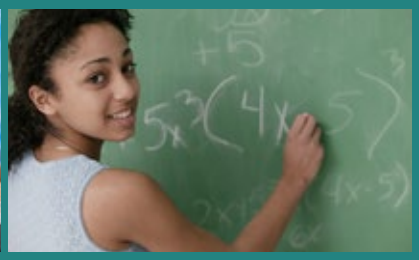
Performance of U.S. 15-Year-Old Students in Science, Reading, and Mathematics Literacy in an International Context

First Look at PISA 2015

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DECEMBER 2016

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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 science, reading, and mathematics 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 73 education systems in 2015.[1] The United States has participated in every cycle of PISA since its inception in 2000. In 2015, Massachusetts, North Carolina, and Puerto Rico also participated separately from the nation. Of these three, Massachusetts previously participated in PISA 2012.

What PISA Measures

PISA's goal is to assess students' preparation for the challenges of life as young adults. The study assesses the application of knowledge in science, reading, and mathematics 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 learned both in and outside of school. For example, when assessing science, PISA examines how well 15-year-old students can understand, use, and reflect on science for a variety of real-life problems and settings that they may encounter in and out of school.

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. Each subject is a major area once every three cycles. Science was the major subject area in 2015, as it was in 2006. In 2015, science, reading, and mathematics literacy were assessed through a computer-based assessment in the majority of countries, including the United States.

In addition to these core assessments, education systems could participate in two optional assessment components: collaborative problem solving and financial literacy. The United States, Massachusetts, and North Carolina administered the computer-based assessment with both optional assessments while Puerto Rico administered the paper-based core assessment without the optional assessments. This report addresses results only of the science,

[1] Of the 73 education systems that participated in PISA 2015, results for three of these—Argentina, Kazakhstan, and Malaysia—are not included due to technical issues with their samples that prevent results from being discussed in this report. For more information, see OECD (2016d).

mathematics, and reading literacy assessments. Results of the collaborative problem solving and financial literacy assessments will be released separately at a later date.

PISA includes questionnaires that provide contextual information for interpreting student achievement. In 2015, the United States administered student, school, and teacher questionnaires. Students answered questions about their background, attitudes towards science, and learning strategies, among other topics. The principal of each participating school completed a school questionnaire that provided information on the school's demographics and learning environment. Lastly, up to 10 science teachers and 15 nonscience teachers per school completed questionnaires on teaching practices, beliefs about teaching, and their qualifications and backgrounds. Massachusetts and North Carolina administered all three questionnaires while Puerto Rico administered the student and school questionnaires only.

Visit http://nces.ed.gov/surveys/pisa for more information on the PISA assessments, including information on how the assessments were designed and examples of PISA test items and questionnaires. PISA questions from the current and previous cycles can also be found at https://www.oecd.org/pisa/pisaproducts/pisa-test-questions.htm.

Science Literacy

In PISA 2015, the major subject was science literacy, defined as

> *the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person, therefore, is willing to engage in reasoned discourse about science and technology which requires the competencies to:*
>
> 1. ***Explain phenomena scientifically:*** *Recognize, offer, and evaluate explanations for a range of natural and technological phenomena.*
> 2. ***Evaluate and design scientific inquiry:*** *Describe and appraise scientific investigations and propose ways of addressing questions scientifically.*
> 3. ***Interpret data and evidence scientifically:*** *Analyze and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions* (OECD 2016a, p. 7).

More specifically, the PISA science assessment measures three science content categories and three science process categories:

Science content categories (OECD 2016a, p. 18):

- **Physical systems:** Are students able to understand the structures, properties, and chemical changes of matter, motion and forces, and energy and interactions between energy and matter?
- **Living systems:** Do students have knowledge of cells, the concept of an organism, human systems, populations, ecosystems, and biospheres?
- **Earth and space systems:** Are 15-year-olds able to comprehend the history and scale of the Universe and the Earth system's structures, energy, and changes?

Science process categories (OECD 2016a, pp. 8–16):

- **Explain phenomena scientifically:** Can 15-year-olds recall appropriate scientific knowledge, identify explanatory models, make and justify predictions and hypotheses, and explain the potential implications of scientific knowledge for society?
- **Evaluate and design scientific enquiry:** Can students identify the questions explored in a given scientific study, propose and evaluate ways of exploring such questions, and describe and evaluate the methods scientists use to ensure data quality?
- **Interpret data and evidence scientifically:** Are 15-year-olds able to analyze and interpret data to draw appropriate conclusions, identify the assumptions in science-related texts, recognize when arguments are based on scientific evidence and theory, and evaluate scientific arguments from different sources?

Science literacy is reported in terms of an overall scale score and seven subscale scores (all of which are on a scale of 0-1,000).[2] For the overall science literacy scale, results are reported also in terms of the percentage of students performing at each of seven proficiency levels. Exhibit 1 describes the seven science literacy proficiency levels and the cut scores associated with each proficiency level.

[2] Science literacy subscale score results by content and process categories can be found online at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp.

Exhibit 1. Description of PISA proficiency levels on the science literacy scale: 2015

Proficiency level and lower cut score	Task descriptions
Level 6 708	At Level 6, students can draw on a range of interrelated scientific ideas and concepts from the physical, life and earth and space sciences and use content, procedural and epistemic knowledge in order to offer explanatory hypotheses of novel scientific phenomena, events, and processes or to make predictions. In interpreting data and evidence, they are able to discriminate between relevant and irrelevant information and can draw on knowledge external to the normal school curriculum. They can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations. Level 6 students can evaluate competing designs of complex experiments, field studies or simulations and justify their choices.
Level 5 633	At Level 5, students can use abstract scientific ideas or concepts to explain unfamiliar and more complex phenomena, events, and processes involving multiple causal links. They are able to apply more sophisticated epistemic knowledge to evaluate alternative experimental designs and justify their choices and use theoretical knowledge to interpret information or make predictions. Level 5 students can evaluate ways of exploring a given question scientifically and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data.
Level 4 559	At Level 4, students can use more complex or more abstract content knowledge, which is either provided or recalled, to construct explanations of more complex or less familiar events and processes. They can conduct experiments involving two or more independent variables in a constrained context. They are able to justify an experimental design, drawing on elements of procedural and epistemic knowledge. Level 4 students can interpret data drawn from a moderately complex data set or less familiar context, draw appropriate conclusions that go beyond the data, and provide justifications for their choices.
Level 3 484	At Level 3, students can draw upon moderately complex content knowledge to identify or construct explanations of familiar phenomena. In less familiar or more complex situations, they can construct explanations with relevant cueing or support. They can draw on elements of procedural or epistemic knowledge to carry out a simple experiment in a constrained context. Level 3 students are able to distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim.
Level 2 410	At Level 2, students are able to draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation, interpret data, and identify the question being addressed in a simple experimental design. They can use basic or everyday scientific knowledge to identify a valid conclusion from a simple data set. Level 2 students demonstrate basic epistemic knowledge by being able to identify questions that could be investigated scientifically.
Level 1a 335	At Level 1a, students are able to use basic or everyday content and procedural knowledge to recognize or identify explanations of simple scientific phenomenon. With support, they can undertake structured scientific enquiries with no more than two variables. They are able to identify simple causal or correlational relationships and interpret graphical and visual data that require a low level of cognitive demand. Level 1a students can select the best scientific explanation for given data in familiar personal, local and global contexts.
Level 1b 261	At Level 1b, students can use basic or everyday scientific knowledge to recognize aspects of familiar or simple phenomenon. They are able to identify simple patterns in data, recognize basic scientific terms and follow explicit instructions to carry out a scientific procedure.

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 can be found at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp. 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), 2015.

Reading Literacy

In PISA 2015, reading literacy is defined as

> *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 2016b, p. 9).

Reading literacy is also reported both in terms of proficiency levels and an overall scale score (on a scale of 0–1,000). Exhibit 2 describes the seven reading literacy proficiency levels and their respective cut scores. Since reading literacy was a minor domain in 2015, no subscale scores are reported.[3]

[3] For readers interested in reading literacy subscale scores produced in previous cycles, please see the PISA 2009 results at http://nces.ed.gov/surveys/pisa/.

Exhibit 2. Description of PISA proficiency levels on reading literacy scale: 2015

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 can be found at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp. Scores are reported on a scale f om 0 to 1,000.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015

Mathematics Literacy

In PISA 2015 mathematics literacy is 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 2016c, p. 5).

