Alignment of Idaho State Standards With The Idaho Direct Mathematics Assessment in In Grades 4, 6, and 8

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G:Idaho/DMA Alignment

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DMA Alignment Process

The process used for this alignment was an abbreviated version of the alignment work and models developed by Norman L. Webb (1997, 1999, 2001, and 2002), and used in alignment studies of the Idaho state assessment system. While the full Webb alignment includes four dimensions, this study only considers two of the dimensions -- Depth of Knowledge and Categorical Concurrence. This report does not apply the criteria developed for the criteria of Range of Knowledge and Balance of Representation. Both of those other two criteria are skewed when a limited number of questions are considered, as would be the case of the DMA. In other words, you would not expect the DMA to meet these two criteria, and it was felt that application of the criteria would add little information. In the dimension of Categorical Concurrence, Webb aligns questions with only one standard, and with the alignment of the Idaho state assessment system questions were aligned with a maximum of 3 standards. With the DMA alignment, test questions are aligned to all standards that are appropriate, without a maximum being set.

Second, again due to the smaller number of questions on each of the DMA instruments, alignment of questions was only done to Idaho Standards level, not to the Content, Knowledge and Skills level. Categorical Concurrence and Depth of Knowledge only apply at the aggregate standards level.

The process included a two step process: first, a desk-top preview and matching of standards and assessment questions and second, an observation of the actual Range Finding session. Range finding was observed to provide context fine tuning of the information about the processes used in the scoring, and to provide background information about the scoring process, the scoring rubrics, and the determination of range finders. This is used in the establishment of Depth of Knowledge levels. It is possible for an question to appear to ask for a deeper depth of knowledge, when in fact the scoring process/rubrics do not recognize this.

Depth of Knowledge was determined in the manner developed by Norman Webb. Depth of Knowledge assigns a level to each question and each standard. Definitions of those four levels is found at the end of this document. The DMA has a large number of questions at the Level 3 – Strategic Thinking level. Included in this definition by Webb is the phrase “In most cases asking a student to explain their thinking is a Level 3.” All but a few questions in the DMA include in the question stem the statement, “Show or explain how you found your answer.”

Comparison of the DMA to the ISAT is most meaningful and significant when looking at the criteria of Depth of Knowledge, since the most noticeable difference between the DMA and the ISAT is in the response mode: multiple-choice on the ISAT and constructed response in the DMA. The ISAT’s heavy reliance on multiple-choice format limits its ability to meet the Depth of Knowledge criteria for any standard that was written at a level 3 or above.

With regard to Categorical Concurrence, the limited number of questions (15-17 at grade 4, 19 at grade 6, and 13 - 17 at grade 8) makes it more difficult to meet the criteria set by Webb in his work, that is 6 questions per standard. This is true even when a specific assessment question is aligned with multiple standards.

This study examined multiple assessment instruments – four year's editions for grades 4 and 8, and two editions at grade 6. While there are differences in the number of questions for specific standards across years, and differences in which standards are assessed across year, the variation is not large.

Idaho is identifying **POWER STANDARDS**. It would appear that "power standards" are in fact power "content, knowledge and skills," which provide a more specific and detailed definition of each standard. These power standards also then define more specifically the content of the questions on the DMA.

Another major difference between the DMA and many other standardized assessment instruments (such as the ISAT) is in the scoring method. With a multiple choice question instrument, questions are scored as correct or incorrect, with each individual question being scored separately. The DMA utilizes a more holistic scoring method. Trained teacher scorers, using a standardized holistic rubric and range finder papers, look at all of the problems on a student's test paper and score the exam as a whole. It is felt that this provides a more representational summation of student abilities. In other words, the holistic score is more accurate than a series of checks of individual questions – and is especially true when looking at assessments at a higher Depth of Knowledge level. This holistic scoring is facilitated by the combination of questions which have a specific mathematical answer, but which also have an open-ended explanation.

Direct comparisons between the DMA and the ISAT are not included in this study. Alignment information for the ISAT is only available for the version used in Spring 2003. The instrument has been revised since that time, including some revision to address the results of the alignment study.

Part I: Alignment

The first section of this report - alignment - records the number of questions, on each version of the assessment instruments, that are related/aligned with each of the state standards.

Part II: Depth of Knowledge

The second section of this report - depth-of-knowledge – examines the consistency between standards and assessment questions -- if what is elicited from students on the assessment is as demanding cognitively as what students are expected to know and do as stated in

the standards." (Webb, 1999, page 7) This alignment examines the alignment not only between contents of standards and assessments, but also the complexity of knowledge required by each.

(Webb 1999, page 8) defines an 'acceptable' level of consistency being that "at least 50% of the questions corresponding to an objective had to be 'at' or 'above' the level of knowledge of the objective" as a whole. Webb also defines a standard that has between 40% and 50% of its questions at or above the depth-of-knowledge of the standard as a whole as having "weakly met" the criteria for Depth-of-Knowledge consistency.

Part III: Categorical Concurrence

The third section of this report – categorical concurrence examines to what degree each standard is assessed. (Webb 1999, page 7) states, "The criterion of categorical concurrence between standards and assessment is met if the same or consistent categories of content appear in both …." State standards and assessments. The criterion is judged by examining both the assessments and the standards to determine whether the assessment instruments do in fact include questions that measure the content of the standards.

