Impact of Multidimensionality of New Science Standards on Student Performance and Alternate Assessment Development

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West Virginia DEPARTMENT OF EDUCATION

Missouri DEPARTMENT OF ELEMENTARY & SECONDARY EDUCATION™

DYNAMIC® LEARNING MAPS

Purpose of Session

- Better understand how the new multidimensional science standards (based on the *Framework for K-12 Science Education* and the NGSS) impact alternate assessment development and student performance.
- Discuss implications for students and teachers and assessment design and reporting.

Session Questions

1. What is the relationship between student responses to test items and item dimensionality?
2. Are there associations between student responses to test items and Science and Engineering Practices (SEPs) the items measure?
3. What implications do the findings have for instruction and assessment?

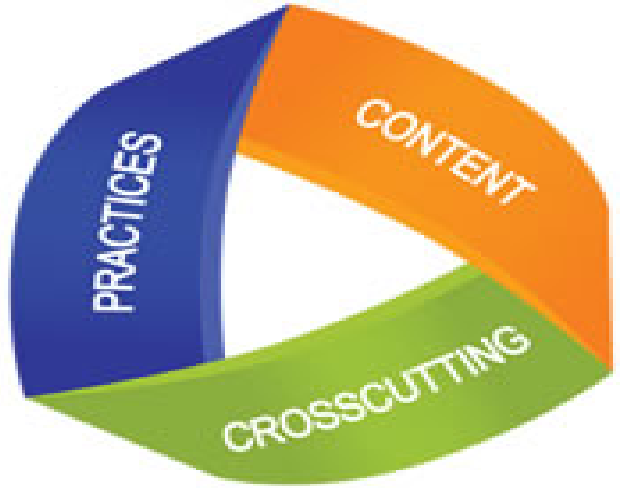
Session Agenda

- Brief description of DLM Science Assessment system – Sue Bechard
- Description of study and results – Brooke Nash
- Implications for students and teachers – Melissa Gholson
- Implications for assessment design and reporting – Shaun Bates
- Audience feedback

