:

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

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



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

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

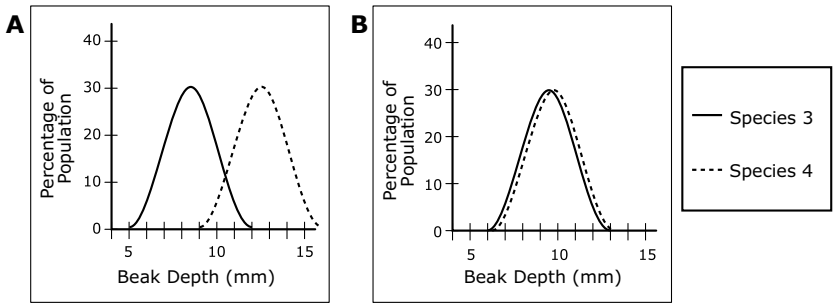
Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Diversity, Adaptation and Natural Selection	Reasoning and Analysis

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

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

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

(Circle the letter by the correct graph.)



Explain why this range of beak depths would be best.

Item Number: S032707

SCORING

Correct Response

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032707

Student Responses

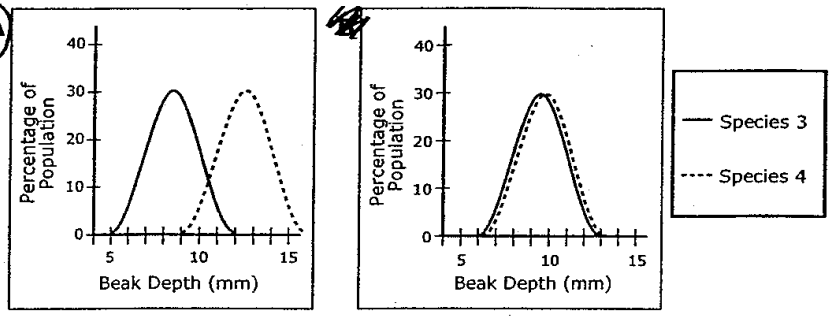
Correct Response:

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

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

(Circle the letter by the correct graph.)

A



Explain why this range of beak depths would be best.

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

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

Item Number: S032707

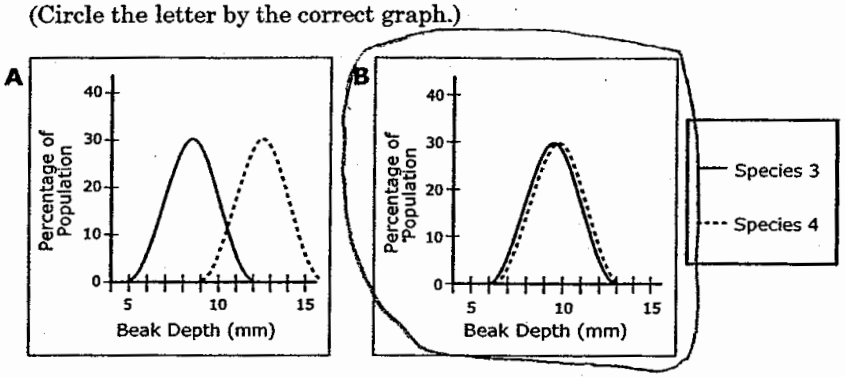
Student Responses (continued)

Incorrect Response:

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

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

(Circle the letter by the correct graph.)



Explain why this range of beak depths would be best.

They would be good for picking seeds.

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: plants/animals inhabited island first

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

(Check one box.)

☐ Land plants

☐ Land animals

Explain your answer.

Item Number: S032704

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

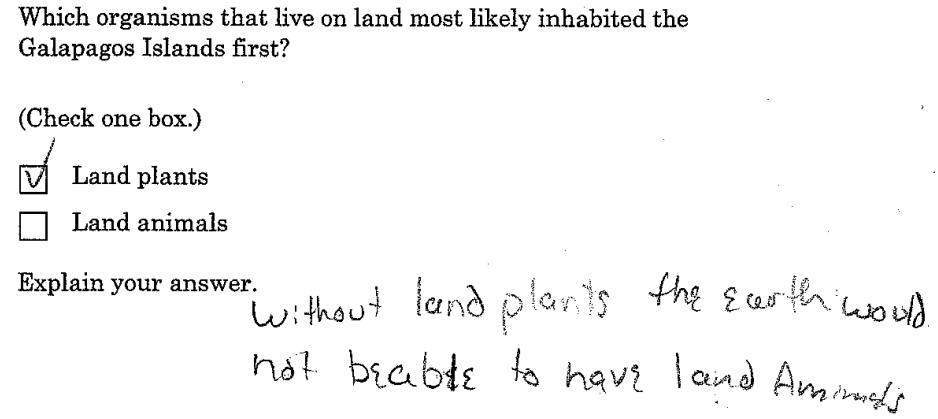
Higher	▲
Not different	O
Lower	▼

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

Item Number: S032704

Student Responses

Correct Response:



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

(Check one box.)

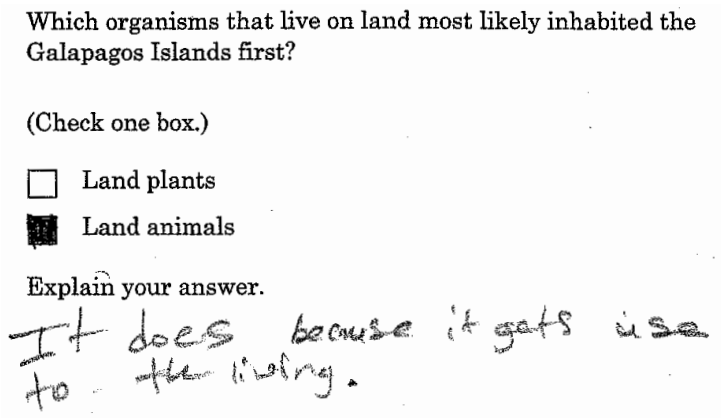
☑ Land plants

☐ Land animals

Explain your answer.

Without land plants the earth would not be able to have land Animals

Incorrect Response:



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

(Check one box.)

☐ Land plants

■ Land animals

Explain your answer.

It does because it gets use to the living.

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: effect of cats

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

A. One effect of **cats**:

B. One effect of **goats**:

Item Number: S032705A

SCORING

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

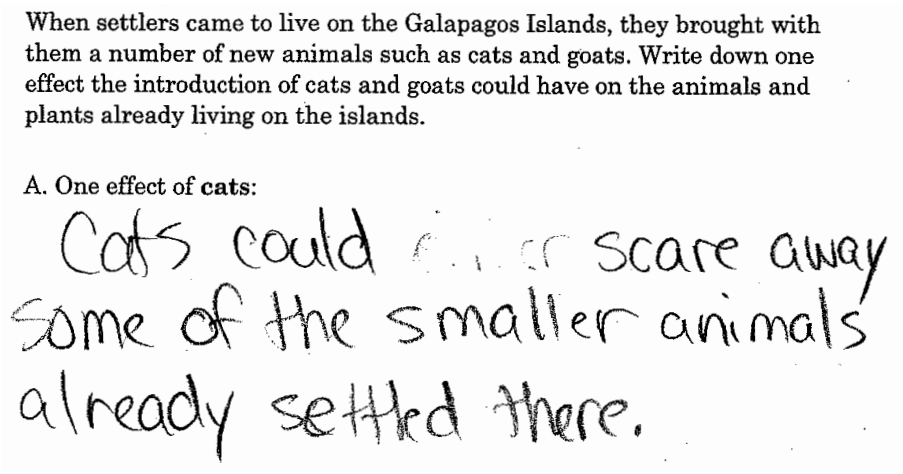
Higher	▲
Not different	O
Lower	▼

Galapagos Islands: effect of cats (continued)

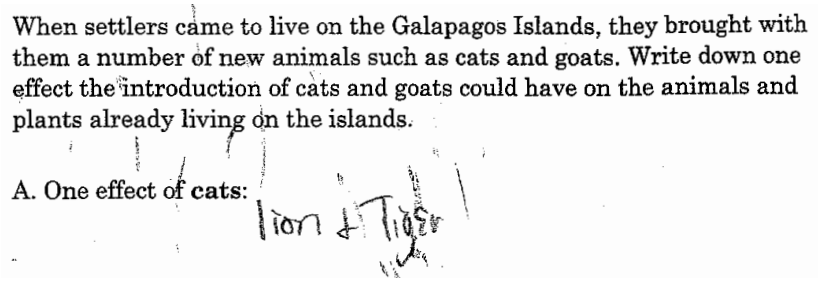
Item Number: S032705A

Student Responses

Correct Response:



Incorrect Response:



Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Conceptual Understanding

Galapagos Islands: effect of goats

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

A. One effect of **cats**:

B. One effect of **goats**:

Item Number: S032705B

SCORING

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Galapagos Islands: effect of goats (continued)

Item Number: S032705B

Student Responses

Correct Response:

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

B. One effect of **goats**:

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

Incorrect Response:

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

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

Content Domain	Main Topic	Cognitive Domain
LIFE SCIENCE	Ecosystems	Factual Knowledge

Elements that make up animals and plants

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

Ⓐ They die with the animal or plant.

Ⓑ They evaporate into the atmosphere.

Ⓒ They are recycled back into the environment.

Ⓓ They change into different elements.

