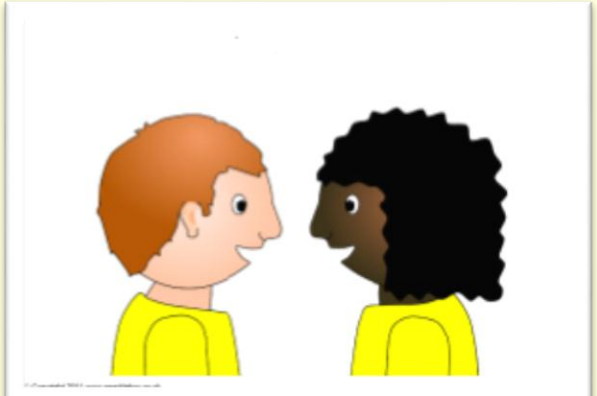
NAEP
MONTANA
NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

Using NAEP to inform Science Instruction

Ashley McGrath and Chris DeWald

2014 State and Data Assessment Conference
January 15-17 2013

- **Tell your neighbor 1 thing you know about each of the following:**
  - Montana Science Content Standards adopted in 2006
  - The K – 12 Framework for Science Education published by the National Research Council
  - The Next Generation Science Standards (NGSS)
  - National Assessment of Educational Progress (NAEP)



Montana
Office of Public Instruction
Denise Juneau, State Superintendent
opi.mt.gov

Content Standards and Instruction: Science

Science is an inquiry process used to investigate natural phenomena, resulting in the formation of theories verified by directed observations. Inquiry challenges students to solve problems by observing and collecting data and constructing inferences from those data. In doing so, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories. (National Science Education Standards, 2004, p.214) Inquiry requires the use of scientific thinking skills to address open-ended problems through non-prescriptive procedures and allows students to construct their own knowledge of the specific concepts. This validates different ways of gathering, synthesizing and communicating knowledge.

This site provides information and resources that support the teaching and learning of science for all students.

More information about Science in Montana K – 12 Schools can be found at: SCIENCE EDUCATION WIKI

Standards | Safety | Science as Inquiry | Professional Associations

Content Standards and Assessment

CURRENT MONTANA CONTENT STANDARDS DOCUMENTS

- Montana Science Content Standards and Performance Descriptors or Word version
- Science Essential Learning Expectations or Excel version
- Science Content Standards Glossary

SCIENCE CRT

Science CRT Released Items – View & download released items, answer keys, and example student answers from constructed response questions.

SCIENCE STANDARDS REVISION

Montana played a key role in the development of the Next Generation Science Standards (NGSS). In 2012 we signed on as a lead state. This meant that we were able to submit comment on four separate drafts of the standards and in turn we will consider them during our next standards revision.

The final NGSS document was released in April of 2013 and can be downloaded at www.nextgenscience.org.

Science Content Standard 1

A proficient student will:

End of Grade 4	End of Grade 8	Upon Graduation
1.3 use data to describe and communicate the results of scientific investigations	**1.3** review, communicate and defend results of investigations, including considering alternative explanations	**1.3** review evidence, communicate and defend results, and recognize that the results of a scientific investigation are always open to revision by further investigations. (e.g., through graphical representation or charts)
1.4 use models that illustrate simple concepts and compare those models to the actual phenomenon	**1.4** create models to illustrate scientific concepts and use the model to predict change (e.g., computer simulation, stream table, graphic representation)	**1.4** analyze observations and explain with scientific understanding to develop a plausible model (e.g., atom, expanding universe)
1.5 identify a valid test in an investigation	**1.5** identify strengths and weakness in an investigation design	**1.5** identify strengths, weaknesses, and assess the validity of the experimental design of an investigation through analysis and evaluation
1.6 identify how observations of nature form an essential base of knowledge among the Montana American Indians	**1.6** compare how observations of nature form an essential base of knowledge among the Montana American Indians	**1.6** explain how observations of nature form an essential base of knowledge among the Montana American Indians

http://opi.mt.gov/pdf/Standards/10ContStds-Science.pdf

K-12 Content Standards

What all Montana students will know, understand and be able to do when they graduate from high school, ready for work and postsecondary education.

Benchmarks

Check points along the K-12 continuum to assess student progress toward meeting standards.

End of Grade 4 | End of Grade 8 | Upon Graduation

Essential Learning Expectations

The necessary content, context and thinking/reasoning skills students must comprehend and apply along the learning continuum.

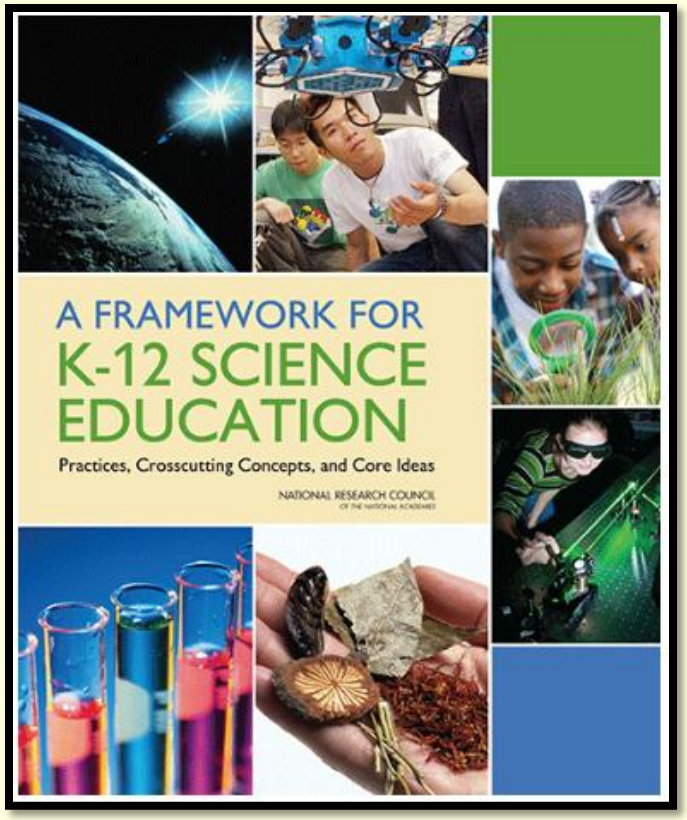
K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12

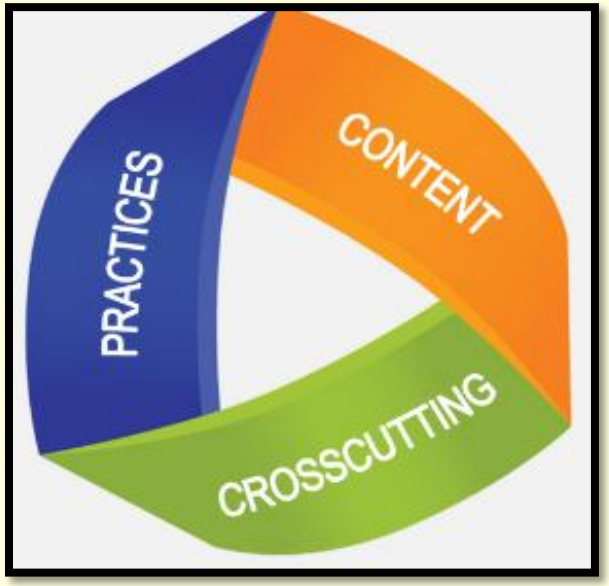
ELE are referenced in this manner: S1.3.gr3.A

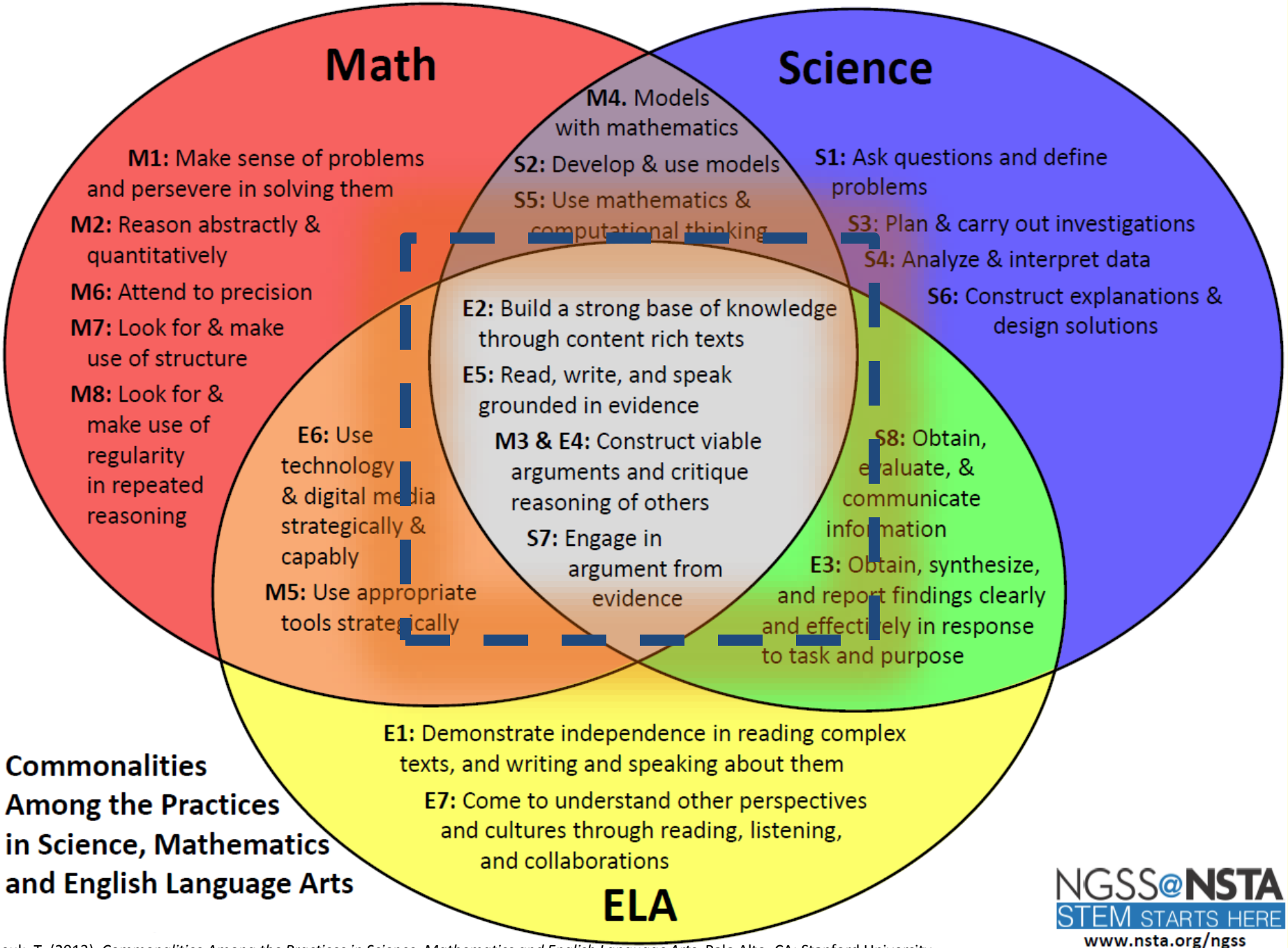
Science Standard 1 | Benchmark 3 | Grade Level 3 | Essential Learning Expectation (ELE) A

Standard	End of Grade 4 Benchmark	Grade Level	ELE
1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.	3. Use data to describe and communicate the results of scientific investigations	3	A. Share results with classmates.

http://opi.mt.gov/pdf/standards/09ScienceELE.pdf


A FRAMEWORK FOR
K-12 SCIENCE
EDUCATION
Practices, Crosscutting Concepts, and Core Ideas
NATIONAL RESEARCH COUNCIL


PRACTICES
CONTENT
CROSSCUTTING



Cheuk, T. (2013). *Commonalities Among the Practices in Science, Mathematics and English Language Arts*. Palo Alto, CA: Stanford University.
http://ell.stanford.edu/content/science

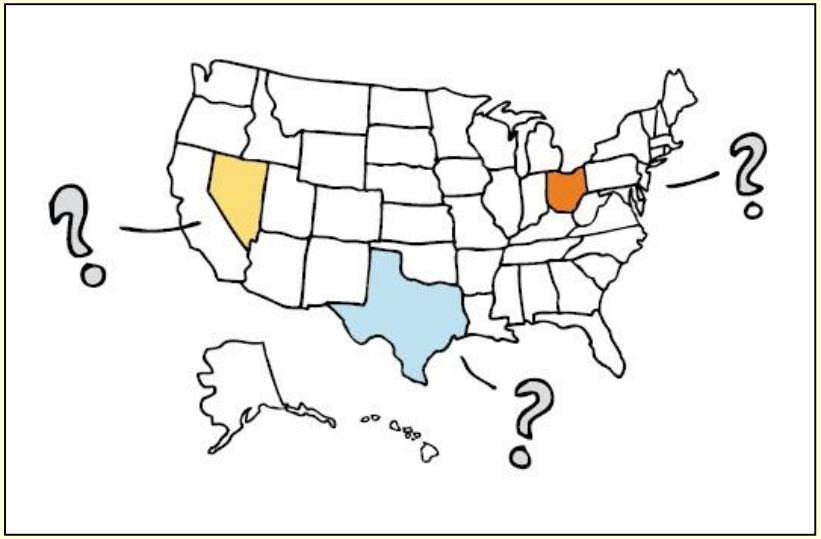
What is NAEP?

