Appendices for
CMAS Technical Report
2015-2016

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APPENDIX A: SAMPLE SCORE REPORTS

Science Performance Level Descriptions

Students demonstrate mastery of science concepts and 21st century skills aligned to the Colorado Academic Standards at various performance levels. The performance level descriptors are organized in a manner that assumes students demonstrating higher levels of command have mastered the concepts and skills within the lower levels. For example, a student at moderate command also masters the concepts and skills of limited command.

Students who Exceeded Expectations demonstrated distinguished command of the Colorado Academic Standards and can typically

- evaluate and provide feedback on scientific evidence and reasoning about the separation of mixtures and how separation affects the total weight/mass;
- develop hypotheses about why similarities and differences exist between the body systems and parts of humans, plants, and animals;
- evaluate scientific claims about natural resources, in terms of reasonability and validity; and
- assess and provide feedback, through reasoning based on evidence, on scientific explanations about weather and factors that change Earth's surface.

Students who Met Expectations demonstrated strong command of the Colorado Academic Standards and can typically

- explain why certain procedures that are used to separate simple mixtures work and discuss any unexpected results;
- evaluate evidence and models of the structure and functions of human, plant, and animal organs and organ systems;
- investigate and generate evidence that human systems are interdependent;
- analyze and interpret data to explore concerns associated with natural resources; and
- formulate testable questions and scientific explanations around weather and factors that change Earth's surface.

Students who Approached Expectations demonstrated moderate command of the Colorado Academic Standards and can typically

- discuss how the mass/weight of a mixture is a sum of its parts and design a procedure to separate simple mixtures based on physical properties;
- create models of human, plant, and animal organ systems, and compare and contrast similarities and differences between the organisms;
- explore and describe the origins and usage of natural resources in Colorado; and
- interpret data about Earth, including weather and changes to Earth's surface.

Students who Partially Met Expectations demonstrated limited command of the Colorado Academic Standards and can typically

- select appropriate tools and follow procedures to separate simple mixtures;
- identify how humans, plants, and animals address basic survival needs;
- identify the functions of human body systems;
- distinguish between renewable and nonrenewable resources; and
- use appropriate tools and resources to gather data regarding weather conditions and Earth processes.

For more information about the standards included in this assessment, please visit the Colorado Department of Education's website at
www.cde.state.co.us/standardsandinstruction

Student Performance Report

Colorado Measures of Academic Success

Student: **SAMPSTUDENT 153 J. SAMPLELAST**
SASID: **2016050151** Birthdate: **01/22/2005**
School: **SAMPLE SCHOOL ONE (1602)**
District: **SAMPLE DISTRICT ONE (8000)**

Spring 2016

Science — Grade 5

This score report provides information about your student's performance on the Colorado Measures of Academic Success (CMAS) Science Assessment.

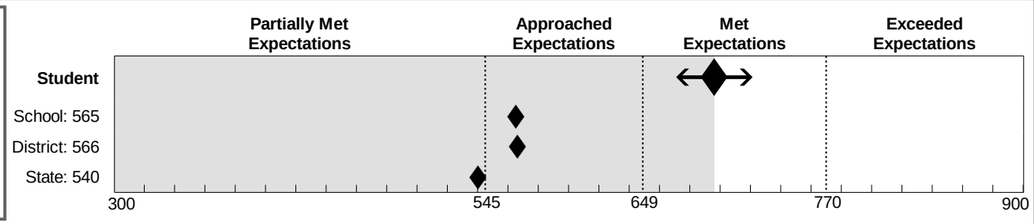
- Your student's performance is represented by a scale score, a performance level, and a percentile rank. (Scores are placed on a scale so that student performance can be compared across years.)
- On the graph, scale scores are represented by diamonds. The arrows around the student's diamond show the range of scores that your student would likely receive if the assessment was taken multiple times.
- School, district, and state averages are provided so that you can compare your student's performance to the performance of others. The percentage of students in each performance level across the state is reported below the graph.
- Dotted lines show where the range of scores is divided into performance levels. Descriptions of the performance levels can be found at the end of this report.

Your Student's Score

696

Met Expectations

81st Percentile



Percent of CO students by Performance Level: 64.4% 12.2% 3.3% 20.0%

The Colorado Academic Standards include expectations for student performance. Your student demonstrated a strong command of 5th grade level concepts and skills in science.

Subscale Performance

- The shaded areas in the table below represent approximately 70% of student scores across the state.
- Scores outside of the shaded area indicate a potential weakness or strength compared to the state.

Reporting Category Description	Subscale Score		Potential Relative Weakness (300) / Typical / Potential Relative Strength (900)
Physical Science			468 – 723
Students know and understand common properties, forms, and changes in matter and energy.	**728**	**Student**	
	575	School	
	575	District	
Life Science			477 – 718
Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.	**686**	**Student**	
	556	School	
	558	District	
Earth Systems Science			475 – 718
Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.	**687**	**Student**	
	569	School	
	569	District	
Scientific Investigations and the Nature of Science			471 – 717
Students understand the processes of scientific investigation and design, conducting and evaluating, as well as communicating about, such investigations. Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.	**711**	**Student**	
	573	School	
	573	District	

Purpose
This report describes your student's mastery of the Colorado Academic Standards in Science.

For more information on the CMAS assessment program, visit:
www.cde.state.co.us/assessment

Colorado Measures of Academic Success

Science

Grade 5

Performance by Prepared Graduate Competencies (PGCs) and Grade Level Expectations (GLEs)

- Within each standard, PGCs are identified. PGCs represent the concepts and skills that students need to master in order to be college and career ready.
- GLEs are grade-specific expectations that indicate a student is making progress toward the PGCs.
- The figure below shows the percentage of items that your student answered correctly for each GLE represented in the grade. If there is more than one GLE for a PGC, the percentage of items your student answered correctly by PGC is also provided.

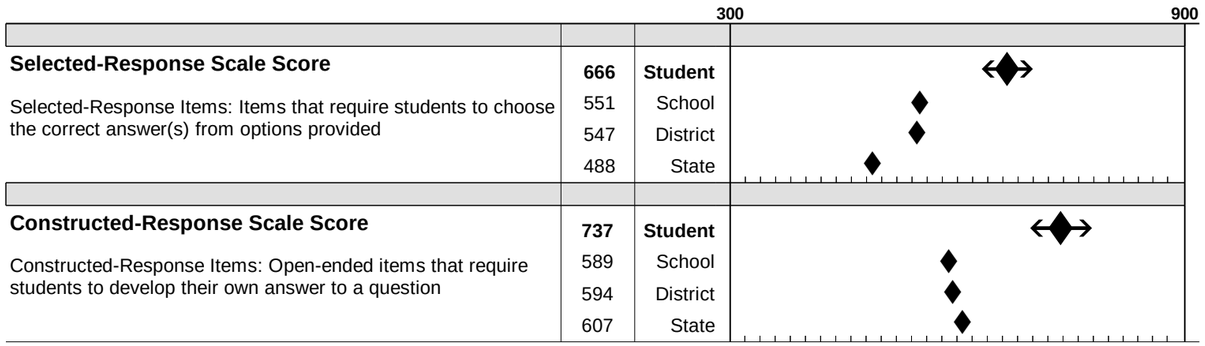
Student's performance
District average
State average

Standard, PGC, and GLE	Points Possible	Percent Correct* 0% 25% 50% 75% 100%
Physical Science		
PGC 1 Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions		
GLE 1: Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts	20	75%
Life Science		
PGC 1: Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment		
GLE 1: All organisms have structures and systems with separate functions	13	62%
PGC 2: Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection		
GLE 2: Human body systems have basic structures, functions, and needs	17	71%
Earth Systems Science		
PGC 1: Describe how humans are dependent on the diversity of resources provided by Earth and Sun		
GLE 1: Earth and sun provide a diversity of renewable and nonrenewable resources	10	70%
PGC 2: Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system	20	65%
GLE 2: Earth's surface changes constantly through a variety of processes and forces	9	67%
GLE 3: Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind, and water in the atmosphere and type of precipitation	11	64%

*Percent correct scores cannot be compared across years because individual items change from year to year. They also cannot be compared across GLEs and PGCs because the number of items and the difficulty of items may not be the same.

Performance by Item Type

CMAS assessments include selected-response and constructed-response items. The figure below shows your student's scale score for each item type in relation to school, district, and state averages.



District School Roster

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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Grade 5

Purpose: This report presents each school's performance on the overall test and content standards for your district.

Performance Levels (PL)	Scale Score Ranges
Exceeded Expectations	771-900
Met Expectations	650-770
Approached Expectations	546-649
Partially Met Expectations	300-545

● = Potential Relative Strength (PRS)
◒ = Typical
○ = Potential Relative Weakness (PRW)

Content Standards Performance District Summary

	Physical Science				Life Science				Earth Systems Science				Scientific Investigations/ Nature of Science			
		●	◒	○		●	◒	○		●	◒	○		●	◒	○
# of Students in district:		18	13	22		18	14	21		18	13	22		18	13	22
% of Students in district:		34%	25%	42%		34%	26%	40%		34%	25%	42%		34%	25%	42%

SCHOOL NAME	Total Number Tested	Average Scale Score	Content Standard Scale Score (SS)															
			SS	●	◒	○	SS	●	◒	○	SS	●	◒	○	SS	●	◒	○
State Average:		540	552	20%	52%	28%	521	20%	51%	29%	550	21%	51%	28%	559	20%	52%	28%
District Average:		566	575	34%	25%	42%	558	34%	26%	40%	569	34%	25%	42%	573	34%	25%	42%
SAMPLE SCHOOL EIGHT	53	467	501	22%	22%	56%	423	0%	44%	56%	453	0%	44%	56%	507	33%	11%	56%
SAMPLE SCHOOL FIVE	16	538	529	0%	92%	8%	515	0%	92%	8%	558	8%	75%	17%	572	0%	92%	8%
SAMPLE SCHOOL FOUR	28	704	705	13%	88%	0%	722	13%	88%	0%	678	13%	88%	0%	738	13%	88%	0%
SAMPLE SCHOOL ONE	453	565	575	33%	24%	43%	556	33%	26%	40%	569	33%	24%	43%	573	33%	24%	43%
SAMPLE SCHOOL ONEX	23	565	575	33%	24%	43%	556	33%	26%	40%	569	33%	24%	43%	573	33%	24%	43%
SAMPLE SCHOOL SEVEN	14	550	552	0%	92%	8%	464	0%	77%	23%	525	0%	92%	8%	625	0%	92%	8%
SAMPLE SCHOOL SIX	34	331	303	0%	0%	100%	300	0%	0%	100%	300	0%	0%	100%	391	0%	33%	67%
SAMPLE SCHOOL THREE	153	667	656	25%	50%	25%	693	63%	13%	25%	633	38%	38%	25%	675	38%	38%	25%

Note: Students with no scores are not included in summary calculations.

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District School Roster

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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Grade 5

Purpose: This report presents each school's performance on the prepared graduate competencies and grade level expectations for your district. Percent correct for each GLE is presented.
If there is more than one GLE within a PGC then percent correct by PGC is also provided.

	Prepared Graduate Competencies (PGC) and Grade Level Expectations (GLE) Performance						
	Physical Science			Life Science		Earth Systems Science	
	Points Possible						
	20	13	17	10	20	9	11
	PGC1 GLE1	PGC1 GLE1	PGC2 GLE2	PGC1 GLE1	PGC2	GLE2	GLE3
State Average:	41%	38%	37%	42%	41%	42%	41%
District Average:	45%	43%	44%	45%	45%	44%	46%
SCHOOL NAME							
SAMPLE SCHOOL EIGHT	32%	19%	15%	19%	24%	24%	0%
SAMPLE SCHOOL FIVE	38%	40%	35%	48%	44%	52%	37%
SAMPLE SCHOOL FOUR	67%	59%	56%	56%	54%	58%	58%
SAMPLE SCHOOL ONE	46%	43%	43%	45%	46%	44%	47%
SAMPLE SCHOOL ONEX	46%	43%	43%	45%	46%	44%	47%
SAMPLE SCHOOL SEVEN	34%	25%	22%	30%	17%	17%	0%
SAMPLE SCHOOL SIX	0%	8%	11%	8%	4%	4%	0%
SAMPLE SCHOOL THREE	61%	61%	62%	52%	58%	58%	0%

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District Performance Level Summary

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

Grade 5

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Purpose: This report describes group achievement in terms of performance levels and average scale scores.

	Number of Valid Scores	Average Scale Score	Performance Levels								Met and Exceeded		No Scores Reported	Total Number of Students
			Partially Met Expectations		Approached Expectations		Met Expectations		Exceeded Expectations					
			#	%	#	%	#	%	#	%	#	%	#	#
State	**90**	**540**	**58**	**64.4%**	**11**	**12.2%**	**3**	**3.3%**	**18**	**20.0%**	**21**	**23.3%**	**5**	**626**
District	53	566	28	52.8%	6	11.3%	1	1.9%	18	34.0%	19	35.9%	0	474
Gender														
Female	34	579	16	47.1%	6	17.6%	1	2.9%	11	32.4%	12	35.3%	0	313
Male	19	542	12	63.2%	0	0.0%	0	0.0%	7	36.8%	7	36.8%	0	161
Ethnicity/Race														
Hispanic or Latino	10	482	7	70.0%	0	0.0%	0	0.0%	3	30.0%	3	30.0%	0	49
American Indian or Alaska Native	3	700	1	33.3%	0	0.0%	0	0.0%	2	66.7%	2	66.7%	0	24
Asian	3	602	1	33.3%	1	33.3%	0	0.0%	1	33.3%	1	33.3%	0	27
Black or African-American	4	670	1	25.0%	1	25.0%	0	0.0%	2	50.0%	2	50.0%	0	29
White	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Native Hawaiian or Other Pacific Islander	3	500	2	66.7%	0	0.0%	0	0.0%	1	33.3%	1	33.3%	0	26
Two or more races	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	5
Not Indicated	28	567	15	53.6%	4	14.3%	1	3.6%	8	28.6%	9	32.1%	0	289
Economic Disadvantage														
Free/Reduced Lunch Eligible	11	577	6	54.5%	1	9.1%	0	0.0%	4	36.4%	4	36.4%	0	161
Not Eligible for Free/Reduced Lunch	42	563	22	52.4%	5	11.9%	1	2.4%	14	33.3%	15	35.7%	0	313
Language Proficiency														
Not English Proficient (NEP)	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	19
Limited English Proficient (LEP)	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
NEP and LEP	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	19
Not NEP and LEP	51	565	27	52.9%	6	11.8%	1	2.0%	17	33.3%	18	35.3%	0	455
Fluent English Proficient	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Primary Home Language other than English	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Former English Language Learner	4	651	2	50.0%	0	0.0%	0	0.0%	2	50.0%	2	50.0%	0	26
Not in ELL Program	45	561	23	51.1%	6	13.3%	1	2.2%	15	33.3%	16	35.6%	0	373
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2

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District Performance Level Summary

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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Grade 5

Purpose: This report describes group achievement in terms of performance levels and average scale scores.

	Number of Valid Scores	Average Scale Score	Performance Levels								Met and Exceeded		No Scores Reported	Total Number of Students
			Partially Met Expectations		Approached Expectations		Met Expectations		Exceeded Expectations					
			#	%	#	%	#	%	#	%	#	%	#	#
Language Background														
English	2	397	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	16
Spanish	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Other	5	581	3	60.0%	0	0.0%	0	0.0%	2	40.0%	2	40.0%	0	43
Not Indicated	46	572	23	50.0%	6	13.0%	1	2.2%	16	34.8%	17	37.0%	0	405
ELL Program - Bilingual														
No	17	612	8	47.1%	1	5.9%	0	0.0%	8	47.1%	8	47.1%	0	96
Yes	6	366	6	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	79
Monitored Y1	5	660	2	40.0%	0	0.0%	0	0.0%	3	60.0%	3	60.0%	0	58
Monitored Y2	8	429	6	75.0%	1	12.5%	0	0.0%	1	12.5%	1	12.5%	0	94
Exited Y3	7	708	1	14.3%	2	28.6%	1	14.3%	3	42.9%	4	57.1%	0	50
Parent Choice	8	592	3	37.5%	2	25.0%	0	0.0%	3	37.5%	3	37.5%	0	95
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
ELL Program - ESL														
No	11	527	7	63.6%	1	9.1%	0	0.0%	3	27.3%	3	27.3%	0	124
Yes	17	610	6	35.3%	4	23.5%	1	5.9%	6	35.3%	7	41.2%	0	112
Monitored Y1	8	517	5	62.5%	1	12.5%	0	0.0%	2	25.0%	2	25.0%	0	78
Monitored Y2	4	600	2	50.0%	0	0.0%	0	0.0%	2	50.0%	2	50.0%	0	28
Exited Y3	5	664	2	40.0%	0	0.0%	0	0.0%	3	60.0%	3	60.0%	0	30
Parent Choice	6	500	4	66.7%	0	0.0%	0	0.0%	2	33.3%	2	33.3%	0	100
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Students with Disabilities														
IEP - Yes	8	675	3	37.5%	0	0.0%	0	0.0%	5	62.5%	5	62.5%	0	43
IEP- No	45	547	25	55.6%	6	13.3%	1	2.2%	13	28.9%	14	31.1%	0	431
504	8	577	4	50.0%	1	12.5%	0	0.0%	3	37.5%	3	37.5%	0	32

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District Performance Level Summary

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

Grade 5

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Purpose: This report describes group achievement in terms of performance levels and average scale scores.

	Number of Valid Scores	Average Scale Score	Performance Levels								Met and Exceeded		No Scores Reported	Total Number of Students
			Partially Met Expectations		Approached Expectations		Met Expectations		Exceeded Expectations					
			#	%	#	%	#	%	#	%	#	%	#	#
Primary Disability														
Intellectual Disability	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Specific Learning Disability	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Hearing Impairment, including Deafness	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Visual Impairment, including Blindness	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Speech or Language Impairment	1	300	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	1
Deaf-Blindness	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	10
Multiple Disabilities	1	900	0	0.0%	0	0.0%	0	0.0%	1	100.0%	1	100.0%	0	19
Autism Spectrum Disorders	1	900	0	0.0%	0	0.0%	0	0.0%	1	100.0%	1	100.0%	0	9
Traumatic Brain Injury (TBI)	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Orthopedic Impairment	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Other Health Impairment	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Developmental Delay	1	900	0	0.0%	0	0.0%	0	0.0%	1	100.0%	1	100.0%	0	1
Emotional Disability	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Not Collected	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	3
None	45	547	25	55.6%	6	13.3%	1	2.2%	13	28.9%	14	31.1%	0	431
Gifted/Talented Designation														
No	36	559	20	55.6%	4	11.1%	1	2.8%	11	30.6%	12	33.3%	0	306
Yes	17	581	8	47.1%	2	11.8%	0	0.0%	7	41.2%	7	41.2%	0	168
Title 1														
No	28	583	13	46.4%	4	14.3%	1	3.6%	10	35.7%	11	39.3%	0	303
Yes	23	552	13	56.5%	2	8.7%	0	0.0%	8	34.8%	8	34.8%	0	169
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Homeless														
No	44	576	21	47.7%	6	13.6%	1	2.3%	16	36.4%	17	38.6%	0	390
Yes and in Physical Custody	3	568	2	66.7%	0	0.0%	0	0.0%	1	33.3%	1	33.3%	0	37
Yes and Not in Physical Custody	4	498	3	75.0%	0	0.0%	0	0.0%	1	25.0%	1	25.0%	0	45
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2

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District Performance Level Summary

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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Grade 5

Purpose: This report describes group achievement in terms of performance levels and average scale scores.

	Number of Valid Scores	Average Scale Score	Performance Levels								Met and Exceeded		No Scores Reported	Total Number of Students
			Partially Met Expectations		Approached Expectations		Met Expectations		Exceeded Expectations					
			#	%	#	%	#	%	#	%	#	%	#	#
Migrant														
No	36	557	19	52.8%	4	11.1%	1	2.8%	12	33.3%	13	36.1%	0	320
Yes	17	585	9	52.9%	2	11.8%	0	0.0%	6	35.3%	6	35.3%	0	154
Colorado Continuously														
No	14	594	7	50.0%	1	7.1%	1	7.1%	5	35.7%	6	42.9%	0	175
Yes	37	560	19	51.4%	5	13.5%	0	0.0%	13	35.1%	13	35.1%	0	297
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Continuous in District														
No	12	652	5	41.7%	0	0.0%	0	0.0%	7	58.3%	7	58.3%	0	81
Yes	39	544	21	53.9%	6	15.4%	1	2.6%	11	28.2%	12	30.8%	0	391
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Continuous in School														
No	22	624	10	45.5%	1	4.5%	0	0.0%	11	50.0%	11	50.0%	0	191
Yes	29	528	16	55.2%	5	17.2%	1	3.5%	7	24.1%	8	27.6%	0	281
Not Indicated	2	483	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Accommodations														
None	32	542	17	53.1%	6	18.8%	1	3.1%	8	25.0%	9	28.1%	0	296
Braille - paper	4	600	2	50.0%	0	0.0%	0	0.0%	2	50.0%	2	50.0%	0	4
Directions in Native Language	10	636	5	50.0%	0	0.0%	0	0.0%	5	50.0%	5	50.0%	0	76
Extended Time	4	600	2	50.0%	0	0.0%	0	0.0%	2	50.0%	2	50.0%	0	67
Human Reader/Signer	1	300	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	1
Large Print - paper	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	2
Response in Language other than English	8	646	4	50.0%	0	0.0%	0	0.0%	4	50.0%	4	50.0%	0	71
Scribe - English	8	675	3	37.5%	0	0.0%	0	0.0%	5	62.5%	5	62.5%	0	58
Text-To-Speech English	2	600	1	50.0%	0	0.0%	0	0.0%	1	50.0%	1	50.0%	0	5
Text-to-Speech Spanish	1	300	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2
Translation - paper	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Word Prediction	11	642	5	45.5%	0	0.0%	0	0.0%	6	54.5%	6	54.5%	0	61
Word to Word Dictionary	7	672	3	42.9%	0	0.0%	0	0.0%	4	57.1%	4	57.1%	0	56

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District Performance Level Summary

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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Grade 5

Purpose: This report describes group achievement in terms of performance levels and average scale scores.

	Total Number of Students
Total Number of Students with No Scores Reported by Category	
Took Other Assessment OR Duplicate Registration/Attempt*	0
Interrupted and Not Completed	0
Withdrew Before Completion*	0
Student Test Refusal	0
Non-approved Accommodation	0
Misadministration	0
Medical Exemption*	0
Part Time Public and Part Time Home School Student*	0
Parent Excuse	0
Absent	0
State Use - Attempt not Met	421

* Not included in "Total Number Tested" and "No Scores Reported".

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District Item Analysis Report

Colorado Measures of Academic Success

Spring 2016

District: **SAMPLE DISTRICT ONE (8000)**

Science

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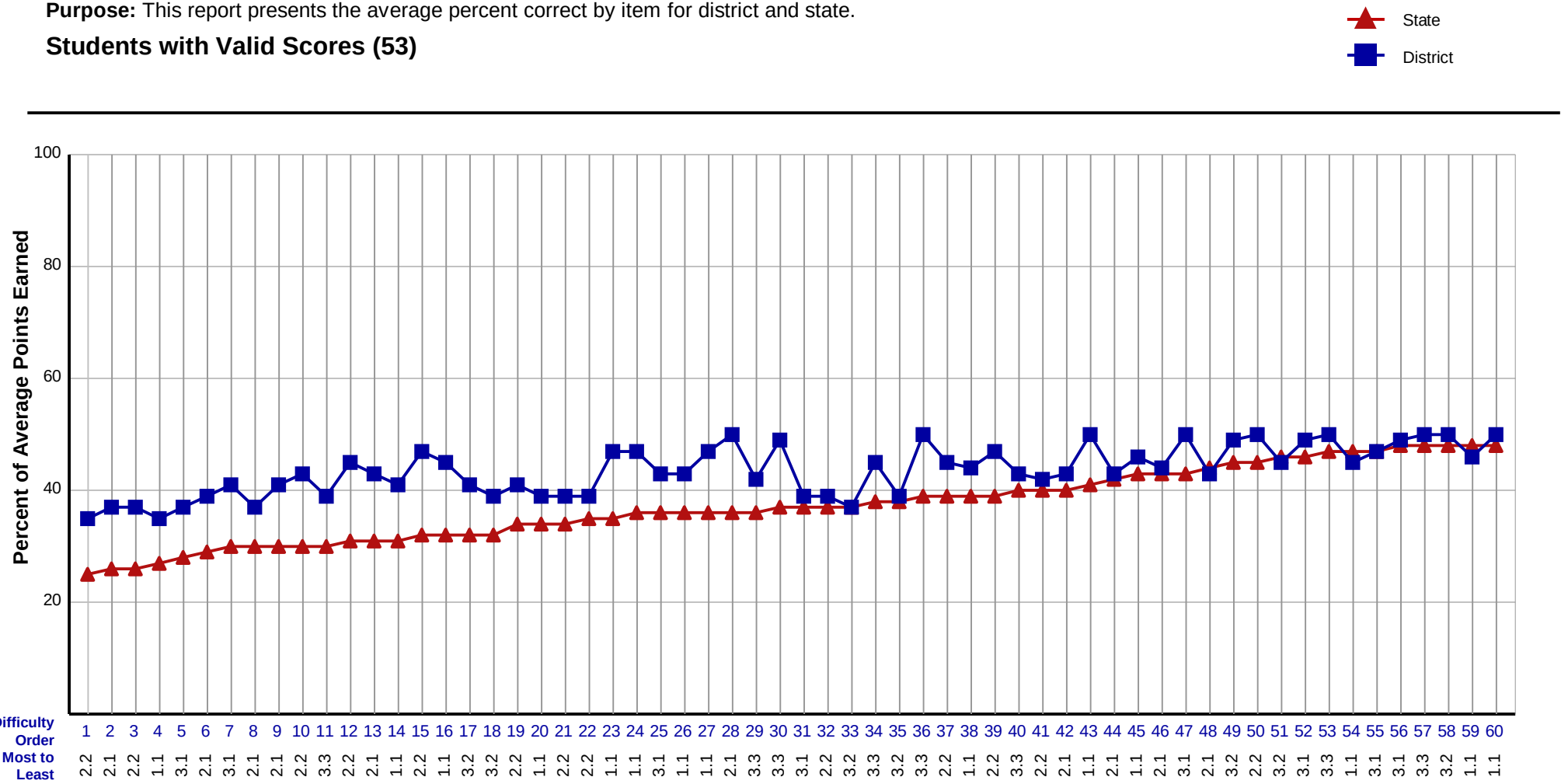
Grade 5

Purpose: This report presents the average percent correct by item for district and state.