Item Number: S032682

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Community of mice, snakes and wheat plants

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

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

Item Number: S032202

SCORING

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

Correct Response

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

Partially Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Community of mice, snakes and wheat plants (continued)

Item Number: S032202

Student Responses

Correct Response:

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

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

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

Partially Correct Response:

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

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

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

Community of mice, snakes and wheat plants (continued)

Item Number: S032202

Student Responses (continued)

Incorrect Response:

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

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

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

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

Leafy vegetables important for human health

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

Ⓐ protein
Ⓑ carbohydrates
Ⓒ minerals
Ⓓ fat

Item Number: S032637

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Transmission of cold in classroom

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

Item Number: S022154

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

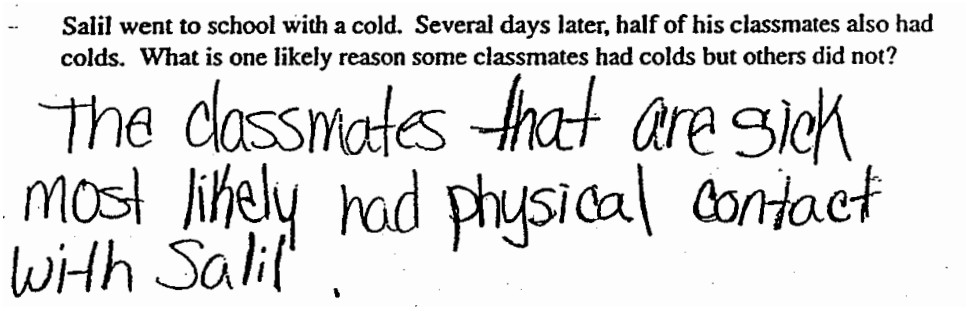
Higher	▲
Not different	O
Lower	▼

Transmission of cold in classroom (continued)

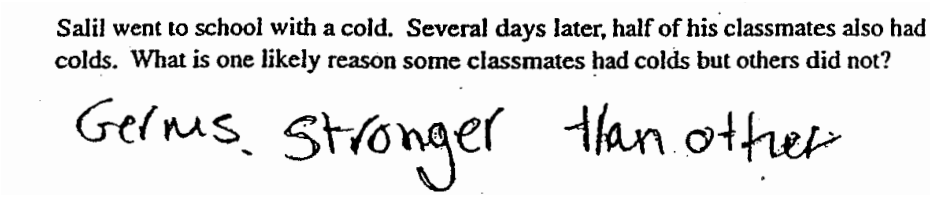
Item Number: S022154

Student Responses

Correct Response:



Incorrect Response:



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

Son inherits traits

A son can inherit traits

Ⓐ only from his father

Ⓑ only from his mother

Ⓒ from both his father and his mother

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

Item Number: S012026

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Traits transferred from generations

Traits are transferred from generation to generation through the

Ⓐ sperm only

Ⓑ egg only

Ⓒ sperm and the egg

Ⓓ testes

Item Number: S012039

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Biological control of insect population

Why would male insects be treated to prevent sperm production?

Ⓐ To increase the number of female insects

Ⓑ To reduce the total population of insects

Ⓒ To produce new species of insects

Ⓓ To prevent insects from mating

Item Number: S022117

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Fertilization in animals

Which of the following takes place during fertilization in animals?

Ⓐ production of sperm and egg

Ⓑ joining of sperm and egg

Ⓒ division of egg

Ⓓ development of embryo

Item Number: S032008

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Bodily process to prevent overheating

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

Item Number: S022152

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

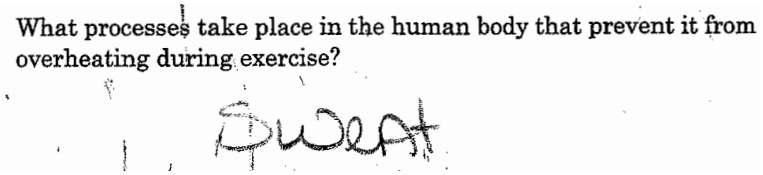
Higher	▲
Not different	O
Lower	▼

Bodily process to prevent overheating (continued)

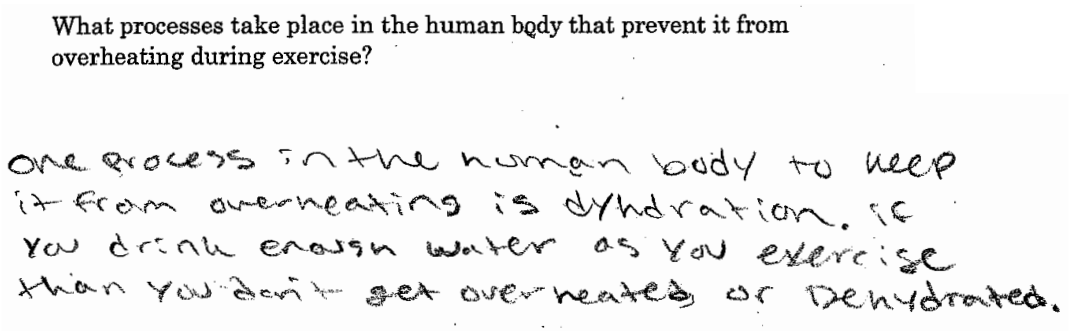
Item Number: S022152

Student Responses

Correct Response:



Incorrect Response:



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

Advantage of having two ears

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

Item Number: S022160

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

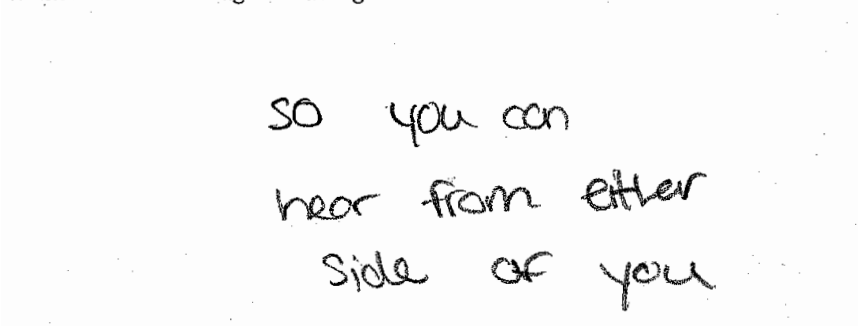
Advantage of having two ears (continued)

Item Number: S022160

Student Responses

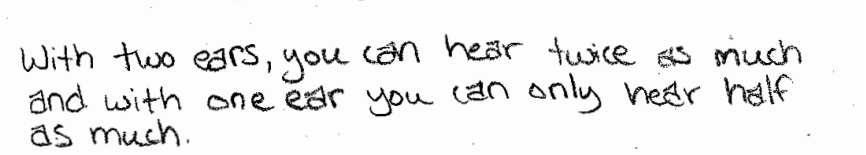
Correct Response:

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



Incorrect Response:

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



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

Organ NOT in abdomen

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

Ⓐ liver
Ⓑ kidney
Ⓒ stomach
Ⓓ bladder
Ⓔ heart

Item Number: S012001

Correct Response: E

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Message from eyes to brain

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

Ⓐ arteries
Ⓑ glands
Ⓒ muscles
Ⓓ nerves
Ⓔ veins

Item Number: S012014

Correct Response: D

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Absorbtion of food into the blood stream

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

Ⓐ stomach

Ⓑ mouth

Ⓒ large intestines

Ⓓ small intestines

Item Number: S032386

Correct Response: D

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Fish organ like human lung

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

Ⓐ kidney

Ⓑ heart

Ⓒ gill

Ⓓ skin

Item Number: S032607

Correct Response: C

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

How glasses/contact lenses work

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

Item Number: S022161

SCORING

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

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

How glasses/contact lenses work (continued)

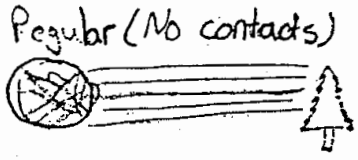
Item Number: S022161

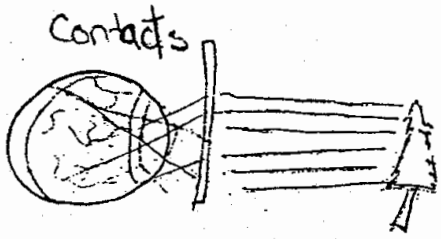
Student Responses

Correct Response:

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

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





S02216

Incorrect Response:

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

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

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

Characteristics of animal groups

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

Ⓐ Legs
Ⓑ Eyes
Ⓒ Nervous system
Ⓓ Skin

Group 1	Group 2
Humans	Snakes
Dogs	Worms
Flies	Fish

Item Number: S012028

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Cats most closely related to which animal

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

Ⓐ crocodiles
Ⓑ whales
Ⓒ frogs
Ⓓ penguins

Item Number: S032595

Correct Response: B

Overall Percent Correct

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

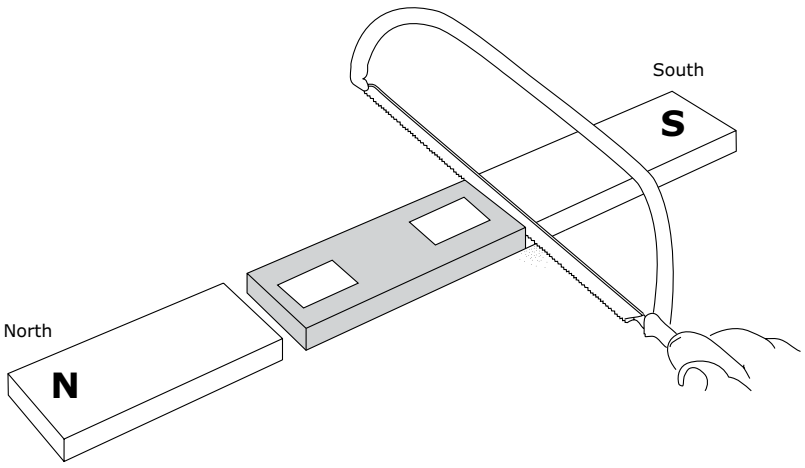
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Poles on cut magnet

