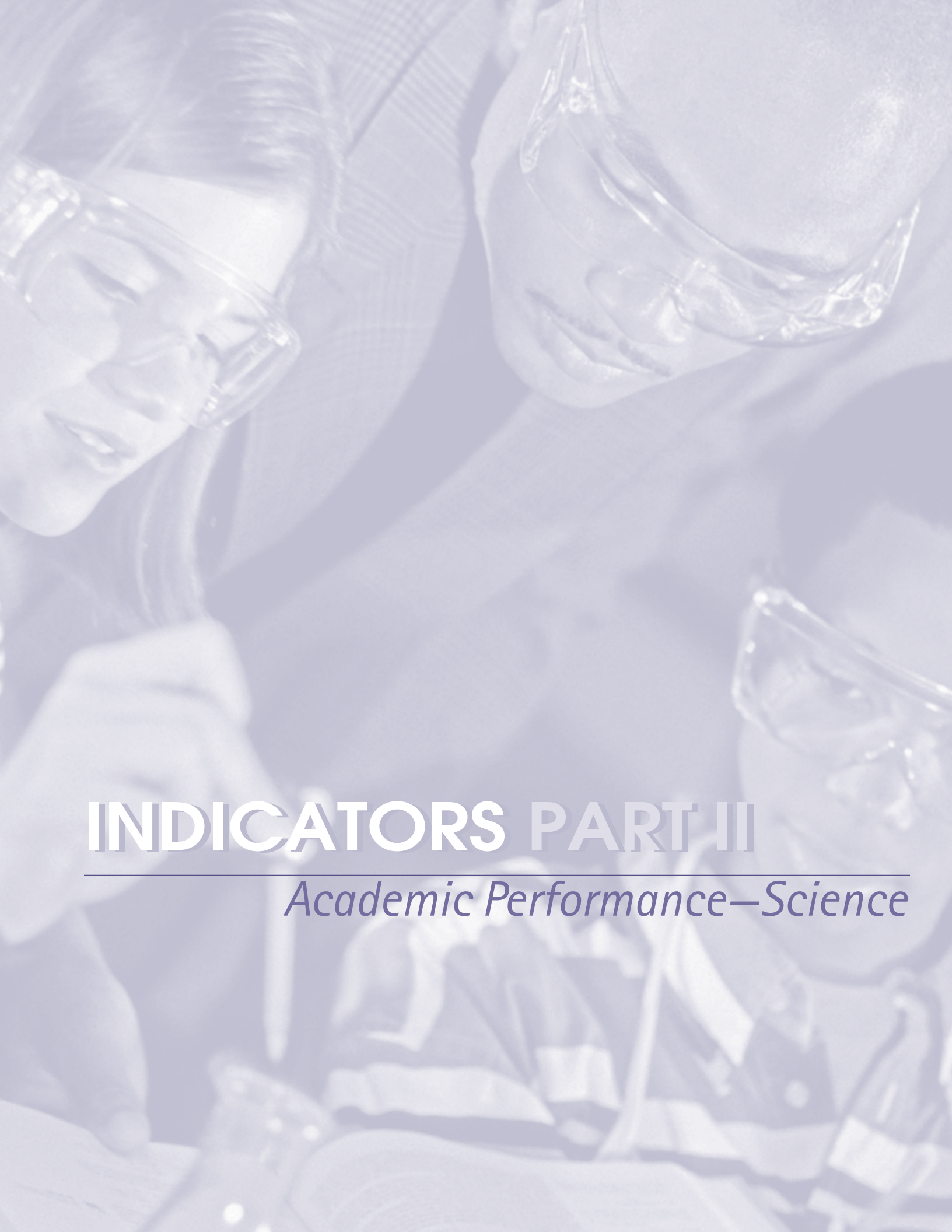


INDICATORS PART II

Academic Performance—Science

PERFORMANCE OF FOURTH- AND EIGHTH-GRADERS IN SCIENCE

G-8 Countries Included: England, Germany,[12] Italy, Japan, Russian Federation, Scotland, United States

At eighth grade, students in Japan scored higher overall in science and generally had larger percentages of students reaching each of the four international benchmarks compared to their G-8 peers.

This indicator presents the percentages of fourth- and eighth-graders reaching the four international benchmarks in science (low, intermediate, high, and advanced) in the Trends in International Mathematics and Science Study (TIMSS) in 2007.

On the TIMSS 2007 fourth-grade science assessment, average scale scores ranged from 500 in Scotland to 548 in Japan (Gonzales et al. 2008). Fourth-graders in Japan scored higher, on average, than their peers in Scotland, Germany, Italy, and the United States, but not measurably different from their peers in England and the Russian Federation.

The percentages of fourth-graders who reached the highest benchmark in science, advanced, ranged from 4 percent in Scotland to 16 percent in the Russian Federation (figure 8). In the United States, 15 percent of fourth-graders reached the advanced benchmark, a higher percentage than in Germany and Scotland.

The percentages of fourth-graders at or above the high benchmark in science ranged from 26 percent in Scotland to 51 percent in Japan. In the United States, 47 percent of fourth-graders reached the high benchmark, a larger percentage than in Germany and Scotland but smaller than in Japan.

Eighty-six percent of fourth-graders in Japan were at or above the intermediate benchmark in science. This was higher than in all other participating G-8 countries, where the percentages ranged from 65 percent in Scotland to 82 percent in the Russian Federation. In the United States, 78 percent of fourth-graders met the intermediate benchmark, a higher percentage than only Scotland.

At eighth grade, students in Japan scored higher overall in science and generally had larger percentages of students reaching each of the four international benchmarks compared to their G-8 peers. A greater percentage of eighth-graders in England and Japan than in all other participating G-8 countries reached the advanced benchmark in science. Seventeen percent of eighth-graders in England and Japan reached the advanced benchmark, compared to a range from 4 percent in Italy to 11 percent in the Russian Federation. In the United States, 10 percent of students reached the advanced benchmark, a higher percentage than in Scotland and Italy.

In Japan, 55 percent of eighth-graders were at or above the high benchmark in science. This was higher than in all other participating G-8 countries, with percentages ranging from 24 percent in Italy to 48 percent in England. In the United States, 38 percent of eighth-graders met the high benchmark, a larger percentage than in Scotland and Italy but smaller than in England and Japan.

Definitions and Methodology

In TIMSS 2007 at fourth grade, countries were required to sample students in the grade that corresponded to the end of 4 years of formal schooling (the end of primary school), providing that the mean age at the time of testing was at least 9.5 years. At eighth grade, countries were required to sample students in the grade that corresponded to the end of 8 years of formal schooling (the end of lower secondary education), providing that the mean age at the time of testing was at least 13.5 years.

