

Exhibit 4.15: Differences in Achievement for Science Content Domains Across Assessment Years<sup>◇</sup>

Read across the row to determine if the performance in the row year is significantly higher (▲) or significantly lower (▼) than the performance in the column year.

Country	Biology				Chemistry				Physics				Earth Science			
	Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years		
		2015	2011	2007		2015	2011	2007		2015	2011	2007		2015	2011	2007
<b>Australia</b>																
2019	531 (3.3)	9 ▲	4	12 ▲	515 (3.8)	22 ▲	13 ▲	10	529 (3.6)	24 ▲	18 ▲	20 ▲	533 (3.3)	11 ▲	0	13 ▲
2015	522 (2.8)		-5	3	493 (3.3)		-8	-12 ▼	505 (2.7)		-6	-4	522 (2.9)		-11	1
2011	527 (4.8)			8	501 (5.0)			-3	511 (5.1)			2	533 (5.5)			13
2007	519 (3.8)				504 (4.0)				509 (4.3)				521 (4.4)			
<b>Bahrain</b>																
2019	492 (1.9)	24 ▲	44 ▲	22 ▲	480 (2.4)	18 ▲	33 ▲	14 ▲	480 (2.6)	19 ▲	23 ▲	17 ▲	475 (2.8)	15 ▲	24 ▲	15 ▲
2015	469 (2.6)		20 ▲	-1	462 (2.8)		15 ▲	-4	461 (2.6)		5	-2	461 (3.5)		9 ▲	0
2011	449 (2.0)			-22 ▼	448 (2.6)			-19 ▼	457 (1.7)			-7 ▼	451 (1.8)			-9 ▼
2007	470 (2.1)				467 (2.9)				463 (1.6)				460 (2.8)			
<b>Chile</b>																
2019	471 (3.0)	12 ▲	10 ▲		442 (2.9)	4	-5		450 (3.7)	11 ▲	-3		464 (3.3)	0	-12 ▼	
2015	459 (3.6)		-3		438 (3.6)		-9		439 (3.8)		-14 ▼		464 (3.2)		-12 ▼	
2011	462 (2.6)				447 (3.0)				453 (2.6)				476 (2.8)			
<b>Chinese Taipei</b>																
2019	576 (2.2)	11 ▲	19 ▲	22 ▲	594 (2.4)	16 ▲	9 ▲	10	555 (2.7)	-5	3	-4	579 (2.5)	-2	11 ▲	27 ▲
2015	565 (2.2)		8 ▲	11 ▲	579 (2.7)		-7	-6	560 (3.0)		8	1	581 (2.7)		12 ▲	29 ▲
2011	557 (2.5)			3	585 (3.8)			1	552 (3.3)			-6	568 (2.8)			16 ▲
2007	554 (3.7)				585 (4.7)				559 (4.2)				552 (3.4)			
<b>Cyprus</b>																
2019	489 (2.4)			45 ▲	478 (2.1)			30 ▲	480 (3.6)			25 ▲	473 (2.6)			20 ▲
2007	444 (2.3)				448 (3.1)				454 (3.6)				453 (2.6)			
<b>Egypt</b>																
<sup>2</sup> 2019	381 (5.6)	33 ▲		-19 ▼	397 (5.9)	2		-7	394 (5.0)	16 ▲		-12	367 (5.5)	16 ▲		-50 ▼
2015	348 (5.0)			-52 ▼	395 (5.0)			-9	378 (4.7)			-28 ▼	351 (4.6)			-65 ▼
2007	400 (3.7)				404 (4.7)				406 (3.8)				417 (4.4)			
<b>England</b>																
2019	516 (5.2)	-26 ▼	-17 ▼	-28 ▼	512 (6.0)	-17 ▼	-17 ▼	-27 ▼	516 (5.1)	-19 ▼	-17 ▼	-32 ▼	517 (5.5)	-18 ▼	-19 ▼	-14
2015	542 (4.0)		9	-2	529 (4.5)		0	-11	535 (3.9)		2	-14 ▼	536 (4.0)		-1	4
