Performance of U.S. 15-Year-Old Students in Mathematics, Science, and Reading Literacy in an International Context

First Look at PISA 2012




NCES 2014-024

U.S. DEPARTMENT OF EDUCATION

ies NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences

Performance of U.S. 15-Year-Old Students in Mathematics, Science, and Reading Literacy in an International Context

First Look at PISA 2012

DECEMBER 2013

Dana Kelly
National Center for Education Statistics

Holly Xie
Project Officer
National Center for Education Statistics

Christine Winquist Nord
Frank Jenkins
Jessica Ying Chan
David Kastberg
Westat

NCES 2014-024
U.S. DEPARTMENT OF EDUCATION

ies NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences

U.S. Department of Education
Arne Duncan
Secretary

Institute of Education Sciences
John Q. Easton
Director

National Center for Education Statistics
Jack Buckley
Commissioner

The National Center for Education Statistics (NCES) is the primary federal entity for collecting, analyzing, and reporting data related to education in the United States and other nations. It fulfills a congressional mandate to collect, collate, analyze, and report full and complete statistics on the condition of education in the United States; conduct and publish reports and specialized analyses of the meaning and significance of such statistics; assist state and local education agencies in improving their statistical systems; and review and report on education activities in foreign countries.

NCES activities are designed to address high-priority education data needs; provide consistent, reliable, complete, and accurate indicators of education status and trends; and report timely, useful, and high-quality data to the U.S. Department of Education, the Congress, the states, other education policymakers, practitioners, data users, and the general public. Unless specifically noted, all information contained herein is in the public domain.

We strive to make our products available in a variety of formats and in language that is appropriate to a variety of audiences. You, as our customer, are the best judge of our success in communicating information effectively. If you have any comments or suggestions about this or any other NCES product or report, we would like to hear from you. Please direct your comments to:

NCES, IES, U.S. Department of Education
1990 K Street, NW
Washington, DC 20006-5651

December 2013

The NCES Home Page address is http://nces.ed.gov.
The NCES Publications and Products address is http://nces.ed.gov/pubsearch.

This publication is only available online. To download, view, and print the report as a PDF file, go to the NCES Publications and Products address shown above.

This report was prepared for the National Center for Education Statistics under Contract No. ED-IES-10-C-0047 with Westat. Mention of trade names, commercial products, or organizations does not imply endorsement by the U.S. Government.

Suggested Citation
Kelly, D., Xie, H., Nord, C.W., Jenkins, F., Chan, J.Y., and Kastberg, D. (2013). *Performance of U.S. 15-Year-Old Students in Mathematics, Science, and Reading Literacy in an International Context: First Look at PISA 2012* (NCES 2014-024). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved [date] from http://nces.ed.gov/pubsearch.

Content Contact
Holly Xie
(202) 502-7314
holly.xie@ed.gov

Acknowledgments

The authors wish to thank the students, teachers, and school officials who participated in the Program for International Student Assessment (PISA) 2012. Without their assistance and cooperation, this study would not be possible. The authors also wish to thank all those who contributed to the PISA design, implementation, and data collection as well as the writing, production, and review of this report.

This page intentionally left blank

Contents

List of Tables

List of Figures

List of Exhibits

Introduction

What Is PISA?

The Program for International Student Assessment (PISA) is a system of international assessments that allows countries to compare outcomes of learning as students near the end of compulsory schooling. PISA core assessments measure the performance of 15-year-old students in mathematics, science, and reading literacy every 3 years. Coordinated by the Organization for Economic Cooperation and Development (OECD), PISA was first implemented in 2000 in 32 countries. It has since grown to 65 education systems in 2012.

What PISA Measures

PISA's goal is to assess students' preparation for the challenges of life as young adults. PISA assesses the application of knowledge in mathematics, science, and reading literacy to problems within a real-life context (OECD 1999). PISA does not focus explicitly on curricular outcomes and uses the term "literacy" in each subject area to indicate its broad focus on the application of knowledge and skills. For example, when assessing mathematics, PISA examines how well 15-year-old students can understand, use, and reflect on mathematics for a variety of real-life problems and settings that they may not encounter in the classroom. Scores on the PISA scales represent skill levels along a continuum of literacy skills.

Each PISA data collection cycle assesses one of the three core subject areas in depth (considered the major subject area), although all three core subjects are assessed in each cycle (the other two subjects are considered minor subject areas for that assessment year). Assessing all three subjects every 3 years allows countries to have a consistent source of achievement data in each of the three subjects, while rotating one area as the primary focus over the years. Mathematics was the major subject area in 2012, as it was in 2003, since each subject is a major subject area once every three cycles. In 2012, mathematics, science, and reading literacy were assessed primarily through a paper-and-pencil assessment, and problem solving was administered via a computer-based assessment. In addition to these core assessments, education systems could participate in optional paper-based financial literacy and computer-based mathematics and reading assessments. The United States participated in these optional assessments. Visit www.nces.ed.gov/surveys/pisa for more information on the PISA assessments, including information on how the assessments were designed and examples of PISA questions.

Mathematics Literacy

In PISA 2012, the major subject was mathematics literacy, defined as:

> *An individual's capacity 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 to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged, and reflective citizens* (OECD 2013, p. 25).

More specifically, the PISA mathematics assessment looks at four mathematical content categories and three mathematical process categories:[1]

Mathematical content categories (OECD 2013, pp. 33–35):

- **Change and relationship:** Can students model change and relationships with the appropriate functions and equations?
- **Space and shape:** Can students understand perspective, create and read maps, and manipulate 3D objects?
- **Quantity:** Are 15-year-olds able to comprehend multiple representations of numbers, engage in mental calculation, employ estimation, and assess the reasonableness of results?
- **Uncertainty and data:** Can students use probability and statistics and other techniques of data representation and description to mathematically describe, model, and interpret uncertainty?

Mathematical process categories (OECD 2013, pp. 28–30):

- **Formulate:** Can 15-year-olds recognize and identify opportunities to use mathematics and then provide mathematical structure to a problem presented in some contextualized form in order to formulate situations mathematically?
- **Employ:** Are students able to employ mathematical concepts, facts, procedures, and reasoning to solve mathematically formulated problems and obtain mathematical conclusions?
- **Interpret:** Can students interpret, apply, and evaluate mathematical outcomes in order to determine whether results are reasonable and make sense in the context of the problem?

