

## ACADEMIC PERFORMANCE OF FOURTH-GRADERS IN MATHEMATICS AND SCIENCE

*Key Findings: Italy, Japan, Russian Federation, United Kingdom (England and Scotland only),<sup>4</sup> United States*

*On the TIMSS 2003 fourth-grade mathematics assessment, students in Japan outperformed students in the other participating G-8 countries, with higher percentages of students in Japan reaching each international benchmark.*

The Trends in International Mathematics and Science Study (TIMSS) assessed students in fourth and eighth grade in mathematics and science in 2003. This indicator presents the percentage of fourth-grade students reaching the four international benchmarks (low, intermediate, high, and advanced) that were established in each of the two subject areas.

On the TIMSS 2003 fourth-grade mathematics assessment, students in Japan outperformed students in the other participating G-8 countries, with higher percentages of students in Japan reaching each benchmark. In Japan, 89 percent of fourth-grade students were at or above the intermediate benchmark in mathematics; the percentages in the other G-8 countries ranged from 60 percent in Scotland to 76 percent in the Russian Federation (figure 4). In the United States, 72 percent of students met the intermediate benchmark in mathematics.

Similarly, a higher percentage of fourth-grade students in Japan than in the other G-8 countries were at or above the high benchmark in mathematics. In Japan, 60 percent of fourth-grade students reached the high benchmark, while in the other countries, the percentages ranged from 22 percent in Scotland to 43 percent in

England. In the United States, 35 percent of fourth-graders reached the high benchmark in mathematics.

The highest international benchmark, advanced, was reached by 21 percent of Japan's fourth-grade students in mathematics, compared with percentages ranging from 3 percent in Scotland to 14 percent in England. In the United States, 7 percent of fourth-graders reached the advanced benchmark in mathematics.

As in mathematics, a greater percentage of Japanese students than their peers in the other G-8 countries were at or above the intermediate benchmark in science. In Japan, 84 percent of fourth-graders met the intermediate benchmark, compared with percentages ranging from 66 percent in Scotland to 79 percent in England. In the United States, 78 percent of fourth-graders met the intermediate benchmark in science.

The percentages of fourth-grade students at or above the high achievement benchmark in science ranged from 27 percent in Scotland to 49 percent in Japan. In the United States, 45 percent of students reached the high benchmark in science.

The percentages of students meeting the advanced benchmark in science ranged from 5 percent in Scotland to 15 percent in England (with Japan at 12 percent). In the United States, 13 percent of fourth-graders reached the advanced benchmark. Thus, whereas higher percentages of students in Japan than in the other G-8 countries reached each benchmark in mathematics, this was not a consistent finding in science.

### *Definitions and Methodology*

On the 2003 Trends in International Mathematics and Science Study (TIMSS 2003), countries were required to sample students in the upper of the two grades that contained the largest number of 9-year-olds. In the United States and most countries, this corresponds to grade 4.

Since the TIMSS mathematics and science achievement scales were designed to provide reliable measures of student achievement over time, the metric of the scale was established originally with the 1995 assessment. To facilitate the cross country comparison of achievement scores, an international average was calculated whereby all the participating countries contributed equally. The data were then standardized to set the international average at 500, with a range from 0 to 1000 and a standard deviation of 100. Since the individual country means were weighted averages of the student scores, this standardization implied that about two-thirds of the students across all the participating countries scored between 400 and 600.