- **National Assessment of Educational Progress (NAEP)**
- **Administered every year**

- **Odd years:** state and national results are reported at Grades 4 and 8. About 2,500–3,000 assessed students for each grade and subject.

- **Even years:** only national results are reported.

- **Overall goal:** Every eligible student in our state has the same probability of selection



NAEP
MONTANA
NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

NAEP

- Results are released to the public as The Nation's Report Card.

http://nationsreportcard.gov/

- Inform parents, the public, education policymakers, etc. about our nation's educational environment (e.g., cognitive data; student, teacher, and school questionnaires)

"For NAEP, "proficient" represents an aspirational goal for what student should know and be able to do, while on most state tests, it describes the level of student performance that is good enough to be regarded as acceptable for a particular grade level"– Chudowsky 2010

NAEP SCIENCE ACHIEVEMENT LEVEL DESCRIPTIONS for GRADE 8

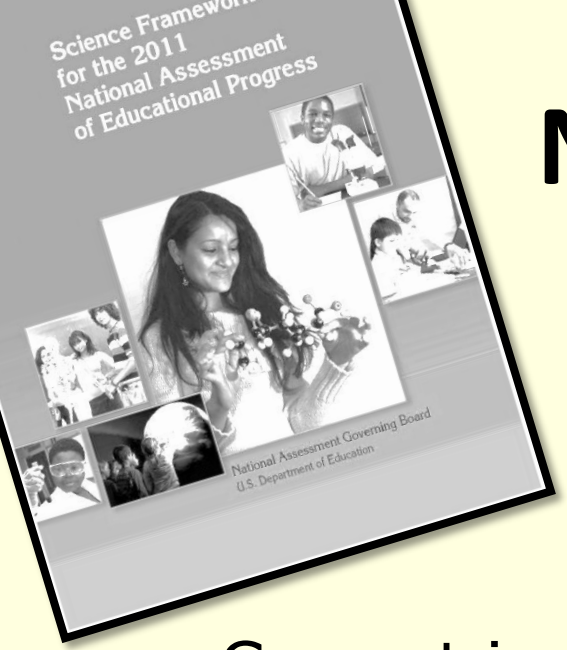
Should be able to….

Proficient (170)

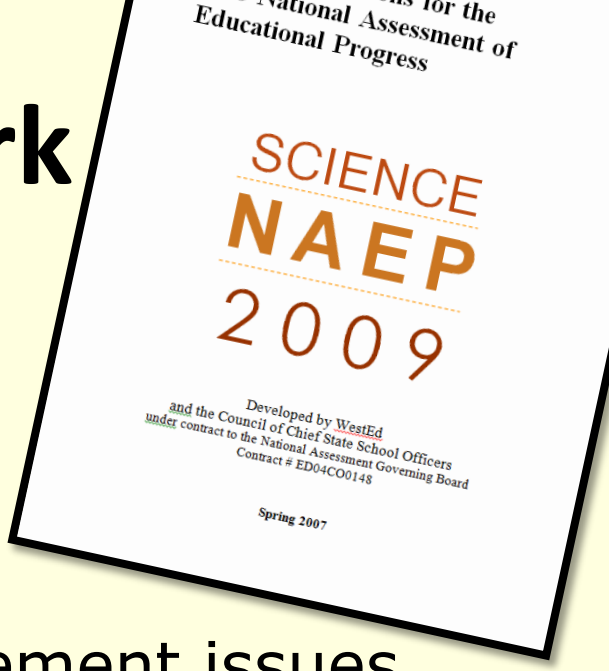
- …
- …
- **design investigations requiring control of variables to test a simple model, employing appropriate sampling techniques and data quality review processes, and use the evidence to communicate an argument that accepts, revises, or rejects the model;**

- **propose and critique solutions and predict the scientific validity of alternative individual and local community responses to design problems.**

NAEP 2011 Science Framework: www.nces.ed.gov

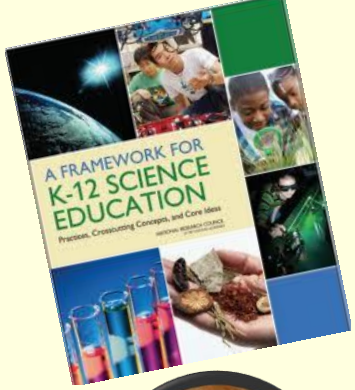


NAEP Framework & Assessment

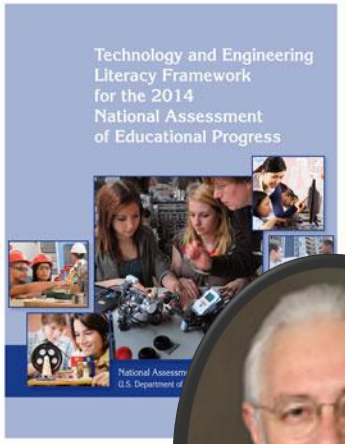


- Current instructional and measurement issues
- Current instructional efforts and best practice
- Research on cognitive development and learning
- Provides detailed descriptions of the content and cognitive dimensions
- Distribution of items across content and cognitive dimensions

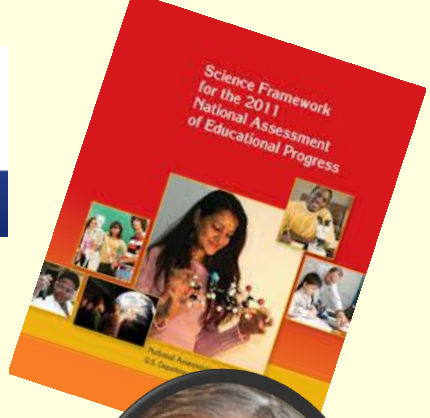
To name a few:



NEXT GENERATION SCIENCE STANDARDS



NATIONAL ASSESSMENT GOVERNING BOARD



Jean Slattery

W. James Popham

Richard Duschl

Rodger W. Bybee

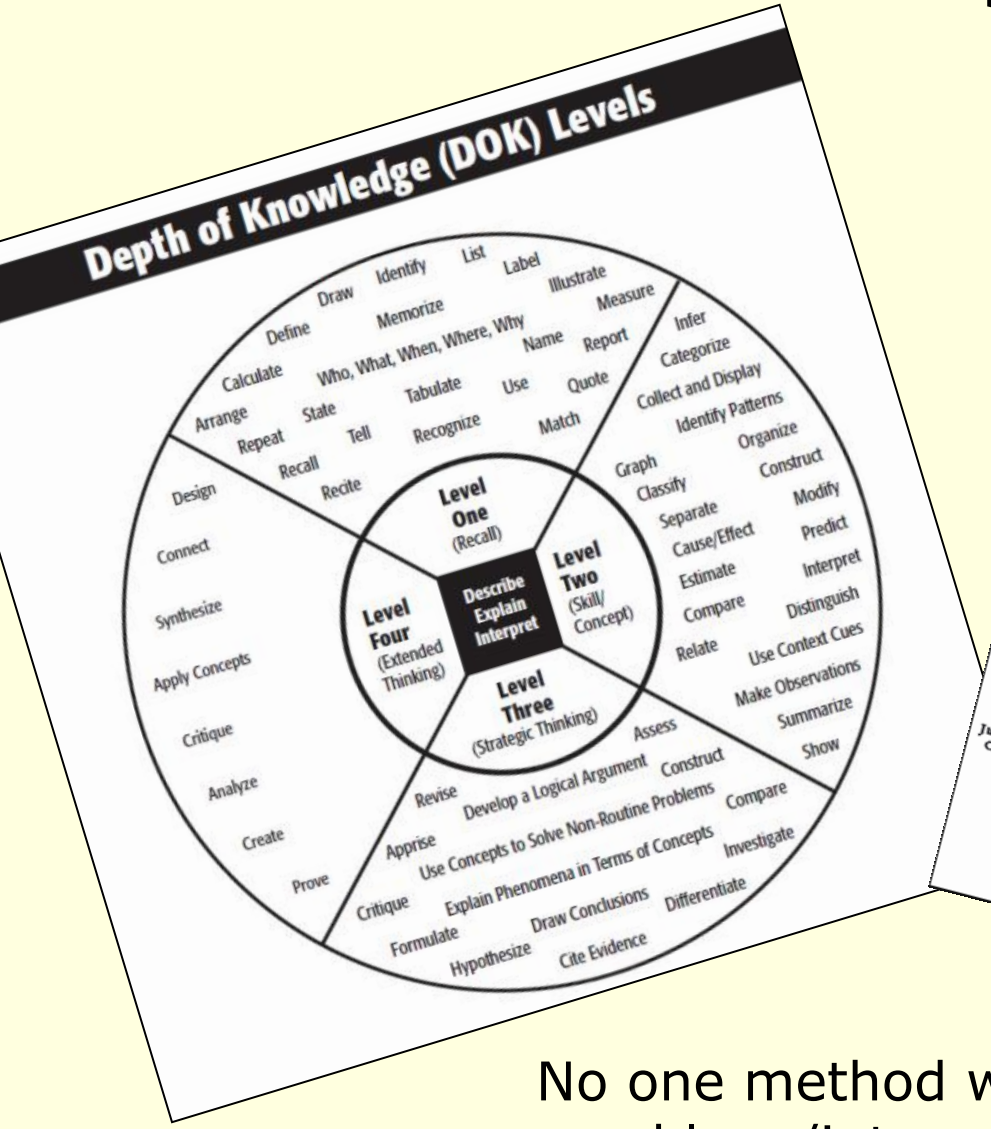
Brett D. Moulding

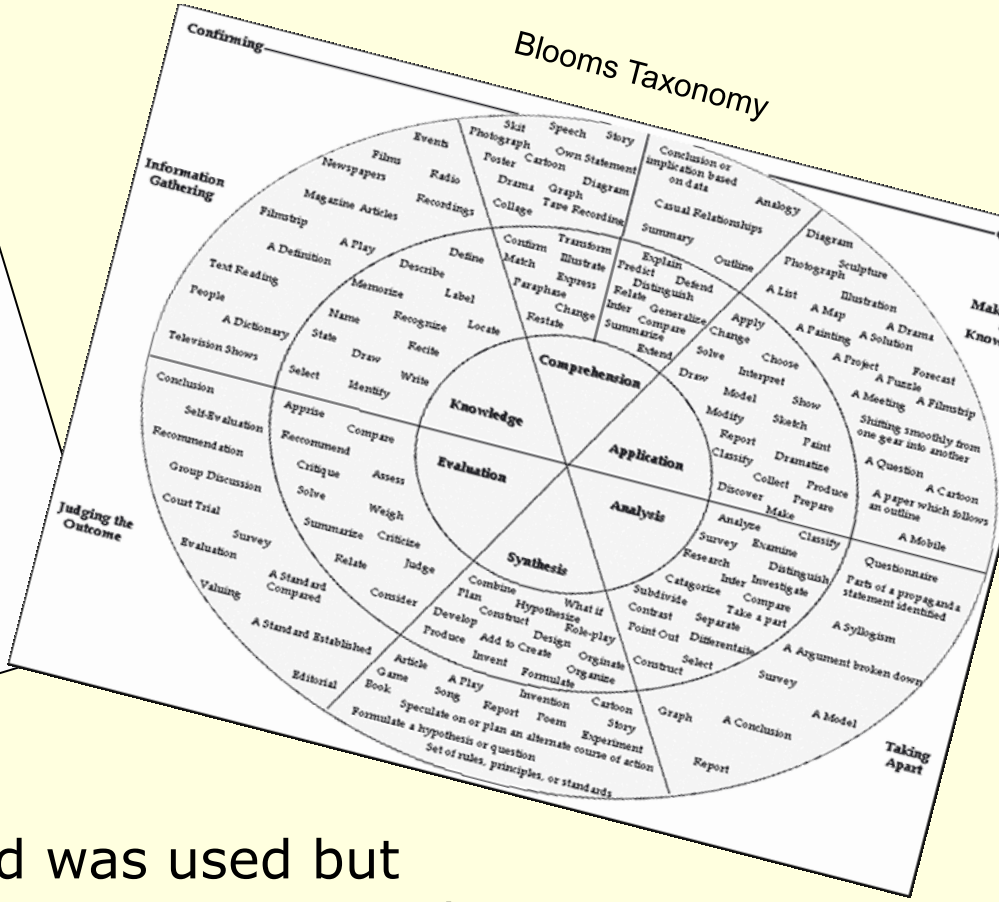
Carlo Parravano

Cary Sneider

Gerald Wheeler

Understanding Objectives





No one method was used but assemblage/integration was used to construct NAEP's complexity