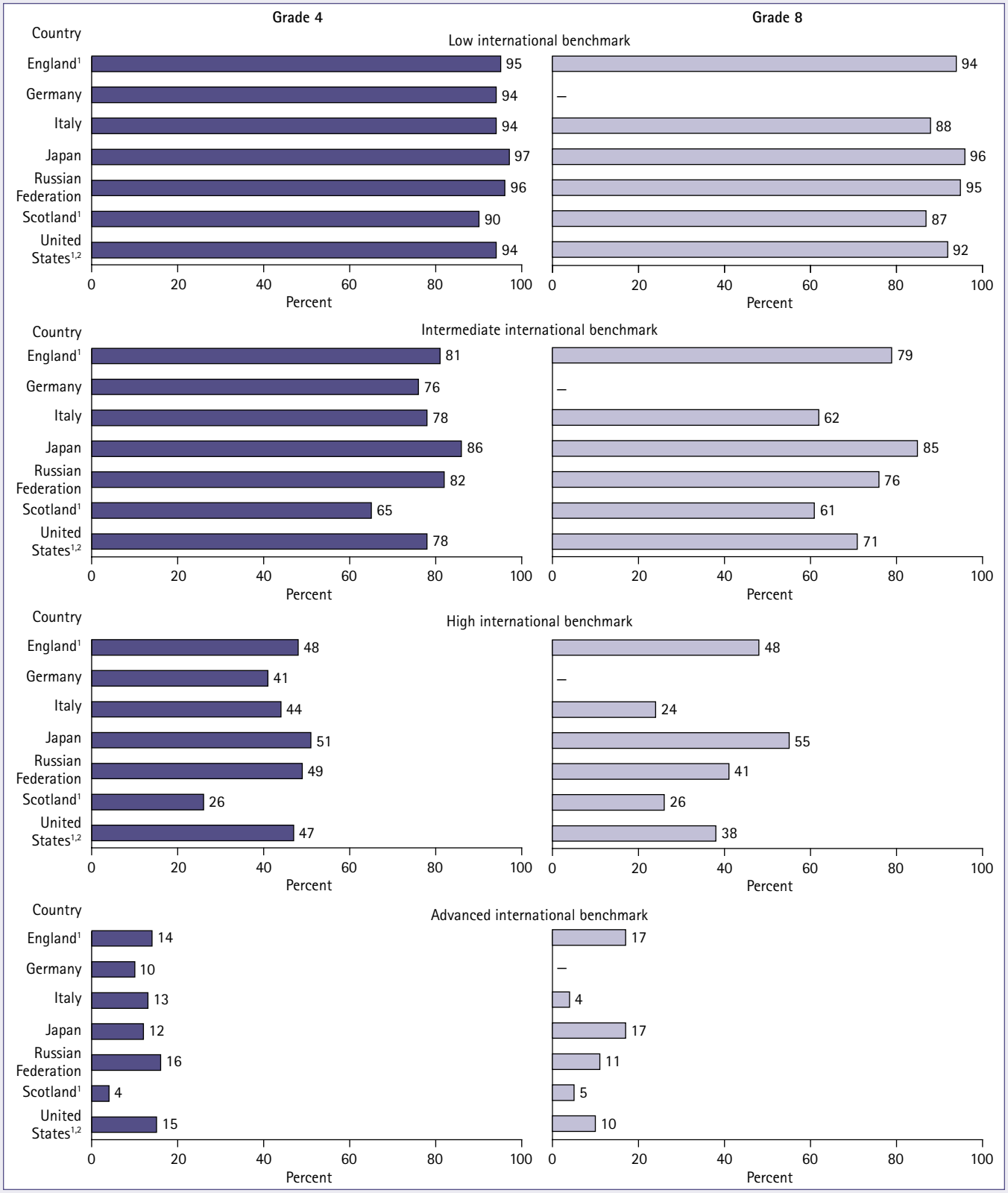
TIMSS scores are reported on a scale from 0 to 1,000 with the scale average fixed at 500 and the standard deviation fixed at 100. Since the TIMSS science achievement scales were designed to reliably measure student achievement over time, the metric of the scales was established originally with the 1995 assessment. In order to describe concretely the knowledge and skills attained along the performance scales, TIMSS established four international achievement benchmarks in mathematics and science (low, intermediate, high, and advanced). Four points on the scales were identified for use as international benchmarks: 400 for the low benchmark, 475 for the intermediate benchmark, 550 for the high benchmark, and 625 for the advanced benchmark. These were selected to represent the range of performance shown by students internationally.

At the fourth-grade level in science, students at the low benchmark have some elementary knowledge of the Earth, life, and physical sciences, such as simple facts about magnets, electricity, and boiling. At the intermediate benchmark, students can apply basic knowledge and understanding to practical situations in the sciences, such as knowing some basic information about Earth's features and processes, human biology, and health. At the high benchmark, students can apply knowledge and understanding to explain everyday phenomena, such as demonstrating some knowledge of life processes, physical states, and chemical changes. Students at the advanced benchmark can apply knowledge and understanding in beginning scientific inquiry, such as classifying organisms according to major physical and behavioral features.

At the eighth-grade level in science, students at the low benchmark recognize some basic facts from the life and physical sciences, including some knowledge about the human body and familiarity with some everyday physical phenomena. Students at the intermediate benchmark can recognize and communicate basic scientific knowledge across a range of topics, including the solar system, human health, and energy. Students at the high benchmark demonstrate conceptual understanding of some science cycles, systems, and principles. For example, they show some understanding of the structure and function of organisms, physical and chemical changes, and major environmental issues. At the advanced benchmark, students demonstrate a grasp of some complex and abstract science concepts. For example, they can apply understanding of the complexity of living organisms and how they relate to their environment.

[12] Data for Germany are only available at the fourth grade, as Germany did not participate in TIMSS 2007 at the eighth grade.

Figure 8. Percentage of fourth- and eighth-grade students reaching TIMSS international benchmarks in science, by country: 2007



– Not available. Data for Germany are only available at the fourth grade, as Germany did not participate in TIMSS 2007 at the eighth grade.

[1] Met international guidelines for participation rates only after substitute schools were included. That is, to avoid sample size losses resulting from sampled schools not participating, a mechanism was instituted to identify, a priori, substitute schools that have similar characteristics to the sampled schools that they may replace. For England, this applies to eighth-grade only.

[2] National Defined Population covers 90 percent to 95 percent of National Target Population.

SOURCE: Martin, M.O., Mullis, I.V.S., and Foy, P. (2008). *TIMSS 2007 International Science Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*, exhibit 2.2. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

DIFFERENCES IN FOURTH- AND EIGHTH-GRADE SCIENCE ACHIEVEMENT BY SEX

G-8 Countries Included: England, Germany,[13] Italy, Japan, Russian Federation, Scotland, United States

In Germany and Italy, fourth-grade males scored higher, on average, than fourth-grade females in science; in the United States and Italy, eighth-grade males outperformed females.

This indicator addresses differences by sex in science achievement among fourth- and eighth-grade students in the G-8 countries that participated in the Trends in International Mathematics and Science Study (TIMSS) in 2007.

On the TIMSS 2007 science assessment, fourth-grade males in Germany and Italy outperformed females. In Germany, the difference in performance was 15 points, with males scoring an average of 535 compared with 520 among females (figures 9a and 9b). In Italy, the difference related to sex was 13 points (541 for males vs. 529 for females). In all other G-8 countries, including the United States, no measurable differences were detected between the average scale scores of fourth-grade males and females.

On the TIMSS 2007 eighth-grade science assessment, males in the United States and Italy outperformed females. In the United States, the difference in performance was 12 points, with males scoring an average of 526 compared with 514 among females. In Italy, the difference related to sex was 8 points (499 for males vs. 491 for females). In all other participating G-8 countries, no measurable differences were detected between the average scale scores of eighth-grade males and females.