Students with Valid Scores (53)



Standard.GLE

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-*- Demonstration Powered by HP Exstream 07/25/2016, Version 8.0.342 64-bit -*-

Item Analysis Report Detail

Colorado Measures of Academic Success — Spring 2016

This report shows the operational items for the given grade and subject sorted by difficulty.

Science — Grade 5

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Difficulty Order Most to Least	Standard.GLE	Section-Item Number	Standard	Prepared Graduate Competencies (PGCs)	Grade Level Expectations (GLEs)	Item Type Selected Response (SR) Constructed Response (CR)
1	2.2	2-020	Life Science	PGC2	GLE2	SR
2	2.1	2-014	Life Science	PGC1	GLE1	SR
3	2.2	2-015	Life Science	PGC2	GLE2	SR
4	1.1	2-024	Physical Science	PGC1	GLE1	SR
5	3.1	1-007	Earth Systems Science	PGC1	GLE1	SR
6	2.1	2-016	Life Science	PGC1	GLE1	SR
7	3.1	1-014	Earth Systems Science	PGC1	GLE1	SR
8	2.1	1-020	Life Science	PGC1	GLE1	SR
9	2.1	2-004	Life Science	PGC1	GLE1	SR
10	2.2	2-005	Life Science	PGC2	GLE2	SR
11	3.3	2-007	Earth Systems Science	PGC2	GLE3	SR
12	2.2	1-024	Life Science	PGC2	GLE2	SR
13	2.1	2-019	Life Science	PGC1	GLE1	SR
14	1.1	2-021	Physical Science	PGC1	GLE1	SR
15	2.2	1-005	Life Science	PGC2	GLE2	SR
16	1.1	2-023	Physical Science	PGC1	GLE1	SR
17	3.2	3-014	Earth Systems Science	PGC2	GLE2	SR
18	3.2	3-017	Earth Systems Science	PGC2	GLE2	SR
19	2.2	1-011	Life Science	PGC2	GLE2	SR
20	1.1	2-012	Physical Science	PGC1	GLE1	SR
21	2.2	3-023	Life Science	PGC2	GLE2	SR
22	2.2	2-011	Life Science	PGC2	GLE2	SR
23	1.1	3-015	Physical Science	PGC1	GLE1	SR
24	1.1	1-004	Physical Science	PGC1	GLE1	SR
25	3.1	1-010	Earth Systems Science	PGC1	GLE1	SR
26	1.1	3-005	Physical Science	PGC1	GLE1	SR
27	1.1	3-020	Physical Science	PGC1	GLE1	SR
28	2.1	3-021	Life Science	PGC1	GLE1	SR
29	3.3	3-013	Earth Systems Science	PGC2	GLE3	CR-3
30	3.3	1-015	Earth Systems Science	PGC2	GLE3	SR
31	3.1	1-021	Earth Systems Science	PGC1	GLE1	SR
32	2.2	3-010	Life Science	PGC2	GLE2	SR
33	3.2	3-012	Earth Systems Science	PGC2	GLE2	SR
34	3.3	3-004	Earth Systems Science	PGC2	GLE3	SR
35	3.2	3-011	Earth Systems Science	PGC2	GLE2	SR
36	3.3	1-012	Earth Systems Science	PGC2	GLE3	SR
37	2.2	1-013	Life Science	PGC2	GLE2	CR-3
38	1.1	2-013	Physical Science	PGC1	GLE1	CR-3
39	2.2	3-024	Life Science	PGC2	GLE2	SR
40	3.3	2-010	Earth Systems Science	PGC2	GLE3	SR
41	2.2	2-017	Life Science	PGC2	GLE2	CR-2
42	2.1	3-006	Life Science	PGC1	GLE1	SR
43	1.1	1-023	Physical Science	PGC1	GLE1	SR
44	2.1	3-009	Life Science	PGC1	GLE1	CR-2
45	1.1	3-018	Physical Science	PGC1	GLE1	CR-2
46	2.1	2-018	Life Science	PGC1	GLE1	CR-2
47	3.1	3-007	Earth Systems Science	PGC1	GLE1	SR
48	2.1	3-008	Life Science	PGC1	GLE1	CR-2
49	3.2	1-006	Earth Systems Science	PGC2	GLE2	CR-2
50	2.2	3-022	Life Science	PGC2	GLE2	CR-2
51	3.2	2-008	Earth Systems Science	PGC2	GLE2	CR-2
52	3.1	2-022	Earth Systems Science	PGC1	GLE1	CR-2
53	3.3	1-022	Earth Systems Science	PGC2	GLE3	CR-2
54	1.1	2-003	Physical Science	PGC1	GLE1	CR-2
55	3.1	2-009	Earth Systems Science	PGC1	GLE1	CR-2
56	3.1	1-008	Earth Systems Science	PGC1	GLE1	SR
57	3.3	2-006	Earth Systems Science	PGC2	GLE3	SR
58	3.2	3-016	Earth Systems Science	PGC2	GLE2	SR
59	1.1	3-019	Physical Science	PGC1	GLE1	CR-2
60	1.1	1-009	Physical Science	PGC1	GLE1	CR-2

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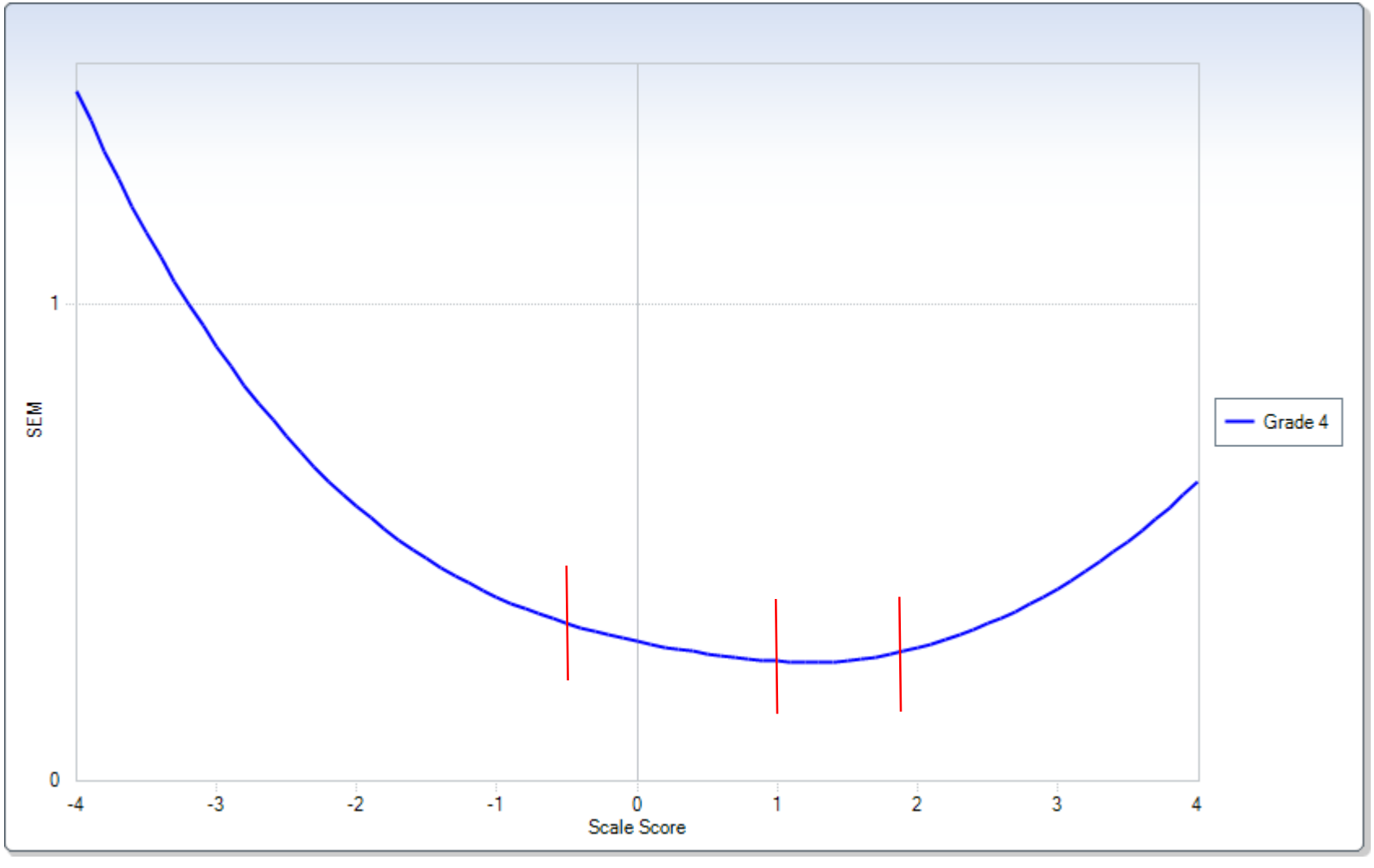
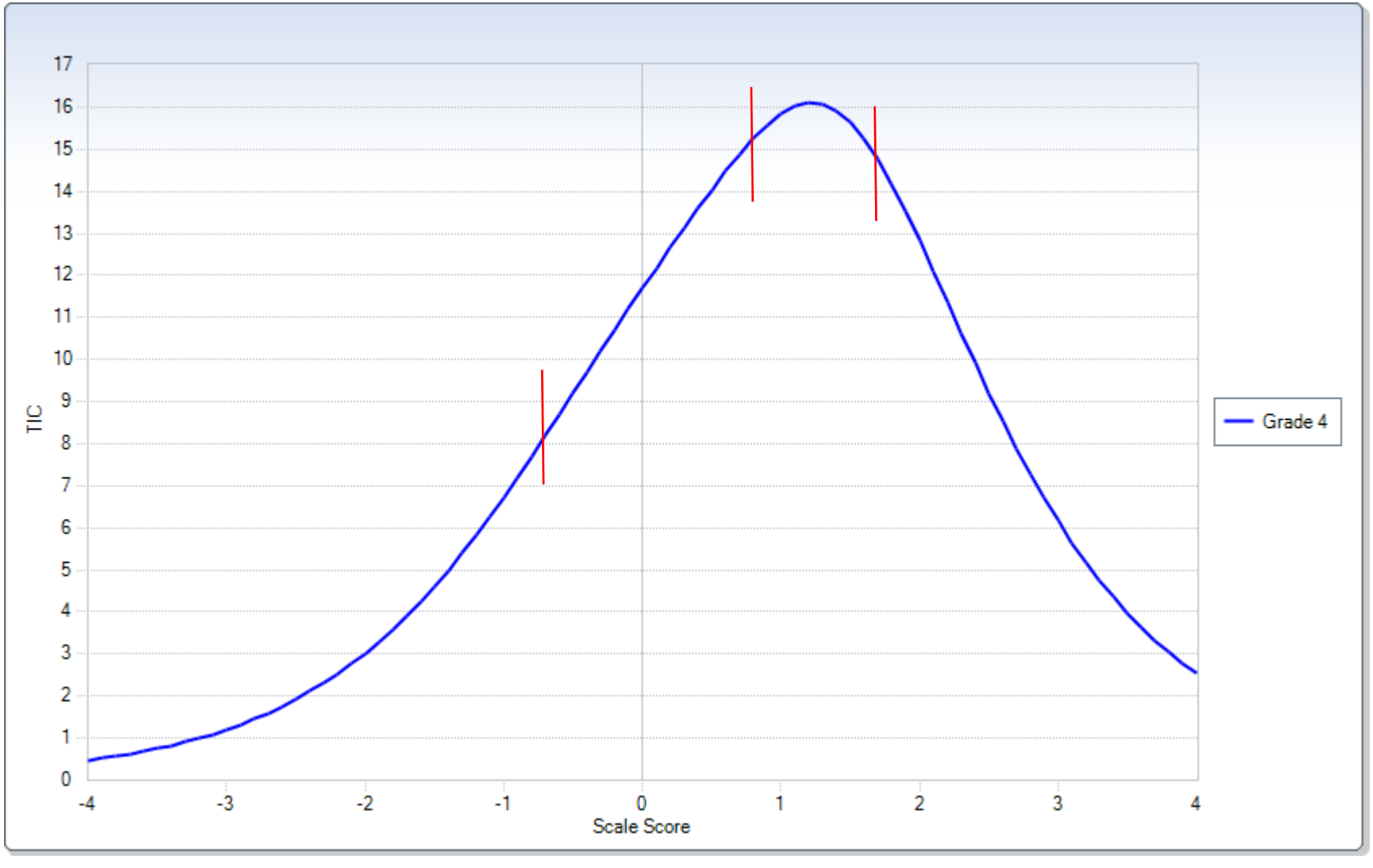
APPENDIX B: IRT CURVES

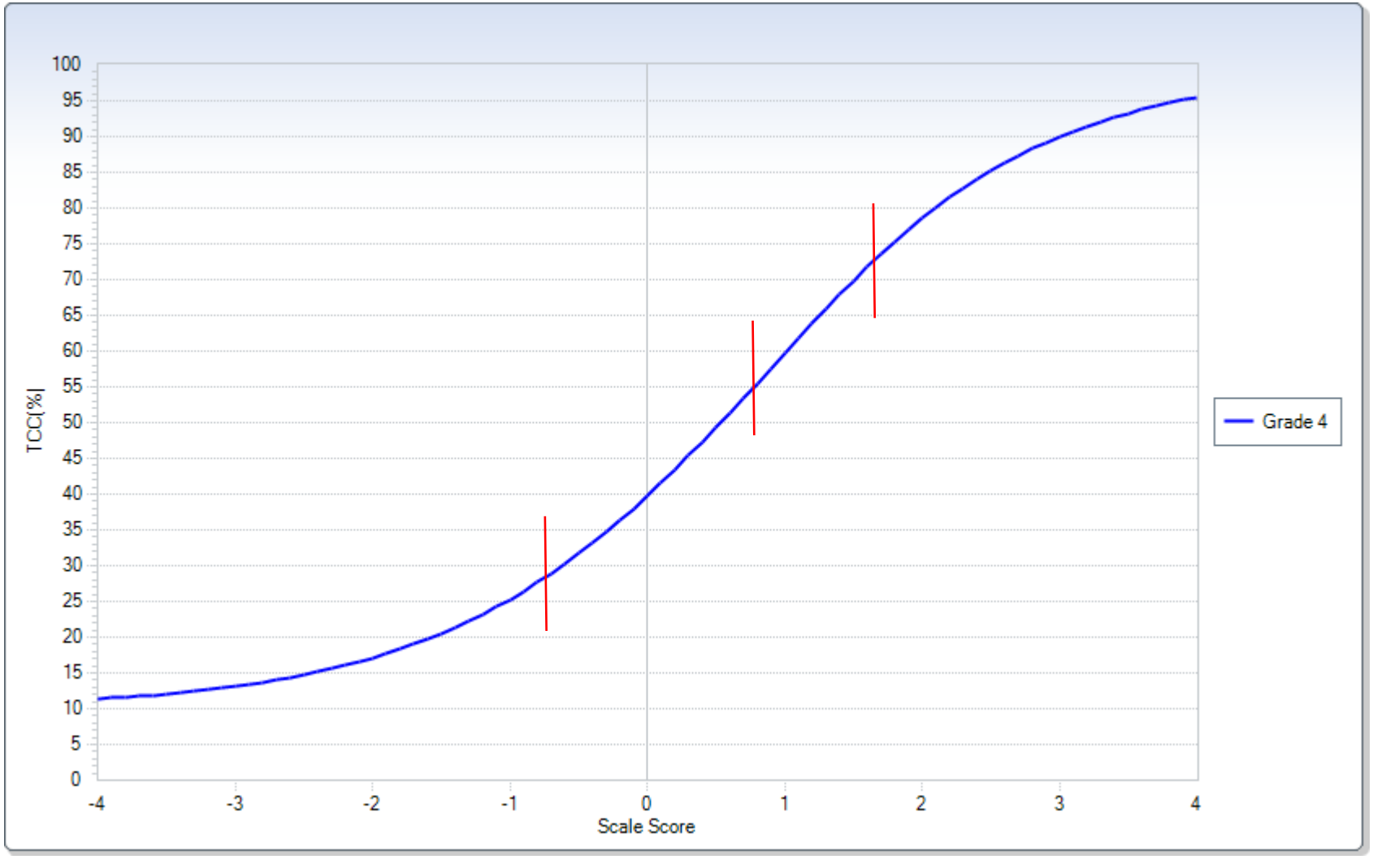
Test Summary Curves
Conditional Standard Error of Measurement Curves



Test Summary Curves
Test Information Curves



Test Summary Curves
Test Characteristic Curves (Percent)



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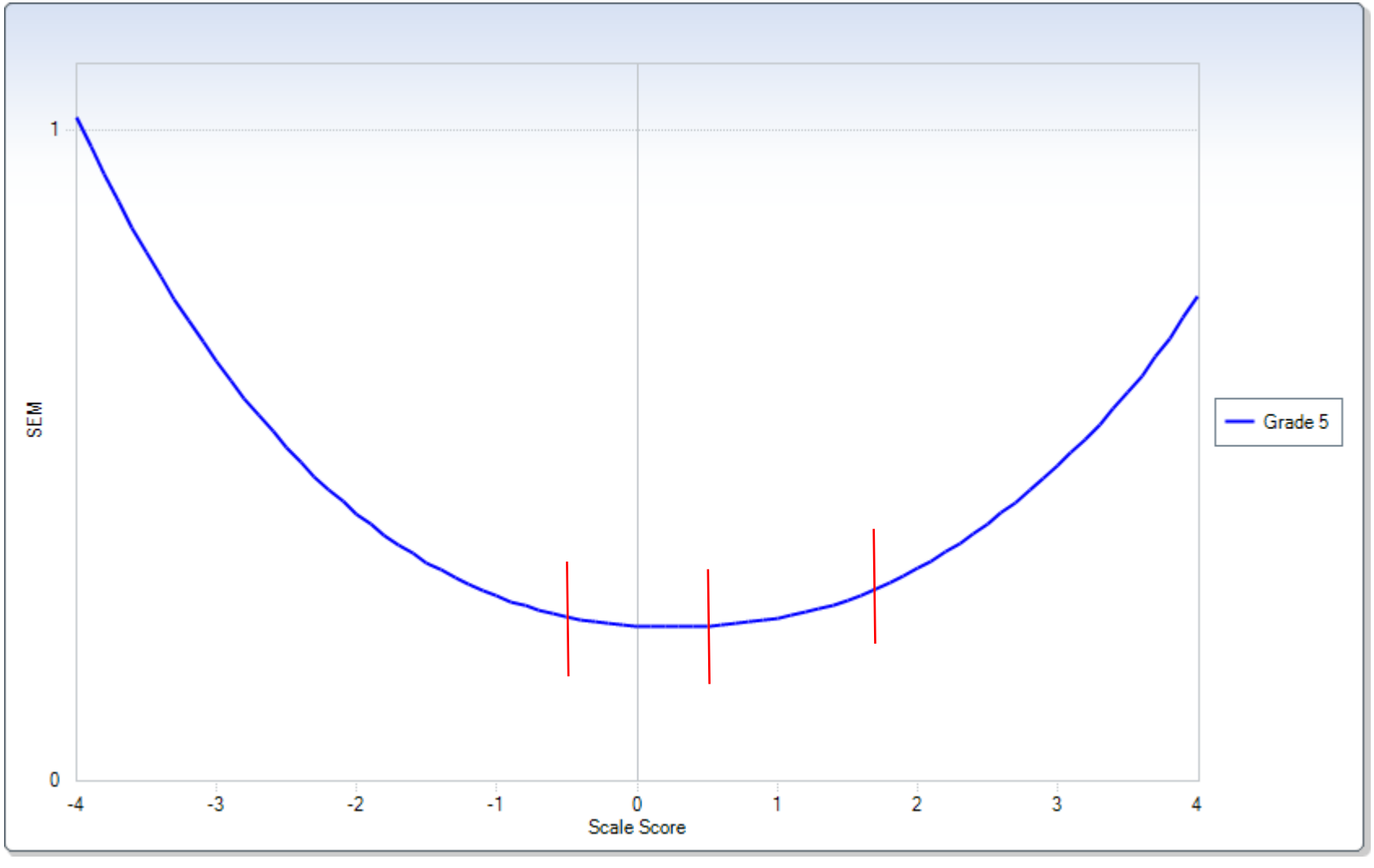

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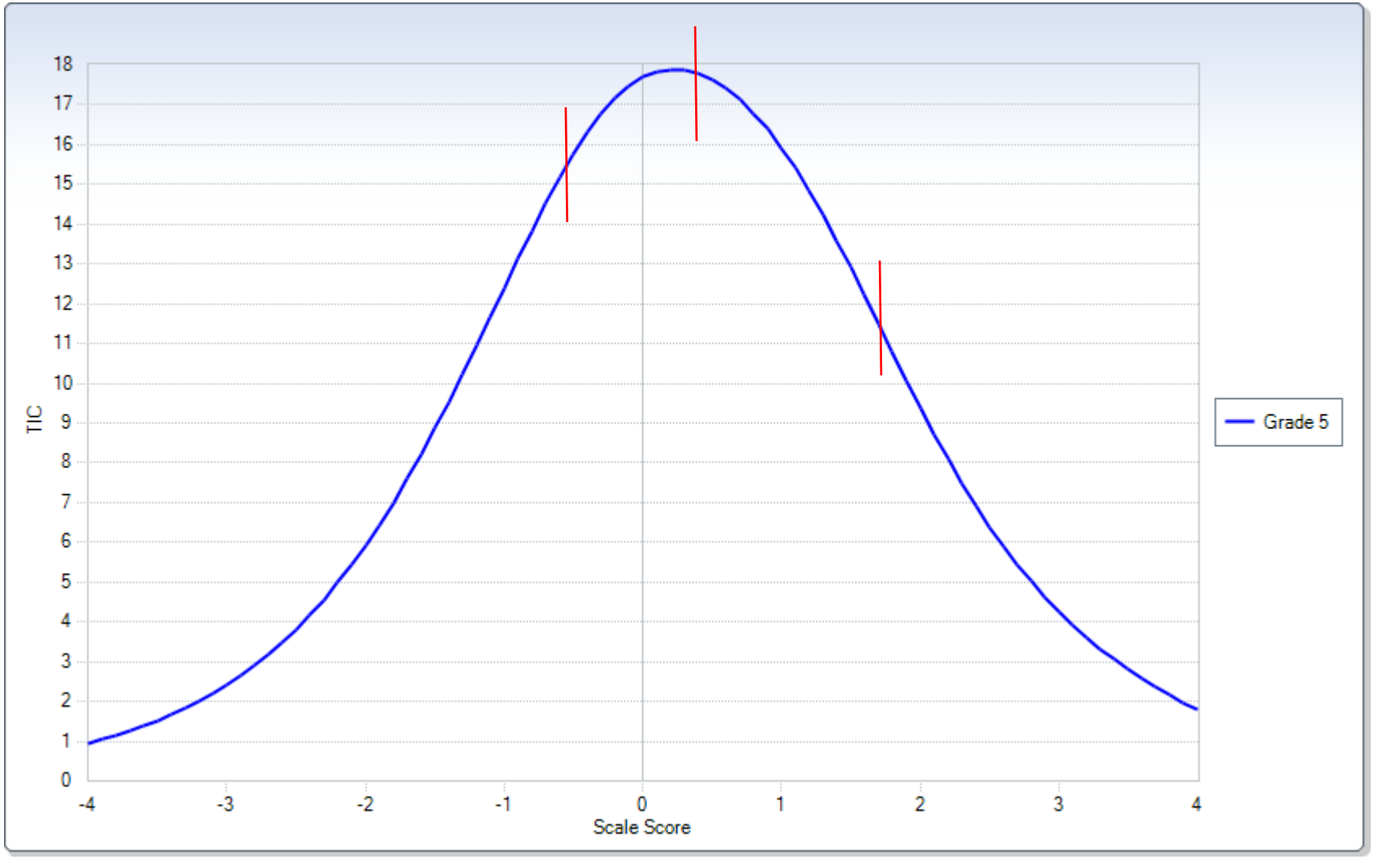
Test Information Curves