Association of the NAEP Science Practices to

Four cognitive demands:

1. **Identifying Science Principles** "knowing that"
2. **Using Scientific Inquiry** "knowing how"
3. **Using Scientific Principles**: "knowing why"
4. **Using Technological Design**: (tasks or problems)
   3 components: "knowing that"; "knowing why AND "knowing when and where to apply knowledge"

(1) "knowing that" (declarative knowledge), (2) "knowing how" (procedural knowledge) (3) "knowing why" (schematic knowledge), and (4) "knowing when and where to apply knowledge"(strategic knowledge)

Background:
NAEP Considers Content and Practice

		Science Content		
		Physical Science Content Statements	Life Science Content Statements	Earth and Space Sciences Content Statements
Science Practices	Identifying Science Principles	Performance Expectations	Performance Expectations	Performance Expectations
	Using Science Principles	Performance Expectations	Performance Expectations	Performance Expectations
	Using Scientific Inquiry	Performance Expectations	Performance Expectations	Performance Expectations
	Using Technological Design	Performance Expectations	Performance Expectations	Performance Expectations

Comparison

NAEP Practices

Identifying Science Principles

1. Describes, measure, or classify observations.
2. State or recognize correct science principles.
3. Demonstrate relationships among closely related science principles.
4. Demonstrate relationships among different representations of principles.

Using Science Principles

1. Explain observation of phenomena.
2. Predict observations of phenomena.
3. Suggest examples of observations that illustrate a science principle.
4. Propose, analyze, and/or evaluate alternative explanations or predictions.

Using Scientific Inquiry

1. Design or critique aspects of scientific investigations.
2. Conduct scientific investigations using appropriate tools and techniques.
3. Identify patterns in data and/or related patters in data to theoretical models.
4. Use empirical evidence to validate or criticize conclusion about explanations and predictions.

Using Technological Design

1. Propose or critique solutions to problems given criteria and scientific constraints.
2. Identify scientific tradeoffs in design decisions and choose among alternative solutions.
3. Apply science principles or data to anticipate effects of technological design decisions.

The Framework Practices

Practice 1. Asking Questions and Defining Problems

Practice 2. Developing and Using Models

Practice 3. Planning and Carrying Out Investigations

Practice 4. Analyzing and Interpreting Data

Practice 5. Using Mathematics and Computational Thinking

Practice 6. Constructing Explanations and Designing Solutions

Practice 7. Engaging in Argument from Evidence

Practice 8. Obtaining, Evaluating, and Communicating Information

Science Content

A Framework for K-12 Science Education: Disciplinary Core Ideas

Physical Science

PS1: Matter and its interactions
PS2: Motion and stability: Forces and interactions
PS3: Energy
PS4: Waves and their applications to technologies for information transfer

Life Sciences

LS1: From molecules to organisms: Structures and processes
LS2: Ecosystems: Interactions, energy and dynamics
LS3: Heredity: Inheritance and variation of traits
LS4: Biological evolution: Unity and diversity

Earth and Space Sciences

ESS1: Earth's place in the universe
ESS2: Earth's systems
ESS3: Earth and human activity

NAEP Framework

Physical Science

Matter
- Properties of matter
- Changes in matter

Energy
- Forms of energy
- Energy transfer and conservation

Motion
- Motion at the macroscopic level
- Forces affecting motion

Life Science

Structures and Functions of Living Systems
- Organization and development
- Matter and energy transformations
- Interdependence

Changes in Living Systems
- Heredity and reproduction
- Evolution and diversity

Earth and Space Sciences

Earth in Space and Time
- Objects in the universe
- History of Earth

Earth Structures
- Properties of Earth materials
- Tectonics

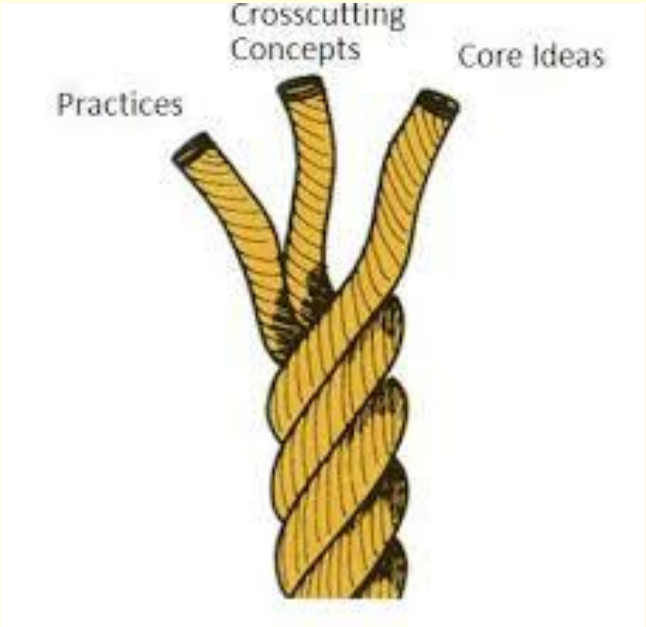
Earth Systems
- Energy in Earth systems
- Climate and weather
- Biogeochemical cycles

Generating Performance Expectations

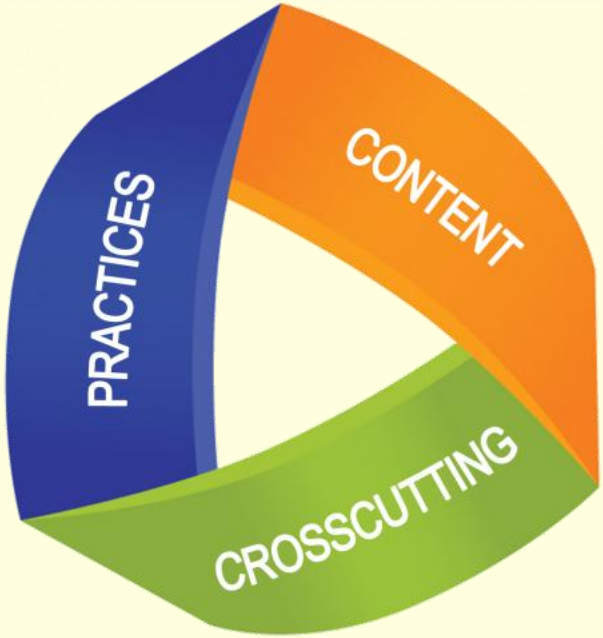
Exhibit 14. Generating examples of grade 8 performance expectations

Science Practices	Science Content: Physical Science Content Statements	Science Content: Life Science Content Statements	Science Content: Earth and Space Sciences Content Statements
Identifying Science Principles	Identify the units that might be used to measure the speed of an ant and the speed of an airplane (see **P8.14**).*	Identify the raw materials that plants use to make sugars (see **L8.4**).	Identify wind as the movement of air from higher to lower pressure regions (see **E8.11**).
Using Science Principles	An object (e.g., a toy car) moves with a constant speed along a straight line. Predict (with justification) what might happen to this object's speed as it rolls downhill (see **P8.16**).	Explain why sugars are found to move primarily down the stem of a growing plant (e.g., potato, carrot) (see **L8.4**).	Explain why mountain soils are generally thinner than floodplain soils (see **E8.6**).
Using Scientific Inquiry	Design an experiment to determine how the speed of a battery-operated toy car changes as a result of added mass (see **P8.16**).	Criticize conclusions about likely consequences of consuming various diets based on flawed premises or flaws in reasoning (see **L8.5**).	Given data (indexed by month) on annual trends of incoming solar radiation for five cities, determine whether the location is in the Northern or Southern Hemisphere (see **E8.12**).
Using Technological Design	Evaluate the following car designs to determine which one is most likely to maintain a constant speed as it goes down a hill (see **P8.16**).	Identify possible ecological side effects of agricultural fertilizer runoff into a lake (see **L8.7**).	Describe the consequences (e.g., erosion) of undercutting a steep slope for a road cut (see **E8.4**).

* To identify the science content statement on which each performance expectation is based, the content statement's unique code (from exhibits 8, 10, and 12 in chapter two) is provided.