Definitions and Methodology

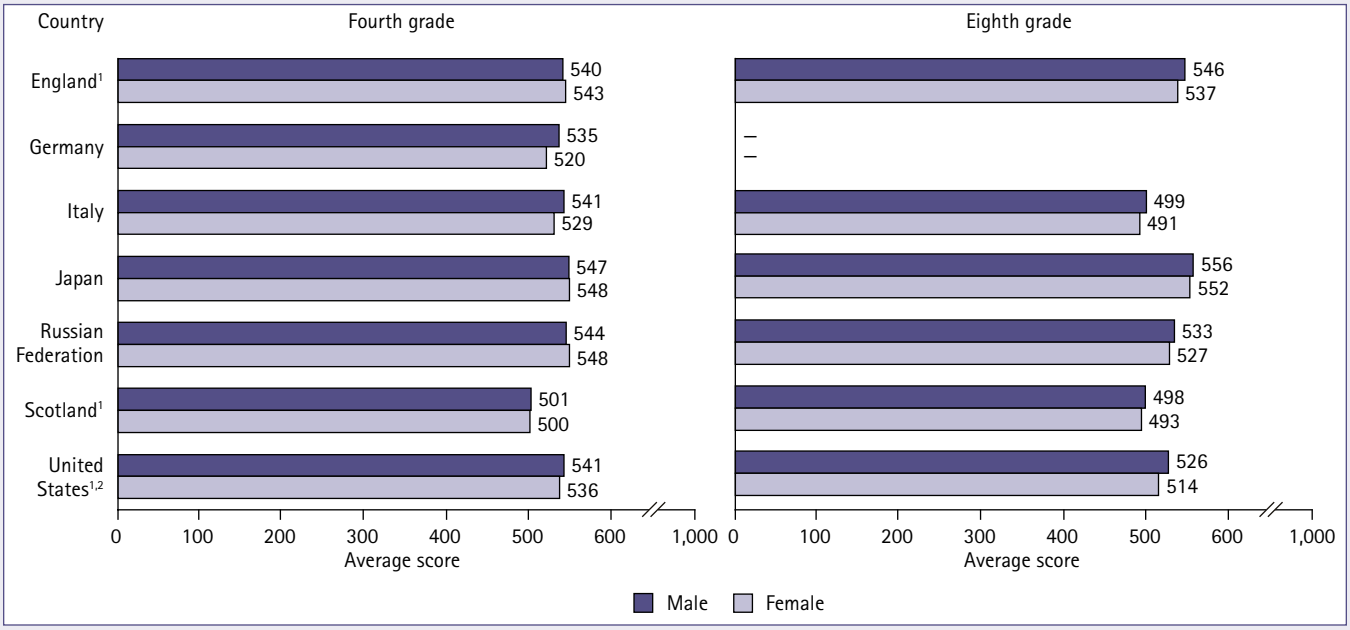
In TIMSS 2007 at fourth grade, countries were required to sample students in the grade that corresponded to the end of 4 years of formal schooling (the end of primary school), providing that the mean age at the time of testing was at least 9.5 years. At eighth grade, countries were required to sample students in the grade that corresponded to the end of 8 years of formal schooling (the end of lower secondary education), providing that the mean age at the time of testing was at least 13.5 years.

TIMSS scores are reported on a scale from 0 to 1,000 with the scale average fixed at 500 and the standard deviation fixed at 100. Since the TIMSS science achievement scales were designed to reliably measure student achievement over time, the metric of the scales was established originally with the 1995 assessment.

Male-female score-point differences in science achievement presented in the text and in figure 9b were computed from unrounded numbers; therefore, they may differ from computations made using the rounded whole numbers that appear in figure 9a.

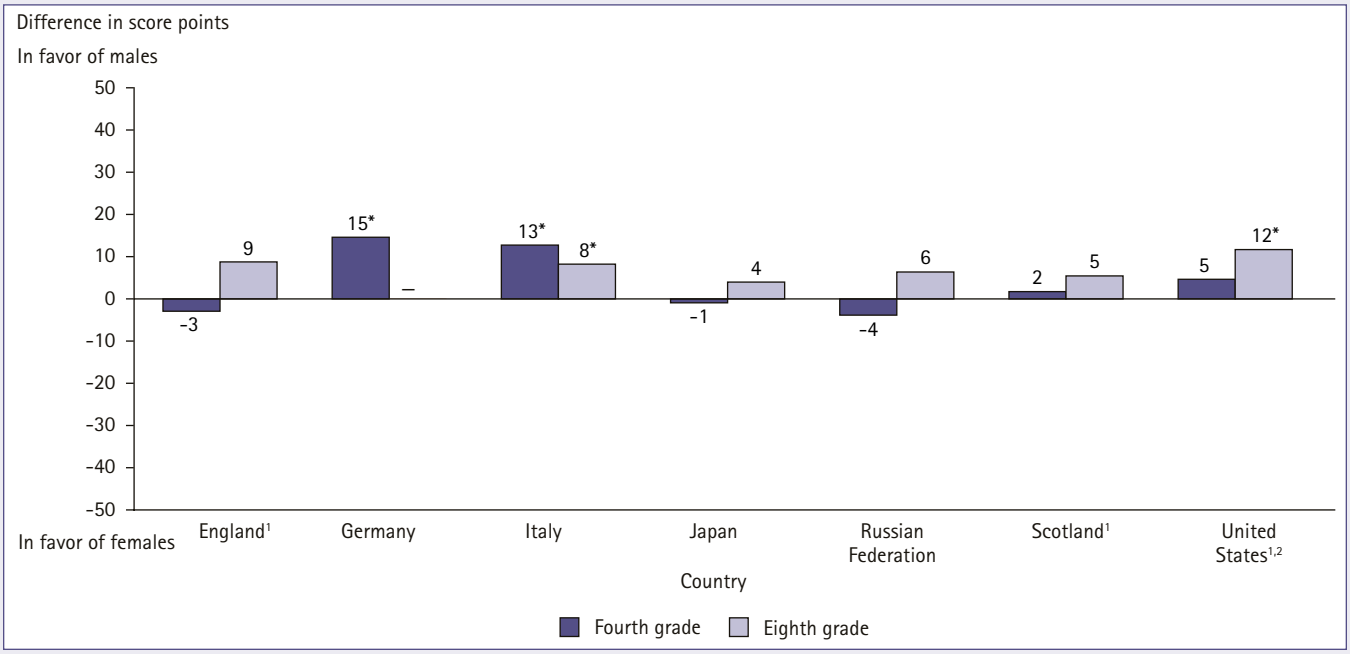
[13] Data for Germany are only available at the fourth grade, as Germany did not participate in TIMSS 2007 at the eighth grade.

Figure 9a. Average scale scores of fourth- and eighth-grade students in science, by sex and country: 2007



– Not available. Data for Germany are only available at the fourth grade, as Germany did not participate in TIMSS 2007 at the eighth grade.
[1] Met international guidelines for participation rates only after substitute schools were included. That is, to avoid sample size losses resulting from sampled schools not participating, a mechanism was instituted to identify, a priori, substitute schools that have similar characteristics to the sampled schools that they may replace. For England, this applies to eighth-grade only.
[2] National Defined Population covers 90 percent to 95 percent of National Target Population.
SOURCE: Martin, M.O., Mullis, I.V.S., and Foy, P. (2008). *TIMSS 2007 International Science Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*, exhibit 1.5. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Figure 9b. Difference in average scale scores between fourth- and eighth-grade males and females in science, by country: 2007



– Not available. Data for Germany are only available at the fourth grade, as Germany did not participate in TIMSS 2007 at the eighth grade.
*$p < .05$ (difference in score points is statistically significant).
[1] Met international guidelines for participation rates only after substitute schools were included. That is, to avoid sample size losses resulting from sampled schools not participating, a mechanism was instituted to identify, a priori, substitute schools that have similar characteristics to the sampled schools that they may replace. For England, this applies to eighth grade only.
[2] National Defined Population covers 90 percent to 95 percent of National Target Population.
NOTE: Differences shown are computed by subtracting the average unrounded score for females from the average unrounded score for males. Thus, positive values indicate higher average scores for males.
SOURCE: Martin, M.O., Mullis, I.V.S., and Foy, P. (2008). *TIMSS 2007 International Science Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*, exhibit 1.5. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

SCIENCE PERFORMANCE OF 15-YEAR-OLDS ACROSS CONTENT AREAS

G-8 Countries Included: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States

In the United States, 15-year-old students in PISA 2006 scored lower, on average, than their peers in Canada, Germany, Japan, and the United Kingdom on each of the three science literacy subscales: identifying scientific issues, explaining phenomena scientifically, and using scientific evidence. U.S. students outperformed their peers in Italy and the Russian Federation on identifying scientific issues and in Italy on using scientific evidence.

The Program for International Student Assessment (PISA) is a system of international assessments that measures 15-year-old students' performance in reading literacy, mathematics literacy, and science literacy every 3 years. In 2006, PISA included an in-depth assessment of science literacy, with less detailed assessments in mathematics and reading literacy.[14] This indicator examines student performance in the G-8 countries on the combined science literacy scale and on the three science literacy subscales: identifying scientific issues, explaining phenomena scientifically, and using scientific evidence.