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



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

Item Number: S022035

SCORING

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

Correct Response

- N-S

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

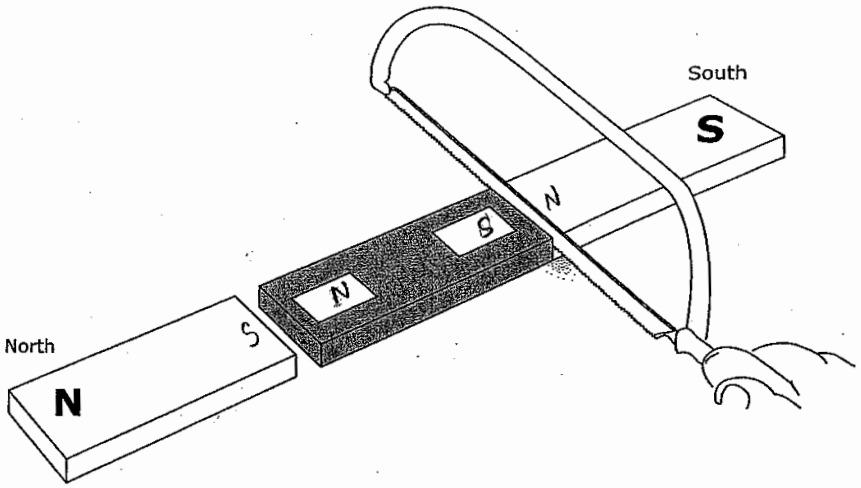
Poles on cut magnet (continued)

Item Number: S022035

Student Responses

Correct Response:

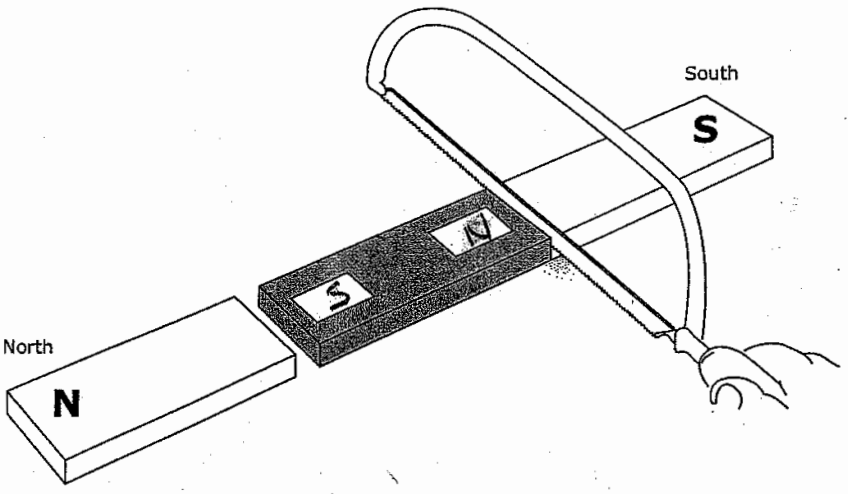
The diagram shows a bar magnet which is cut into three pieces with a hacksaw.



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

Incorrect Response:

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

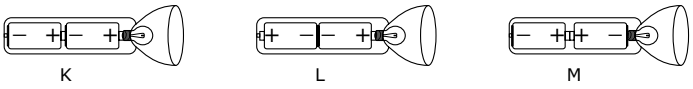


Write an "N" or an "S" in each box on the diagram to show the polarity of each end of the center piece.

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

Diagram of batteries in a flashlight

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



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

Ⓐ Only as in K

Ⓑ Only as in L

Ⓒ Only as in M

Ⓓ None of these ways would work.

Item Number: S012037

Correct Response: A

Overall Percent Correct

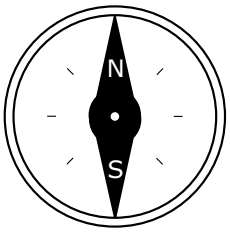
Singapore	97	▲
England	95	▲
Korea, Republic of	93	▲
Japan	93	▲
Hong Kong, SAR	93	▲
Russian Federation	93	▲
Slovak Republic	93	▲
Estonia	93	▲
Chinese Taipei	92	▲
Malaysia	91	▲
Romania	91	▲
Latvia	91	▲
Hungary	91	▲
Bulgaria	91	▲
Bahrain	90	▲
Lithuania	90	▲
Moldova, Rep. of	90	▲
Sweden	89	▲
United States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

Country average vs. International average:

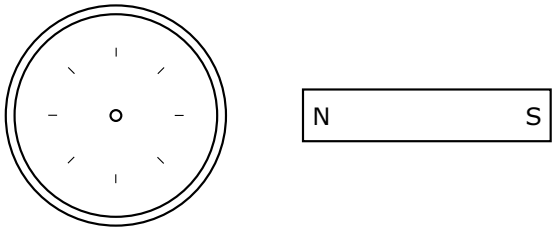
Higher ▲
Not different O
Lower ▼

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

Compass placed next to a magnet/draw



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



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

B. Explain your answer using your knowledge of magnets.

Item Number: S032625A

SCORING

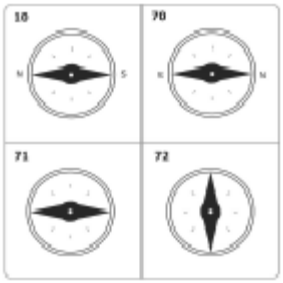
Correct Response

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

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

Incorrect Response

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



Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

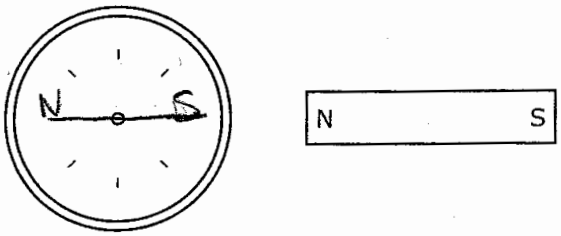
Compass placed next to a magnet/draw (continued)

Item Number: S032625A

Student Responses

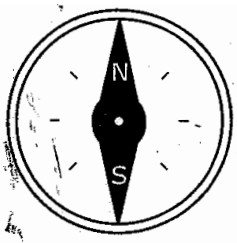
Correct Response:

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

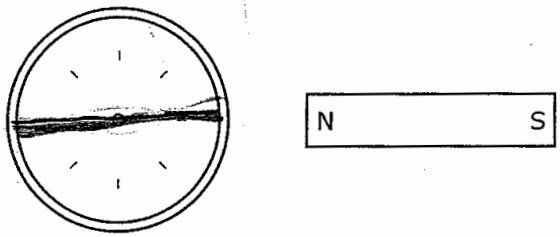


A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

Incorrect Response:



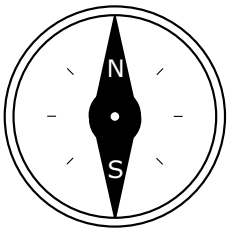
The diagram above shows a compass needle with its North and South poles labeled (N and S). It is placed next to a strong magnet as shown in the diagram below.



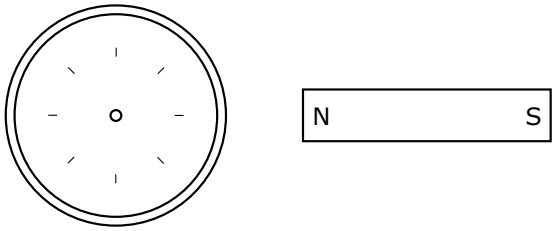
A. Draw the compass needle in the circle on the diagram above. Label the North (N) and South (S) poles of the needle.

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

Compass placed next to a magnet/explain



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



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

B. Explain your answer using your knowledge of magnets.

Item Number: S032625B

Scoring for Explanation

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

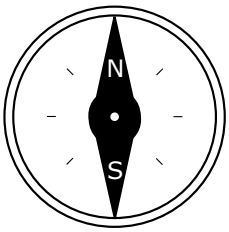
Higher ▲
Not different O
Lower ▼

Compass placed next to a magnet/explain (continued)

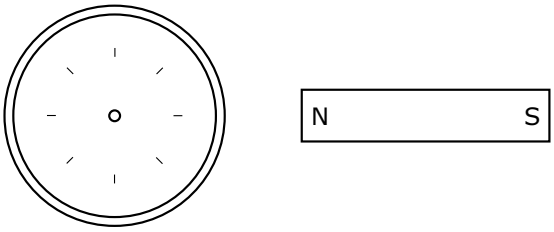
Item Number: S032625B

Student Responses

Correct Response:



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



B. Explain your answer using your knowledge of magnets.

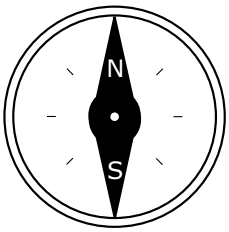
opposites attract and the north side of the magnet is facing the compass so the needle with south on it will point to the magnet

Compass placed next to a magnet/explain (continued)

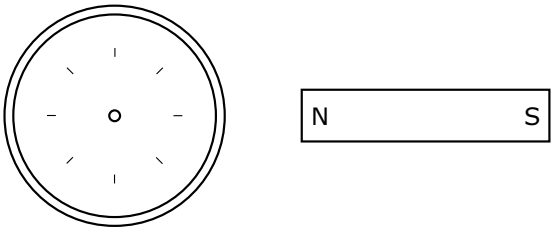
Item Number: S032625B

Student Responses (continued)

Incorrect Response:



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



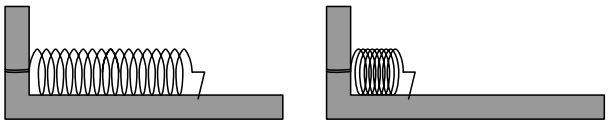
B. Explain your answer using your knowledge of magnets.