(**Webb 1999) assumes that if an assessment instrument contains at least six questions measuring the content of a standard, that assessment has attained 'acceptable' categorical concurrence.** Six is considered to be the minimum for an assessment to be considered 'acceptable." For further discussion of Webb's rationale on this matter, please refer to page 7 of Webb's *Research Monograph No. 18 – Alignment of Science and Mathematics Standards and Assessments in Four States*, published by the National Institute for Science Education and the Council of Chief State School Officers in 1999.

Part One: Alignment

Alignment

*This is a duplicated count. A single assessment question may relate to more than a single standard, in fact, most questions address between two and five standards.
At grade 4, (as well as with grade 6 and 8) the first two standards are: "understand and use numbers," and "perform computations accurately." Almost all of the questions on the instruments could be argued to address these two standards, plus additional standards.

The Total Questions For Strand (Duplicated) row is a sum of the number of questions for each of the sub parts of the strand.

Table 1.1
Grade 4 Idaho Mathematics Standards, Number of Questions by Standard

Grade 4 (Number of questions for each standard.)				
Total Number of Questions *on Instrument*	**2000-2001 Edition 16**	**2001-2002 Edition 17**	**2002-2003 Edition 16**	**2003-2004 Edition 13**
297. Basic Arithmetic, Estimation, and Accurate Computations				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**34**	**32**	**30**	**16**
297.01 Understand and use numbers. **POWER STANDARD**	12	13	13	2
297.02 Perform computations accurately. **POWER STANDARD**	12	13	13	8
297.03 Estimate and judge reasonableness of results.	10	6	4	6

POWER STANDARD				
298. Mathematical Reasoning and Problem Solving				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**43**	**42**	**43**	**22**
298.01 Understand and use a variety of problem-solving skills. **POWER STANDARD**	16	17	16	11
298.02 Use reasoning skills to recognize problems and express them mathematically. **POWER STANDARD**	13	12	11	5
298.03 Apply appropriate technology and models to find solutions to problems.	0	0	0	0
298.04 Communicate results using appropriate terminology and methods.	14	13	16	6
299. Concepts and Principles of Measurement				
.	**2000-2001 Edition**	**2001-2002Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**6**	**4**	**7**	**3**
299.01 Understand and use U.S. customary and metric measurements **POWER STANDARD**	6	4	7	3

300. Concepts and Language of Algebra				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**0**	**0**	**0**	**0**
300.01 Use algebraic symbolism as a tool to represent mathematical relationships. **POWER STANDARD**	0	0	0	0
300.02 Evaluate algebraic expressions. **POWER STANDARD**	0	0	0	0
300.03 Solve algebraic equations and inequalities. **POWER STANDARD**	0	0	0	0
301. Concepts and Principles of Geometry				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**4**	**4**	**3**	**4**
301.01 Apply concepts of size, shape, and spatial relationships. **POWER STANDARD**	4	4	3	4
301.02 Apply graphing in two dimensions.	0	0	0	0
302. Data Analysis, Probability, and Statistics				

	2000-2001Edition	2001-2002 Edition	2002-2003 Edition	2003-2004 Edition
Total Questions For Strand (Duplicated) *	**7**	**6**	**9**	**4**
302.01 Understand data analysis. **POWER STANDARD**	0	0	2	2
302.02 Collect, organize, and display data. **POWER STANDARD**	7	6	2	2
302.03 Apply simple statistical measurements. **POWER STANDARD**	0	0	0	0
302.04 Understand basic concepts of probability.	0	0	0	0
302.05Make predictions or decisions based on data. **POWER STANDARD**	0	0	0	0
303. Functions and Mathematical Models				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**3**	**2**	**4**	**0**
303.01 Understand the concept of functions. **POWER STANDARD**	3	2	4	0

Table 1.2

Grade 6 Idaho Mathematics Standards, Number of Questions by Standard

*This is a duplicated count. A single assessment question may relate to more than a single standard, in fact, most questions address between two and five standards.

At grade 4, (as well as with grade 6 and 8) the first two standards are: "understand and use numbers," and "perform computations accurately." Almost all of the questions on the instruments could be argued to address these two standards, plus additional standards.

Grade 6			
Total Number of Questions *on Instrument*		**2002-2003 Edition 19**	**2003-2004 Edition 19**
317. Basic Arithmetic, Estimation, and Accurate Computations			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**30**	**26**
317.01 Understand and use numbers. **POWER STANDARD**		15	19
317.02 Perform computations accurately. **POWER STANDARD**		11	7
317.03 Estimate and judge reasonableness of results. **POWER STANDARD**		4	0
318. Mathematical Reasoning and Problem Solving			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**42**	**45**
318.01 Understand and use a variety of problem-solving skills. **POWER STANDARD**		15	13
318.02 Use reasoning skills		4	12

to recognize problems and express them mathematically. **POWER STANDARD**			
318.03 Apply appropriate technology and models to find solutions to problems.		4	1
318.04 Communicate results using appropriate terminology and methods.		19	19
319. Concepts and Principles of Measurement			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**7**	**10**
319.01 Understand and use U.S. customary and metric measurements. **POWER STANDARD**		4	5
319.02 Apply concepts of rates and other derived or indirect measurements.		0	2
319.03 Apply the concepts of ratios and proportions.		2	4
319.04 Apply dimensional analysis.		1	1
320. Concepts and Language of Algebra			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**4**	**0**
320.01 Use algebraic symbolism as a tool to represent		4	0

mathematical relationships. **POWER STANDARD**			
320.02 Evaluate algebraic expressions. **POWER STANDARD**		0	0
320.03 Solve algebraic equations and inequalities.		0	0
321. Concepts and Principles of Geometry			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**4**	**3**
321.01 Apply concepts of size, shape, and spatial relationships. **POWER STANDARD**		4	3
321.02 Apply graphing in two dimensions. **POWER STANDARD**		0	0
322. Data Analysis, Probability, and Statistics			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**23**	**8**
322.01 Understand data analysis. **POWER STANDARD**		10	4
322.02 Collect, organize, and display data. **POWER STANDARD**		6	0
322.03 Apply simple statistical measurements.		7	4