Average scores of 15-year-old students on the combined science literacy scale ranged from 475 in Italy to 534 in Canada, with the United States at 489 (figure 10). The U.S. average score was lower than the average score of 500 for the participating Organization for Economic Cooperation and Development (OECD) countries (Baldi et al. 2007). Among the G-8 countries, the U.S. average score was lower than the average scores of the United Kingdom, Germany, Japan, and Canada; higher than the average score of Italy; and not measurably different from the average scores of the Russian Federation and France.

U.S. 15-year-olds scored lower, on average, than their peers in the United Kingdom, Germany, Japan, and Canada on the three science literacy subscales. The U.S. average score of 492 on the identifying scientific issues subscale was lower than the average scores of Germany (510), the United Kingdom (514), Japan (522), and Canada (532) (figure 10). However, students in the United States outperformed their peers in Italy (474) and the Russian Federation (463) on this subscale. Among the G-8 countries, students in Canada had the highest score on the identifying scientific issues subscale.

On the explaining phenomena scientifically subscale, 15-year-olds in Canada scored higher, on average, than their peers in all other G-8 countries except for Japan (there was no measurable difference between Canada and Japan on this subscale). U.S. students had an average score of 486 and were outperformed by students in the United Kingdom (517), Germany (519), Japan (527), and Canada (531). Unlike the identifying scientific issues subscale, U.S. students did not perform better, on average, than their peers in any other G-8 country on this subscale.

On the using scientific evidence subscale, students in Japan and Canada scored higher, on average, than their peers in all other G-8 countries. U.S. students had an average score of 489 and were outperformed, on average, by students in France (511), the United Kingdom (514), Germany (515), Canada (542), and Japan (544). However, students in the United States outperformed their peers in Italy (467) on this subscale.

Definitions and Methodology

In PISA, "15-year-olds" refers to students between 15 years and 3 months to 16 years and 2 months old at the time of the assessment and who have completed at least 6 years of formal schooling.

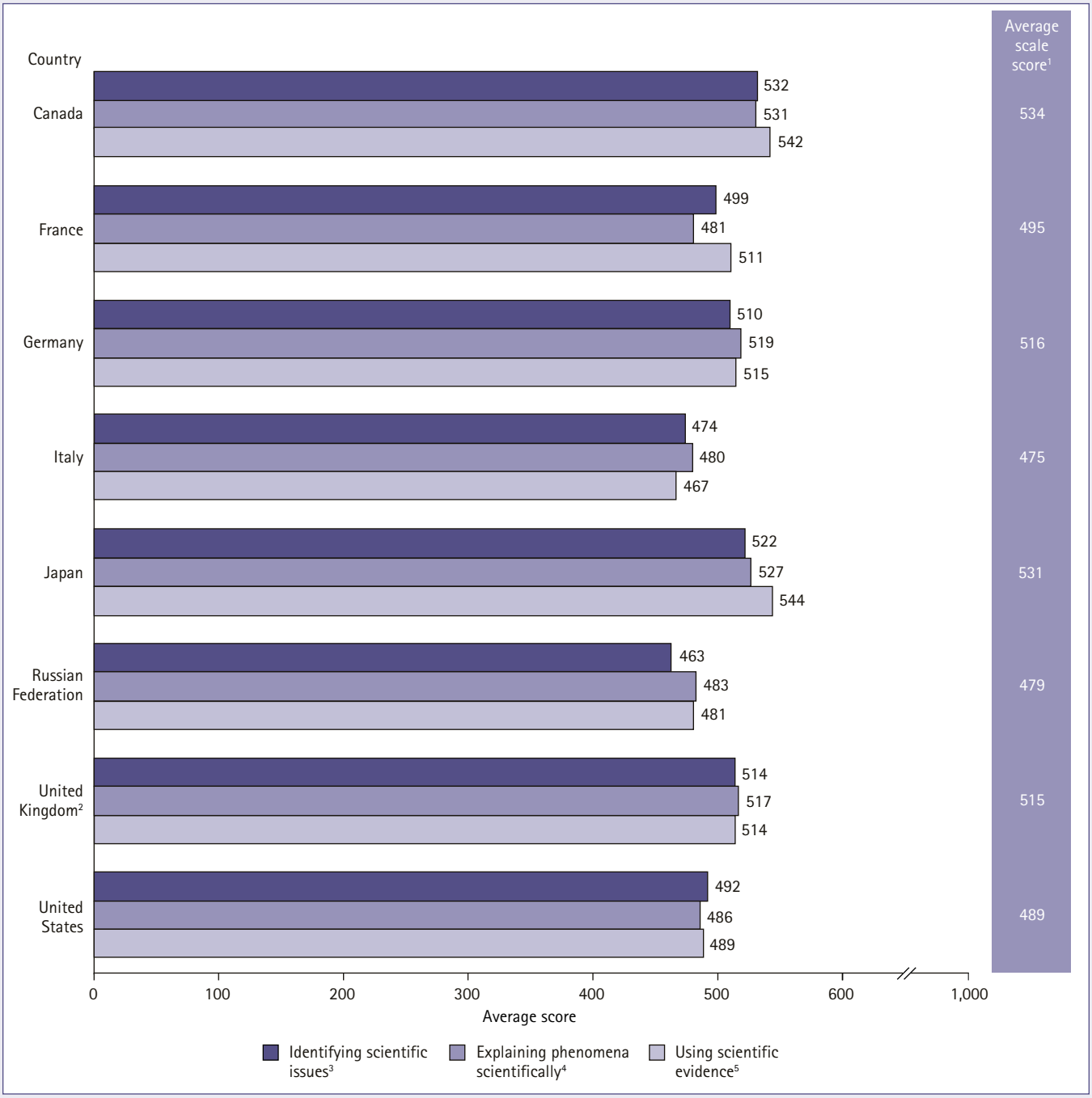
PISA defines scientific literacy as "an individual's scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues, understanding of the characteristic features of science as a form of human knowledge and inquiry, awareness of how science and technology shape our material, intellectual, and cultural environments, and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen" (OECD 2006, p. 12). In PISA 2006, students were assessed on their scientific literacy in relation to scientific knowledge or concepts, scientific processes, and situations or contexts, which were reflected in three subscales (identifying scientific issues, explaining phenomena scientifically, and using scientific evidence).

The identifying scientific issues subscale includes recognizing issues that are possible to investigate scientifically; identifying keywords to search for scientific information; and recognizing the key features of a scientific investigation. The explaining phenomena scientifically subscale includes applying knowledge of science in a given situation; describing or interpreting phenomena scientifically and predicting changes; and identifying appropriate descriptions, explanations, and predictions. The using scientific evidence subscale includes interpreting scientific evidence and making and communicating conclusions; identifying the assumptions, evidence, and reasoning behind conclusions; and reflecting on the societal implications of science and technological developments.

Scores on the PISA 2006 combined science literacy scale are reported on a scale from 0 to 1,000 with the OECD average fixed at 500 and the standard deviation fixed at 100.

[14] Reading scores were not reported for the United States because of an error in printing the test booklets.

Figure 10. Average subscale scores of 15-year-old students in science literacy, by country: 2006



[1] The average scale score in science literacy is made up of all the items in the three subscales. However, the average scale score and the three subscales are computed separately through Item Response Theory models. Therefore, the average scale score is not the average of the three subscale scores.
[2] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.
[3] The identifying scientific issues subscale includes recognizing issues that are possible to investigate scientifically; identifying keywords to search for scientific information; and recognizing the key features of a scientific investigation.
[4] The explaining phenomena scientifically subscale includes applying knowledge of science in a given situation; describing or interpreting phenomena scientifically and predicting changes; and identifying appropriate descriptions, explanations, and predictions.
[5] The using scientific evidence subscale includes interpreting scientific evidence and making and communicating conclusions; identifying the assumptions, evidence, and reasoning behind conclusions; and reflecting on the societal implications of science and technological developments.
SOURCE: Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006: Science Competencies for Tomorrow's World, Volume 2: Data,* tables 2.1c, 2.2c, 2.3c, and 2.4c. Paris: Author.

