CHAPTER 4

South African science achievement in an international context

This chapter summarises achievement of the TIMSS 2003 science assessment for each of the participating countries and contextualises the performance of South African learners in relation to the 50 study participants. The overview, as presented here, is based on trends in the TIMSS 2003 report (Martin, Mullis, Gonzalez & Chrostowski 2004).[1] In addition to presenting the international comparative results, a comparison of the results for the participating group of African countries is given. There is also a discussion of the performance trend from 1999 to 2003, an examination of performance as it relates to gender, and an analysis of performance at the different performance benchmarks.

Science achievement of participating countries in TIMSS 2003

Figure 4.1 presents the average science achievement distribution for each of the participating countries. TIMSS used IRT methods to calculate the achievement scores. A scale of 800 points and a standard deviation of 100 points was used. The international average was computed by averaging the mean scores of each of the participating countries. In Figure 4.1, average scores are arranged from the highest to the lowest. The results show substantial differences in science achievement between the highest and lowest performing countries, from an average of 578 for Singapore to 244 for South Africa. Twenty-eight countries achieved average science scores significantly higher than the international average and 18 countries achieved scores significantly lower than the international average. The five highest performing countries were: Singapore, Chinese Taipei, Republic of Korea, Hong Kong (SAR) and Estonia. The five lowest performing countries were: Lebanon, Philippines, Botswana, Ghana and South Africa.

Figure 4.1 illustrates the broad range of achievement both within and across the countries assessed. Achievement for each country is shown at the 25th and 75th percentiles, as well as the 5th and 95th percentiles. Each percentile point indicates the percentage of learners performing below and above that point on the scale. For example, 25 per cent of the learners in each country performed below the 25th percentile and 75 per cent performed above the 25th percentile. The range between the 25th and 75th percentiles represents performance by the middle half of the learners. Performance at the 5th and 95th percentile represents the extremes in lower and higher achievement. The range of performance between these two score points, which included 90 per cent of the population, is approximately 200 to 300 points in most countries. The dark boxes at the midpoints of the distributions show the 95 per cent confidence intervals around the average achievement in each country.

As shown in Figure 4.1, the average scale score for South African Grade 8 learners was the lowest at 244 (SE = 6.7), and this was significantly lower than the international average scale score of 474 (SE = 0.6). In comparing individual countries, the South African average was not statistically different from that of Ghana, but it was significantly lower than those of the remaining participating countries.

1 This report is available at: http://www.timss/bc/edu.

Apart from the substantial difference in science achievement scores between the highest performing country (Singapore) and South Africa, it is interesting to observe the variation of scores within countries. This variation was examined using the range of scores between the 5th and 95th percentiles. A striking feature of Figure 4.1 is the fact that Singapore's average performance exceeds South African performance at the 95th percentile – this means that only the most proficient learners in South Africa approached the average proficiency of Singaporean learners. Secondly, of all the countries participating, South Africa had the widest range of scores between the 5th and 95th percentiles – a difference of approximately 450 points. This suggests that South Africa has some learners who perform very poorly and some who perform very well.

When interpreting the comparative results presented in this report, it is important to remember that each country's result is an estimate of the total population value, inferred from the result obtained from the sample of learners tested. Because it is an estimate, it is subject to some potential level of error. The variability of the average score is given by the SE of the average, presented in the tables. We can say with 95 per cent confidence that the true population average lies within about 2 standard errors of the sample average. Standard errors are influenced by the size of the sample, the design of the sample and the variation scores in the sample.

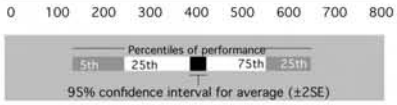
To illustrate the use of standard errors with the average, we can look at South Africa's score. South Africa had an average score of 244 with a standard error of 6.7. This means that the average score for the population of Grade 8 learners in South Africa lies between 237 and 251.

To help interpret scores of the different countries, Figure 4.1 also includes the years of formal schooling and the average age of the learners assessed in each of the participating countries. Most countries assessed the learners at the end of their eighth year of schooling. The international average age of the learners assessed is 14.5 years. Learners in some Eastern European countries start school later and so tended to be older. Learners were older in many African countries where they may have started school later or had their schooling interrupted.

Not all countries have similar socio-economic conditions. Figure 4.1 includes the value of the HDI for each of the participating countries. This index, calculated by UNDP has a minimum value of 0 and a maximum value of 1. The index is a summary measure of human development in a country and is constructed from three dimensions: values for life expectancy at birth, knowledge – constructed from the adult literacy rate and combined primary, secondary and tertiary gross enrolment rates – and standard of living, as measured by the per capita GDP. TIMSS countries with an HDI value greater than 0.9 included Australia, Belgium, England, Israel, Japan, Norway and the United States. The HDI for South Africa was 0.684. Other TIMSS countries with an HDI less than 0.7 were Indonesia (0.682), Botswana (0.614), Morocco (0.606) and Ghana (0.567).