As the magnet contects the magnet moves the opposite way.

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

Stored energy in two springs

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



1 2

Which spring has more stored energy?

Ⓐ Spring 1

Ⓑ Spring 2

Ⓒ Both springs have the same energy.

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

Item Number: S012002

Correct Response: B

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Nail pulled out of a wooden board

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

Item Number: S032131

SCORING

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Nail pulled out of a wooden board (continued)

Item Number: S032131

Student Responses

Correct Response:

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

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

Incorrect Response:

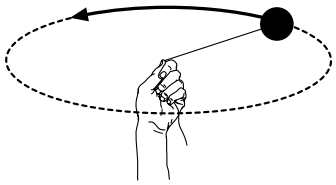
When a nail is pulled out of a wooden board, the nail becomes warm. Explain why.

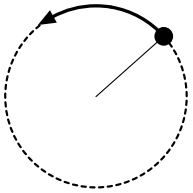
Because the inside of the board is warmer than it is on the outside

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

Path of ball released from orbit

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

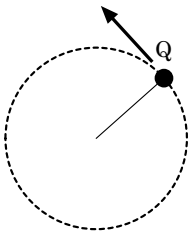




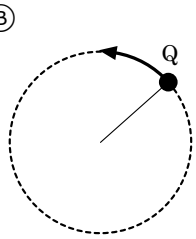
(View from above)

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

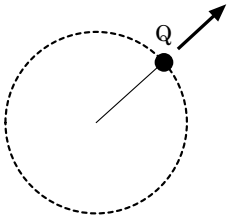
Ⓐ



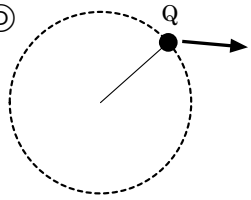
Ⓑ



Ⓒ



Ⓓ



Item Number: S022040

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Why helium balloon moves upward

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

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

Ⓑ The air resistance lifts the balloon up.

Ⓒ There is no gravity acting on helium balloons.

Ⓓ The wind blows the balloon upward.

Item Number: S032281

Correct Response: A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Metal crown: why scientists repeated measurement

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

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

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

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

Item Number: S032712A

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: why scientists repeated measurement (continued)

Item Number: S032712A

SCORING

Why Scientists Repeat Measurements

Correct Response

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

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

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

  They want a more exact answer.

  To get an accurate measure of the volume.

  It's more reliable.

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

  Examples: To find the average volume.

  To work out the mean.

- Other correct.

Incorrect Response

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

  Examples: In case mistakes happen.

  To make sure it wasn't changing.

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

  To make sure they did it right.

  To check if it was correct.

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

  Examples: To make sure it was a fair test.

  To ensure a fair test.

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

Metal crown: why scientists repeated measurement (continued)

Item Number: S032712A

Student Responses

Correct Response:

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

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

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

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

Incorrect Response:

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

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

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

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

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

Metal crown: determination of average/median value

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

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

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

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

Item Number: S032712B

SCORING

Correct Response

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

Incorrect Response

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

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Item Number: S032712B

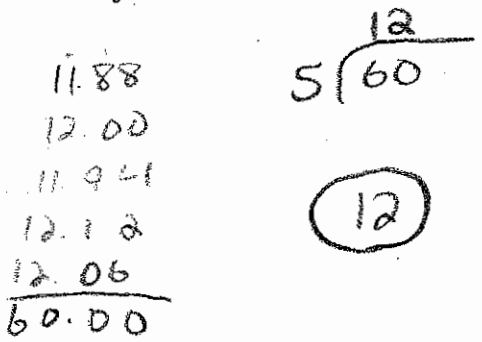
Student Responses

Correct Response:

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

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

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



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

Item Number: S032712B

Student Responses

Incorrect Response:

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

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

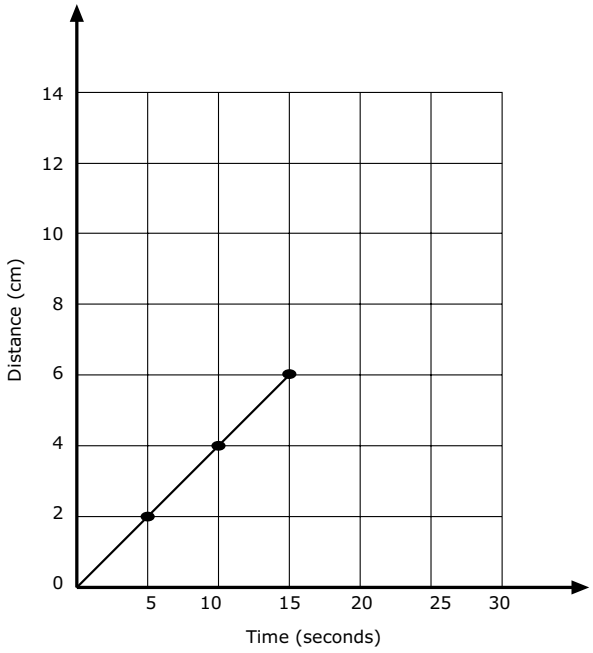
B. The scientists reported to the king that the density of the crown was 12.0 g/cm^3. Show how the scientists used their results to obtain this value for the density.

He took the average and used that.

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

Extrapolation of distance/time graph

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



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

Ⓐ 4 seconds

Ⓑ 6 seconds

Ⓒ 20 seconds

Ⓓ 25 seconds

Item Number: S022041

Correct Response: D

Overall Percent Correct

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

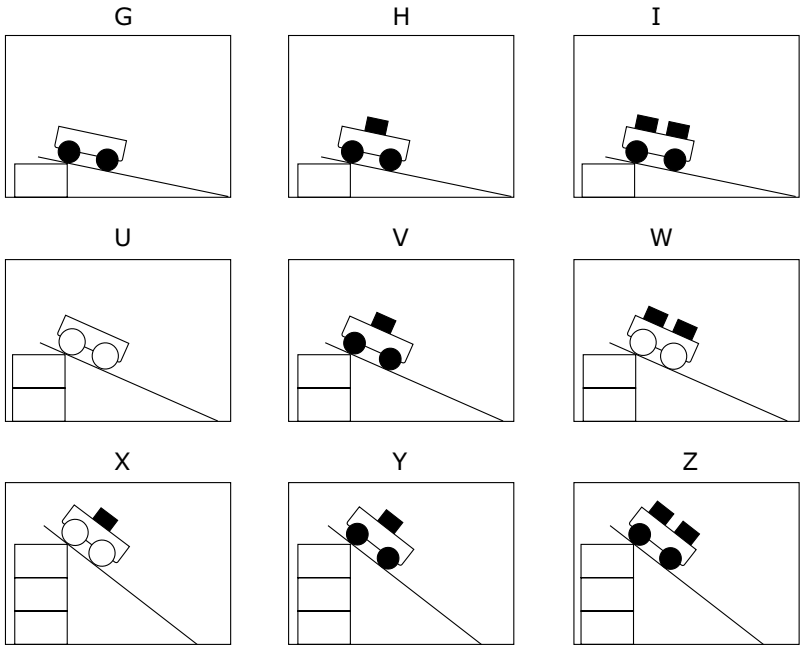
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Controlled experiment with cart

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



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

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

Item Number: S022222

Correct Response: E

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

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

Data trend of masses on spring

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

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

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

Item Number: S022286

Overall Percent Correct

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

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Data trend of masses on spring (continued)

Item Number: S022286

SCORING

Note: To receive credit, responses must address two basic regions in the table to describe the trend in spring length as a function of the mass added:

(i) initially, the spring increases in length (at a constant rate) as more mass is added.

(ii) after a point (40 grams), the spring length starts to level off and then remains constant as more mass is added.

Responses may be quantitative or qualitative in nature. [No credit is lost for using wrong or no units in describing length or mass.]

Correct Response

- Response includes both regions (i) and (ii).
  Examples: At low mass, it grew 2 for every 10 grams. Then it changed by 1 at 40g. Then at 50g, it did not grow any more.
  It increases by 2's until 30, increases by 1's until 50, and increases by 0 at 60.
  The length increased steadily up to 40g, and then it increased just a little bit more until it was 13cm at 50 and 60 grams.
  At first it got longer every time you added a mass, but then after a while, it did not get any longer.
- Other correct.