SCIENCE PROFICIENCY OF 15-YEAR-OLDS

G-8 Countries Included: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States

About one-quarter of 15-year-old students in the United States scored at or below the lowest proficiency level on the PISA 2006 combined science literacy scale, a larger percentage of students than in the United Kingdom, Germany, Japan, and Canada.

The Program for International Student Assessment (PISA) assessed the science literacy of 15-year-old students in 2006. This indicator presents the percentages of students reaching the established international proficiency levels in science literacy. These range from level 1 to level 6, with level 6 the highest. Students who failed to answer correctly more than half of the items associated with level 1 were categorized as having proficiency below level 1.

In Italy and the Russian Federation, 15-year-old students performed, on average, at proficiency level 2 on the PISA 2006 combined science literacy scale (see average scale scores as shown in indicator 10 and Definitions and Methodology of this indicator for cut point scores of proficiency levels). In all other G-8 countries, students scored, on average, at level 3 on the combined science literacy scale.

The United States had a lower percentage of students at each of the higher proficiency levels of 6, 5, and 4 than did the United Kingdom, Japan, and Canada, and a lower percentage of students at levels 5 and 4 than Germany. Italy and the Russian Federation had lower percentages of students scoring at levels 6, 5, and 4 than the United States. For example, the percentage of students who scored at level 5 was 12 percent in Japan and Canada, 11 percent in the United Kingdom, 10 percent in Germany, 8 percent in the United States, 7 percent in France, and 4 percent in Italy and the Russian Federation (figure 11).

The percentage of 15-year-olds who scored at level 1 or below ranged from 10 percent in Canada to 25 percent in Italy; these students failed to demonstrate the kind of science literacy skills that enable them to actively use science as outlined in the PISA definition (see Definitions and Methodology). Canada had a lower percentage of students who scored at level 1 or below than all other G-8 countries except Japan (Japan's percentage did not measurably differ from Canada's). Twenty-four percent of U.S. students scored at level 1 or below, which was higher than the percentages in four other G-8 countries (the United Kingdom, Germany, Japan, and Canada), and not measurably different from the percentages in France, the Russian Federation, and Italy.

Definitions and Methodology

In PISA, "15-year-olds" refers to students between 15 years and 3 months to 16 years and 2 months old at the time of the assessment and who have completed at least 6 years of formal schooling.

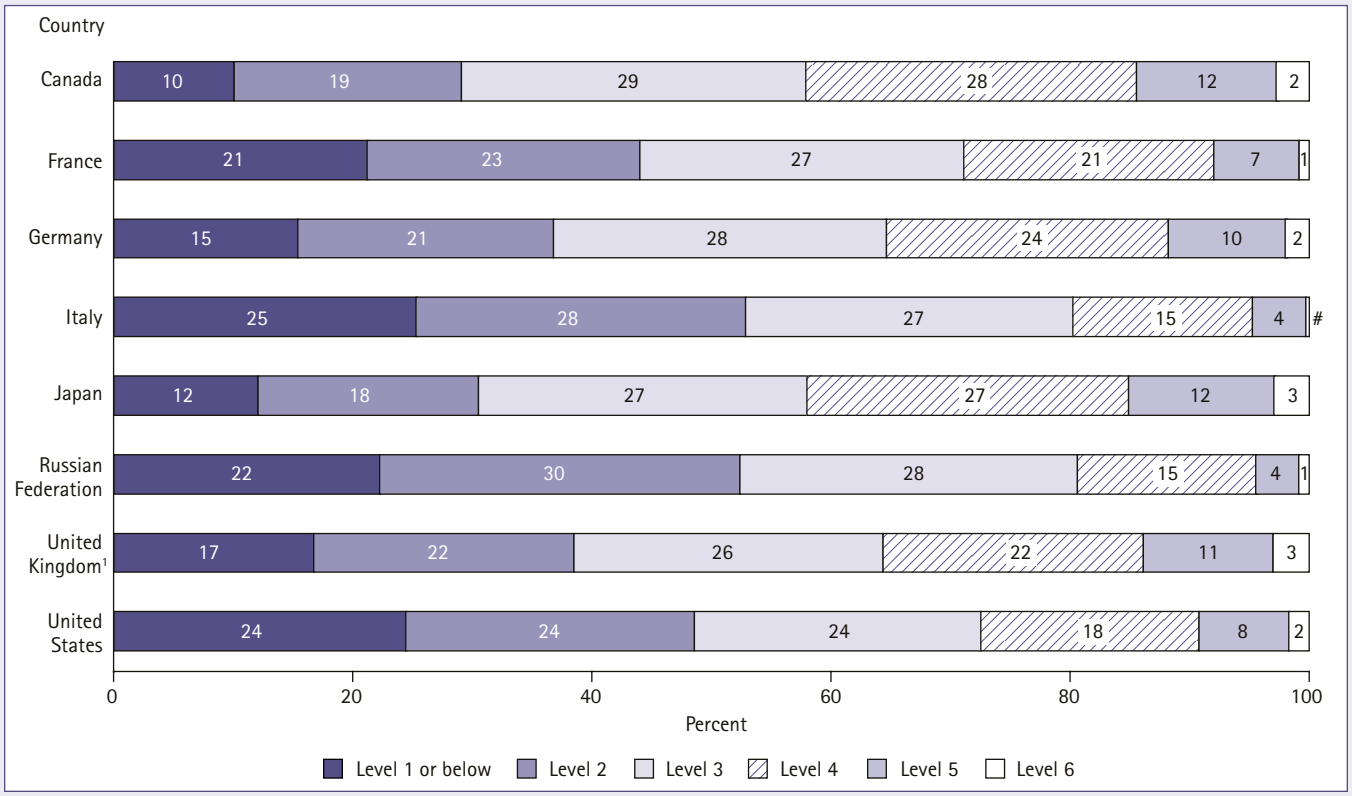
PISA defines science literacy as "an individual's scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues, understanding of the characteristic features of science as a form of human knowledge and inquiry, awareness of how science and technology shape our material, intellectual, and cultural environments, and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen" (OECD 2006, p. 12).

Scores on the PISA 2006 combined science literacy scale are reported on a scale from 0 to 1,000 with the OECD average fixed at 500 and the standard deviation fixed at 100.

Science proficiency was defined in terms of six levels (levels 1 through 6) based on student performance scores on the combined science literacy scale. Exact cut point scores are as follows: level 6 (a score greater than 707.93); level 5 (a score greater than 633.33 and less than or equal to 707.93); level 4 (a score greater than 558.73 and less than or equal to 633.33); level 3 (a score greater than 484.14 and less than or equal to 558.73); level 2 (a score greater than 409.54 and less than or equal to 484.14); and level 1 (a score greater than 334.94 and less than or equal to 409.54). Students who perform below level 1 (a score less than or equal to 334.94) "…are unable to demonstrate science competencies in situations required by the easiest PISA tasks… such a low level of science competency can be regarded as putting them at a serious disadvantage for full participation in society and the economy" (OECD 2007a, p. 42). In order to reach a particular proficiency level, a student must have been able to correctly answer a majority of items at that level. Students at each succeeding level are capable of solving science problems of increasing complexity.

Students proficient at level 1 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 that follow explicitly from given evidence. Students at level 2 have adequate scientific knowledge to provide possible explanations 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. At level 3, students can identify clearly described scientific issues in a range of contexts; they can directly apply simple models or inquiry strategies to explain phenomena, interpret and use scientific concepts, and can make decisions based on scientific knowledge. At level 4, students can work effectively with situations that may involve explicit phenomena requiring them to make inferences about the role of science; they can select, integrate, and link explanations from different disciplines of science to real-world situations; they can reflect on their actions and can communicate decisions using scientific evidence. Students at level 5 can identify the scientific components of many complex real-world situations and can apply scientific concepts to these situations and evaluate scientific evidence; they can use well-developed inquiry abilities, bring critical insights to situations, and construct explanations based on evidence and arguments based on their critical analysis. Students proficient at level 6 clearly and consistently demonstrate advanced scientific thinking and reasoning, demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar situations, and can develop real-world arguments based on scientific knowledge. For more information about how proficiency levels were set for PISA 2006, see the technical appendix in Baldi et al. (2007).