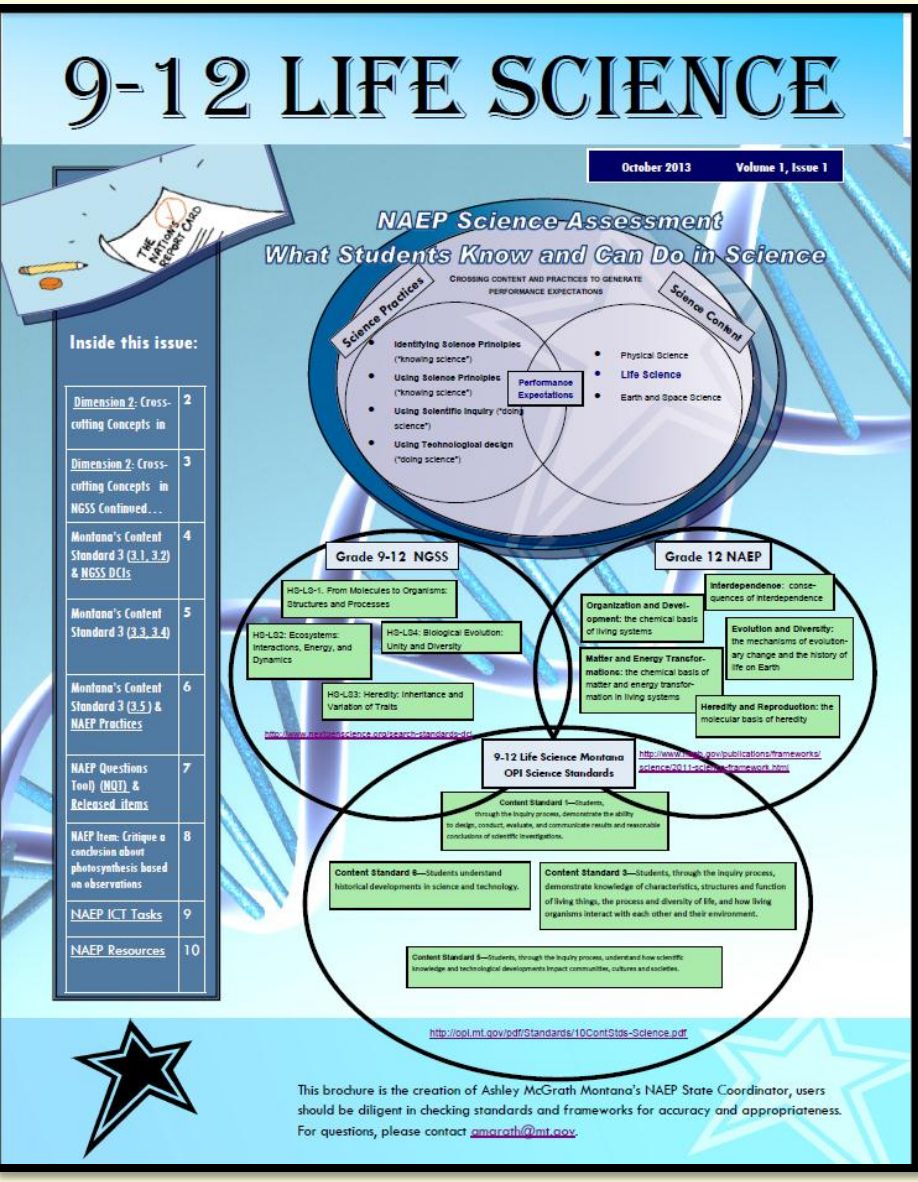


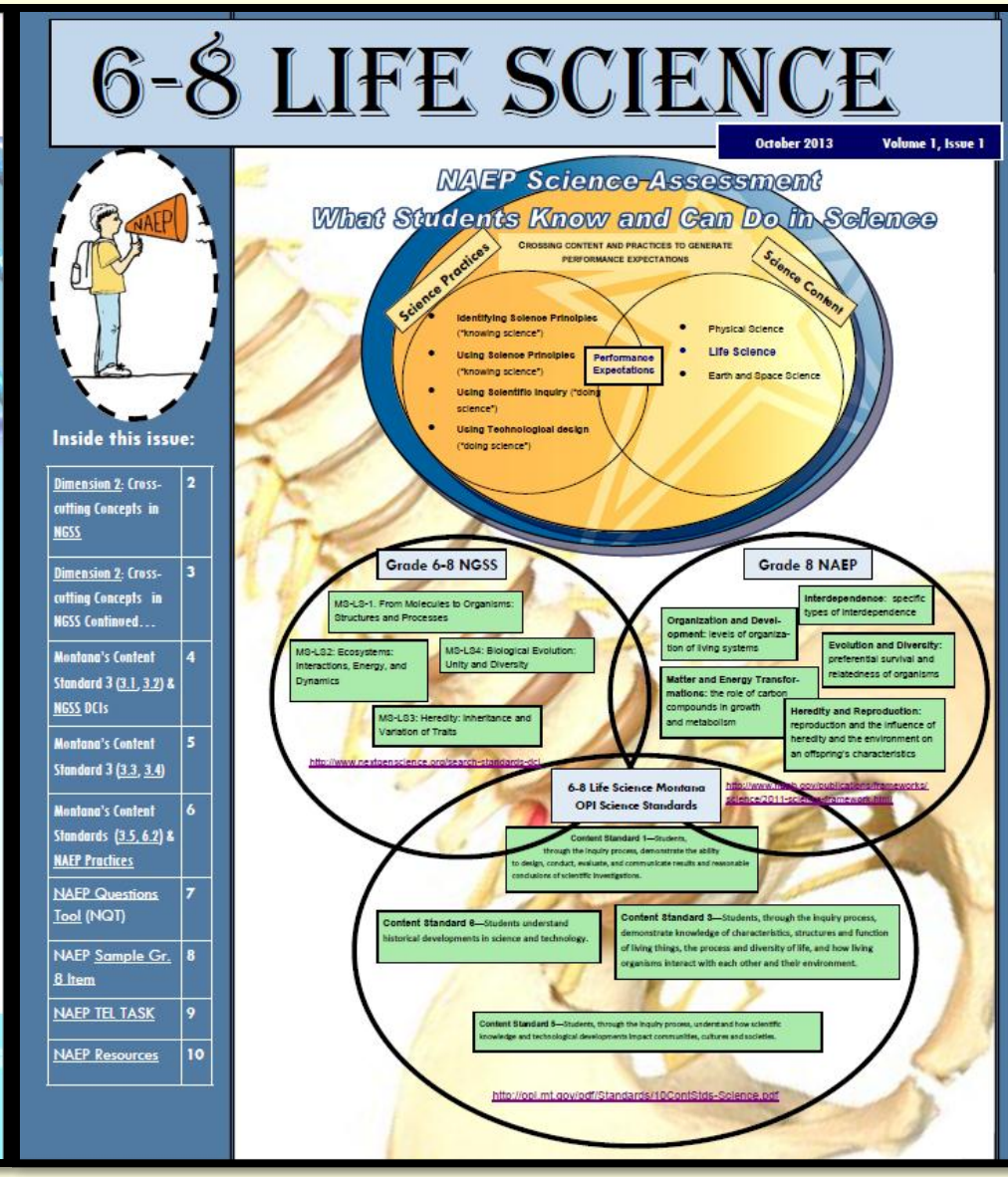
NGSS Integration



MS Structure and Function:

Use argument supported by evidence for how the body is a system of interactive subsystems composed of groups of cells.





http://opi.mt.gov/groups/montananaep/

OPI Assessment and Data Conference 2014 click here

Dimension 2: Crosscutting Concepts in NGSS

Users should be diligent in checking standards and frameworks for accuracy and appropriateness.

DIMENSION 2: CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

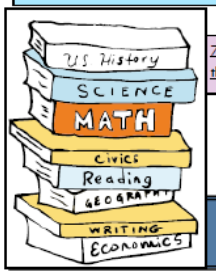
5. Energy and matter: Flows, cycles, and conservation– Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
- The total amount of energy and matter in closed systems is conserved.
- Energy drives the cycling of matter within and between systems.
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

6. Structure and Function – The way an object is shaped or structured determines many of its properties and functions.

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

37 1/2 % of the Grade 12 (2009) assessment was Life Science, 37 1/2 % Physical Science and 25% Earth and Space Science.

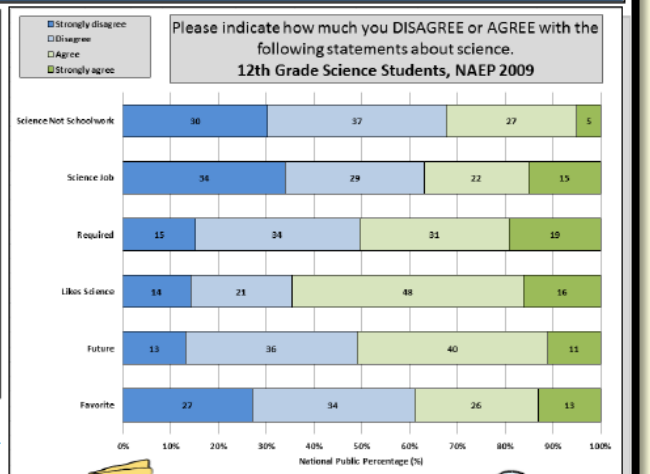


7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Systems can be designed for greater or lesser stability.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Much of science deals with constructing explanations of how things change and how they remain stable.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Classroom contexts. Results from the cognitive items provide information about what students know and can do in a subject area. Information from the background items gives context to NAEP results and allows researchers to track factors associated with academic achievement. More information can be found here, here and here.

In the life sciences- "students should be able to explain chemical mechanisms for metabolism, growth, and reproduction in living systems; analyze cases of evolutionary change in populations using the following related science principles: the potential of a species to increase its numbers, the genetic variability of its offspring, limitations on the resources required for life, and the ensuing selection of those organisms better able to survive and leave offspring; and use scientific models to explain data patterns related to metabolism, genetics, or changes in ecosystems" (The Nation's Report Card, p.52).



NOTE: Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Explore NAEP data in the NDE

Montana's Content Standard 3: 3.3 and 3.4

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

3. Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., punnett squares)

- A. Explain the function of a chromosome. NGSS: MS-LS3-1
- B. Identify organisms that have different numbers of chromosomes. NGSS: MS-LS3-1
- C. Identify the number of chromosomes in human body cells and human sex cells.
- D. Identify the purposes of cell division. NAEP: L8.2
- E. Describe the key events in each phase of mitosis. NAEP: L8.3; L8.2 NGSS: MS-LS3-2
- F. Identify the differences in mitosis and meiosis. NAEP: L8.9; L8.2 NGSS: MS-LS3-2
- G. Differentiate between sexual reproduction and asexual reproduction. NAEP: L8.9 NGSS: MS-LS3-2
- H. Define and identify gene, inheritance, phenotype, and genotype. NGSS: MS-LS3-1; MS-LS4-5
- I. Define and identify dominant and recessive traits. NGSS: MS-LS4-5
- J. Identify examples of inherited characteristics. NAEP: L8.9; L8.10 NGSS: MS-LS4-5
- K. Explain why inherited characteristics of living things depend on genes. NAEP: L8.10 NGSS: MS-LS3-1
- L. Define punnett square and genetic cross
- M. Predict genetic crosses using punnett squares
- N. Interpret simple genetic crosses using punnett squares

http://www.nextgenscience.org/msls3-heredity-inheritance-variation-traits
http://www.nextgenscience.org/msls4-biological-evolution-unity-diversity

4. Investigate and explain the interdependent nature of populations and communities in the environment and describe how species in these populations adapt by evolving

- A. Distinguish between a population and a community. NAEP: L8.6 NGSS: MS-LS2-1
- B. Identify living and non-living factors that affect populations and communities. NAEP: L8.4; L8.7 NGSS: MS-LS2-4; MS-LS2-3; MS-LS2-1; MS-LS2-2; MS-LS2-5
- C. Identify the different types of symbiosis and their positive and negative effects. NAEP: L8.6
- D. Explain how populations are impacted by changes in living —and non-living factors in the environment. NAEP: L8.7; L8.8; L8.11
- E. Explain and provide examples of adaptations NAEP L8.6; L8.4 NGSS: MS-LS4-2
- F. Define natural selection NAEP: L8.8; L8.11 NGSS: MS-LS4-4
- G. Explain the relationship between adaptations and natural selection. NAEP: L8.6; L8.11 NGSS: MS-LS4-1; MS-LS4-2; MS-LS1-4
- H. Identify natural selection as a mechanism for evolution. NAEP: L8.6; L8.8; L8.11 NGSS: MS-LS1-5; MS-LS1-4; MS-LS4-1; MS-LS4-4
- I. Identify lines of evidence that support evolution. NAEP: L8.8 NGSS: MS-LS4-1; MS-LS4-3
- J. Explain how the fossil record provides evidence of life forms' appearance, diversification, and extinction. NAEP: L8.8; L8.11 NGSS: MS-LS4-1; MS-LS4-3

*NGSS: MS-LS4-6 AND MS-LS2-5 not categorized

http://www.nextgenscience.org/msls1-molecules-organisms-structures-processes
http://www.nextgenscience.org/msls2-ecosystems-interactions-energy-dynamics
http://www.nextgenscience.org/msls4-biological-evolution-unity-diversity

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

http://opi.mt.gov/groups/montananaep/

OPI Assessment and Data Conference 2014 click here

What NAEP data tells us about what we could be doing better

Item Analysis

Question | Key/Scoring Guide | Sample Responses | National Data | Jurisdiction Data

Print

Question Information

- Description: Draw a conclusion about soil permeability using data
- Grade: 8
- Year: 2011
- Block & Number: Block S11 Question #6
- Type of Question: Short Constructed Response
- Difficulty: Hard (27.16% Correct)
- Content Classification:
  - **Content Area:** Earth and Space Sciences
  - **Science Practices (2009 and on):** Using Scientific Inquiry

Questions 6 - 8 refer to the following information.

Most soils are a mixture of particles of different sizes. Water moves through soil at different rates, depending largely on how much of each size particle makes up the soil. The table below shows the percentage of each size particle in five different soils (A, B, C, D, E) and the rate at which water moves through each of the soils.

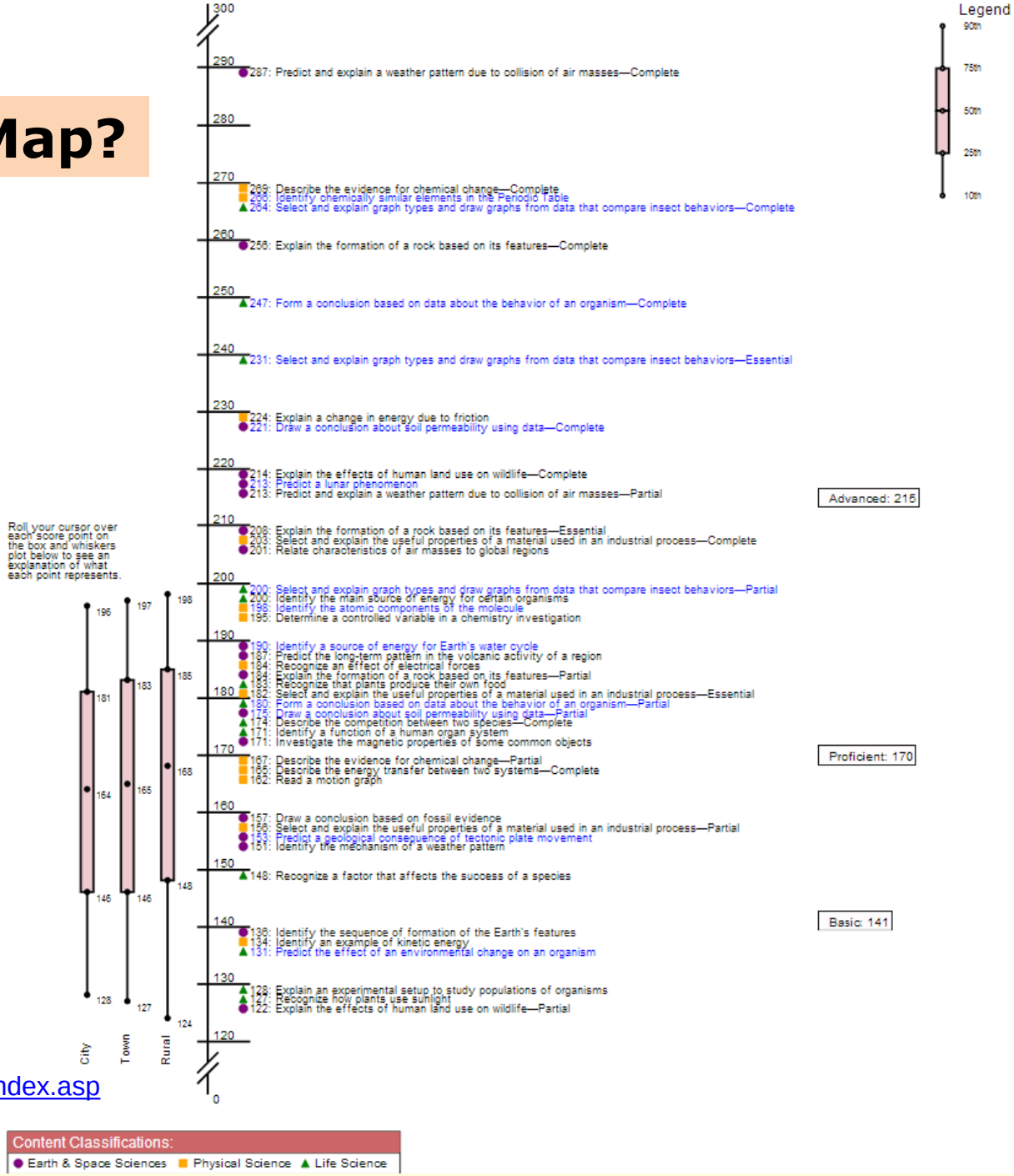
RATE OF WATER MOVING THROUGH DIFFERENT SOILS

Soil	Percentage Largest Particles (%)	Percentage Medium-Sized Particles (%)	Percentage Smallest Particles (%)	Rate of Water Draining Through Soil (cm/hr)
A	100	0	0	21
B	85	10	5	6.1
C	40	40	20	1.3
D	20	65	15	0.69
E	0	0	100	0.05

6. Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

What is an Item Map?