POWER STANDARD			
322.04 Understand basic concepts of probability. **POWER STANDARD**		0	0
322.05 Make predictions or decisions based on data.		0	0
323. Functions and Mathematical Models			
		2002-2003 Edition	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *		**8**	**8**
323.01 Understand the concept of functions. **POWER STANDARD**		4	4
323.02 Apply functions to a variety of problems. **POWER STANDARD**		4	4

Table 1.2
Grade 8 Idaho Mathematics Standards, Number of Questions by Standard

*This is a duplicated count. A single assessment question may relate to more than a single standard, in fact, most questions address between two and five standards.

At grade 4, (as well as with grade 6 and 8) the first two standards are: "understand and use numbers," and "perform computations accurately." Almost all of the questions on the instruments could be argued to address these two standards, plus additional standards.

Grade 8				
Total Number of Questions *on Instrument*	**2000-2001 Edition 13**	**2001-2002 Edition 17**	**2002-2003 Edition 17**	**2003-2004 Edition 18**
337. Basic Arithmetic, Estimation, and Accurate Computations				
	2000 Edition	**2001 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**28**	**30**	**33**	**17**
337.01 Understand and use numbers. **POWER STANDARD**	13	17	16	6
337.02 Perform computations accurately. **POWER STANDARD**	13	12	16	11
337.03 Estimate and judge reasonableness of results. **POWER STANDARD**	2	1	1	0
338. Mathematical Reasoning and Problem Solving				

	2000-2001 Edition	2001-2002 Edition	2002-2003 Edition	2003-2004 Edition
Total Questions For Strand (Duplicated) *	**35**	**33**	**34**	**31**
338.01 Understand and use a variety of problem-solving skills. **POWER STANDARD**	13	16	14	7
338.02 Use reasoning skills to recognize problems and express them mathematically. **POWER STANDARD**	9	3	3	4
338.03 Apply appropriate technology and models to find solutions to problems.	0	0	0	2
338.04 Communicate results using appropriate terminology and methods.	13	14	17	18
339. Concepts and Principles of Measurement				
	2000-2001 Edition	**2001-2003 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**7**	**8**	**5**	**2**
339.01 Understand and use U.S. customary and metric measurements. **POWER STANDARD**	6	4	0	0
339.02 Apply concepts of rates and other derived or indirect measurements. **POWER STANDARD**	1	0	0	2

339.03 Apply the concepts of ratios and proportions. **POWER STANDARD**	0	4	2	0
339.04 Apply dimensional analysis. **POWER STANDARD**	0	0	3	0
340. Concepts and Language of Algebra				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**0**	**1**	**6**	**1**
340.01 Use algebraic symbolism as a tool to represent mathematical relationships. **POWER STANDARD**	0	1	2	1
340.02 Evaluate algebraic expressions. **POWER STANDARD**	0	0	2	0
340.03 Solve algebraic equations and inequalities. **POWER STANDARD**	0	0	2	0
341. Concepts and Principles of Geometry				
	2000 Edition	**2001 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**4**	**4**	**2**	**3**
341.01 Apply concepts of size, shape, and spatial relationships.	4	4	1	3

POWER STANDARD				
341.02 Apply the geometry of right triangles. **POWER STANDARD**	0	0	1	0
341.03 Apply graphing in two dimensions.	0	0	0	0
342. Data Analysis, Probability, and Statistics				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**
Total Questions For Strand (Duplicated) *	**16**	**12**	**32**	**4**
342.01 Understand data analysis. **POWER STANDARD**	4	0	11	0
342.02 Collect, organize, and display data. **POWER STANDARD**	11	10	16	1
342.03 Apply simple statistical measurements. **POWER STANDARD**	0	0	1	1
342.04 Understand basic concepts of probability. **POWER STANDARD**	0	1	2	2
342.05 Make predictions or decisions based on data. **POWER STANDARD**	1	1	2	0
343. Functions and Mathematical Models				
	2000-2001 Edition	**2001-2002 Edition**	**2002-2003 Edition**	**2003-2004 Edition**

Total Questions For Strand (Duplicated) *	**1**	**0**	**1**	**0**
343.01 Understand the concept of functions. **POWER STANDARD**	1	0	0	0
343.02 Represent equations, inequalities, and functions in a variety of formats. **POWER STANDARD**	0	0	1	0
343.03 Apply functions to a variety of problems. **POWER STANDARD**	0	0	0	0

PART TWO: DEPTH OF KNOWLEDGE

Depth of Knowledge

Depth of Knowledge examines the level of complexity of both the standards and the questions. Norman Webb classifies questions and standards on a scale of 1 – 4, with level four being the most complex. Depth of knowledge examines whether assessment questions are written at a level comparable to level of the standards – in other words, do we have a complex standard being assess by questions written at a similar level of complexity.

The tables below indicate the percent of questions written at each of the four Depth of Knowledge levels, and compares that to the Depth of Knowledge levels at which the Idaho standards were written. Information for comparison is also provided for the Spring 2003 version of the on-grade, on-level questions of the ISAT.