Incorrect Response

- Includes only region (i). Response references only an increase in length as more mass is added but discussion of leveling off is inadequate or missing.
  Examples: The length increased as more mass was added.
  The spring length got 2cm longer with each mass.
  It increased by 2cm each time until 40 grams.
- Refers only to leveling off of spring length or decreasing increments at higher masses. [Description of change in region (i) is inadequate or missing.]
  Examples: It stretches but only up to 13 cm.
  After 50 grams it did not change.
  It stretches less at higher masses.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Data trend of masses on spring (continued)

Item Number: S022286

Student Responses

Correct Response:

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

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

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

The length increased by 2 until it reached a mass of 30 grams it than increased by 1 and than sustained after a mass of 50.

Data trend of masses on spring (continued)

Item Number: S022286

Student Responses (continued)

Incorrect Response:

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

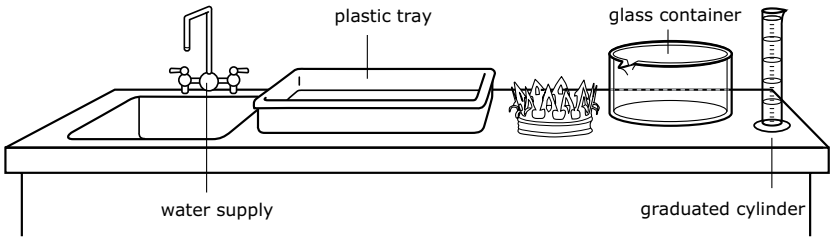
Mass (grams)	Length of Spring (cm)
0	5
10	7
20	9
30	11
40	12
50	13
60	13

Describe how the length of the spring changed as different masses were hung from it. it got longer as you hung heavier things from it.

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

Metal crown: procedure to find volume of crown

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Item Number: S032711

Overall Percent Correct

Singapore	38	▲
Japan	36	▲
Hong Kong, SAR	33	▲
Korea, Republic of	33	▲
Chinese Taipei	32	▲
Jordan	27	▲
Russian Federation	25	▲
Estonia	21	▲
Lithuania	20	▲
Slovak Republic	20	▲
Sweden	19	▲
Slovenia	19	▲
United States	17	▲
Belgium (Flemish)	16	▲
New Zealand	16	O
Hungary	15	O
Israel	15	O
Australia	14	O
International average	**13**	
Romania	13	O
Latvia	13	O
Netherlands	13	O
Italy	12	O
Malaysia	11	O
Cyprus	11	O
Bulgaria	11	O
Serbia and Montenegro	10	▼
Norway	9	▼
Saudi Arabia	9	▼
Scotland	8	▼
Macedonia, Republic of	8	▼
England	8	▼
Bahrain	8	▼
Palestinian Nat'l Auth.	7	▼
Egypt	5	▼
Armenia	5	▼
Indonesia	5	▼
Lebanon	5	▼
Iran, Islamic Republic of	4	▼
Botswana	4	▼
Philippines	3	▼
South Africa	2	▼
Chile	2	▼
Ghana	2	▼
Tunisia	1	▼
Morocco	0	▼
Moldova, Rep. of	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

SCORING

Note: For full credit, responses must describe or diagram a procedure based on displacement and clearly identify how the volume of the crown is determined. Partial credit is given for procedures or diagrams that demonstrate knowledge of displacement without a complete description of the steps/measurements to be made. Responses may also implicitly refer to other materials not indicated in the diagram (e.g., ruler, marker, etc.). Because it is not totally clear from the diagram what the relative size of the crown, beaker, and tray are, credit is given for procedures that use any of these materials for displacement even if the actual procedure might not be completely successful.

Correct Response

- Describes or diagrams a procedure based on displacement of water using measured water level differences:

  i) Adding water to the beaker (sink or tray) and marking the water level.

  ii) Placing the crown in the beaker (sink or tray) and marking the new water level.

  iii) Measuring the volume difference before/after adding the crown using the graduated cylinder
- Describes or diagrams a procedure based on displacement of water using measured overflow:

  i) Filling the beaker (or tray) with water.

  ii) Placing the crown in the beaker (or tray) and collecting the overflow.

  iii) Measuring the volume of the overflow using the graduated cylinder
- Other fully correct.

Partially Correct Response

- Describes or diagrams a partial procedure that includes displacement of water but with inadequate or no description of the steps/measurements to determine the volume.

  Examples: Put some water in the beaker and add the crown. Measure how much the level of water went up.

  Add the crown to the beaker filled with water. See how much overflowed.
- Other partially correct.

Incorrect Response

- Mentions putting the crown in the beaker (sink or tray) of water with no explicit mention that the water level will rise/overflow and no or incorrect procedure given for measuring the volume.

  Examples: Fill the beaker to the top with water and add the crown. You can get the volume that way.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

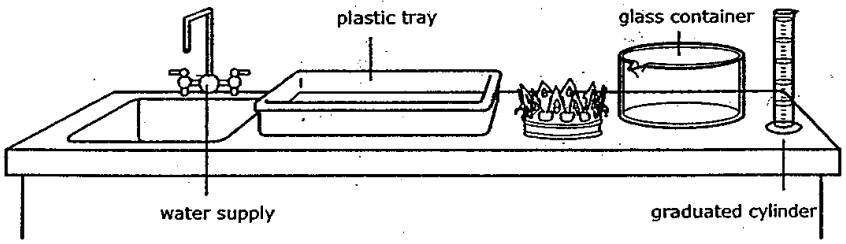
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

Student Responses

Correct Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

① Fill glass container to the very rim with water
② Place graduated cylinder under the spout
③ Place the crown carefully into the glass container
④ Measure how much water fell into the cylinder.
⑤ However much water spilled into the cylinder is the volume of the crown,
⑥ Convert mL into cm^3

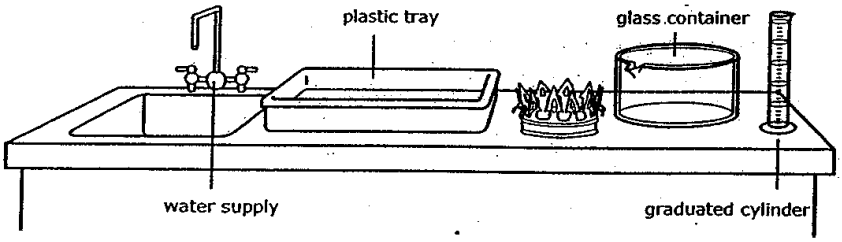
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

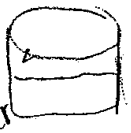
Student Responses (continued)

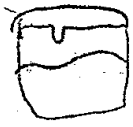
Partially Correct Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Put water in glass container →  → mesaure it

 →  →  → Measure how much higher it goes

Take away that number from the one without the crown & get the answer.

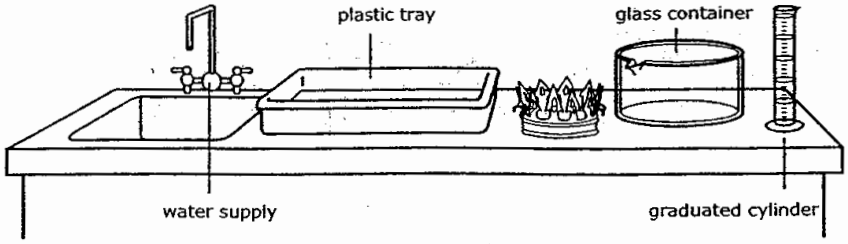
Metal crown: procedure to find volume of crown (continued)

Item Number: S032711

Student Responses (continued)

Incorrect Response:

The scientists then needed to find the volume of the crown in order to determine its density. The following equipment and materials were available for them to use.



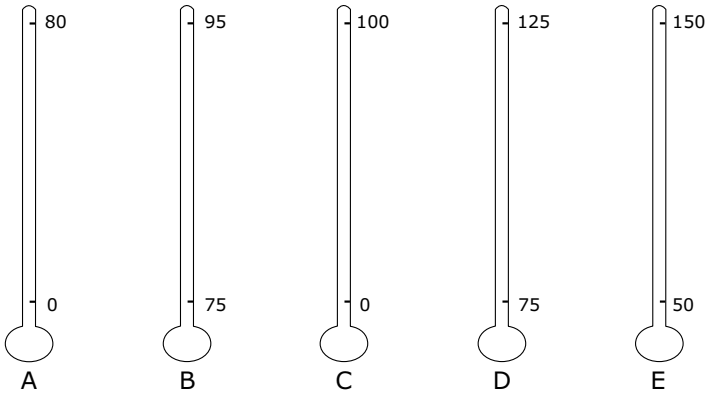
Describe a procedure that the scientists could use to find the volume of the crown using some or all of the equipment and materials shown above. You may use diagrams to help explain your procedure.

Put the crown into the plastic tray then weigh it.

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Heat and Temperature	Reasoning and Analysis

Thermometer scale for boiling water

At different altitudes, the boiling point of water ranges from about 80° C to 100° C. Which of the Celsius thermometers shown below would give the most accurate measurement of the boiling point of water at different altitudes?