- A mapping of individual assessment items to points on the NAEP scale
- An item is mapped to the point on the scale at which students are likely to get the item correct/complete



http://nces.ed.gov/nationsreportcard/itemmaps/index.asp

HANDS-ON EXPERIENCE

What is it like to be a NAEP science scorer?

NAEP Scoring

- Constructed response types:
  - SCR (2-3 score points)
  - ECR (4 or more score points)
- Explicit scoring guides matched to assessment specification document
- Qualified and experienced scorers
- Monitors scoring consistency
- Assesses scorer decision-making
- Documents all scoring aspects of the assessment

Processing and scoring totals, national main and state assessments, by year and subject area: 2000–2008

Year	Subject Area	Grade	Number of booklets scored	Number of constructed responses	Number of individual cognitive items	Number of team leaders	Number of scorers
2005	Science	4,8,12	349,100	4,424,511	539	39	393

Training Materials – Anchor Set

NAEP Science 2009
09F2S11_06
Relationship size of particles and rate of water
Anchor Set

Paper	Ref #	Score	Notes
A-1	(256337)	3	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil and includes supporting data from the table: . . . *more large particles, water will drain more quickly. . . Soil A has 100% larger . . . water moves at 21 cm/hr . . . Soil E, which has 100% smaller particles . . . moves at 0.05 cm/hr.*
A-2	(256401)	3	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil and includes supporting data from the table: *The larger the particles in the soil, the faster the water moves through. Soil A had 100% large particles and the water moved faster through Soil A.*
A-3	(256311)	3	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil and includes supporting data from the table: *moves slower through little particles (E) moves faster through big particles (A).*
A-4	(256476)	2A	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil but does not include supporting data: *The larger the partioles the faster water moves the smaller the particles the slower water moves.*
A-5	(256375)	2A	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil but does not include supporting data: . . . *smaller the particles sizes . . .the slower water will move.*
A-6	(256485)	2A	Response correctly describes the relationship between size of soil particles to rate of water passing through the soil but does not include supporting data: *The larger the soil particles, the faster water moves through the soil.*

Training Materials – Anchor Set

WFMID: Z3526900
NAEP 2009 Grade 08 Subject SC Batch I0077900 Sequence 0000256337
UIN 00020346919815200902 Import Item ID 09F2S11_06 PAS 007700199
Clip VC298869

A-1

3

VC298869

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

If there are more larger particles, the water will drain more quickly. Soil A has 100% larger particles, so water moves through the soil more rapidly than Soil E, which has 100% smaller particles. Soil A's water moves at 21cm/hr, and Soil E's water moves at 0.05cm/hr.

WFMID: Z3526900
NAEP 2009 Grade 08 Subject SC Batch I0119900 Sequence 0000256476
UIN 00020800479809200902 Import Item ID 09F2S11_06 PAS 011900022
Clip VC298869

A-4

2A

VC298869

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

The larger the particles the faster water moves the smaller the particles the slower water moves.

WFMID: Z3526900
NAEP 2009 Grade 08 Subject SC Batch I0009900 Sequence 0000256432
UIN 00020795509803200902 Import Item ID 09F2S11_06 PAS 000900119
Clip VC298869

A-7

2B

VC298869

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

When at soil A 100% of the largest particles it moves through the water at a rate of 21 cm. per hour. At soil E 100% of the smallest particles it drains through the water at 0.05 cm. per hour.

WFMID: Z3524900
NAEP 2009 Grade 08 Subject SC Batch I0003900 Sequence 0000000018
UIN 00020247099813200902 Import Item ID 09F2S11_06 PAS 000300037
Clip VC298869

A-9

1

VC298869

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

The bigger the soil particle is, the slower it moves. The smaller it is, the quicker it moves.

"A" Anchor

Question #

Reviewer's score

Training Materials – Scoring Form

Scoring Form

Project: NAEP **Grade**: 8 **Subject**: Science

Item: F2S11_06 Relationship size of particles and rate of water

Scorer Name:_____ **ID#**: _____ **Date**: _____

P1	*Reader Score*	*Actual Score*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		%

P2	*Reader Score*	*Actual Score*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		%

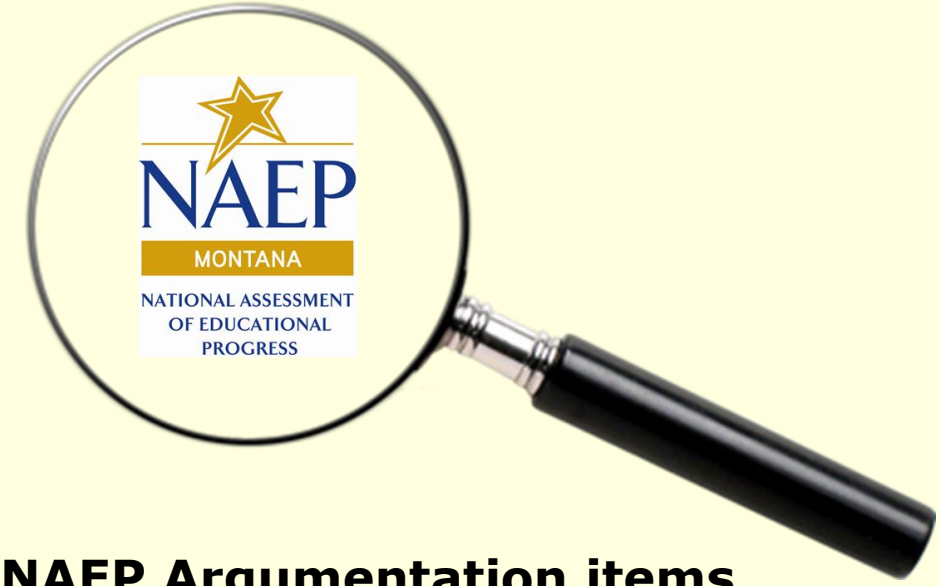
Potential scorers use this form to record practice scores.

To qualify to score this item, the potential scorer must score 90% correctly.

Practice

15 mins to score 10 items

Leveraging Large Scale Test Data: Using NAEP to Affect State Level Policy



1. **How can state level data on NAEP Argumentation items inform decisions about standards adoption?**

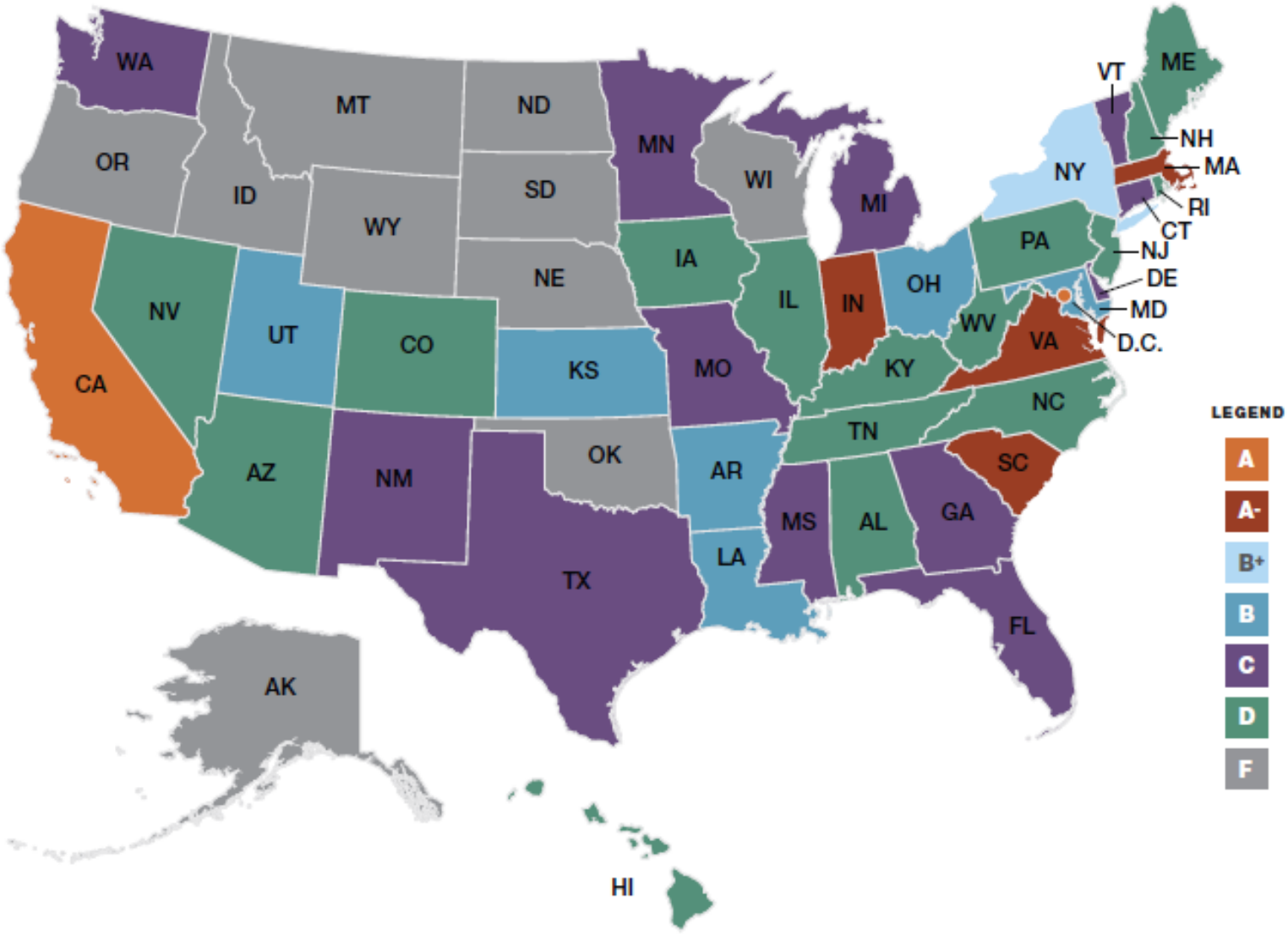
2. **NGSS integrates science practices and content.**
   1. Argumentation is a NGSS Practice
   2. Coverage of Argumentation is weak in the current MT Standards

3. **Refine items - Grade 4 and Grade 8 Constructed Response items from 2009 – 2011.**

4. **Evaluated available items for argumentation.**

5. **Review Scoring guides-complete answer requires correct science content AND evidence/reasoning**