Figure 11. Percentage distribution of 15-year-old students on PISA 2006 proficiency levels in science literacy, by country: 2006



Rounds to zero.

[1] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.

NOTE: In the Program for International Student Assessment (PISA), science proficiency was defined in terms of six levels (levels 1 through 6) based on student performance scores on the combined science literacy scale. In this way, science literacy was assessed along a continuum, with level 1 or below indicative of the lowest performing students. Detail may not sum to totals because of rounding.

SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2006.

SCIENCE ACHIEVEMENT AND PARENT OCCUPATIONAL STATUS

G-8 Countries Included: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States

In 2006, U.S. students from families with low occupational status were outperformed by students from families with low occupational status in the United Kingdom, Germany, Canada, and Japan in science literacy.

The Program for International Student Assessment (PISA) measured the occupational status of the 15-year-old student's mother or father (whichever parent had the higher occupational status), with parental occupation reported by the student. Parental occupations were translated into index scores. A low index score (i.e., between 16 and 34 points) corresponds with a parental occupation requiring a minimal level of education (e.g., taxi driver, waiter/waitress), and a high index score (i.e., between 71 and 90 points) corresponds with a parental occupation requiring a high level of education (e.g., medical doctor, university professor). This indicator focuses on the relationship between parent occupational status and science achievement as measured in PISA 2006.

Results from PISA showed that U.S. students tended to come from homes with parents whose occupations required comparatively higher levels of education relative to their peers in other G-8 countries. In 2006, the United States and Canada had the highest mean occupational index scores of all the G-8 countries, which is similar to what was found in PISA in 2003.[15] In 2006, the range across the G-8 countries was from 46.4 in Italy to 53.5 in Canada, with the United States at 52.5 (OECD 2007b). Furthermore, when students were classified into national quarters on the occupational index, U.S. 15-year-olds in the bottom national quarter had a higher mean index score than their peers in Italy, France, Germany, and the Russian Federation (29.9 in the United States compared to a range from 27.2 in Italy to 29.5 in the Russian Federation). In Canada and Japan, students in the bottom national quarter had a higher mean index score (32.7 and 34.2, respectively) than their U.S. counterparts. These results showed that parent occupational status was generally higher for U.S. students compared to their G-8 peers. Among those students from families with low occupational status relative to other students in their country, U.S. students tended to have parents whose occupations required comparatively higher levels of education relative to their peers in other G-8 countries.

On the other hand, when looking at the science achievement of those students from families with low occupational status, U.S. students did not perform higher than their counterparts in any G-8 country. U.S. students in the bottom national quarter of the occupational index were outperformed by students in the bottom national quarter of the index in the United Kingdom, Germany, Canada, and Japan on the PISA 2006 combined science literacy scale (445 in the United States compared to a range from 472 in the United Kingdom to 506 in Japan) (figure 12a).

Nevertheless, within all G-8 countries, there was a relationship between parent occupational status and students' achievement scores. Specifically, students in the top national quarter of the occupational index scored higher on the combined science literacy scale than students in the bottom national quarter of the index. This difference ranged from 53 points in Japan to 111 points in France; in the United States, this difference was 97 points.

Another way to evaluate the relationship between parent occupational status and science achievement is to examine the specific change in score on the combined science literacy scale in response to a one-standard-deviation increase (i.e., 17.1 units) in the occupational index score. A greater increase in a country's average achievement score per one-standard-deviation increase in the occupational index score implies a stronger relationship between parent occupational status and performance in that country. Across the G-8 countries, an increase of one standard deviation on the index was associated with an average performance increase that ranged from 19 score points in Japan to 42 score points in France (figure 12b). In the United States, an increase of one standard deviation on the index was associated with an average performance increase of 36 score points. Compared to the United States, four G-8 countries had a weaker relationship between the occupational index and science literacy performance—Japan, the Russian Federation, Canada, and Italy—and the other G-8 countries were not measurably different from the United States in this regard.

Definitions and Methodology

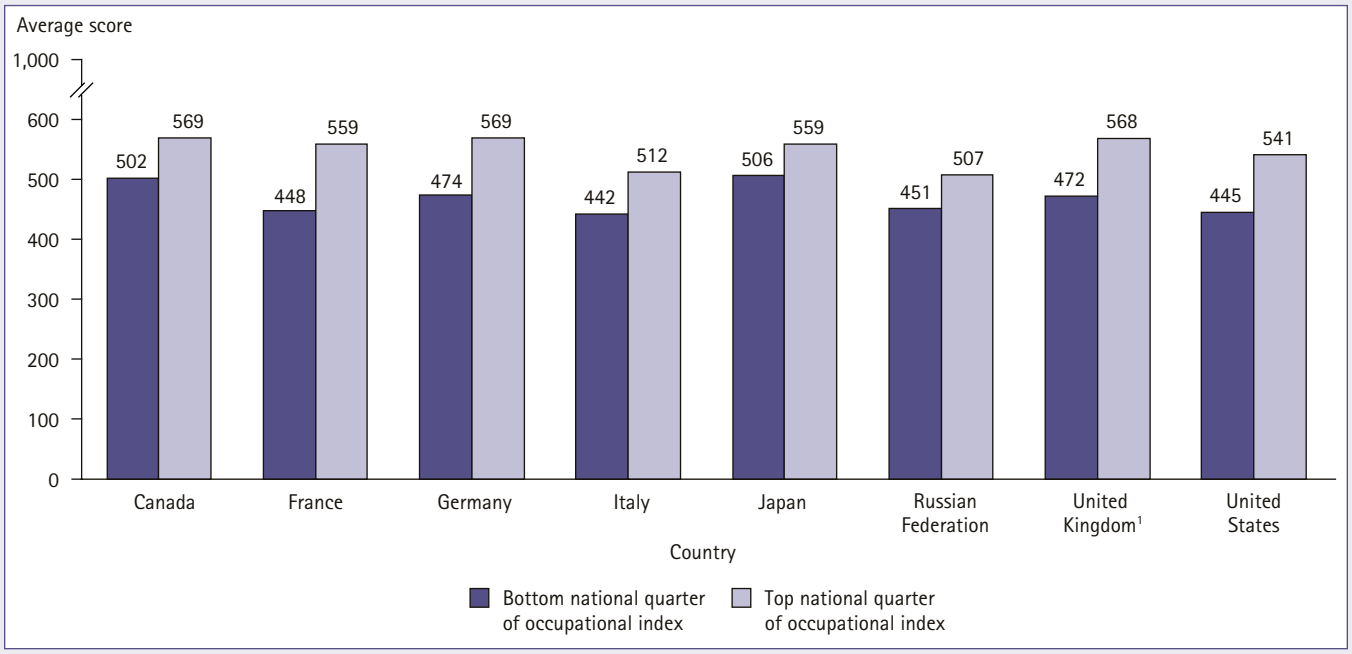
In PISA, "15-year-olds" refers to students between 15 years and 3 months to 16 years and 2 months old at the at the time of the assessment and who have completed at least 6 years of formal schooling.

Scores on the PISA 2006 combined science literacy scale are reported on a scale from 0 to 1,000 with the OECD average fixed at 500 and the standard deviation fixed at 100. For more information about science literacy in PISA 2006, see the Definitions and Methodology section of indicators 10 and 11.

Parent occupational status is measured by the Highest International Socioeconomic Index of Occupational Status (HISEI), which corresponds to the highest occupational index score of the student's father or mother. Parental occupation, as reported by the student, was coded based on the current version of the International Standard Classification of Occupations (ISCO-88) (International Labor Organization 1988). Occupational codes were, in turn, mapped onto an internationally comparable index of occupational status, the International Socioeconomic Index of Occupational Status (ISEI), developed by Ganzeboom, De Graaf, and Treiman (1992). The ISEI captures the attributes of occupations that convert parents' education into income. It is derived by optimally scaling occupation groups to maximize the indirect effect of education on income through occupation and to minimize the direct effect of education on income, net of occupation (both effects being net of age). As discussed in this indicator, students were also classified into national quarters on the ISEI.