The PISA mathematics framework was updated for the 2012 assessment. The revised framework is intended to clarify the mathematics relevant to 15-year-old students, while ensuring that the items developed remain set in meaningful and authentic contexts, and defines the mathematical processes in which students engage as they solve problems. These processes, described above, are being used for the first time in 2012 as a primary reporting dimension. Although the framework has been updated, it is still possible to measure trends in mathematics literacy over time, as the underlying construct is intact.

Mathematics literacy is reported both in terms of proficiency levels and scale scores (reported on a scale of 0–1,000). Exhibit 1 (see following page) describes the six mathematics literacy proficiency levels and their respective cut scores.

[1] Mathematics literacy subscale results can be found online at http://nces.ed.gov/surveys/pisa/pisa2012/.

Exhibit 1. Description of PISA proficiency levels on mathematics literacy scale: 2012

Proficiency level and lower cut score	Task descriptions
Level 6 669	At level 6, students can conceptualize, generalize, and utilize information based on their investigations and modeling of complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations and flexibly translate among 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 reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments and the appropriateness of these to the original situations.
Level 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, appropriate linked representations, symbolic and formal characterizations, and insight pertaining to these situations. They begin to reflect on their work and can formulate and communicate their interpretations and reasoning.
Level 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, linking them directly to aspects of real-world situations. Students at this level can utilize their limited range of skills and can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions.
Level 3 482	At level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
Level 2 420	At level 2, students can interpret and recognize 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 to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
Level 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 almost always obvious and follow immediately from the given stimuli.

NOTE: To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into mathematics literacy levels according to their scores. Cut scores in the exhibit are rounded; exact cut scores are provided in appendix A. Scores are reported on a scale from 0 to 1,000.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Science Literacy

In PISA 2012, science literacy is defined 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 2013, p. 100).

Science literacy is reported both in terms of proficiency levels and scale scores (reported on a scale of 0–1,000). Exhibit 2 (see below) describes the six science literacy proficiency levels and their respective cut scores.

Exhibit 2. Description of PISA proficiency levels on science literacy scale: 2012

Proficiency level and lower cut score	Task descriptions
Level 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 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 center on personal, social, or global situations.
Level 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.
Level 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.
Level 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.
Level 2 410	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.
Level 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.

NOTE: To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into science literacy levels according to their scores. Cut scores in the exhibit are rounded; exact cut scores are provided in appendix A. Scores are reported on a scale from 0 to 1,000.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Reading Literacy

In PISA 2012, reading literacy is defined as:

> *Reading literacy is understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society* (OECD 2013, p. 61).

Reading literacy is reported both in terms of proficiency levels and scale scores (reported on a scale of 0–1,000). Exhibit 3 (see following page) describes the seven reading literacy proficiency levels and their respective cut scores.

Exhibit 3. Description of PISA proficiency levels on reading literacy scale: 2012

Proficiency level and lower cut score	Task descriptions
Level 6 698	At level 6, tasks typically require the reader to make multiple inferences, comparisons, and contrasts that are both detailed and precise. They require demonstration of a full and detailed understanding of one or more texts and may involve integrating information from more than one text. Tasks may require the reader to deal with unfamiliar ideas, in the presence of prominent competing information, and to generate abstract categories for interpretations. Reflect and evaluate tasks may require the reader to hypothesize about or critically evaluate a complex text on an unfamiliar topic, taking into account multiple criteria or perspectives, and applying sophisticated understandings from beyond the text. A salient condition for access and retrieve tasks at this level is precision of analysis and fine attention to detail that is inconspicuous in the texts.
Level 5 626	At level 5, tasks that involve retrieving information require the reader to locate and organize several pieces of deeply embedded information, inferring which information in the text is relevant. Reflective tasks require critical evaluation or hypothesis, drawing on specialized knowledge. Both interpretative and reflective tasks require a full and detailed understanding of a text whose content or form is unfamiliar. For all aspects of reading, tasks at this level typically involve dealing with concepts that are contrary to expectations.
Level 4 553	At level 4, tasks that involve retrieving information require the reader to locate and organize several pieces of embedded information. Some tasks at this level require interpreting the meaning of nuances of language in a section of text by taking into account the text as a whole. Other interpretative tasks require understanding and applying categories in an unfamiliar context. Reflective tasks at this level require readers to use formal or public knowledge to hypothesize about or critically evaluate a text. Readers must demonstrate an accurate understanding of long or complex texts whose content or form may be unfamiliar.
Level 3 480	At level 3, tasks require the reader to locate, and in some cases recognize the relationship between, several pieces of information that must meet multiple conditions. Interpretative tasks at this level require the reader to integrate several parts of a text in order to identify a main idea, understand a relationship, or construe the meaning of a word or phrase. They need to take into account many features in comparing, contrasting or categorizing. Often the required information is not prominent or there is much competing information; or there are other text obstacles, such as ideas that are contrary to expectation or negatively worded. Reflective tasks at this level may require connections, comparisons, and explanations, or they may require the reader to evaluate a feature of the text. Some reflective tasks require readers to demonstrate a fine understanding of the text in relation to familiar, everyday knowledge. Other tasks do not require detailed text comprehension but require the reader to draw on less common knowledge.
Level 2 407	At level 2, some tasks require the reader to locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. Others require recognizing the main idea in a text, understanding relationships, or construing meaning within a limited part of the text when the information is not prominent and the reader must make low level inferences. Tasks at this level may involve comparisons or contrasts based on a single feature in the text. Typical reflective tasks at this level require readers to make a comparison or several connections between the text and outside knowledge, by drawing on personal experience and attitudes.
Level 1a 335	At level 1a, tasks require the reader to locate one or more independent pieces of explicitly stated information; to recognize the main theme or author's purpose in a text about a familiar topic, or to make a simple connection between information in the text and common, everyday knowledge. Typically, the required information in the text is prominent and there is little, if any, competing information. The reader is explicitly directed to consider relevant factors in the task and in the text.
Level 1b 262	At level 1b, tasks require the reader to locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text with a familiar context and text type, such as a narrative or a simple list. The text typically provides support to the reader, such as repetition of information, pictures, or familiar symbols. There is minimal competing information. In tasks requiring interpretation the reader may need to make simple connections between adjacent pieces of information.