Ⓐ Thermometer A
Ⓑ Thermometer B
Ⓒ Thermometer C
Ⓓ Thermometer D
Ⓔ Thermometer E

Item Number: S022225

Correct Response: D

Overall Percent Correct

Hong Kong, SAR	38	▲
Korea, Republic of	33	▲
Netherlands	33	▲
Slovak Republic	33	▲
Estonia	31	▲
Chinese Taipei	30	▲
Japan	29	▲
Belgium (Flemish)	27	▲
Israel	27	▲
Lithuania	26	▲
United States	26	▲
Singapore	25	▲
Hungary	24	▲
Russian Federation	23	▲
Sweden	22	O
Slovenia	22	O
New Zealand	22	O
Australia	22	O
Latvia	22	O
Palestinian Nat'l Auth.	21	O
Egypt	21	O
Jordan	20	O
England	20	O
International average	**20**	
Bulgaria	20	O
Scotland	19	O
Cyprus	17	O
Romania	16	▼
Italy	16	▼
Serbia and Montenegro	16	▼
Bahrain	16	▼
Norway	16	▼
Macedonia, Republic of	15	▼
South Africa	14	▼
Tunisia	13	▼
Moldova, Rep. of	13	▼
Philippines	13	▼
Lebanon	12	▼
Indonesia	11	▼
Iran, Islamic Republic of	10	▼
Armenia	9	▼
Chile	9	▼
Ghana	8	▼
Botswana	8	▼
Malaysia	6	▼
Morocco	0	▼
Saudi Arabia	0	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Seeing person in a dark room

A person in a dark room looking through a window can clearly see a person outside in the daylight. But a person outside cannot see the person inside. Why does this happen?

Ⓐ There is not enough light being reflected off the person in the room.

Ⓑ Light rays cannot pass through a window twice.

Ⓒ Outside light does not pass through windows.

Ⓓ Sunlight is not as intense as other sources of light.

Item Number: S012004

Correct Response: A

Overall Percent Correct

Singapore	87	▲
England	83	▲
Scotland	81	▲
New Zealand	81	▲
Sweden	80	▲
United States	79	▲
Lithuania	79	▲
Chinese Taipei	79	▲
Netherlands	79	▲
Korea, Republic of	78	▲
Australia	76	▲
Estonia	76	▲
Norway	75	▲
Israel	75	▲
Hong Kong, SAR	73	▲
Latvia	72	▲
Belgium (Flemish)	71	▲
Slovenia	70	▲
Romania	69	O
Hungary	69	O
Serbia and Montenegro	69	O
Indonesia	68	O
Italy	68	O
Moldova, Rep. of	68	O
Iran, Islamic Republic of	66	O
Bahrain	66	O
International average	**66**	
Philippines	66	O
Jordan	65	O
Cyprus	62	▼
Chile	61	▼
Japan	61	▼
Saudi Arabia	60	▼
Tunisia	60	▼
Macedonia, Republic of	59	▼
Slovak Republic	59	▼
Botswana	58	▼
Morocco	57	▼
Palestinian Nat'l Auth.	57	▼
Russian Federation	52	▼
Bulgaria	50	▼
Egypt	50	▼
Malaysia	47	▼
Ghana	44	▼
Armenia	42	▼
South Africa	42	▼
Lebanon	35	▼

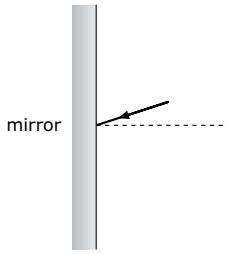
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

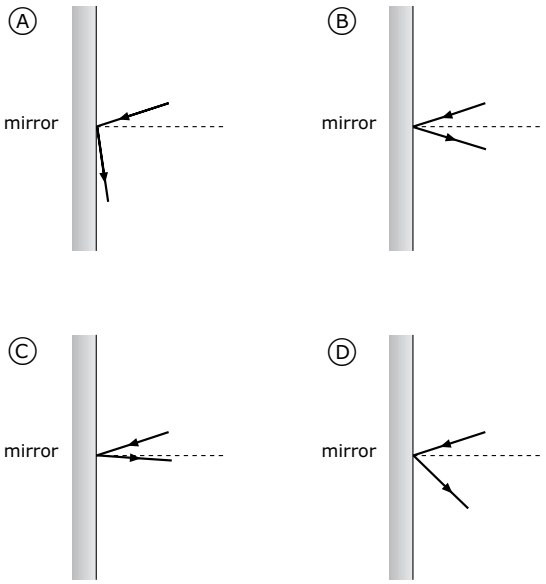
Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Angle of reflected light ray

A ray of light strikes a mirror as shown.



Which picture best shows the direction of the reflected light?



Item Number: S022058

Correct Response: B

Overall Percent Correct

Estonia	83	▲
England	83	▲
Korea, Republic of	81	▲
Netherlands	81	▲
Japan	80	▲
Singapore	79	▲
Armenia	76	▲
New Zealand	76	▲
Chinese Taipei	75	▲
Latvia	74	▲
Malaysia	72	▲
Cyprus	72	▲
Sweden	71	▲
Lithuania	71	▲
Hong Kong, SAR	68	▲
Belgium (Flemish)	67	▲
Scotland	67	O
Australia	66	O
Bulgaria	66	O
Hungary	66	O
International average	**63**	
Slovenia	63	O
Serbia and Montenegro	62	O
Iran, Islamic Republic of	62	O
Slovak Republic	62	O
Israel	61	O
Russian Federation	61	O
Macedonia, Republic of	61	O
Indonesia	61	O
Palestinian Nat'l Auth.	60	O
Romania	59	O
United States	59	▼
Jordan	59	▼
Moldova, Rep. of	58	▼
Lebanon	57	▼
Norway	57	▼
Italy	57	▼
Egypt	54	▼
Bahrain	54	▼
Morocco	51	▼
Philippines	51	▼
Saudi Arabia	49	▼
Chile	45	▼
Tunisia	44	▼
Ghana	41	▼
Botswana	38	▼
South Africa	33	▼

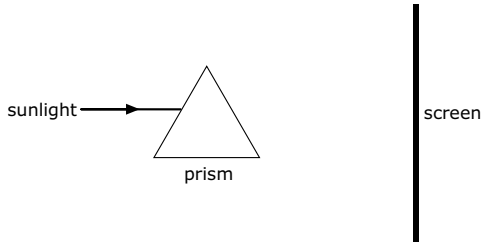
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Sunlight through a glass prism

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

Item Number: S032375

SCORING

Note: For full credit, responses must explicitly indicate that different colors are seen on the screen, either by textual description or by drawing on the diagram. A completely correct or complete sequence of colors is not required for full credit. Partial credit will be given for responses that show or describe refraction even if the appearance of the light beams on the screen is not fully described.

Correct Response

- Describes or draws the visible color spectrum.
  Examples: A spectrum of seven colors which is red, orange, yellow, green, blue, indigo, violet.
- Refers to a spectrum, rainbow, colors, etc. (no color spectrum shown)
  Examples: I will see many colors on it like the rainbow.
  All the colors of the color spectrum.
  There will be seven colors.
- Other fully correct.

Partially Correct Response

- Describes or draws multiple refracted rays but with no explicit connection to color.
  Examples: There will be a lot of rays coming out the other side of the prism.
  The light will spread out across that side of the prism and be seen on most of the screen.
- Describes or draws only the refraction (bending) of light beam (no mention of color dispersion).
  Examples: The light inside the prism will bend.
  The sunlight would go through at an angle.
- Other partially correct.

Incorrect Response

- Describes or draws a shadow or image of the prism (or similar).
  Examples: The prism will make a shadow on the screen.
- Refers only to seeing sunlight or light on the screen. [No mention of color dispersion or refraction.]
  Examples: Sunlight hitting the screen.
  The screen will be bright because there is light falling on it.
- Other incorrect (including crossed out/erased, stray marks, illegible or off task).

Overall Percent Correct

Korea, Republic of	74	▲
Singapore	65	▲
Malaysia	53	▲
Hong Kong, SAR	49	▲
United States	49	▲
England	47	▲
Netherlands	45	▲
New Zealand	43	▲
Chinese Taipei	38	▲
Jordan	36	▲
Bahrain	34	▲
Armenia	33	▲
Palestinian Nat'l Auth.	33	▲
Lithuania	32	▲
Iran, Islamic Republic of	31	▲
Scotland	28	O
Sweden	25	O
Egypt	24	O
Hungary	24	O
Italy	24	O
International average	**23**	
Australia	22	O
Estonia	20	O
Romania	18	▼
Israel	17	▼
Latvia	17	▼
Belgium (Flemish)	15	▼
Norway	15	▼
Slovenia	15	▼
Saudi Arabia	14	▼
Chile	11	▼
Russian Federation	11	▼
Philippines	10	▼
Japan	10	▼
Indonesia	9	▼
Lebanon	7	▼
Bulgaria	7	▼
Macedonia, Republic of	7	▼
Slovak Republic	6	▼
Botswana	5	▼
Cyprus	4	▼
South Africa	3	▼
Moldova, Rep. of	2	▼
Serbia and Montenegro	2	▼
Ghana	1	▼
Morocco	1	▼
Tunisia	0	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

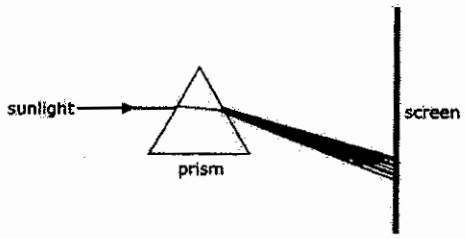
Sunlight through a glass prism (continued)

Item Number: S032375

Student Responses

Correct Response:

The diagram shows a ray of sunlight entering a glass prism.

