STUDENT PERFORMANCE IN SCIENCE

When science was the major subject in 2006, six proficiency levels were defined on the science scale. These same proficiency levels are used for reporting science results in PISA 2009. The process used to produce proficiency levels in science is similar to that used to produce proficiency levels in reading and mathematics, as described in Volume I, Chapter 2.

Figure I.3.19 presents a description of the scientific knowledge and skills which students possess at the various proficiency levels, with Level 6 being the highest level of proficiency.

■ Figure I.3.19 ■

Summary descriptions for the six levels of proficiency in science

Level	Lower score limit	What students can typically do
6	708	At Level 6, students can consistently identify, explain and apply scientific knowledge and *knowledge about science* in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on *personal, social* or *global* situations.
5	633	At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and *knowledge about science* to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis.
4	559	At Level 4, students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence.
3	484	At Level 3, students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge.
2	409	At Level 2, students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.
1	335	At Level 1, students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence.

Proficiency at Level 6 (scores higher than 708 points)

Students proficient at Level 6 on the science scale can consistently identify, explain and apply scientific knowledge and *knowledge about science* in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they use their scientific understanding to solve unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social, or global situations.

Across OECD countries, an average of 1.1% of students perform at Level 6. Between 2% and 5% of the students are at this level in New Zealand (3.6%), Finland (3.3%), Australia (3.1%) and Japan (2.6%) as well as in the partner countries and economies Singapore (4.6%), Shanghai-China (3.9%) and Hong Kong-China (2.0%). In Mexico, Chile and Turkey, 0% of students reach this level, and the situation is similar in half of the partner countries, namely Indonesia, Azerbaijan, Kyrgyzstan, Montenegro, Panama, Albania, Colombia, Tunisia, Jordan, Romania, Brazil, Kazakhstan, Peru, Serbia, Thailand and Argentina.

STUDENT PERFORMANCE IN MATHEMATICS

The six proficiency levels used in mathematics in the PISA 2009 assessment are the same as those established for mathematics in 2003 when it was the major area of assessment. The process used to produce proficiency levels in mathematics is similar to that used to produce proficiency levels in reading, as described in Volume I, Chapter 2.

■ Figure I.3.8 ■

Summary descriptions for the six levels of proficiency in mathematics

Level	Lower score limit	What students can typically do
6	669	At Level 6 students can conceptualise, generalise and utilise information based on their investigations and modelling of complex problem situations. They can link different information sources and representations and flexibly translate between them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situations.
5	607	At Level 5 students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriately linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning.
4	545	At Level 4 students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. Students at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	482	At Level 3 students can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications reporting their interpretations, results and reasoning.
2	420	At Level 2 students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and literal interpretations of the results.
1	358	At Level 1 students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.

Proficiency at Level 6 (scores higher than 669 points)

Students proficient at Level 6 on the mathematics scale can conceptualise, generalise, and utilise information based on their investigations and modelling of complex problem situations. They can link different information sources and representations and flexibly translate them. They are capable of advanced mathematical thinking and reasoning. These students can apply insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for addressing novel situations. Students at this level can formulate and accurately communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the given situations.

Across OECD countries, an average of 3.1% of students perform at Level 6 in mathematics. In Korea and Switzerland, around 8% of students are at this level, and more than 5% of students in Japan, Belgium and New Zealand perform at this level. Among the partner countries and economies, in Shanghai-China, more than one-quarter of students perform at Level 6, while in Singapore, Chinese Taipei and Hong Kong-China the proportion is 15.6%, 11.3% and 10.8%, respectively. In contrast, less than 1% of students in Mexico, Chile, Greece and Ireland reach Level 6, and in the partner countries Kyrgyzstan, Indonesia, Colombia, Jordan, Albania, Tunisia and Panama, the percentage is close to zero.

■ Figure I.1.2 ■

Summary of the assessment areas in PISA 2009

	READING	MATHEMATICS	SCIENCE
Definition and its distinctive features	The capacity of an individual to understand, use, reflect on and engage with written texts in order to achieve his/her goals, to develop his/her knowledge and potential, and to participate in society. In addition to decoding and literal comprehension, *reading literacy* also involves interpretation and reflection, and the ability to use reading to fulfil one's goals in life. PISA focuses on reading to learn rather than learning to read. Therefore, students are not assessed on the most basic reading skills.	The capacity of an individual to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and in making well-founded judgments and decisions that constructive, engaged and reflective citizens would require. *Mathematical literacy* is related to wider, functional use of mathematics; engagement includes the ability to recognise and formulate mathematical problems in various situations.	The extent to which an individual: ■ Possesses scientific knowledge and uses that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues. ■ Understands the characteristic features of science as a form of human knowledge and enquiry. ■ Shows awareness of how science and technology shape our material, intellectual and cultural environments. ■ Engages in science-related issues and with the ideas of science, as a reflective citizen. *Scientific literacy* requires an understanding of scientific concepts, as well as the ability to apply a scientific perspective and to think scientifically about evidence.
Knowledge domain	The form of reading materials: ■ *Continuous texts:* including different kinds of prose such as narration, exposition, argumentation ■ *Non-continuous texts:* including graphs, forms and lists ■ *Mixed texts:* including both continuous and non-continuous formats ■ *Multiple texts:* including independent texts (same or different formats) juxtaposed for specific purposes	Clusters of relevant mathematical areas and concepts: ■ *Quantity* ■ *Space and shape* ■ *Change and relationships* ■ *Uncertainty*	*Knowledge of science,* such as: ■ "Physical systems" ■ "Living systems" ■ "Earth and space systems" ■ "Technology systems" *Knowledge about science,* such as: ■ "Scientific enquiry" ■ "Scientific explanations"
Competencies involved	Type of reading tasks or processes: ■ *Access and retrieve* ■ *Integrate and interpret* ■ *Reflect and evaluate* ■ Complex – *e.g.* finding, evaluating and integrating information from multiple electronic texts	Competency clusters define skills needed for mathematics: ■ *Reproduction* (simple mathematical operations) ■ *Connections* (bringing together ideas to solve straightforward problems) ■ *Reflection* (wider mathematical thinking)	Type of scientific tasks or processes: ■ *Identifying scientific issues* ■ *Explaining scientific phenomena* ■ *Using scientific evidence*
Context and situation	The use for which the text is constructed: ■ *Personal* ■ *Educational* ■ *Occupational* ■ *Public*	The area of application of mathematics, focusing on uses in relation to personal, social and global settings, such as: ■ *Personal* ■ *Educational and occupational* ■ *Public* ■ *Scientific*	The area of application of science, focusing on uses in relation to personal, social and global settings, such as: ■ "Health" ■ "Natural resources" ■ "Environment" ■ "Hazard" ■ "Frontiers of science and technology"