Figure 4.1: Distribution of science achievement

Countries	Years of schooling*	Average age	Science achievement distribution	Average scale score	Human Development Index**
Singapore	8	14.3		578 (4.3) h	0.884
Chinese Taipei	8	14.2		571 (3.5) h	–
Korea, Rep. of	8	14.6		558 (1.6) h	0.879
Hong Kong, SAR	8	14.4		556 (3.0) h	0.889
Estonia	8	15.2		552 (2.5) h	0.833
Japan	8	14.4		552 (1.7) h	0.932
Hungary	8	14.5		543 (2.8) h	0.837
Netherlands	8	14.3		536 (3.1) h	0.938
United States	8	14.2		527 (3.1) h	0.937
Australia	8 or 9	13.9		527 (3.8) h	0.939
Sweden	8	14.9		524 (2.7) h	0.941
Slovenia	7 or 8	13.8		520 (1.8) h	0.881
New Zealand	8.5 - 9.5	14.1		520 (5.0) h	0.917
Lithuania	8	14.9		519 (2.1) h	0.824
Slovak Republic	8	14.3		517 (3.2) h	0.836
Belgium (Flemish)	8	14.1		516 (2.5) h	0.937
Russian Federation	7 or 8	14.2		514 (3.7) h	0.779
Latvia	8	15.0		512 (2.6) h	0.811
Scotland	9	13.7		512 (3.4) h	0.930
Malaysia	8	14.3		510 (3.7) h	0.790
Norway	7	13.8		494 (2.2) h	0.944
Italy	8	13.9		491 (3.1) h	0.916
Israel	8	14.0		488 (3.1) h	0.905
Bulgaria	8	14.9		479 (5.2)	0.795
Jordan	8	13.9		475 (3.8)	0.743
International avg.	8	14.5		474 (0.6)	–
Moldova, Rep. of	8	14.9		472 (3.4)	0.700
Romania	8	15.0		470 (4.9)	0.773
Serbia	8	14.9		468 (2.5) l	–
Armenia	8	14.9		461 (3.5) l	0.729
Iran, Islamic Rep. of	8	14.4		453 (2.3) l	0.719
Macedonia, Rep. of	8	14.6		449 (3.6) l	0.784
Cyprus	8	13.8		441 (2.0) l	0.891
Bahrain	8	14.1		438 (1.8) l	0.839
Palestinian Nat'l Autl	8	14.1		435 (3.2) l	0.731
Egypt	8	14.4		421 (3.9) l	0.648
Indonesia	8	14.5		420 (4.1) l	0.682
Chile	8	14.2		413 (2.9) l	0.831
Tunisia	8	14.8		404 (2.1) l	0.740
Saudi Arabia	8	14.1		398 (4.0) l	0.769
Morocco	8	15.2		396 (2.5) l	0.606
Lebanon	8	14.6		393 (4.3) l	0.752
Philippines	8	14.8		377 (5.8) l	0.751
Botswana	8	15.1		365 (2.8) l	0.614
Ghana	8	15.5		255 (5.9) l	0.567
South Africa	8	15.1		244 (6.7) l	0.684
England	9	14.3		544 (4.1) h	0.930
Benchmarking Participants					
Basque Country, Spa	8	14.1		489 (2.7) h	–
Indiana State, US	8	14.5		531 (4.8) h	–
Ontario Province, Car	8	13.8		533 (2.7) h	–
Quebec Province, Car	8	14.2		531 (3.0) h	–



Notes:
* Represents years of schooling counting from the first year of ISCED Level 1.
** Taken from United Nations Development Program's *Human Development Report 2003*: 237–240.
Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
h Country average significantly higher than international average.
l Country average significantly lower than international average.

South Africa in relation to other African countries

The TIMSS 2003 study included six African countries. These were: Botswana, Egypt, Ghana, Morocco, Tunisia and South Africa. South Africa, Morocco and Tunisia had participated in TIMSS 1999, while the other three made their debut in TIMSS 2003. A comparison of these countries is sensible because other variables, together with science achievement scores, can provide a more contextualised perspective. Table 4.1 provides information on key indicators in these countries.

Table 4.1: Scale scores and key indicators of African country participants in TIMSS 2003

	Average science scale score (SE)	Population (millions)	Life expectancy (years)	Net enrolment (primary)	Net enrolment (secondary)	GNI per capita in US$
Egypt	421 (3.9)	66.4	69	90	78	1 470
Tunisia	404 (2.1)	9.8	73	97	68	1 990
Morocco	396 (2.5)	29.6	68	88	31	1 170
Botswana	365 (2.8)	1.7	38	81	55	3 010
Ghana	255 (5.9)	20.3	55	60	30	270
South Africa	244 (6.7)	45.3	46	90	62	2 500

Sources: UNDP 2003; Martin, Mullis, Gonzales et al 2004

Table 4.1 illustrates the differences, in the six African countries, on indicators which could influence education outcomes. For example, the population of Botswana is 1.7 million, whereas the size of the South African education system is 12 million; in Ghana, 30 per cent of the secondary learners of the age cohort who are supposed to be in secondary school are in school, whereas in South Africa the net enrolment rate in secondary schools is 62 per cent. South Africa has one of the highest GNIs (in US dollars) per capita of the group, yet has the lowest average mean score in science. Table 4.1 suggests that the explanations for learner achievement cannot be provided by a single indicator – it is the interaction of a number of variables that produces a particular outcome.