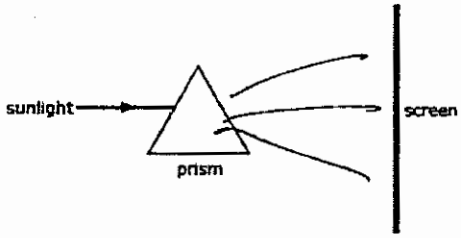


Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

Seven different colours namely red, orange, yellow, green blue, indigo and violet will be seen.

Partially Correct Response:

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

You will see many different light rays

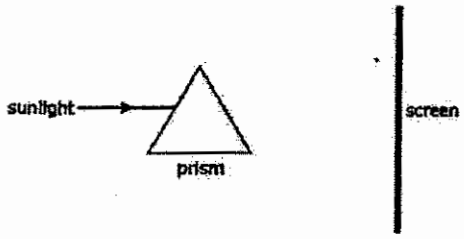
Sunlight through a glass prism (continued)

Item Number: S032375

Student Responses (continued)

Incorrect Response:

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

There will be a reflection of one side of the prism

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Conceptual Understanding

Lightning seen before thunder heard

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

Explain why she saw lightning before she heard thunder.

Item Number: S032626

SCORING

Correct Response

- Refers to light traveling faster than sound (or similar).
  Examples: Speed of light is faster than speed of sound.
  Light travels quicker than sound.
  It takes more time for sound to reach her than light.
- Other correct.

Incorrect Response

- Refers only to lightning being closer or thunder being further away (explicitly or implicitly).
  Examples: Thunder has a longer way to go.
  Thunder is striking from kilometers away.
- Refers to lightning occurring first, causing thunder, or similar.
  [No explicit mention of the relative speed of light/sound to travel.]
  Examples: Lightning is so quick, thunder only happens afterward.
  The noise occurs later.
  Thunder occurs from lightning.
  Thunder is the echo of lightning.
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Overall Percent Correct

Singapore	88	▲
England	74	▲
Chinese Taipei	70	▲
Japan	65	▲
Hong Kong, SAR	62	▲
Lithuania	61	▲
Sweden	59	▲
Botswana	54	▲
Hungary	54	▲
Norway	54	▲
Estonia	53	▲
Latvia	52	▲
Netherlands	52	▲
Australia	51	▲
Korea, Republic of	47	▲
Malaysia	47	▲
Israel	46	O
United States	46	▲
Bahrain	45	O
Saudi Arabia	45	O
Romania	44	O
Slovenia	44	O
Bulgaria	43	O
New Zealand	43	O
Scotland	43	O
Belgium (Flemish)	42	O
International average	**42**	
Italy	41	O
Slovak Republic	41	O
Macedonia, Republic of	41	O
Egypt	40	O
Jordan	39	O
Serbia and Montenegro	37	▼
Russian Federation	36	▼
Cyprus	35	▼
Moldova, Rep. of	35	▼
Lebanon	32	▼
Palestinian Nat'l Auth.	31	▼
Armenia	26	▼
Chile	19	▼
Indonesia	19	▼
Iran, Islamic Republic of	15	▼
Philippines	13	▼
Morocco	12	▼
Tunisia	8	▼
South Africa	4	▼
Ghana	1	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Lightning seen before thunder heard (continued)

Item Number: S032626

Student Responses

Correct Response:

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

Explain why she saw lightning before she heard thunder.

Light travels faster than sound. So the lightning was moving faster than the thunder even though the were part of the same thing.

Incorrect Response:

Mary was looking out her window on a stormy night. She saw lightning and then heard thunder a few seconds later.

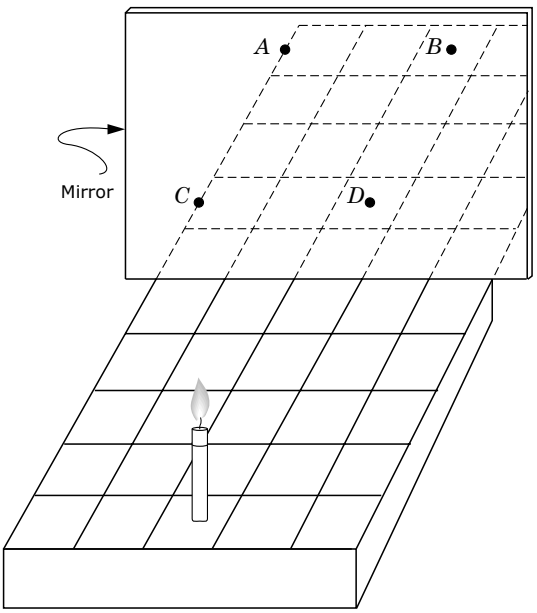
Explain why she saw lightning before she heard thunder.

She saw lightning first because, the lightning is close

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Candle position reflected on grid

A candle is placed on a ruled grid in front of a mirror, as shown. At what point will the reflection of the candle appear to be?



Ⓐ Point A
Ⓑ Point B
Ⓒ Point C
Ⓓ Point D

Item Number: S012015

Correct Response: B

Overall Percent Correct

Belgium (Flemish)	89	▲
Singapore	88	▲
Netherlands	87	▲
New Zealand	86	▲
England	86	▲
Scotland	83	▲
Hungary	80	▲
Hong Kong, SAR	80	▲
Estonia	80	▲
Australia	80	▲
Slovak Republic	77	▲
Korea, Republic of	77	▲
Chinese Taipei	77	▲
Japan	75	▲
Bahrain	74	▲
Malaysia	73	▲
United States	73	▲
Slovenia	72	▲
Russian Federation	71	▲
Norway	70	▲
Latvia	69	▲
Lithuania	68	▲
Cyprus	65	O
Armenia	65	O
International average	**64**	
Italy	64	O
Israel	63	O
Chile	63	O
Indonesia	60	▼
Sweden	60	▼
Serbia and Montenegro	59	▼
Moldova, Rep. of	56	▼
Palestinian Nat'l Auth.	55	▼
Bulgaria	54	▼
Romania	53	▼
Macedonia, Republic of	53	▼
Egypt	53	▼
Iran, Islamic Republic of	52	▼
Lebanon	51	▼
Saudi Arabia	48	▼
Morocco	46	▼
Jordan	45	▼
Tunisia	43	▼
Botswana	42	▼
Philippines	41	▼
Ghana	28	▼
South Africa	25	▼

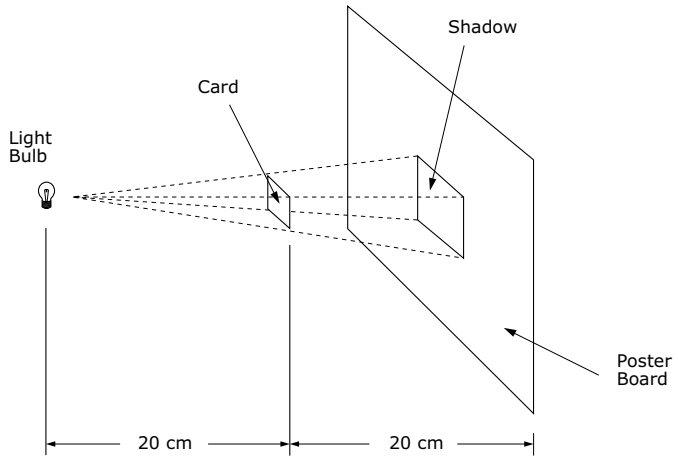
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Shadow size from distance diagram

A tiny light bulb is held 20 centimeters to the left of a square card, which is in turn held 20 centimeters to the left of a poster board, as shown. The shadow of the card on the poster board has a side of 10 centimeters.



If the poster board is moved 40 cm further to the right so that it is 80 cm from the light, what will be the new side of the card's shadow on the poster board?

Ⓐ 5 cm
Ⓑ 10 cm
Ⓒ 15 cm
Ⓓ 20 cm

Item Number: S012029

Correct Response: D

Overall Percent Correct

Korea, Republic of	79	▲
Sweden	69	▲
Belgium (Flemish)	69	▲
Estonia	68	▲
Chinese Taipei	68	▲
Japan	67	▲
Russian Federation	67	▲
Singapore	66	▲
Netherlands	64	▲
Lithuania	63	O
Lebanon	63	O
Malaysia	63	▲
Scotland	63	O
Romania	62	O
Hungary	61	O
United States	61	O
Latvia	61	O
Hong Kong, SAR	61	O
Slovenia	61	O
Botswana	60	O
Armenia	60	O
Israel	60	O
England	60	O
International average	**59**	
Italy	59	O
Moldova, Rep. of	59	O
Macedonia, Republic of	58	O
Australia	58	O
Serbia and Montenegro	58	O
Bahrain	58	O
New Zealand	57	O
Iran, Islamic Republic of	57	O
Philippines	57	O
Norway	57	O
Bulgaria	56	O
Morocco	56	O
Jordan	56	O
Palestinian Nat'l Auth.	56	▼
Cyprus	55	▼
Tunisia	53	▼
Slovak Republic	53	▼
South Africa	51	▼
Indonesia	50	▼
Saudi Arabia	49	▼
Egypt	48	▼
Chile	47	▼
Ghana	47	▼

