

Defining the NGSS Domain to be Assessed: Challenges and solution approaches

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Overview

- Aspects of domain definition for assessment
- Some key challenges of domain definition for NGSS
- Some principles and solution approaches
- Presentations by states working on NGSS assessments
 - California (Kathleen Scalise, University of Oregon)
 - Washington (Kevin King, WestED)
 - Delaware (April McCrae, Delaware Dept. of Education)
- Discussion

Domain definition for NGSS assessment

- Content/skills
- Expertise/performance
- Assessment vs. instruction vs. other
- Assessment validity argument
- Documents that embody domain definition for assessment

Definition of NGSS content/skills

- Domain of “science” content(/skills/dispositions)
 - Scope
 - Dimensions: NGSS’ Scientific & Engineering Practices (SEP), Disciplinary Content Ideas (DCI), and Cross-Cutting Concepts (CCC)
 - Specific knowledge/skills: 39 DCI sub-ideas; 8 SEP, 7 CCC
 - Combinations
 - Performance Expectations (PEs) to define assessment targets
 - 1-D, 2-D, 3-D (definition of CCC)
 - If multiple-dimension, can/should be pulled apart in scoring or analysis for assessment?
 - Sequence
 - Temporal order (e.g., grade/band-specific)
 - Logical dependencies over time (within and across grades)

Definition of expertise/performance

- Cognitive complexity
 - What is presented
 - Question/problem: What it takes to respond

Cognitive rigor matrix – science (Hess)



Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/ Reasoning	Webb's DOK Level 4 Extended Thinking
<p>Apply</p> <p>Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task</p>	<ul style="list-style-type: none"> • Follow simple procedures (recipe-type directions) • Calculate, measure, apply a rule (e.g., rounding) • Apply algorithm or formula (e.g., area, perimeter) • Make conversions among representations or numbers, or within and between customary and metric measures 	<ul style="list-style-type: none"> • Select a procedure according to criteria and perform it • Solve routine problem applying multiple concepts or decision points • Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps • Construct models given criteria 	<ul style="list-style-type: none"> • Design investigation for a specific purpose or research question • Conduct a designed investigation • Use concepts to solve non-routine problems • Use & show reasoning, planning, and evidence • Translate between problem & symbolic notation when not a direct translation 	<ul style="list-style-type: none"> • Select or devise approach among many alternatives to solve a problem • Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results