Sue Bechard

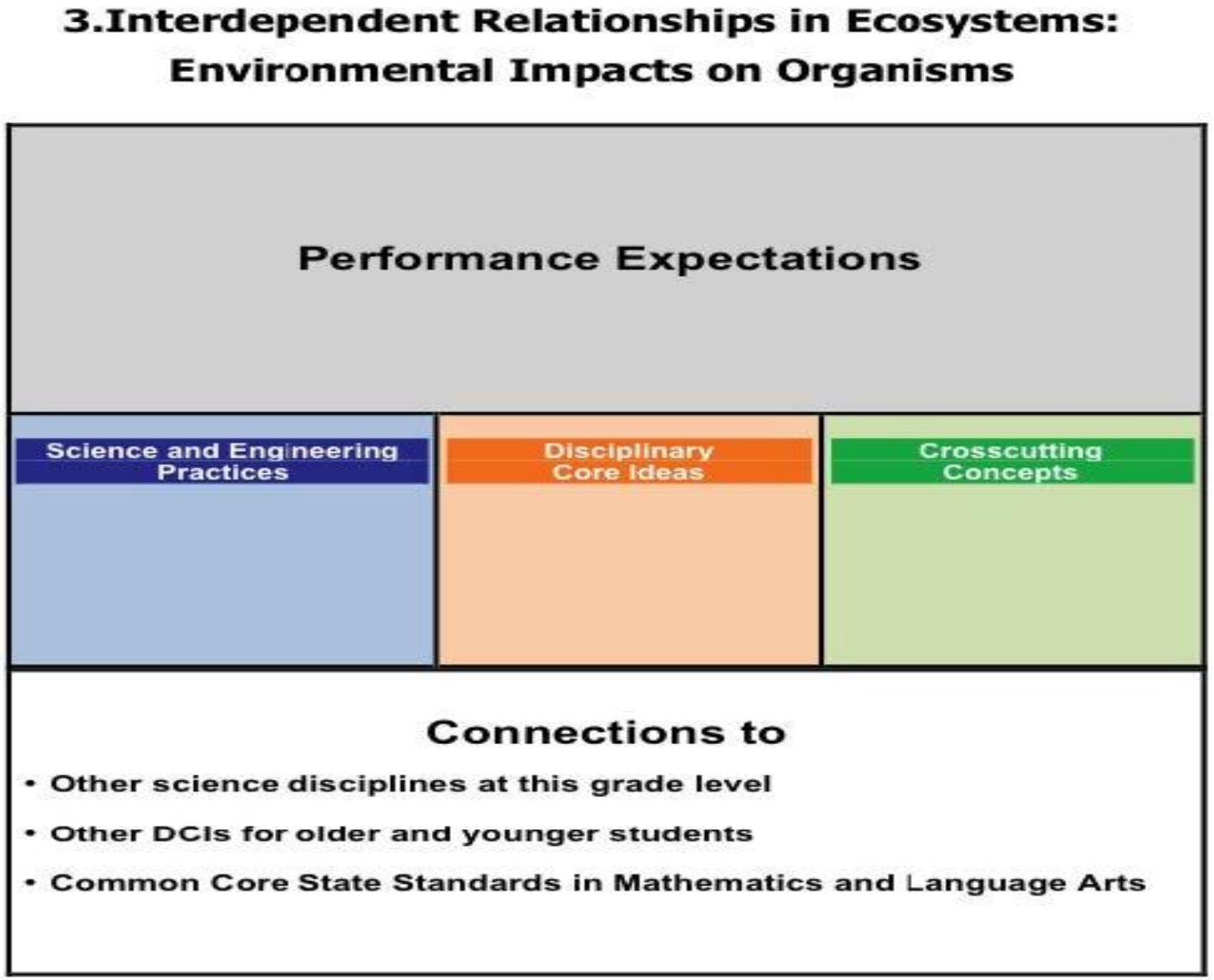
BRIEF OVERVIEW OF DLM SCIENCE

A Framework for K-12 Science Education



- 3 Dimensions
  - **Disciplinary Core Ideas**
    - » Grouped by discipline (PS, ESS, LS)
    - » Each group has 3 to 5 topics
  - **Science and Engineering Practices**
    - » 8 practices that scientists and engineers use
    - » Described as sets of smaller skills for each grade span
  - **Crosscutting Concepts**
    - » 7 overarching concepts that span multiple science disciplines (e.g., patterns)

Performance Expectations are the "standards"



Middle School

Domain: Physical
Core Idea: **PS2:** Motion and Stability: Forces and Interactions
Topic: **PS2.A:** Forces and Motion
State Standard for General Education: **MS-PS2-2:** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
Essential Element: EE.MS-PS2-2 **Target Level:** Investigate and predict the change in motion of objects based on the forces acting on those objects.
Precursor Level: Investigate and identify ways to change the motion of an object (e.g., change an incline's slope to make an object go slower, faster, farther).
Initial Level: Identify ways to change the movement of an object (e.g., faster, slower, stop).
Connections to Science Practices Planning and Carrying Out Investigations
Connections to Crosscutting Concepts Stability and Change
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements **EE.6.EE.1-2:** Identify equivalent number sentences. **EE.7.EE.4:** Use the concept of equality with models to solve one-step addition and subtraction equations.

Example: DLM Essential Element in Science

IDEAs that Work
U.S. Office of Special Education Programs

DYNAMIC LEARNING MAPS

Essential Elements in Science Assessed in 2017

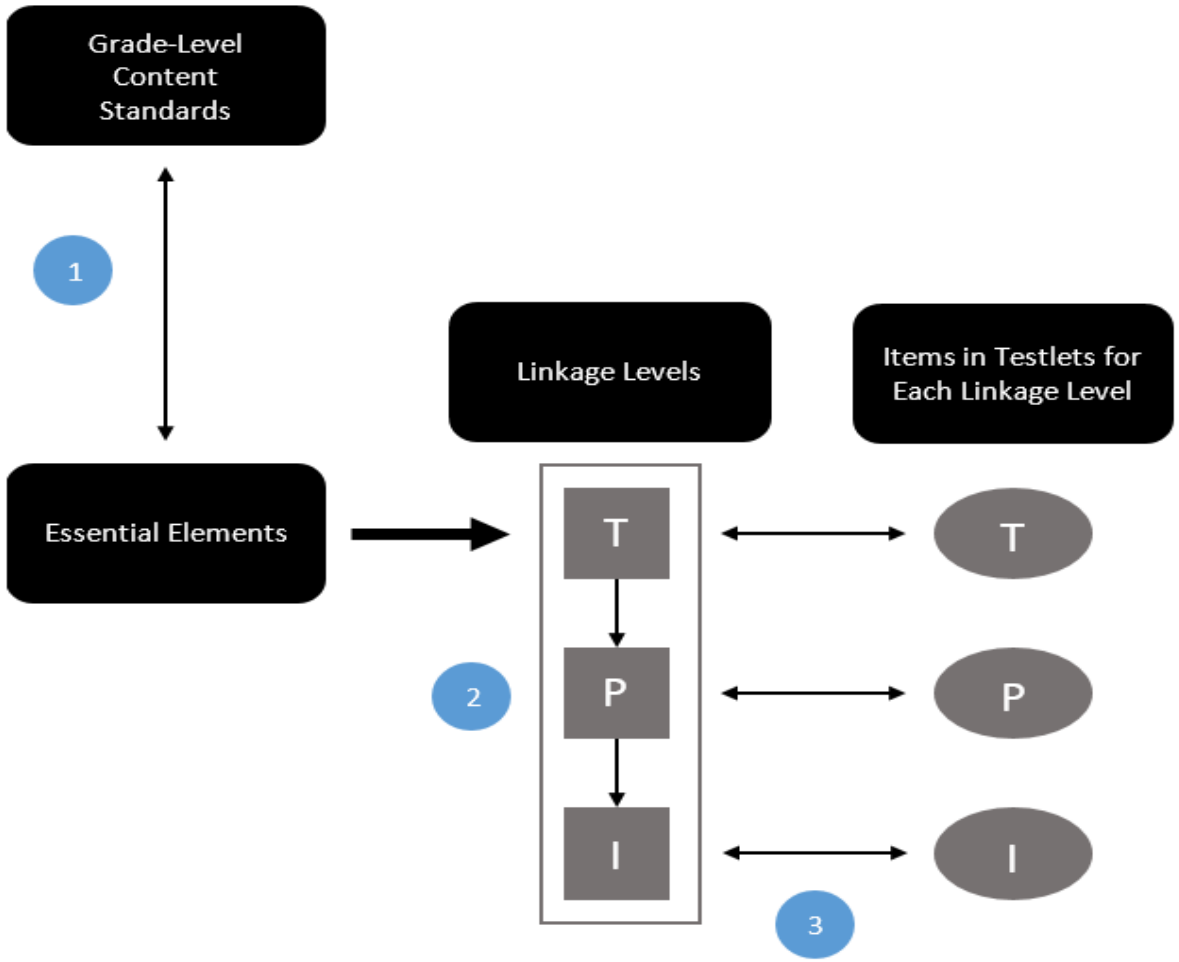
9 EEs assessed at each grade band, covering 14 topics across 10 DCIs and 3 domains :