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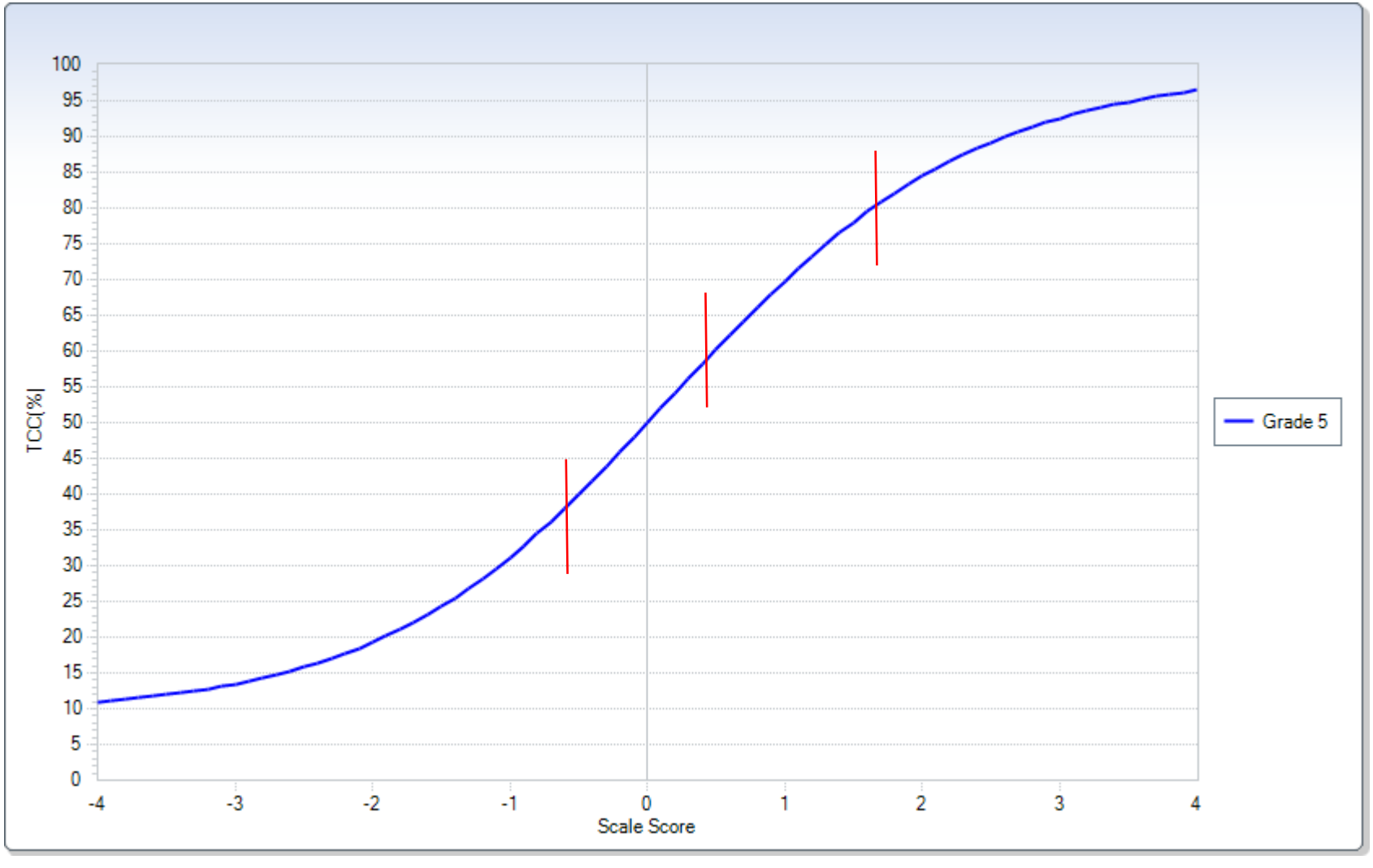

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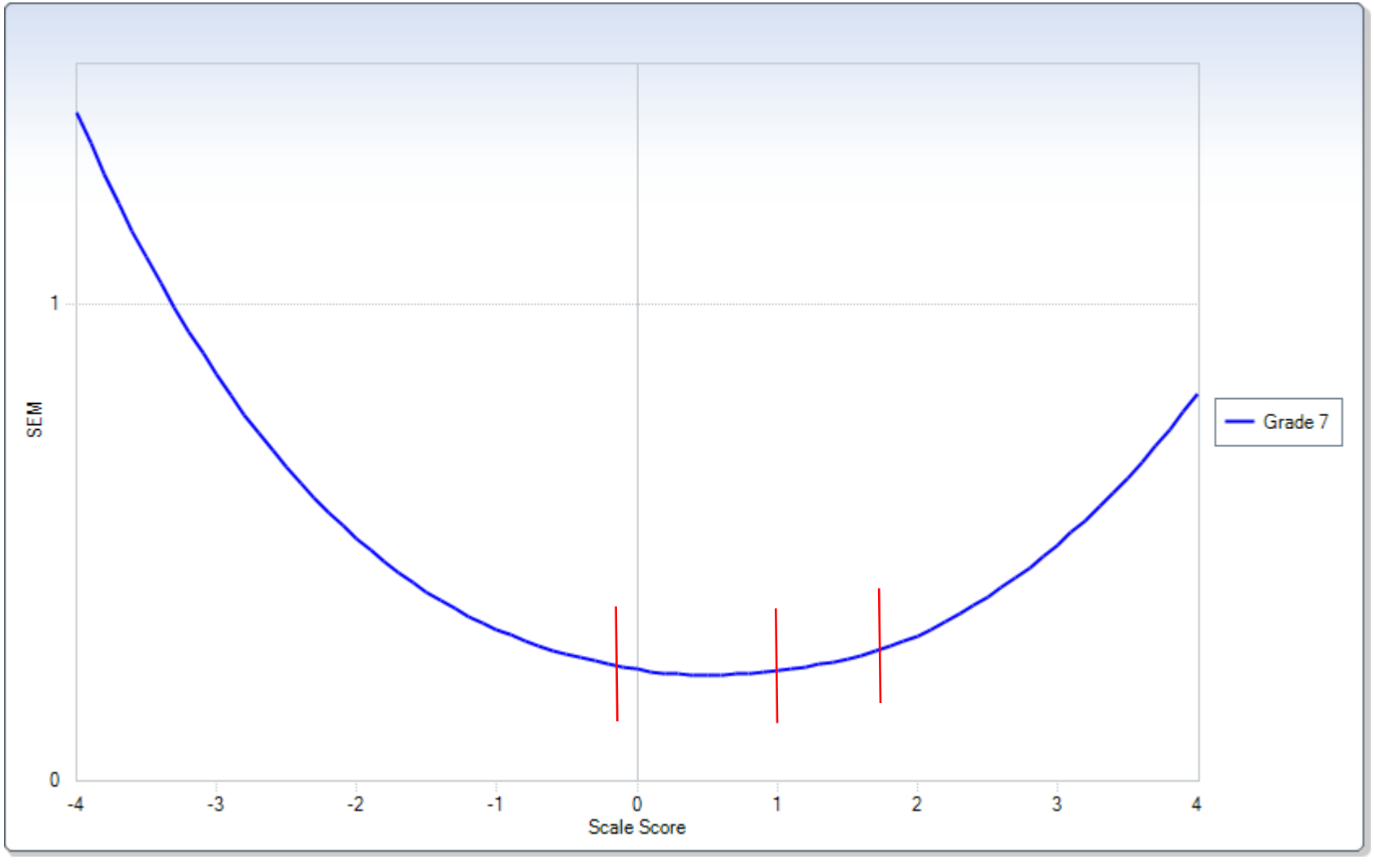
Conditional Standard Error of Measurement Curves



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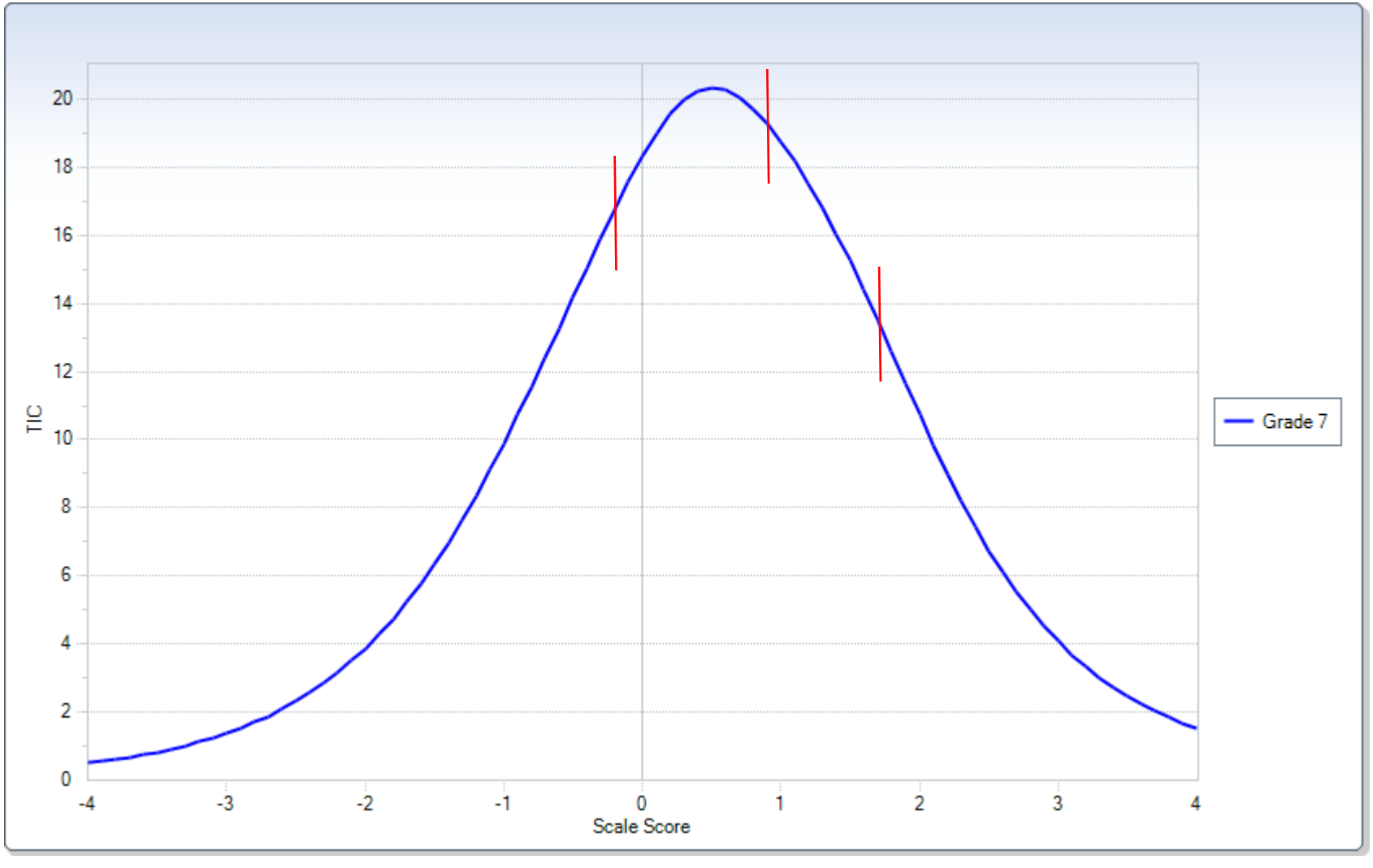
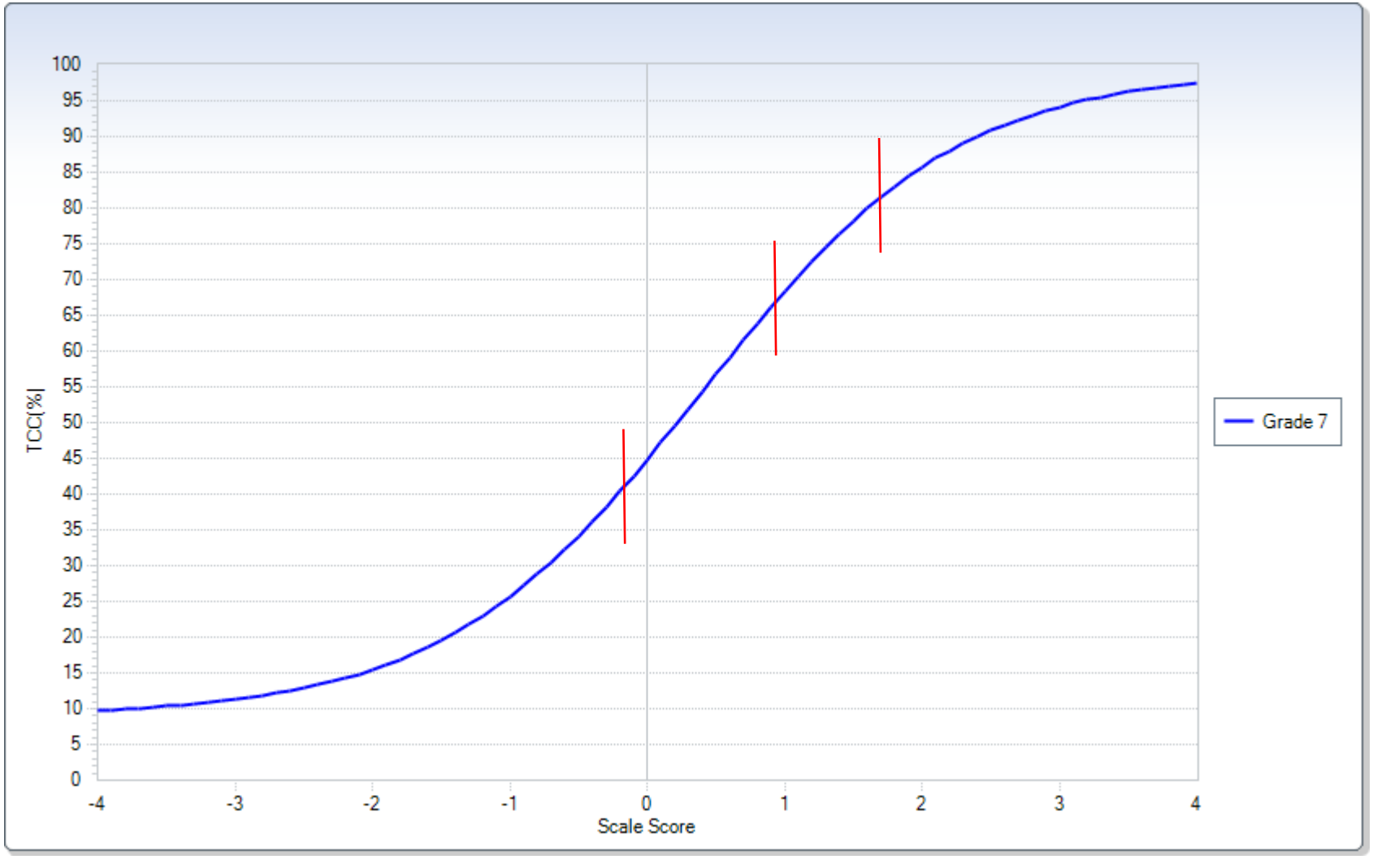
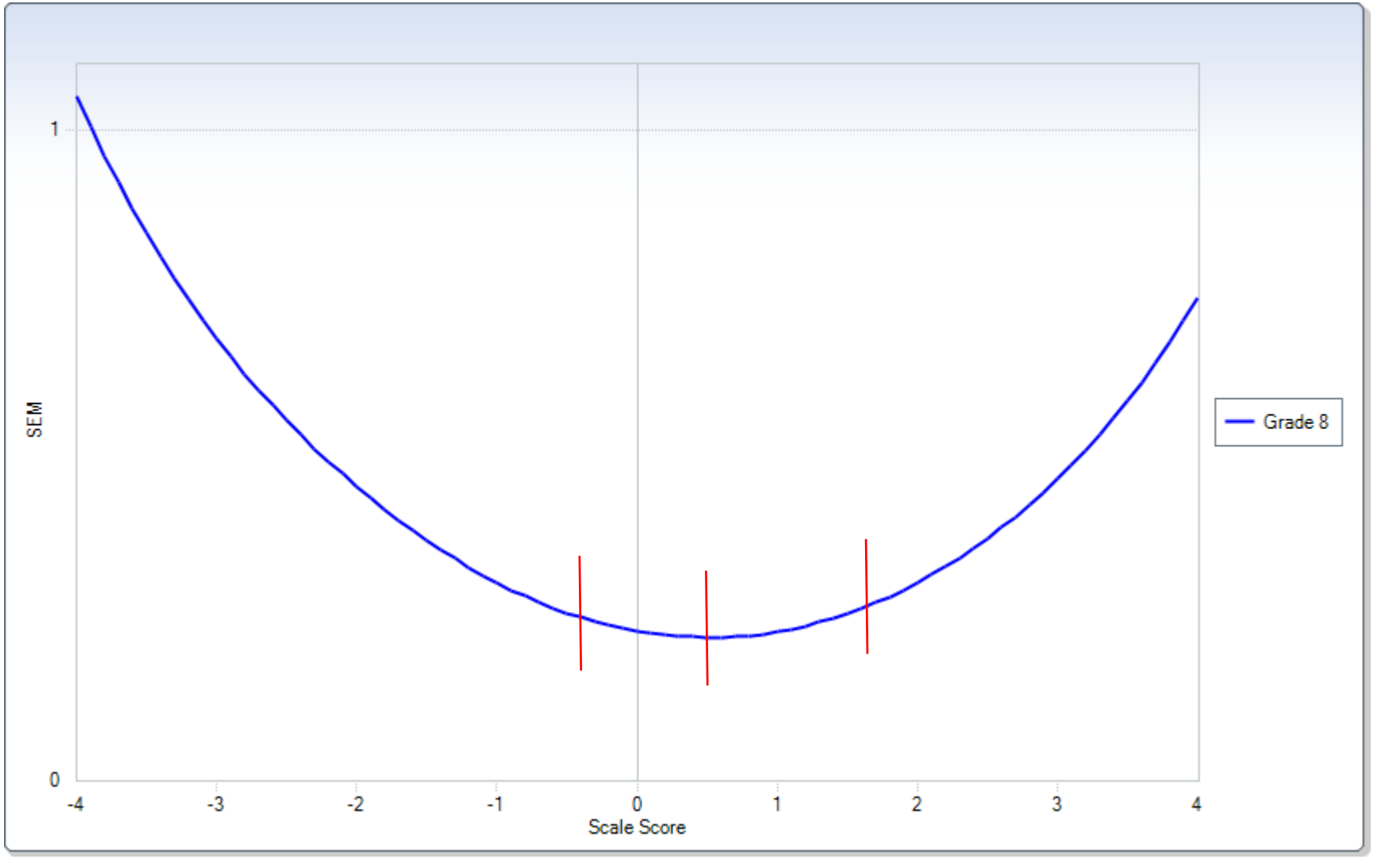
Test Information Curves



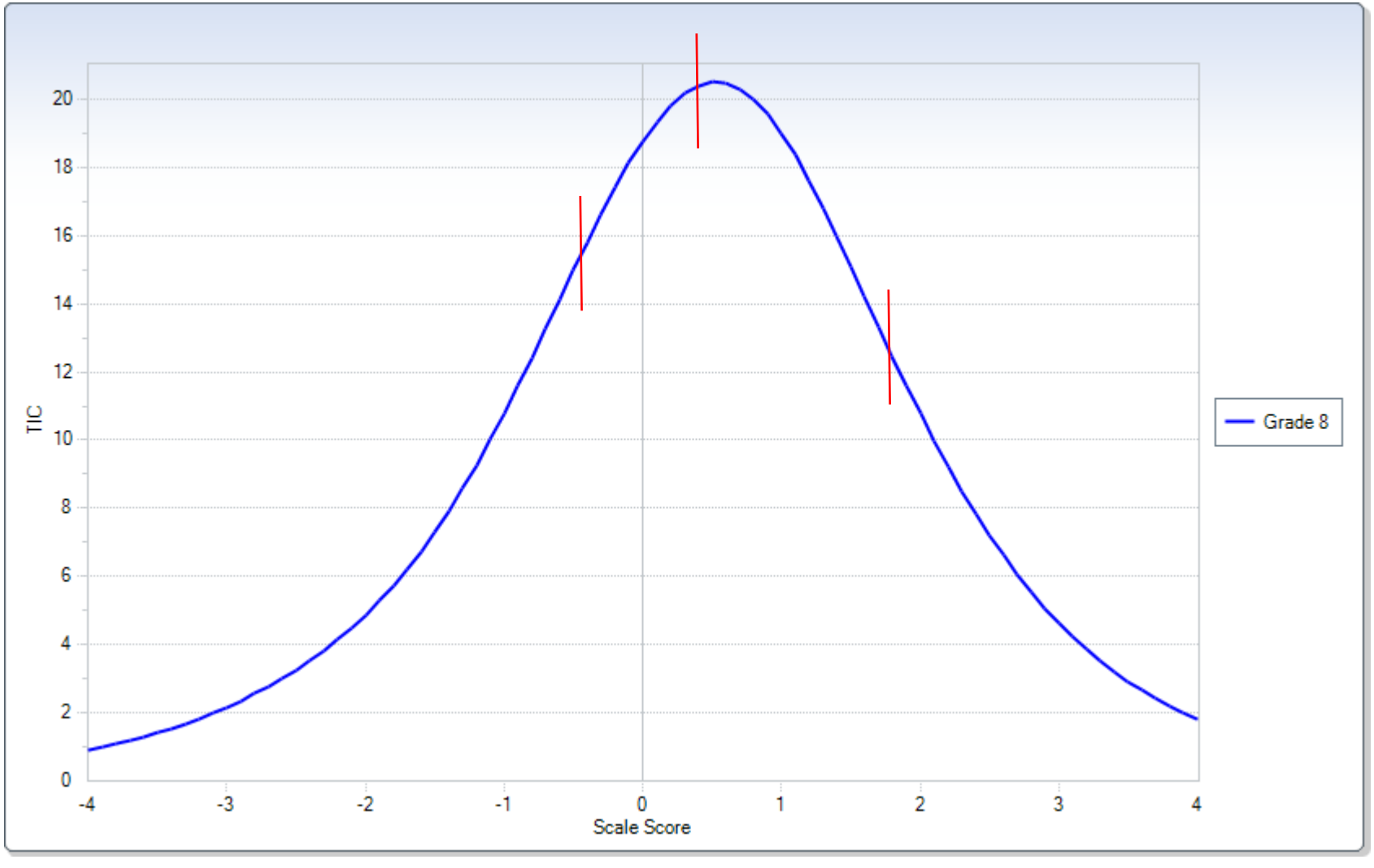
Test Summary Curves
Test Characteristic Curves (Percent)



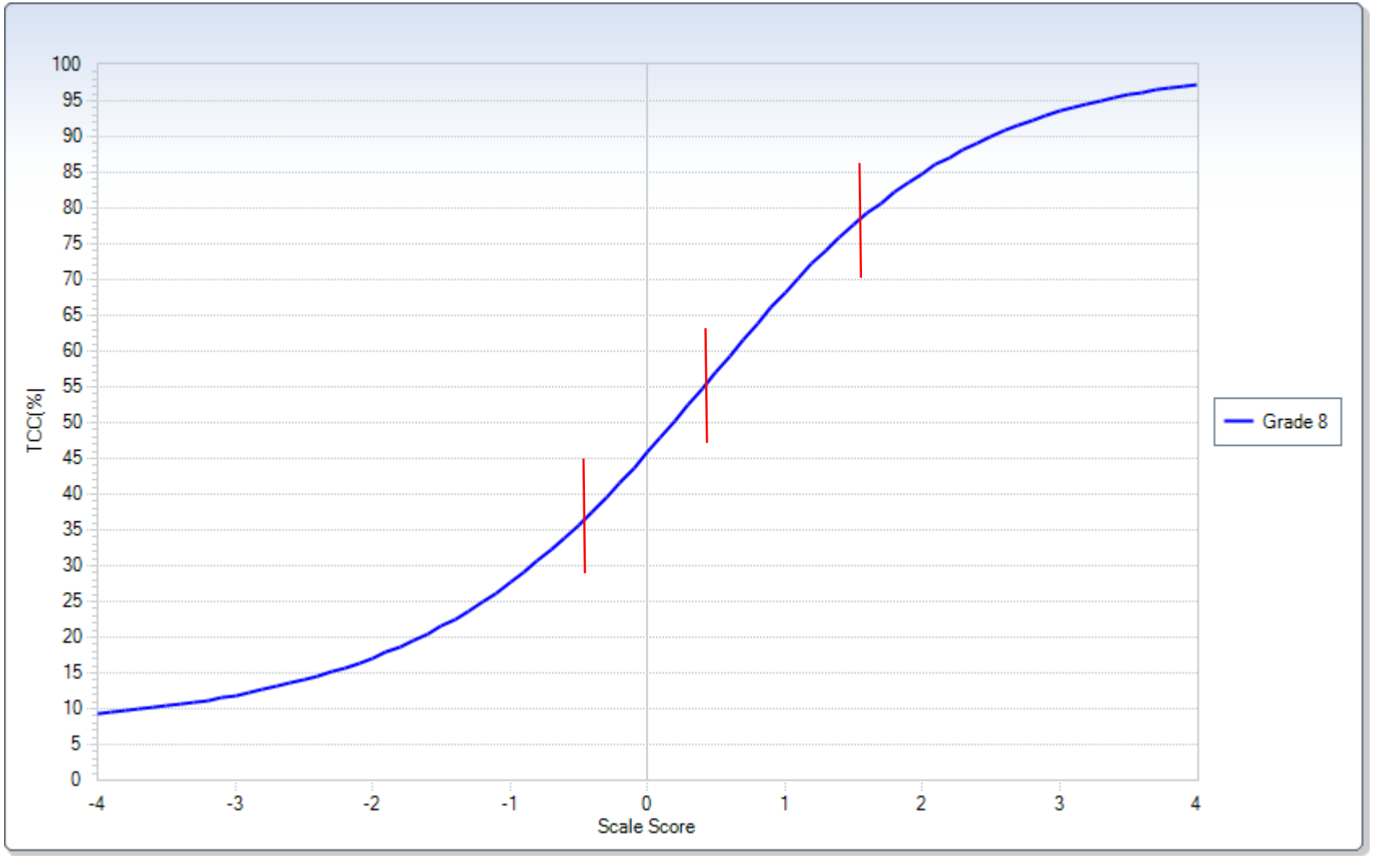
Test Summary Curves
Conditional Standard Error of Measurement Curves