Even a cursory examination should show that the Depth of Knowledge level, the level of complexity, is higher on the DMA due to the open ended nature of the questions.

Depth of Knowledge is one of the major strengths of the DMA. The instrument is designed to include an open-ended response opportunity within almost all questions – students are asked to "Show or explain" their answers. This automatically raises the Depth of Knowledge to a level 3 for the question (as per Webb) – which in turn is much more consistent with the Depth of Knowledge of the Idaho standards.

Table 2.1
Fourth Grade Instruments
Number and percent of questions at each cognitive level.

	Level 1	Level 2	Level 3	Level 4
2000-2001 Edition	0 0%	6 37.5%	10 62.5%	0 0%
2001-2002 Edition	0 0%	5 29.4%	12 70.6%	0 0%
2002-2003 Edition	1 6%	2 11.75%	13 81.25%	0 0%
2003-2004 Edition	0 0%	1 7.7%	12 92.3%	0 0%
DMA Overall	**1.6%**	**22.6%**	**75.8%**	**0%**

Idaho Standards	**5.3%**	**84.2%**	**10.5%**	**0%**

ISAT (Percent of questions Spring 2003)	**26%**	**74%**	**0%**	**0%**

Table 2.2
Sixth Grade Instruments
Number and percent of questions at each cognitive level.

	Level 1	Level 2	Level 3	Level 4
2002-2003 Edition	0 0%	1 5.3%	18 94.7%	0 0%
2003-2004 Edition	0 0%	1 5.3%	18 94.7%	0 0%
DMA Overall	**0%**	**5.3%**	**94.7%**	**0%**

Idaho Standards	**0%**	**52.2%**	**47.8%**	**0**

There is no sixth grade ISAT for comparison.

Table 2.3
Eighth Grade Instruments
Number and percent of questions at each cognitive level.

	Level 1	Level 2	Level 3	Level 4
2000-2001 Edition	0 0%	2 15.4%	11 84.6%	0 0%
2001-2002	0	3	14	0

Edition	0%	17.6%	82.4%	0%
2002-2003 Edition	0 0%	2 11.8%	15 88.2%	0 0%
2003-2004 Edition	0 0%	2 12.5%	16 87.5%	0 0%
DMA Overall	**0%**	**13.8%**	**86.2%**	**0%**

Idaho Standards	**3.7%**	**85.2%**	**11.1%**	**0%**

ISAT (Percent of questions Spring 2003)	**31%**	**69%**	**0%**	**0%**

PART THREE: CATEGORICAL CONCURRENCE

Categorical Concurrence

The concept of Categorical Concurrence is used to examine whether or not a standard is being fully assessed on an instrument – in other words, is a standard being assessed by multiple questions, or in fact any questions at all.

The tables below show which questions, on each of the versions of the DMA, match or assess which Idaho state standards. By looking across rows, one can determine how many, and which questions assess each of the standards. Any rows without any marks, indicate those standards that are not assessed on that particular instrument.

The table at the end of this section attempts to summarize this information across the two or four instruments.

Discussion of Categorical Concurrence and comparisons between the DMA and the ISAT are limited by the fact that ISAT questions were aligned to a maximum of three standards, which the DMA were aligned to a maximum of five standards (see discussion in the introduction for more information).

How to read the following Alignment Charts:

Top Row identifies the question number on the test.

Second Row identifies the Depth of Knowledge level for the each question on the test. Depth of Knowledge levels range from a low of 1 to a high of 4. For more information see the last page of this report.

Column One gives the Idaho State Standard by number, provides the standard statement, and indicates whether the standard is a Power Standard (indicted by BOLD print and the letters PS after the number).

All Other Columns provide a cross reference showing an X to indicate which questions assess which standards. Example: If question 1A assesses four different standards you will find four X's in that column to show which four standards are assessed with that question.

Table 3.1
4th Grade Question Alignment Information 2000-2001 Edition

Question #	1A	B	C	D	2A	B	C	3A	B	C	4A	B	C	D	5A	B	
Depth of Knowledge	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	
Standard #																	
297.01 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**					**X**	**X**	
297.02 PS Perform computations accurately	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**					**X**	**X**	
297.03 PS Estimate and judge reasonableness of results.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**							
298.01 PS Understand and use a variety of problem-solving skills	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
298.02 PS Use reasoning skills to recognize problems and express them mathematically.	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**		**X**		**X**	**X**	**X**	
298.03 Apply appropriate technology and models to find solutions to problems.																	
298.04 Communicate results using appropriate terminology and methods.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**		**X**	**X**	**X**	
299.01 PS Understand and use U. S. customary and metric measurements.					**X**	**X**	**X**	**X**	**X**								
300.01 PS Use algebraic symbolism a s a tool to represent mathematical relationships.																	
300.02 PS Evaluate algebraic expressions.																	
300.03 PS Solve algebraic equations and inequalities.																	
301.01 PS Apply concepts of size, shape, and spatial relationships.											**X**	**X**	**X**	**X**			
301.02 Apply graphing in two dimensions.																	
302.01 PS Understand data analysis.																	
302.02 PS Collect, organize, and display data.					**X**	**X**	**X**	**X**	**X**	**X**					**X**		
302.03 PS Apply simple statistical measurements.																	
302.04 Understand basic concepts of probability.																	
302.05 PS Make predictions or decisions on data.																	
303.01 PS Understand the concept of functions.					**X**	**X**	**X**										