- Elementary – grades 3-5
- Middle School – grades 6-8
- High School – grades 9-12

Each target level EE references one DCI and one SEP

- 7/8 SEPs are addressed across grade bands (all except: *asking questions and defining problems*)

Design of the DLM Science Assessment



Linkage levels:
T=Target
P=Precursor
I=Initial

Test Administration

- Science testlets are adaptive
  - The first testlet administered is based on the student's academic/communication skills
  - Subsequent testlets are determined by the student's performance
- Initial level testlets are delivered off-line
- Precursor and Target level testlets are computer-delivered

Brooke Nash

STUDY METHODS AND RESULTS

Data

- Student response data from the 2017 spring operational window.
- Parameters:
  - As of May 8th, 2017 (completed testlets)
  - 5th grade only
- Sample size = 2,300 students

DCIs and SEPs

- 4 SEPs are measured in 5th grade
  - Planning and carrying out investigations
  - Engaging in argument from evidence
  - Developing and using models
  - Analyzing and interpreting data
- 8 DCIs are measured in 5th grade

Items

- 46 items measure a DCI only
  - These are considered the unidimensional items (i.e., DCI only)
- 35 items measure both a DCI and a SEP
  - These are considered the multidimensional items (i.e., DCI+SEP)

Logistic Regression

- Does item dimensionality predict student response, after accounting for item difficulty?
- Predictor variables entered in blocks:
  - Block 1 = item difficulty (p-value)
  - Block 2 = item dimensionality code
    - 0 = unidimensional (DCI only)
    - 1 = multidimensional (DCI+SEP)
- Three separate regression analyses conducted; one per linkage level

Initial Level

Coefficient	β	SE	Wald	Sig.	Exp(β)	95% CI
P-value	3.38	0.14	564.34	.000	29.33	22.21 – 38.75
Dimensionality	0.24	0.45	27.67	.000	0.79	0.53 – 3.06
Constant	-1.34	0.06	509.47	.000	0.26	0.23 – 0.29

Precursor Level

Coefficient	β	SE	Wald	Sig.	Exp(β)	95% CI
P-value	4.15	0.17	616.18	.000	63.25	45.59 – 87.73
Dimensionality	0.09	0.03	7.61	.000	0.92	1.03 – 1.16
Constant	-2.06	0.10	393.18	.000	0.13	0.10 – 0.16

Target Level

Coefficient	β	SE	Wald	Sig.	Exp(β)	95% CI
P-value	4.77	0.15	1041.23	.000	118.08	88.32 – 157.76
Dimensionality	0.16	0.05	11.13	.001	0.85	1.07 – 1.30
Constant	-2.61	0.10	723.45	.000	0.07	0.06 – 0.09

Interpretation of Results

- For all linkage levels, item dimensionality was a statistically significant predictor of item response, after controlling for item difficulty.
  - May be an artifact of large number of cases
- In comparison to unidimensional items (DCI only), multidimensional items (DCI+SEP) increased the log odds probability of a correct response.
  - However, the odds ratios were close to one and therefore likely negligible.