As with other subject areas, mathematics literacy is reported both in terms of proficiency levels and an overall scale score (on a scale of 0–1,000). Exhibit 3 describes the six mathematics literacy proficiency levels and their respective cut scores. Since mathematics literacy was a minor subject in 2015, no subscale scores are reported.[4]

[4] For readers interested in mathematics literacy subscale scores produced in previous cycles, please see the PISA 2012 results at http://nces.ed.gov/surveys/pisa/pisa2012/index.asp.

Exhibit 3. Description of PISA proficiency levels on the mathematics literacy scale: 2015

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 can be found at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp. 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), 2015.

Computer-Based Assessment

In 2012, PISA began offering parts of the assessment through a computer-based system. For those countries, like the United States, that wanted to start the transition to a computer-based assessment, the 2012 assessment cycle included both paper-based and computer-based components. All sampled students took the paper-and-pencil based version of the reading, mathematics, and science literacy assessment. In addition, some countries (including the United States), chose to administer separate optional computer-based reading and mathematics literacy assessments to a subsample of students. For the 2015 cycle, all parts of the PISA assessment moved to a completely computer-based assessment platform (although some participating education systems chose to administer PISA in the traditional paper-and-pencil format).

The 2015 field trial included a mode effect study to determine whether or not the paper-based assessment and the fully computer-based assessment were psychometrically comparable and could be reported on the same scale. To do this, the mode effect study pooled data from all the participating education systems to examine whether differences in the delivery mode could be detected in the student outcomes. The study found few systematic differences between computer-based and paper-based student achievement at the international level. Although some differences between the computer-based and paper-based results were found among students who used computers infrequently or not at all, this group accounted for about 10 percent of students across countries. Overall, the mode effect portion of the field trial study found that paper-based items were comparable to their computer-based counterparts and the level of difficulty of items varied little between paper-based and computer-based modes (OECD 2016d; see also OECD forthcoming). This finding provided reasonable assurance that scores from prior cycles could be compared with those from the 2015 cycle without the need for any adjustments or recalculations, and that scores derived from the paper-based version of PISA and the computer-based version can be reported on the same scale.

For education systems that administered the computer-based assessment in the 2015 cycle, all parts of the study were computer-based, including the school, teacher, and student questionnaires. In 2015, some 57 out of 70 education systems, including the United States, chose to administer the computer-based assessment.[5] Although Massachusetts and North Carolina also administered the computer-based assessment, Puerto Rico opted to administer the paper-based assessment.

[5] A list of education systems that administered PISA 2015 on computer and on paper is available in the OECD's PISA 2015 International Report: Volume 1 (OECD 2016d).

Reporting PISA 2015 Results

This report presents performance on PISA 2015 in science, reading, and mathematics literacy from a U.S. perspective. Results are presented for the 70 education systems that participated in PISA 2015 as well as Massachusetts, North Carolina, and Puerto Rico. The U.S. national results include both public and private schools. Massachusetts and North Carolina chose to sample public schools only. Puerto Rico sampled both public and private schools. To maintain the trend with previous administrations, PISA U.S. national results do not include Puerto Rico.

In this report, results for each participating education system are presented in terms of average scale scores, percentile scores, and the percentage of 15-year-old students reaching selected proficiency levels, comparing the United States with other participating education systems. For percentile scores, the threshold (or cut) scores for the 10th percentile of the distribution of student performance (i.e., the bottom 10 percent of students) and the 90th percentile (i.e., the top 10 percent of students) are shown, providing a view of student performance that goes beyond the average score. The percentile ranges are specific to each education system's distribution of scores, enabling users to compare cut scores across education systems. For proficiency levels, results are reported in terms of the percentage reaching levels 5 and 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 (see exhibits 1–3 for descriptions of the PISA proficiency levels). Conversely, students performing below level 2 are below what the OECD calls "a baseline level of proficiency that all young adults should be expected to attain in order to take advantage of further learning opportunities and participate fully in the social, economic and civic life of modern societies in a globalized world" (OECD 2016d, p. 16).[6] This report also presents U.S. trends over time in science, reading, and mathematics literacy. Results for the collaborative problem solving and financial literacy assessments will be released in 2017.

In reporting PISA results, the OECD differentiates between OECD member countries, of which there are 35, and all other participating education systems, some of which are countries and some of which are subnational entities (i.e., cities, states, provinces, and territories). 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 the 35 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 2015, Massachusetts, North Carolina, and Puerto Rico—are reported in appendices of the OECD PISA reports, but are not discussed in the report text.

[6] The data in this report focus on the highest- and lowest-level skills and knowledge along the science, reading, and mathematics literacy proficiency scales. For a full description of the percentage of students at every proficiency level, please see the data tables and figures at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp.

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, of which there are 70 total. Massachusetts, North Carolina, and Puerto Rico are presented in a separate part of the tables and figures; results for these three education systems 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 2015 results and is by no means comprehensive. For in-depth results using PISA 2015 data, please see http://nces.ed.gov/surveys/pisa/pisa2015/index.asp, which includes additional findings from the science, reading, and mathematics literacy assessments, science subscales, proficiency levels, percentile cut-scores, trends in performance, performance by students' gender, race and ethnicity, and socioeconomic status, as well as more detailed results for Massachusetts, North Carolina, and Puerto Rico. Detailed notes on technical aspects of PISA 2015, including sample design, test design, and scoring, with an emphasis on the U.S. implementation, can be found on the NCES website at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp. In addition, PISA results are available through the PISA International Data Explorer (IDE) at https://nces.ed.gov/surveys/pisa/idepisa/. The PISA IDE provides anyone with an internet connection the opportunity to create statistical tables and charts and conduct regression analyses. These analyses can be performed on student performance as well as contextual data, including student demographics, instructional experiences, and school characteristics, across all participating education systems.

All statistically significant differences described in this report were tested at the .05 level of statistical significance. 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 the technical notes at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp for additional details on interpreting statistical significance). No adjustments were made for multiple comparisons.

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Selected Findings

U.S. Performance in Science Literacy

- In 2015, average scores of 15-year-olds in science literacy ranged from 556 in Singapore to 332 in the Dominican Republic. The U.S. average score was 496, which was not measurably different than the OECD average of 493. The U.S. average was lower than 18 education systems, higher than 39, and not measurably different than 12 education systems. It was lower than the average in Massachusetts (529), not measurably different than in North Carolina (502), and higher than in Puerto Rico (403) (table 1).
- Education systems varied in the range in performance between their highest performing students and their lowest performing students. The difference in science literacy scores between the highest performing (90th percentile) and low performing (10th percentile) students in the United States was 258 score points, which was not measurably different than the average difference across the OECD countries (247 score points). It was smaller than in 4 education systems, not measurably different than in 26, and larger than in 39 education systems. The U.S. score difference was not measurably different than the gap in Massachusetts (253) and North Carolina (252), and larger than the gap in Puerto Rico (226) (figure 1).
- The distribution of students across the seven PISA science literacy proficiency levels in 2015 showed that the percentages of top performing 15-year-old students (those scoring at proficiency levels 5 and above) ranged from 24 percent in Singapore to rounding to 0 percent in 10 education systems. Nearly one in ten U.S. 15-year-olds (9 percent) scored at proficiency levels 5 and above, which was not measurably different than the OECD average (8 percent). The U.S. percentage of students at the top levels was lower than in 14 education systems, higher than in 34, and not measurably different than in 15 education systems. The U.S. percentage at the top levels was lower than in Massachusetts (14 percent), and not measurably different than in North Carolina (9 percent) (figure 2; see also exhibit 1).
- The percentages of low performing 15-year-old students (those scoring below proficiency level 2)—which is considered below the baseline of proficiency by the OECD—ranged from 6 percent in Vietnam to 86 percent in the Dominican Republic. In the United States, one in five 15-year-olds (20 percent) scored below level 2 in science literacy, which was not measurably different than the OECD average (21 percent). The percentage of low performers in the United States was higher than in 21 education systems, lower than in 37, and not measurably different than in 11 education systems. It was higher than the percentage in Massachusetts (12 percent), not measurably different than in North Carolina (18 percent), and lower than in Puerto Rico (55 percent) (figure 2; see also exhibit 1).