NOTE: To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into reading literacy levels according to their scores. Cut scores in the exhibit are rounded; exact cut scores are provided in appendix A. Scores are reported on a scale from 0 to 1,000.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012. NOTE: To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into mathematics literacy levels according to their scores. Cut scores in the exhibit are rounded; exact cut scores are provided in appendix A. Scores are reported on a scale from 0 to 1,000.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Computer-Based Assessments

In 2012, computer-based assessments in mathematics and reading were offered as optional assessments for participating education systems. Thirty-two education systems, including the United States, chose to administer them. In these education systems, a subset of students who took the paper-based assessment also took an additional computer-based assessment. Although the paper-based assessment items and the computer-based assessment items were derived from the same frameworks, there was no overlap in the assessment items between the two assessment modes. The interactive nature of computer-based assessment allowed PISA to assess students in novel contexts that are not possible with a traditional paper-based format. For instance, the computer-based mathematics assessment was designed to measure the same mathematics content and processes as the paper-based assessment, but the computer-based environment provided the opportunity to include tasks requiring students to manipulate mathematical tools like statistical software, geometric construction, visualization utilities, and virtual measuring instruments (OECD 2013, pp. 43–44). And, while individuals use many of the same reading processes and skills when they are reading print or reading online, there are reading processes that are unique to an electronic environment, such as navigation across multiple sites without explicit direction or using web-based navigation tools such as drop-down menus (OECD 2013, p. 80). The computer-based reading assessment was designed to investigate students' proficiency in that context. For both mathematics and reading, the paper-based assessment and computer-based assessment were scaled separately. Therefore, scores on the paper-based assessment cannot be compared to scores on the computer-based assessment.

Reporting PISA 2012 Results

This report presents performance on PISA 2012 in mathematics, science, and reading literacy from a U.S. perspective. Results are presented for the 65 education systems, including the United States, that participated in PISA 2012 and for the three U.S. states—Connecticut, Florida, and Massachusetts—that participated as separate education systems. These three states opted to have separate samples of public-school schools and students included in PISA in order to obtain state-level results.

In this report, results are presented in terms of average scale scores and the percentage of 15-year-old students reaching selected proficiency levels, comparing the United States with other participating education systems. For proficiency levels, results are reported in terms of the percentage reaching level 5 or above and the percentage below level 2. Higher proficiency levels represent the knowledge, skills, and capabilities needed to perform tasks of greater complexity. At levels 5 and 6, students demonstrate higher level skills and may be referred to as "top performers" in the subject. Conversely, students performing below level 2 are below what the OECD calls "a baseline level of proficiency, at which students begin to demonstrate the…literacy competencies that will enable them to participate effectively and productively in life" (OECD 2010, p. 154).[2]

This report also presents U.S. trends over time in mathematics, science, and reading literacy and overall results for the computer-based mathematics and reading assessments. Results for the problem-solving and financial literacy assessments will be released in 2014.

In reporting PISA results, the OECD differentiates between OECD member countries, of which there are 34, and all other participating education systems, some of which are countries and some

[2] Percentages of students at each proficiency level may be found at http://nces.ed.gov/surveys/pisa/pisa2012/.

of which are subnational entities. In the OECD's PISA reports, OECD member countries and other participating education systems are reported in the tables and figures in the main body of the report, along with the average for the OECD countries (the average of all OECD member country averages with each country weighted equally), and are discussed in the accompanying text. Also, for some participating education systems, results for subnational entities—including, in 2012, the three U.S. states—are reported in appendixes of the OECD PISA reports but are not discussed in the report text.

To facilitate readers moving between the OECD and U.S. national PISA reports, this report's tables and figures follow the OECD convention of placing OECD member countries and all other participating education systems in the main part of the tables and figures. These are all referred to as education systems in this report, and there are 65 altogether. The three U.S. states that participated in PISA 2012 are presented in a separate part of the tables and figures; results for the states are discussed in the text but are not included in counts of education systems performing above, below, or not measurably different from the United States.

This report is merely a first look at the PISA 2012 results and is by no means comprehensive. For more PISA 2012 results, visit the National Center for Education Statistics PISA website at http://nces.ed.gov/surveys/pisa/pisa2012/. The website includes more results from the mathematics, reading, science, and computer-based assessments, including results for various subgroups (e.g., by gender, race/ethnicity), in mathematics subscales, and on trends in performance, and more detailed results for the three U.S. states that participated in 2012.

All statistically significant differences described in this report are at the .05 level. Differences that are statistically significant are discussed using comparative terms such as "higher" and "lower." Differences that are not statistically significant are either not discussed or referred to as "not measurably different." In almost all instances, the tests for significance used were standard *t* tests (see appendix A for additional details on interpreting statistical significance). No adjustments were made for multiple comparisons.

Selected Findings

U.S. Performance in Mathematics Literacy

- Percentages of top performing 15-year-old students (those scoring at level 5 or above) in mathematics literacy ranged from 55 percent in Shanghai-China to nearly 0 percent in Colombia and Argentina. In the United States, 9 percent of 15-year-old students scored at proficiency level 5 or above, which was lower than the OECD average of 13 percent. The U.S. percentage was lower than 27 education systems, higher than 22 education systems, and not measurably different than 13 education systems. The percentage of top performers in mathematics in the United States overall (9 percent) was higher than the state of Florida (6 percent), but lower than Massachusetts (19 percent) and Connecticut (16 percent) (figure 1).
- In mathematics literacy, the percentage of 15-year-old students performing below level 2, which is considered a baseline of proficiency by the OECD, ranged from 4 percent in Shanghai-China to 76 percent in Indonesia. In the United States, 26 percent of 15-year-old students scored below level 2, which was higher than the OECD average of 23 percent. The U.S. percentage was higher than 29 education systems, lower than 26 education systems, and not measurably different than 9 education systems. The percentage of low performers in mathematics in the United States overall (26 percent) was higher than the states of Connecticut (21 percent) and Massachusetts (18 percent), but not measurably different than Florida (30 percent) (figure 1).
- Average scores in mathematics literacy ranged from 613 in Shanghai-China to 368 in Peru. The U.S. average score was 481, which was lower than the OECD average of 494. The U.S. average was lower than 29 education systems, higher than 26 education systems, and not measurably different than 9 education systems. The U.S. average was lower than the states of Massachusetts (514) and Connecticut (506), but higher than Florida (467) (table 1).

