Exhibit 4.13: Description of the TIMSS 2019 Advanced International Benchmark (625) of Science Achievement

● **Advanced** International Benchmark

625

Summary

Students communicate understanding of concepts related to biology, chemistry, physics, and Earth science in a variety of contexts. Students can classify animals into taxonomic groups. They can apply knowledge of cell structures and their functions. Students show some understanding of diversity, adaptation, and natural selection. They also recognize the interdependence of populations of organisms in an ecosystem. Students demonstrate knowledge of the composition of matter and the periodic table of the elements. Students use physical properties of matter to sort, classify, and compare substances and materials. They also recognize evidence that a chemical reaction has occurred. Students communicate understanding of particle spacing and motion in different physical states. Students apply knowledge of energy transfer and electrical circuits, can relate the properties of light and sound to common phenomena, and demonstrate understanding of forces in everyday contexts. Students communicate understanding of Earth's structure, physical features, and processes. They demonstrate knowledge of the Earth's resources and their conservation.

Students can classify animals into taxonomic groups. They can apply knowledge of cell structures and their functions. Students show some understanding of diversity, adaptation, and natural selection among organisms. They also recognize the interdependence of populations of organisms in an ecosystem.

Students demonstrate knowledge of the composition of matter. They demonstrate understanding of how the elements are arranged in the periodic table. Students use physical properties of matter to sort, classify, and compare substances and materials. They also recognize evidence that a chemical reaction has occurred.

Students communicate understanding of particle spacing and motion in different physical states. They can apply knowledge of energy transfer in practical and abstract contexts. Students can relate the properties of light and sound to common phenomena. They can apply knowledge of electricity. For example, they can recognize components in a circuit, indicate whether parts of a lightbulb are electrical conductors or insulators, and evaluate statements about battery life and bulb brightness in two circuits. Students demonstrate understanding of forces and motion and pressure in everyday contexts.

Students communicate understanding of Earth's structure, physical features, and processes. They also demonstrate knowledge of the Earth's resources and their conservation.

Students can combine and compare information from several sources to draw conclusions. They can interpret information in diagrams, graphs, and tables to identify and explain science concepts.

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Exhibit 4.13.1: Advanced International Benchmark of Science Achievement – Example Item 1

Content Domain: Biology
Cognitive Domain: Applying
Description: Classifies 7 of 7 animals as mammals or non-mammals

Country	Percent Full Credit	
Japan	75 (1.9)	▲
Chinese Taipei	63 (1.9)	▲
[2] Singapore	62 (2.0)	▲
Hungary	53 (2.8)	▲
[†] Hong Kong SAR	46 (2.6)	▲
[2] Russian Federation	44 (2.5)	▲
[1] Georgia	42 (3.2)	▲
Italy	41 (2.6)	▲
Romania	40 (2.4)	▲
Finland	37 (1.7)	▲
Lithuania	37 (2.7)	▲
[2] Kazakhstan	35 (2.6)	▲
Australia	35 (1.6)	▲
Portugal	35 (2.6)	▲
[3] Israel	33 (2.5)	
Korea, Rep. of	31 (2.1)	
[†] New Zealand	30 (2.0)	
[†] United States	30 (1.9)	
International Average	**30 (0.3)**	
England	27 (2.5)	
Cyprus	27 (2.0)	
United Arab Emirates	27 (1.2)	▽
Lebanon	26 (2.3)	
Bahrain	24 (2.3)	▽
Qatar	22 (1.7)	▽
Malaysia	21 (1.5)	▽
France	21 (1.8)	▽
Turkey	20 (2.0)	▽
Ireland	20 (1.9)	▽
Oman	20 (1.5)	▽
Jordan	18 (1.8)	▽
[2] Sweden	17 (1.7)	▽
[†] Norway (9)	16 (2.0)	▽
Chile	16 (1.7)	▽
Kuwait	16 (2.3)	▽
Morocco	16 (1.5)	▽
Iran, Islamic Rep. of	12 (1.4)	▽
[2] Saudi Arabia	10 (1.3)	▽
[2] Egypt	7 (1.2)	▽
South Africa (9)	5 (0.4)	▽

Benchmarking Participants

Moscow City, Russian Fed.	55 (2.5)	▲
[2] Dubai, UAE	37 (2.0)	▲
Ontario, Canada	37 (3.0)	▲
[‡] Quebec, Canada	27 (2.2)	
Abu Dhabi, UAE	23 (1.5)	▽
Western Cape, RSA (9)	14 (1.4)	▽
Gauteng, RSA (9)	10 (1.6)	▽

Here is a list of animals.

ant   cat   dolphin   earthworm

fish   frog   jellyfish

Classify the animals into two groups based on whether or not the animal is a mammal. List the animals in each group in the table.