Crosstabs

- Are there associations between student responses to test items and specific practices the items measure?
- Table layout:
  - Rows = item scores (0/1)
  - Columns = science and engineering practices
  - Layered by linkage level
  - Values = percent of students

Crosstabs

Linkage Level	Item Score	Planning & carrying out investigations	Engaging in argument from evidence	Using & developing models	Analyzing & interpreting data
Initial	0			60.4%	52.7%
	1			39.6%	47.3%
Precursor	0		34.7%	37.6%	45.8%
	1		65.3%	62.4%	54.2%
Target	0	26.2%	42.1%	46.0%	28.3%
	1	73.8%	57.9%	54.0%	71.7%
Total	0	26.2%	37.5%	43.6%	43.8%
	1	73.8%	62.5%	56.4%	56.2%

Summary of Results

- The evidence is inconclusive as to whether or not students are more likely to answer items correctly about a particular DCI when they are presented in a multidimensional context with a SEP.
  - **More research is needed to evaluate across grades and with more items.**

Summary of Results continued

- Some SEPs may provide a context for DCIs that make the multidimensional items easier.
  - **More research is needed to evaluate across grades and with more items.**

Next Steps

- Evaluate the relationship between SEPs and the DCIs across grades.
- Evaluate how students with the most significant cognitive disabilities attain these skills. Do they attain them independently or in tandem?

Implications for Students and Teachers

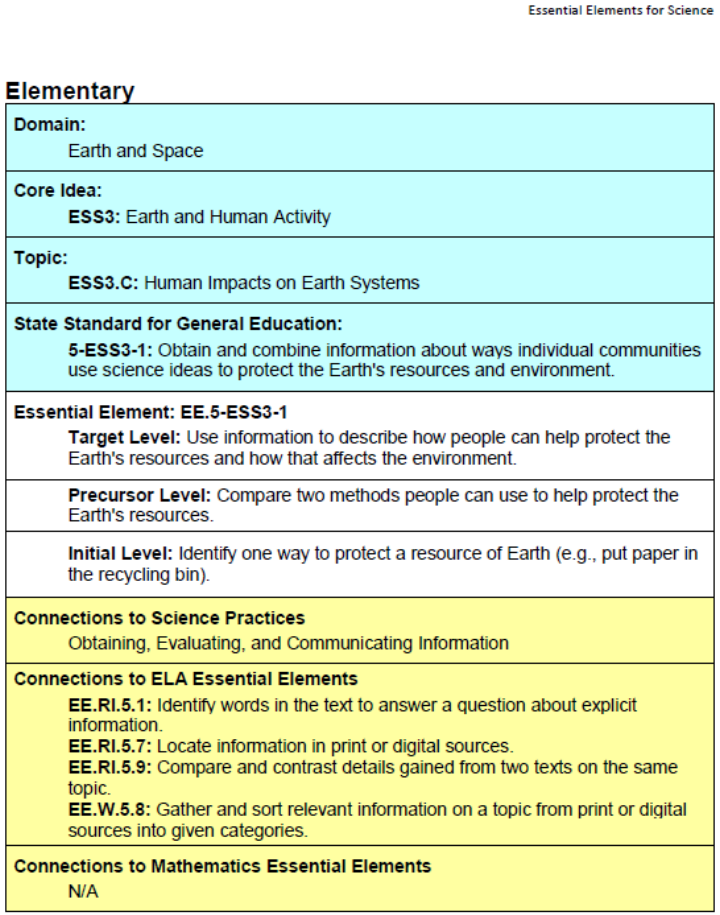
Melissa Gholson

Implications for students and teachers

- What have teachers discovered about students' ability to demonstrate knowledge of content in the context of applying a science practice?
- What have been the challenges for instruction?
- Have there been any surprises?
- Have there been shifts in performance expectations for students with SCD?

Essential Elements and Concept Development

- Teachers discovered students' have the ability to demonstrate knowledge of content in the context of applying a science practice.
- Teachers reported during surveys and observations that students were excited about the content and they felt confident in delivery.
- Teachers gave examples of how the this supported concept development for their students and provided them guidance and support for how to integrate other elements so that they were not teaching standards in isolation.