Test Summary Curves
Test Information Curves



Test Summary Curves
Test Characteristic Curves (Percent)



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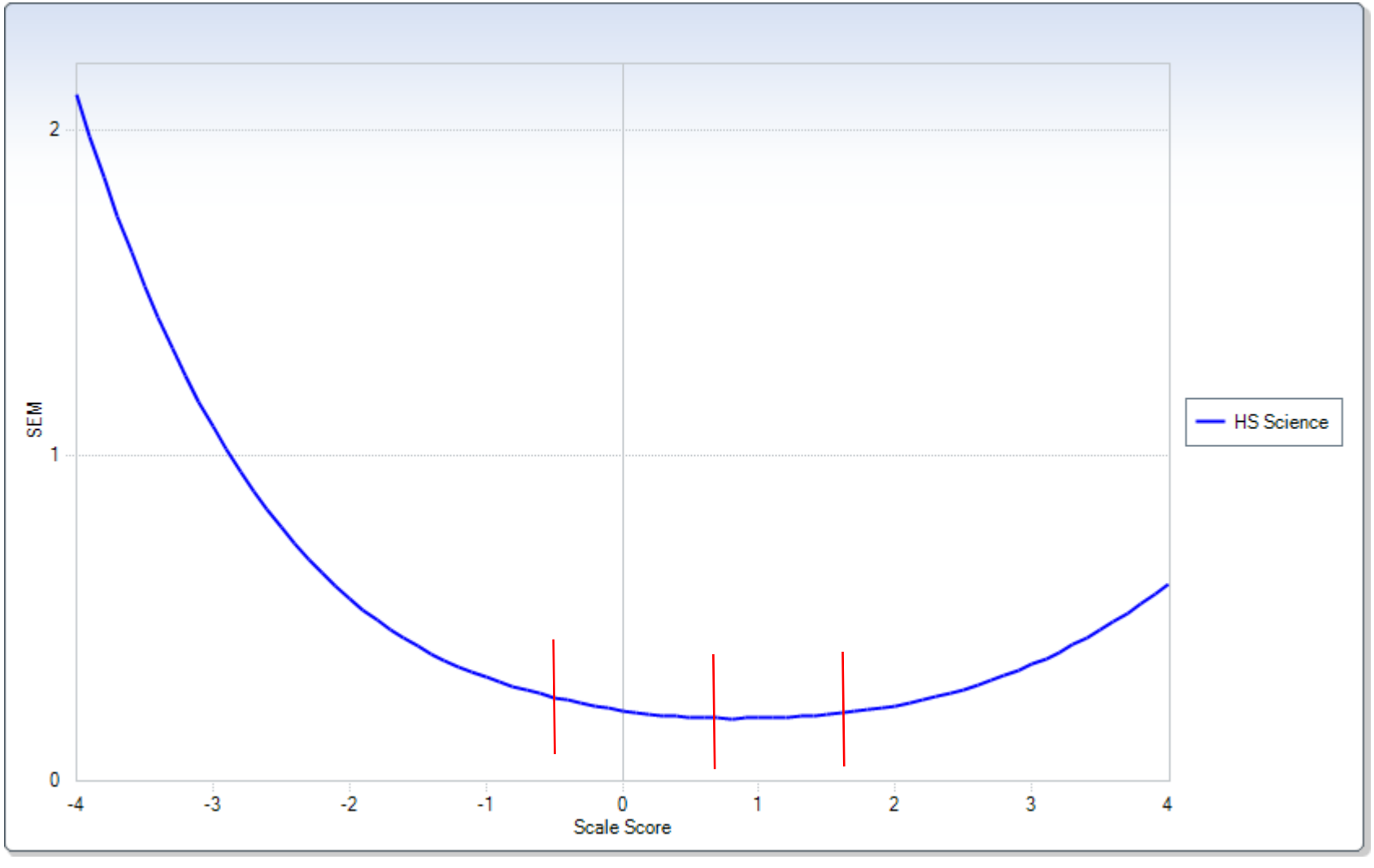
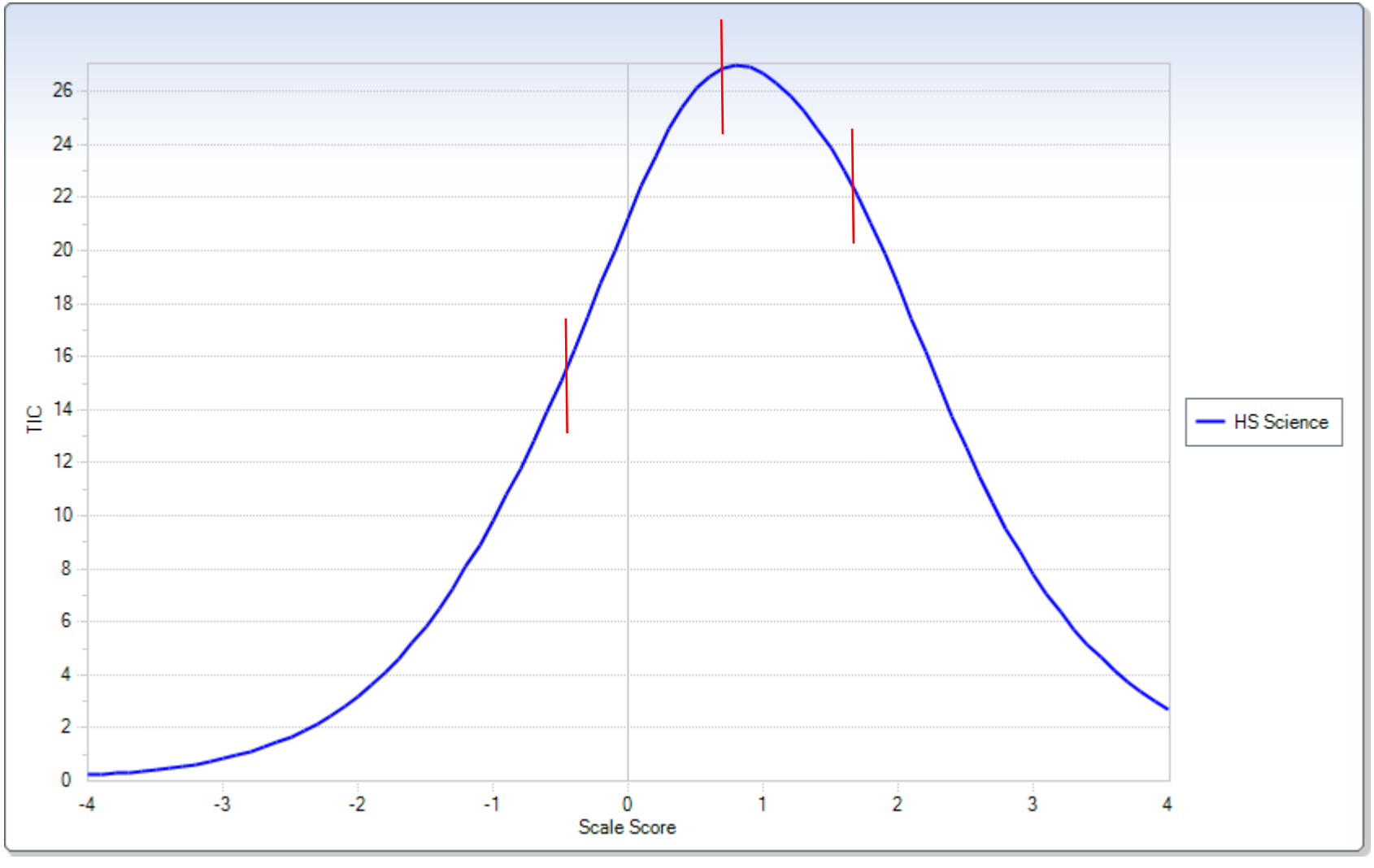
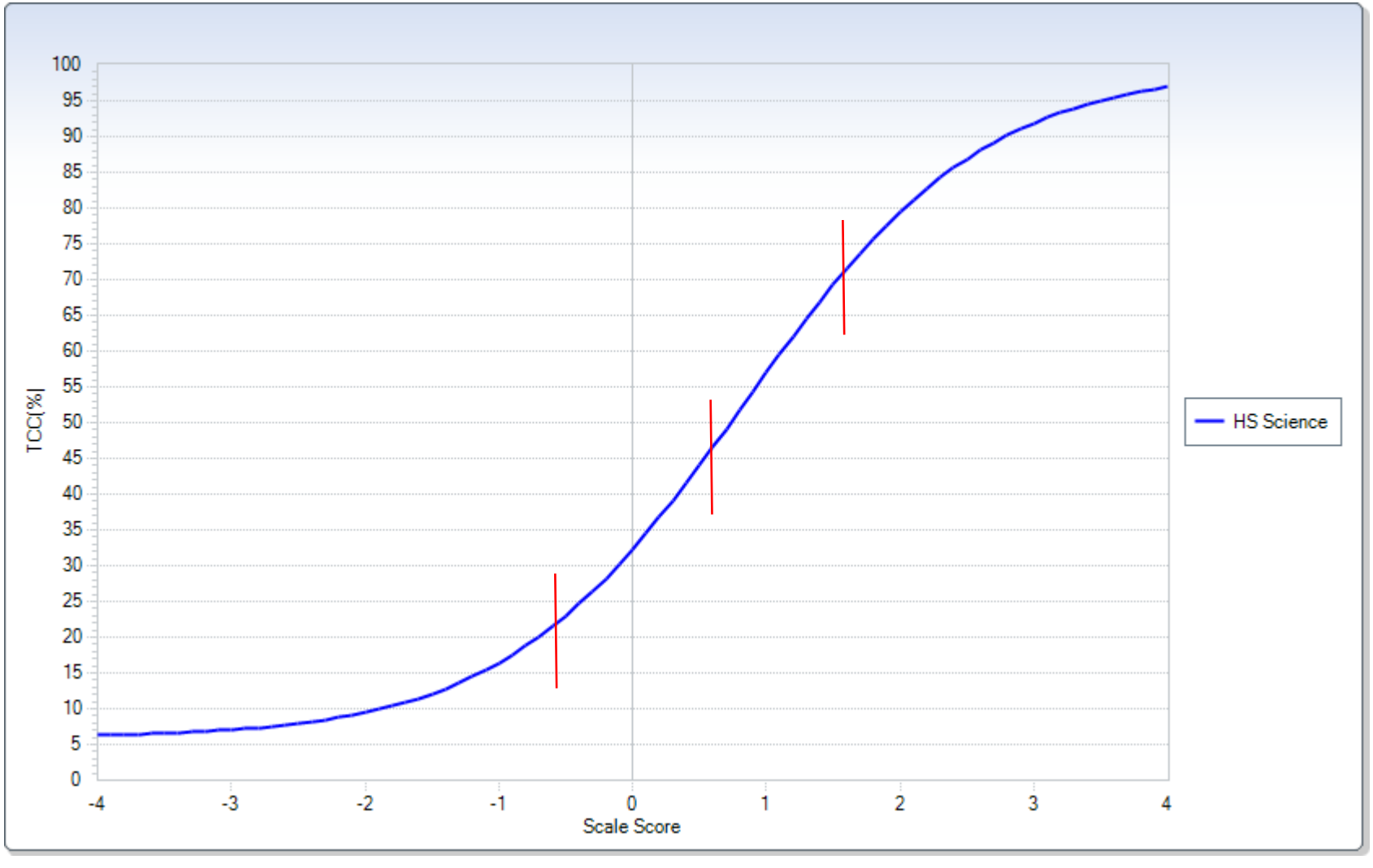
Conditional Standard Error of Measurement Curves



Test Summary Curves
Test Information Curves



Test Summary Curves
Test Characteristic Curves (Percent)



APPENDIX C: ALIGNMENT STUDY

2016 No. 003

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

Independent Alignment Review of the Colorado Measures of Academic Success (CMAS) Science and Social Studies Tests

Final Report

Prepared for:	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	Prepared under:	Contract # C 13-13 Task Order 22
Authors:	Emily R, Dickinson Arthur A. Thacker	Date:	March 1, 2016

Headquarters: 66 Canal Center Plaza, Suite 700, Alexandria, VA 22314 | Phone: 703.549.3611 | Fax: 703.549.9025 | **humrro.org**

Independent Alignment Review of the Colorado Measures of Academic Success (CMAS) Science and Social Studies Tests

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Independent Alignment Review of the Colorado Measures of Academic Success (CMAS) Science and Social Studies Tests

Executive Summary

Scope of Work

The Human Resources Research Organization (HumRRO) was contracted by Pearson Educational Measurement on behalf of the Colorado Department of Education (CDE) to conduct an external, independent alignment study of the Colorado Measures of Academic Success (CMAS) science and social studies tests. The alignment study included a review and analysis of the science tests administered at grades 5 and 8 and high school and the social studies tests administered at grades 4 and 7 and high school, to the Colorado Academic Standards (CAS) for science and social studies, respectively.

CDE requested the alignment study in order to meet both state and federal accountability requirements related to its use of the CMAS. The federal requirement of the U.S. Department of Education (USDE) stems from the Elementary and Secondary Education Act (ESEA). ESEA challenges each state to establish a coherent assessment system based on solid academic standards. This law calls for states to provide independent evidence of the validity of their assessments used to calculate Adequate Yearly Progress (AYP). All states receiving Title I funds must present evidence that their assessment system is consistent and fair, that it is based on rigorous standards with sufficient alignment between standards and assessments, and that it generates high-quality educational results. States are required to submit this information as part of the federal peer review process.

An alignment review can provide one form of evidence supporting the validity of the state assessment system. Alignment results should demonstrate that the assessments represent the full range of the content standards and that the assessments measure student knowledge in the same manner and at the same level of complexity as specified in the content standards.

Methodology

To conduct the study, HumRRO facilitated a review of the alignment between the CMAS science and social studies items and the CAS for science and social studies by two panels (one per content area) of Colorado educators. Following the reviews and examination of the alignment, HumRRO analyzed the results for presentation in this report.

Review of Content Alignment

HumRRO convened panels of Colorado educators to review the extent of the alignment between the science and social studies CMAS tests and the standards they are intended to assess. The review involved two major tasks for panelists to complete: (a) providing depth of knowledge (DOK) ratings for the CAS for science and social studies, and (b) evaluating the science and social studies items by matching them to grade level CAS, providing an item DOK rating, and selecting a rating of the overall alignment between item and standard, To maintain the independent and external nature of the study, CDE did not take part in this process. This process was conducted and directed solely by HumRRO.

Pearson recruited the two review panels with the administrative assistance of CDE. Every effort was made to produce panels consisting of teachers reflecting the population of students who take the assessments. Once selected, the panels were convened at the Sheraton Denver West Hotel in Denver, CO on November 9-10, 2015. Panels included 4-8 reviewers, referred to as panelists.

To conduct the content alignment review, HumRRO applied the Webb (2005) alignment method. This procedure, developed by Dr. Norman Webb, is based on four indicators (or statistics) using the data gathered from the two tasks mentioned above. These statistics describe how well the test items, regardless of item type and point value, cover the content standards in terms of content breadth and depth. The alignment indicators include:

- Categorical concurrence – determines the degree of overall content coverage by the assessment for each content strand (i.e., standard). Webb recommends a minimum of six test questions to adequately assess each content strand.
- Range-of-knowledge correspondence – indicates the specific content expectations (i.e., evidence outcome) assessed within each content strand. Webb recommends at least 50% of the content expectations per strand are linked with items.
- Balance-of-knowledge representation – provides a statistical index reflecting the distribution of assessed content within each content strand (i.e., how evenly the content is assessed). Webb recommends a minimum index of 70 for a single content strand.
- Depth-of-knowledge consistency – compares the cognitive complexity ratings of the items with the complexity ratings of each content standard. Webb recommends that at least 50% of the items should have complexity ratings at or above the level corresponding to content expectations as determined by panelists.

Summary of Results

Key Findings and Conclusions

The cumulative results provide validity evidence to support that the content of CMAS science and social studies test items match the intended content as specified in the standards. Expert panelists from both content areas tended to agree that items were measuring the intended grade level expectations, and to rate items as highly aligned to the Colorado Academic Standards.

The number of items included on an operational form, when considered along with the number of prepared graduate competencies, grade level expectations, and evidence outcomes included in the content standards, provide important context for interpreting the Webb (1997) criteria. Across the content areas and grade levels, for example, it was difficult for range-of-knowledge correspondence to be fully met given the number of items. This was most apparent at the high school level, which had a substantially larger amount of testable content. Even with these limitations, the majority of Webb's criteria were met on the CMAS science and social studies tests.

Alignment of CMAS Science to Colorado Academic Standards

Table 1 provides summary conclusions on the alignment of the CMAS science test to the Colorado Academic Standards per grade tested. The conclusions are based on the following decision criteria (Webb, 2005):

- Fully aligned – assessments align to all content strands (91%–100%),
- Highly aligned – assessments align to the majority of strands (70%–90%),
- Partially aligned – assessments align well to some strands (50%–69%),
- Weakly aligned – assessments align to less than half the strands (below 50%).

Webb's alignment method does not allow for a *single* judgment of overall alignment across the four alignment indicators. However, one can get a sense of overall alignment between the assessments and standards by looking at all of the alignment indicators together.

Table 1. Summary Alignment Outcomes on Each Webb Criterion by Grade Level for Science CMAS

Grade Level	Percentage of GLEs that Met Webb Criteria			
	Categorical Concurrence	Depth-of-Knowledge Consistency	Range-of-Knowledge Correspondence	Balance-of-Knowledge Representation
5	Fully aligned (100%)	Partially aligned (50%)	Fully aligned (100%)	Fully aligned (100%)
8	Fully aligned (100%)	Highly aligned (70%)	Fully aligned (100%)	Fully aligned (100%)
High School	Fully aligned (100%)	Partially aligned (68%) / Highly aligned (82%)	Weakly aligned (32%; 9%)	Fully aligned (100%)

Notes. Categorical concurrence is evaluated at the Standard level to reflect score reporting practices. High school percentages reflect GLEs and PGCs, respectively.

As shown in Table 1 with green highlighting, approximately 83% of the results indicate strong content alignment of the CMAS science test to the Colorado Academic Standards. Each of the three grade level tests includes sufficient numbers of items to cover the Colorado Academic Standards, and a sufficiently even distribution of evidence outcomes within the associated grade level expectation. The grade 8 and high school tests also include sufficient numbers of items at DOK levels at or above the DOK assigned to the corresponding evidence outcome. The grade 5 and grade 8 tests both demonstrated sufficient coverage of the range of evidence outcomes within each grade level expectation.

Alignment of CMAS Social Studies to Colorado Academic Standards

Table 2 provides summary conclusions on the alignment of the CMAS social studies test to the Colorado Academic Standards per grade tested, using the same criteria described above.

Table 2. Summary Alignment Outcomes on Each Webb Criterion by Grade Level for Social Studies CMAS

Grade Level	Percentage of GLEs that Met Webb Criteria			
	Categorical Concurrence	Depth-of-Knowledge Consistency	Range-of-Knowledge Correspondence	Balance-of-Knowledge Representation
4	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)
7	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)
High School	Fully aligned (100%)	Highly/fully aligned (88%; 100%)	Partially aligned (56%; 50%)	Highly/fully aligned (88%; 100%)

Notes. Categorical concurrence is evaluated at the Standard level to reflect score reporting practices. High school percentages reflect GLEs and PGCs, respectively.

As shown in Table 2, 92% of the results indicate strong content alignment of the CMAS social studies test to the Colorado Academic Standards. Each of the three grade level tests includes sufficient numbers of items to cover the Colorado Academic Standards, sufficient numbers of items at DOK levels at or above the DOK assigned to the corresponding evidence outcomes, and a sufficiently even distribution of evidence outcomes within the associated grade level expectation. The high school test demonstrated only partial alignment to the content standards in terms of range of knowledge consistency.

Recommendations

- ***Review range of knowledge.*** Assessments may not adequately reflect all of the content that students are expected to know based solely on the number of items on the assessment (not the item type or point value as these are not factors in Webb's (1997) criteria). From strictly an item count perspective, there are several ways CDE can choose to mitigate this situation such as increase the number of items on the assessment, collapse or otherwise reduce the number of grade level expectations/evidence outcomes in the state standards, or designate some of the grade level expectations/evidence outcomes for local assessment only.
- ***Review depth of knowledge.*** The DOK consistency review showed that science items at the grade 5 level did not adequately reflect the cognitive complexity of the grade level expectations. There were items of varying DOKs, but a substantial percentage was lower than their associated standards. Expert panelists' ratings of the DOK levels of evidence outcomes were generally consistent with the range of DOK levels assigned in the standards document, but with some exceptions. It may be useful to review the clarity of the evidence outcomes to ensure that the intended level of cognitive complexity is conveyed to all users of the content standards. It may also be necessary to concentrate grade 5 science item development on higher DOK items.

Independent Alignment Review of the Colorado Measures of Academic Success (CMAS) Science and Social Studies Tests

Chapter 1: Introduction

The Human Resources Research Organization (HumRRO) was contracted by Pearson Educational Measurement on behalf of the Colorado Department of Education (CDE) to conduct an external, independent alignment study of the Colorado Measures of Academic Success (CMAS) science and social studies tests. The alignment study included a review and analysis of the science tests administered at grades 5 and 8 and high school and the social studies tests administered at grades 4 and 7 and high school, to the Colorado Academic Standards (CAS) for science and social studies, respectively.

CDE requested the alignment study in order to meet both state and federal accountability requirements related to its use of the CMAS. The federal requirement of the U.S. Department of Education (USDE) stems from the Elementary and Secondary Education Act (ESEA). ESEA challenges each state to establish a coherent assessment system based on solid academic standards. This law calls for states to provide independent evidence of the validity of their assessments used to calculate Adequate Yearly Progress (AYP). All states receiving Title I funds must present evidence that their assessment system is consistent and fair, that it is based on rigorous standards with sufficient alignment between standards and assessments, and that it generates high-quality educational results. States are required to submit this information as part of the federal peer review process.

An alignment review can provide one form of evidence supporting the validity of the state assessment system. Alignment results should demonstrate that the assessments represent the full range of the content standards and that the assessments measure student knowledge in the same manner and at the same level of complexity as specified in the content standards.

Organization and Contents of the Report

This report contains five chapters. Chapter 2 explains the alignment methodologies used in the study and Chapters 3 and 4 provide alignment results for science and social studies, respectively. Chapter 5 summarizes the results and provides recommendations.

Additional information is provided in the appendices of this report. Appendix A contains tables with additional details for each Webb (1997) indicator regarding the content alignment results for each science test, Appendix B contains tables with additional details for each Webb indicator regarding the content alignment results for each social studies test, and Appendix C provides examples of rating forms and training materials used in the alignment workshops.

Chapter 2: Alignment Study Design and Methodology

In this section, we discuss key concepts related to assessment alignment research. This discussion is followed by a description of the alignment evaluations and methods used for this study.

Alignment of Assessments and Standards on Content

Alignment studies, at their heart, answer one vital question related to the validity of an assessment, "Does the assessment content adequately reflect the content that students are expected to learn as provided in the state standards?" School curriculum must include appropriate content to meet the goals specified by the state standards and consequently assessments must also measure the same content.

In general, alignment evaluations for any Kindergarten to grade 12 educational assessments in the United States reveal (a) the breadth, or scope, of knowledge and (b) the depth of knowledge, or cognitive processing, expected of students by the state's content standards. In addition to the question related to assessment validity, alignment analyses help to answer questions such as the following:

- How much and what type of content is covered by the assessment?
- Are students asked to demonstrate this knowledge at the same level of rigor as expected in the content standards?

Content Alignment and Accessibility

Several methods of alignment are in current use (e.g., Porter, 2002; Webb, 1997, 1999, 2005). These methods involve panelists subjectively evaluating several aspects of the assessment items relative to the content standards. The data from the evaluations are analyzed statistically to determine the extent of alignment. HumRRO used the alignment method developed by Norman Webb to evaluate the CMAS. Webb's alignment methodology is the most widely used in the United States.

Webb Alignment Method

The Webb alignment method (1997; 1999; 2005) was originally designed for use with standard large-scale assessments. Dr. Norman Webb has researched and refined this method over time, and his approach is supported by the Council of Chief State School Officers (CCSSO).

The Webb method includes four major indicators to evaluate alignment. These indicators link with statistical procedures used to assess how well items on the assessment, regardless of item type and point value, and the state's standards document actually match. The four alignment indicators are: categorical concurrence, depth-of-knowledge consistency, range-of-knowledge correspondence, and balance-of-knowledge representation.

Categorical concurrence is a basic measure of alignment between content standards and test items. This term refers to the proportion of overlap between the content stated in the standards document and that assessed by items on the test.

Depth of knowledge (DOK) measures the type of cognitive processing required by items and content standards. For example, is a student expected to simply identify or recall basic facts or

use reason to manipulate information, or to strategize how to best solve a complex problem? Using Science as an example, a student may be asked to identify the planets of our solar system among several answer choices. This task should be less complex than trying to compare and contrast the composition of the planets in preparation of landing unmanned probes.

The purpose of using DOK as a measure of alignment is to determine whether a test item and its corresponding standard are written at the same level of cognitive complexity. Panelists make two separate judgments about cognitive complexity, one rating for the standard and one rating for the item. These two judgments are compared to determine whether the item is written at the same level as the standard to which it is linked. Webb (1997) refers to this comparison as *Depth-of-Knowledge consistency*.