State Science Standards Grades, 2012



REPORT CARD

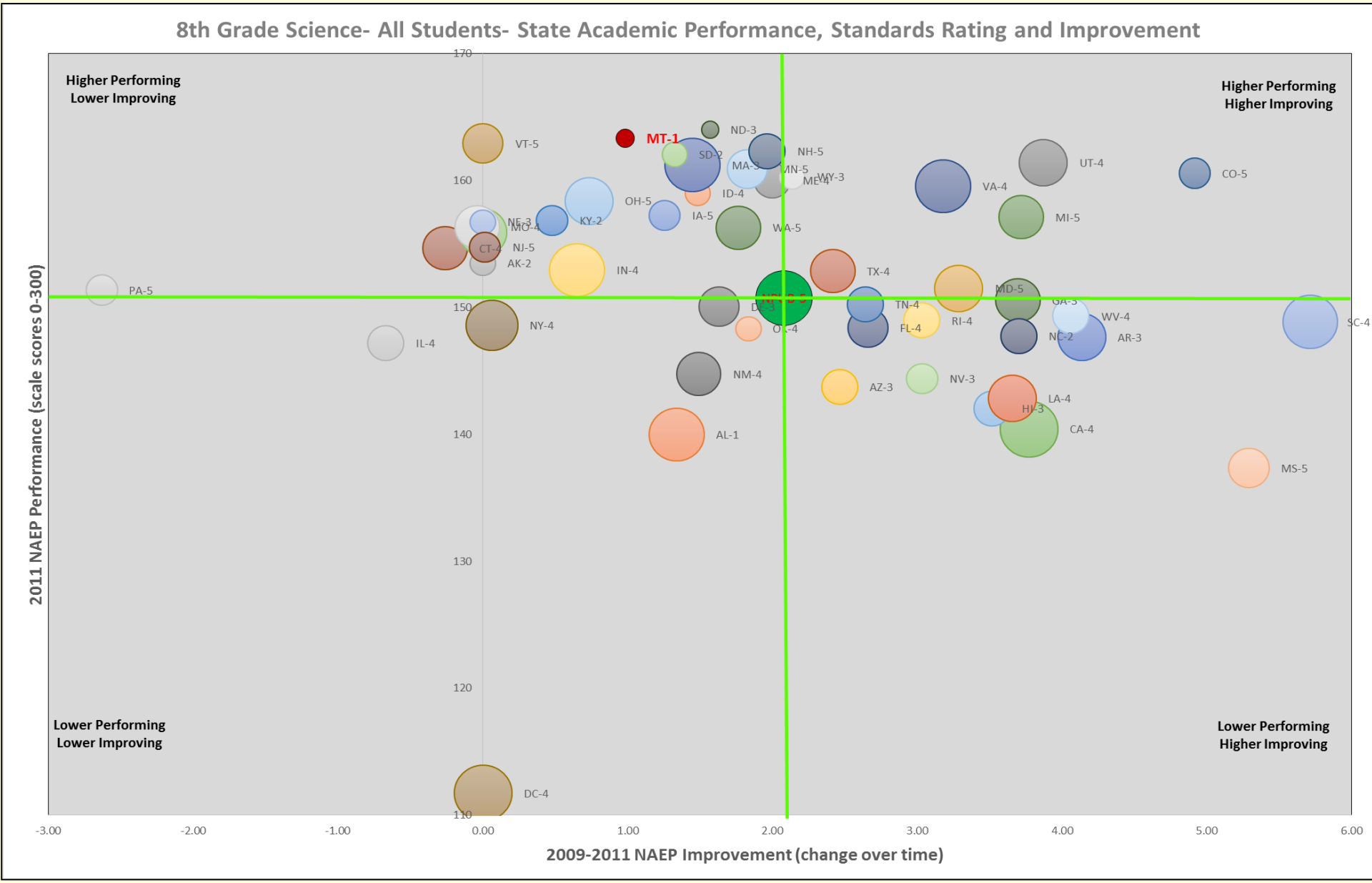
Content & Rigor	**1.3**
Scientific Inquiry & Methodology	2
Physical Science	1
Physics	0
Chemistry	0
Earth & Space Science	2
Life Science	3
Clarity & Specificity	**0.0**

Average numerical evaluations

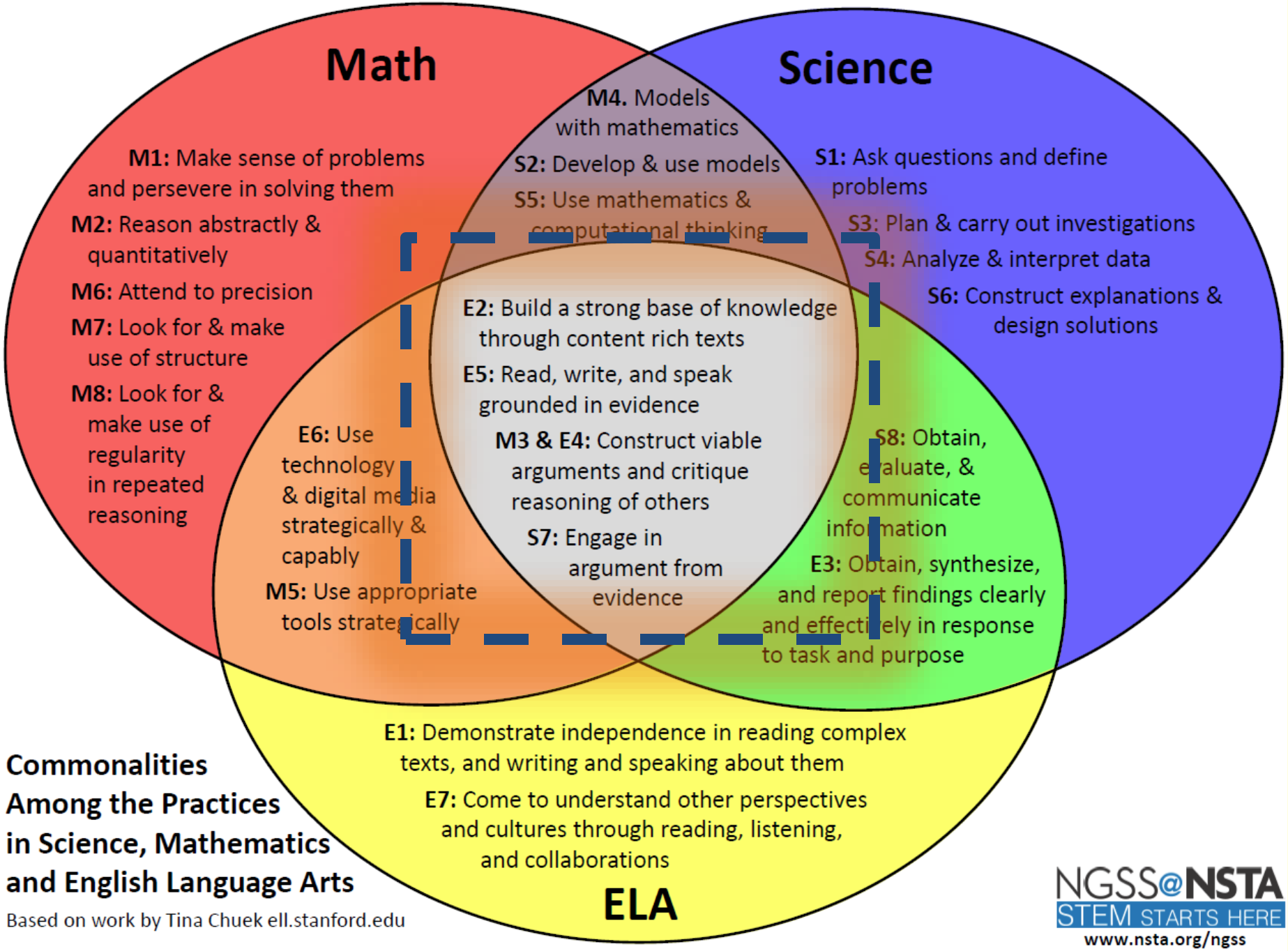
GRADE	SCORES		TOTAL SCORE
F	Content and Rigor	1/7	1/10
	Clarity and Specificity	0/3	

Fordham Score

Grade 8 Overall Science



NOTE: The green lines represent national public (NPUB) averages: the vertical green line is average improvement, and the horizontal green line is the average 2011 performance. The focus state (Montana) appears in solid red. The number after the state's jurisdiction token is the state's argumentation score (0-5) for review of their standards. Circle size correlates to the Fordham (2012) state standards review.



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

NGSS@NSTA
STEM STARTS HERE
www.nsta.org/ngss

Argumentation

- An essential element (1) for building new knowledge and (2) learning of science
- Is a best practice and reinforces 21st century skills *(e.g., communicative practices & critically thinking).*
- Evidence-based explanations (E-E) facilitate the construction of conceptual knowledge
- E-E is a key aspect of science and should be a key component of science pedagogy.

MS Structure and Function:

Use argument supported by evidence for how the body is a system of interactive subsystems composed of groups of cells.

NGSS:
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Montana Science Content Standards:
Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate the results and form reasonable conclusions of scientific investigations.
1.3 review, communicate and defend results of investigations, including considering alternative explanations

3 Criteria

Table 2

	Criteria for Item Selection
Criteria 1	Question must require use of data or reasoning to support a claim
Criteria 2	No item scoring category that allows for multiple response types can have both a response that has correct science content without supporting data or reasoning AND a response with incorrect science content either in the scoring guide or the sample responses
Criteria 3	Item must have two scoring categories that both have correct science content where one requires supporting data or reasoning and the other does not

Page 7 Page 11 Page 28

What NAEP items are E-E Items

Table 3

Item	Criteria 1	Criteria 2	Criteria 3
Choose and critique setups for investigating the growth of plants	Pass	Pass	Fail[c]
Compare the relative speeds of two balls	Pass	Pass	Pass
Critique a conclusion about chemical change based on observations	Pass	Fail[a]	
Critique and improve investigation about forces	Pass	Pass	Fail[c]
Critique prediction about the amount of soil runoff	Pass	Fail[a]	
Design an experiment to investigate inheritance in plants	Pass	Pass	Fail[c]
Design investigation to compare types of bird food	Fail		
Draw a conclusion about soil permeability using data	Pass	Pass	Pass
Draw representation of part of solar system	Fail		
Explain and critique two plans to prevent erosion	Pass	Fail[b]	
Explain cause of change in soil permeability	Pass	Pass	Fail[c]
Explain change in volume due to evaporation	Pass	Pass	Fail
Explain choice of material based on protection of the environment	Pass	Pass	Fail
Explain differences between related individuals	Pass	Pass	Pass
Explain how particle size affects permeability	Pass	Pass	Fail
Explain why rainwater is not salty	Pass	Pass	Fail[c]
Form a conclusion based on data about the behavior of an organism	Pass	Fail[a]	
Identify and explain most recent rock formation	Pass	Fail[a]	
Identify relationships in a food web	Fail		
Predict and explain the phenomenon based on evaporation	Pass	Fail[a]	
Predict changes in populations based on the food web	Pass	Fail[b]	
Provide ways to reduce greenhouse gas emissions	Fail		
Relate a weather condition to patterns in data	Pass	Pass	Fail[d]
Relate variations in temperature to absorption and reflection of sunlight	Pass	Pass	Fail[c]
Select and explain graph types and draw graphs from data that compare insect behaviors	Pass	Fail[b]	

- **Fail[a]** allows for two response types that are inconsistent with criteria 2.
- **Fail[b]** composite score breakdown on the question is inconsistent with criteria 2.
- **Fail[c]** difference between score categories is completeness of explanation, not incorrectness. In these items, the missing part of the answer could be related to content or supporting data/reasoning.
- **Fail[d]** scoring category that allows for both a response with no supporting data/reasoning AND a response with incomplete supporting data/reasoning