U.S. Performance in Reading Literacy

- In 2015, the average scores of U.S. 15-year-olds in reading literacy was 497, and ranged among the other education systems from 535 in Singapore to 347 in Lebanon. The U.S. average was lower than the averages in 14 education systems, higher than in 42, and not measurably different than in 13 education systems and the OECD average. The overall U.S. average was lower than the average in Massachusetts (527), not measurably different than in North Carolina (500), and higher than in Puerto Rico (410) (table 2).
- The distribution of student scores in reading literacy showed that the U.S. score difference between the 90th and 10th percentiles (259 points) was larger than the difference in 30 education systems, not measurably different than in 30 other systems, and smaller than in 9. The U.S. difference between the 90th and 10th percentiles was not measurably different than in Massachusetts (243), North Carolina (251), and Puerto Rico (250) (figure 3).
- In reading literacy, the percentage of top performing students (those scoring at proficiency levels 5 and above) ranged from 18 percent in Singapore to rounding to 0 percent in 5 education systems. One in ten U.S. 15-year-olds (10 percent) scored at proficiency levels 5 and above in reading literacy in 2015. The percentage of U.S. top performers was higher than in more than half of the other educations systems (40 of 69), not measurably different than in 16 systems and the OECD average, and lower than in 8 systems. The percentage of top performers in the United States overall was lower than the percentage in Massachusetts (14 percent), not measurably different than in North Carolina (10 percent), and higher than in Puerto Rico (1 percent) (figure 4; see also exhibit 2).
- The percentages of low performing 15-year-old students (those scoring below proficiency level 2) ranged from 9 percent in Hong Kong (China) to 79 percent in Algeria. Nearly one in five U.S. 15-year-olds (19 percent) scored below level 2, which was not measurably different than the OECD average (20 percent). This percentage was higher than in 14 education systems, lower than in 36, and not measurably different than in 19 education systems. The percentage of low performers in in the United States overall was higher than the percentage in Massachusetts (11 percent), not measurably different than North Carolina (18 percent) and lower than in Puerto Rico (50 percent) (figure 4; see also exhibit 2).

U.S. Performance in Mathematics Literacy

- Average mathematics literacy scores in 2015 ranged from 564 in Singapore to 328 in the Dominican Republic, with the U.S. average score at 470. The U.S. average was lower than in more than half of the other education systems (36 of 69) as well as the OECD average, higher than in 28 education systems, and not measurably different than in 5. It was lower than the average in Massachusetts (500), not measurably different than in North Carolina (471), and higher than in Puerto Rico (378) (table 3).

- The difference in mathematics literacy scores between students at the 90th percentile of performance and those at the 10th percentile in the United States was 230 points, which was larger than the difference in 15 education systems, smaller than in 20, and not measurably different than in 34 education systems. The U.S. difference was not measurably different than the difference between the highest and lowest performers in Massachusetts (218) and North Carolina (225) and was larger than in Puerto Rico (197) (figure 5).
- In 2015, the percentage of top performing students in mathematics literacy (those scoring at levels 5 and above) ranged from 35 percent in Singapore to rounding to 0 percent in five education systems. Six percent of U.S. 15-year-olds scored at proficiency levels 5 and above, which was lower than the percentages in 36 educations and the OECD average, higher than in 24 education systems, and not measurably different than in 6 systems. The overall U.S. percentage of top performers was lower than the percentage in Massachusetts (10 percent) and was not measurably different than in North Carolina (6 percent) (figure 6; see also exhibit 3).
- The percentage of low performing students in PISA mathematics literacy (below proficiency level 2) ranged from 7 percent in Macau (China) to 91 percent in the Dominican Republic. In the United States, nearly three out of ten of 15-year-old students (29 percent) scored below proficiency level 2, which was higher than the OECD average of 23 percent. The percentage of U.S. low performers was higher than in more than half of the other education systems (35 of 69), lower than in 28 education systems, and not measurably different than in 6 systems. The percentage of low performers in mathematics literacy in the United States overall was larger than in Massachusetts (17 percent), was not measurably different than in North Carolina (29 percent), and smaller than in Puerto Rico (73 percent) (figure 6; see also exhibit 3).

Looking across student performance in science, reading, and mathematics literacy, 15-year-olds in 11 education systems demonstrated higher average scores in all three subjects than students in the United States: Canada, Estonia, Finland, Germany, Hong Kong (China), Japan, Macau (China), New Zealand, Republic of Korea, Singapore, and Slovenia. In addition, 15-year-olds in Massachusetts had higher average scores in all three subjects than 15-year-olds in the United States overall (tables 1, 2, and 3).

U.S. Performance Over Time

- The U.S. average scores in science and reading literacy in 2015 were not measurably different than the average scores observed in previous PISA assessment years with which comparisons can be made (2006, 2009, and 2012 for science literacy; 2000, 2003, 2009, and 2012 for reading literacy). The U.S. average score in mathematics literacy in 2015 was 12 score points lower than the average score in 2012 and 18 score points lower than the average in 2009, but was not measurably different than the average mathematics literacy scores in 2003 and 2006 (table 4).

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Figures and Tables

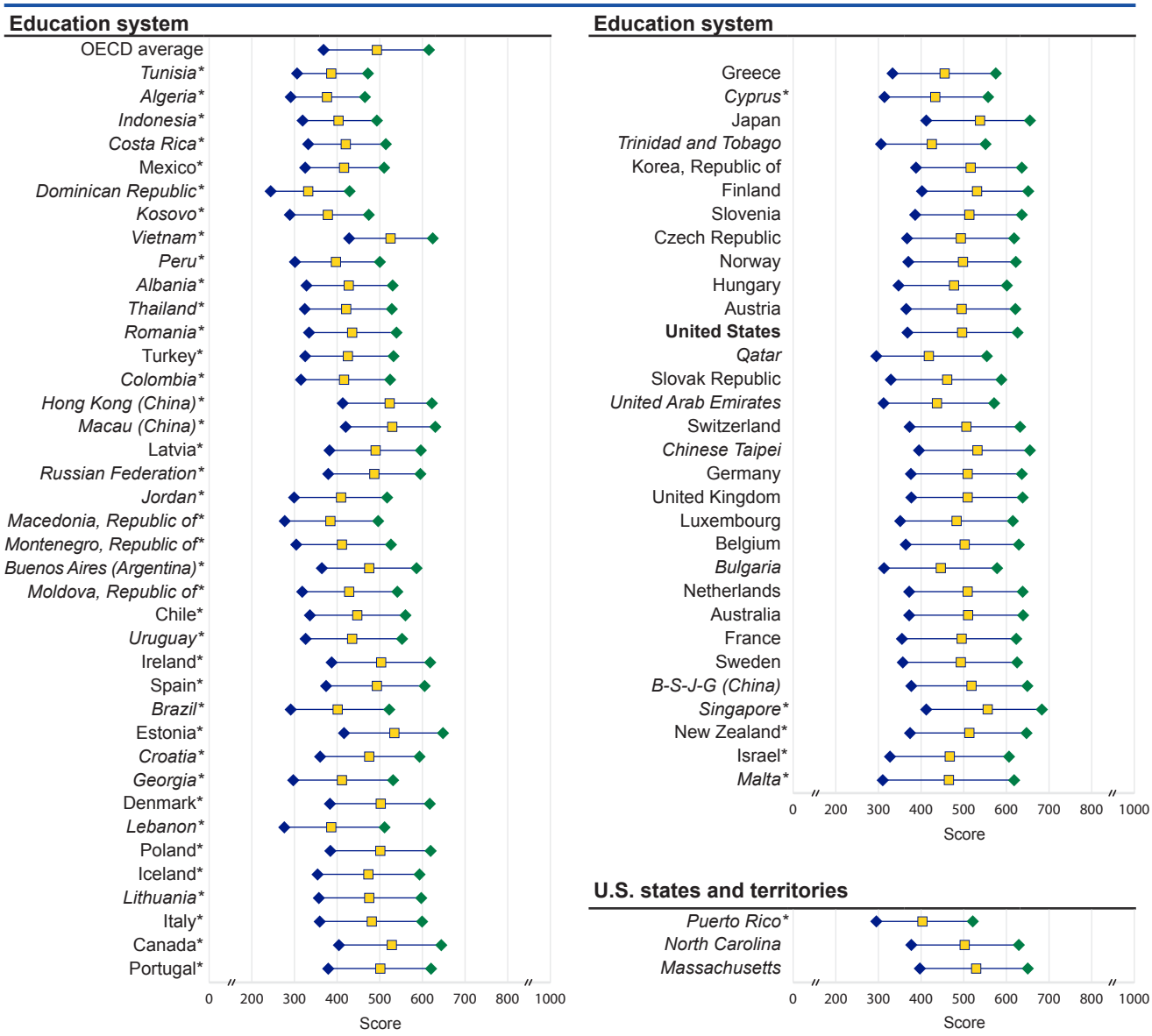
Table 1. Average scores of 15-year-old students on the PISA science literacy scale, by education system: 2015