Range-of-knowledge correspondence examines the range-of-knowledge correspondence between the assessment and content standards. The range-of-knowledge correspondence measure looks in greater detail at the breadth of knowledge represented by test items. Categorical concurrence simply notes whether a sufficient number of items on the test covers each general content topic (i.e., standard). However, states usually lay out more specific content objectives (i.e., grade level expectations, evidence outcomes), under each strand. The range-of-knowledge correspondence indicates the number of specific content objectives assessed by items.

Balance-of-knowledge representation focuses on content coverage in yet more detail. In this case, the number of items matched to the content objective does matter. The balance of representation determines whether the assessment measures the content objectives equitably within each content topic using only the content objectives identified by panelists and not all content objectives eligible to be assessed. Based on Webb's (1997) method, items should be distributed evenly across the objectives per content topic for good balance. The balance-of-knowledge representation is determined by calculating an index, or score, for each content topic. Each should meet or surpass a minimum index level to demonstrate adequate balance.

Scope of Alignment Evaluations for CMAS Science and Social Studies

The alignment evaluation performed for this study involved a comparison of the CMAS science and social studies test items to the Colorado Academic Standards (CAS). Colorado educators highly familiar with the content standards and the assessment provided alignment ratings for the evaluation. To maintain the independent and external nature of the study, CDE did not take part in this process. This process was conducted and directed solely by HumRRO.

Review of Content Alignment

For the content alignment review, HumRRO convened panels of Colorado educators to review grades 5 and 8 and high school CMAS science test items, and grades 4 and 7 and high school CMAS social studies test items. The review involved two major tasks for panelists to complete: (a) providing depth of knowledge (DOK) ratings for each Evidence Outcome (EO) within the CAS for science and social studies, and (b) evaluating the science and social studies items by matching them to a grade level EO, providing an item DOK rating, and selecting a rating of the quality of alignment between the item and the matched EO.

Panelists

Pearson recruited the two review panels with the administrative assistance of CDE. Every effort was made to produce panels consisting of teachers reflecting the population of students who take the assessments. Once selected, the panels were convened at the Sheraton Denver West Hotel in Denver, CO on November 9-10, 2015. Panels included 4-8 reviewers, referred to as panelists. Table 2.1 presents the characteristics of the panels by content area and grade level.

Table 2.1. Professional and Demographic Characteristics of Panelists

Professional Position	Science									Social Science								
	# Panelist	School Setting			Education			Gender		# Panelist	School Setting			Education			Gender	
		Urban	Sub.	Rural	BA	MA	PhD	M	F		Urban	Sub.	Rural	BA	MA	PhD	M	F
Elementary																		
Teacher	6	4	1	1	2	4	0	0	6	6	2	1	2	2	3	0	1	5
Administrator	1	0	0	1	0	1	0	1	0	1	0	1	0	0	1	0	0	1
Middle																		
Teacher	4	1	2	1	1	3	0	1	3	6	0	5	0	2	3	0	2	4
Administrator	2	1	1	0	0	2	0	0	2	2	2	0	0	0	2	0	2	0
High School																		
Teacher	6	2	3	0	2	3	0	0	6	4	0	0	2	2	1	0	3	1
Administrator	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0

Note. Demographic data were not available for all participants.

Training

All panelists received a common introductory training prior to participating in the study. During this large group session, HumRRO provided general alignment study information, roles and responsibilities, key alignment concepts, security and confidentiality concerns, and the alignment workshop procedures. Panelists then moved into content-specific breakout sessions in which they were assigned to a specific grade level. In the breakout rooms, panelists signed non-disclosure agreements and then received additional targeted-training on the process and associated materials prior to beginning their evaluation.

Materials

During the alignment workshop, panelists evaluated the alignment of the CMAS items with the CAS by accessing items via a secure web-based platform and completing electronic rating forms adapted from Webb (2005). All rating forms were completed electronically in Excel®. The item presentation and rating forms are discussed in further detail below.

Test Items. Panelists evaluated CMAS operational items. Table 2.2 lists the number of items for each grade-level test. The CMAS tests are administered as online assessments. Many items include dynamic graphics that demonstrate concepts or require student interaction to formulate a response. Panelists were able to access the items via a secure web-based platform, and thus were able to view and interact with items in a manner similar to tested students. Because the test items are secure, this report does not include any examples of items or references to specific item content.

Table 2.2. Number of CMAS Items Reviewed

Subject	Grade	Total Items
Science	5	60
	8	60
	High school	60
Social Studies	4	51
	7	48
	High school	52

Rating Forms and Instructions. Panelists were given instruction sheets describing the rating tasks, the codes to be used, and the excel documents used during their review. Panelists completed two rating forms, the first was completed as a group (by consensus) to provide depth of knowledge (DOK) ratings for the content EOs and the second form, an item rating form, captures individual ratings for the items. Samples of the materials are found in Appendix C.

Procedures

HumRRO conducted the alignment study at Sheraton Denver West Hotel in Denver, CO. The workshop began with a general session that included introductions of staff and observers followed by a brief review of the agenda for the two-day workshop. Panelists then moved to content area breakout rooms to receive more targeted alignment task training before starting to work. Within each breakout room, panelists were seated at grade-specific tables, with 4-8 panelists per group. One HumRRO staff member served as a facilitator in each breakout room. A third HumRRO staff member moved between the rooms and provided assistance as needed. Prior to beginning their review, panelists read and signed affidavits of nondisclosure for the secure materials they would be reviewing during the workshop.

Before each of the rating tasks, a HumRRO staff member trained panelists on the procedures to complete the task, answered questions on the rating criteria, and facilitated a short calibration activity to ensure panelists were comfortable applying ratings. HumRRO staff provided general suggestions and comments when appropriate; however, they emphasized to panelists that staff would not give explicit direction on how to rate standards or items because panelists were valued as content experts. Each panelist was assigned a workstation with rating forms already uploaded on their assigned laptop computer. HumRRO staff provided instructions as needed for working with the electronic rating forms.

Panelists began with DOK evaluations of the content EOs. Panelists started this process by independently assigning a DOK level to one EO and then discussing their individual ratings with the group until a consensus rating was reached. When all panelists felt comfortable with the task, groups followed a similar process in which they provided independent ratings for each EO prior to identifying a group consensus rating. A volunteer scribe within each group recorded these consensus ratings.

Panelists then received specific instructions for rating the items. As a calibration activity, HumRRO staff asked panelists to rate the first two items individually and then discuss the ratings as a group. Once panelists were comfortable using the ratings, they continued the item rating activity on their own. Panelists rated the individual items on the test forms on several dimensions: (a) depth of knowledge required by the item, (b) content match to the EOs in the Colorado Academic Standards, (c) and the degree of alignment (i.e., how well the item links to

the identified EO). Within the content match dimension, panelists assigned a *primary EO* to an item based on a judgment that an item clearly measured this content. Panelists could also assign an *additional EO* if the item seemed to assess another EO as well (or nearly as well) as the primary GLE. Again, these were individual ratings, not consensus.

All panelists finished their rating tasks within the 2 days allotted for the workshop. Once panelists finished the review, their session ended.

Chapter 3: Results: Science Content Alignment

The content alignment evaluation analyses discussed in this chapter are based on panelists' ratings of the CMAS science items for grades 5 and 8 and high school.

Reliability Results

In this section, we report on the comparison of panelists' ratings of content match to the item bank's documented content match. In other words, do panelists assign the same EO to an item as the item writer during item development?

Panelist-Test Developer Analyses

This analysis examined the agreement outcomes between the EO assigned to an item by panelists, and the EO assigned to an item as noted in the item bank. Table 3.1 presents the agreement outcomes between panelists and the item bank on the content assessed by items. Agreement was analyzed at several levels of specificity. All of the items were analyzed first for 'Exact Match', which indicates that panelists chose the same EO. If panelists did not show an exact match with the item bank, we determined the percent agreement at the Grade Level Expectation (GLE) level. For high school, we also determine the percent agreement at the Prepared Graduate Competency (PGC) level. Finally, we determined the percent agreement at the standard level (i.e., physical science, life science, earth systems science).The last column in Table 3.1 shows the percentage of ratings by panelists that did not match the item bank coding at all on items.

Table 3.1. Percent Agreement between Panelists and Item Bank on Target Content

Grade	Total Number of Panelist Ratings across Items	Percent Agreement with Item Bank Codes				
		Exact Match	GLE Match	PGC Match	Standard Match	No Match
5	420	54.0%	80.5%	NA	88.3%	11.7%
8	360	54.7%	92.2%	NA	99.2%	0.08%
High School	420	48.8%	72.1%	84.0%	95.5%	4.5%

As Table 3.1 indicates, panelists were moderately consistent with the item bank in identifying the content codes of items. Panelists identified an exact match for 49–55% of the items and a content match at the GLE level or below for 72–92% of the items. Panelists differed completely from the item bank on content match for 1–12% of the items. Overall these findings suggest that the majority of science items do measure the intended content.

Webb Alignment Results

In this section, we review the general outcomes of item analyses for science on the four Webb alignment indicators.

All of Webb's (1997) measures begin with calculations for each panelist and build up to a summary of results across panelists per EO. First, we calculated the mean ratings across items for each panelist, and then we determined the mean rating across panelists per EO. Depending on the component under review, results are presented at the broader GLE and Standard levels

(as well as the PGC level for high school). Results at the more specific EO level are presented in Appendix A.

Categorical Concurrence

Categorical concurrence describes the extent to which the CMAS items, regardless of item type and point value, cover the content of the Colorado Academic Standards. Webb (1997, 1999, 2005) recommends a minimum of six test questions to adequately assess each standard. This criterion serves as a guideline for reasonable content coverage based on earlier research on the reliability of tests compared to the number of items (Subkoviak, 1988). Tables 3.2 through 3.4 summarize the CMAS alignment results for categorical concurrence for each grade level. The standards that meet Webb's indicator criterion are in bold. Tables A-1 through A-3 in Appendix A also contain the standard deviations for each standard.

Table 3.2. Summary of Categorical Concurrence Results for Science CMAS – Grade 5

Standard	Mean Number of Items per Standard
Physical Science	**13.57**
Life Science	**23.14**
Earth Systems Science	**21.43**
Standards with at Least Six Items	**3 of 3**

Table 3.3. Summary of Categorical Concurrence Results for Science CMAS – Grade 8

Standard	Mean Number of Items per Standard
Physical Science	**22.33**
Life Science	**17.67**
Earth Systems Science	**19.83**
Standards with at Least Six Items	**3 of 3**

Table 3.4. Summary of Categorical Concurrence Results for Science CMAS – High School

Standard	Mean N of Items Standard
Physical Science	**21.14**
Life Science	**19.71**
Earth Systems Science	**19.14**
Standards with at Least Six Items	**3 of 3**

As Tables 3.2 through 3.4 indicate, all three assessments include a sufficient number of items to meet the minimum requirements for categorical concurrence on all science standards.

In addition to identifying the content assessed by each item, we asked panelists to indicate *how well* the item assessed the content. Panelists subjectively rated the extent of item alignment to the content on a 4-point scale ranging from 'not aligned to any EO' to 'fully aligned'. Table 3.5 presents the mean number of items (across panelists) at each level of alignment. For each grade level, panelists rated items as well aligned to the EO matched to that item.

Table 3.5. Panelist Ratings on Overall Item Alignment

Grade	Degree of Alignment	Mean Number of Items (*N*=60) per Level	*SD*	Percent of Items per Level
5	Not at all aligned	2.75	1.50	2.64
	Weakly aligned	4.83	2.71	6.95
	Highly aligned	48.43	11.18	81.29
	Fully aligned	19.00	14.14	9.11
8	Not at all aligned	1.00	NA	0.28
	Weakly aligned	6.00	3.09	10.00
	Highly aligned	26.17	10.85	43.61
	Fully aligned	27.67	10.95	46.11
High School	Not at all aligned	1.50	0.71	0.71
	Weakly aligned	3.50	2.81	5.00
	Highly aligned	48.71	12.74	81.19
	Fully aligned	18.33	12.74	13.10

In general, panelists across the three grade levels rated at least 90% of the items as being 'Highly aligned' or 'Fully aligned'. The grade 8 assessment had the highest percentage of items rated by panelists as being 'Weakly aligned' or 'Not at all aligned' at 10%.

Depth-of-Knowledge Consistency

Analyses of depth-of-knowledge (DOK) measure the type of cognitive processing required of students by content standards. The DOK requirements implied by the EOs should be matched by assessment items. To confirm this match, panelists were asked to rate the EOs and the science items separately. Webb (1997) includes an alignment indicator that directly compares panelists' DOK ratings of content standards and test items, which he refers to as *depth-of-knowledge consistency*.

To make their ratings, panelists used a rating scale (adapted from Webb, 2005) with four levels of cognitive complexity.

- Level 1 Recognition – simple recall of information (i.e., facts, terms); sequencing; more automatic.
- Level 2 Skills/Concepts – beyond habitual response; applying concepts; problem-solving.
- Level 3 Strategic Thinking – requires basic reasoning, planning, or use of evidence; generating hypotheses.
- Level 4 Extended Thinking – complex reasoning; evaluation of multiple sources or independent pieces of evidence; often over an extended period of time.

Tables 3.6 through 3.8 summarize the depth-of-knowledge consistency results for each grade level of the CMAS science test. Because panelists evaluated depth of knowledge at the most specific level of the standards document (EOs), the table refers to consistency between the items and the EOs to which they were matched. Results are summarized at the GLE level for ease of presentation. Tables A-4 through A-6 in Appendix A contain the means and standard deviations for DOK ratings at all levels.

Webb's (1997) suggested criterion for this alignment indicator is that at least 50% of the items should have complexity ratings at or above the level of the corresponding EO. The percentages of GLEs that reach the 50% criterion are bolded.

Table 3.6. Summary of Depth-of-Knowledge Results for Science CMAS – Grade 5

Standard	Grade Level Expectations	Percent of Items with DOK At or Above the Level of the EOs
Physical Science	Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	**61.34**
Life Science	All organisms have structures and systems with separate functions.	40.50
	Human body systems have basic structures, functions, and needs.	26.67
Earth Systems Science	Earth and Sun provide a diversity of renewable and nonrenewable resources.	40.05
	Earth's surface changes constantly through a variety of processes and forces.	**93.81**
	Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	**56.79**
	Number of GLEs with item DOK at or above EO DOK	**3 of 6**

Table 3.7. Summary of Depth-of-Knowledge Results for Science CMAS – Grade 8

Standard	Grade Level Expectations	Percent of Items with DOK At or Above the Level of the EOs
Physical Science	Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	**63.33**
	There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	39.05
	Distinguish between physical and chemical changes, noting that mass is conserved during any change.	**80.56**
	Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	**63.33**
Life Science	Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	**50.23**
	Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	**72.22**
Earth Systems Science	Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	**64.29**
	Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	49.17
	The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	**88.76**
	The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	37.50
	Number of GLEs with item DOK at or above EO DOK	**7 of 10**

Table 3.8. Summary of Depth-of-Knowledge Results for Science CMAS – High School

Standard	Prepared Graduate Competencies	Grade Level Expectations	Percent of Items with DOK At or Above the Level of the EOs	
			GLE	PGC
Physical Science	Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects.	Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	36.14	36.14
	Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions.	Matter has definite structure that determines characteristic physical and chemical properties.	**78.81**	**69.74**
		Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	**64.52**	
		Atoms bond in different ways to form molecules and compounds that have definite properties.	**74.52**	
	Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable.	Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	46.67	37.86
		When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	41.67	
Life Science	Explain and illustrate with examples how living systems interact with the biotic and abiotic environment.	Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	**100.00**	**66.71**
		The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	34.09	
	Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection.	Cellular metabolic activities are carried out by biomolecules produced by organisms.	**88.10**	**73.47**
		The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	**57.14**	
		Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	**50.00**	
		Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	**100.00**	
	Analyze how various	Physical and behavioral characteristics of	**74.76**	**71.90**

Standard	Prepared Graduate Competencies	Grade Level Expectations	Percent of Items with DOK At or Above the Level of the EOs	
			GLE	PGC
	organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment.	an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins.		
		Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	0.00	
	Explain how biological evolution accounts for the unity and diversity of living organisms.	Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	**91.67**	**91.67**
Earth Systems Science	Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet.	The history of the universe, solar system and Earth can be inferred from evidence left from past events.	**75.00**	**68.10**
		As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.	**50.00**	
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	42.86	**66.67**
		Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	**100.00**	
	Describe how humans are dependent on the diversity of resources provided by Earth and Sun.	There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	**90.48**	**90.48**
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	**77.62**	**61.48**
		Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	28.57	
	Number of GLEs with item DOK at or above EO DOK		**15 of 22**	
	Number of PGCs with item DOK at or above EO DOK		**9 of 11**	

In grade 5, half of the GLEs met Webb's (1997) criterion for assessing appropriate levels of cognitive complexity. In grade 8, 70% of the GLEs had a sufficient number of items at the same or higher DOK level. In high school, 68% of GLEs and 82% of PGCs met Webb's criterion for DOK consistency. It is important to note that the comparisons of standard and item DOKs was based on panelists' assignment of a single DOK to each EO, rather than using the range of

DOK levels provided in the standards document. There were several EOs that the panelists rated at a DOK outside the ranges specified in the standards document, which may have impacted the results reported here.

Range of Knowledge Correspondence

The *range-of-knowledge correspondence* measure examines in greater detail the breadth of knowledge covered by the assessment. In addition to evaluating which grade level expectations are assessed, we must look at how many of the EOs within a GLE are represented by items. The EOs should be linked with at least one item. Webb's (1997) minimum level of acceptability for range-of-knowledge correspondence is that at least 50% of EOs per GLE link with items. Tables 3.9 through 3.11 summarize the range-of-knowledge results for each grade level CMAS science test per GLE. The GLEs that meet Webb's indicator criterion are in bold.

Table 3.9. Summary of Range-of-Knowledge Results for the Science CMAS – Grade 5

Standard	Grade Level Expectations	Percent of EOs per GLE Matched to at Least One Item
Physical Science	Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	**100.00**
Life Science	All organisms have structures and systems with separate functions.	**85.71**
	Human body systems have basic structures, functions, and needs.	**97.14**
Earth Systems Science	Earth and Sun provide a diversity of renewable and nonrenewable resources.	**92.86**
	Earth's surface changes constantly through a variety of processes and forces.	**92.86**
	Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	**85.71**
	Number of GLEs Assessed Adequately	**6 of 6**

Table 3.10. Summary of Range-of-Knowledge Results for the Science CMAS – Grade 8

Standard	Grade Level Expectations	Percent of EOs per GLE Matched to at Least One Item
Physical Science	Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	**88.89**
	There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	**83.33**
	Distinguish between physical and chemical changes, noting that mass is conserved during any change.	**76.67**
	Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	**100.00**
Life Science	Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	**76.67**
	Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	**83.33**
Earth Systems Science	Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	**83.33**
	Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	**66.67**
	The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	**63.89**
	The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	**94.44**
	Number of GLEs Assessed Adequately	**10 of 10**

Table 3.11. Summary of Range-of-Knowledge Results for the Science CMAS – High School

Standard	Prepared Graduate Competencies	Grade Level Expectations	Percent of EOs per GLE Matched to at Least One Item	
			GLE	PGC
Physical Science	Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects.	Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	48.57	48.57
	Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions.	Matter has definite structure that determines characteristic physical and chemical properties.	46.43	**61.54**
		Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	**85.71**	
		Atoms bond in different ways to form molecules and compounds that have definite properties.	**54.29**	
	Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable.	Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	**60.00**	33.33
		When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	30.00	
Life Science	Explain and illustrate with examples how living systems interact with the biotic and abiotic environment.	Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	35.71	41.56
		The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	**60.71**	
	Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection.	Cellular metabolic activities are carried out by biomolecules produced by organisms.	42.86	36.97
		The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	42.86	
		Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	34.29	
		Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	28.57	

Standard	Prepared Graduate Competencies	Grade Level Expectations	Percent of EOs per GLE Matched to at Least One Item	
			GLE	PGC
	Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment.	Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins.	**71.43**	42.86
		Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	25.00	
	Explain how biological evolution accounts for the unity and diversity of living organisms.	Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	30.00	30.00
Earth Systems Science	Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet.	The history of the universe, solar system and Earth can be inferred from evidence left from past events.	**62.86**	44.44
		As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.	37.50	
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	42.86	37.14
		Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	33.33	
	Describe how humans are dependent on the diversity of resources provided by Earth and Sun.	There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	42.86	42.86
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	39.29	44.60
		Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	**52.38**	
		Number of GLEs Assessed Adequately	**7 of 22**	
		Number of PGCs Assessed Adequately	**1 of 11**	

Both the grade 5 and grade 8 science tests met the minimum range-of-knowledge criterion for all of the GLEs. At the high school level, this criterion was met for less than half of the GLEs and only one of the PGCs. This difference is a direct result of the larger number of EOs available to be assessed at the high school level compared to the other grades. Tables A-7 through A-9 in

Appendix A contain the means and standard deviations for each GLE and the number of assessable EOs per GLE.

Balance-of-Knowledge Representation

The fourth measure of alignment included in the Webb (1997) method is *balance-of-knowledge representation*. This measure describes the distribution of items linked to each EO within each GLE. The number of items should be distributed rather evenly between the EOs to achieve good balance.

The content balance is determined by calculating an index, or score, for each GLE[1]. According to Webb (1997), the minimum acceptable index for a single content strand is 70 (on a scale of 0 to 100 with 100 representing perfect balance). An index of 70 or higher suggests that items broadly assess the EOs for a GLE instead of clustering around one or two EOs.

Two cautions should be noted regarding the balance index when interpreting the results. First, only those EOs actually matched to items by the panelists are included in calculations of the balance index. A given GLE may include more EOs than are actually linked to items by panelists. For example, if a particular GLE includes eight EOs in the state content standards document but panelists found items matching to just three EOs, only these three EOs are evaluated for item distribution. Recognizing this feature of the balance index is important in cases when the range measure and balance measure produce seemingly contrasting results. And second, when states choose to emphasize particular content strands over others, the balance statistic becomes uninterpretable. Colorado does not emphasize any particular GLEs on the CMAS science tests.

Tables 3.12 through 3.14 summarize the results on balance-of-content representation per grade for the CMAS science tests. All of the grades assessed surpassed the minimum level of acceptability (index of 70) for demonstrating good content balance among those EOs matched to items for each GLE. The GLEs that meet Webb's (1997) indicator criterion are in bold. Tables A-10 through A-12 contain means associated with the calculation of the balance index.

[1] The exact formula for calculating the balance index is explained in detail in Webb's (2005) alignment training manual: http://www.wcer.wisc.edu/WAT/index.aspx.

Table 3.12. Summary of Balance-of-Knowledge Representation Results Science CMAS – Grade 5

Standard	Grade Level Expectations	Balance Index
Physical Science	Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	**92.91**
Life Science	All organisms have structures and systems with separate functions.	**78.76**
	Human body systems have basic structures, functions, and needs.	**72.35**
Earth Systems Science	Earth and Sun provide a diversity of renewable and nonrenewable resources.	**87.33**
	Earth's surface changes constantly through a variety of processes and forces.	**84.29**
	Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	**76.85**
	Number of GLEs Assessed Adequately	**6 of 6**

Table 3.13. Summary of Balance-of-Knowledge Representation Results Science CMAS – Grade 8

Standard	Grade Level Expectations	Balance Index
Physical Science	Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	**80.00**
	There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	**76.43**
	Distinguish between physical and chemical changes, noting that mass is conserved during any change.	**83.89**
	Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	**82.22**
Life Science	Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	**83.98**
	Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	**79.81**
Earth Systems Science	Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	**76.43**
	Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	**91.94**
	The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	**80.63**
	The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	**87.78**
	Number of GLEs Assessed Adequately	**10 of 10**

Table 3.14. Summary of Balance-of-Knowledge Representation Results Science CMAS – High School

			Balance Index	
Standard	Prepared Graduate Competencies	Grade Level Expectations	GLE	PGC
Physical Science	Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects.	Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	**80.61**	**80.61**
	Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions.	Matter has definite structure that determines characteristic physical and chemical properties.	**89.05**	**81.68**
		Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	**90.71**	
		Atoms bond in different ways to form molecules and compounds that have definite properties.	**93.10**	
	Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable.	Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	**96.67**	**90.48**
		When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	**100.00**	
Life Science	Explain and illustrate with examples how living systems interact with the biotic and abiotic environment.	Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	**94.44**	**88.07**
		The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	**90.69**	
	Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection.	Cellular metabolic activities are carried out by biomolecules produced by organisms.	**100.00**	**98.30**
		The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	**100.00**	
		Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	**100.00**	
		Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	**100.00**	
	Analyze how various organisms grow, develop, and differentiate during their	Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode	**79.05**	**78.81**

			Balance Index	
Standard	Prepared Graduate Competencies	Grade Level Expectations	GLE	PGC
	lifetimes based on an interplay between genetics and their environment.	instructions for the production of proteins.		
		Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	**100.00**	
	Explain how biological evolution accounts for the unity and diversity of living organisms.	Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	**100.00**	**100.00**
Earth Systems Science	Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet.	The history of the universe, solar system and Earth can be inferred from evidence left from past events.	**89.29**	**89.52**
		As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.	**100.00**	
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	**92.86**	**83.57**
		Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	**100.00**	
	Describe how humans are dependent on the diversity of resources provided by Earth and Sun.	There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	**90.48**	**90.48**
	Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system.	The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes.	**91.67**	**77.77**
		Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms.	**96.43**	
		Number of GLEs Assessed Adequately	**22 of 22**	
		Number of PGCs Assessed Adequately	**11 of 11**	

Summary and Discussion on Webb Alignment Indicators

The overall alignment results provide generally positive support for the content validity of the CMAS science tests. Summary alignment judgments are based on Webb (2005). These summary judgments focus on the percentage of content standards or GLEs represented well by the assessment. Webb outlined a scale with a range of potential alignment outcomes applied to each of the four indicators:

- Fully aligned – assessments align to all standards/GLEs (91%–100%),
- Highly aligned – assessments align to the majority of standards/GLEs (70%–90%),

- Partially aligned – assessments align well to some standards/GLEs (50%–69%),
- Weakly aligned – assessments align to less than half the standards/GLEs (below 50%).