U.S. Performance in Science Literacy

- Percentages of top-performing 15-year-old students (those scoring at level 5 or above) in science literacy ranged from 27 percent in Shanghai-China and 23 percent in Singapore to nearly 0 percent in eight education systems. In the United States, 7 percent of 15-year-old students scored at proficiency level 5 or above, which was not measurably different from the OECD average of 8 percent. The U.S. percentage was lower than 16 education systems, higher than 27 education systems, and not measurably different than 16 education systems. The percentage of top performers in science in the United States overall (7 percent) was lower than the states of Massachusetts (14 percent) and Connecticut (13 percent), but not measurably different than Florida (5 percent) (figure 2).
- In science literacy, the percentage of 15-year-old students performing below level 2, which is considered a baseline of proficiency by the OECD, ranged from 3 percent in Shanghai-China and 5 percent in Estonia to 67 percent in Indonesia and 68 percent in Peru. In the United States, 18 percent of U.S. 15-year-old students scored below level 2, which was not measurably different from the OECD average of 18 percent. The U.S. percentage was higher than 21 education systems, lower than 29 education systems, and not measurably different than 14 education systems. The percentage of low performers in science in the United States overall (18 percent) was higher than the states of Connecticut (13 percent) and Massachusetts (11 percent), but not measurably different than Florida (21 percent) (figure 2).

- Average scores in science literacy ranged from 580 in Shanghai-China to 373 in Peru. The U.S. average score was 497, which was not measurably different from the OECD average of 501. The U.S. average was lower than 22 education systems, higher than 29 education systems, and not measurably different than 13 education systems. The U.S. average was lower than the states of Massachusetts (527) and Connecticut (521), but not measurably different than Florida (485) (table 2).

U.S. Performance in Reading Literacy

- Percentages of top performing 15-year-old students (those scoring at level 5 or above) in reading literacy ranged from 25 percent in Shanghai-China and 21 percent in Singapore to nearly 0 percent in 3 education systems. In the United States, 8 percent of U.S. 15-year-old students scored at proficiency level 5 or above, which was not measurably different from the OECD average of 8 percent. The U.S. percentage was lower than 14 education systems, higher than 33 education systems, and not measurably different than 12 education systems. The percentage of top performers in reading in the United States overall (8 percent) was higher than the state of Florida (6 percent), but lower than Massachusetts (16 percent) and Connecticut (15 percent) (figure 3).
- In reading literacy, the percentage of 15-year-old students performing below level 2, which is considered a baseline of proficiency by the OECD, ranged from 3 percent in Shanghai-China to 60 percent in Peru. In the United States, 17 percent of U.S. 15-year-old students scored below level 2, which was not measurably different from the OECD average of 18 percent. The U.S. percentage was higher than 14 education systems, lower than 33 education systems, and not measurably different than 17 education systems. The percentage of low performers in reading in the United States overall (17 percent) was higher than the state of Massachusetts (11 percent), but not measurably different than Connecticut (13 percent) and Florida (17 percent) (figure 3).
- Average scores in reading literacy ranged from 570 in Shanghai-China to 384 in Peru. The U.S. average score was 498, which was not measurably different from the OECD average of 496. The U.S. average was lower than 19 education systems, higher than 34 education systems, and not measurably different than 11 education systems. The U.S. average was lower than the U.S. states Massachusetts (527) and Connecticut (521), but not measurably different than Florida (492) (table 3).

Eighteen education systems had higher average scores than the United States in *all three subjects*. The 18 education systems are: Australia, Canada, Chinese Taipei, Estonia, Finland, Germany, Hong Kong-China, Ireland, Japan, Liechtenstein, Macao-China, Netherlands, New Zealand, Poland, Republic of Korea, Shanghai-China, Singapore, and Switzerland. The U.S. states Massachusetts and Connecticut also had higher average scores than the United States in *all three subjects* (tables 1, 2, and 3).

U.S. Performance Over Time

- The U.S. average mathematics, science, and reading literacy scores in 2012 were not measurably different from average scores in previous PISA assessment years with which comparisons can be made (2003, 2006, and 2009 for mathematics; 2006 and 2009 for science; and 2000, 2003, and 2009 for reading) (table 4).