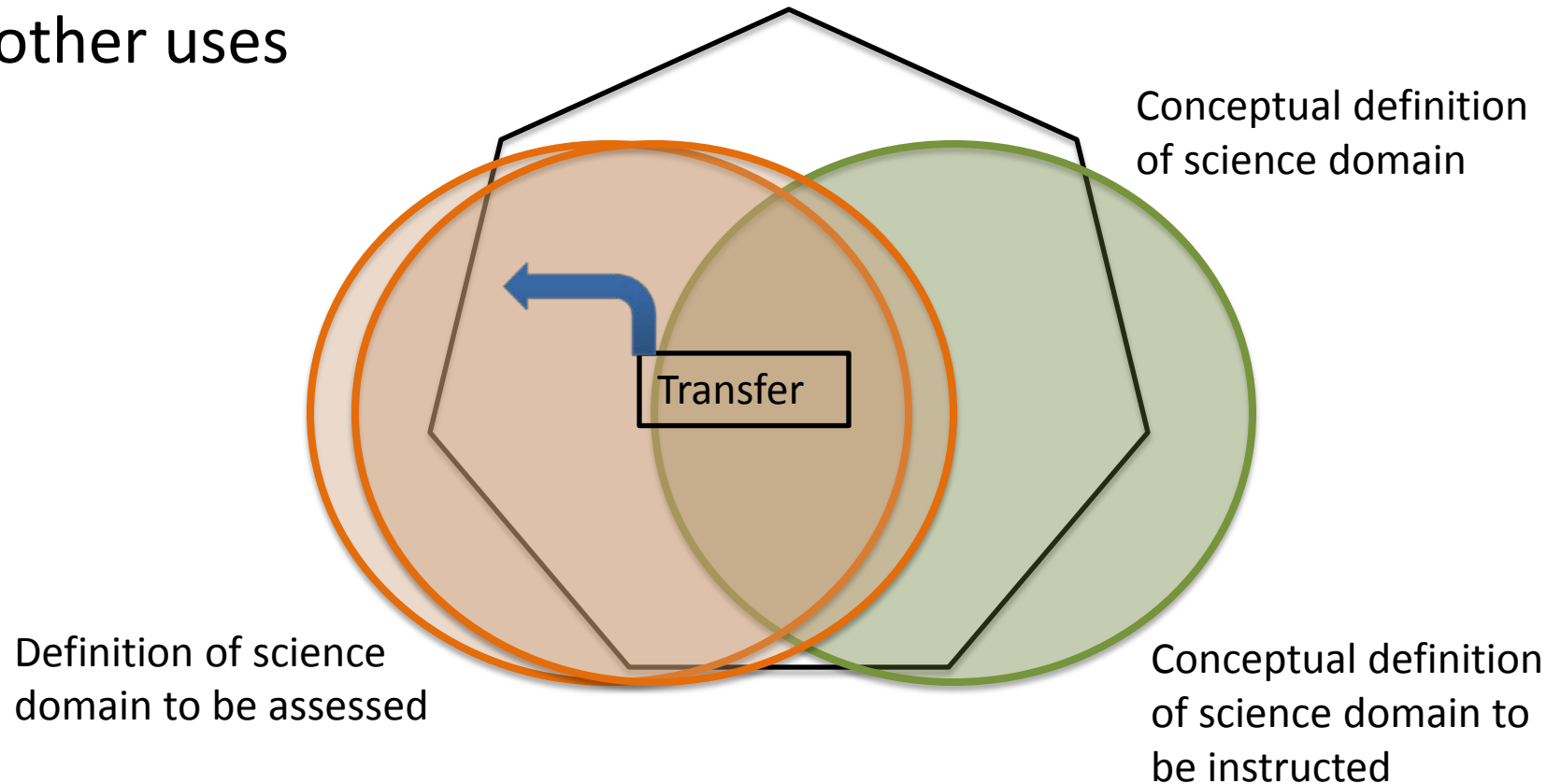


Definition of expertise/performance

- Cognitive/performance complexity in context
 - Retention how long after instruction
 - Assess grade level/grade span?
 - Instruct grade level/review grade span?
 - Similarity to what, how was instructed (application/transfer)
 - Support/scaffolding... free-form
 - Integration of knowledge, skills
 - Individual/collaborative

Definitions for assessment vs. other uses

- Purposes: conceptual, instructional, assessment, other uses



- Domain definition for assessment may differ

Assessment validity argument - ECD

- **Claim** about person/performance in relation to domain, and intended uses
- Assessment designed to provide sufficient **evidence** to inform claims
 - Test design
 - Assessment task/item design and scoring
- How information from evidence will be **combined** to inform claims (collection of evidence) and intended uses [measurement models, comparability]

Documents that embody domain definition

- Content standards' elaboration in terms of domain definition
- Claims (and theory of action)
- Achievement/performance level descriptors
- Reports
 - Student annual score reports' categories/dimensions
 - Combined and derivative scores' reports (e.g., trend, growth, gaps)
- Test blueprints
- Item/task templates/detailed specifications including scoring templates

Some challenges to NGSS domain definition

- Need domain definition of aspects in addition to NGSS standards and Performance Expectations
- Breadth of NGSS; sampling represented in PEs

NGSS breadth

- 39 DCI sub-ideas, 8 SEP, 7 CCC = 2,184 distinct “things”
- SEP/DCI/CCC (and PEs) by grades K-5 and grade spans for middle and high school

Sparse sampling in PEs

- The PEs designate specific combinations of SEP, DCI, and CCC. Generally the sampling across all the PE at a grade is so sparse that it would be difficult to claim the NGSS have been represented adequately or coherently.
- At a grade span, the PE cumulatively sample the SEP and CCC relatively more, but still sample the DCI fairly sparsely.

SEP x DCI sampling in PEs

Number of NGSS Scientific & Engineering Practices in the Performance Expectations by DCI Disciplines

Grade	AQDP	DUM	PCOI	AID	UMCT	CEDS	EAE	OECI
Grade 5								
PS		2	2		1		1	
LS		1					1	
ESS		1		1	1		1	1
3-5 ETS	1		1			1		
Middle School								
PS	1	5	3	2	1	3	2	2
LS		5	1	3	1	5	4	2
ESS	1	5	1	3		4	1	
ETS	1	1		1			1	
High School								
PS	1	5	4		5	5	1	3
LS	1	5	1		4	6	4	1
ESS	1	4	1	2	3	3	3	
ETS	1				1	2		

PS = Physical Science; LS = Life Science; ESS = Earth & Space Science; ETS = Engineering/Technology Science

AQDP Asking Questions and Defining Problems DUM Developing and Using Models PCOI Planning and Carrying Out Investigations

AID Analyzing and Interpreting Data UMCT Using Mathematics and Computational Thinking CEDS Constructing Explanations and

Designing Solutions EAE Engaging in Argument from Evidence OECI Obtaining, Evaluating, and Communicating Information

SEP, CCC, DCI sub-ideas in PEs, Grade 5

Performance Expectations by DCI by SEP by CCC

		Grade 5	AQDP	DUM	PCOI	AID	UMCT	CEDS	EAE	OEI
Life Sciences	LS1, From Molecules to Organisms: Structures and Processes	LS1.A, Structure and Function LS1.B, Growth and Development of Organisms LS1.C, Organization for Matter and Energy Flow in Organisms LS1.D, Social Interactions and Group Behavior							5-LS1-1	
	LS2, Ecosystems: Interactions, Energy, and Dynamics	LS2.A, Interdependent Relationships in Ecosystems LS2.B, Cycles of Matter and Energy Transfer in Ecosystems LS2.C, Ecosystem Dynamics, Functioning, and Resilience LS2.D, Social Interactions and Group Behavior		5-LS2-1						
	LS3, Heredity: Inheritance and Variation of Traits	LS3.A, Inheritance of Traits LS3.B, Variation of Traits								
	LS4, Biological Evolution: Unity and Diversity	LS4.A, Evidence of Common Ancestry LS4.B, Natural Selection LS4.C, Adaptation LS4.D, Biodiversity and Humans								

Some solution principles & approaches

- Attend to domain definition up front and elaborate and articulate your specifications of the NGSS for assessment; avoid retro-fitting item development to claims and reporting structures (some iteration expected)
- Make your test-level claims coherent (may need to modify or adapt PEs); test-level not the same as item level!
- Focus and simplify the NGSS
 - Reduce content scope
 - Cluster SEP and possibly CCC
- Consider test designs that provide more “assessment space,” e.g., matrix sampling, through-course, multiple EOC
- Specify where application and transfer fit for you, in instruction and assessment

For more information:

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