Webb's (1997) alignment method does not allow for a *single* judgment of overall alignment across the four alignment indicators. However, one can get a sense of overall alignment between the assessments and standards by looking at all of the alignment indicators together.

Table 3.15 presents the summary alignment outcomes for the CMAS science tests based on the above scale. The table includes a summary judgment for each Webb alignment indicator per grade level based on the percentage of standards/GLEs that met the minimum alignment criteria. This summary table is linked to the bottom row of Tables A-1 through A-12 in Appendix A. Thus, these summary judgments reflect a final evaluation of each grade assessment per Webb indicator criteria *across* the standards/GLEs.

As shown in Table 3.15 with green highlighting, approximately 83% of the results indicate strong content alignment of the CMAS science test to the Colorado Academic Standards. Each of the three grade level tests includes sufficient numbers of items to cover the Colorado Academic Standards, and a sufficiently even distribution of evidence outcomes within the associated grade level expectation. The grade 8 and high school tests also include sufficient numbers of items at DOK levels at or above the DOK assigned to the corresponding evidence outcome. The grade 5 and grade 8 tests demonstrated sufficient coverage of the range of evidence outcomes within each grade level expectation.

Table 3.15. Summary Alignment Outcomes on Each Webb Criterion by Grade Level for Science CMAS

Grade Level	Percentage of GLEs that Met Webb Criteria			
	Categorical Concurrence	Depth-of-Knowledge Consistency	Range-of-Knowledge Correspondence	Balance-of-Knowledge Representation
5	Fully aligned (100%)	Partially aligned (50%)	Fully aligned (100%)	Fully aligned (100%)
8	Fully aligned (100%)	Highly aligned (70%)	Fully aligned (100%)	Fully aligned (100%)
High School	Fully aligned (100%)	Partially aligned (68%) / Highly aligned (82%)	Weakly aligned (32%; 9%)	Fully aligned (100%)

Notes. Categorical concurrence is evaluated at the Standard level to reflect score reporting practices. High school percentages reflect GLEs and PGCs, respectively.

It is important to note that there was a restricted range of content assessed at the high school level. The range of knowledge correspondence results indicate approximately 32% of the GLEs met the minimum criteria of having 50% of the EOs within a GLE matched to an item. The highest percentage of EOs within a GLE matched to an item occur in the 'Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy' GLE. This restricted range of content assessed is a result of a much larger number of EOs available to be assessed than items on the assessment. This restricted range of content assessed is a result of a much larger number of EOs available to be assessed than items on the assessment. For the high school test, there are 99 EOs that are assessable, but only 60 items are administered.

Tables A-13 through A-15 in Appendix A present the mean number of items matched to each EO and the number of panelists represented.

Suggestions for improving the alignment between the CMAS science tests and Colorado Academic Standards are discussed in Chapter 5, Summary and Recommendations.

Chapter 4: Results: Social Studies Content Alignment

The content alignment evaluation analyses discussed in this chapter are based on panelists' ratings of the CMAS social studies items for grades 4 and 7 and high school.

Reliability Results

In this section, we report on the comparison of panelists' ratings of content match to the item bank's documented content match. In other words, do panelists assign the same EO to an item as the item writer during item development?

Panelist-Test Developer Analyses

This analysis examined the agreement outcomes between the EO assigned to an item by panelists, and the EO assigned to an item as noted in the item bank. Table 4.1 presents the agreement outcomes between panelists and the item bank on the content assessed by items. Agreement was analyzed at several levels of specificity. All of the items were analyzed first for 'Exact Match', which indicates that panelists chose the same EO. If panelists did not show an exact match with the item bank, we determined the percent agreement at the Grade Level Expectation (GLE) level. For high school, we also determine the percent agreement at the Prepared Graduate Competency (PGC) level. Finally, we determined the percent agreement at the standard level (i.e., history, geography, economics, and civics).The last column in Table 4.1 shows the percentage of ratings by panelists that did not match the item bank coding at all on items.

Table 4.1. Percent Agreement between Panelists and Item Bank on Target Content

Grade	Total Number of Panelist Ratings across Items	Percent Agreement with Item Bank Codes				
		Exact Match	GLE Match	PGC Match	Standard Match	No Match
4	357	51.3%	70.6%	NA	82.6%	17.4%
7	384	41.4%	66.4%	NA	93.0%	7.0%
High School	260	40.7%	56.1%	61.2%	66.8%	33.2%

As Table 4.1 indicates, panelists were moderately consistent with the item bank in identifying the content codes of items. Panelists identified an exact match for 41–51% of the ratings and a content match at the GLE level or below for 56–71% of the ratings. Panelists differed completely from the item bank on content match for 7–33% of the ratings. Overall these findings suggest that the majority of social studies items do measure the intended content. Discrepancies in standard match at the high school level most frequently involved panelists matching a civics item to a history EO.

Webb Alignment Results

In this section, we review the general outcomes of item analyses on the four Webb (1997) alignment indicators.

All of Webb's measures begin with calculations for each panelist and build up to a summary of results across panelists per EO. First, we calculated the mean ratings across items for each panelist, and then we determined the mean rating across panelists per EO. Depending on the

component under review, results are presented at the broader GLE level and Standard levels (as well as the PGC level for high school). Results at the more specific EO level are presented in Appendix B.

Categorical Concurrence

Categorical concurrence describes the extent to which the CMAS items, regardless of item type and point value, cover the content of the Colorado Academic Standards. Webb (1997) recommends a minimum of six test questions to adequately assess each standard. This criterion serves as a guideline for reasonable content coverage based on earlier research on the reliability of tests compared to the number of items (Subkoviak, 1988). Tables 4.2 through 4.4 summarize the CMAS alignment results for categorical concurrence for each grade level. The standards that meet Webb's indicator criterion are in bold. Tables B-1 through B-3 in Appendix B also contain the standard deviations for each standard.

Table 4.2. Summary of Categorical Concurrence Results for Social Studies CMAS – Grade 4

Standard	Mean Number of Items per Standard
History	**10.86**
Geography	**17.29**
Economics	**14.00**
Civics	**8.86**
Standards with at Least Six Items	**4 of 4**

Table 4.3. Summary of Categorical Concurrence Results for Social Studies CMAS – Grade 7

Standard	Mean Number of Items per Standard
History	**11.38**
Geography	**12.00**
Economics	**13.13**
Civics	**11.50**
Standards with at Least Six Items	**4 of 4**

Table 4.4. Summary of Categorical Concurrence Results for Social Studies CMAS – High School

Standard	Mean Number of Items per Standard
History	**16.25**
Geography	**12.25**
Economics	**12.00**
Civics	**11.50**
Standards with at Least Six Items	**4 of 4**

As Tables 4.2 through 4.4 indicate, all of the social studies tests include a sufficient number of items to meet the minimum requirements for categorical concurrence on all social studies standards.

In addition to identifying the content assessed by each item, we asked panelists to indicate *how well* the item assessed the content. Panelists subjectively rated the extent of item alignment to the content on a 4-point scale ranging from 'not aligned to any EO' to 'fully aligned'. Table 4.5 presents the mean number of items (across panelists) at each level of alignment. For each grade level, panelists rated items as well aligned to the EO matched to that item.

Table 4.5. Panelist Ratings on Overall Item Alignment

Grade	Degree of Alignment	Mean Number of Items (*N*=) per Level	*SD*	Percent of Items per Level
4	Not at all aligned	2.83	1.94	4.76
	Weakly aligned	5.57	2.88	10.92
	Highly aligned	26.57	10.52	52.10
	Fully aligned	16.43	10.23	32.21
7	Not at all aligned	1.00	0.00	1.04
	Weakly aligned	4.38	1.60	9.11
	Highly aligned	22.50	7.86	46.88
	Fully aligned	20.63	9.44	42.97
High School	Not at all aligned	0.00	0.00	0.00
	Weakly aligned	2.00	0.00	0.96
	Highly aligned	21.50	9.29	41.35
	Fully aligned	30.00	8.87	57.69

In general, panelists across the three grade levels rated at least 84% of the items as being 'Highly aligned' or 'Fully aligned'. The grade 4 assessment had the highest percentage of items rated by panelists as being 'Weakly aligned' or 'Not at all aligned' at 16%.

Depth-of-Knowledge Consistency

Analyses of depth-of-knowledge (DOK) measure the type of cognitive processing required of students by content standards. The DOK requirements implied by the EOs should be matched by assessment items. To confirm this match, panelists were asked to rate the EOs and the social studies items separately. Webb (1997) includes an alignment indicator that directly compares panelists' DOK ratings of content standards and test items, which he refers to as *depth-of-knowledge consistency*.

To make their ratings, panelists used a rating scale (adapted from Webb, 2005) with four levels of cognitive complexity.

- Level 1 Recognition – simple recall of information (i.e., facts, terms); sequencing; more automatic.
- Level 2 Skills/Concepts – beyond habitual response; applying concepts; problem-solving.
- Level 3 Strategic Thinking – requires basic reasoning, planning, or use of evidence; generating hypotheses.
- Level 4 Extended Thinking – complex reasoning; evaluation of multiple sources or independent pieces of evidence; often over an extended period of time.

Tables 4.6 through 4.8 summarize the depth-of-knowledge consistency results for each grade level of the CMAS social studies test. Because panelists evaluated depth of knowledge at the most specific level of the standards document (EOs), the table refers to consistency between the items and the EOs to which they were matched. Results are summarized at the GLE level for ease of presentation. Tables B-4 through B-6 in Appendix B contain the means and standard deviations for DOK ratings at all levels.

Webb's (1997) suggested criterion for this alignment indicator is that at least 50% of the items should have complexity ratings at or above the level of the corresponding EO. The percentages of GLEs that reach the 50% criterion are bolded.

Table 4.6. Summary of Depth-of-Knowledge Results for Social Studies CMAS – Grade 4

Standard	Grade Level Expectation	Percent of Items with DOK At or Above the Level of the EOs
History	Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	**65.52**
	The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	**85.24**
Geography	Use several types of geographic tools to answer questions about the geography of Colorado.	**89.38**
	Connections within and across human and physical systems are developed.	**73.99**
Economics	People respond to positive and negative incentives.	**79.88**
	The relationship between choice and opportunity cost (PFL).	**82.31**
Civics	Analyze and debate multiple perspectives on an issue.	**79.76**
	The origins, structure, and functions of the Colorado government	**62.86**
	Number of GLEs with item DOK at or above EO DOK	**8 of 8**

Table 4.7. Summary of Depth-of-Knowledge Results for Social Studies CMAS – Grade 7

Standard	Grade Level Expectation	Percent of Items with DOK At or Above the Level of the EOs
History	Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	**75.63**
	The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	**65.87**
Geography	Use geographic tools to gather data and make geographic inferences and predictions.	**69.35**
	Regions have different issues and perspectives.	**71.04**
Economics	Supply and demand influence price and profit in a market economy.	**91.22**
	The distribution of resources influences economic production and individual choices (Economics and PFL).	**84.23**
Civics	Compare how various nations define the rights, responsibilities, and roles of citizens.	**85.92**
	Different forms of government and international organizations and their influence in the world community.	**54.05**
	Number of GLEs with item DOK at or above EO DOK	**8 of 8**

Table 4.8. Summary of Depth-of-Knowledge Results for Social Studies CMAS – High School

Standard	Prepared Graduate Competency	Grade Level Expectation	Percent of Items with DOK At or Above the Level of the EOs	
			GLE	PGC
History	Develop an understanding of how people view, construct, and interpret history.	Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	**87.50**	**87.50**
	Analyze key historical periods and patterns of change over time within and across nations and cultures	The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	**62.30**	**63.29**
		The significance of ideas as powerful forces throughout history.	**64.46**	
Geography	Develop spatial understanding, perspectives, and personal connections to the world	Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	**85.42**	**80.68**
		Explain and interpret geographic variables that influence the interactions of people, places and environments.	**77.08**	
	Examine places and regions and the connections among them	The interconnected nature of the world, its people and places.	**95.83**	**95.83**

Standard	Prepared Graduate Competency	Grade Level Expectation	Percent of Items with DOK At or Above the Level of the EOs	
			GLE	PGC
Economics	Understand the allocation of scarce resources in societies through analysis of individual choice, market interaction, and public policy.	Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	**60.12**	**64.29**
		Economic policies affect markets.	**100.00**	
		Government and competition affect markets.	NA	
	Acquire the knowledge and economic reasoning skills to make sound financial decisions (PFL).	Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	**75.00**	**75.00**
		Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	NA	
		The components of personal credit to manage credit and debt (PFL).	**58.33**	
		Identify, develop, and evaluate risk-management strategies (PFL).	**100.00**	
Civics	Analyze and practice rights, roles, and responsibilities of citizens.	Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	**93.75**	**93.75**
	Analyze origins, structure, and functions of governments and their impacts on societies and citizens.	Purposes of and limitations on the foundations, structures and functions of government.	**100.00**	**92.71**
		Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	**76.67**	
	Number of GLEs with item DOK at or above EO DOK		**14 of 16**	
	Number of PGCs with item DOK at or above EO DOK		**8 of 8**	

In grades 4 and 7, panelists' ratings using Webb (1997) DOK levels indicate that items on all of the grade level expectations assess students at the appropriate cognitive complexity. At the high school level, 88% of the GLEs and 100% of the PGCs met Webb's criterion. It is important to note that the comparisons of standard and item DOKs was based on panelists' assignment of a single DOK to each EO, rather than using the range of DOK levels provided in the standards document. There were several EOs that the panelists rated at a DOK outside the ranges specified in the standards document, which may have impacted the results reported here.

Range of Knowledge Correspondence

The *range-of-knowledge correspondence* measure examines in greater detail the breadth of knowledge covered by the assessment. In addition to evaluating which grade level expectations are assessed, we must look at how many of the EOs within a GLE are represented by items. The EOs should be linked with at least one item. Webb's (1997) minimum level of acceptability for range-of-knowledge correspondence is that at least 50% of EOs per GLE link with items.

Tables 4.9 through 4.11 summarize the range-of-knowledge results for each grade level CMAS social studies test per GLE. The GLEs that meet Webb's indicator criterion are in bold.

Table 4.9. Summary of Range-of-Knowledge Results for the Social Studies CMAS – Grade 4

Standard	Grade Level Expectation	Percent of EOs per GLE Matched to at Least One Item
History	Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	**71.43**
	The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	**67.86**
Geography	Use several types of geographic tools to answer questions about the geography of Colorado.	**80.00**
	Connections within and across human and physical systems are developed.	**82.14**
Economics	People respond to positive and negative incentives.	**100.00**
	The relationship between choice and opportunity cost (PFL).	**77.14**
Civics	Analyze and debate multiple perspectives on an issue.	**71.43**
	The origins, structure, and functions of the Colorado government	**74.29**
	Number of GLEs Assessed Adequately	**8 of 8**

Table 4.10. Summary of Range-of-Knowledge Results for the Social Studies CMAS – Grade 7

Standard	Grade Level Expectation	Percent of EOs per GLE Matched to at Least One Item
History	Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	**81.25**
	The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	**72.50**
Geography	Use geographic tools to gather data and make geographic inferences and predictions.	**90.63**
	Regions have different issues and perspectives.	**53.13**
Economics	Supply and demand influence price and profit in a market economy.	**89.58**
	The distribution of resources influences economic production and individual choices (Economics and PFL).	**56.25**
Civics	Compare how various nations define the rights, responsibilities, and roles of citizens.	**77.50**
	Different forms of government and international organizations and their influence in the world community.	**60.00**
	Number of GLEs Assessed Adequately	**8 of 8**

Table 4.11. Summary of Range-of-Knowledge Results for the Social Studies CMAS – High School

Standard	Prepared Graduate Competency	Grade Level Expectation	Percent of EOs per GLE Matched to at Least One Item	
			GLE	PGC
History	Develop an understanding of how people view, construct, and interpret history	Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	**68.75**	**68.75**
	Analyze key historical periods and patterns of change over time within and across nations and cultures	The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	**56.25**	**60.71**
		The significance of ideas as powerful forces throughout history.	**66.67**	
Geography	Develop spatial understanding, perspectives, and personal connections to the world	Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	**68.75**	**62.50**
		Explain and interpret geographic variables that influence the interactions of people, places and environments.	**58.33**	
	Examine places and regions and the connections among them	The interconnected nature of the world, its people and places.	37.50	37.50
Economics	Understand the allocation of scarce resources in societies through analysis of individual choice, market interaction, and public policy	Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	**75.00**	23.21
		Economic policies affect markets.	16.67	
		Government and competition affect markets.	0.00	
	Acquire the knowledge and economic reasoning skills to make sound financial decisions (PFL)	Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	40.00	45.00
		Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	0.00	
		The components of personal credit to manage credit and debt (PFL).	**100.00**	
		Identify, develop, and evaluate risk-management strategies (PFL).	**58.33**	
Civics	Analyze and practice rights, roles, and responsibilities of citizens	Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	**50.00**	**50.00**
	Analyze origins, structure, and functions of governments and their impacts on societies and citizens	Purposes of and limitations on the foundations, structures and functions of government.	42.86	34.62
		Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	33.33	
		Number of GLEs Assessed Adequately	**9 of 16**	
		Number of PGCs Assessed Adequately	**4 of 8**	

Both the grade 4 and grade 7 social studies tests met the minimum range-of-knowledge criterion for all of the GLEs. At the high school level, this criterion was met for slightly more than half of the GLEs and half of the PGCs. This difference is a direct result of the larger number of EOs available to be assessed at the high school level compared to the other grades. Tables B-7 through B-9 in Appendix B contain the means and standard deviations for each GLE and the number of assessable EOs per GLE.

Balance-of-Knowledge Representation

The fourth measure of alignment included in the Webb (1997) method is *balance-of-knowledge representation*. This measure describes the distribution of items linked to each EO within each GLE. The number of items should be distributed rather evenly between the EOs to achieve good balance.

The content balance is determined by calculating an index, or score, for each GLE[2]. According to Webb, the minimum acceptable index for a single content strand is 70 (on a scale of 0 to 100 with 100 representing perfect balance). An index of 70 or higher suggests that items broadly assess the EOs for a GLE instead of clustering around one or two EOs.

Two cautions should be noted regarding the balance index when interpreting the results. First, only those EOs actually matched to items by the panelists are included in calculations of the balance index. A given GLE may include more EOs than are actually linked to items by panelists. For example, if a particular GLE includes eight EOs in the state content standards document but panelists found items matching to just three EOs, only these three EOs are evaluated for item distribution. Recognizing this feature of the balance index is important in cases when the range measure and balance measure produce seemingly contrasting results. And, second, when states choose to emphasize particular content strands over others, the balance statistic becomes uninterpretable. Colorado does not emphasize any particular GLEs on the CMAS social studies tests.

Tables 4.12 through 4.14 summarize the results on balance-of-content representation per grade for the CMAS social studies tests. All of the grades assessed surpassed the minimum level of acceptability (index of 70) for demonstrating good content balance among those EOs matched to items for each GLE, with the exception of two high school GLEs to which no items were matched. The GLEs that meet Webb's (1997) indicator criterion are in bold. Tables B-10 through B-12 contain means associated with the calculation of the balance index.

[2] The exact formula for calculating the balance index is explained in detail in Webb's (2005) alignment training manual: http://www.wcer.wisc.edu/WAT/index.aspx.

Table 4.12. Summary of Balance-of-Knowledge Representation Results Social Studies CMAS – Grade 4

Standard	Grade Level Expectation	Balance Index
History	Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	**82.70**
	The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	**88.57**
Geography	Use several types of geographic tools to answer questions about the geography of Colorado.	**79.15**
	Connections within and across human and physical systems are developed.	**79.88**
Economics	People respond to positive and negative incentives.	**82.57**
	The relationship between choice and opportunity cost (PFL).	**77.01**
Civics	Analyze and debate multiple perspectives on an issue.	**90.48**
	The origins, structure, and functions of the Colorado government	**82.74**
	Number of GLEs Assessed Adequately	**8 of 8**

Table 4.13. Summary of Balance-of-Knowledge Representation Results Social Studies CMAS – Grade 7

Standard	Grade Level Expectation	Balance Index
History	Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	**91.46**
	The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	**85.27**
Geography	Use geographic tools to gather data and make geographic inferences and predictions.	**80.53**
	Regions have different issues and perspectives.	**81.25**
Economics	Supply and demand influence price and profit in a market economy.	**89.55**
	The distribution of resources influences economic production and individual choices (Economics and PFL).	**86.83**
Civics	Compare how various nations define the rights, responsibilities, and roles of citizens.	**84.42**
	Different forms of government and international organizations and their influence in the world community.	**85.68**
	Number of GLEs Assessed Adequately	**8 of 8**

Table 4.14. Summary of Balance-of-Knowledge Representation Results Social Studies CMAS – High School

Standard	Prepared Graduate Competencies	Grade Level Expectation	Balance Index	
			GLE	PGC
History	Develop an understanding of how people view, construct, and interpret history.	Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	**92.92**	**92.92**
	Analyze key historical periods and patterns of change over time within and across nations and cultures	The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	**76.94**	**76.76**
		The significance of ideas as powerful forces throughout history.	**85.60**	
Geography	Develop spatial understanding, perspectives, and personal connections to the world	Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	**85.00**	**81.00**
		Explain and interpret geographic variables that influence the interactions of people, places and environments.	**91.67**	
	Examine places and regions and the connections among them	The interconnected nature of the world, its people and places.	**91.67**	**91.67**
Economics	Understand the allocation of scarce resources in societies through analysis of individual choice, market interaction, and public policy.	Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	**93.15**	**93.15**
		Economic policies affect markets.	**100.00**	
		Government and competition affect markets.	NA	
	Acquire the knowledge and economic reasoning skills to make sound financial decisions (PFL).	Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	**83.33**	**88.99**
		Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	NA	
		The components of personal credit to manage credit and debt (PFL).	**100.00**	
		Identify, develop, and evaluate risk-management strategies (PFL).	**100.00**	
Civics	Analyze and practice rights, roles, and responsibilities of citizens.	Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	**83.33**	**88.33**
	Analyze origins, structure, and functions of governments and their impacts on societies and citizens.	Purposes of and limitations on the foundations, structures and functions of government.	**84.79**	**82.71**
		Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	**91.11**	
		Number of GLEs Assessed Adequately	**14 of 16**	
		Number of PGCs Assessed Adequately	**8 of 8**	

Summary and Discussion on Webb Alignment Indicators

The overall alignment results provide generally positive support for the content validity of the CMAS social studies tests. Summary alignment judgments are based on Webb (2005). These summary judgments focus on the percentage of content standards or GLEs represented well by the assessment. Webb outlined a scale with a range of potential alignment outcomes applied to each of the four indicators:

- Fully aligned – assessments align to all standards/GLEs (91%–100%),
- Highly aligned – assessments align to the majority of standards/GLEs (70%–90%),
- Partially aligned – assessments align well to some standards/GLEs (50%–69%),
- Weakly aligned – assessments align to less than half the standards/GLEs (below 50%).

Webb's (1997) alignment method does not allow for a *single* judgment of overall alignment across the four alignment indicators. However, one can get a sense of overall alignment between the assessments and standards by looking at all of the alignment indicators together.

Table 4.15 presents the summary alignment outcomes for the CMAS social studies tests based on the above scale. The table includes a summary judgment for each Webb (1997) alignment indicator per grade level based on the percentage of standards/GLEs that met the minimum alignment criteria. This summary table is linked to the bottom row of Tables B-1 through B-12 in Appendix B. Thus, these summary judgments reflect a final evaluation of each grade assessment per Webb indicator criteria *across* the standards/GLEs.

As shown in Table 4.15 with green highlighting, 92% of the results indicate strong content alignment of the CMAS social studies test to the Colorado Academic Standards. Each of the three grade level tests includes sufficient numbers of items to cover the Colorado Academic Standards, sufficient numbers of items at DOK levels at or above the DOK assigned to the corresponding evidence outcomes, and a sufficiently even distribution of evidence outcomes within the associated grade level expectation. The high school test demonstrated only partial alignment to the content standards in terms of range of knowledge consistency.

Table 4.15. Summary Alignment Outcomes on Each Webb Criterion by Grade Level for Social studies CMAS

Grade Level	Percentage of GLEs that Met Webb Criteria			
	Categorical Concurrence	Depth-of-Knowledge Consistency	Range-of-Knowledge Correspondence	Balance-of-Knowledge Representation
4	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)
7	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)	Fully aligned (100%)
High School	Fully aligned (100%)	Highly/fully aligned (88%; 100%)	Partially aligned (56%; 50%)	Highly/fully aligned (88%; 100%)

Notes. Categorical concurrence is evaluated at the Standard level to reflect score reporting practices. High school percentages reflect GLEs and PGCs, respectively.

There was restricted range of content assessed at the high school level. The range of knowledge correspondence results indicate that approximately 56% of the GLEs met the minimum criteria of having 50% of the EOs within a GLE matched to an item. This restricted

range of content assessed is a result of a much larger number of EOs available to be assessed than items on the assessment. This restricted range of content assessed is a result of a much larger number of EOs available to be assessed than items on the assessment. For the high school test, there are 84 EOs that are assessable but only 52 items are administered.

Tables B-13 and B-15 in Appendix B present the mean number of items matched to each EO and the number of panelists represented.

Suggestions for improving the alignment between the CMAS social studies tests and Colorado Academic Standards are discussed in Chapter 5, Summary and Recommendations.

Chapter 5: Summary and Recommendations

HumRRO conducted a review of the CMAS science and social studies tests to examine the content alignment to the Colorado Academic Standards. Alignment of assessments and achievement standards to the state academic content standards is a requirement of the No Child Left Behind Act (2002).