<sup>‡</sup> 2011	533 (4.8)			-11	529 (5.2)			-11	533 (4.7)			-15 ▼	536 (5.3)			5
<sup>†</sup> 2007	544 (4.7)				539 (4.7)				549 (4.5)				531 (5.2)			
<b>Finland</b>																
2019	534 (3.3)		-14 ▼		545 (3.8)		-8		539 (3.9)		-1		558 (3.5)		-16 ▼	
2011	548 (2.8)				554 (2.6)				540 (2.9)				574 (3.0)			
<b>Georgia</b>																
<sup>1</sup> 2019	447 (3.5)	0	12 ▲	28 ▲	456 (4.3)	0	61 ▲	48 ▲	436 (5.0)	6	35 ▲	25 ▲	431 (3.6)	11 ▲	13 ▲	15 ▲
<sup>1,2</sup> 2015	447 (3.1)		12 ▲	28 ▲	456 (3.7)		61 ▲	48 ▲	429 (4.6)		28 ▲	19 ▲	420 (3.6)		2	4
<sup>1</sup> 2011	435 (3.2)			16 ▲	395 (3.2)			-13 ▼	401 (4.2)			-9	417 (3.5)			2
<sup>1</sup> 2007	419 (4.1)				408 (5.4)				411 (5.9)				416 (4.5)			
<b>Hong Kong SAR</b>																
<sup>†</sup> 2019	501 (5.7)	-48 ▼	-35 ▼	-29 ▼	485 (5.5)	-51 ▼	-41 ▼	-36 ▼	510 (5.6)	-30 ▼	-29 ▼	-20 ▼	512 (5.6)	-46 ▼	-28 ▼	-24 ▼
2015	549 (4.7)		13 ▲	19 ▲	536 (4.1)		10	15 ▲	540 (4.1)		2	10	558 (4.3)		19 ▲	23 ▲
2011	535 (3.6)			6	526 (3.6)			5	539 (3.6)			9	539 (3.6)			4
<sup>†</sup> 2007	529 (5.0)				521 (5.3)				530 (5.4)				535 (5.1)			
<b>Hungary</b>																
2019	530 (2.7)	9 ▲	11 ▲	-5	527 (3.5)	-7	-7	-13 ▼	528 (2.9)	-3	3	-16 ▼	535 (3.9)	13 ▲	24 ▲	0
2015	521 (3.3)		1	-14 ▼	534 (3.6)		0	-6	531 (4.0)		6	-13 ▼	521 (3.9)		10 ▲	-13 ▼
2011	520 (3.0)			-15 ▼	534 (3.3)			-6	525 (3.7)			-19 ▼	511 (3.3)			-24 ▼
2007	535 (2.9)				540 (4.0)				544 (3.7)				535 (3.3)			
<b>Iran, Islamic Rep. of</b>																
2019	448 (3.7)	-1	-18 ▼	3	450 (4.5)	-8	-19 ▼	-7	453 (4.2)	-22 ▼	-30 ▼	-14 ▼	437 (4.0)	-2	-40 ▼	-35 ▼
2015	448 (3.8)		-18 ▼	3	458 (4.6)		-12	1	475 (4.4)		-8	8	439 (4.5)		-38 ▼	-33 ▼
2011	466 (3.9)			21 ▲	469 (4.4)			12 ▲	483 (4.1)			16 ▲	477 (4.0)			5
2007	445 (3.7)				457 (4.1)				467 (4.1)				472 (4.3)			
<b>Ireland</b>																
2019	521 (3.2)	-13 ▼			512 (3.9)	-5			519 (3.8)	-6			536 (3.8)	-6		
2015	534 (2.9)				517 (3.6)				525 (3.2)				542 (3.1)			
<b>Israel</b>																
<sup>3</sup> 2019	512 (4.2)	8	-11		518 (4.6)	3	5		520 (4.9)	11	6		495 (4.7)	2	-9	
<sup>3</sup> 2015	504 (4.2)		-19 ▼		516 (4.6)		2		508 (4.0)		-5		493 (4.0)		-12 ▼	
<sup>3</sup> 2011	523 (4.2)				514 (5.0)				514 (4.1)				504 (4.3)			

▲ Average from more recent year significantly higher  
 ▼ Average from more recent year significantly lower

<sup>◇</sup> Trend reporting in content domains using current methodology began with TIMSS 2007.