Mammal	Not a mammal
cat dolphin	ant earthworm fish frog jellyfish

The answer shown illustrates the type of response that would receive full credit (1 point).

▲ Percent significantly higher than international average

▽ Percent significantly lower than international average

See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

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Exhibit 4.13.2: Advanced International Benchmark of Science Achievement – Example Item 2

Country	Percent Full Credit	
[2] Singapore	60 (2.1)	▲
Korea, Rep. of	56 (2.0)	▲
Turkey	49 (2.2)	▲
[2] Russian Federation	46 (2.4)	▲
Japan	44 (2.3)	▲
[†] Norway (9)	44 (2.5)	▲
Chinese Taipei	43 (2.2)	▲
Lithuania	42 (2.8)	▲
Hungary	41 (2.7)	▲
[2] Kazakhstan	40 (2.7)	▲
Australia	40 (2.1)	▲
[†] New Zealand	38 (2.2)	▲
Finland	36 (2.0)	▲
[†] United States	35 (1.8)	▲
Ireland	35 (2.3)	▲
[1] Georgia	32 (3.2)	
England	31 (2.7)	
[3] Israel	31 (2.4)	
[2] Sweden	29 (2.6)	
International Average	**29 (0.3)**	
United Arab Emirates	27 (1.1)	
Romania	26 (2.7)	
Bahrain	23 (2.0)	▽
Kuwait	23 (2.3)	▽
Lebanon	23 (2.2)	▽
Italy	21 (2.1)	▽
South Africa (9)	21 (1.1)	▽
Chile	21 (1.9)	▽
[†] Hong Kong SAR	21 (2.1)	▽
Iran, Islamic Rep. of	19 (2.3)	▽
Jordan	19 (2.1)	▽
[2] Egypt	18 (1.9)	▽
Portugal	17 (1.6)	▽
Qatar	15 (2.3)	▽
Cyprus	15 (1.8)	▽
France	15 (1.5)	▽
Malaysia	11 (1.1)	▽
Oman	8 (1.0)	▽
[2] Saudi Arabia	7 (1.3)	▽
Morocco	6 (1.1)	▽
Benchmarking Participants		
[‡] Quebec, Canada	56 (2.7)	▲
Moscow City, Russian Fed.	55 (2.3)	▲
[2] Dubai, UAE	41 (2.0)	▲
Western Cape, RSA (9)	32 (2.1)	
Gauteng, RSA (9)	31 (2.3)	
Abu Dhabi, UAE	23 (1.4)	▽
Ontario, Canada	23 (2.4)	▽

Content Domain: Chemistry
Cognitive Domain: Applying
Description: Uses a portion of the periodic table to order four elements from the smallest atomic number to the largest atomic number

This is a portion of the periodic table of elements.

[1]H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

Hydrogen (H) is the first element of the periodic table. The nucleus of a hydrogen atom contains one proton. The atomic number of hydrogen is 1.

Four elements from the periodic table are shown below. The elements are not ordered by their atomic numbers.

Drag the four elements below to sort them by atomic number from smallest to largest.

Smallest .... **Largest**

| Helium (He) | Carbon (C) | Fluorine (F) | Sodium (Na) |

The answer shown illustrates the type of response that would receive full credit (1 point).

▲ Percent significantly higher than international average

▽ Percent significantly lower than international average

See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study - TIMSS 2019
Downloaded from http://timss2019.org/download

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Exhibit 4.13.3: Advanced International Benchmark of Science Achievement – Example Item 3

Country	Percent Correct	
[2] Singapore	69 (2.2)	▲
[3] Israel	68 (2.1)	▲
Portugal	56 (2.6)	▲
Korea, Rep. of	56 (2.3)	▲
Bahrain	50 (2.1)	▲
Australia	50 (2.5)	▲
United Arab Emirates	50 (1.0)	▲
[2] Russian Federation	49 (2.5)	▲
England	49 (2.5)	▲
Turkey	49 (2.3)	▲
Chile	47 (2.6)	▲
Qatar	47 (2.4)	▲
[†] United States	47 (1.7)	▲
Japan	46 (2.6)	▲
Oman	45 (1.8)	▲
Lithuania	43 (2.4)	
[2] Sweden	41 (2.4)	
International Average	**41 (0.4)**	
Italy	40 (2.5)	
[†] New Zealand	40 (2.6)	
Chinese Taipei	38 (2.0)	
Kuwait	37 (2.3)	
Jordan	37 (2.5)	
France	36 (2.2)	▽
Malaysia	36 (2.1)	▽
[2] Saudi Arabia	36 (1.6)	▽
[1] Georgia	36 (3.0)	
[†] Hong Kong SAR	35 (3.1)	
[2] Kazakhstan	35 (2.1)	▽
Ireland	34 (2.4)	▽
Finland	34 (2.0)	▽
[†] Norway (9)	34 (2.1)	▽
Iran, Islamic Rep. of	31 (2.0)	▽
Cyprus	31 (2.2)	▽
Hungary	31 (2.0)	▽
Morocco	28 (1.8)	▽
Romania	27 (2.4)	▽
Lebanon	23 (2.4)	▽
[2] Egypt	22 (2.0)	▽
South Africa (9)	20 (0.9)	▽