Essential Elements for Science

Elementary

Domain: Earth and Space
Core Idea: **ESS3:** Earth and Human Activity
Topic: **ESS3.C:** Human Impacts on Earth Systems
State Standard for General Education: **5-ESS3-1:** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Essential Element: EE.5-ESS3-1 **Target Level:** Use information to describe how people can help protect the Earth's resources and how that affects the environment.
Precursor Level: Compare two methods people can use to help protect the Earth's resources.
Initial Level: Identify one way to protect a resource of Earth (e.g., put paper in the recycling bin).
Connections to Science Practices Obtaining, Evaluating, and Communicating Information
Connections to ELA Essential Elements **EE.RI.5.1:** Identify words in the text to answer a question about explicit information. **EE.RI.5.7:** Locate information in print or digital sources. **EE.RI.5.9:** Compare and contrast details gained from two texts on the same topic. **EE.W.5.8:** Gather and sort relevant information on a topic from print or digital sources into given categories.
Connections to Mathematics Essential Elements N/A

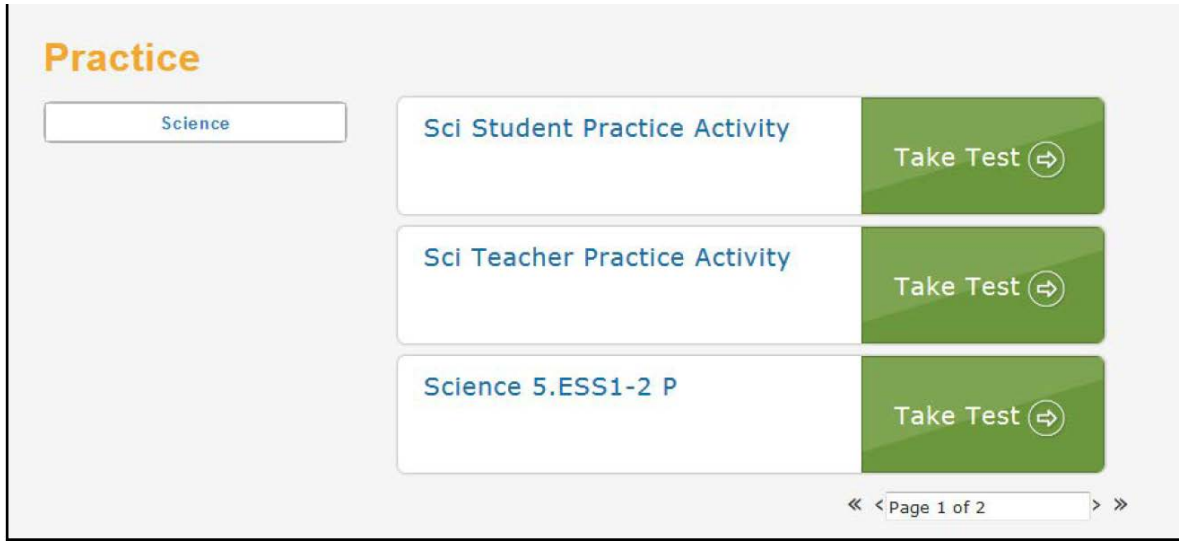
Challenges for Instruction

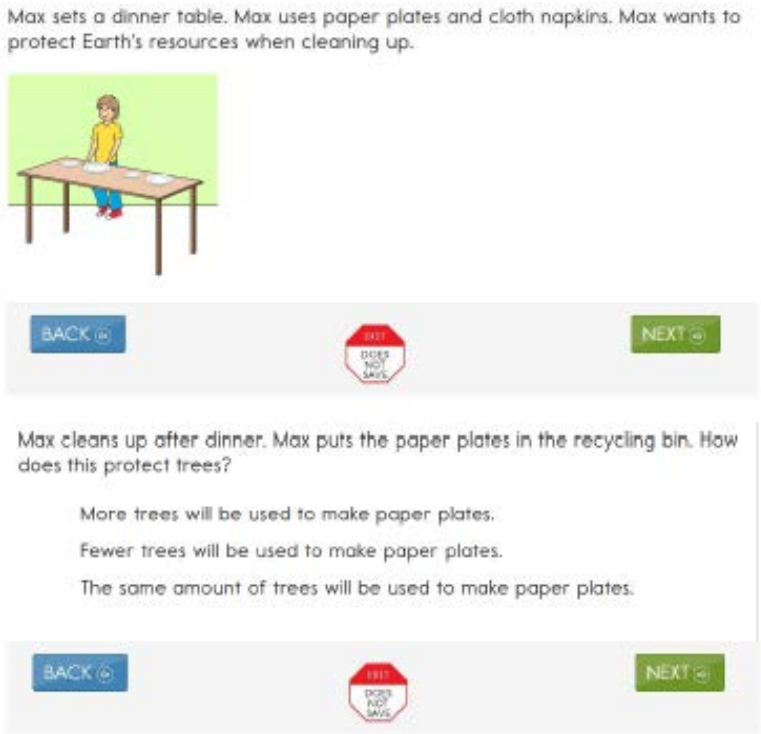
- Believed science content was “too difficult” or “abstract” for their students. Some educators felt the standards were inappropriate for their students and doubted that the instruction would be relevant for the population.
- In the beginning educators often felt inadequate in their own ability to instruct on the content and felt they needed more professional development.
- Many teachers wanted guidance on what “to do” for the grades not tested.
- Some teachers felt they did not have adequate materials or resources.