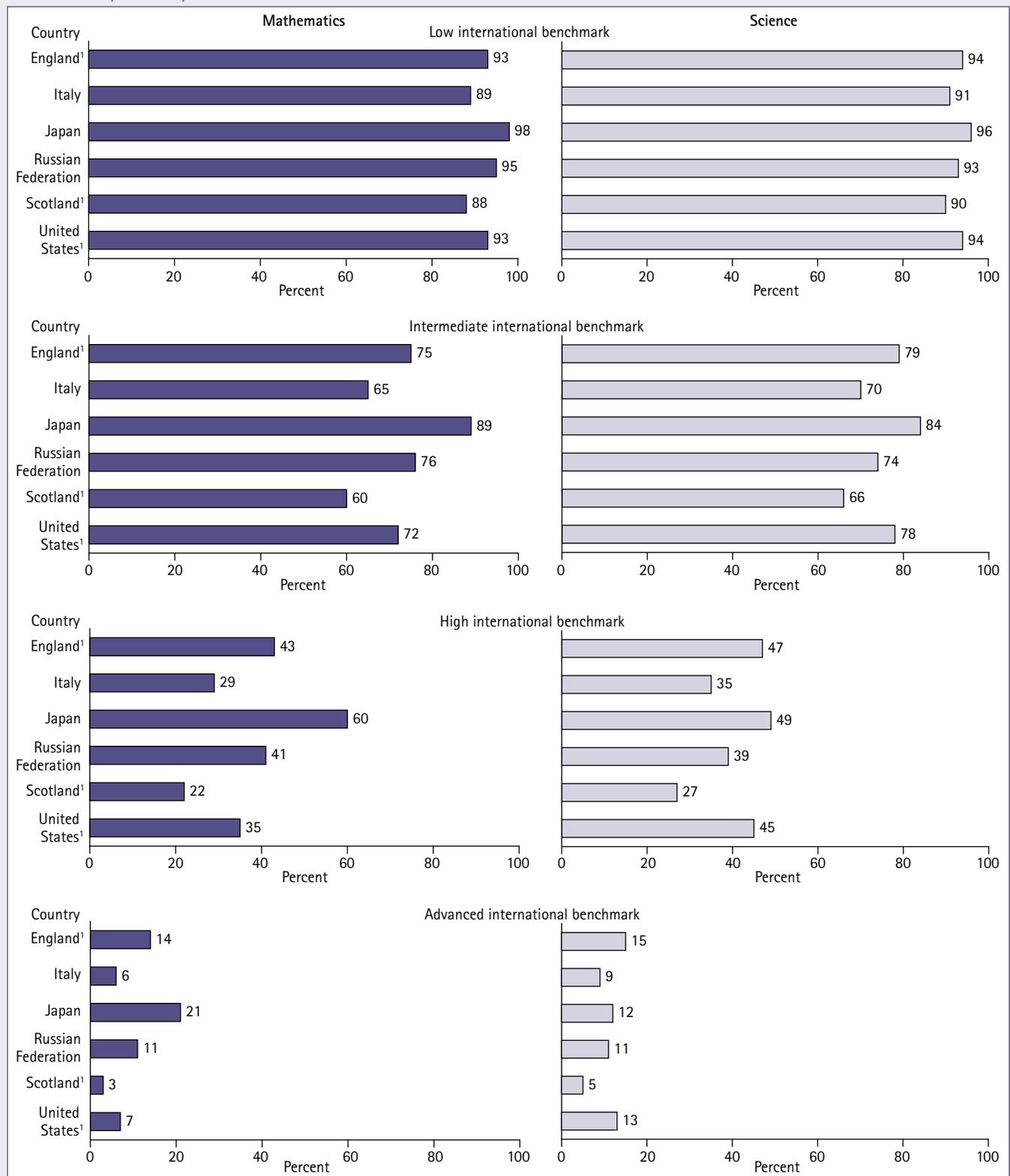
In order to provide meaningful descriptions of what performance on the scales could mean in terms of the mathematics or science that students know and can do, TIMSS established four international achievement benchmarks in mathematics and science (low, intermediate, high, and advanced). Four points on the scales were identified for use as international benchmarks: 625 for the advanced benchmark, 550 for the high benchmark, 475 for the intermediate benchmark, and 400 for the low benchmark. These were selected to represent the range of performance shown by students internationally.

At the fourth-grade level in mathematics, students at the low benchmark demonstrate some basic mathematical knowledge, such as an understanding of whole numbers and the properties of basic geometric shapes. At the intermediate benchmark, students can apply basic mathematical knowledge in straightforward situations, such as performing operations with 3- and 4-digit numbers and decimals and extending simple patterns. At the high benchmark, students can apply their knowledge and understanding to solve problems, such as multistep word problems involving addition, multiplication, and division and problems requiring the use of data in tables and graphs. Students at the advanced benchmark demonstrate an understanding of fractions, decimals, and measurement concepts, and use data interpretation in a wide variety of relatively complex situations.

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

<sup>4</sup>In the data source for this indicator (TIMSS 2003), the United Kingdom is represented separately by two of its component jurisdictions, England and Scotland. Northern Ireland and Wales did not participate in this study.

Figure 4. Percentage of fourth-grade students reaching TIMSS international benchmarks in mathematics and science, by country: 2003



<sup>1</sup>Met guidelines for sample participation rates only after replacement schools were included. That is, to avoid sample size losses resulting from sampled schools not participating in the 2003 Trends in International Mathematics and Science Study (TIMSS 2003), a mechanism was instituted to identify, a priori, replacement schools that have similar characteristics to the sampled schools that they may replace.

SOURCE: Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., and Chrostowski, S.J. (2004). *TIMSS 2003 International Science Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*, exhibit 2.2. Chestnut Hill, MA: Boston College; and Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., and Chrostowski, S.J. (2004). *TIMSS 2003 International Mathematics Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*, exhibit 2.2. Chestnut Hill, MA: Boston College.