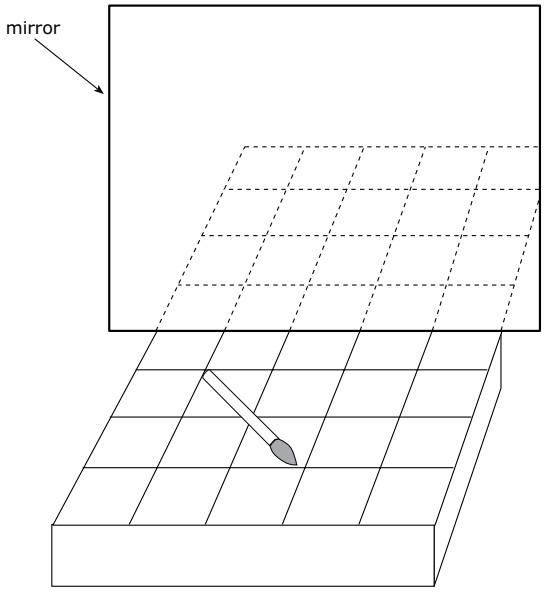
Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Content Domain	Main Topic	Cognitive Domain
PHYSICS	Light	Reasoning and Analysis

Brush reflected in mirror at angle

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Item Number: S022279

Overall Percent Correct

New Zealand	75	▲
Netherlands	72	▲
Belgium (Flemish)	71	▲
England	71	▲
Scotland	70	▲
Estonia	67	▲
Japan	66	▲
Australia	61	▲
Hungary	61	▲
Hong Kong, SAR	60	▲
Singapore	59	▲
Latvia	59	▲
Lithuania	58	▲
Russian Federation	56	▲
Armenia	54	▲
Norway	53	▲
Slovenia	53	▲
Slovak Republic	52	▲
Chinese Taipei	52	▲
Sweden	51	▲
Malaysia	51	▲
Moldova, Rep. of	51	▲
United States	51	▲
Korea, Republic of	46	O
Serbia and Montenegro	45	O
Bahrain	44	O
International average	**44**	
Italy	42	O
Romania	41	O
Bulgaria	37	▼
Israel	36	▼
Chile	35	▼
Indonesia	35	▼
Macedonia, Republic of	35	▼
Iran, Islamic Republic of	32	▼
Cyprus	31	▼
Tunisia	26	▼
Philippines	24	▼
Morocco	23	▼
Egypt	22	▼
Palestinian Nat'l Auth.	22	▼
Saudi Arabia	21	▼
Lebanon	21	▼
Jordan	20	▼
Botswana	17	▼
South Africa	8	▼
Ghana	4	▼

Country average vs. International average:

Higher	▲
Not different	O
Lower	▼

Brush reflected in mirror at angle (continued)

Item Number: S022279

SCORING

Note: A brush on the borderline of the correct squares should be accepted as correct. Credit is given for a brush in the correct squares even if the hairs are not clearly shown. Only if the hairs are clearly shown in the wrong direction is the answer incorrect.

Correct Response

- Correct placement: angle, grid position, and direction (hairs to the right). (See Figure 1.)

Incorrect Response

- Correct angle and placement, but image flipped with hairs clearly turned to the left. (See Figure 2.)
- Image parallel to original (hairs to the right or left). (See Figure 3; other rows/columns are possible).
- Correct angle but image translated (hairs to the right or left). (See Figure 4; other rows/columns are possible).
- Other incorrect (including crossed out/erased, stray marks, illegible, or off task).

Figure 1

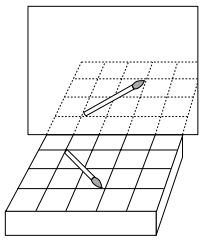


Figure 2

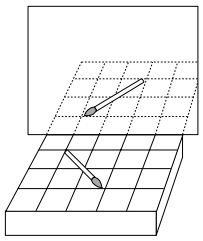


Figure 3

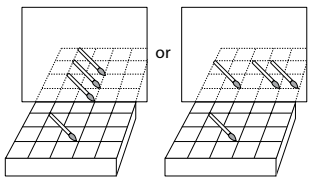
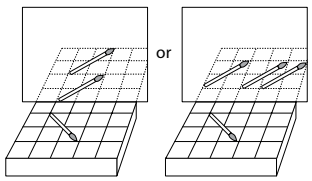


Figure 4



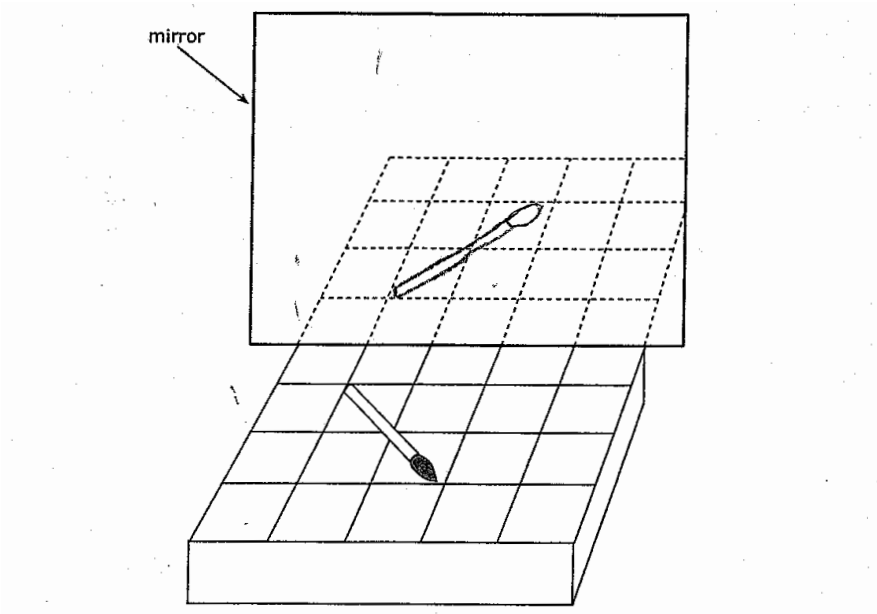
Brush reflected in mirror at angle (continued)

Item Number: S022279

Student Responses

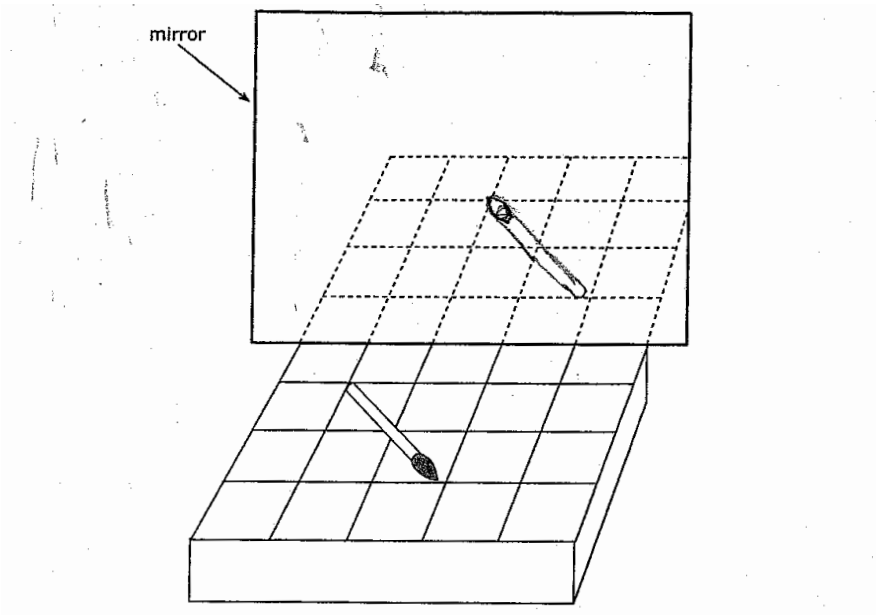
Correct Response:

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Incorrect Response:

The picture shows a paint brush that is lying on a shelf in front of a mirror. Draw a picture of the paint brush as you would see it in the mirror. Use the patterns of lines on the shelf to help you.



Content Domain	Main Topic	Cognitive Domain
PHYSICS	Physical States and Changes in Matter	Factual Knowledge

Wet towel dries in the sun

A wet towel will dry when it is left in the Sun. Which process occurs to make this happen?

Ⓐ melting

Ⓑ boiling

Ⓒ condensation

Ⓓ evaporation

Item Number: S032055

Correct Response: D

Overall Percent Correct

Chinese Taipei	98	▲
Singapore	95	▲
Hungary	95	▲
Estonia	94	▲
Slovak Republic	94	▲
Hong Kong, SAR	94	▲
Japan	94	▲
Russian Federation	94	▲
Korea, Republic of	93	▲
Tunisia	91	▲
Lithuania	91	▲
Slovenia	90	▲
England	89	▲
Moldova, Rep. of	89	▲
New Zealand	88	▲
Australia	88	▲
Latvia	88	▲
Netherlands	88	▲
Malaysia	87	▲
Bulgaria	87	▲
Scotland	87	O
Jordan	86	O
Romania	86	O
Armenia	86	O
Belgium (Flemish)	85	O
United States	85	O
Israel	85	O
Serbia and Montenegro	85	O
Bahrain	84	O
Norway	84	O
International average	**83**	
Iran, Islamic Republic of	83	O
Morocco	83	O
Sweden	82	O
Saudi Arabia	82	O
Italy	81	O
Palestinian Nat'l Auth.	78	▼
Macedonia, Republic of	78	▼
Cyprus	77	▼
Indonesia	77	▼
Chile	76	▼
Lebanon	76	▼
Philippines	69	▼
Botswana	67	▼
Egypt	59	▼
South Africa	51	▼
Ghana	39	▼

Country average vs. International average:

Higher ▲
Not different O
Lower ▼

Item Index 2003

Item Index 2003