Page 7 **Page 11** **Page 28**

Figure 1 **Page 7**

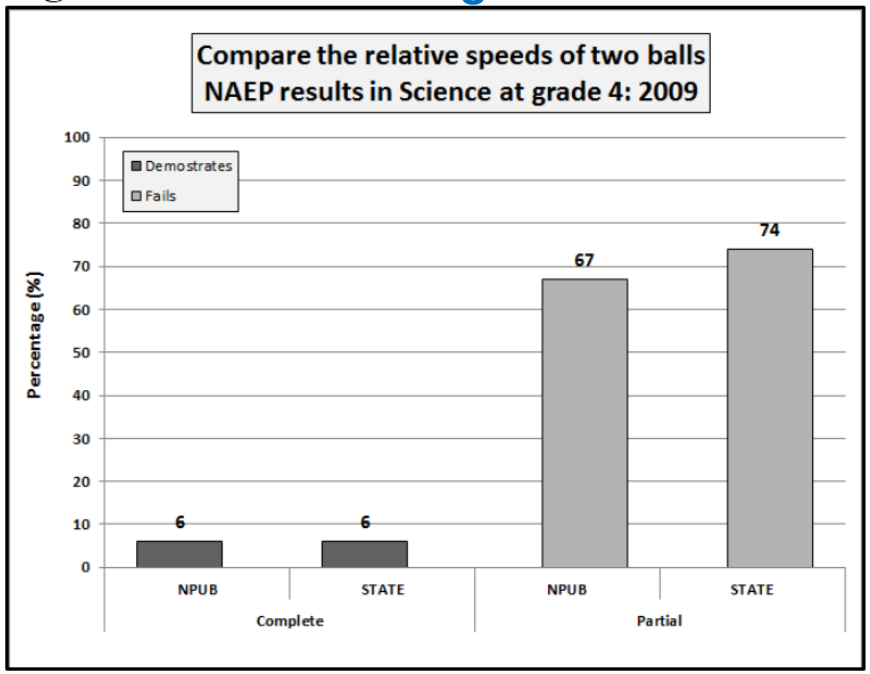


Figure 2 **Page 11**

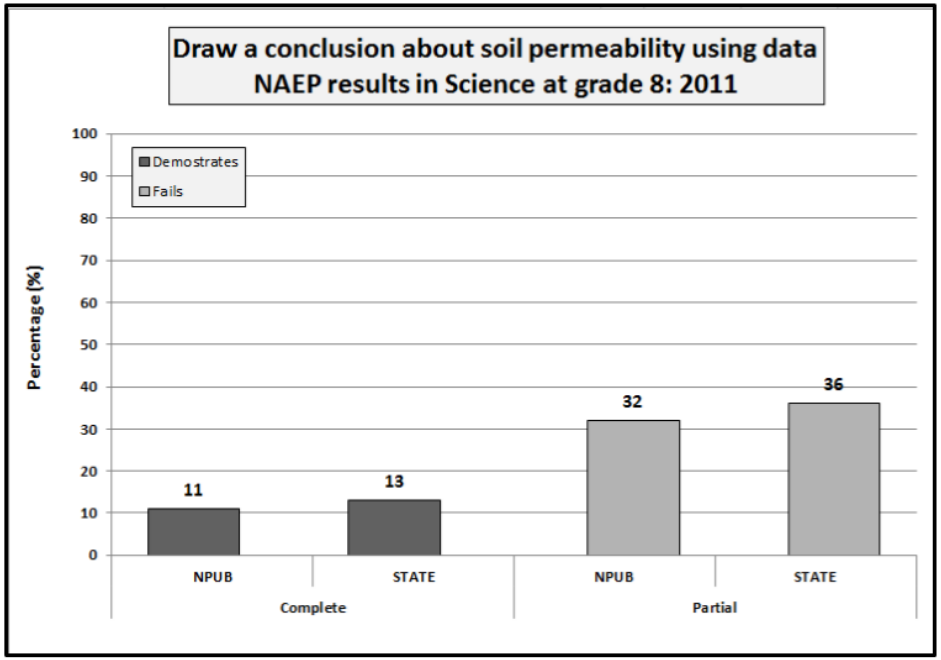
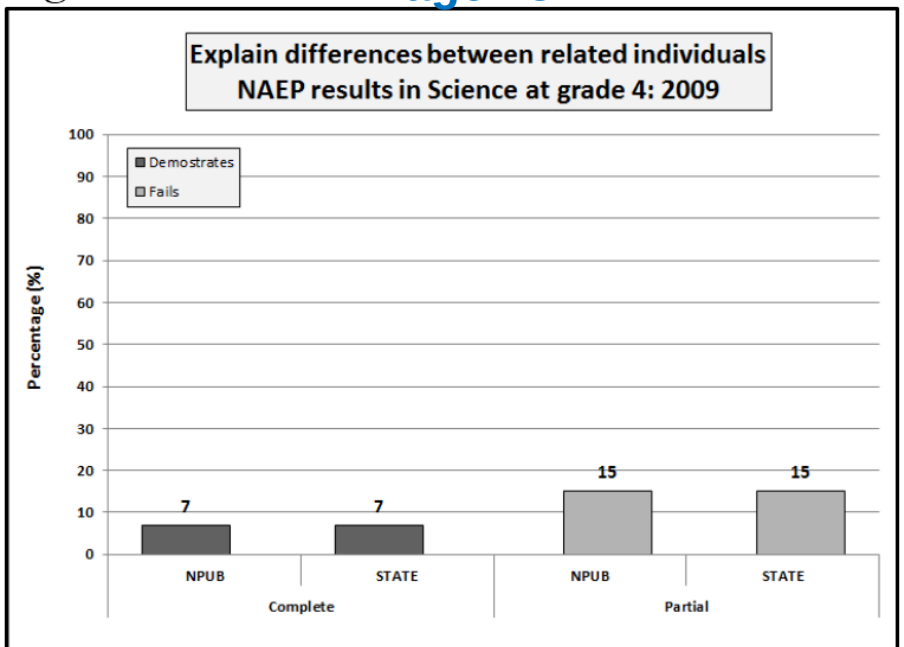


Figure 3 **Page 28**



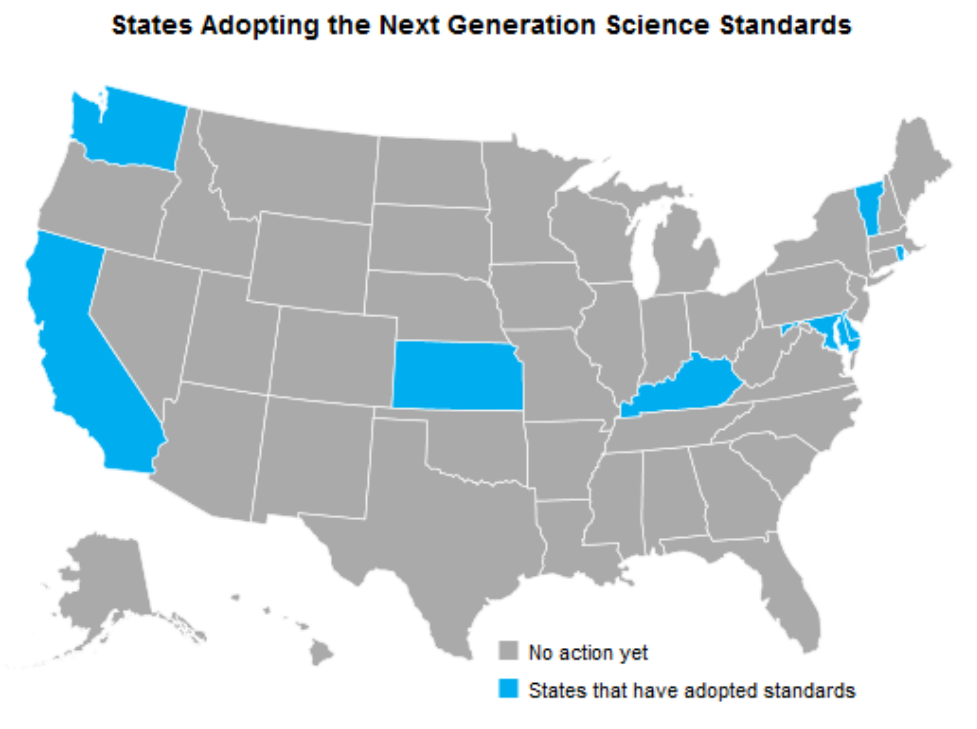
Figures 1 – 3

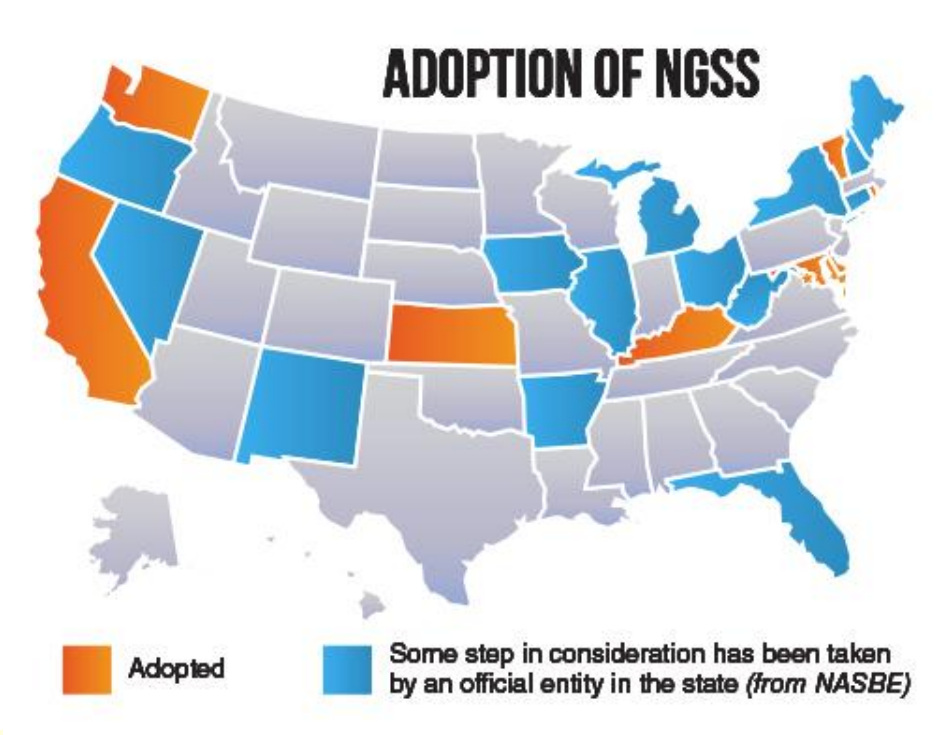
National Public (NPUB).
"**Complete**" = demonstrates argumentation.

"**Partial**" = failure to demonstrate argumentation.

Total count of adopting states to 9

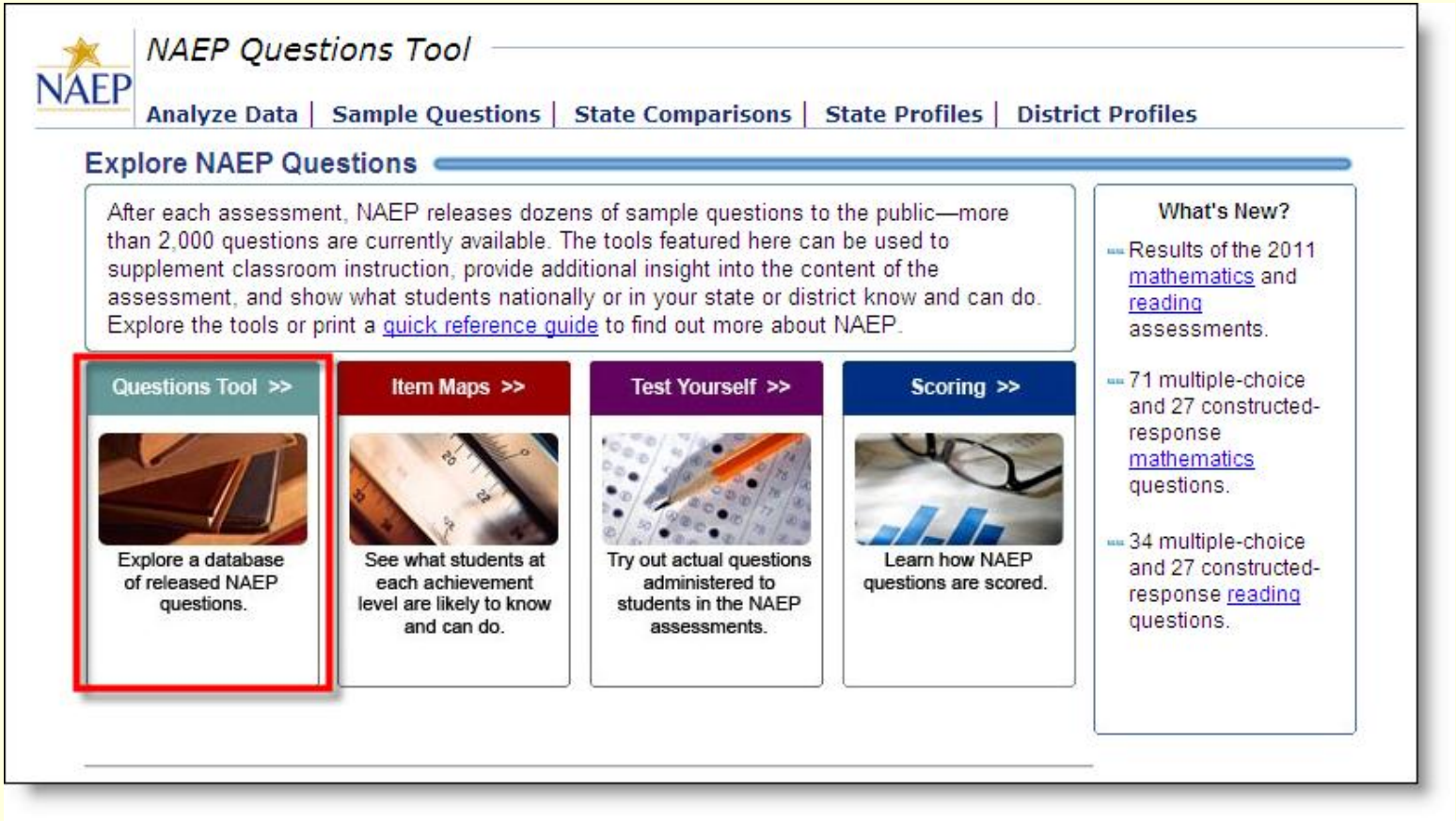
Rhode Island, Kentucky, Kansas, Maryland, Vermont, California, Delaware, Washington, and the District of Columbia.