Table 3.2
4th Grade Question Alignment Information 2001-2002 Edition

Question #	1A	B	C	D	2A	B	C	3A	B	C	D	4A	B	5A	B	C	D
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**
Standard #																	
297.02 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				
297.02 PS Perform computations accurately	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				
297.03 PS Estimate and judge reasonableness of results.	**X**	**X**	**X**	**X**	**X**	**X**											
298.01 PS Understand and use a variety of problem-solving skills	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
298.02 PS Use reasoning skills to recognize problems and express them mathematically.	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**				
298.03 Apply appropriate technology and models 298.04 to find solutions to problems.																	
298.05 Communicate results using appropriate 298.06 terminology and methods.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				
299.01 PS Understand and use U. S. customary and metric measurements.								**X**	**X**	**X**	**X**						
300.01 PS Use algebraic symbolism a s a tool to represent mathematical relationships.																	
300.02 PS Evaluate algebraic expressions.																	
300.02 PS Solve algebraic equations and inequalities.																	
301.01 PS Apply concepts of size, shape, and spatial relationships.														**X**	**X**	**X**	**X**
301.02 Apply graphing in two dimensions.																	
302.01 PS Understand data analysis.																	
302.02 PS Collect, organize, and display data.								**X**	**X**	**X**	**X**	**X**	**X**				
302.03 PS Apply simple statistical measurements.																	
302.04 Understand basic concepts of probability.																	
302.05 PS Make predictions or decisions on data.																	
303.01 PS Understand the concept of functions.												**X**	**X**				

Table 3.3
4th Grade Question Alignment Information 2002-2003 Edition

Question #	1A	B	C	D	2A	B	C	D	3A	B	C	4A	B	C	5A	B	
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	
Standard #																	
297.04 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				**X**	**X**	
297.02 PS Perform computations accurately	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				**X**	**X**	
297.05 PS Estimate and judge reasonableness of results.	**X**	**X**	**X**	**X**													
298.03 PS Understand and use a variety of problem-solving skills	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
298.04 PS Use reasoning skills to recognize problems and express them mathematically.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**						
298.07 Apply appropriate technology and models 298.08 to find solutions to problems.																	
298.09 Communicate results using appropriate 298.10 terminology and methods.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
299.02 PS Understand and use U. S. customary and metric measurements.					**X**	**X**	**X**	**X**	**X**	**X**	**X**						
300.03 PS Use algebraic symbolism a s a tool to represent mathematical relationships.																	
300.02 PS Evaluate algebraic expressions.																	
300.04 PS Solve algebraic equations and inequalities.																	
301.02 PS Apply concepts of size, shape, and spatial relationships.												**X**	**X**	**X**			
301.02 Apply graphing in two dimensions.																	
302.01 PS Understand data analysis.															**X**	**X**	
302.02 PS Collect, organize, and display data.															**X**	**X**	
302.03 PS Apply simple statistical measurements.																	
302.04 Understand basic concepts of probability.																	
302.05 PS Make predictions or decisions on data.																	
303.01 PS Understand the concept of functions.					**X**	**X**	**X**	**X**									

Table 3.4
4th Grade Question Alignment Information 2003-2004 Edition

Question #	1A	B	C	D	2A	B	3A	B	C	4A	B	5A	B				
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**				
Standard #																	
297.06 PS Understand and use numbers.												**X**	**X**				
297.02 PS Perform computations accurately	**X**	**X**	**X**	**X**						**X**	**X**	**X**	**X**				
297.04 PS Estimate and judge reasonableness of results.	**X**	**X**	**X**	**X**								**X**	**X**				
298.01 PS Understand and use a variety of problem-solving skills	**X**	**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**				
298.02 PS Use reasoning skills to recognize problems and express them mathematically.							**X**	**X**	**X**	**X**	**X**						
298.03 Apply appropriate technology and models to find solutions to problems.																	
298.04 Communicate results using appropriate terminology and methods.					**X**	**X**				**X**	**X**	**X**	**X**				
299.01 PS Understand and use U. S. customary and metric measurements.							**X**	**X**	**X**								
300.01 PS Use algebraic symbolism a s a tool to represent mathematical relationships.																	
300.02 PS Evaluate algebraic expressions.																	
300.03 PS Solve algebraic equations and inequalities.																	
301.01 PS Apply concepts of size, shape, and spatial relationships.										**X**	**X**						
301.02 Apply graphing in two dimensions.										**X**	**X**						
302.01 PS Understand data analysis.					**X**	**X**											
302.02 PS Collect, organize, and display data.					**X**	**X**											
302.03 PS Apply simple statistical measurements.																	
302.04 Understand basic concepts of probability.																	
302.05 PS Make predictions or decisions on data.																	
303.01 PS Understand the concept of functions.																	

