Exhibit 2.1.3: Summary of TIMSS 2023 International Benchmarks of Science Achievement

Advanced International Benchmark	
625	*Students can show, apply, and communicate their knowledge of life, physical, and earth sciences, and engage in multiple scientific inquiry practices.* Students show knowledge of the characteristics of living things, and they can construct and reason with representations of the relationships among organisms in ecosystems. They demonstrate knowledge of inheritance, killing germs, and environmental pollution. They show knowledge of properties of matter and of changes in states of matter, and they reason about dissolving rates in a laboratory setting. Students can communicate their understanding of Earth's physical characteristics and processes and of how humans use and impact the Earth's natural resources. They show knowledge of the motion and relative position of the Earth, Moon, and Sun. Students can design fair tests, predict outcomes, and evaluate possible conclusions.
High International Benchmark	
550	*Students show and apply knowledge of life, physical, and earth science, and they engage in some scientific inquiry practices.* They can distinguish between living and nonliving things, they show knowledge about plant and animal reproduction and survival, and they can apply knowledge about some of the characteristics of plants and animals and their life cycles. Students can apply knowledge about the spread of germs. They can apply knowledge about states and properties of matter, magnets, sound, and heat and can reason using knowledge of dissolving rates in an everyday context. They show and can apply some knowledge of forces and motion. Students know various facts about the Earth's physical characteristics, and they apply their knowledge about Earth's different climates and changes over time. They can apply knowledge of the Earth-Sun system, and they show basic knowledge of the Moon's phases. Students describe observations and interpret models and graphical representations.
Intermediate International Benchmark	
475	*Students show and apply knowledge of some scientific concepts.* Students show and apply some knowledge about plants and animals, and they have basic knowledge of human health. They show knowledge about properties of matter, energy, and light, and they apply basic knowledge about forces and motion. They show basic understanding of the Earth's surface. Students can provide partial descriptions of observations, and they can relate observations and data to scientific facts.
Low International Benchmark	
400	*Students show knowledge of some science facts.* They demonstrate basic knowledge of plants, animals, and the environment. They show knowledge about some properties of matter in everyday situations, and they know that turbines provide electricity to some regions. They show some knowledge about Earth's characteristics, its changes over time, and its climate.

Exhibit 2.1.5: Description of the TIMSS 2023 Low International Benchmark (400) of Science Achievement

Low International Benchmark

400

Summary

Students show knowledge of some science facts. They demonstrate basic knowledge of plants, animals, and the environment. They show knowledge about some properties of matter in everyday situations, and they know that turbines provide electricity to some regions. They show some knowledge about Earth's characteristics, its changes over time, and its climate.

Students show partial knowledge about the needs of living things to live and grow and about the life cycle stages of a common plant. They can classify common animals into major groups and match them to their habitats. They can classify human activities as harmful or helpful to the environment.

Students show limited knowledge of physics and chemistry in everyday contexts. They can recognize everyday objects that can rust, conduct heat, or are attracted to a magnet, and understand one property of water. Students demonstrate an understanding that turbines provide electricity to some regions.

Students know where salt water is found, that the Earth's climate is hot and dry near the equator, and how increasing global temperature affects deserts and ice caps. Students can recognize that wind can change the location of sand dunes.

Exhibit 2.1.5a: TIMSS 2023 Low International Benchmark (400) of Science Achievement – Example Item 1

Content Domain: Physical Science

Cognitive Domain: Applying

Description: Identifies the most likely material making up a spoon that gets hot sitting in a pot of boiling soup

Jenny stirs a pot of boiling soup and leaves her spoon in the pot.

Later, the spoon is too hot to pick up.

What material is the spoon most likely made from?

A wood

B rubber

C plastic

D metal

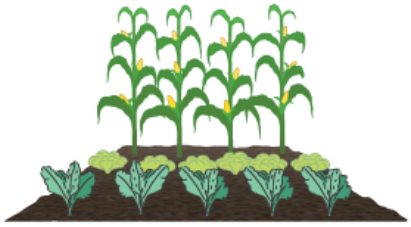
Exhibit 2.1.5b: TIMSS 2023 Low International Benchmark (400) of Science Achievement – Example Item 2

Content Domain: Earth Science

Cognitive Domain: Knowing

Description: Identifies natural resources used to grow plants

Harriet has a small vegetable garden.