Education system	Average score
OECD average	493
Singapore	556 ▲
Japan	538 ▲
Estonia	534 ▲
Chinese Taipei	532 ▲
Finland	531 ▲
Macau (China)	529 ▲
Canada	528 ▲
Vietnam	525 ▲
Hong Kong (China)	523 ▲
B-S-J-G (China)	518 ▲
Korea, Republic of	516 ▲
New Zealand	513 ▲
Slovenia	513 ▲
Australia	510 ▲
United Kingdom	509 ▲
Germany	509 ▲
Netherlands	509 ▲
Switzerland	506 ▲
Ireland	503
Belgium	502
Denmark	502
Poland	501
Portugal	501
Norway	498
United States	**496**
Austria	495
France	495
Sweden	493
Czech Republic	493
Spain	493
Latvia	490
Russian Federation	487 ▼
Luxembourg	483 ▼
Italy	481 ▼
Hungary	477 ▼
Lithuania	475 ▼
Croatia	475 ▼
Buenos Aires (Argentina)	475 ▼
Iceland	473 ▼
Israel	467 ▼
Malta	465 ▼
Slovak Republic	461 ▼
Greece	455 ▼
Chile	447 ▼
Bulgaria	446 ▼
United Arab Emirates	437 ▼
Uruguay	435 ▼
Romania	435 ▼
Cyprus	433 ▼
Moldova, Republic of	428 ▼
Albania	427 ▼
Turkey	425 ▼
Trinidad and Tobago	425 ▼
Thailand	421 ▼
Costa Rica	420 ▼
Qatar	418 ▼
Colombia	416 ▼
Mexico	416 ▼
Montenegro, Republic of	411 ▼
Georgia	411 ▼
Jordan	409 ▼
Indonesia	403 ▼
Brazil	401 ▼
Peru	397 ▼
Lebanon	386 ▼
Tunisia	386 ▼
Macedonia, Republic of	384 ▼
Kosovo	378 ▼
Algeria	376 ▼
Dominican Republic	332 ▼

U.S. states and territories	
Massachusetts	529 ▲
North Carolina	502
Puerto Rico	403 ▼

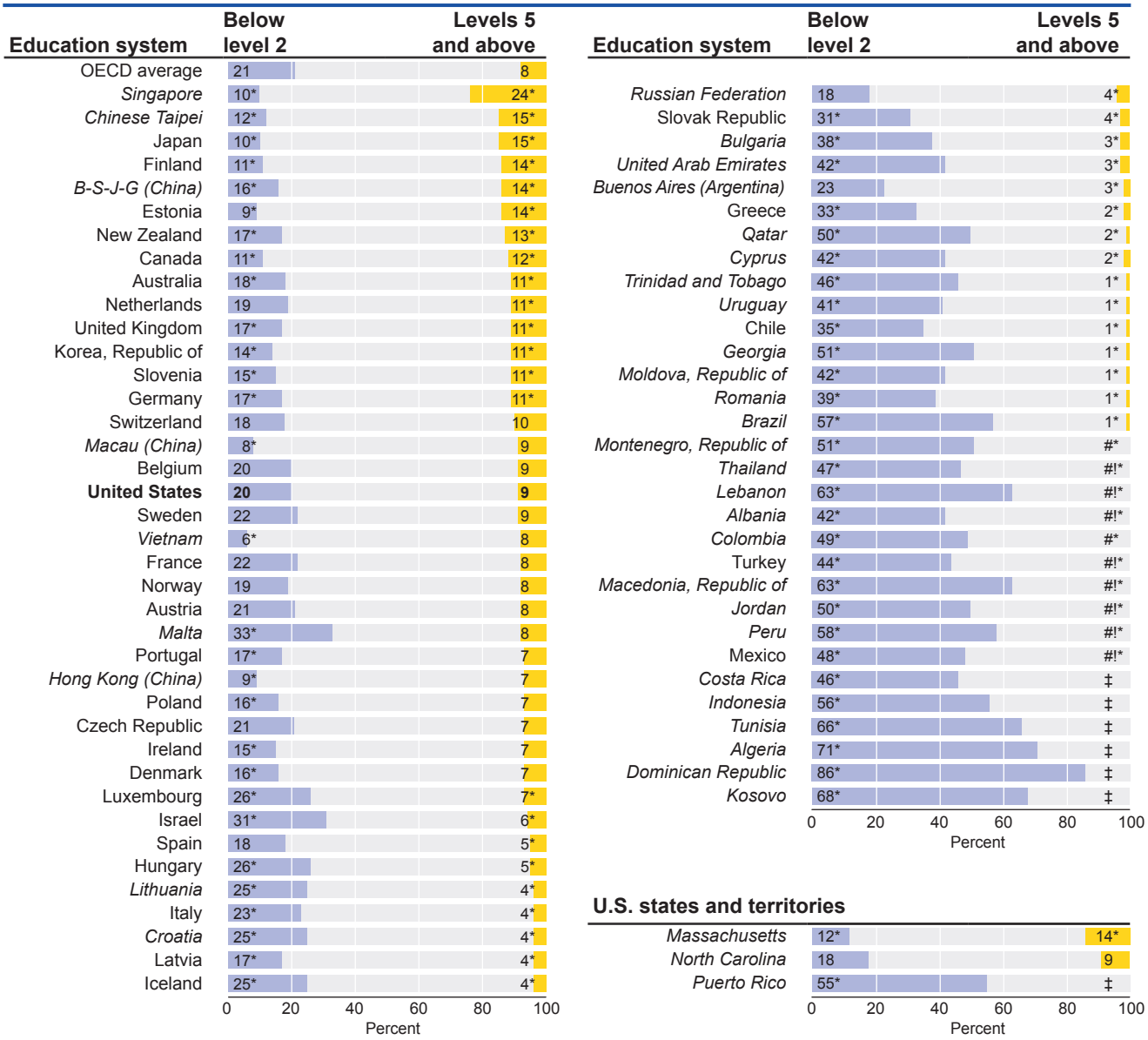
▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2015 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table S1 available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 1. Average scores and 10th and 90th percentile cut scores of 15-year-old students on the PISA science literacy scale, by education system: 2015



* p<.05. Cut score gap is significantly different from the U.S. 90th to 10th percentile cut score gap at the .05 level of significance.
NOTE: Education systems are ordered by cut score gap, from smaller to larger. This table shows the threshold (or cut) scores for the following: (a) 10th percentile— the bottom 10 percent of students; (b) 90th percentile— the top 10 percent of students. The cut score gap for each education system is the difference between its 90th and 10th percentile cut scores. The percentile ranges are specific to each education system's distribution of scores, enabling users to compare cut scores across education systems. 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. Italics indicate non-OECD countries and education systems. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table S1b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 2. Percentage of 15-year-old students performing at PISA science literacy proficiency levels below level 2 and levels 5 and above, by education system: 2015



Below level 2
Levels 5 and above

Rounds to zero.

! Interpret with caution. Estimate is unstable due to high coefficient of variation (>30 percent and <=50 percent).

‡ Reporting standards not met due to coefficient of variation over 50 percent.

* p<.05. Significantly different from the U.S. percentage at the .05 level of significance.

NOTE: Education systems are ordered by percentage of 15-year-olds in Levels 5 and above. To reach a particular proficiency level, students 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 exhibit 1 of this report and in table A-1 available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp. 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table S2b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.

SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

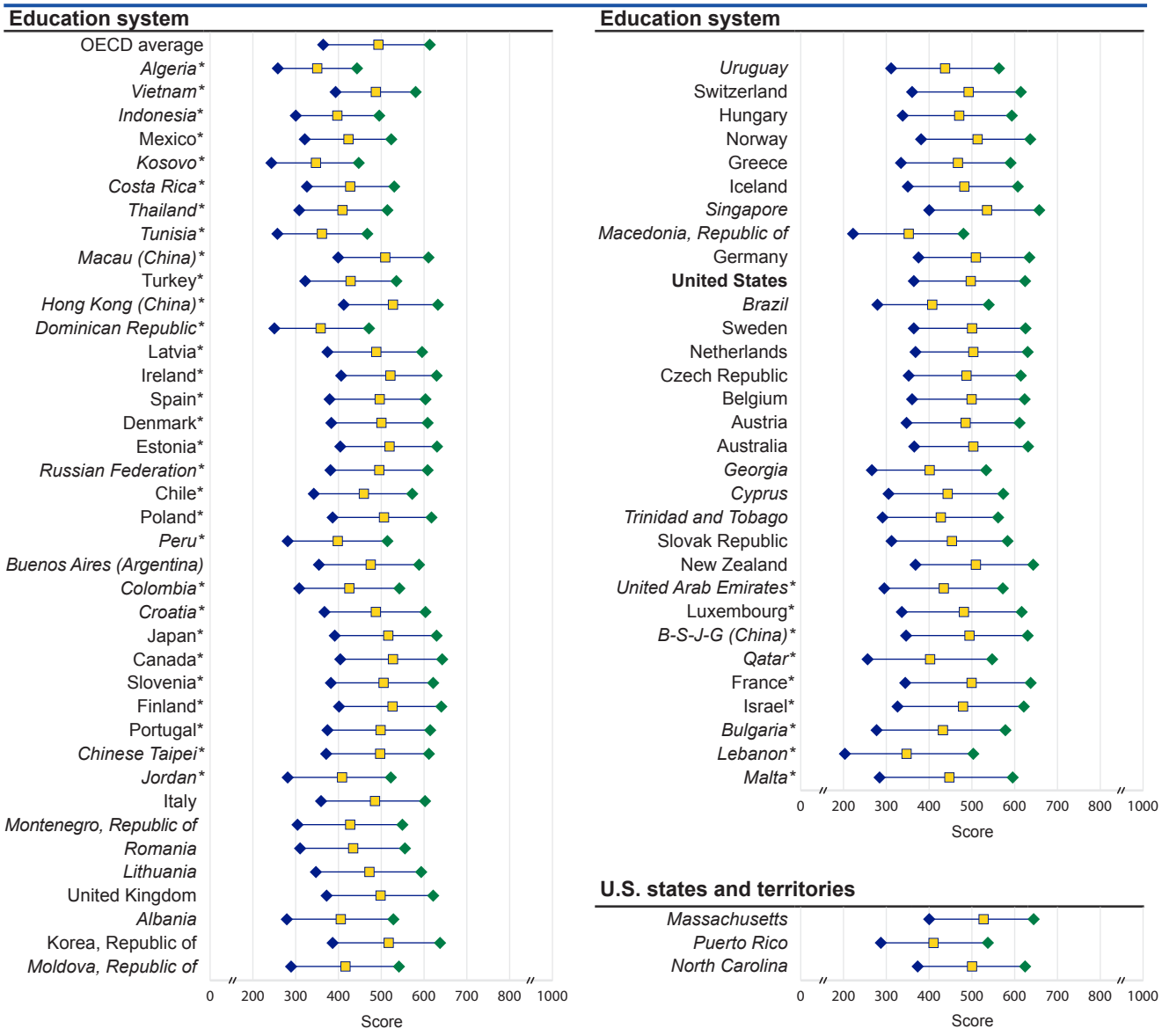
Table 2. Average scores of 15-year-old students on the PISA reading literacy scale, by education system: 2015

Education system	Average score
OECD average	493
Singapore	535 ▲
Hong Kong (China)	527 ▲
Canada	527 ▲
Finland	526 ▲
Ireland	521 ▲
Estonia	519 ▲
Korea, Republic of	517 ▲
Japan	516 ▲
Norway	513 ▲
New Zealand	509 ▲
Germany	509 ▲
Macau (China)	509 ▲
Poland	506 ▲
Slovenia	505 ▲
Netherlands	503
Australia	503
Sweden	500
Denmark	500
France	499
Belgium	499
Portugal	498
United Kingdom	498
Chinese Taipei	497
United States	**497**
Spain	496
Russian Federation	495
B-S-J-G (China)	494
Switzerland	492
Latvia	488 ▼
Czech Republic	487 ▼
Croatia	487 ▼
Vietnam	487 ▼
Austria	485 ▼
Italy	485 ▼
Iceland	482 ▼
Luxembourg	481 ▼
Israel	479 ▼
Buenos Aires (Argentina)	475 ▼
Lithuania	472 ▼
Hungary	470 ▼
Greece	467 ▼
Chile	459 ▼
Slovak Republic	453 ▼
Malta	447 ▼
Cyprus	443 ▼
Uruguay	437 ▼
Romania	434 ▼
United Arab Emirates	434 ▼
Bulgaria	432 ▼
Turkey	428 ▼
Costa Rica	427 ▼
Trinidad and Tobago	427 ▼
Montenegro, Republic of	427 ▼
Colombia	425 ▼
Mexico	423 ▼
Moldova, Republic of	416 ▼
Thailand	409 ▼
Jordan	408 ▼
Brazil	407 ▼
Albania	405 ▼
Qatar	402 ▼
Georgia	401 ▼
Peru	398 ▼
Indonesia	397 ▼
Tunisia	361 ▼
Dominican Republic	358 ▼
Macedonia, Republic of	352 ▼
Algeria	350 ▼
Kosovo	347 ▼
Lebanon	347 ▼

U.S. states and territories	
Massachusetts	527 ▲
North Carolina	500
Puerto Rico	410 ▼

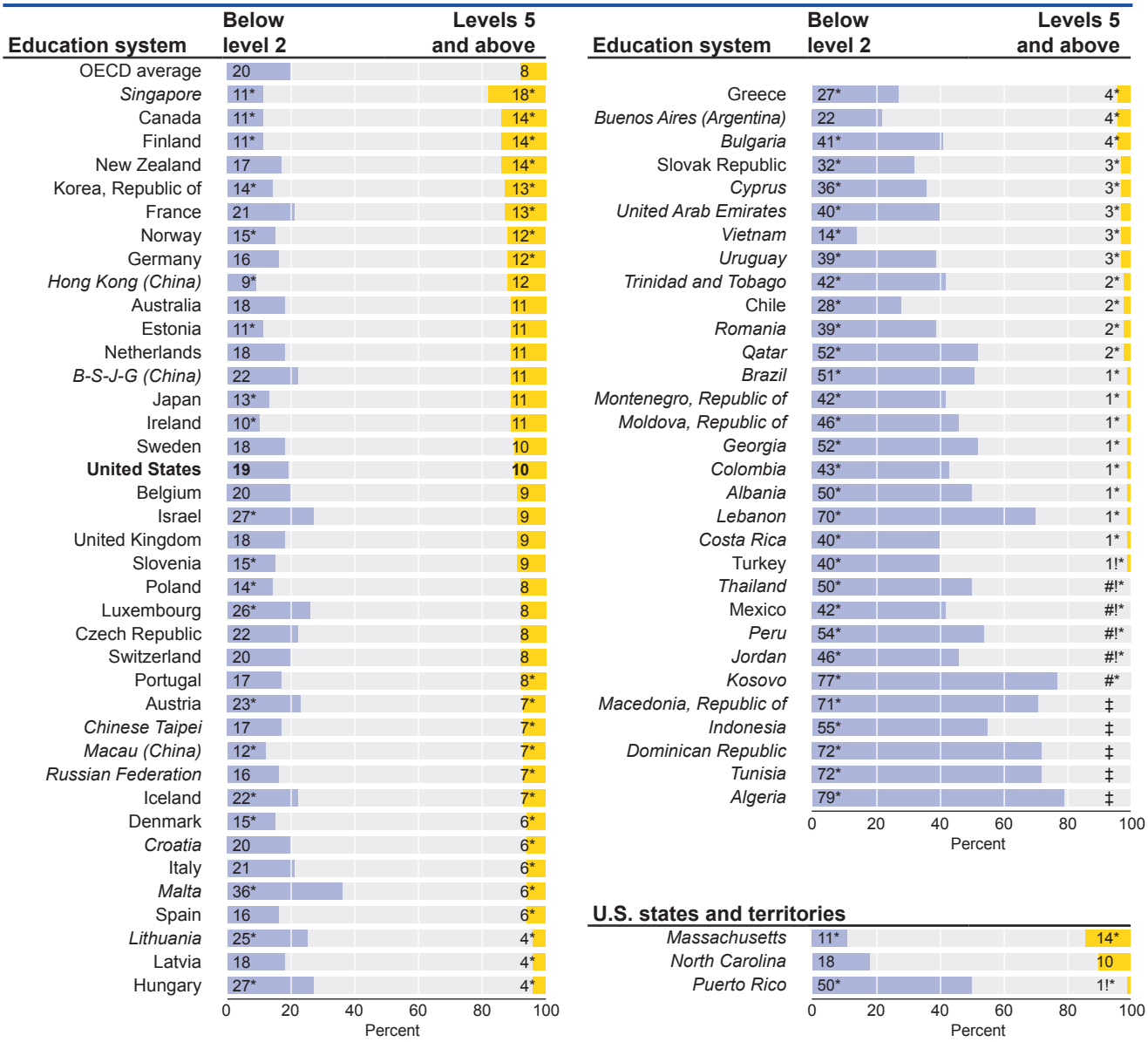
▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2015 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table R1 available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 3. Average scores and 10th and 90th percentile cut scores of 15-year-old students on the PISA reading literacy scale, by education system: 2015