http://ngss.nsta.org/wp-content/uploads/2013/12/AdoptionOfNGSS_map.jpg

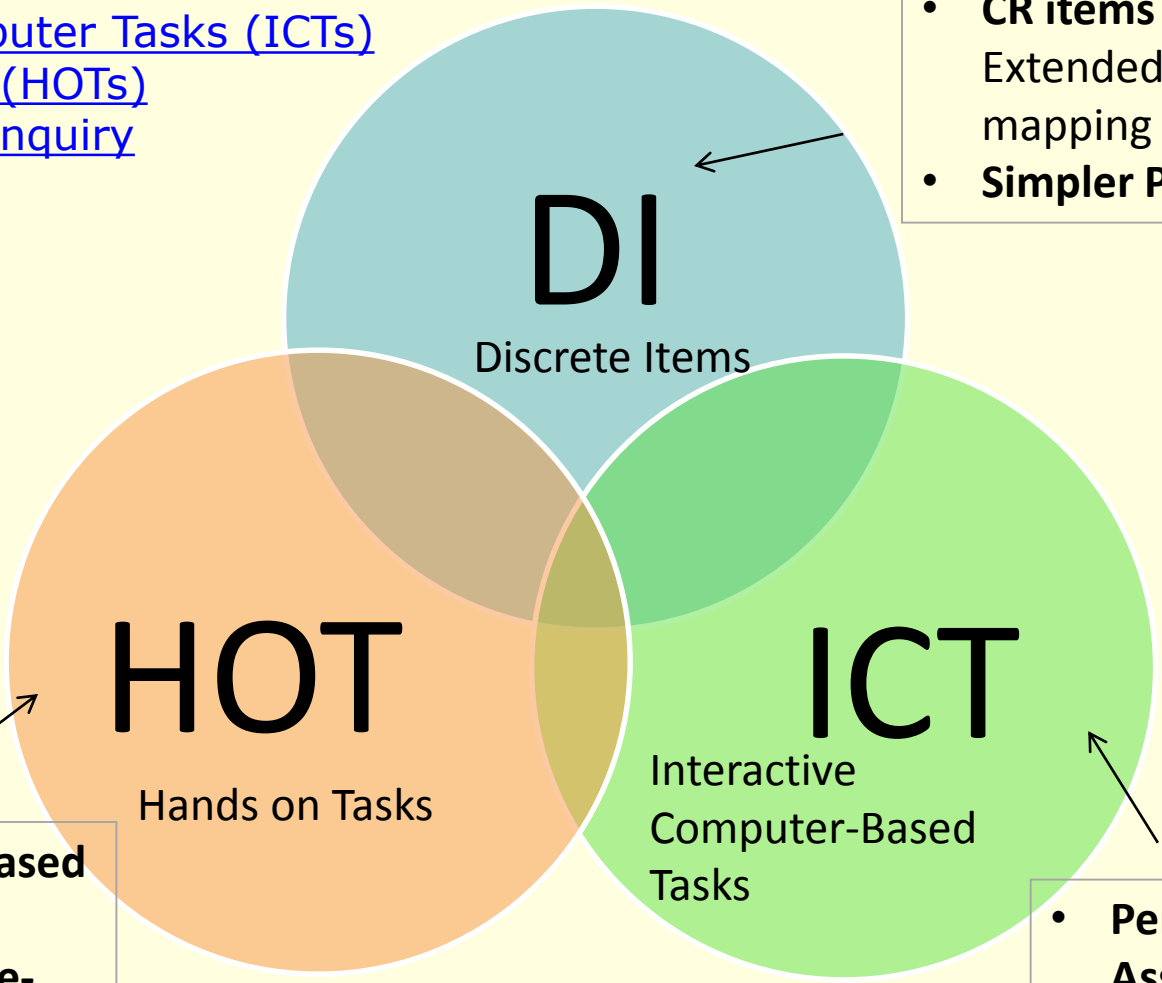
Using the NAEP Questions Tool to Locate Additional Test Items



Task Types in NAEP Science

Item Examples:
[Interactive Computer Tasks (ICTs)]
[Hands-On Tasks (HOTs)]
[Using Scientific Inquiry]
[NQT]

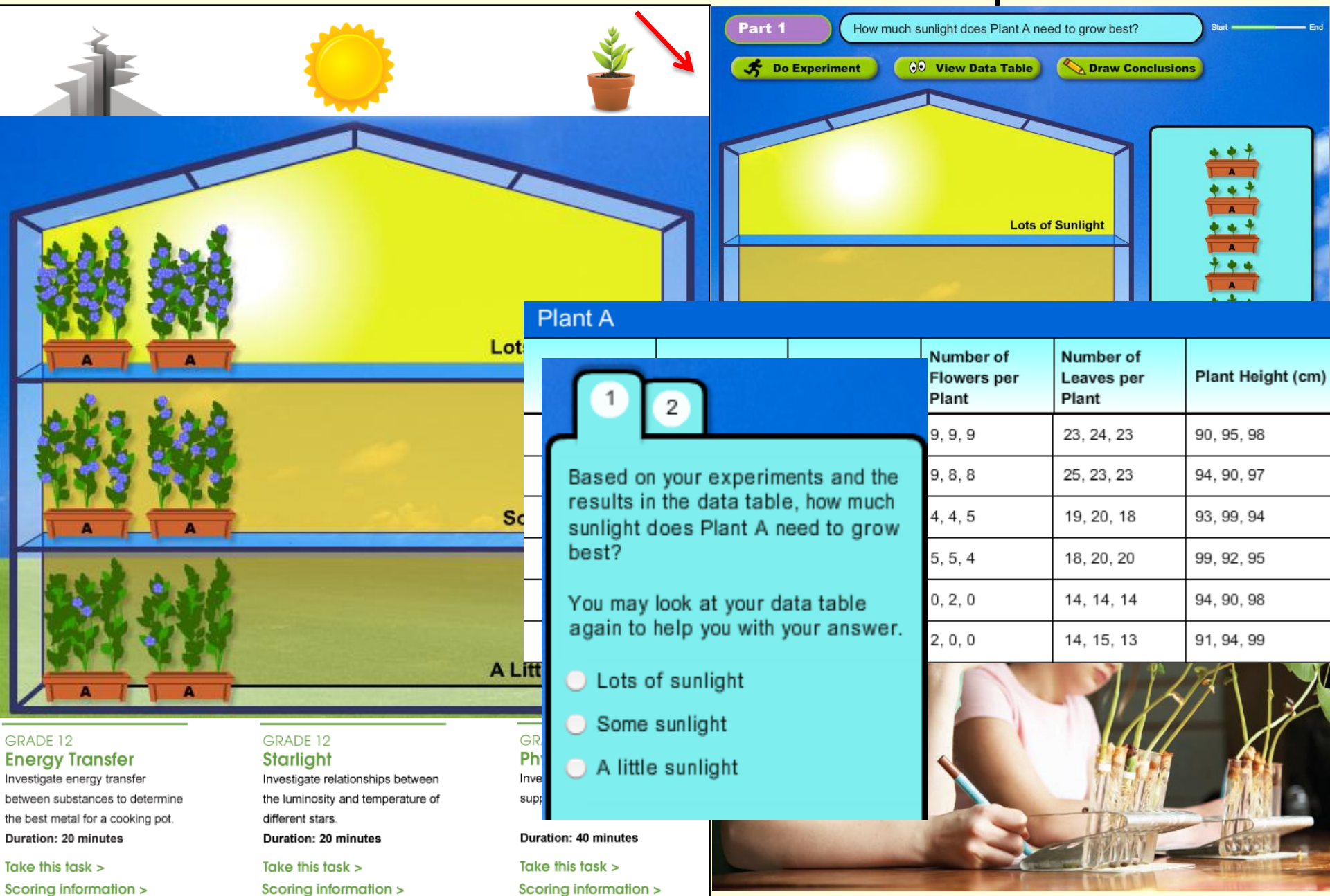
- Selected response (**MC)**
- **CR items** — Short CR; Extended CR; Concept-mapping tasks
- **Simpler Processes or Tasks**



- **Performance Based Assessment**
- **Predict-Observe-Explain (POE)**
- **More Complex Processes or Tasks**

- **Performance Based Assessment**
- **More Complex Processes or Tasks**

1. Test Yourself on an Interactive Computer Task



http://nationsreportcard.gov/science_2009/ict_tasks.asp

“state testing consortia are designing technology-enhanced items to test English Language Arts and Math common core standards, so it is likely that tests of the forthcoming Next Generation Science Standards will include innovative task and item formats” (Quellmalz, et. al, 2012).

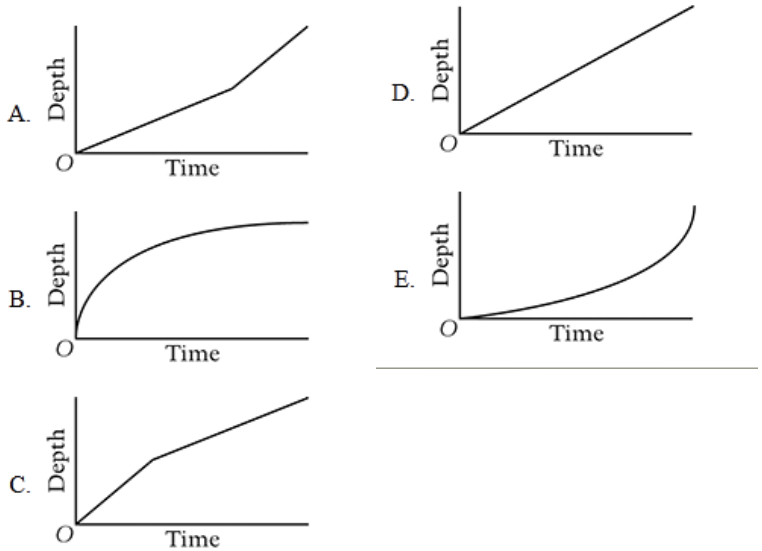
http://nationsreportcard.gov/science_2009/

Not just limited to "Science" review items and scoring guides

NAEP Mathematics at grade 8: 2013
Identify graph representing a situation

Math Example

Martine is filling a rectangular fish tank using two hoses that fill the tank at the same flow rate. When the tank is about half full, she turns off one hose but does not change the flow rate of the other hose. Which of the following graphs best represents how the depth of the water in the tank changes over time?



Answer: C

62% of MT students answered correctly

NAEP Reading at grade 4: 2013
Little Great White: Use information from article to provide and support an opinion

Reading Example

Based on the article, is it a good idea to keep white sharks in captivity? Explain your answer using information from the article.

It is not a good idea because alot of them do not eat in captivity so they will die. It is also not a good idea because ther are not in their natural habbitat.

Scorer Comments:

Both responses support an opinion with information from the article. The first response refers to the overall idea of sharks being studied as well as to the text detail that sharks "have a terrifying reputation." The second response refers to a specific idea from the article about sharks not eating in captivity.

NAEP Online Resources

Sample Questions Booklets
Examine the types of questions students will answer.
http://nces.ed.gov/nationsreportcard/parents/

Content Area Frameworks
Frameworks guide the development of NAEP and determine the content to be assessed.
http://www.nagb.org/publications/frameworks.htm

Frameworks overviews provide short summaries for each subject
http://nces.ed.gov/nationsreportcard/frameworks.asp

Information for Parents
Read eight things parents should know about NAEP.
http://nationsreportcard.gov/parents.asp

See more information at
http://nces.ed.gov/nationsreportcard/parents/

Information for Educators
Create your own NAEP test and see what students know and can do.
http://nationsreportcard.gov/educators.asp

Information for Students
Encourage students to test themselves using NAEP questions.

Show students where they can find answers to their questions about NAEP.
http://nces.ed.gov/nationsreportcard/students/

Watch the popular video featuring interviews with actual students.
http://nces.ed.gov/nationsreportcard/videos/naepstudent.asp

Data Tools
Explore NAEP results with online data tools.
http://nationsreportcard.gov/data_tools.asp

NAEP on the Go!
Download the new NAEP Results mobile app today!