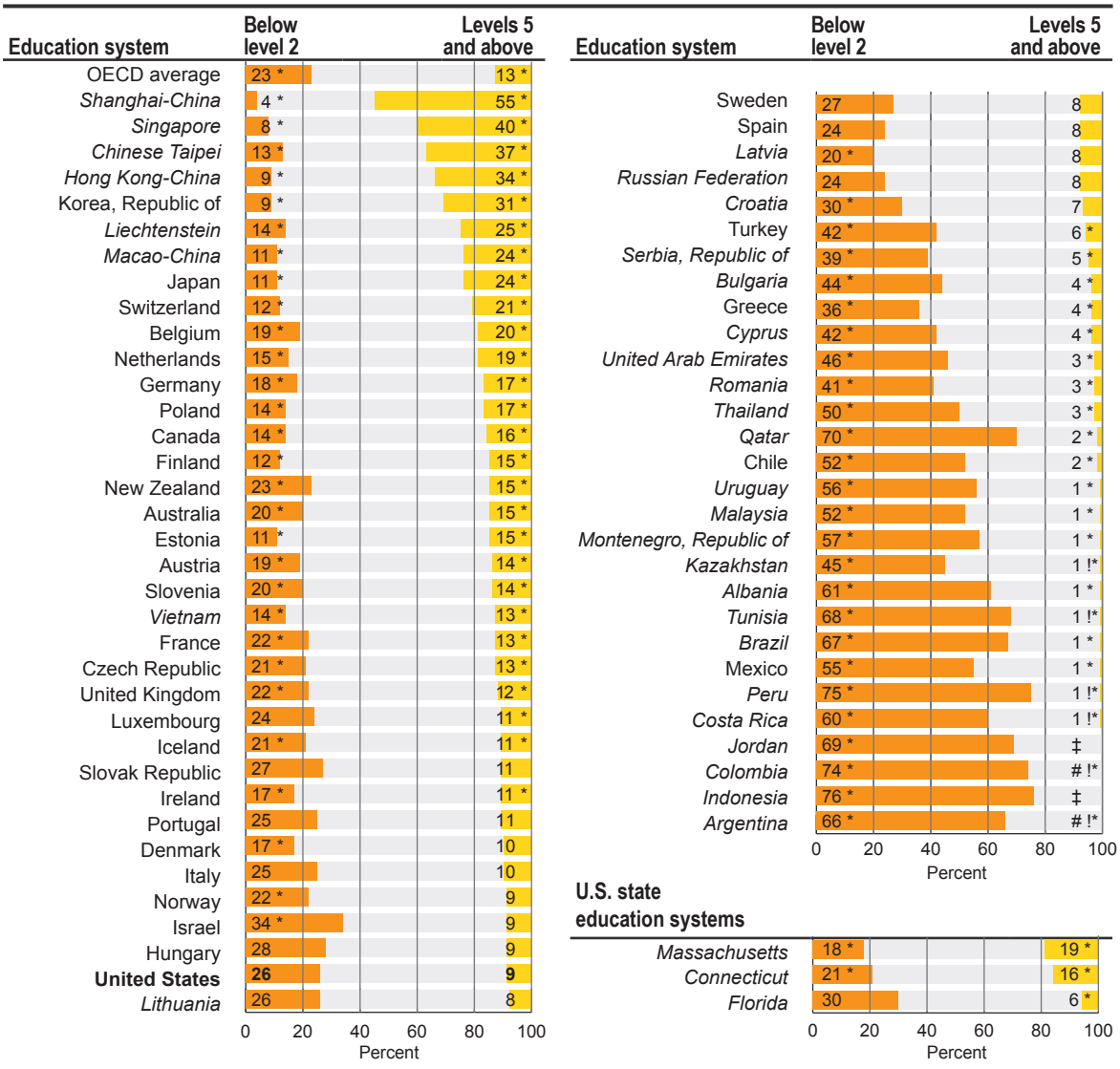
U.S. Performance on Computer-Based Assessments

- On the computer-based mathematics literacy assessment (administered in 32 education systems), average scores ranged from 566 in Singapore and 562 in Shanghai-China to 397 in Colombia. U.S. 15-year-old students had an average score of 498, which was not measurably different from the OECD average of 497. Twelve education systems had higher average scores, 8 had lower average scores, and 11 had average scores that were not measurably different than the United States (table 5).
- On the computer-based reading literacy assessment (administered in 32 education systems), average scores ranged from 567 in Singapore to 396 in Colombia. U.S. 15-year-old students had an average score of 511, which was higher than the OECD average of 497. Seven education systems had higher average scores, 17 had lower average scores, and 7 had average scores that were not measurably different than the United States (table 6).

This page intentionally left blank

Figures and Tables

Figure 1. Percentage of 15-year-old students performing at PISA mathematics literacy proficiency levels 5 and above and below level 2, by education system: 2012



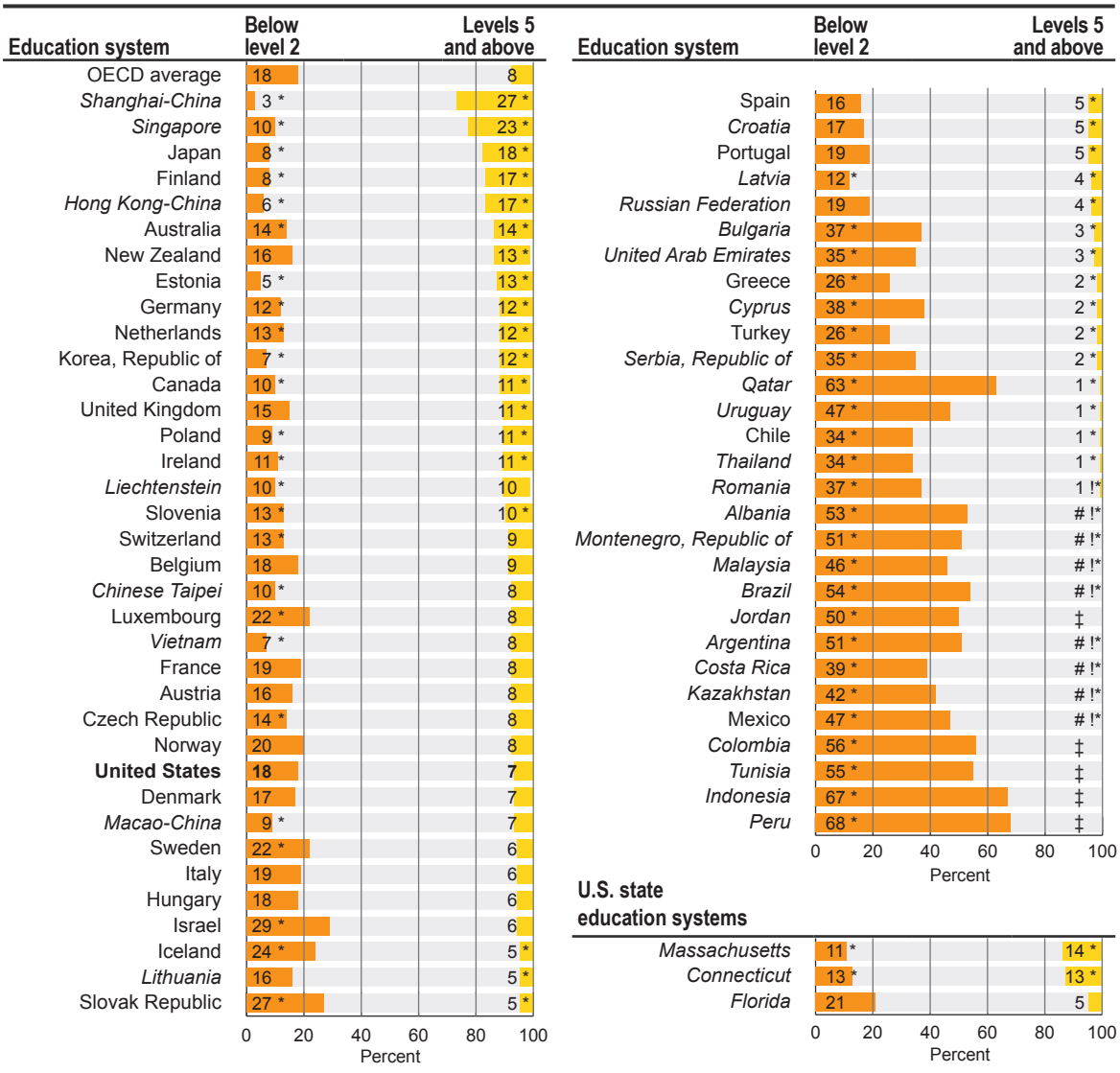
Below level 2
Levels 5 and above
Rounds to zero.
! Interpret with caution. Estimate is unstable due to high coefficient of variation.
‡ Reporting standards not met.
* $p < .05$. Significantly different from the U.S. percentage at the .05 level of significance.
NOTE: Education systems are ordered by 2012 percentages of 15-year-olds in levels 5 and above. To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into mathematics proficiency levels according to their scores. Cut scores for each proficiency level can be found in table A-1 in appendix A. The OECD average is the average of the national percentages of the OECD member countries, with each country weighted equally. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table M1b available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Table 1. Average scores of 15-year-old students on PISA mathematics literacy scale, by education system: 2012