Which natural resources does Harriet use to grow plants?

A water and soil

B water and wind

C soil and oil

D oil and wind

Exhibit 2.1.6: Description of the TIMSS 2023 Intermediate International Benchmark (475) of Science Achievement

Intermediate International Benchmark

475

Summary

Students show and apply knowledge of some scientific concepts. Students show and apply some knowledge about plants and animals, and they have basic knowledge of human health. They show knowledge about properties of matter, energy, and light, and they apply basic knowledge about forces and motion. They show basic understanding of the Earth's surface. Students can provide partial descriptions of observations, and they can relate observations and data to scientific facts.

Students can apply knowledge about some physical features and behaviors of living things, as well as their needs to live, grow, and survive. They can identify animals as predators or prey and show knowledge of part of the life cycle of a common animal. They can describe why plastic objects are dangerous for sea animals. Students have some basic knowledge about the role of one type of food in a balanced diet and about germs and avoiding illness.

Students can recognize materials in the three states of matter and solid materials that can conduct heat, conduct electricity, and are attracted to a magnet. They can describe one way to increase how quickly a common solid dissolves in water. They demonstrate knowledge of simple electrical circuits, energy sources, and transformation of energy in a common device. Students can reason about the formation of shadows. They can apply basic knowledge of forces and motion in everyday contexts, and they know that gravity pulls things down.

Students can recognize that most of the Earth's surface is covered by salt water.

Students can partially describe observations and relate observations and data to basic scientific facts.

Exhibit 2.1.6a: TIMSS 2023 Intermediate International Benchmark (475) of Science Achievement – Example Item 1

Content Domain: Life Science

Cognitive Domain: Applying

Description: Explains why a plant kept by a window is healthier than a plant kept in a closed closet

John investigated the effect of different amounts of light on two identical plants.

He put the plants in identical pots with the same kind of soil and the same amount of water.

John put Plant A near the window and put Plant B inside a closet with the door closed.

After two weeks, the plants looked like this:

Why is Plant B that was kept in the closet less healthy than Plant A that was kept by the window?

A is healthy because it had light

The answer shown illustrates one type of response that would receive full credit.
Other types of correct responses are possible as defined by the item's unique scoring guide.

Exhibit 2.1.6b: TIMSS 2023 Intermediate International Benchmark (475) of Science Achievement – Example Item 2

Content Domain: Physical Science

Cognitive Domain: Knowing

Description: Identifies which of six objects can be picked up using a magnet

Joseph has several piles of objects to pick up. Which objects can he pick up using a magnet?

Click **all** the sets of objects that Joseph could pick up using a magnet.

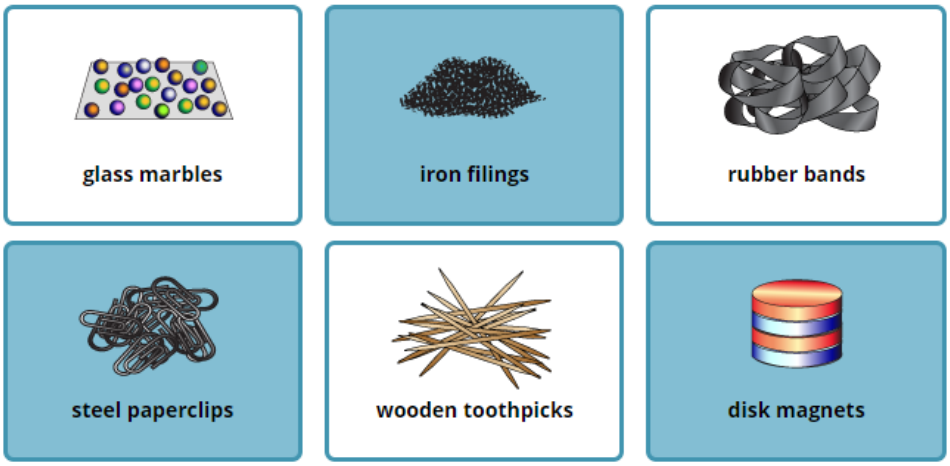


Exhibit 2.1.7: Description of the TIMSS 2023 High International Benchmark (550) of Science Achievement