Surprises

- Gaining entrance into the general education classroom and working with typical peers.
- The increase of use of the instructionally embedded assessments.
- Educators have embraced the idea of instruction of multiple standards.
- Released testlets encouraged teachers how to design instruction to support students and preparation of the assessment.
- Improved understanding of test design among some educators who used the blueprint.

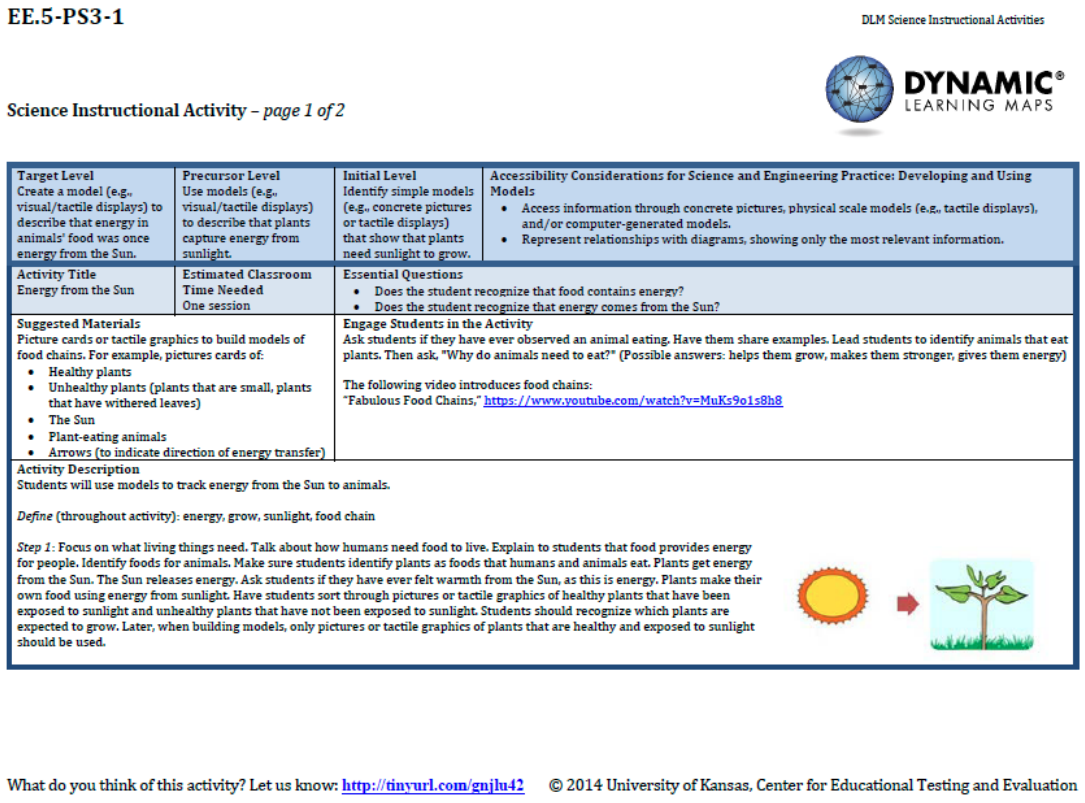
Released Testlets





Things Teachers Were Excited About

- Science Instructional Activities
- Picture response cards are included in the TIP for testlets that require them
- Use of common materials on materials list
- Released testlets



EE.5-PS3-1

DLM Science Instructional Activities

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Science Instructional Activity – *page 1 of 2*

Target Level Create a model (e.g., visual/tactile displays) to describe that energy in animals' food was once energy from the Sun.	**Precursor Level** Use models (e.g., visual/tactile displays) to describe that plants capture energy from sunlight.	**Initial Level** Identify simple models (e.g., concrete pictures or tactile displays) that show that plants need sunlight to grow.	**Accessibility Considerations for Science and Engineering Practice: Developing and Using Models** • Access information through concrete pictures, physical scale models (e.g., tactile displays), and/or computer-generated models. • Represent relationships with diagrams, showing only the most relevant information.
Activity Title Energy from the Sun	**Estimated Classroom Time Needed** One session	**Essential Questions** • Does the student recognize that food contains energy? • Does the student recognize that energy comes from the Sun?	
Suggested Materials Picture cards or tactile graphics to build models of food chains. For example, pictures cards of: • Healthy plants • Unhealthy plants (plants that are small, plants that have withered leaves) • The Sun • Plant-eating animals • Arrows (to indicate direction of energy transfer)		**Engage Students in the Activity** Ask students if they have ever observed an animal eating. Have them share examples. Lead students to identify animals that eat plants. Then ask, "Why do animals need to eat?" (Possible answers: helps them grow, makes them stronger, gives them energy) The following video introduces food chains: "Fabulous Food Chains," https://www.youtube.com/watch?v=MuKs9o1s8h8	
Activity Description Students will use models to track energy from the Sun to animals. *Define* (throughout activity): energy, grow, sunlight, food chain *Step 1*: Focus on what living things need. Talk about how humans need food to live. Explain to students that food provides energy for people. Identify foods for animals. Make sure students identify plants as foods that humans and animals eat. Plants get energy from the Sun. The Sun releases energy. Ask students if they have ever felt warmth from the Sun, as this is energy. Plants make their own food using energy from sunlight. Have students sort through pictures or tactile graphics of healthy plants that have been exposed to sunlight and unhealthy plants that have not been exposed to sunlight. Students should recognize which plants are expected to grow. Later, when building models, only pictures or tactile graphics of plants that are healthy and exposed to sunlight should be used.			