The cumulative results provide validity evidence to support that the content of CMAS science and social studies test items match the intended content as specified in the standards. Expert panelists from both content areas tended to agree that items were measuring the intended grade level expectations, and to rate items as highly aligned to the Colorado Academic Standards.

The number of items included on an operational form, when considered along with the number of prepared graduate competencies, grade level expectations, and evidence outcomes included in the content standards, provide important context for interpreting the Webb (1997) criteria. Across the content areas and grade levels, for example, it was difficult for range-of-knowledge correspondence to be fully met given the number of items. This was most apparent at the high school level, which had a substantially larger amount of testable content. Even with these limitations, the majority of Webb's criteria were met on the CMAS science and social studies tests.

As with most reviews of state assessment systems, these findings point to areas where the alignment between assessments and content standards could be strengthened. For this reason, HumRRO makes the following recommendation to Colorado on ways in which alignment might be improved:

- ***Review range of knowledge.*** Assessments may not adequately reflect all of the content that students are expected to know based solely on the number of items on the assessment (not the item type or point value as these are not factors in Webb's (1997) criteria). From strictly an item count perspective, there are several ways CDE can choose to mitigate this situation such as increase the number of items on the assessment, collapse or otherwise reduce the number of grade level expectations/evidence outcomes in the state standards, or designate some of the grade level expectations/evidence outcomes for local assessment only.

- ***Review depth of knowledge.*** The DOK consistency review showed that science items at the grade 5 level did not adequately reflect the cognitive complexity of the grade level expectations. There were items of varying DOKs, but a substantial percentage was lower than their associated standards. Expert panelists' ratings of the DOK levels of evidence outcomes were generally consistent with the range of DOK levels assigned in the standards document, but with some exceptions. It may be useful to review the clarity of the evidence outcomes to ensure that the intended level of cognitive complexity is conveyed to all users of the content standards. It may also be necessary to concentrate grade 5 science item development on higher DOK items.

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Appendix A.
Content Alignment Results: Science

The following tables include complete statistical results on the Webb (1997) alignment indicators, including means and standard deviations per standard for each CMAS science test.

Categorical Concurrence

The categorical concurrence results for the grades 5 and 8 and high school CMAS science tests are presented below. Each table includes: the mean number of items matched by panelists; the standard deviation among panelists' ratings; and, the final alignment conclusion (Yes or No). The bottom row indicates the percentage of standards that met the minimum alignment indicator criterion.

Table A-1. Categorical Concurrence for CMAS Science, Grade 5: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
Physical Science	13.57	0.79	Yes
Life Science	23.14	2.48	Yes
Earth Systems Science	121.43	1.72	Yes
Percentage of standards with at least six items: 100%			

Table A-2. Categorical Concurrence for CMAS Science, Grade 8: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
Physical Science	22.33	0.52	Yes
Life Science	17.67	0.52	Yes
Earth Systems Science	19.83	0.41	Yes
Percentage of standards with at least six items: 100%			

Table A-3. Categorical Concurrence for CMAS Science, High School: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
Physical Science	21.14	0.38	Yes
Life Science	19.71	1.89	Yes
Earth Systems Science	19.14	2.27	Yes
Percentage of standards with at least six items: 100%			

Depth-of-Knowledge Consistency

The Depth-of-Knowledge (DOK) consistency results for the grades 5 and 8 and high school CMAS science tests are presented below. The tables present the results from the comparison between the depth-of-knowledge expected in the matched evidence outcome and the depth-of-knowledge assessed by items. The tables include the mean percentage of items rated as below, at the same level, or above the DOK level of the EOs along with the corresponding standard deviations. GLEs with at least 50% of items at the same (or above) DOK level of the matched EO met the minimum indicator criterion.

Table A-4. DOK Consistency for CMAS Science, Grade 5: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	13.57	38.66	18.49	42.63	16.55	18.71	11.45	Yes
All organisms have structures and systems with separate functions.	9.71	59.50	26.04	38.12	26.24	2.38	4.07	No
Human body systems have basic structures, functions, and needs.	13.43	73.33	16.47	24.29	15.09	2.38	4.07	No
Earth and Sun provide a diversity of renewable and nonrenewable resources.	6.71	59.95	20.51	27.98	14.16	12.07	12.26	No
Earth's surface changes constantly through a variety of processes and forces.	6.14	6.19	8.03	56.19	27.38	37.62	24.62	Yes
Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	8.57	43.21	18.80	35.15	19.77	21.64	20.59	Yes
Percentage of GLEs with 50% of item DOK at or above EO DOK: 50%								

Table A-5. DOK Consistency for CMAS Science, Grade 8: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	5.00	36.67	23.38	46.67	24.22	16.67	15.06	Yes
There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	5.33	60.95	14.53	20.00	12.65	19.05	12.86	No
Distinguish between physical and chemical changes, noting that mass is conserved during any change.	6.00	19.44	6.80	47.22	26.70	33.33	29.81	Yes
Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	6.00	36.67	24.04	22.78	8.28	40.56	21.65	Yes
Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	8.67	49.77	21.47	33.10	23.01	17.13	13.40	Yes
Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	9.00	27.78	13.61	38.89	9.30	33.33	18.59	Yes
Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	4.83	35.71	17.33	24.88	17.97	39.40	24.54	Yes
Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	4.00	50.83	25.77	25.83	19.34	23.33	20.41	No
The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	6.83	11.24	9.18	57.01	19.56	31.75	20.52	Yes
The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	4.17	62.50	12.55	37.50	12.55	0.00	0.00	No
Percentage of GLEs with 50% of item DOK at or above EO DOK: 70%								

Table A-6. DOK Consistency for CMAS Science, High School: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	6.71	63.86	13.87	31.72	8.53	4.42	7.58	No
Matter has definite structure that determines characteristic physical and chemical properties.	3.29	21.19	21.19	38.57	17.28	40.24	10.11	Yes
Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	4.29	35.48	11.37	53.81	17.34	10.71	14.20	Yes
Atoms bond in different ways to form molecules and compounds that have definite properties.	3.29	25.48	22.91	53.10	29.07	21.43	20.89	Yes
Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	2.60	53.33	7.45	30.00	27.39	16.67	23.57	No
When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	2.00	58.33	49.16	25.00	27.39	16.67	25.82	No
Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	2.83	0.00	0.00	22.22	25.09	77.78	25.09	Yes
The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	4.00	65.91	34.39	25.76	32.53	8.33	14.43	No
Cellular metabolic activities are carried out by biomolecules produced by organisms.	2.14	11.90	20.89	88.10	20.89	0.00	0.00	Yes

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	1.43	42.86	44.99	50.00	40.82	7.14	18.90	Yes
Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	1.71	50.00	28.87	42.86	34.50	7.14	18.90	Yes
Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	1.14	0.00	0.00	100.00	0.00	0.00	0.00	Yes
Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins.	5.29	25.24	15.38	41.43	26.10	33.33	27.28	Yes
Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	1.00	100.00	0.00	0.00	0.00	0.00	0.00	No
Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	1.50	8.33	20.41	58.33	49.16	33.33	51.64	Yes
The history of the universe, solar system and Earth can be inferred from evidence left from past events.	3.86	25.00	11.79	39.29	17.16	35.71	10.45	Yes
As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic	1.50	50.00	57.74	25.00	50.00	25.00	50.00	Yes

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.								
The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	3.14	57.14	31.71	20.24	28.81	22.62	24.87	No
Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	2.00	0.00	0.00	33.33	23.57	66.67	23.57	Yes
There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	2.57	9.52	16.27	58.33	37.58	32.14	33.48	Yes
The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	4.57	22.38	23.70	39.76	28.34	37.86	12.54	Yes
Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	2.14	71.43	39.34	28.57	39.34	0.00	0.00	No
Percentage of GLEs with 50% of item DOK at or above EO DOK: 68%								

Range-of-Knowledge Correspondence

The results for Range-of-Knowledge correspondence for the grades 5 and 8 and high school CMAS science tests are presented below. The tables include the mean number, standard deviation, and percentage of EOs by GLE. For acceptable range-of-knowledge correspondence, a minimum of 50% of EOs within each GLE should be matched to at least one item.

Table A-7. Range-of-Knowledge for CMAS Science, Grade 5: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	2	13.6	2.00	0.00	100.00	Yes
All organisms have structures and systems with separate functions.	3	9.7	2.57	0.79	85.71	Yes
Human body systems have basic structures, functions, and needs.	5	13.4	4.86	0.38	97.14	Yes
Earth and Sun provide a diversity of renewable and nonrenewable resources.	2	6.71	1.86	0.38	92.86	Yes
Earth's surface changes constantly through a variety of processes and forces.	2	6.14	1.86	0.38	92.86	Yes
Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	4	8.57	3.43	0.79	85.71	Yes
Percentage of GLEs with 50% of EOs linked to at least one item: 100%						

Table A-8. Range-of-Knowledge for CMAS Science, Grade 8: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	3	5.00	2.67	0.52	88.89	Yes
There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	3	5.33	2.50	0.55	83.33	Yes
Distinguish between physical and chemical changes, noting that mass is conserved during any change.	5	6.00	3.83	0.75	76.67	Yes
Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	4	5.83	4.00	0.00	100.00	Yes
Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	5	8.67	3.83	0.75	76.67	Yes
Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	5	9.00	4.17	0.98	83.33	Yes
Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	3	4.83	2.50	0.55	83.33	Yes
Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	3	4.00	2.00	0.63	66.67	Yes
The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	6	6.67	3.83	0.75	63.89	Yes
The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	3	4.17	2.83	0.41	94.44	Yes
Percentage of GLEs with 50% of EOs linked to at least one item:100%						

Table A-9. Range-of-Knowledge for CMAS Science, High School: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	5	6.71	2.43	0.53	48.57	No
Matter has definite structure that determines characteristic physical and chemical properties.	4	3.29	1.86	0.69	46.43	No
Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	4	4.29	3.43	0.79	85.71	Yes
Atoms bond in different ways to form molecules and compounds that have definite properties.	5	3.29	2.71	1.11	54.29	Yes
Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	4	2.60	2.40	0.55	60.00	Yes
When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	5	2.00	1.50	0.55	30.00	No
Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	7	2.83	2.50	0.55	35.71	No
The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	4	4.00	2.43	0.53	60.71	Yes
Cellular metabolic activities are carried out by biomolecules produced by organisms.	5	2.14	2.14	0.38	42.86	No
The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	3	1.43	1.29	0.49	42.86	No
Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	5	1.71	1.71	0.49	34.29	No
Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	4	1.14	1.14	0.38	28.57	No

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which 4 encode instructions for the production of proteins.	5	5.29	3.57	0.53	71.43	Yes
Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	4	1.00	1.00	0.00	25.00	No
Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	5	1.50	1.50	0.55	30.00	No
The history of the universe, solar system and Earth can be inferred from evidence left from past events.	5	3.86	3.14	0.69	62.86	Yes
As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.	4	1.50	1.50	0.58	37.50	No
The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	4	3.00	1.71	0.49	42.86	No
Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	6	2.00	2.00	0.58	33.33	No
There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	4	2.57	1.71	0.49	42.86	No
The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	4	4.43	1.57	0.79	39.29	No
Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	3	2.14	1.57	0.53	52.38	Yes
Percentage of GLEs with 50% of EOs linked to at least one item:32%						

Balance-of-Knowledge Representation

The results for Balance-of-Knowledge representation for the grades 5 and 8 and high school CMAS science tests are presented below. The tables also include the percentage of items linked to each grade level expectation. The minimum acceptable balance index is 70 out of 100.

Table A-10. Balance-of-Knowledge Representation for CMAS Science Grade 5: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts.	2	2.00	13.57	23.39	92.91	5.94	Yes
All organisms have structures and systems with separate functions.	3	2.57	9.71	16.68	78.76	11.16	Yes
Human body systems have basic structures, functions, and needs.	5	4.86	13.29	22.91	72.35	5.33	Yes
Earth and Sun provide a diversity of renewable and nonrenewable resources.	2	1.86	6.71	11.60	87.33	9.19	Yes
Earth's surface changes constantly through a variety of processes and forces.	2	1.86	6.14	10.66	84.29	11.97	Yes
Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation.	4	3.43	8.57	14.76	76.85	8.08	Yes
Total	19						
Percentage of GLEs with a balance of representation index of 70 or greater: 100%							

Table A-11. Balance-of-Knowledge Representation for CMAS Science Grade 8: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.	3	2.67	5.00	8.40	80.00	8.69	Yes
There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved.	3	2.50	5.33	8.96	76.43	11.31	Yes
Distinguish between physical and chemical changes, noting that mass is conserved during any change.	5	3.83	6.00	10.09	83.89	1.36	Yes
Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties.	4	4.00	5.83	9.81	82.22	3.60	Yes
Human activities can deliberately or inadvertently alter ecosystems and their resiliency.	5	3.83	8.67	14.56	83.98	10.19	Yes
Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation.	5	4.17	9.00	15.13	79.81	6.14	Yes
Weather is a result of complex interactions of Earth's atmosphere, land and water that are driven by energy from the sun, and can be predicted and described through complex models.	3	2.50	4.83	8.11	76.43	3.89	Yes
Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location.	3	2.00	4.00	6.73	91.94	10.13	Yes
The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics.	6	3.83	6.67	11.22	80.63	3.84	Yes
The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases.	3	2.83	4.17	6.98	87.78	6.21	Yes
Total	40						
Percentage of GLEs with a balance of representation index of 70 or greater: 100%							

Table A-12. Balance-of-Knowledge Representation for CMAS Science High School: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	5	2.43	6.71	11.25	80.61	14.96	Yes
Matter has definite structure that determines characteristic physical and chemical properties.	4	1.86	3.29	5.50	89.05	13.67	Yes
Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.	4	3.43	4.29	7.18	90.71	8.71	Yes
Atoms bond in different ways to form molecules and compounds that have definite properties.	5	2.71	3.29	5.50	93.10	8.63	Yes
Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.	4	2.40	2.60	4.34	96.67	7.45	Yes
When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.	5	1.50	2.00	3.35	100.00	0.00	Yes
Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.	7	2.50	2.83	4.75	94.44	8.61	Yes
The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem.	4	2.43	4.00	6.69	90.69	8.72	Yes
Cellular metabolic activities are carried out by biomolecules produced by organisms.	5	2.14	2.14	3.59	100.00	0.00	Yes
The energy for life primarily derives from the interrelated processes of photosynthesis and	3	1.29	1.43	2.39	100.00	0.00	Yes

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.							
Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments.	5	1.71	1.71	2.87	100.00	0.00	Yes
Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.	4	1.14	1.14	1.91	100.00	0.00	Yes
Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which 4encode instructions for the production of proteins.	5	3.57	5.29	8.85	79.05	6.15	Yes
Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	4	1.00	1.00	1.68	100.00	0.00	Yes
Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment.	5	1.50	1.50	2.51	100.00	0.00	Yes
The history of the universe, solar system and Earth can be inferred from evidence left from past events.	5	3.14	3.86	6.46	89.29	10.45	Yes
As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.	4	1.50	1.50	2.51	100.00	0.00	Yes

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
The theory of plate tectonics helps explain geological, physical, and geographical features of Earth.	4	1.71	3.00	5.02	92.86	8.91	Yes
Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.	6	2.00	2.00	3.35	100.00	0.00	Yes
There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.	4	1.71	2.57	4.31	90.48	8.91	Yes
The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	4	1.57	4.43	7.41	91.67	14.43	Yes
Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	3	1.57	2.14	3.59	96.43	9.45	Yes
Total	99						
Percentage of GLEs with a balance of representation index of 70 or greater: 100%							

EOs Matched to Items by Panelists

Tables A-13 through A-15 present the EOs, along with the mean number of items, matched by panelists. Column 1 presents the HumRRO code corresponding to each of the EOs. One note of caution when reading these tables, the same items may not be represented by the mean number of items. For example, EO code '1.1.a' in the first row shows that 7 panelists matched a mean number of 7.14 items to this EO. This does not mean/assume that the items matched to the EO by the panelists were the same items across panelists.

Table A-13. Grade 5 CMAS Science: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	7	7.14	1.46
1.1.b	7	6.43	0.98
2.1.a	7	4.57	2.99
2.1.b	6	3.67	1.97
2.1.c	5	2.80	2.05
2.2.a	7	2.00	1.00
2.2.b	7	2.86	1.21
2.2.c	7	4.57	1.81
2.2.d	6	1.50	0.84
2.2.e	7	2.71	4.11
3.1.a	6	3.33	1.21
3.1.b	7	3.86	1.86
3.2.a	7	4.29	2.21
3.2.b	6	2.17	0.75
3.3.a	6	1.17	0.41
3.3.b	6	3.83	1.47
3.3.c	5	1.60	1.34
3.3.d	7	3.14	1.35

Table A-14. Grade 8 CMAS Science: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	5	2.80	0.84
1.1.b	6	1.33	0.52
1.1.c	5	1.60	0.89
1.2.a	6	3.00	1.41
1.2.b	4	1.25	0.50
1.2.c	5	1.80	1.10
1.3.a	6	2.00	0.00
1.3.b	1	1.00	--
1.3.c	5	2.00	0.71
1.3.d	5	1.40	0.89
1.3.e	6	1.00	0.00
1.4.a	6	2.17	0.41
1.4.b	6	1.33	0.52
1.4.c	6	1.33	0.52
1.4.d	6	1.00	0.00
2.1.a	6	2.67	1.03
2.1.b	5	2.20	0.84
2.1.c	6	2.67	1.03
2.1.d	4	1.25	0.50
2.1.e	2	2.00	1.41
2.2.a	4	2.50	1.91
2.2.b	4	1.50	1.00
2.2.c	6	1.50	0.55
2.2.d	6	2.83	0.98
2.2.e	5	2.40	1.14
3.1.a	6	2.67	0.52
3.1.b	4	2.00	2.00
3.1.c	5	1.00	0.00
3.2.a	5	1.80	0.84
3.2.b	6	2.33	1.03
3.2.c	1	1.00	--
3.3.a	5	2.20	0.45
3.3.b	6	2.83	0.41
3.3.c	1	2.00	--
3.3.d	3	1.00	0.00
3.3.e	5	1.00	0.00
3.3.f	3	1.00	0.00
3.4.a	6	1.50	0.55
3.4.b	5	1.80	0.45
3.4.c	6	1.17	0.41

Table A-15. High School CMAS Science: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	2	2.00	1.41
1.1.b	7	3.43	1.72
1.1.c	1	2.00	--
1.1.d	7	2.43	1.40
1.1.e	0	--	--
1.2.a	0	--	--
1.2.b	6	1.33	0.82
1.2.c	6	2.33	1.03
1.2.d	1	1.00	--
1.3.a	7	1.43	0.53
1.3.b	6	1.50	0.84
1.3.c	5	1.00	0.00
1.3.d	6	1.00	0.00
1.4.a	4	1.00	0.00
1.4.b	2	1.50	0.71
1.4.c	7	1.29	0.49
1.4.d	2	1.50	0.71
1.4.e	4	1.00	0.00
1.5.a	2	1.00	0.00
1.5.b	5	1.00	0.00
1.5.c	4	1.00	0.00
1.5.d	1	2.00	--
1.6.a	2	1.00	0.00
1.6.b	0	--	--
1.6.c	6	1.50	0.55
1.6.d	0	--	--
1.6.e	1	1.00	--
2.1.a	3	1.00	0.00
2.1.b	0	--	--
2.1.c	4	1.00	0.00
2.1.d	2	1.00	0.00
2.1.e	2	1.00	0.00
2.1.f	0	--	--
2.1.g	4	1.50	0.58
2.2.a	7	1.86	1.07
2.2.b	1	1.00	--
2.2.c	7	1.14	0.38
2.2.d	2	3.00	2.83
2.3.a	7	1.00	0.00
2.3.b	1	1.00	--
2.3.c	1	1.00	--
2.3.d	0	--	--
2.3.e	6	1.00	0.00
2.4.a	6	1.00	0.00
2.4.b	2	1.00	0.00
2.4.c	1	2.00	--

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
2.5.a	6	1.00	0.00
2.5.b	0	--	--
2.5.c	5	1.00	0.00
2.5.d	1	1.00	--
2.5.e	0	--	--
2.6.a	0	--	--
2.6.b	7	1.00	0.00
2.6.c	1	1.00	--
2.6.d	0	--	--
2.7.a	7	1.14	0.38
2.7.b	7	1.29	0.76
2.7.c	1	3.00	--
2.7.d	4	1.00	0.00
2.7.e	6	2.17	0.75
2.8.a	0	--	--
2.8.b	2	1.00	0.00
2.8.c	0	--	--
2.8.d	0	--	--
2.9.a	2	1.00	0.00
2.9.b	1	1.00	--
2.9.c	0	--	--
2.9.d	5	1.00	0.00
2.9.e	1	1.00	--
3.1.a	6	1.00	0.00
3.1.b	7	1.71	0.76
3.1.c	3	1.00	0.00
3.1.d	0	--	--
3.1.e	6	1.00	0.00
3.2.a	0	--	--
3.2.b	2	1.00	0.00
3.2.c	3	1.00	0.00
3.2.d	1	1.00	--
3.3.a	3	1.33	0.58
3.3.b	7	2.14	0.69
3.3.c	1	1.00	--
3.3.d	1	1.00	--
3.4.a	1	1.00	--
3.4.b	3	1.00	0.00
3.4.c	4	1.00	0.00
3.4.d	6	1.00	0.00
3.4.e	0	--	--
3.4.f	1	1.00	--
3.5.a	3	1.33	0.58
3.5.b	6	1.50	0.55
3.5.c	2	1.50	0.71
3.5.d	1	2.00	--

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
3.6.a	2	1.00	0.00
3.6.b	7	3.57	0.98
3.6.c	2	2.00	1.41
3.6.d	0	--	--
3.7.a	5	1.60	0.89
3.7.b	2	1.00	0.00
3.7.c	4	1.25	0.50

Appendix B.
Content Alignment Results: Social Studies

The following tables include complete statistical results on the Webb (1997) alignment indicators, including means and standard deviations per standard for each CMAS social studies test.

Categorical Concurrence

The categorical concurrence results for the grades 4 and 7 and high school CMAS social studies tests are presented below. Each table includes: the mean number of items matched by panelists; the standard deviation among panelists' ratings; and, the final alignment conclusion (Yes or No). The bottom row indicates the percentage of standards that met the minimum alignment indicator criterion.

Table B-1. Categorical Concurrence for CMAS Social Studies, Grade 4: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
History	10.86	1.35	Yes
Geography	17.29	1.80	Yes
Economics	14.00	1.00	Yes
Civics	8.86	1.35	Yes
Percentage of standards with at least six items: 100%			

Table B-2. Categorical Concurrence for CMAS Social Studies, Grade 7: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
History	11.38	0.92	Yes
Geography	12.00	0.76	Yes
Economics	13.13	0.83	Yes
Civics	11.50	0.93	Yes
Percentage of standards with at least six items: 100%			

Table B-3. Categorical Concurrence for CMAS Social Studies, High School: Mean Number of Items per Standard

Standard	Number of Items per Standard		At Least Six Items per Standard
	Mean Items Matched	*SD*	
History	16.25	3.30	Yes
Geography	12.25	2.99	Yes
Economics	12.00	1.63	Yes
Civics	11.50	3.11	Yes
Percentage of standards with at least six items: 100%			

Depth-of-Knowledge Consistency

The Depth-of-Knowledge (DOK) consistency results for the grades 4 and 7 and high school CMAS social studies tests are presented below. The tables present the results from the comparison between the depth-of-knowledge expected in the matched evidence outcome and the depth-of-knowledge assessed by items. The tables include the mean percentage of items rated as below, at the same level, or above the DOK level of the EOs along with the corresponding standard deviations. GLEs with at least 50% of items at the same (or above) DOK level of the matched EO met the minimum indicator criterion.