High International Benchmark

550

Summary

Students show and apply knowledge of life, physical, and earth science, and they engage in some scientific inquiry practices. They can distinguish between living and nonliving things, they show knowledge about plant and animal reproduction and survival, and they can apply knowledge about some of the characteristics of plants and animals and their life cycles. Students can apply knowledge about the spread of germs. They can apply knowledge about states and properties of matter, magnets, sound, and heat and can reason using knowledge of dissolving rates in an everyday context. They show and can apply some knowledge of forces and motion. Students know various facts about the Earth's physical characteristics, and they apply their knowledge about Earth's different climates and changes over time. They can apply knowledge of the Earth-Sun system, and they show basic knowledge of the Moon's phases. Students describe observations and interpret models and graphical representations.

Students can distinguish between living and nonliving things, and they identify the distinguishing characteristics of major animal groups. They tend to know the function of major structures in living things and reason about some of their characteristics. Students can apply knowledge about the complete life cycles of common plants and animals. They can complete food chains and recognize that plants produce their own food. They can recognize that two adult animals of the opposite sex can reproduce, and that plant offspring resemble their parent plant. Students can relate animals' physical features and behaviors to the success of their survival in a given environment. Students apply knowledge about how germs spread to a given situation.

Students can apply basic knowledge about changes in states of matter, magnets, sound production, and heat conduction. They can reason with the knowledge that size affects how quickly a common solid dissolves in water and about concentration in an everyday context. They can recognize how a simple machine makes motion easier. Students can identify air resistance and friction and apply knowledge about the direction of forces in various contexts. They can identify forms of energy in a simple electrical circuit.

Students show knowledge of the ratio of land area to water area covering Earth's surface and they can apply their knowledge about temperature and rainfall in tropical and desert climates. They can make deductions about changes over time in Earth's surface and in animal remains from observations. Students show basic knowledge about the phases of the Moon and Earth's position in the solar system, and they can apply knowledge of the Earth-Sun system to recognize daytime and the seasons.

Students can describe a contrast from observations and interpret models and quantitative information in different graphical representations.

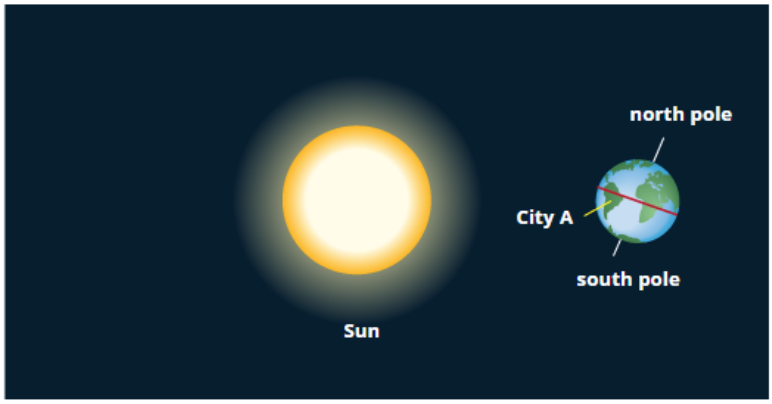
Exhibit 2.1.7a: TIMSS 2023 High International Benchmark (550) of Science Achievement – Example Item 1

Content Domain: Earth Science

Cognitive Domain: Applying

Description: Interprets a diagram of the Sun and the Earth to identify the season in a labeled city

The diagram shows the Earth orbiting the Sun.



What season is it in City A in this diagram?

A winter

B spring

C summer

D autumn

Exhibit 2.1.7b: TIMSS 2023 High International Benchmark (550) of Science Achievement – Example Item 2

Content Domain: Life Science

Cognitive Domain: Knowing

Description: Describes how germs can still spread if a person covers their mouth with their hands when they cough

George has a cold. He coughs into his hands to help stop spreading germs to his sister.