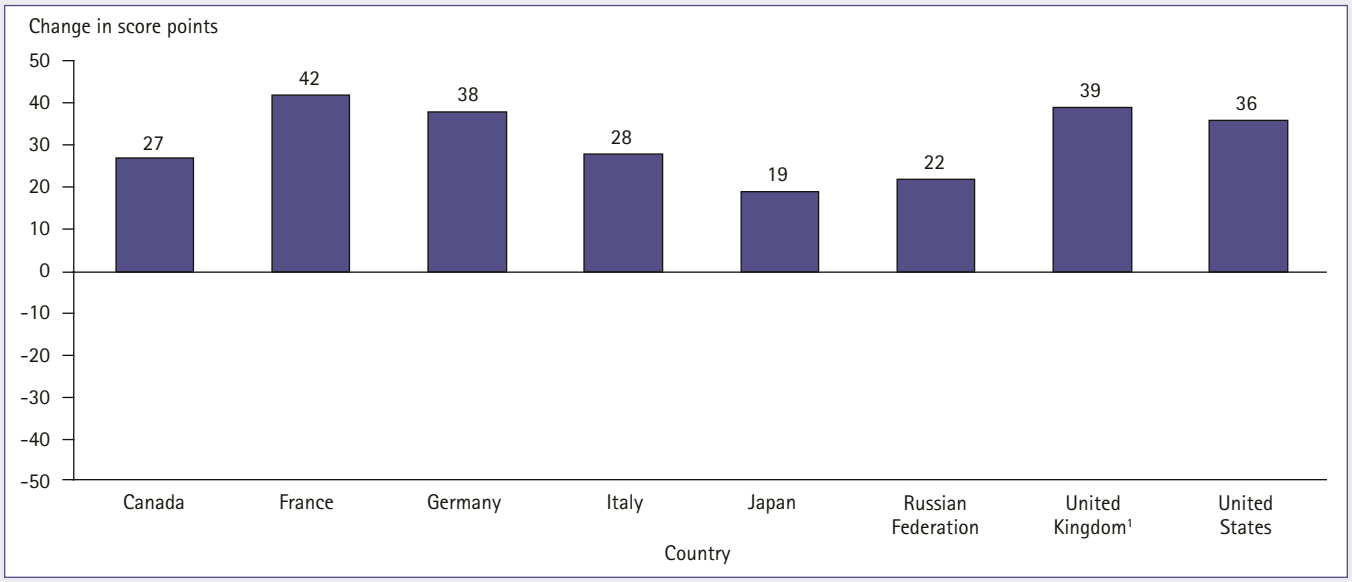
[15] In PISA 2003, the United States had the highest mean index score of all the G-8 countries reporting data (OECD 2004).

Figure 12a. Average scale scores of 15-year-old students in science literacy in PISA 2006, by parent occupational status and country: 2006



[1] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.
NOTE: In the 2006 Program for International Student Assessment (PISA 2006), parent occupational status is measured by the Highest International Socioeconomic Index of Occupational Status (HISEI), which corresponds to the highest occupational index score of the student's father or mother. This information, derived from students' responses to questionnaire items pertaining to parental occupation, is transformed into an index developed by Ganzeboom, De Graaf, and Treiman (1992). The index is keyed to the International Standard Classification of Occupations (ISCO) and allows direct comparisons between nations.
SOURCE: Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006: Science Competencies for Tomorrow's World, Volume 2: Data*, table 4.8b. Paris: Author.

Figure 12b. Change in average scale scores of 15-year-old students in science literacy in PISA 2006 per one-standard-deviation increase in the parent occupational index, by country: 2006



[1] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.
NOTE: In the 2006 Program for International Student Assessment (PISA 2006), parent occupational status is measured by the Highest International Socioeconomic Index of Occupational Status (HISEI), which corresponds to the highest occupational index score of the student's father or mother. This information, derived from students' responses to questionnaire items pertaining to parental occupation, is transformed into an index developed by Ganzeboom, De Graaf, and Treiman (1992). The index is keyed to the International Standard Classification of Occupations (ISCO) and allows direct comparisons between nations. Shown in this figure is the average score-point difference that is associated with an increase of one standard deviation (i.e., 17.1 units) on the parent occupational index.
SOURCE: Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006: Science Competencies for Tomorrow's World, Volume 2: Data*, table 4.8b. Paris: Author.

SCIENCE ACHIEVEMENT AND IMMIGRANT STATUS

G-8 Countries Included: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States

In all G-8 countries with data shown except the Russian Federation, 15-year-old second- and first-generation students scored lower on the PISA 2006 combined science literacy scale compared to their native peers.

Using data from the 2006 Program for International Student Assessment (PISA 2006), this indicator compares 15-year-old students' science achievement by immigration status across the G-8 countries. In PISA 2006, the student background questionnaire asked 15-year-olds to report if they were *native* (born in the country of assessment with at least one of their parents born in the same country), or had an immigrant background within two generations. Students not reporting native also reported if they were *second generation* (born in the country of assessment but with parents born in another country), or *first generation* (born in another country and with parents born in another country).[16] In 2006, 15 percent of U.S. 15-year-olds had an immigrant background within two generations; of these, 9 percent reported being second generation students and 6 percent reported being first generation students (figure 13a). The U.S. percentage of students with an immigrant background within two generations (15 percent) was higher than the corresponding percentage for the Russian Federation (9 percent), the United Kingdom (9 percent), Italy (4 percent), and Japan (0.4 percent), but lower than that for Canada (21 percent).

In all G-8 countries with data shown[17] except the Russian Federation, 15-year-old students with an immigrant background scored lower, on average, on the PISA 2006 combined science literacy scale than their native peers (figure 13b). Excluding the Russian Federation (where score points were not measurably different), score-point differences ranged from 12 points in Canada to 93 points in Germany between second-generation and native students and from 22 points in Canada to 77 points in Germany between first-generation and native students; in the United States, the corresponding score-point differences were 43 and 57 points, respectively.

Among native students, the United States scored lower, on average, than the United Kingdom, Japan, Germany, and Canada but higher, on average, than the Russian Federation and Italy on the combined science literacy scale. Second- and first-generation students in the United States were outperformed, on average, by their peers in the United Kingdom and Canada. First-generation students in the United States were also outperformed, on average, by their peers in the Russian Federation, although U.S. first-generation students scored higher, on average, than their peers in Italy.

Definitions and Methodology

In PISA, "15-year-olds" refers to students between 15 years and 3 months to 16 years and 2 months old at the at the time of the assessment and who have completed at least 6 years of formal schooling. Students were tested in the language of instruction used in their school. Multilingual countries developed as many versions of the test instruments as there were languages of instruction used in the schools included in their national sample.

PISA was designed to be as inclusive as possible. Each participating country attempted to maximize the coverage of 15-year-olds enrolled in education in its national sample so that results would be representative of the entire national school system. Thus, efforts were made to ensure that exclusions at the school or student level, if they were necessary, were minimized according to the PISA technical standards. Countries might find it necessary to reduce their coverage of the target population by excluding, for example, a small, remote geographical region due to inaccessibility. Instances where minority languages were used in only a very limited number of schools could be excluded from the target population if this was determined not to affect the overall quality of the data collection. Within schools, students could be excluded for being intellectually disabled, functionally disabled, or having insufficient language experience. Students were not to be excluded solely because of poor academic performance or normal discipline problems. With respect to insufficient language experience, students could be excluded only if they met the following three criteria: not being native speakers in the assessment language, having limited proficiency in the assessment language, and receiving less than 1 year of instruction in the assessment language.