See Appendix B.7 for target population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Exhibit 4.15: Differences in Achievement for Science Content Domains Across Assessment Years<sup>o</sup>

(Continued)

Country	Biology				Chemistry				Physics				Earth Science			
	Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years		
		2015	2011	2007		2015	2011	2007		2015	2011	2007		2015	2011	2007
<b>Italy</b>																
2019	508 (2.7)	13 ▲	5	6	484 (3.0)	-4	-8	6	487 (4.5)	-10	-4	-2	512 (3.5)	-2	-1	10 ▲
<sup>2</sup> 2015	496 (2.6)		-8 ▼	-6	487 (2.4)		-4	9 ▲	496 (2.5)		6	8	514 (2.8)		1	12 ▲
2011	503 (3.0)			1	491 (3.0)			13 ▲	490 (2.8)			2	513 (3.8)			11 ▲
2007	502 (3.2)				478 (3.5)				489 (3.5)				502 (3.5)			
<b>Japan</b>																
2019	574 (2.3)	3	13 ▲	19 ▲	560 (2.7)	-10 ▼	0	2	570 (2.5)	1	12 ▲	7 ▲	572 (3.2)	-2	23 ▲	36 ▲
2015	570 (2.9)		10 ▲	16 ▲	570 (2.4)		10 ▲	11 ▲	570 (2.3)		12 ▲	6 ▲	574 (2.0)		26 ▲	38 ▲
2011	561 (2.9)			6 ▲	560 (2.7)			1	558 (2.8)			-5	548 (2.8)			12 ▲
2007	554 (2.0)				559 (2.4)				563 (2.2)				536 (3.4)			
<b>Jordan</b>																
2019	457 (5.2)	38 ▲	10	-19 ▼	454 (5.3)	17 ▲	-8	-38 ▼	449 (4.6)	25 ▲	3	-28 ▼	428 (4.7)	12 ▲	-8	-54 ▼
2015	420 (3.9)		-28 ▼	-57 ▼	438 (3.8)		-25 ▼	-55 ▼	424 (3.6)		-22 ▼	-53 ▼	416 (3.0)		-20 ▼	-66 ▼
2011	447 (4.4)			-29 ▼	463 (4.4)			-30 ▼	446 (4.2)			-31 ▼	436 (4.3)			-46 ▼
2007	476 (4.2)				493 (4.7)				478 (4.3)				481 (4.2)			
<b>Kazakhstan</b>																
<sup>2</sup> 2019	476 (3.2)		-7		494 (3.6)		-15 ▼		476 (3.9)		-13 ▼		448 (4.1)		-24 ▼	
2011	483 (4.4)				508 (4.7)				489 (4.3)				472 (4.8)			
<b>Korea, Rep. of</b>																
2019	560 (2.2)	6	-1	8 ▲	551 (2.5)	0	0	12 ▲	569 (2.7)	5	-7	-7	562 (3.2)	7	14 ▲	19 ▲
2015	554 (2.2)		-7 ▼	2	550 (2.5)		-1	11 ▲	564 (2.8)		-12 ▼	-12 ▼	554 (2.7)		7	12 ▲
2011	561 (2.3)			9 ▲	551 (2.1)			12 ▲	577 (2.7)			0	548 (3.2)			5
2007	552 (2.0)				539 (3.0)				576 (2.6)				543 (2.4)			
<b>Lebanon</b>																
2019	355 (5.1)	-11	-40 ▼	-44 ▼	412 (4.6)	-25 ▼	-22 ▼	-27 ▼	378 (4.9)	-34 ▼	-27 ▼	-46 ▼	337 (5.1)	-28 ▼	-28 ▼	-41 ▼
2015	366 (6.2)		-29 ▼	-33 ▼	438 (6.2)		3	-2	412 (6.6)		7	-12	365 (6.4)		1	-13
2011	395 (5.2)			-4	435 (5.2)			-5	405 (5.4)			-19 ▼	365 (6.4)			-14
2007	399 (6.7)				440 (6.5)				424 (5.7)				378 (6.8)			