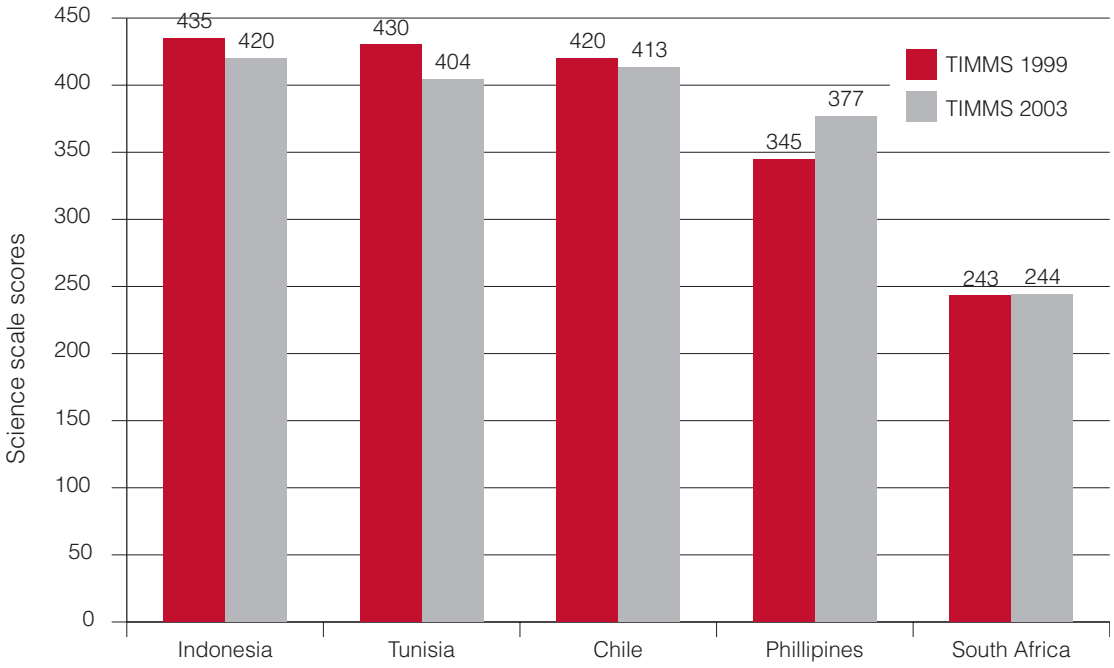
Changes in science achievement between TIMSS 1999 and TIMSS 2003

There are some countries that participated in both TIMSS 1999 and TIMSS 2003. For these countries it was possible to track the changes in performance over these two periods of time. The international science average score in TIMSS 1999 was 488 (SE = 0.7) and in TIMSS 2003 it was 474 (SE = 0.6).[2]

Figure 4.2 presents national comparisons for the two assessment periods for the five lowest performing countries. Scores for Indonesia and Tunisia decreased significantly from 1999 to 2003. In the Philippines there was a significant increase in the average science score. The South African average science score for TIMSS 2003 was one point higher than for TIMSS 1999. This difference is not significant.

2 One cannot compare the international averages because different countries participated in different years.

Figure 4.2: Change in science performance from TIMSS 1999 to TIMSS 2003, by country



Gender analysis

Participation rates

In most countries there was an almost equal participation between boys and girls, with rates located between 48–52 per cent. In South Africa, the TIMSS sample was 51 per cent of girls and 49 per cent boys. Table 4.2 indicates the countries where the difference between girl and boy participation rates was 6 per cent or more.

Table 4.2: Countries where the difference in Grade 8 participation rates between girls and boys was 6 per cent or more

Girl participation > boy participation		Boy participation > girl participation	
Philippines	(by 16%)	Iran, Islamic Rep of	(by 20%)
Lebanon	(14%)	Saudi Arabia	(14%)
Palestinian Nat'l Auth	(10%)	Ghana	(10%)
Belgium	(8%)	Egypt	(8%)
Armenia	(6%)		
Tunisia	(6%)		

Performance by gender

Figure 4.3 presents the distribution of average science achievement scores by gender. The international science average scale score for girls is 471 (SE = 0.7) and the average scale score for boys is 477 (SE = 0.7). The difference of 6 (SE = 0.6) is statistically significant, with boys outperforming girls. For South Africa, the girls average scale score is 242 (SE = 7.2) and the boys 244 (SE = 7.7). The difference of 2 points is not statistically significant.

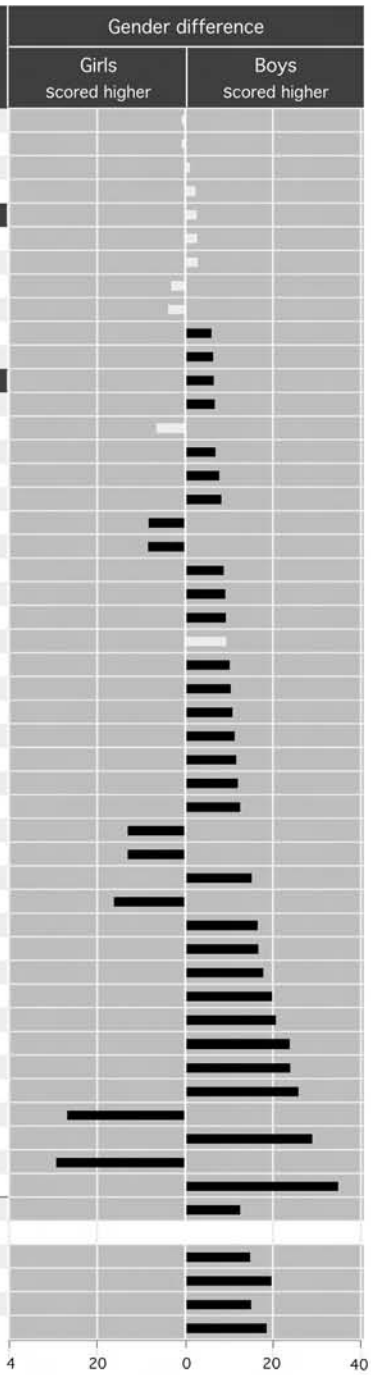
There were 11 countries where science average scores were not significantly different between boys and girls. In seven countries the science score of girls was significantly higher than that of the boys, and in 28 countries the boys science score was statistically higher than that of the girls. Table 4.3 lists the countries where there was a significant difference between the average scale scores of girls and boys. In addition, Figure 4.3 illustrates the average science scores for girls and boys, as well as the difference. The horizontal bar for each country in Figure 4.3 shows the level of 'difference' between girls and boys.