What do you think of this activity? Let us know: http://tinyurl.com/gnjlu42 © 2014 University of Kansas, Center for Educational Testing and Evaluation

Science Resources

Home ›› Assessment Resources ›› Science Resources

SCIENCE RESOURCES

for Alaska, Iowa, Illinois, Kansas, Maryland, Miccosukee, Missouri, Oklahoma, West Virginia, and Wisconsin

Science assessments are only available during the spring window.

Training for test administrators who will administer Dynamic Learning Maps science assessments is built into your state's Moodle training.

- Science Blueprint Phase 1 (pdf)
  pool of available preliminary Essential Elements (EEs) for Science
- Essential Elements for Science (pdf) *1/23*
- Development of DLM Essential Elements for Science (pdf)
  a short description of how Essential Elements in science were developed
- Guide to Practice Activities & Released Testlets for Science (pdf)
  familiarizes educators and students with testlets and KITE Client
- About Science Testlet Information Pages (pdf)
- Science Materials Collections for Spring 2017 Assessment (pdf) *2/28*
  list of common science materials by grade, including materials to use with alternate test forms for students with visual impairments

Released Testlets and Sample TIPs

- Released Testlet Elementary 5 ESS3-1 T
- Released Testlet Middle School MS.PS1-2.I
- Released Testlet High School HS.PS2-3.P
- Sample TIP Elementary
- Sample TIP Middle School

Required Training

Required test administrator training for teachers participating in 2016–17 DLM testing is available on a state-driven schedule. The Guide to DLM Required Test Administrator Training (pdf) is a great place to start, with information about accessing the DLM Moodle training site for your first login.

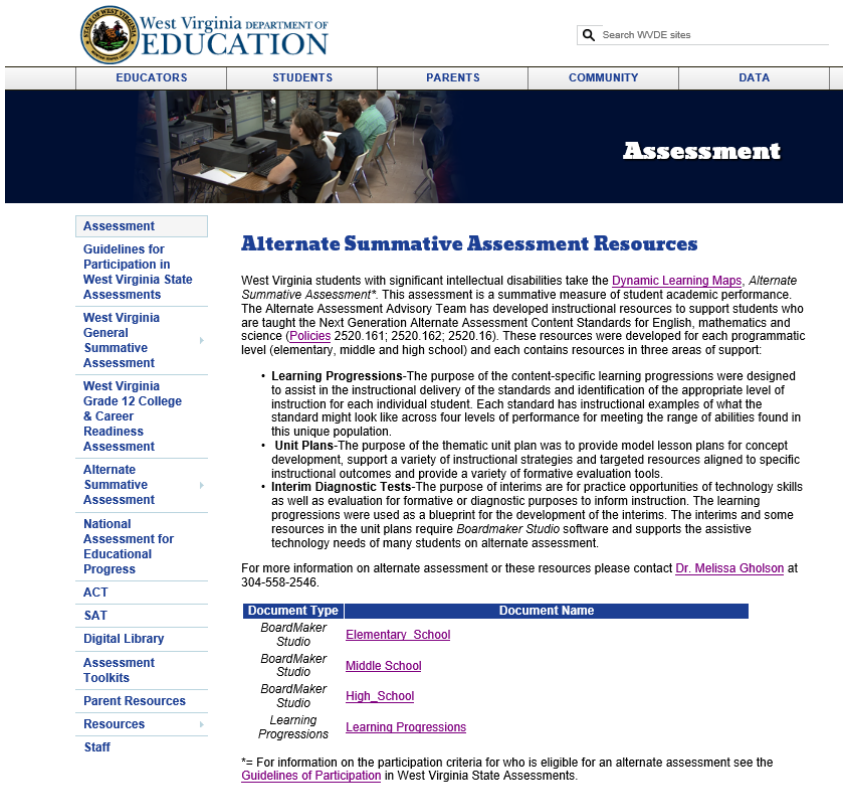
Science Instructional Activities

The DLM Science Consortium developed several model science instructional activities that are intended to support teachers who are beginning to use the DLM Science Essential Elements during instruction. Activities for each grade span (Elementary, Middle, and High School) are located below.