Table 3.5
6th Grade Question Alignment Information 2002-2003 Edition

Question #	1A	B	C	D	2A	B	C	D	3A	B	C	D	4A	B	C	5A	B	C	D
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
Standard #																			
317.01 PS Understand and use numbers.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
317.02 PS Perform computations accurately	X	X		X	X	X	X	X	X		X	X			X				
317.03 PS Estimate and judge reasonableness of results.			X						X	X	X								
318.01 PS Understand and use a variety of problem-solving skills.	X	X		X	X	X	X	X	X	X	X	X			X		X	X	X
318.02 PS Use reasoning skills to recognize problems and express them mathematically.	X	X		X															X
318.03 Apply appropriate technology and models to find solutions to problems.					X	X	X	X											
318.04 Communicate results using appropriate terminology and methods.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
319.01 PS Understand and use U. S. customary and metric measurements.					X	X	X	X											
319.02 Apply concepts of rates and other derived or indirect measurements.																			
319.03 Apply the concepts of rations and proportions.				X				X											
319.04 Apply dimensional analysis.		X																	
320.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.						X	X	X											X
320.02 PS Evaluate algebraic expressions.																			
320.03 Solve algebraic equations and inequalities.																			
321.01 PS Apply concepts of size, shape, and spatial relationships.					X				X	X	X								
321.02 PS Apply graphing in two dimensions.																			
322.01 PS Understand data analysis.					X	X	X	X	X	X	X	X		X	X				
322.02 PS Collect, organize, and display					X	X	X	X					X			X			

data.																			
322. 03 PS Apply simple statistical measurements.									**X**	**X**	**X**	**X**	**X**	**X**	**X**				
322.04 PS Understand basic concepts of probability.																			
322.05 Make predictions or decisions based on data.																			
323.01 PS Understand the concept of functions.																**X**	**X**	**X**	**X**
323.02 PS Apply functions to a variety of problems.																**X**	**X**	**X**	**X**

Table 3.6
6th Grade Question Alignment Information 2003-2004 Edition

Question #	1A	B	C	D	2A	B	C	D	3A	B	C	4A	B	C	D	5A	B	C	D
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
Standard #																			
317.01 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
317.02 PS Perform computations accurately	**X**	**X**	**X**	**X**						**X**	**X**	**X**							
317.04 PS Estimate and judge reasonableness of results.																			
318.01 PS Understand and use a variety of problem-solving skills.	**X**	**X**	**X**	**X**				**X**	**X**	**X**		**X**			**X**	**X**	**X**	**X**	**X**
318.02 PS Use reasoning skills to recognize problems and express them mathematically.	**X**	**X**	**X**	**X**					**X**	**X**		**X**			**X**	**X**	**X**	**X**	**X**
318.02 Apply appropriate technology and models to find solutions to problems.										**X**									
318.03 Communicate results using appropriate terminology and methods.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
319.01 PS Understand and use U. S. customary and metric measurements.					**X**	**X**	**X**	**X**			**X**								
319.02 Apply concepts of rates and other derived or indirect measurements.																			
319.03 Apply the concepts of rations and proportions.								**X**	**X**	**X**	**X**								
319.04 Apply dimensional analysis.			**X**																
320.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.																			
320.02 PS Evaluate algebraic expressions.																			
320.03 Solve algebraic equations and inequalities.																			
321.01 PS Apply concepts of size, shape, and spatial relationships.					**X**	**X**		**X**											
321.02 PS Apply graphing in two dimensions.																			
322.01 PS Understand data analysis.												**X**	**X**	**X**	**X**				
322.02 PS Collect, organize, and display data.																			
322. 03 PS Apply simple statistical measurements.												**X**	**X**	**X**	**X**				
322.04 PS Understand basic concepts of probability.																			
322.05 Make predictions or decisions based on data.																			
323.01 PS Understand the concept of functions.																**X**	**X**	**X**	**X**
323.02 PS Apply functions to a variety of problems.																**X**	**X**	**X**	**X**

Table 3.7
8th Grade Question Alignment Information 2000-2001 Edition

Question #	1A	B	C	2A	B	C	3A	B	C	4A	B	C	5
Depth of Knowledge	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
Standard #													
337.01 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
337.02 PS Perform computations accurately.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
337.03 PS Estimate and judge reasonableness of results.						**X**		**X**					
338.01 PS Understand and use a variety of problem-solving skills.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
338.02 PS Use reasoning skills to recognize problems and express them mathematically.	**X**	**X**	**X**	**X**	**X**	**X**	**X**					**X**	**X**
338.03 Apply appropriate technology and models to find solutions to problems.													
338.04 Communicate results using appropriate terminology and methods.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
339.01 PS Understand and use U. S. customary and metric measurements.	**X**						**X**	**X**	**X**	**X**	**X**		
339.02 PS Apply concepts of rates and other derived or indirect measurements.					**X**								
339.03 PS Apply the concepts of ratios and proportions.													
339.04 PS Apply dimensional analysis.													
340.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.													
340.02 PS Evaluate algebraic expressions.													
340.03 PS Solve algebraic equations and inequalities.													
341.01 PS Apply concepts of size, shape, and spatial relationships.							**X**	**X**	**X**	**X**			
341.02 PS Apply the geometry of right triangles.													
341.03 Apply graphing in two dimensions.													
342.01 PS Understand data analysis.							**X**	**X**	**X**				**X**
342.02 PS Collect, organize, and display data.	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
342. 03 PS Apply simple statistical measurements.													
342.04 PS Understand basic concepts of probability.													
342.05 PS Make predictions or decisions based on data.						**X**							
343.01 PS Understand the concept of functions.												**X**	

343.02 PS Represent equations, inequalities, and functions in a variety of formats.													
343.03 PS Apply functions to a variety of problems.													