Table 4.3: Countries where there was a difference between the average science scale scores of girls and boys

No gender difference in performance	Girls score statistically > than boys	Boys score statistically > than girls	
Botswana	Armenia	Australia	Lithuania
Chinese Taipei	Bahrain	Belgium (Flemish)	Malaysia
Cyprus	Jordan	Bulgaria	Morocco
Egypt	Macedonia	Chile	Netherlands
Estonia	Moldova	England	Norway
Iran, Islamic Rep of	Palestinian Nat'l Auth.	Ghana	Romania
Lebanon	Saudi Arabia	Hong Kong, SAR	Russia Federation
New Zealand		Hungary	Serbia
Philippines		Indonesia	Scotland
Singapore		Israel	Slovak Republic
South Africa		Italy	Slovenia
		Japan	Sweden
		Korea, Rep. of	Tunisia
		Latvia	United States

Figure 4.3: Average science achievement by gender

Countries	Girls		Boys		Difference (absolute value)	Gender difference
	Percent of students	Average scale score	Percent of students	Average scale score		Girls scored higher / Boys scored higher
Egypt	46 (2.7)	422 (4.8)	54 (2.7)	421 (5.5)	1 (6.8)	
Iran, Islamic Rep. of	40 (4.1)	454 (3.9)	60 (4.1)	453 (3.7)	1 (6.1)	
Chinese Taipei	48 (1.0)	571 (3.8)	52 (1.0)	572 (3.8)	1 (3.1)	
Botswana	51 (0.7)	364 (3.2)	49 (0.7)	366 (3.4)	2 (3.3)	
South Africa	51 (0.9)	242 (7.2)	49 (0.9)	244 (7.7)	2 (6.1)	
Lebanon	57 (1.8)	392 (4.8)	43 (1.8)	395 (6.0)	3 (6.4)	
Singapore	49 (0.8)	576 (4.0)	51 (0.8)	579 (5.0)	3 (3.1)	
Estonia	50 (1.0)	554 (2.8)	50 (1.0)	551 (2.9)	3 (2.8)	
Cyprus	49 (0.6)	443 (2.3)	51 (0.6)	440 (2.8)	4 (3.0)	
Lithuania	50 (0.9)	516 (2.7)	50 (0.9)	522 (2.4)	6 (2.5)	
Serbia	49 (0.8)	465 (2.9)	51 (0.8)	471 (2.6)	6 (2.5)	
International avg.	50 (0.2)	471 (0.7)	50 (0.2)	477 (0.7)	6 (0.6)	
Slovenia	50 (0.9)	517 (2.4)	50 (0.9)	524 (2.3)	7 (3.0)	
Philippines	58 (0.9)	380 (5.9)	42 (0.9)	374 (6.4)	7 (4.1)	
Latvia	49 (0.8)	509 (2.6)	51 (0.8)	516 (3.0)	7 (2.4)	
Sweden	51 (0.9)	521 (3.2)	49 (0.9)	528 (2.7)	8 (2.5)	
Norway	50 (0.8)	490 (2.2)	50 (0.8)	498 (3.0)	8 (2.9)	
Macedonia, Rep. of	49 (0.9)	454 (3.7)	51 (0.9)	445 (4.2)	8 (3.3)	
Moldova, Rep. of	51 (0.8)	477 (3.5)	49 (0.8)	468 (3.7)	8 (2.6)	
Romania	52 (0.9)	465 (5.5)	48 (0.9)	474 (4.9)	9 (3.5)	
Hong Kong, SAR	50 (2.4)	552 (3.4)	50 (2.4)	561 (3.8)	9 (3.9)	
Japan	49 (1.2)	548 (3.0)	51 (1.2)	557 (2.7)	9 (4.5)	
New Zealand	52 (1.7)	515 (4.8)	48 (1.7)	525 (6.7)	9 (5.7)	
Malaysia	50 (1.8)	505 (4.3)	50 (1.8)	515 (4.0)	10 (4.0)	
Italy	50 (0.9)	486 (2.7)	50 (0.9)	496 (3.8)	10 (2.5)	
Russian Federation	49 (1.2)	508 (3.7)	51 (1.2)	519 (4.2)	11 (3.1)	
Morocco	50 (1.8)	392 (3.2)	50 (1.8)	403 (3.8)	11 (4.6)	
Indonesia	50 (0.7)	415 (3.9)	50 (0.7)	426 (4.6)	11 (2.7)	
Scotland	50 (1.3)	506 (4.0)	50 (1.3)	517 (3.5)	12 (3.6)	
Korea, Rep. of	48 (2.8)	552 (2.1)	52 (2.8)	564 (1.9)	12 (2.5)	
Armenia	53 (0.7)	468 (4.0)	47 (0.7)	455 (3.4)	13 (2.8)	
Palestinian Nat'l Au	55 (2.4)	441 (3.7)	45 (2.4)	428 (5.2)	13 (6.2)	
Netherlands	49 (1.2)	528 (3.3)	51 (1.2)	543 (3.8)	15 (3.5)	
Saudi Arabia	43 (2.3)	407 (6.2)	57 (2.3)	391 (5.4)	16 (8.2)	
Bulgaria	48 (1.3)	470 (6.3)	52 (1.3)	487 (5.2)	16 (5.2)	
United States	52 (0.7)	519 (3.2)	48 (0.7)	536 (3.4)	16 (2.1)	
Slovak Republic	48 (1.3)	508 (3.8)	52 (1.3)	525 (3.4)	18 (3.1)	
Israel	52 (1.6)	479 (3.2)	48 (1.6)	498 (4.1)	20 (4.2)	
Australia	51 (2.2)	517 (4.6)	49 (2.2)	537 (4.6)	20 (5.6)	
Belgium (Flemish)	54 (2.1)	505 (3.0)	46 (2.1)	528 (3.4)	24 (4.2)	
Tunisia	53 (0.7)	392 (2.3)	47 (0.7)	416 (2.6)	24 (2.6)	
Hungary	50 (1.0)	530 (3.4)	50 (1.0)	556 (3.0)	26 (3.0)	
Jordan	49 (1.7)	489 (4.5)	51 (1.7)	462 (5.6)	27 (6.9)	
Chile	48 (1.6)	398 (3.2)	52 (1.6)	427 (3.6)	29 (4.0)	
Bahrain	50 (0.4)	453 (2.7)	50 (0.4)	423 (2.3)	29 (3.5)	
Ghana	45 (0.9)	236 (6.4)	55 (0.9)	271 (6.5)	35 (4.7)	
England	50 (2.4)	538 (4.7)	50 (2.4)	550 (5.1)	12 (5.3)	
Benchmarking participants						
Basque Country, Sp	49 (1.7)	481 (3.0)	51 (1.7)	496 (3.3)	15 (3.6)	
Indiana State, US	49 (1.2)	521 (4.7)	51 (1.2)	540 (5.3)	19 (3.1)	
Ontario Province, C	51 (0.9)	526 (3.1)	49 (0.9)	540 (2.8)	15 (2.6)	
Quebec Province, C	50 (1.6)	522 (3.7)	50 (1.6)	540 (3.2)	18 (3.1)	