* p<.05. Cut score gap is significantly different from the U.S. 90th to 10th percentile cut score gap at the .05 level of significance.
NOTE: Education systems are ordered by cut score gap, from smaller to larger. This table shows the threshold (or cut) scores for the following: (a) 10th percentile— the bottom 10 percent of students; (b) 90th percentile— the top 10 percent of students. The cut score gap for each education system is the difference between its 90th and 10th percentile cut scores. The percentile ranges are specific to each education system's distribution of scores, enabling users to compare cut scores across education systems. 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. Italics indicate non-OECD countries and education systems. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table R1b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 4. Percentage of 15-year-old students performing at PISA reading literacy proficiency levels below level 2 and levels 5 and above, by education system: 2015



Below level 2
Levels 5 and above

Rounds to zero.

! Interpret with caution. Estimate is unstable due to high coefficient of variation (>30 percent and <=50 percent).

‡ Reporting standards not met due to coefficient of variation over 50 percent.

* p<.05. Significantly different from the U.S. percentage at the .05 level of significance.

NOTE: Education systems are ordered by percentage of 15-year-olds in Levels 5 and above. To reach a particular proficiency level, students 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 exhibit 2 of this report and in table A-1 at http://nces.edu.gov/surveys/pisa/PISA2015/index.asp. 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table R2b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.

SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

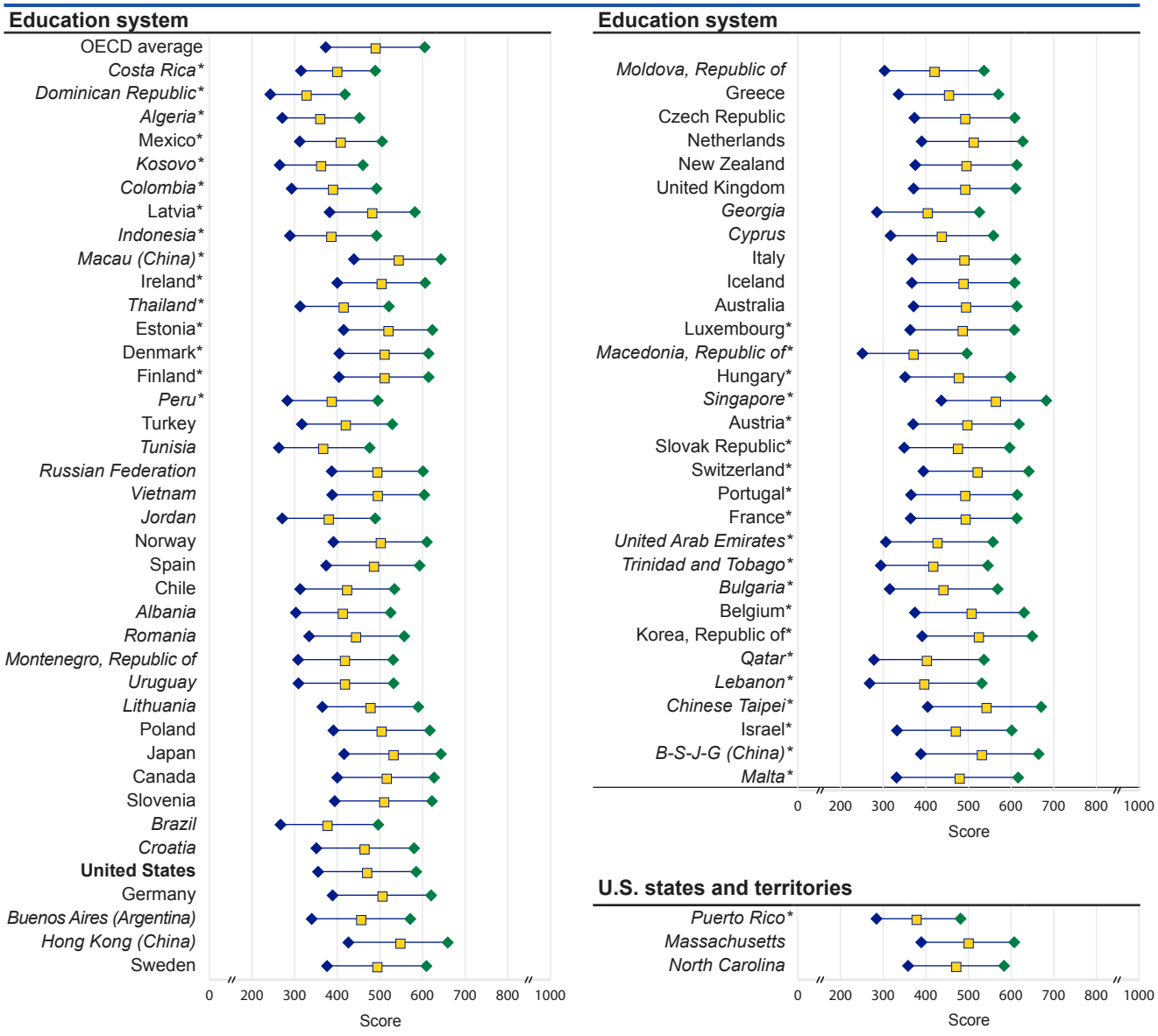
Table 3. Average scores of 15-year-old students on the PISA mathematics literacy scale, by education system: 2015

Education system	Average score
OECD average	490 ▲
Singapore	564 ▲
Hong Kong (China)	548 ▲
Macau (China)	544 ▲
Chinese Taipei	542 ▲
Japan	532 ▲
B-S-J-G (China)	531 ▲
Korea, Republic of	524 ▲
Switzerland	521 ▲
Estonia	520 ▲
Canada	516 ▲
Netherlands	512 ▲
Denmark	511 ▲
Finland	511 ▲
Slovenia	510 ▲
Belgium	507 ▲
Germany	506 ▲
Poland	504 ▲
Ireland	504 ▲
Norway	502 ▲
Austria	497 ▲
New Zealand	495 ▲
Vietnam	495 ▲
Russian Federation	494 ▲
Sweden	494 ▲
Australia	494 ▲
France	493 ▲
United Kingdom	492 ▲
Czech Republic	492 ▲
Portugal	492 ▲
Italy	490 ▲
Iceland	488 ▲
Spain	486 ▲
Luxembourg	486 ▲
Latvia	482 ▲
Malta	479 ▲
Lithuania	478 ▲
Hungary	477
Slovak Republic	475
Israel	470
United States	**470**
Croatia	464
Buenos Aires (Argentina)	456
Greece	454 ▼
Romania	444 ▼
Bulgaria	441 ▼
Cyprus	437 ▼
United Arab Emirates	427 ▼
Chile	423 ▼
Turkey	420 ▼
Moldova, Republic of	420 ▼
Uruguay	418 ▼
Montenegro, Republic of	418 ▼
Trinidad and Tobago	417 ▼
Thailand	415 ▼
Albania	413 ▼
Mexico	408 ▼
Georgia	404 ▼
Qatar	402 ▼
Costa Rica	400 ▼
Lebanon	396 ▼
Colombia	390 ▼
Peru	387 ▼
Indonesia	386 ▼
Jordan	380 ▼
Brazil	377 ▼
Macedonia, Republic of	371 ▼
Tunisia	367 ▼
Kosovo	362 ▼
Algeria	360 ▼
Dominican Republic	328 ▼