Table B-4. DOK Consistency for CMAS Social Studies, Grade 4: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	5.86	34.48	9.34	52.54	10.34	12.98	13.62	Yes
The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	5.00	14.76	17.94	52.62	19.76	32.62	26.24	Yes
Use several types of geographic tools to answer questions about the geography of Colorado.	9.71	10.62	9.84	49.08	23.20	40.30	22.88	Yes
Connections within and across human and physical systems are developed.	7.57	26.01	17.58	40.57	29.27	33.42	33.59	Yes
People respond to positive and negative incentives.	7.57	20.12	14.66	47.76	21.87	32.11	11.86	Yes
The relationship between choice and opportunity cost (PFL).	6.43	17.69	17.38	52.72	11.45	29.59	15.72	Yes
Analyze and debate multiple perspectives on an issue.	3.57	20.24	14.32	65.48	30.97	14.29	26.23	Yes
The origins, structure, and functions of the Colorado government.	5.29	37.14	16.24	40.24	25.65	22.62	17.82	Yes
Percentage of GLEs with 50% of item DOK at or above EO DOK: 100%								

Table B-5. DOK Consistency for CMAS Social Studies, Grade 7: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	2.88	24.38	17.34	49.17	29.10	26.46	27.12	Yes
The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	8.50	34.13	18.98	48.65	12.56	17.22	14.29	Yes
Use geographic tools to gather data and make geographic inferences and predictions.	7.75	30.65	11.31	51.74	11.13	17.61	13.18	Yes
Regions have different issues and perspectives.	4.25	28.96	14.58	17.71	17.50	53.33	14.83	Yes
Supply and demand influence price and profit in a market economy.	6.38	8.78	12.55	39.69	16.17	51.53	16.80	Yes
The distribution of resources influences economic production and individual choices (Economics and PFL).	6.75	15.77	15.65	60.45	13.98	23.78	17.68	Yes
Compare how various nations define the rights, responsibilities, and roles of citizens.	6.13	14.08	14.14	45.55	25.98	40.37	33.82	Yes
Different forms of government and international organizations and their influence in the world community.	5.38	45.95	28.84	47.68	21.43	6.37	8.92	Yes
Percentage of GLEs with 50% of item DOK at or above EO DOK: 100%								

Table B-6. DOK Consistency for CMAS Social Studies, High School: Mean Percent of Items with DOK Below, At, and Above DOK Level of EOs

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	3.50	12.50	25.00	82.50	23.63	5.00	10.00	Yes
The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	7.00	37.70	36.48	58.73	37.83	3.57	7.14	Yes
The significance of ideas as powerful forces throughout history.	5.75	35.54	16.40	48.75	23.24	15.71	12.01	Yes
Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	4.75	14.58	17.18	76.25	20.56	9.17	10.67	Yes
Explain and interpret geographic variables that influence the interactions of people, places and environments.	4.50	22.92	20.83	52.08	25.80	25.00	21.52	Yes
The interconnected nature of the world, its people and places.	3.00	4.17	8.33	50.00	36.00	45.83	41.67	Yes
Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	4.00	39.88	28.40	41.96	31.19	18.15	14.40	Yes
Economic policies affect markets.	1.00	0.00	0.00	100.00	0.00	0.00	0.00	Yes
Government and competition affect markets.	0.00	--	--	--	--	--	--	No
Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	3.00	25.00	16.67	25.00	16.67	50.00	19.25	Yes
Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	0.00	--	--	--	--	--	--	No
The components of personal credit to manage credit and debt	3.00	41.67	31.91	41.67	31.91	16.67	19.25	Yes

Grade Level Expectation	Mean Items per GLE	Depth-of-Knowledge Consistency						DOK Consistency Target Met
		% Items Below		% Items Same Level		% Items Above		
		M	*SD*	*M*	*SD*	*M*	*SD*	
(PFL).								
Identify, develop, and evaluate risk-management strategies (PFL).	1.75	0.00	0.00	50.00	40.82	50.00	40.82	Yes
Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	3.50	6.25	12.50	75.00	28.87	18.75	23.94	Yes
Purposes of and limitations on the foundations, structures and functions of government.	5.50	0.00	0.00	67.71	31.25	32.29	31.25	Yes
Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	3.33	23.33	25.17	63.33	32.15	13.33	23.09	Yes
Percentage of GLEs with 50% of item DOK at or above EO DOK: 88%								

Range-of-Knowledge Correspondence

The results for Range-of-Knowledge correspondence for the grades 4 and 7 and high school CMAS social studies tests are presented below. The tables include the mean number, standard deviation, and percentage of EOs by GLE. For acceptable range-of-knowledge correspondence, a minimum of 50% of EOs within each GLE should be matched to at least one item.

Table B-7. Range-of-Knowledge for CMAS Social Studies, Grade 4: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	4	5.86	2.86	0.69	71.43	Yes
The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	4	5.00	2.71	1.11	67.86	Yes
Use several types of geographic tools to answer questions about the geography of Colorado.	5	9.71	4.00	0.58	80.00	Yes
Connections within and across human and physical systems are developed.	4	7.57	3.29	1.11	82.14	Yes
People respond to positive and negative incentives.	3	7.57	3.00	0.00	100.00	Yes
The relationship between choice and opportunity cost (PFL).	5	6.43	3.86	0.69	77.14	Yes
Analyze and debate multiple perspectives on an issue.	3	3.57	2.14	0.38	71.43	Yes
The origins, structure, and functions of the Colorado government	5	5.29	3.71	0.76	74.29	Yes
Percentage of GLEs with 50% of EOs linked to at least one item: 100%						

Table B-8. Range-of-Knowledge for CMAS Social Studies, Grade 7: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	2	2.88	1.63	0.52	81.25	Yes
The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	5	8.50	3.63	0.92	72.50	Yes
Use geographic tools to gather data and make geographic inferences and predictions.	4	7.75	3.63	0.52	90.63	Yes
Regions have different issues and perspectives.	4	4.00	2.13	0.64	53.13	Yes
Supply and demand influence price and profit in a market economy.	6	6.38	5.38	0.74	89.58	Yes
The distribution of resources influences economic production and individual choices (Economics and PFL).	8	6.75	4.50	1.31	56.25	Yes
Compare how various nations define the rights, responsibilities, and roles of citizens.	5	6.13	3.88	0.64	77.50	Yes
Different forms of government and international organizations and their influence in the world community.	5	5.38	3.00	0.53	60.00	Yes
Percentage of GLEs with 50% of EOs linked to at least one item:100%						

Table B-9. Range-of-Knowledge for CMAS Social Studies, High School: Mean Percent of EOs per GLE Linked with Items

Grade Level Expectation	Number of EOs	Mean Items per GLE	Range of EOs			Range-of-Knowledge Target Met
			EOs with At Least One Item		% of Total EOs per GLE	
			M	*SD*		
Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	4	3.50	2.75	0.96	68.75	Yes
The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	8	7.00	4.50	1.73	56.25	Yes
The significance of ideas as powerful forces throughout history.	6	5.75	4.00	1.41	66.67	Yes
Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	4	4.75	2.75	0.50	68.75	Yes
Explain and interpret geographic variables that influence the interactions of people, places and environments.	6	4.50	3.50	1.00	58.33	Yes
The interconnected nature of the world, its people and places.	6	3.00	2.25	1.26	37.50	No
Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	4	4.00	3.00	0.82	75.00	Yes
Economic policies affect markets.	6	1.00	1.00	--	16.67	No
Government and competition affect markets.	4	0.00	0.00	0.00	0.00	No
Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	5	3.00	2.00	0.00	40.00	No
Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	4	0.00	0.00	0.00	0.00	No
The components of personal credit to manage credit and debt (PFL).	3	3.00	3.00	0.00	100.00	Yes
Identify, develop, and evaluate risk-management strategies (PFL).	3	1.75	1.75	0.50	58.33	Yes
Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	5	3.50	2.50	0.58	50.00	Yes
Purposes of and limitations on the foundations, structures and functions of government.	7	5.50	3.00	1.15	42.86	No
Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	6	3.33	2.00	1.00	33.33	No
Percentage of GLEs with 50% of EOs linked to at least one item:56%						

Balance-of-Knowledge Representation

The results for Balance-of-Knowledge representation for the grades 4 and 7 and high school CMAS social studies tests are presented below. The tables also include the percentage of items linked to each grade level expectation. The minimum acceptable balance index is 70 out of 100.

Table B-10. Balance-of-Knowledge Representation for CMAS Social studies Grade 4: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Organize and sequence events to understand the concepts of chronology and cause and effect in the history of Colorado.	4	2.86	5.86	11.48	82.70	5.39	Yes
The historical eras, individuals, groups, ideas and themes in Colorado history and their relationships to key events in the United States.	4	2.71	5.00	9.80	88.57	7.90	Yes
Use several types of geographic tools to answer questions about the geography of Colorado.	5	4.00	9.71	19.05	79.15	5.33	Yes
Connections within and across human and physical systems are developed.	4	3.29	7.57	14.85	79.88	12.14	Yes
People respond to positive and negative incentives.	3	3.00	7.57	14.85	82.57	9.91	Yes
The relationship between choice and opportunity cost (PFL).	5	3.86	6.43	12.61	77.01	6.90	Yes
Analyze and debate multiple perspectives on an issue.	3	2.14	3.57	7.00	90.48	8.91	Yes
The origins, structure, and functions of the Colorado government	5	3.71	5.29	10.36	82.74	2.39	Yes
Total	33						
Percentage of GLEs with a balance of representation index of 70 or greater: 100%							

Table B-11. Balance-of-Knowledge Representation for CMAS Social studies Grade 7: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Seek and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend a thesis with evidence.	2	1.63	2.88	6.01	91.46	9.98	Yes
The historical eras, individuals, groups, ideas and themes within regions of the Eastern Hemisphere and their relationships with one another	5	3.63	8.50	17.82	85.27	13.00	Yes
Use geographic tools to gather data and make geographic inferences and predictions.	4	3.63	7.75	16.23	80.53	11.84	Yes
Regions have different issues and perspectives.	4	2.13	4.00	8.37	81.25	12.40	Yes
Supply and demand influence price and profit in a market economy.	6	5.38	6.38	13.36	89.55	9.16	Yes
The distribution of resources influences economic production and individual choices (Economics and PFL).	8	4.50	6.75	14.13	86.83	9.53	Yes
Compare how various nations define the rights, responsibilities, and roles of citizens.	5	3.88	6.13	12.82	84.42	1.77	Yes
Different forms of government and international organizations and their influence in the world community.	5	3.00	5.38	11.27	85.68	8.34	Yes
Total	39						
Percentage of GLEs with a balance of representation index of 70 or greater: 100%							

Table B-12. Balance-of-Knowledge Representation for CMAS Social studies High School: Mean Balance Index per GLE

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	4	2.75	3.50	6.73	92.92	8.21	Yes
The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	8	4.50	7.00	13.46	76.94	5.29	Yes
The significance of ideas as powerful forces throughout history.	6	4.00	5.75	11.06	85.60	11.34	Yes
Use different types of maps and geographic tools to analyze features on Earth to investigate and solve geographic questions.	4	2.75	4.75	9.13	85.00	11.06	Yes
Explain and interpret geographic variables that influence the interactions of people, places and environments.	6	3.50	4.50	8.65	91.67	9.62	Yes
The interconnected nature of the world, its people and places.	6	2.25	3.00	5.77	91.67	9.62	Yes
Productive resources – natural, human, capital – are scarce; therefore, choices are made about how individuals, businesses, governments, and societies allocate these resources.	4	3.00	4.00	7.69	93.15	8.27	Yes
Economic policies affect markets.	6	1.00	1.00	1.92	100.00	--	Yes
Government and competition affect markets.	4	0.00	0.00	0.00	0.00	0.00	No
Design, analyze, and apply a financial plan based on short- and long-term financial goals (PFL).	5	2.00	3.00	5.77	83.33	0.00	Yes
Analyze strategic spending, saving, and investment options to achieve the objectives of diversification, liquidity, income, and growth (PFL).	4	0.00	0.00	0.00	0.00	0.00	No

Grade Level Expectation	EOs per GLE	Balance-of-Knowledge Representation					Balance Index Target Met
		Mean EOs Linked with Items	Mean Items per GLE	Mean % of Items (of total) Linked to GLE	Mean Balance Index		
		M	*M*	*M*	*M*	*SD*	
The components of personal credit to manage credit and debt (PFL).	3	3.00	3.00	5.77	100.00	0.00	Yes
Identify, develop, and evaluate risk-management strategies (PFL).	3	1.75	1.75	3.37	100.00	0.00	Yes
Research, formulate positions, and engage in appropriate civic participation to address local, state, and national issues or policies.	5	2.50	3.50	6.73	88.33	7.93	Yes
Purposes of and limitations on the foundations, structures and functions of government.	7	3.00	5.50	10.58	84.79	1.97	Yes
Analyze how public policy - domestic and foreign - is developed at the local, state, and national levels and compare how policy-making occurs in other forms of government.	6	2.00	3.33	6.41	91.11	15.40	Yes
Total	81						
Percentage of GLEs with a balance of representation index of 70 or greater: 88%							

EOs Matched to Items by Panelists

Tables B-13 through B-15 present the EOs, along with the mean number of items, matched by panelists. Column 1 presents the HumRRO code corresponding to each of the EOs. One note of caution when reading these tables, the same items may not be represented by the mean number of items. For example, EO code '1.1.a' in the first row shows that 7 panelists matched a mean number of 2.14 items to this EO. This does not mean/assume that the items matched to the EO by the panelists were the same items across panelists.

Table B-13. Grade 4 CMAS Social Studies: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	7	2.14	0.38
1.1.b	5	2.40	1.34
1.1.c	6	2.00	1.26
1.1.d	2	1.00	0.00
1.2.a	4	1.00	0.00
1.2.b	4	1.50	0.58
1.2.c	6	2.50	0.84
1.2.d	5	2.00	0.00
2.1.a	7	3.57	2.23
2.1.b	7	3.00	0.58
2.1.c	6	2.00	0.63
2.1.d	2	1.00	0.00
2.1.e	6	1.33	0.52
2.2.a	7	3.57	1.51
2.2.b	5	2.40	1.14
2.2.c	6	1.33	0.52
2.2.d	5	1.60	0.89
3.1.a	7	3.71	0.76
3.1.b	7	2.00	0.82
3.1.c	7	1.86	0.69
3.2.a	6	1.50	0.84
3.2.b	7	2.71	0.95
3.2.c	6	1.50	0.84
3.2.d	4	1.00	0.00
3.2.e	4	1.00	0.00
4.1.a	2	1.50	0.71
4.1.b	6	1.83	0.41
4.1.c	7	1.57	0.53
4.2.a	5	1.60	0.55
4.2.b	7	1.43	0.53
4.2.c	7	1.43	0.53
4.2.d	4	1.00	0.00
4.2.e	3	1.67	1.15

Table B-14. Grade 7 CMAS Social Studies: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	5	1.80	0.84
1.1.b	8	1.75	0.89
1.2.a	3	1.67	1.15
1.2.b	7	3.00	1.63
1.2.c	7	2.00	1.15
1.2.d	6	2.67	0.82
1.2.e	6	2.00	0.89
2.1.a	8	2.88	1.36
2.1.b	8	2.00	0.76
2.1.c	8	2.25	1.04
2.1.d	5	1.00	0.00
2.2.b	6	1.00	0.00
2.2.c	3	1.00	0.00
2.2.d	8	3.13	0.64
3.1.a	8	1.00	0.00
3.1.b	7	1.43	0.79
3.1.c	7	1.29	0.49
3.1.d	6	1.17	0.41
3.1.e	7	1.29	0.49
3.1.f	8	1.00	0.00
3.2.a	4	1.75	0.96
3.2.b	8	1.38	0.52
3.2.c	4	2.50	1.29
3.2.d	1	1.00	--
3.2.e	3	1.00	0.00
3.2.f	2	1.00	0.00
3.2.g	8	1.75	0.46
3.2.h	6	1.00	0.00
4.1.a	8	1.88	0.35
4.1.b	8	2.00	0.53
4.1.c	7	1.14	0.38
4.1.d	2	1.00	0.00
4.1.e	6	1.33	0.82
4.2.a	8	1.50	0.76
4.2.b	7	2.14	0.38
4.2.c	1	1.00	--
4.2.d	8	1.88	0.99

Table B-15. High School CMAS Social Studies: EOs Matched to Items by Panelists

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
1.1.a	4	1.25	0.50
1.1.b	3	1.33	0.58
1.1.c	2	1.00	0.00
1.1.d	2	1.50	0.71
1.2.a	1	1.00	
1.2.b	3	1.33	0.58
1.2.c	2	1.00	0.00
1.2.d	0	0.00	0.00
1.2.e	1	1.00	--
1.2.f	4	2.25	1.26
1.2.g	4	1.50	1.00
1.2.h	3	1.67	1.15
1.3.a	2	1.00	0.00
1.3.b	3	1.67	1.15
1.3.c	4	1.00	0.00
1.3.d	2	1.00	0.00
1.3.e	4	2.25	0.96
1.3.f	1	1.00	--
2.1.a	4	2.25	0.96
2.1.b	3	1.00	0.00
2.1.c	1	1.00	--
2.1.d	3	2.00	0.00
2.2.a	3	1.67	0.58
2.2.b	2	1.00	0.00
2.2.c	3	1.67	0.58
2.2.d	1	1.00	--
2.2.e	1	1.00	--
2.2.f	4	1.00	0.00
2.3.a	1	2.00	--
2.3.b	1	1.00	--
2.3.c	1	2.00	--
2.3.d	2	1.50	0.71
2.3.e	2	1.00	0.00
2.3.f	2	1.00	0.00
3.1.a	3	1.67	0.58
3.1.b	4	1.25	0.50
3.1.c	2	1.50	0.71
3.1.d	3	1.00	0.00
3.2.a	0	0.00	0.00
3.2.b	0	0.00	0.00
3.2.c	1	1.00	--
3.2.d	0	0.00	0.00
3.2.e	0	0.00	0.00
3.2.f	0	0.00	0.00
3.3.a	0	0.00	0.00
3.3.b	0	0.00	0.00

HumRRO EO Code	Number of Panelists	Mean Number of Items per EO	*SD*
3.3.c	0	0.00	0.00
3.3.d	0	0.00	0.00
3.4.a	4	1.00	0.00
3.4.b	0	0.00	0.00
3.4.c	4	2.00	0.00
3.4.d	0	0.00	0.00
3.4.e	0	0.00	0.00
3.5.a	0	0.00	0.00
3.5.b	0	0.00	0.00
3.5.c	0	0.00	0.00
3.5.d	0	0.00	0.00
3.6.a	4	1.00	0.00
3.6.b	4	1.00	0.00
3.6.c	4	1.00	0.00
3.7.a	4	1.00	0.00
3.7.b	2	1.00	0.00
3.7.c	1	1.00	--
4.1.a	1	1.00	--
4.1.b	3	1.67	0.58
4.1.c	2	1.00	0.00
4.1.d	2	1.50	0.71
4.1.e	2	1.50	0.71
4.2.a	4	2.00	0.82
4.2.b	1	1.00	--
4.2.c	2	1.00	0.00
4.2.d	1	1.00	--
4.2.e	0	0.00	0.00
4.2.f	4	2.50	1.73
4.2.g	0	0.00	0.00
4.3.a	2	1.50	0.71
4.3.b	1	1.00	--
4.3.c	0	0.00	0.00
4.3.d	2	1.50	0.71
4.3.e	1	3.00	--
4.3.f	0	0.00	0.00

Appendix C.
Sample Alignment Review Materials

Panelists received the following instruction sheet and Colorado Academic Standards document as reference materials corresponding with verbal instructions from HumRRO facilitators. They also were provided rating forms for DOK and test items. Examples of all materials are provided in Appendix C.

CMAS Social Studies Alignment Process
Panelist Instructions

	Rating Task	Documents Needed	File Format
1	CMAS Social Studies Evidence Outcomes (EOs) (Consensus)	Social Studies G4 Panelist Instructions	Print copy
		Social Studies G4 EO Consensus	Print copy
		Social Studies G4 EO Consensus	Excel
2	CMAS Social Studies Items (Individual)	Social Studies G4 Panelist Instructions	Print copy
		Social Studies G4 Evidence Outcomes	Print copy
		Grade 4 Social Studies Items	Online
		Social Studies G4 Item Rating	Excel

Prior to alignment steps, train:

(1) Review handouts, particularly the CMAS Panelist Instructions
(2) Access HumRRO item rating forms:
    a. Locate form on desktop, double click to open.
    b. "Save As" the file name and add **underscore and your 3 initials** (e.g., Social Studies G4 Item Rating_***eas***).

1 Review CMAS EOs and provide Depth of Knowledge (DOK) rating (Consensus)

Train Task:

(1) Receive the Social Studies G4 EO Consensus paper copy.
    a. You will handwrite your DOK rating on this form.
(2) Make DOK ratings
    a. The facilitator will discuss the 4 DOK levels and will ask for a volunteer to record the panel's ratings in the G4 EO Consensus Excel form. See the Support Materials section in this document for DOK information. Refer to this section as needed.

Conduct Task:

(1) Provide individual ratings on the paper copy.
(2) Determine if everyone provided the same rating. If not, share your reasons for your rating.
(3) The group will come to a consensus on the rating and majority will rule if necessary.
(4) The volunteer will enter the group's consensus rating in the Social Studies G4 EO Consensus Excel form.

2 Rate CMAS Social Studies Items

Train Task:

(1) You will review CMAS test items, assign a DOK level, select the EO that the item is targeting, and provide ratings regarding the linkage.
(2) The facilitator will discuss the columns in the Excel form, including any other tabs toward the bottom of the screen for multiple test sections.
    a. Columns B and C: The item sequence number and UIN
    b. Column D: Assign the DOK level
    c. Column E-H: Item Linkage and Overall Alignment
        - E: Select the grade level EO that best covers the content measured by the item
        - F: Indicate how well the content measured by the item aligns (matches or links) with the selected EO using the following rating scale.

Rating	Overall Alignment for Item and EO Rating Descriptions
1	Not aligned to any EO (No EO was entered in column E)
2	Weakly aligned (item does not assess the content of the EO well)
3	Highly aligned (item assesses EO core content reasonably well)
4	Fully aligned (item assesses content that clearly matches with the EO)

        - G and H: If you rate the overall alignment as 1 or 2, describe exactly what content in the item is not covered by the EO. Provide a secondary EO if you feel the item equally assesses another EO.

Conduct the Task:

(1) Save the Social Studies G4 Item Rating file on desktop with your 3 initials.
(2) Rate 2 or so (facilitator will determine) items independently, then conduct calibration discussion.
(3) Conduct individual ratings for each item in order. No consensus discussions.
(4) Save the file regularly!!!

Support Materials

DOK Definitions

- **Level 1 (recall)** Items or standards require student recall of information such as fact, definition, term or simple procedure as well as performance of a simple subject process or procedure.

  Keywords: Identify, define, determine, perform (simple procedure), list.

- **Level 2 (skill/concept)** Items or standards require student engagement of some mental processing beyond a habitual response. Students are required to make some decisions as to how to approach a problem or activity, such as selecting procedures, describing or giving examples of subject concepts, deciding how to display or interpret data.

  Keywords: Describe, observe, classify, confirm, organize, distinguish, compare.

- **Level 3 (strategic thinking)** Items or standards require student to use reasoning and evidence, plan, and make conjectures. Students should be able to explain phenomena in terms of scientific concepts, explain simple relationships, explain thought process and conclusions, solve non-routine problems, and develop research questions.

  Keywords: Connect, explain, analyze, outline procedures, make conclusions, interpret.

- **Level 4 (extended thinking)** Items or standards require student to use complex and abstract reasoning and thinking, often over an extended period of time. Students must design and plan experimental studies, select and appropriate method among alternatives, or deduct the relationship among several variables.

  Keywords: Design, plan, and develop experiments; make inferences from results; critique; predict; explain (complex) relationships or differences among variables.

Panelists received the Colorado Academic Standards for science and social studies coded for data entry into rating forms. The content of the standards was extracted exactly from the full Colorado Academic Standards document. Only a portion of the coded high school science standards is replicated below.

Standard	Prepared Graduate Competency	Concepts & Skills	Evidence Outcomes	HumRRO ID
Physical Science	Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects	Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.	Gather, analyze and interpret data and create graphs regarding position, velocity and acceleration of moving objects.	1.1.a
			Develop, communicate and justify an evidence-based analysis of the forces acting on an object and the resultant acceleration produced by a net force.	1.1.b
			Develop, communicate and justify an evidence-based scientific prediction regarding the effects of the action-reaction force pairs on the motion of two interacting objects.	1.1.c
			Examine the effect of changing masses and distance when applying Newton's law of universal gravitation to a system of two bodies.	1.1.d
			Identify the limitations of Newton's laws in extreme situations.	1.1.e
	Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions	Matter has definite structure that determines characteristic physical and chemical properties.	Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom.	1.2.a
			Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity.	1.2.b
			Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table.	1.2.c
			Develop a model that differentiates atoms and molecules, elements and compounds, and pure substances and mixtures.	1.2.d

Panelists received the Colorado Academic Standards for science and social studies in a rating form in which to make DOK ratings for each EO. Panelists handwrote DOK ratings (1, 2, 3, or 4) in the last column of the table next to each EO to facilitate the consensus discussion. The content of the standards was extracted exactly from the full Colorado Academic Standards document. Only a portion of the high school social studies standards is replicated as an example.

Standard	Prepared Graduate Competency	Concepts & Skills	Evidence Outcomes	HumRRO ID	DOK Rating 1 = Recall 2 = Skills/Concepts 3 = Strategic Thinking 4 = Extended Thinking
History	Develop an understanding of how people view, construct, and interpret history	Use the historical method of inquiry to ask questions, evaluate primary and secondary sources, critically analyze and interpret data, and develop interpretations defended by evidence.	Evaluate a historical source for point of view and historical context.	1.1.a	
			Gather and analyze historical information, including contradictory data, from a variety of primary and secondary sources, including sources located on the Internet, to support or reject hypotheses.	1.1.b	
			Construct and defend a written historical argument using relevant primary and secondary sources as evidence.	1.1.c	
			Differentiate between facts and historical interpretations, recognizing that a historian's narrative reflects his or her judgment about the significance of particular facts.	1.1.d	
	Analyze key historical periods and patterns of change over time within and across nations and cultures	The key concepts of continuity and change, cause and effect, complexity, unity and diversity over time.	World history (both East and West including modern world history):		
			Evaluate continuity and change over the course of world history.	1.2.a	

Appendix D.
Item Rating Form Example

Panelists reviewed the individual CMAS items using the following rating form in electronic format. The format of the rating form was identical for grade/subject test. The number of items listed per rating form did differ for each grade/subject test.

	CMAS Science Item Review for Grade 8						
			Item DOK	Item Linkage and Overall Alignment			
	Item Number	UIN	Depth Of Knowledge	Linked EO	Overall Alignment	Explanation	EO 2
			1-Recall 2-Skills/concepts 3-Strategic thinking 4-Extended thinking	Enter EO ID Code	1- Not aligned 2- Weakly aligned 3- Highly aligned 4- Fully aligned	If not highly or fully aligned, describe what the item measures that does not match with the EO	Enter Secondary EO ID Code
1	4	SC080268					
2	5	COSC120293					
		SCS08011_drct					
3	6	SC080236-SCS08011					
4	7	SC080237-SCS08011					
5	8	SC080242-SCS08011					
6	9	SC080238-SCS08011					
7	10	SC080264					
8	11	COSC120100					
9	12	SC080077					
10	13	COSC130039					
11	14	SC080140					
12	15	SC080346					
13	20	COSC130032					
14	21	SC080267					
15	22	SC080293					
16	23	SC080279					
17	24	SC080319					