Notes:
Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
■ Gender difference statistically significant.
□ Gender difference not statistically significant.

Performance at international benchmarks

TIMSS identified four benchmarks on the achievement scale to describe what learners know, and can do, in science. Selected to represent the range of performance shown by learners internationally, TIMSS identified four points on the scale for use as international benchmarks. The four benchmarks were defined as: the Advanced International Benchmark (AIB), set at 625 and above; the High International Benchmark (HIB), set between 550 and 625; the Intermediate International Benchmark (IIB), set between 475 and 550; and the Low International Benchmark (LIB), set between 400 and 475. The descriptions of the levels are cumulative, so that a learner who has reached the higher benchmarks can demonstrate the knowledge and skills achieved at the lower levels (see Table 4.4).

Table 4.4: Descriptions of TIMSS 2003 international benchmarks for science

Low (400)	Intermediate (475)	High (550)	Advanced (625)
Learners recognise some basic facts from the life and physical sciences. Learners: • have some knowledge of the human body and heredity, and can demonstrate familiarity with everyday physical phenomena; and • can interpret some pictorial diagrams and apply knowledge of simple physical concepts to practical situations.	Learners can recognise and communicate basic scientific knowledge across a range of topics. Learners: • recognise some characteristics of the solar system, water cycle, animals, and human health; • are acquainted with some aspects of energy, force and motion, light reflection, and sound; • demonstrate elementary knowledge of human impact on and changes in the environment; and • can apply and briefly communicate knowledge, extract tabular information, extrapolate from data presented in a simple linear graph, and interpret pictorial diagrams.	Learners demonstrate conceptual understanding of some science cycles, systems, and principles. Learners: • have some understanding of Earth's processes and the solar system, biological systems, populations, reproduction and heredity, and the structure and function of organisms; • show some understanding of physical and chemical changes and the structure of matter; • solve some basic physics problems related to light, heat, electricity and magnetism, and they demonstrate basic knowledge of major environmental issues; • demonstrate some scientific inquiry skills; and • can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge and cause/effect relationships.	Learners demonstrate a grasp of some complex and abstract science concepts. Learners: • can apply knowledge of the solar system and of earth features, processes and conditions, and apply understanding of the complexity of living organisms and how they relate to their environment; • show understanding of electricity, thermal expansion and sound, as well as the structure of matter and physical and chemical properties and changes; • show understanding of environmental and resource issues; • understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems; and • can provide written explanations to communicate scientific knowledge.

A scale-anchoring technique was used to develop descriptions of achievement for the TIMSS 2003 benchmarks. Scale anchoring describes learners' performance at different points on the achievement scale. The scale-anchoring technique involved an empirical component; in which items that discriminate between successive points on the scale were identified, and a judgemental component; in which experts in science examined item content and used this to generalise learners' knowledge and understanding. In the scale-anchoring technique, results of all learners were pooled, so that the benchmark descriptions refer to all learners achieving at *that* level.