U.S. states and territories	
Massachusetts	500 ▲
North Carolina	471
Puerto Rico	378 ▼

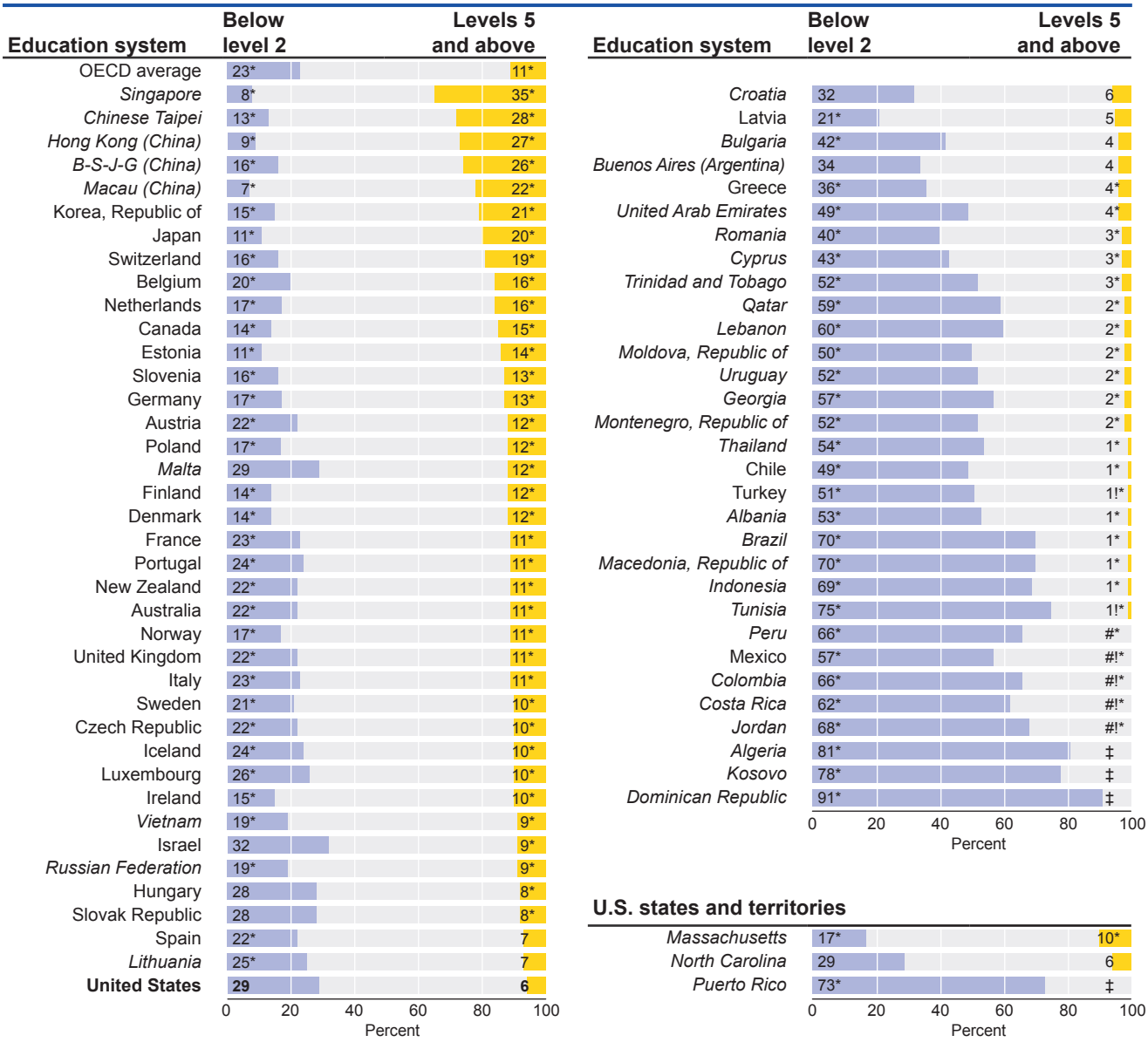
▲ Average score is higher than U.S. average score.
▼ Average score is lower than U.S. average score.
NOTE: Education systems are ordered by 2015 average score. The OECD average is the average of the national averages of the OECD member countries, with each country weighted equally. Scores are reported 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table M1 available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 5. Average scores and 10th and 90th percentile cut scores of 15-year-old students on the PISA mathematics literacy scale, by education system: 2015



* p<.05. Cut score gap is significantly different from the U.S. 90th to 10th percentile cut score gap at the .05 level of significance.
NOTE: Education systems are ordered by cut score gap, from smaller to larger. This table shows the threshold (or cut) scores for the following: (a) 10th percentile— the bottom 10 percent of students; (b) 90th percentile— the top 10 percent of students. The cut score gap for each education system is the difference between its 90th and 10th percentile cut scores. The percentile ranges are specific to each education system's distribution of scores, enabling users to compare cut scores across education systems. 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. Italics indicate non-OECD countries and education systems. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table M1b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Figure 6. Percentage of 15-year-old students performing at PISA mathematics literacy proficiency levels below level 2 and levels 5 and above, by education system: 2015



Below level 2
Levels 5 and above
Rounds to zero.
! Interpret with caution. Estimate is unstable due to high coefficient of variation (>30 percent and <=50 percent).
‡ Reporting standards not met due to coefficient of variation over 50 percent.
* p<.05. Significantly different from the U.S. percentage at the .05 level of significance.
NOTE: Education systems are ordered by percentage of 15-year-olds in Levels 5 and above. To reach a particular proficiency level, students 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 exhibit 3 of this report and in table A-1 at http://nces.edu.gov/surveys/pisa/PISA2015/index.asp. 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. B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. Results for Massachusetts and North Carolina are for public school students only. Although Argentina, Malaysia, and Kazakhstan participated in PISA 2015, technical problems with their samples prevent results from being discussed in this report. The standard errors of the estimates are shown in table M2b available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015.

Table 4. Average scores and changes in average scores of U.S. 15-year-old students on the PISA science, reading, and mathematics literacy scales: 2003, 2006, 2009, 2012, and 2015

	Average score					Change in average score			
Subject	**2003**	**2006**	**2009**	**2012**	**2015**	**2015–2003**	**2015–2006**	**2015–2009**	**2015–2012**
Science	†	489	502	497	496	†	○	○	○
Reading	†	†	500	498	497	†	†	○	○
Mathematics	483	474	487	481	470	○	○	▼	▼

▲ Average score in 2015 is higher than the average score in the comparison year at the .05 level of statistical significance.
○ Average score in 2015 is not measurably different from average score in comparison year.
▼ Average score in 2015 is lower than the average score in the comparison year at the .05 level of statistical significance.
† Not applicable. Although science was assessed in 2000 and 2003, because the science framework was revised for 2006, it is possible to look at changes in science only from 2006 forward. Similarly, although reading was assessed in 2000, 2003, and 2006, and mathematics was assessed in 2000, because the reading framework was revised for PISA 2009 and mathematics framework was revised for PISA 2003, it is possible to look at changes in reading only from 2009 forward and in mathematics only from 2003 forward.
NOTE: All average scores reported as higher or lower than the comparison year are different at the .05 level of statistical significance.
For information on the results for these three countries, see OECD (2016d). The standard errors of the estimates are shown in table T1 available at http://nces.ed.gov/surveys/pisa/PISA2015/index.asp.
SOURCE: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2003, 2006, 2009, 2012, and 2015.

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Technical Notes

This section briefly describes features of the PISA 2015 assessment, with a particular focus on implementation in the United States. For further details about the assessment and any of the topics discussed here, see the fuller description of technical notes on the NCES PISA website at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp as well as the OECD's *PISA 2015 Technical Report* (forthcoming).