Benchmarking Participants

Country	Percent Correct	
[2] Dubai, UAE	63 (1.9)	▲
Ontario, Canada	60 (2.6)	▲
Moscow City, Russian Fed.	59 (2.5)	▲
[‡] Quebec, Canada	48 (2.8)	▲
Abu Dhabi, UAE	43 (1.9)	
Western Cape, RSA (9)	28 (2.0)	▽
Gauteng, RSA (9)	28 (2.0)	▽

Content Domain: Physics
Cognitive Domain: Applying
Description: Recognizes a diagram of what happens to gas molecules inside a balloon when the balloon expands

▲ Percent significantly higher than international average

▽ Percent significantly lower than international average

See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.
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Exhibit 4.13.4: Advanced International Benchmark of Science Achievement – Example Item 4

Country	Percent Correct	
Japan	68 (1.9)	▲
[2] Russian Federation	66 (2.6)	▲
Lithuania	65 (2.0)	▲
Korea, Rep. of	63 (2.2)	▲
Chinese Taipei	63 (2.0)	▲
Turkey	62 (2.4)	▲
[2] Kazakhstan	57 (2.4)	▲
Finland	55 (2.0)	▲
Hungary	52 (2.3)	▲
Bahrain	51 (2.0)	▲
[†] Hong Kong SAR	50 (2.5)	▲
France	49 (2.1)	▲
Italy	45 (2.8)	
[2] Singapore	45 (2.1)	
Romania	43 (2.3)	
England	42 (2.6)	
International Average	**42 (0.3)**	
[1] Georgia	42 (3.0)	
[2] Saudi Arabia	42 (2.0)	
Australia	41 (1.9)	
[†] United States	40 (1.8)	
Portugal	40 (2.1)	
United Arab Emirates	39 (1.0)	▽
[†] Norway (9)	39 (2.4)	
Qatar	37 (2.0)	▽
Ireland	36 (2.0)	▽
[2] Sweden	35 (2.2)	▽
[3] Israel	35 (2.7)	▽
[†] New Zealand	34 (2.5)	▽
Oman	34 (1.8)	▽
Cyprus	34 (2.2)	▽
Kuwait	33 (1.8)	▽
Chile	33 (2.2)	▽
Malaysia	32 (1.7)	▽
Morocco	30 (1.7)	▽
Jordan	29 (2.1)	▽
[2] Egypt	28 (1.8)	▽
Lebanon	25 (2.0)	▽
Iran, Islamic Rep. of	18 (1.5)	▽
South Africa (9)	12 (0.7)	▽

Benchmarking Participants

Country	Percent Correct	
Moscow City, Russian Fed.	74 (2.3)	▲
[‡] Quebec, Canada	51 (3.3)	▲
[2] Dubai, UAE	47 (1.9)	▲
Ontario, Canada	37 (2.9)	
Abu Dhabi, UAE	37 (1.5)	▽
Gauteng, RSA (9)	18 (1.4)	▽
Western Cape, RSA (9)	18 (1.5)	▽

Content Domain: Earth Science
Cognitive Domain: Knowing
Description: Recognizes why a balloon gets bigger as its height above the ground increases

The diagram shows the height above the ground of a helium-filled weather balloon during a period of several hours.

Height above ground (km) / *Time (hours)*

What causes the balloon to become bigger as its height above the ground increases?

(A) Gravity decreases.

(B) Atmospheric pressure decreases.

(C) The balloon is heated by the Sun.
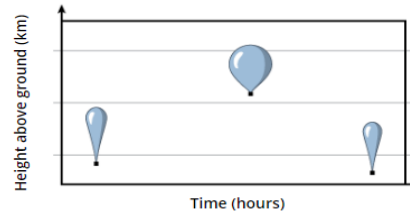
(D) The balloon absorbs air.

▲ Percent significantly higher than international average

▽ Percent significantly lower than international average

See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.
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