<b>Lithuania</b>																
2019	535 (3.0)	14 ▲	18 ▲	5	530 (3.2)	13 ▲	13 ▲	23 ▲	529 (3.5)	16 ▲	26 ▲	22 ▲	534 (3.3)	16 ▲	18 ▲	17 ▲
<sup>2</sup> 2015	521 (3.1)		4	-9 ▼	517 (3.2)		0	11 ▲	513 (3.6)		10 ▲	6	518 (3.3)		2	1
<sup>1</sup> 2011	517 (2.7)			-13 ▼	517 (2.3)			11 ▲	503 (3.2)			-4	517 (3.5)			0
<sup>1</sup> 2007	530 (2.7)				506 (2.6)				507 (3.1)				517 (3.0)			
<b>Malaysia</b>																
2019	463 (3.7)	-4	36 ▲	-3	434 (4.2)	-39 ▼	8	-41 ▼	475 (3.4)	-5	40 ▲	-7	452 (4.3)	-9	50 ▲	-5
2015	466 (4.4)		39 ▲	1	473 (4.0)		47 ▲	-2	480 (3.9)		45 ▲	-2	460 (4.5)		59 ▲	4
2011	427 (6.2)			-39 ▼	426 (6.5)			-49 ▼	435 (6.6)			-47 ▼	401 (6.5)			-56 ▼
2007	466 (6.2)				475 (5.9)				482 (6.4)				457 (6.1)			
<b>Morocco</b>																
2019	387 (3.0)	7	9 ▲		402 (3.0)	3	28 ▲		402 (2.9)	7	53 ▲		357 (3.3)	-38 ▼	-20 ▼	
2015	380 (2.5)		2		400 (3.0)		25 ▲		395 (2.9)		47 ▲		395 (2.2)		18 ▲	
2011	378 (3.1)				374 (2.3)				349 (2.6)				377 (3.3)			
<b>New Zealand</b>																
<sup>†</sup> 2019	498 (3.7)	-22 ▼	-16 ▼		482 (3.8)	-16 ▼	-19 ▼		502 (3.8)	-7	-7		510 (3.7)	-7	-13 ▼	
<sup>†</sup> 2015	520 (3.5)		5		498 (3.5)		-3		508 (3.2)		0		517 (3.6)		-6	
2011	514 (4.8)				501 (5.3)				509 (4.6)				523 (4.8)			
<b>Norway (9)</b>																
<sup>†</sup> 2019	486 (2.8)	-16 ▼			492 (3.7)	-10 ▼			493 (3.6)	-19 ▼			519 (3.9)	-4		
2015	502 (2.6)				503 (2.9)				512 (3.1)				523 (3.3)			
<b>Oman</b>																
2019	466 (3.3)	12 ▲	59 ▲	59 ▲	443 (3.1)	-9 ▼	35 ▲	35 ▲	449 (3.1)	1	23 ▲	11 ▲	449 (3.0)	-8	17 ▲	17 ▲
2015	454 (2.7)		47 ▲	47 ▲	452 (2.7)		44 ▲	44 ▲	449 (3.0)		22 ▲	10 ▲	456 (2.4)		25 ▲	24 ▲
2011	407 (3.5)			0	408 (3.5)			0	427 (3.3)			-12 ▼	431 (3.0)			-1
2007	408 (3.2)				408 (4.4)				439 (3.1)				432 (2.9)			
<b>Qatar</b>																
2019	476 (4.4)	22 ▲	65 ▲		474 (4.4)	19 ▲	59 ▲		469 (4.4)	10	43 ▲		465 (5.0)	19 ▲	57 ▲	
2015	454 (3.0)		43 ▲		455 (3.6)		39 ▲		459 (3.4)		33 ▲		446 (3.7)		38 ▲	
2011	411 (4.2)				416 (4.0)				426 (3.8)				408 (3.8)			
<b>Romania</b>																
2019	479 (4.4)		21 ▲	22 ▲	466 (5.0)		-2	9	458 (4.3)		2	3	453 (4.7)		-17 ▼	-13 ▼
2011	458 (3.7)			2	469 (4.3)			11	456 (3.9)			2	470 (3.6)			4
2007	457 (3.8)				458 (5.2)				454 (3.8)				466 (4.0)			