Sampling and Response Rates

The OECD required all participating education systems to adhere to the PISA 2015 technical standards (OECD forthcoming), which provided detailed specifications for the required target population, sampling, response rates, translation, assessment administration, and data submission. According to the standards, the international desired population in each education system consisted of 15-year-olds attending either publicly or privately controlled schools in grade 7 and higher. More specifically, the technical standards required that students in the sample be 15 years and 3 months to 16 years and 2 months at the beginning of the testing period (referred to as "15-year-olds" or "15-year-old students"). The maximum length of the testing period was 42 consecutive days. Most education systems conducted testing from March through August 2015.[1] The sample design for PISA 2015 was a stratified systematic sample, with sampling probabilities proportional to the estimated number of 15-year-old students in the school based on grade enrollments.

The U.S. PISA 2015 national school sample consisted of 240 schools, which was higher than the international sampling minimum of 150 to offset anticipated school nonresponse and ineligibility. The samples for Massachusetts and North Carolina consisted of 59 schools each; the sample for Puerto Rico consisted of 55 schools. The U.S. national and Puerto Rico samples included both public and private schools; the Massachusetts and North Carolina samples included public schools only. As with the PISA national sample, the samples for Massachusetts, North Carolina, and Puerto Rico were also increased from the international minimum of 50 schools for subnational entities to offset anticipated school nonresponse and ineligibility. In the U.S. national, Massachusetts, and North Carolina samples, 42 students in each school took the core PISA assessment in mathematics literacy, science literacy, reading literacy, and collaborative problem solving. Eleven of the 42 students in the U.S. national, Massachusetts, and North Carolina samples were also subsampled to take the financial literacy assessment, which was held in a separate session after the main PISA assessment. The financial literacy assessment was not administered to the 42 students in each school in Puerto Rico.

[1] The United States and the United Kingdom were given permission to move the testing dates to September through November in an effort to improve response rates.

A total of 177 schools participated in the administration of national PISA, including 142 participating schools sampled as part of the original sample and 35 schools sampled as replacements for nonparticipating "original" schools. The overall weighted school response rate after replacements was 83 percent. For the United States as a whole, the weighted student response rate was 90 percent and the student exclusion rate was 3 percent. In Massachusetts, there were 48 participating schools (out of 53 eligible schools), resulting in an overall weighted school response rate of 92 percent. The overall weighted student response rate was 90 percent and the overall student exclusion rate was 4 percent. All eligible schools (54) participated in North Carolina, yielding an overall weighted school response rate of 100 percent with an overall weighted student response rate of 92 percent and an exclusion rate of 5 percent. All of Puerto Rico's 47 eligible schools participated (100 percent). The weighted student response and exclusion rates in Puerto Rico were 93 percent and 3 percent, respectively.

See http://nces.ed.gov/surveys/pisa/pisa2015/index.asp for PISA international sampling guidelines and requirements regarding accommodations, exclusions, and response rate requirements, as well as response rates of all participating education systems.

Assessment and Questionnaires

The 2015 assessment instruments were developed by international experts and PISA international consortium test developers and included items submitted by participating education systems. In addition to the core subject areas of science, mathematics and reading literacy, PISA also offered two optional assessment components: financial literacy and collaborative problem solving. The United States administered both the core subject areas and the two optional assessment components. Massachusetts, North Carolina, and Puerto Rico administered the core PISA assessment components. In addition, Massachusetts and North Carolina administered the financial literacy and collaborative problem solving components.

All mathematics and reading items in the 2015 assessment instrument were trend items from previous assessments. Science items included both trend items and new items developed for 2015. Items were reviewed by representatives of each country for possible bias and relevance to PISA's goals and by PISA subject-matter expert groups. To further examine potential biases and design issues in the PISA assessment, all participating education systems field tested the assessment items in spring 2014. After the field trial, items that did not meet the established measurement criteria or were otherwise found to include intrinsic biases were dropped from the main assessment.

The final 2015 main study computer-based assessment included six clusters from each of the trend domains of science, reading, and mathematics literacy, six clusters of new science literacy test items, and three clusters of new collaborative problem solving materials. The clusters were allocated in a rotated design to create six groups of test forms. Every student taking the assessment answered science items, and at least one but up to two of the other

subjects of mathematics literacy, reading literacy, and/or collaborative problem solving. Students who were subsampled for the financial literacy assessment returned for a second session in which the focus was only on financial literacy and the accompanying student questionnaire. For education systems administering the paper-based version of PISA, as in the case of Puerto Rico, the assessment included six clusters from each of the trend domains of science, reading, and mathematics literacy only. Every student taking the paper-based assessment answered science items, but not all students answered mathematics literacy or reading literacy items. In order to keep PISA as inclusive as possible and to keep the exclusion rate down, the United States, Massachusetts, and North Carolina used the UH ('*Une Heure*') instrument designed for students with special education needs (Puerto Rico did not use the UH instrument).

Approximately 65 percent of science items were multiple-choice and 35 percent of science items were open response. For reading and mathematics items, approximately 40 percent were multiple choice and 60 percent open response. Open response items were graded by trained scorers following international coding guidelines.

After the cognitive assessment, students also completed a questionnaire designed to provide information about their backgrounds, attitudes, and experiences in school. Principals in schools where PISA was administered also completed a questionnaire designed to provide information on their school's structure, resources, instruction, climate, and policies. In addition, in the U.S. national school sample, Massachusetts school sample, and North Carolina school sample, a sample of teachers within each school were selected to complete a computer-based questionnaire. (Puerto Rico did not administer the teacher questionnaire.)

See http://nces.ed.gov/surveys/pisa/pisa2015/index.asp for more information about the PISA 2015 assessment design and questionnaires.

Reporting Results

In PISA, results are generally reported in two ways: scale scores (on a scale of 0 to 1,000) and the percentage of students reaching each proficiency level. Scale scores are reported in terms of both average scores and the threshold (or cut) scores at certain percentiles. In addition to scale scores as the basic form of measurement, PISA describes student performance in terms of levels of proficiency. Higher levels represent the knowledge, skills, and capabilities needed to perform tasks of increasing complexity. Proficiency level results are reported in terms of percentages of the student population at each of the predefined levels. In some displays, comparisons are made to the OECD average, which is the average of the 35 OECD member country averages with each country weighted equally. See http://nces.ed.gov/surveys/pisa/pisa2015/index.asp for more information about PISA scaling and proficiency levels.

Sampling Weights and Standard Errors

The use of sampling weights is necessary to compute statistically sound estimates. Adjusted survey weights adjust for the probabilities of selection for individual schools and students, for school or student nonresponse, and for errors in estimating the size of the school or the number of 15-year-olds in the school at the time of sampling.

As with any study, there are limitations to PISA 2015 that should be taken into consideration. Estimates produced using data from PISA 2015 are subject to two types of error: nonsampling errors and sampling errors. The sources of nonsampling errors are typically problems such as unit and item nonresponse, the differences in respondents' interpretations of the meaning of survey questions, and mistakes in data preparation. Sampling errors arise when a sample of the population, rather than the whole population, is used to estimate some statistic. Different samples from the same population would likely produce somewhat different estimates of the statistic in question. This uncertainty is referred to as sampling variance and is usually expressed as the standard error of a statistic estimated from sample data. Standard errors for all statistics reported in this report are available online at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp.

Statistical Comparisons

Comparisons made in this report have been tested for statistical significance. For example, in the commonly made comparison of OECD averages to U.S. averages, tests of statistical significance were used to establish whether or not the observed differences from the U.S. average were statistically significant. In almost all instances, the tests for significance used were standard t tests. These fell into three categories according to the nature of the comparison being made: comparisons of independent samples, comparisons of nonindependent samples, and comparisons of performance over time. A difference is "significant" if the probability associated with the t test is less than .05. If a test is significant this implies that difference in the observed means in the sample represents a real difference in the population. When analyzing change in performance over time, the test for significance includes the addition of a standard error term. This is because the uncertainty that results from link item sampling, referred to as a "linking error," must be taken into account when making certain comparisons between previous rounds of PISA (2003, 2006, 2009, and 2012) and PISA 2015 results. No adjustments were made for multiple comparisons.

More detailed information on the implementation of PISA in the United States is available on the NCES website at http://nces.ed.gov/surveys/pisa/pisa2015/index.asp.

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