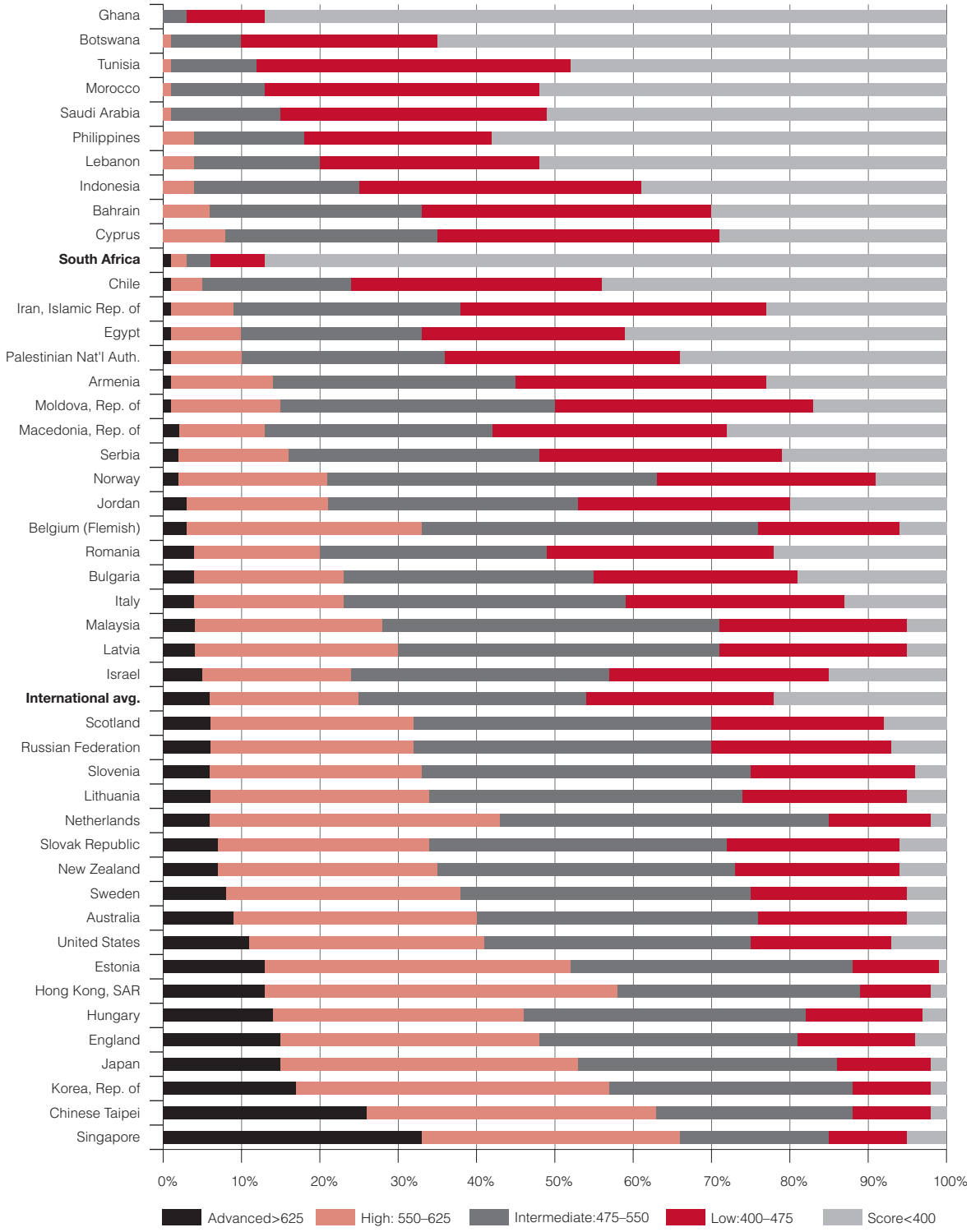
Figure 4.4 indicates how the different countries performed in respect of reaching the different international benchmarks in science. The chart is arranged in rank order of performance at the AIB. While the chart is organised to draw particular attention to the percentage of high-achieving learners in each country, it also conveys information about middle and low performers.

The profile of performance in each of the countries varied. Singapore had 33 per cent of its learners performing at the AIB level; 33 per cent performing at the HIB level; approximately 20 per cent performing at the IIB level; and 10 per cent performing at the LIB level. In Singapore, 95 per cent of learners achieved a score above the LIB (that is, higher than 400). The Netherlands displayed a slightly different learner profile, with 6 per cent of its learners performing at the AIB level; 37 per cent performing at the HIB level; 42 per cent at the IIB level; and 13 per cent at the LIB level. In the Netherlands, 98 per cent of learners achieved a score above the LIB (that is, higher than 400).

South Africa had 13 per cent of its learners achieving a score greater than 400. Of these, 1 per cent scored above the AIB level; 2 per cent scored at the HIB level; 3 per cent scored at the IIB level; and 7 per cent scored at the LIB level. These scores are cumulative. In Botswana, 35 per cent of the learners achieved a score higher than 400, and, in Ghana, 13 per cent of the learners achieved a score higher than 400.

It is worth noting South Africa's position (as shown in Figure 4.4). Unlike many countries at the bottom end of the scale, 1 per cent of South African learners achieved scores at the AIB level. Whereas all the other countries (except Ghana) at the bottom end of the scale had at least one-third of their learners reach the LIB level (that is, they scored 400), South Africa and Ghana had only 13 per cent of their learners reaching the scaled score of 400. This means that 87 per cent of South African and Ghanain learners scored below 400. This again illustrates the large variation in South African performance – with a few learners performing very well but the majority performing poorly.

Figure 4.4: Percentage of learners reaching the different benchmarks for science in TIMSS 2003, by country



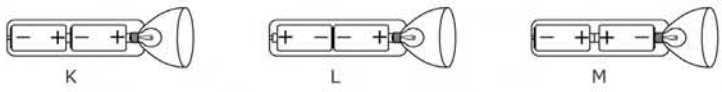
Examples of performance at different benchmarks

The following section provides examples of items from the TIMSS tests, classified at the different benchmarks. These examples provide an indication of the skills and abilities that the learner at each level could demonstrate. Each item is described and is accompanied by the percentage correct for South Africa; for the five top performing countries; the countries at the low-performing end of the spectrum; and the international average percentage.