▲ Average from more recent year significantly higher  
 ▼ Average from more recent year significantly lower

Exhibit 4.15: Differences in Achievement for Science Content Domains Across Assessment Years<sup>o</sup>

(Continued)

Country	Biology			Chemistry			Physics			Earth Science						
	Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years			Average Scale Score	Differences Between Years						
		2015	2011	2007		2015	2011	2007		2015	2011	2007	2015	2011	2007	
<b>Russian Federation</b>																
<sup>2</sup> 2019	543 (4.5)	4	6	16 ▲	551 (4.2)	-7	-3	11	540 (4.7)	-7	-7	20 ▲	533 (4.4)	1	-2	5
2015	539 (4.4)		2	12 ▲	558 (4.9)		4	18 ▲	548 (4.2)		1	27 ▲	532 (4.7)		-3	4
<sup>2</sup> 2011	537 (3.3)			10	554 (3.5)			13 ▲	547 (3.6)			26 ▲	535 (3.6)			7
2007	527 (3.9)				540 (4.2)				521 (4.3)				528 (4.2)			
<b>Singapore</b>																
<sup>2</sup> 2019	622 (4.2)	13 ▲	27 ▲	55 ▲	616 (5.0)	22 ▲	25 ▲	49 ▲	619 (4.1)	11 ▲	17 ▲	37 ▲	562 (4.1)	-3	-4	15 ▲
<sup>2</sup> 2015	609 (3.5)		15 ▲	42 ▲	593 (3.6)		3	27 ▲	608 (3.1)		7	26 ▲	565 (3.6)		-1	17 ▲
<sup>2</sup> 2011	594 (4.8)			27 ▲	590 (4.7)			24 ▲	602 (4.2)			19 ▲	566 (4.5)			19 ▲
2007	567 (4.5)				566 (4.8)				582 (4.3)				547 (4.9)			
<b>South Africa (9)</b>																
<sup>ψ</sup> 2019	359 (3.0)	3	41 ▲		372 (4.2)	3	36 ▲		381 (3.0)	22 ▲	30 ▲		366 (3.2)	36 ▲	72 ▲	
2015	356 (5.9)		38 ▲		369 (6.1)		33 ▲		359 (5.5)		8		330 (6.4)		36 ▲	
<sup>ψ</sup> 2011	318 (3.5)				336 (3.8)				351 (3.6)				294 (3.7)			
<b>Sweden</b>																
<sup>2</sup> 2019	519 (3.4)	-1	6	3	509 (3.7)	-4	7	10 ▲	520 (3.8)	-4	22 ▲	13 ▲	530 (3.2)	-2	10 ▲	19 ▲
2015	520 (3.6)		7	5	512 (3.6)		10 ▲	13 ▲	524 (3.7)		26 ▲	17 ▲	532 (4.5)		12 ▲	20 ▲
2011	513 (2.9)			-3	502 (2.6)			3	498 (3.2)			-9 ▽	520 (2.7)			8
2007	515 (2.6)				499 (2.8)				507 (3.0)				511 (3.3)			
<b>Turkey</b>																
2019	513 (3.4)	22 ▲	29 ▲		516 (4.8)	22 ▲	39 ▲		518 (4.0)	13 ▲	24 ▲		509 (3.8)	32 ▲	41 ▲	
2015	491 (4.1)		7		493 (4.7)		16 ▲		506 (4.2)		12 ▲		477 (3.9)		9	
2011	484 (3.7)				477 (4.0)				494 (3.6)				468 (3.4)			
<b>United Arab Emirates</b>																