Table 3.8
8th Grade Question Alignment Information 2001-2002 Edition

Question #	1A	B	C	D	2A	B	C	D	3A	B	C	D	4A	B	C	5A	B
Depth of Knowledge	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
Standard #																	
337.01 PS Understand and use numbers.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
337.02 PS Perform computations accurately.	**X**	**X**	**X**	**X**				**X**	**X**	**X**	**X**	**X**		**X**		**X**	**X**
337.03 PS Estimate and judge reasonableness of results.																**X**	
338.01 PS Understand and use a variety of problem-solving skills.	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
338.02 PS Use reasoning skills to recognize problems and express them mathematically.		**X**		**X**	**X**												
338.03 Apply appropriate technology and models to find solutions to problems.																	
338.04 Communicate results using appropriate terminology and methods.		**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**
339.01 PS Understand and use U. S. customary and metric measurements.									**X**	**X**	**X**					**X**	
339.02 PS Apply concepts of rates and other derived or indirect measurements.																	
339.03 PS Apply the concepts of ratios and proportions.													**X**		**X**	**X**	**X**
339.04 PS Apply dimensional analysis.																	
340.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.								**X**									
340.02 PS Evaluate algebraic expressions.																	
340.03 PS Solve algebraic equations and inequalities.																	
341.01 PS Apply concepts of size, shape, and spatial relationships.									**X**	**X**	**X**	**X**					
341.02 PS Apply the geometry of right triangles.																	
341.03 Apply graphing in two dimensions.																	
342.01 PS Understand data analysis.																	

342.02 PS Collect, organize, and display data.	**X**		**X**	**X**	**X**				**X**	**X**	**X**	**X**		**X**	**X**		
342. 03 PS Apply simple statistical measurements.																	
342.04 PS Understand basic concepts of probability.															**X**		
342.05 PS Make predictions or decisions based on data.														**X**			
343.01 PS Understand the concept of functions.																	
343.02 PS Represent equations, inequalities, and functions in a variety of formats.																	
343.03 PS Apply functions to a variety of problems.																	

Table 3.9
8th Grade Question Alignment Information 2002-2003 Edition

Question #	1A	B	C	D	2A	B	C	3A	B	C	D	4A	B	C	5A	B	C
Depth of Knowledge	2	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Standard #																	
337.01 PS Understand and use numbers.	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
337.02 PS Perform computations accurately.	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
337.03 PS Estimate and judge reasonableness of results.															X		
338.01 PS Understand and use a variety of problem-solving skills.			X	X	X	X	X	X	X	X	X		X	X	X	X	X
338.02 PS Use reasoning skills to recognize problems and express them mathematically.			X	X			X										
338.03 Apply appropriate technology and models to find solutions to problems.																	
338.04 Communicate results using appropriate terminology and methods.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
339.01 PS Understand and use U. S. customary and metric measurements.																	
339.02 PS Apply concepts of rates and other derived or indirect measurements.																	
339.03 PS Apply the concepts of ratios and proportions.			X			X											
339.04 PS Apply dimensional analysis.															X	X	X
340.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.												X					X
340.02 PS Evaluate algebraic expressions.												X	X				
340.03 PS Solve algebraic equations and inequalities.													X	X			
341.01 PS Apply concepts of size, shape, and spatial relationships.					X												
341.02 PS Apply the geometry of right triangles.					X												
341.03 Apply graphing in two dimensions.																	
342.01 PS Understand data analysis.	X	X	X	X				X	X	X	X				X	X	X

342.02 PS Collect, organize, and display data.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**
342. 03 PS Apply simple statistical measurements.											**X**						
342.04 PS Understand basic concepts of probability.																**X**	**X**
342.05 PS Make predictions or decisions based on data.																**X**	**X**
343.01 PS Understand the concept of functions.																	
343.02 PS Represent equations, inequalities, and functions in a variety of formats.									**X**								
343.03 PS Apply functions to a variety of problems.																	

Table 3.10
8th Grade Question Alignment Information 2003-2004 Edition

Question #	1A	B	C	2A	B	C	D	3A	B	C	D	4A	B	C	D	5A	B	C
Depth of Knowledge	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Standard #																		
337.01 PS Understand and use numbers.		X	X							X				X			X	X
337.02 PS Perform computations accurately.	X	X	X		X	X	X							X	X	X	X	X
337.03 PS Estimate and judge reasonableness of results.																		
338.01 PS Understand and use a variety of problem-solving skills.	X	X	X			X	X									X		X
338.02 PS Use reasoning skills to recognize problems and express them mathematically.						X	X									X		X
338.03 Apply appropriate technology and models to find solutions to problems.		X	X															
338.04 Communicate results using appropriate terminology and methods.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
339.01 PS Understand and use U. S. customary and metric measurements.																		
339.02 PS Apply concepts of rates and other derived or indirect measurements.						X	X											
339.03 PS Apply the concepts of ratios and proportions.																		
339.04 PS Apply dimensional analysis.																		
340.01 PS Use algebraic symbolism as a tool to represent mathematical relationships.											X							
340.02 PS Evaluate algebraic expressions.																		
340.03 PS Solve algebraic equations and inequalities.																		
341.01 PS Apply concepts of size, shape, and spatial relationships.								X	X		X							
341.02 PS Apply the geometry of right triangles.																		
341.03 Apply graphing in two dimensions.																		

342.01 PS Understand data analysis.																		
342.02 PS Collect, organize, and display data.				**X**														
342. 03 PS Apply simple statistical measurements.					**X**													
342.04 PS Understand basic concepts of probability.												**X**	**X**					
342.05 PS Make predictions or decisions based on data.																		
343.01 PS Understand the concept of functions.																		
343.02 PS Represent equations, inequalities, and functions in a variety of formats.																		
343.03 PS Apply functions to a variety of problems.																		