Performance at the Low International Benchmark (400)

Learners who reached this benchmark on TIMSS had some knowledge and basic facts of life and physical sciences.

The diagrams show a flashlight and three ways to put batteries in it.



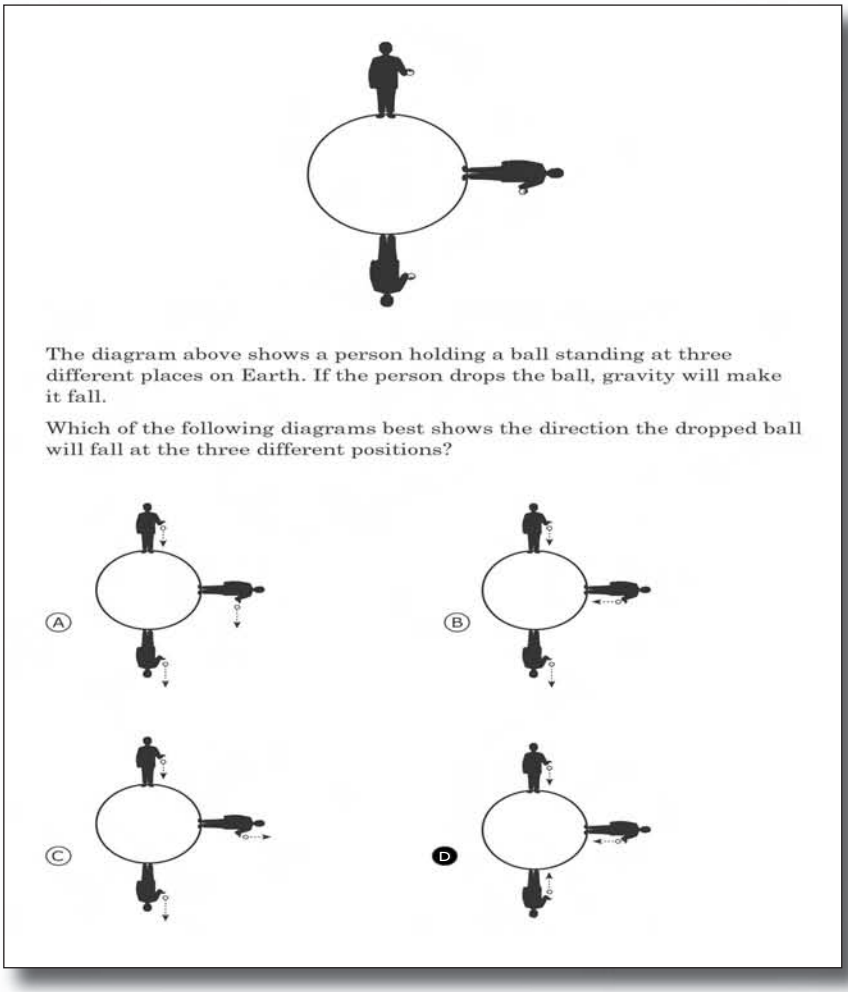
In order to make the flashlight work, which way must the batteries be placed?

(A) Only as in K
(B) Only as in L
(C) Only as in M
(D) None of these ways would work.

Content area: physics	Performance of selected countries	
In this item, learners were asked to identify the diagram depicting the correct arrangement of batteries in a flashlight or torch. This was a simple item for most learners in the international study, with 85% of all learners scoring correctly on the item. South Africa had the lowest number of learners (at 52%) correctly answering this item.	Singapore	97 (0.5)
	Korea, Rep. of	93 (0.8)
	Japan	93 (0.9)
	Hong Kong, SAR	93 (0.9)
	International average	85 (0.2)
	Botswana	81 (1.3)
	Morocco	81 (2.2)
	Jordan	78 (1.9)
	Saudi Arabia	78 (2.3)
	Palestinian Nat'l Auth.	78 (1.8)
	Philippines	77 (1.6)
	Egypt	67 (2.1)
	Tunisia	59 (1.9)
	Ghana	55 (1.8)
	South Africa	52 (1.7)

Performance at the Intermediate International Benchmark (475)

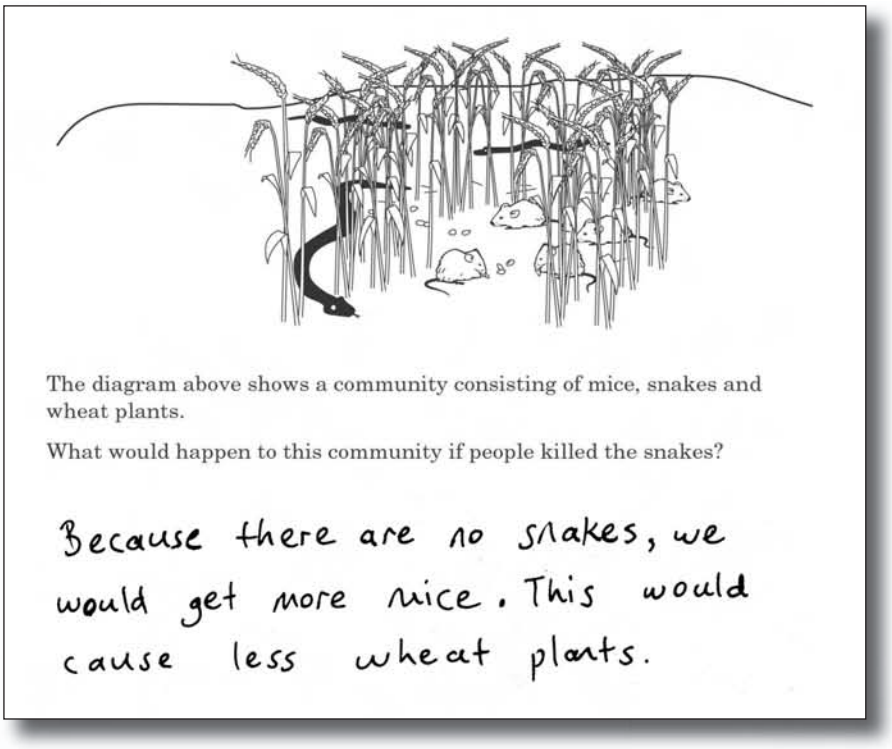
Learners who reached this benchmark could recognise and communicate basic scientific knowledge across a range of topics.