2019	474 (2.5)	0	11 ▲		475 (2.4)	-6	12 ▲		469 (2.3)	-5	8 ▲		465 (2.4)	-10 ▽	-1	
2015	475 (2.4)		12 ▲		481 (3.2)		17 ▲		475 (2.5)		13 ▲		475 (2.4)		8 ▲	
2011	463 (2.4)				464 (2.3)				461 (2.3)				466 (2.5)			
<b>United States</b>																
<sup>†</sup> 2019	530 (4.8)	-11	0	-1	509 (5.2)	-10	-11	-1	515 (5.0)	-1	1	11 ▲	530 (5.1)	-5	-4	3
<sup>†</sup> 2015	540 (2.9)		10 ▲	10 ▲	519 (3.2)		-1	9 ▲	516 (2.9)		3	13 ▲	535 (3.1)		2	9
<sup>2</sup> 2011	530 (2.5)			0	520 (2.6)			10 ▲	513 (2.5)			10 ▲	533 (2.7)			7
<sup>2†</sup> 2007	531 (3.0)				510 (3.1)				503 (3.0)				526 (3.7)			
<b>Benchmarking Participants</b>																
<b>Ontario, Canada</b>																
2019	534 (3.2)	-3	3	-3	492 (3.9)	-11 ▽	-3	-12 ▽	520 (3.5)	-2	-2	-3	520 (3.0)	-6	-8	-13 ▽
2015	538 (2.9)		7	0	503 (2.7)		8 ▲	-1	521 (2.9)		0	-1	526 (3.2)		-2	-7
<sup>2</sup> 2011	531 (2.6)			-6	495 (2.4)			-9 ▽	521 (2.8)			-1	528 (3.4)			-5
<sup>2</sup> 2007	537 (4.1)				504 (4.1)				523 (4.6)				533 (4.8)			
<b>Quebec, Canada</b>																
<sup>‡</sup> 2019	531 (3.8)	4	6	18 ▲	548 (4.1)	18 ▲	33 ▲	53 ▲	521 (4.2)	1	19 ▲	29 ▲	553 (4.5)	10	17 ▲	38 ▲
<sup>‡</sup> 2015	527 (4.3)		2	15 ▲	531 (4.6)		15 ▲	35 ▲	520 (4.7)		18 ▲	28 ▲	542 (4.2)		7	28 ▲
2011	525 (2.8)			12 ▲	515 (3.0)			20 ▲	502 (3.1)			10 ▲	536 (2.9)			21 ▲
<sup>3</sup> 2007	512 (3.2)				495 (3.4)				492 (3.5)				514 (4.3)			
<b>Abu Dhabi, UAE</b>																
2019	417 (3.9)	-35 ▽	-43 ▽		421 (4.1)	-38 ▽	-40 ▽		420 (3.8)	-34 ▽	-39 ▽		413 (4.1)	-41 ▽	-48 ▽	
2015	452 (6.1)		-7		459 (6.7)		-2		454 (5.4)		-5		453 (5.8)		-8	
2011	459 (4.2)				461 (4.1)				459 (3.9)				461 (4.6)			
<b>Dubai, UAE</b>																
<sup>2</sup> 2019	554 (2.2)	29 ▲	69 ▲	71 ▲	554 (2.2)	26 ▲	67 ▲	62 ▲	539 (2.6)	15 ▲	58 ▲	50 ▲	538 (2.3)	20 ▲	52 ▲	50 ▲
2015	525 (2.4)		40 ▲	42 ▲	528 (2.5)		41 ▲	36 ▲	525 (2.4)		43 ▲	36 ▲	518 (2.3)		31 ▲	30 ▲
2011	485 (2.7)			2	487 (2.4)			-5	482 (2.1)			-7	487 (3.1)			-1
<sup>‡</sup> 2007	483 (3.3)				492 (3.9)				489 (3.5)				488 (3.7)			

▲ Average from more recent year significantly higher  
 ▽ Average from more recent year significantly lower

<sup>ψ</sup> Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.