How could germs from George's cough still spread to his sister?

If George touches his sister, he will get his germs on her

The answer shown illustrates one type of response that would receive full credit.
Other types of correct responses are possible as defined by the item's unique scoring guide.

Exhibit 2.1.8: Description of the TIMSS 2023 Advanced International Benchmark (625) of Science Achievement

Advanced International Benchmark

625

Summary

Students can show, apply, and communicate their knowledge of life, physical, and earth sciences, and engage in multiple scientific inquiry practices. Students show knowledge of the characteristics of living things, and they can construct and reason with representations of the relationships among organisms in ecosystems. They demonstrate knowledge of inheritance, killing germs, and environmental pollution. They show knowledge of properties of matter and of changes in states of matter, and they reason about dissolving rates in a laboratory setting. Students can communicate their understanding of Earth's physical characteristics and processes and of how humans use and impact the Earth's natural resources. They show knowledge of the motion and relative position of the Earth, Moon, and Sun. Students can design fair tests, predict outcomes, and evaluate possible conclusions.

Students can recognize that both plants and animals require energy to grow. They can construct a food chain, interpret food webs, and reason about competition and population changes in ecosystems. They can identify traits that are inherited and those that are not inherited, and they can identify the effect of pollution on crops. Students tend to know that boiling water kills germs.

Students show knowledge of the properties of a liquid and recognize that no new materials are formed during a change of state. They can reason about concentration in a laboratory setting and they describe two ways to increase how quickly a common solid dissolves in water.

Students can describe how humans use river water as a natural resource for farming and distinguish renewable from nonrenewable energy sources. They can recognize that wind and water change the shape of rocks over time and that water in a puddle evaporates. They show knowledge about the relative position and motion of the Sun, Moon, and Earth, and they state the motion that results in day and night.

Students can predict the outcome of an experiment, can design fair tests in different science content domains, and can evaluate possible conclusions from an investigation.

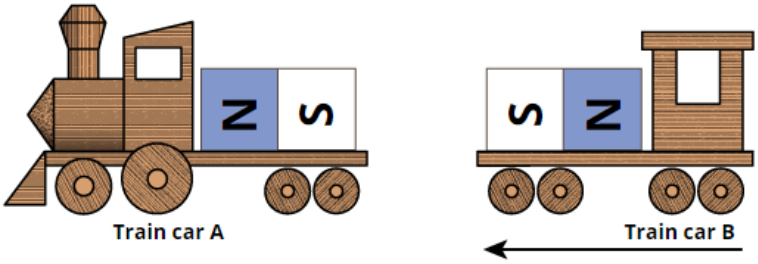
Exhibit 2.1.8a: TIMSS 2023 Advanced International Benchmark (625) of Science Achievement – Example Item 1

Content Domain: Physical Science

Cognitive Domain: Applying

Description: Predicts how a train car with a magnet attached will move when another train car with a magnet attached is brought towards it

The picture shows two toy train cars carrying magnets.



Ahmad moves Train car B toward Train car A.

What will happen to Train car A?

(Click one box.)

- [x] Train car A will move away from Train car B.
- [ ] Train car A will move toward Train car B.

Explain your answer.

Like poles repel

The answer shown illustrates one type of response that would receive full credit.
Other types of correct responses are possible as defined by the item's unique scoring guide.

Exhibit 2.1.8b: TIMSS 2023 Advanced International Benchmark (625) of Science Achievement – Example Item 2

Content Domain: Physical Science

Cognitive Domain: Applying

Description: Identifies a statement describing the change that occurs when water boils

Water is heated in a metal pot and begins to boil.

Carla says that new materials are being created because the water is bubbling.

Is Carla correct?

A. Yes, the hot metal in the pot is releasing a gas.

B. Yes, the hot metal and hot water mix and release a gas.

C. No, the hot water is turning into a gas.

D. No, the air near the pot is mixing into the water.