The sampling standards used in PISA permitted countries to exclude up to a total of 5 percent of the relevant population for approved reasons. All G-8 countries achieved this standard except for Canada, which had an overall exclusion rate of 6 percent. Canada's within-school exclusion rate was 5 percent. In all other G-8 countries, the within-school exclusion rates ranged from 0 percent in Japan to 4 percent in the United States. (See OECD 2009 for additional details about exclusions, including procedures, criteria, and rates.)

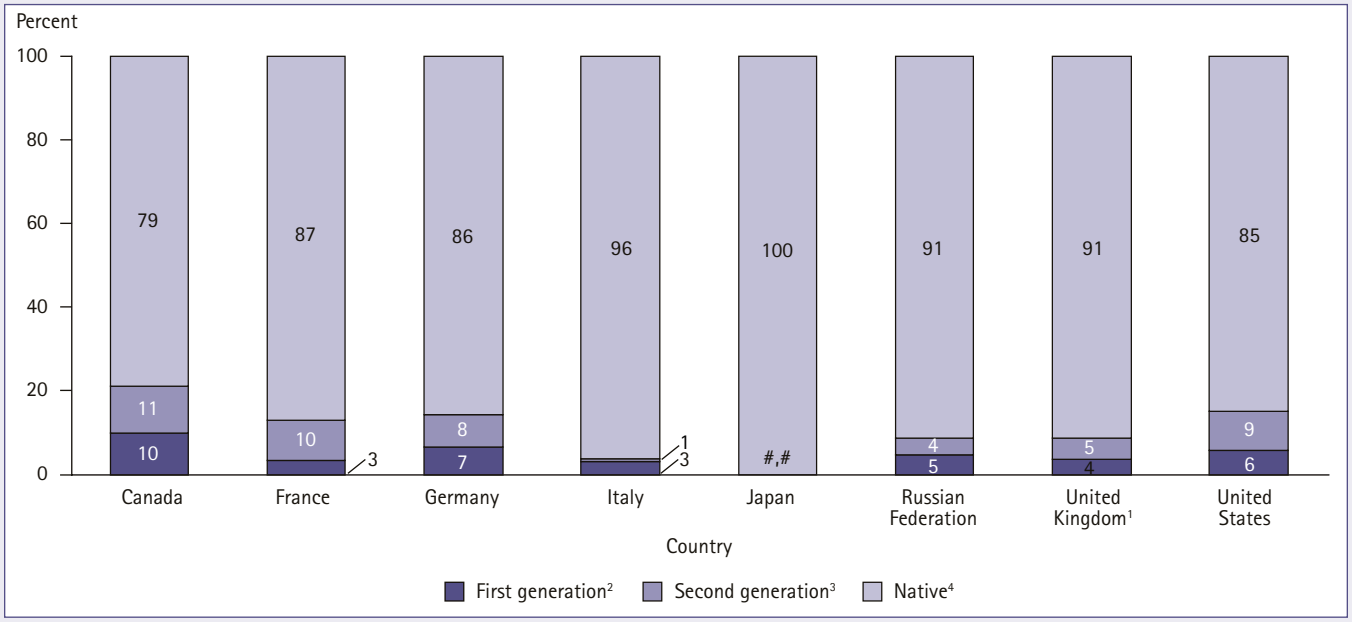
Scores on the PISA 2006 combined science literacy scale are reported on a scale from 0 to 1,000 with the OECD average fixed at 500 and the standard deviation fixed at 100. For more information about science literacy in PISA 2006, see the Definitions and Methodology section of indicators 10 and 11.

The computations presented in the text were carried out using unrounded numbers; therefore, they may differ from computations made using the rounded numbers that appear in figures 13a and 13b.

[16] PISA was not designed to specifically sample populations of immigrant and non-immigrant students. Rather, the study was designed to represent general populations of 15-year-old students in national school systems, which typically include both immigrant and non-immigrant students. Students with insufficient language experience could be excluded from participating in PISA. Thus, results from PISA may differ from other studies that have immigrant and non-immigrant students as target populations. See the Definitions and Methodology section for more information about the PISA sampling and administration, including exclusions.

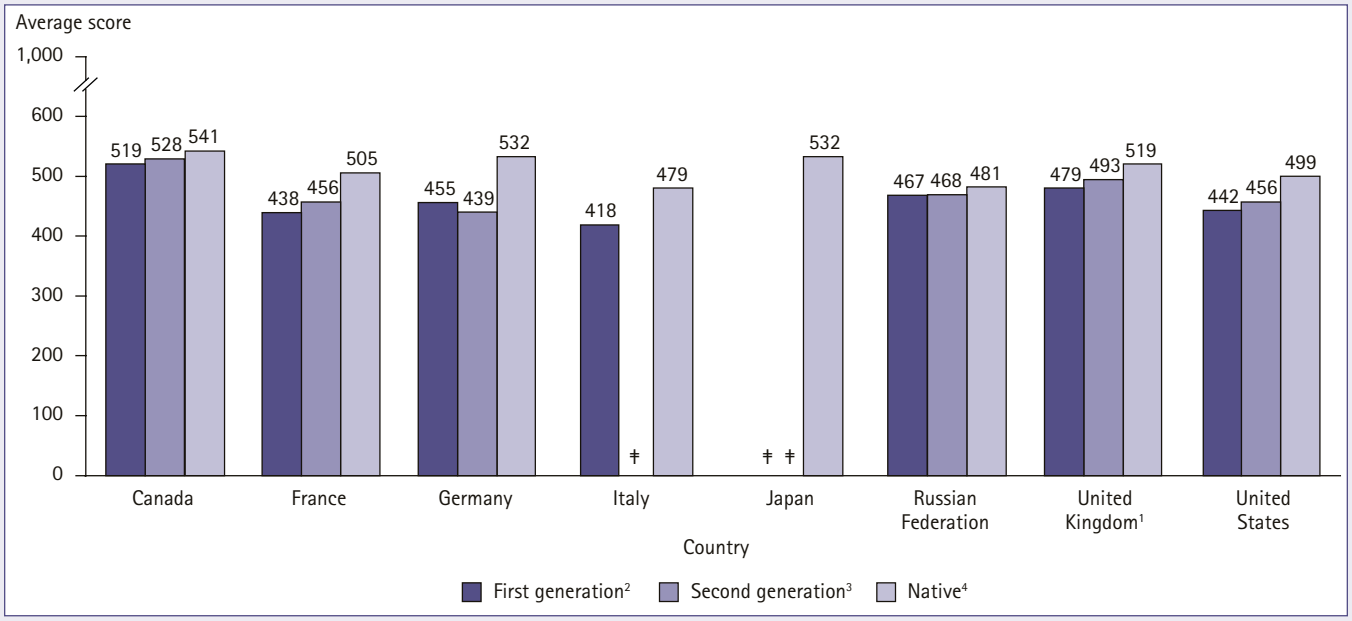
[17] Combined science literacy scores are not shown for Italy for second-generation students and for Japan for first-and second-generation students because there are too few cases to provide reliable estimates.

Figure 13a. Percentage distribution of 15-year-old students, by immigrant status and country: 2006



Rounds to zero.
[1] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.
[2] First-generation students are those who were born in another country and whose parents were born in another country.
[3] Second-generation students are those who were born in the country of assessment but whose parents were born in another country.
[4] Native students are those who were born in the country of assessment with at least one of their parents born in the same country.
NOTE: Detail may not sum to totals because of rounding.
SOURCE: Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006: Science Competencies for Tomorrow's World, Volume 2: Data*, table 4.2c. Paris: Author.

Figure 13b. Average scale scores of 15-year-old students in science literacy, by immigrant status and country: 2006



‡ Reporting standards not met. Too few observations to provide reliable estimates.
[1] The United Kingdom includes England, Northern Ireland, Scotland, and Wales.
[2] First-generation students are those who were born in another country and whose parents were born in another country.
[3] Second-generation students are those who were born in the country of assessment but whose parents were born in another country.
[4] Native students are those who were born in the country of assessment with at least one of their parents born in the same country.
SOURCE: Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006: Science Competencies for Tomorrow's World, Volume 2: Data*, table 4.2c. Paris: Author.