Education system	Average score
OECD average	494 ▲
Shanghai-China	613 ▲
Singapore	573 ▲
Hong Kong-China	561 ▲
Chinese Taipei	560 ▲
Korea, Republic of	554 ▲
Macao-China	538 ▲
Japan	536 ▲
Liechtenstein	535 ▲
Switzerland	531 ▲
Netherlands	523 ▲
Estonia	521 ▲
Finland	519 ▲
Canada	518 ▲
Poland	518 ▲
Belgium	515 ▲
Germany	514 ▲
Vietnam	511 ▲
Austria	506 ▲
Australia	504 ▲
Ireland	501 ▲
Slovenia	501 ▲
Denmark	500 ▲
New Zealand	500 ▲
Czech Republic	499 ▲
France	495 ▲
United Kingdom	494 ▲
Iceland	493 ▲
Latvia	491 ▲
Luxembourg	490 ▲
Norway	489
Portugal	487
Italy	485
Spain	484
Russian Federation	482
Slovak Republic	482
United States	**481**
Lithuania	479
Sweden	478
Hungary	477
Croatia	471 ▼
Israel	466 ▼
Greece	453 ▼
Serbia, Republic of	449 ▼
Turkey	448 ▼
Romania	445 ▼
Cyprus	440 ▼
Bulgaria	439 ▼
United Arab Emirates	434 ▼
Kazakhstan	432 ▼
Thailand	427 ▼
Chile	423 ▼
Malaysia	421 ▼
Mexico	413 ▼
Montenegro, Republic of	410 ▼
Uruguay	409 ▼
Costa Rica	407 ▼
Albania	394 ▼
Brazil	391 ▼
Argentina	388 ▼
Tunisia	388 ▼
Jordan	386 ▼
Colombia	376 ▼
Qatar	376 ▼
Indonesia	375 ▼
Peru	368 ▼
U.S. state education systems	
Massachusetts	514 ▲
Connecticut	506 ▲
Florida	467 ▼

▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2012 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported on a scale from 0 to 1,000. All average scores reported as higher or lower than the U.S. average score are different at the .05 level of statistical significance. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table M4 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024 .
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Figure 2. Percentage of 15-year-old students performing at PISA science literacy proficiency levels 5 and above and below level 2, by education system: 2012



Below level 2
Levels 5 and above
Rounds to zero.
! Interpret with caution. Estimate is unstable due to high coefficient of variation.
‡ Reporting standards not met.
* $p < .05$. Significantly different from the U.S. percentage at the .05 level of significance.

NOTE: Education systems are ordered by 2012 percentages of 15-year-olds in levels 5 and above. To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into science proficiency levels according to their scores. Cut scores for each proficiency level can be found in table A-1 in appendix A. The OECD average is the average of the national percentages of the OECD member countries, with each country weighted equally. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table S1b available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.

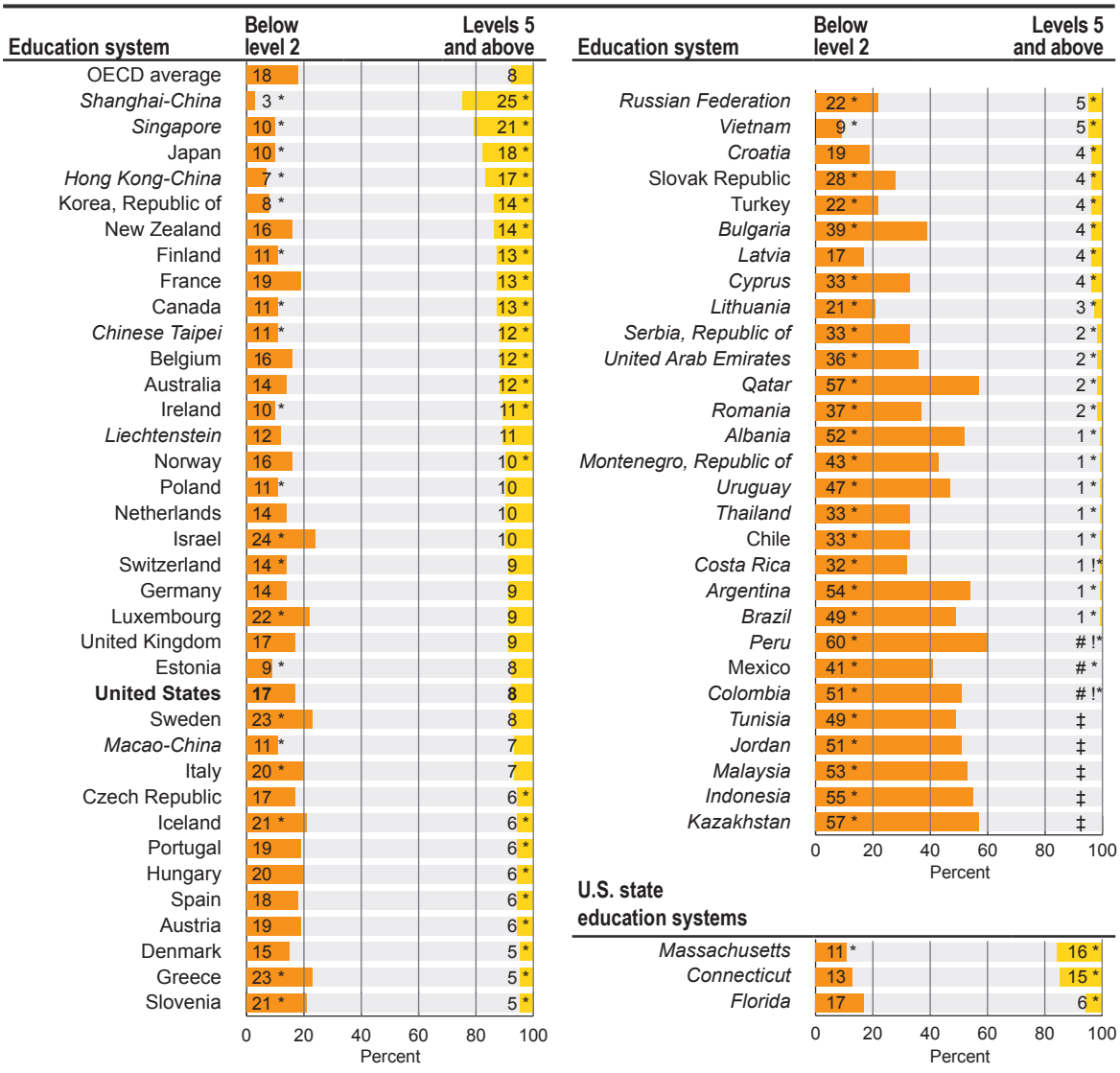
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Table 2. Average scores of 15-year-old students on PISA science literacy scale, by education system: 2012