Content area: physics	Performance of selected countries	
Learner uses knowledge of gravity to recognise that objects fall towards the centre of earth. The international average was 70%, and 40% of South African learners correctly answered this question.	Japan	92 (1.2)
	Estonia	91 (1.7)
	Korea, Rep. of	90 (1.5)
	Hungary	88 (2.1)
	Sweden	87 (1.8)
	International average	70 (0.4)
	Botswana	61 (2.7)
	Egypt	51 (2.3)
	Tunisia	47 (2.5)
	Ghana	43 (2.9)
	South Africa	40 (2.1)
	Morocco	6 (1.3)

Performance at the High International Benchmark (550)

Learners who reached this benchmark demonstrated conceptual understanding of some science cycles, systems and principles.



Content area: life sciences	Performance of selected countries	
Given that a community consists of mice, snakes and wheat plants, learners must explain what would happen to the mice and wheat plants if the snakes are killed. This is an example of a constructed-response question. Internationally, 33% of all learners answered correctly, and in South Africa 6% of learners answered correctly.	Singapore	78 (1.8)
	Malaysia	68 (2.1)
	Chinese Taipei	55 (2.0)
	Estonia	52 (2.3)
	Australia	50 (2.3)
	International average	33 (0.3)
	Morocco	16 (1.8)
	Philippines	16 (1.5)
	Lebanon	9 (1.6)
	Botswana	6 (1.1)
	South Africa	6 (1.1)
	Ghana	3 (0.6)

Performance at the Advanced International Benchmark (625)

Learners who reached this benchmark demonstrated a grasp of some complex and abstract science concepts.

The table shows some information about the planets Venus and Mercury.

	Average Surface Temperature (°C)	Atmospheric Composition	Mean Distance from the Sun (millions of km)	Time to Revolve Around the Sun (Number of Days)
Venus	470	Mostly Carbon Dioxide	108	225
Mercury	300	Trace amounts of gases	58	88

Which of the following best explains why the surface temperature of Venus is higher than that of Mercury?

Ⓐ There is less absorption of sunlight on Mercury because of the lack of atmospheric gases.

● Ⓑ The high percentage of carbon dioxide in the atmosphere of Venus causes a greenhouse effect.

Ⓒ The longer time for Venus to revolve around the Sun allows it to absorb more heat from the Sun.

Ⓓ The Sun's rays are less direct on Mercury because it is closer to the Sun.

Content area: earth science	Performance of selected countries	
Given a table showing information about Venus and Mercury, the learner recognises that the higher average surface temperature on Venus is due to the greenhouse effect. Internationally, just over one third of learners answered the question correctly and South Africa performed relatively well, with 23% of the learners answering correctly.	Korea, Rep. of	70 (1.9)
	Hong Kong, SAR	69 (1.7)
	Chinese Taipei	69 (1.6)
	Singapore	60 (1.8)
	International average	36 (0.3)
	South Africa	23 (1.3)
	Ghana	22 (1.7)
	Tunisia	19 (1.3)
	Saudi Arabia	18 (2.0)
	Indonesia	16 (1.4)
	Morocco	16 (1.8)
	Macedonia, Rep. of	15 (1.7)
	Armenia	15 (1.7)

Summary

There were 50 participating countries in TIMSS 2003. The five highest performing countries were Singapore, Chinese Taipei, Republic of Korea, Hong Kong (SAR) and Estonia. The five lowest performing countries were Lebanon, Philippines, Botswana, Ghana and South Africa. The science average scale score for South African Grade 8 learners was the lowest, at 244 (SE = 6.7), and this was significantly lower than the international average score (M = 474, SE = 0.6). The South African scores displayed the widest range when compared against any other country.

In most countries there were equitable participation rates, with participation of girls and boys varying from 48 to 52 per cent. The international science average score for girls (M = 471, SE = 0.7) and for boys (M = 477, SE = 0.7) is worth commenting on, as this difference of 6 (SE = 0.6) is statistically significant, with boys outperforming girls. For South Africa, the girls average scale score was 242 (SE = 7.2) and the boys average scale score was 244 (SE =7.7). The difference is not statistically significant. In 11 countries the average science scores for girls and boys did not show a gender difference; in seven (7) countries the girls score was significantly higher than that of the boys; and in 28 countries the boys score was significantly higher than for the girls.

South Africa has 13 per cent of the population achieve a score higher than the LIB (that is, a score higher than 400). This means that 87 per cent of the learners scored lower than 400 scale points. This again illustrates the vast variation in South African performance – a few learners performing very well and the majority performing poorly. South Africa and Ghana had the highest number of learners scoring below the LIB.