Table 4.1 Standards Assessed on the DMA – Across Editions

4th Grade DMA	Assessed on DMA		6th Grade DMA	Assessed in DMA		8th Grade DMA	Assessed on DMA
Standard #			Standard #			Standard #	
297.01 PS	$		**317.01 PS**	$		**337.01 PS**	$
297.02 PS	$		**317.02 PS**	$		**337.02 PS**	$
297.03 PS	$		**317.03 PS**	I		**337.03 PS**	I
298.01 PS	$		**318.01 PS**	$		**338.01 PS**	$
298.02 PS	$		**318.02 PS**	$		**338.02 PS**	$
298.03	#		318.03	I		338.03	#
298.04	$		318.04	**$**		338.04	**$**
299.01 PS	$		**319.01 PS**	$		**339.01 PS**	#
300.01 PS	#		319.02	#		**339.02 PS**	I
300.02 PS	#		319.03	$		**339.03 PS**	I
300.03 PS	#		319.04	I		**339.04 PS**	I
301.01 PS	$		**320.01 PS**	$		**340.01 PS**	#
301.02	I		**320.02 PS**	#		**340.02 PS**	#
302.01 PS	I		320.03	#		**340.03 PS**	#
302.02 PS	$		**321.01 PS**	I		**341.01 PS**	I
302.03 PS	#		**321.02 PS**	#		**341.02 PS**	I
302.04	#		**322.01 PS**	$		341.03	#
302.05 PS	#		**322.02 PS**	I		**342.01 PS**	I
303.01 PS	$		**322.03 PS**	$		**342.02 PS**	$
			322.04 PS	#		**342.03 PS**	I
			322.05	#		**342.04 PS**	I
			323.01 PS	$		**342.05 PS**	I
			323.02 PS	$		**343.01 PS**	I
						343.02 PS	I
						343.03 PS	#

Key

$	Assessed by multiple questions on all the instruments.
#	Assessed by 2 or less questions, on the instruments.
I	Intermittently assessed by the different editions of the instrument.

PS after a standard number indicates a Power Standard.

Conclusions and Considerations

The greatest strength of the DMA, while it is limited in the number of questions on each instrument, lies in the fact that it allows for open-ended, constructed-responses to questions. Students are asked to "Show or explain how you got your answer." Along with the fact that this in itself raises the Depth of Knowledge rating for the questions to be more in line with the level of the stated Standards, it also allows for a more in-depth demonstration of understanding than does a multiple-choice, selected-response format. The open-ended format of the DMA allows students to demonstrate, and teachers to assess, mathematical communication – a key aspect of being mathematically literate.

It must also be noted that an inherent strength and benefit of the DMA lies in the process used for scoring of student responses. The broad range of teacher in-put and participation in the range finding and scoring not only provides for consistent scoring of the student work, but provides a great opportunity for staff development for those teachers involved in the process. Not only does the DMA process provide for assessment of student learning, but it provides an excellent opportunity for staff development. The staff development aspects, provided by the teacher scoring, not only provide training in assessment, but is also an excellent opportunity for discussions with and between teachers to clarify the meaning, -- to "operational-ize" the Idaho standards – that is, clarify what each of the standards really means, how students demonstrate mastery of the standard, and what teaching techniques have promise for teaching the standards.

The DMA and the ISAT compliment each other. Both the multiple-choice format of the ISAT and the open-ended, holistically scored DMA have inherent strengths and limitations. Together they allow for a fuller and more authentic assessment of student skills and knowledge related to the Idaho State Standards. The DMA, in conjunction with the ISAT, assesses students across more of the Idaho State Mathematics Standards than does either of the instruments by themselves. This is especially true in grades 4 and 8 where students currently take both the DMA and on-grade level ISAT. This is also important when one examines the Idaho Power Standards, many of which cannot be fully assessed in a multiple-choice format. The ISAT, due partly to its greater number of test questions, can provide student learning data broken down into smaller segments or strands. This information is useful when looking at individuals or groups, in that it provides for more detailed diagnosis of strengths and weaknesses on the standards that it does assess.

With the development of Power Standards, Idaho may wish to use the information in this report to fine tune their assessment system. The DMA is limited in the number of questions to be presented to students. Future versions may wish to consistently assess the Power Standards and to sample content from the non-Power Standards. The state might also examine which Power Standards are assessed with the ISAT and use the DMA to provide information on student learning on those standards that cannot be fully assessed in a multiple-choice format.

Appendix A
Depth of Knowledge Levels

General Descriptions

Level 1: Recall

Recall of fact, information, definition, term, or procedure.
Key words may include: identify, recall, recognize, use and measure. Verbs such as describe and explain could be classified at different levels depending on what is to be described and explained.

Level 2: Skill/Concept

Use of information, conceptual knowledge, procedures, two or more steps, etc. Requires students to make decisions on how to proceed. Key words may include: classify, organize, estimate, make observations, collect and display data and compare data. Implies more than one step.

Level 3: Strategic Thinking

Requires reasoning, developing a plan or sequence of steps; has some complexity; more than one possible answer; generally takes less than 10 minutes to do. In most cases asking a student to explain their thinking is a Level 3. May include citing evidence, drawing conclusions from observations, and developing a logical argument and using concepts to solve a problem.

Level 4: Extended Thinking

Requires an investigation; time to think and process multiple conditions of the problem or task; and more than 10 minutes to do non-routine manipulations. Cognitive demands are high and the work complex. May include designing and conducting experiments, making connections between a finding and related concepts, combining and synthesizing ideas into new concepts or critiquing experimental designs.