Education system	Average score	
OECD average	501	
Shanghai-China	580	▲
Hong Kong-China	555	▲
Singapore	551	▲
Japan	547	▲
Finland	545	▲
Estonia	541	▲
Korea, Republic of	538	▲
Vietnam	528	▲
Poland	526	▲
Canada	525	▲
Liechtenstein	525	▲
Germany	524	▲
Chinese Taipei	523	▲
Netherlands	522	▲
Ireland	522	▲
Australia	521	▲
Macao-China	521	▲
New Zealand	516	▲
Switzerland	515	▲
Slovenia	514	▲
United Kingdom	514	▲
Czech Republic	508	▲
Austria	506	
Belgium	505	
Latvia	502	
France	499	
Denmark	498	
United States	**497**	
Spain	496	
Lithuania	496	
Norway	495	
Hungary	494	
Italy	494	
Croatia	491	
Luxembourg	491	
Portugal	489	
Russian Federation	486	▼
Sweden	485	▼
Iceland	478	▼
Slovak Republic	471	▼
Israel	470	▼
Greece	467	▼
Turkey	463	▼
United Arab Emirates	448	▼
Bulgaria	446	▼
Chile	445	▼
Serbia, Republic of	445	▼
Thailand	444	▼
Romania	439	▼
Cyprus	438	▼
Costa Rica	429	▼
Kazakhstan	425	▼
Malaysia	420	▼
Uruguay	416	▼
Mexico	415	▼
Montenegro, Republic of	410	▼
Jordan	409	▼
Argentina	406	▼
Brazil	405	▼
Colombia	399	▼
Tunisia	398	▼
Albania	397	▼
Qatar	384	▼
Indonesia	382	▼
Peru	373	▼
U.S. state education systems		
Massachusetts	527	▲
Connecticut	521	▲
Florida	485	

▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2012 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported on a scale from 0 to 1,000. All average scores reported as higher or lower than the U.S. average score are different at the .05 level of statistical significance. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table S2 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Figure 3. Percentage of 15-year-old students performing at PISA reading literacy proficiency levels 5 and above and below level 2, by education system: 2012



Below level 2
Levels 5 and above
Rounds to zero.
! Interpret with caution. Estimate is unstable due to high coefficient of variation.
‡ Reporting standards not met.
* $p < .05$. Significantly different from the U.S. percentage at the .05 level of significance.
NOTE: Education systems are ordered by 2012 percentages of 15-year-olds in levels 5 and above. To reach a particular proficiency level, a student must correctly answer a majority of items at that level. Students were classified into reading proficiency levels according to their scores. Cut scores for each proficiency level can be found in table A-1 in appendix A. The OECD average is the average of the national percentages of the OECD member countries, with each country weighted equally. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table R1b available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Table 3. Average scores of 15-year-old students on PISA reading literacy scale, by education system: 2012

Education system	Average score	Education system	Average score
OECD average	496		
Shanghai-China	570 ▲	Iceland	483 ▼
Hong Kong-China	545 ▲	Slovenia	481 ▼
Singapore	542 ▲	*Lithuania*	477 ▼
Japan	538 ▲	Greece	477 ▼
Korea, Republic of	536 ▲	Turkey	475 ▼
Finland	524 ▲	*Russian Federation*	475 ▼
Ireland	523 ▲	Slovak Republic	463 ▼
Canada	523 ▲	*Cyprus*	449 ▼
Chinese Taipei	523 ▲	*Serbia, Republic of*	446 ▼
Poland	518 ▲	*United Arab Emirates*	442 ▼
Estonia	516 ▲	Chile	441 ▼
Liechtenstein	516 ▲	*Thailand*	441 ▼
New Zealand	512 ▲	*Costa Rica*	441 ▼
Australia	512 ▲	*Romania*	438 ▼
Netherlands	511 ▲	*Bulgaria*	436 ▼
Switzerland	509 ▲	Mexico	424 ▼
Macao-China	509 ▲	*Montenegro, Republic of*	422 ▼
Belgium	509 ▲	*Uruguay*	411 ▼
Vietnam	508	*Brazil*	410 ▼
Germany	508 ▲	*Tunisia*	404 ▼
France	505	*Colombia*	403 ▼
Norway	504	*Jordan*	399 ▼
United Kingdom	499	*Malaysia*	398 ▼
United States	**498**	*Indonesia*	396 ▼
Denmark	496	*Argentina*	396 ▼
Czech Republic	493	*Albania*	394 ▼
Italy	490	*Kazakhstan*	393 ▼
Austria	490	*Qatar*	388 ▼
Latvia	489 ▼	*Peru*	384 ▼
Hungary	488		
Spain	488 ▼		
Luxembourg	488 ▼	**U.S. state education systems**	
Portugal	488		
Israel	486	*Massachusetts*	527 ▲
Croatia	485 ▼	*Connecticut*	521 ▲
Sweden	483 ▼	*Florida*	492

▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2012 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported on a scale from 0 to 1,000. All average scores reported as higher or lower than the U.S. average score are different at the .05 level of statistical significance. Italics indicate non-OECD countries and education systems. Results for Connecticut, Florida, and Massachusetts are for public school students only. The standard errors of the estimates are shown in table R2 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Table 4. Average scores and changes in average scores of U.S. 15-year-old students on PISA mathematics, science, and literacy scales: 2000, 2003, 2006, 2009, and 2012

	Average score					Change in average score			
Subject	2000	2003	2006	2009	2012	2000–2012	2003–2012	2006–2012	2009–2012
Mathematics literacy	†	483	474	487	481	†	○	○	○
Science literacy	†	†	489	502	497	†	†	○	○
Reading literacy	504	495	—	500	498	○	○	—	○

○ Average score in 2012 is not measurably different than average score in comparison year.
— Not available. PISA 2006 reading literacy results are not reported for the United States because of an error in printing the test booklets and comparisons are not possible.
† Not applicable. Although mathematics was assessed in 2000 and science was assessed in 2000 and 2003, because the mathematics framework was revised for PISA 2003 and the science framework was revised for 2006, it is possible to look at changes in mathematics only from 2003 forward and in science only from 2006 forward.
NOTE: All average scores reported as higher or lower than the comparison year are different at the .05 level of statistical significance. The standard errors of the estimates are shown in table T1 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2000, 2003, 2006, 2009, 2012.

Table 5. Average scores of 15-year-old students on PISA computer-based mathematics literacy scale, by education system: 2012

Education system	Average score		Education system	Average score	
OECD average	497				
Singapore	566	▲	Norway	498	
Shanghai-China	562	▲	Slovak Republic	497	
Korea, Republic of	553	▲	Denmark	496	
Hong Kong-China	550	▲	Ireland	493	
Macao-China	543	▲	Sweden	490	
Japan	539	▲	*Russian Federation*	489	
Chinese Taipei	537	▲	Poland	489	
Canada	523	▲	Portugal	489	
Estonia	516	▲	Slovenia	487	▼
Belgium	512	▲	Spain	475	▼
Germany	509	▲	Hungary	470	▼
France	508		Israel	447	▼
Australia	508	▲	*United Arab Emirates*	434	▼
Austria	507		Chile	432	▼
Italy	499		*Brazil*	421	▼
United States	**498**		*Colombia*	397	▼

▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: The computer-based mathematics literacy assessment was an optional assessment for education systems in 2012. Education systems are ordered by 2012 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported on a scale from 0 to 1,000. All average scores reported as higher or lower than the U.S. average score are different at the .05 level of statistical significance. Italics indicate non-OECD countries and education systems. The standard errors of the estimates are shown in table CM2 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Table 6. Average scores of 15-year-old students on PISA computer-based reading literacy scale, by education system: 2012

Education system	Average score	Education system	Average score
OECD average	497 ▼		
Singapore	567 ▲	Sweden	498 ▼
Korea, Republic of	555 ▲	Denmark	495 ▼
Hong Kong-China	550 ▲	Germany	494 ▼
Japan	545 ▲	Portugal	486 ▼
Canada	532 ▲	Austria	480 ▼
Shanghai-China	531 ▲	Poland	477 ▼
Estonia	523 ▲	Slovak Republic	474 ▼
Australia	521	Slovenia	471 ▼
Ireland	520	Spain	466 ▼
Chinese Taipei	519	*Russian Federation*	466 ▼
Macao-China	515	Israel	461 ▼
United States	**511**	Chile	452 ▼
France	511	Hungary	450 ▼
Italy	504	*Brazil*	436 ▼
Belgium	502	*United Arab Emirates*	407 ▼
Norway	500 ▼	*Colombia*	396 ▼

▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: The computer-based reading literacy assessment was an optional assessment for education systems in 2012. Education systems are ordered by 2012 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported on a scale from 0 to 1,000. All average scores reported as higher or lower than the U.S. average score are different at the .05 level of statistical significance. Italics indicate non-OECD countries and education systems. The standard errors of the estimates are shown in table CM2 available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014024.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

References

Australian Council for Educational Research (ACER). (2011). *PISA 2012 Main Survey Test Administrator's Manual (Core PISA)*. Camberwell: Author.

Judkins, D.R. (1990). Fay's Method for Variance Estimation. *Journal of Official Statistics 6*(3): 223-239.

Kastberg, D., Roey, S., Lemanski, N., Chan, J.Y., and Murray, G. (forthcoming). *Technical Report and User Guide for the Program for International Student Assessment (PISA).* U.S. Department of Education, National Center for Education Statistics, Washington, DC: U.S. Government Printing Office.

Krenzke, T., Roey, S., Dohrmann, S., Mohadjer, L., Haung, W., Kaufman, S., and Seastrom, M. (2006). Tactics for Reducing the Risk of Disclosure Using the NCES DataSwap Software. *Proceedings of the Survey Research Methods Section 2006*. Alexandria, VA: American Statistical Association.

Organization for Economic Cooperation and Development (OECD). (1999). *Measuring Student Knowledge and Skills: A New Framework for Assessment*. Paris: Author.

Organization for Economic Cooperation and Development (OECD). (2010). *PISA 2009 Results: What Students Know and Can Do—Student Performance in Reading, Mathematics and Science (Volume I).* Paris: Author.

Organization for Economic Cooperation and Development (OECD). (2013). *PISA 2012 Assessment Framework—Key Competencies in Reading, Mathematics and Science*. Paris: Author.

Organization for Economic Cooperation and Development (OECD). (forthcoming). *PISA 2012 Technical Report*. Paris: Author.

This page intentionally left blank