EE.5.ESS1-2: The Daylight Hours
EE.5.LS2-1: Food Cycles
EE.5.PS3-1: Energy from the Sun
EE.MS.ESS2-6: Weather Watchers
EE.MS.LS2-2: What Animals Eat
EE.MS.PS1-2: Chemical Changes
EE.HS.ESS3-3: Conserving Natural Resources
EE.HS.LS1-2: Respiratory System

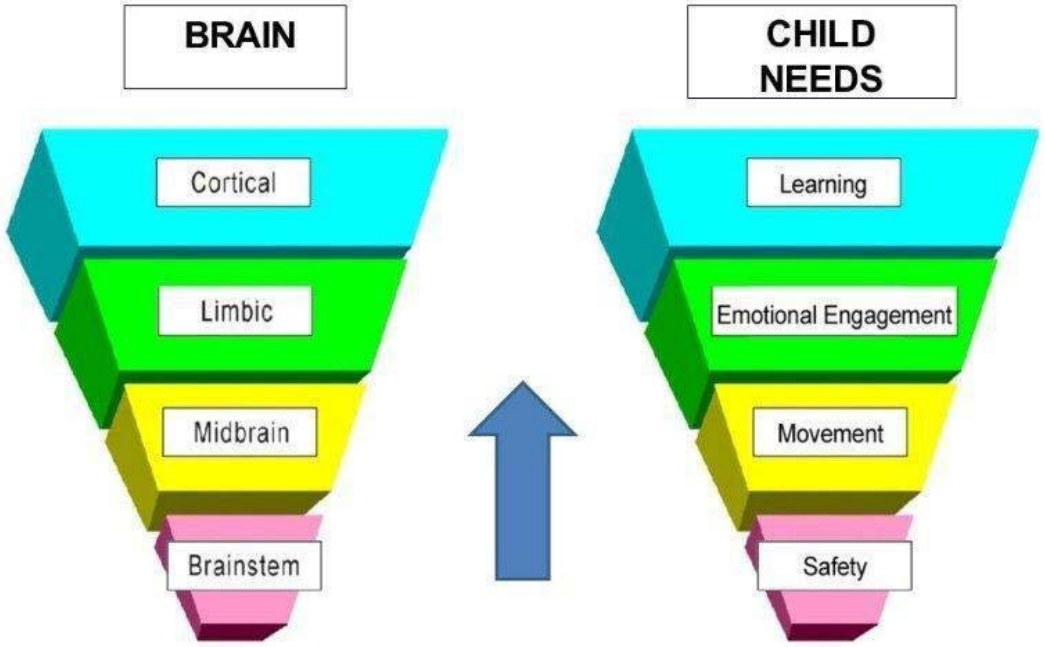
Have there been shifts in performance expectations for students with SCD?

- Due to demand the alternate assessment advisory team developed additional activities addressing science and merged it within their preexisting units created for instruction.
- Teachers during test administration observations were excited about the progress and higher levels of interaction between students and peers.
- Increased opportunity for multiple settings and generalized learning.



High Expectations & Developmental Appropriateness

- Project-based and interactive learning has benefits for students at all levels of the educational spectrum including those who have intellectual disabilities.
- Many educators expressed increased engagement of their students around science content.
- As a result educators saw increased retention of content in their students.



Adapted from: McCaleb, M. & Mikaere-Wallis, N. Relationship-shaping: Teacher consistency and implications for brain development. *The First Years/Ngā Tau Tuatahi: New Zealand Infant and Toddler Education*, 7(2), 21-25

Shaun Bates

IMPLICATIONS FOR ASSESSMENT DESIGN AND REPORTING

Topics

- What are the challenges in assessing multiple dimensions within each EE?
- Are there considerations for testlet design and/or delivery?
- What information should be included on assessment reports that would be beneficial to teachers?
- What are the implications for learning progressions in science?

Challenges in Assessing Multiple Dimensions

- Identifying if the content or the practice may be the lack of student understanding.

- Build the interconnections of English Language Arts and mathematics

Considerations for Testlet Design and/or Delivery

- The Essential Elements currently support 3 levels as compared to English language arts and mathematics.

- How to build a system to meet the diversity of the population and depth of the Elements.

Assessment Reports

- Design and development of reports that provide information that lead to change in instruction.
- Secondary report of SEP's?
- Connecting English language arts and mathematics for a picture of the whole child.

Implications for Learning Progressions

- The Essential Elements currently support 5 levels in English language arts and mathematics.

- Complete the science map to ensure the learning progressions and interconnections have been identified, vetted and provide useful information.

THANK YOU!

For more information:

www.dynamiclearningmaps.org

http://dynamiclearningmaps.org/sci_resources

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