Planning Science Instruction and Assessment for Students with Significant Cognitive Disabilities

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Overview

- Description of the strands of science content
- What we know and do not know from research about teaching standards in this area
- Why and how to use and inquiry-based approach
- Issues to consider in aligning state standards in science

National Science Education Standards (NRC, 1996)

- Eight Content Standards
  - Unifying concepts and processes in science.
  - Science as inquiry.
  - Physical science.
  - Life science.
  - Earth and space science.
  - Science and technology.
  - Science in personal and social perspectives.
  - History and nature of science.

Unifying Concepts and Processes

- Systems, order, and organization.
- Evidence, models, and explanation.
- Change, constancy, and measurement.
- Evolution and equilibrium.
- Form and function.

Science As Inquiry

- Students learn skills such as
  - Observation
  - Inference
  - Experimentation
- Engaging in inquiry helps students develop
  - An understanding of science concepts
  - An appreciation of how we know what we know in science
  - An understanding of the nature of science
  - Skills necessary to become independent inquirers
  - Dispositions to use the skills, abilities, & attitudes associated with science

Physical Science

- **K-4, Students should develop an understanding of**
  - Properties of objects and materials
  - Position and motion of objects
  - Light, heat, electricity, and magnetism
- **5-8, Students should develop an understanding of**
  - Properties and changes of properties in matter
  - Motions and forces
  - Transfer of energy
- **9-12, Students should develop an understanding of**
  - Structure of atoms
  - Structure and properties of matter
  - Chemical reactions
  - Motions and forces
  - Conservation of energy and increase in disorder
  - Interactions of energy and matter

Life Science

- **K-4, Students should develop understanding of**
  - The characteristics of organisms
  - Life cycles of organisms
  - Organisms and environments
- **5-8, Students should develop understanding of**
  - Structure and function in living systems
  - Reproduction and heredity
  - Regulation and behavior
  - Populations and ecosystems
  - Diversity and adaptations of organisms
- **9-12, Students should develop understanding of**
  - The cell
  - Molecular basis of heredity
  - Biological evolution
  - Interdependence of organisms
  - Matter, energy, and organization in living systems
  - Behavior of organisms

Earth & Space Science

- **K-4, Students should develop an understanding of**
  - Properties of earth materials
  - Objects in the sky
  - Changes in earth and sky
- **5-8, Students should develop an understanding of**
  - Structure of the earth system
  - Earth's history
  - Earth in the solar system
- **9-12, Students should develop an understanding of**
  - Energy in the earth system
  - Geochemical cycles
  - Origin and evolution of the earth system
  - Origin and evolution of the universe

Science & Technology

- **K-12, all students should develop**
  - Abilities of technological design
  - Understanding about science and technology
  - Abilities to distinguish between natural objects and objects made by humans

Science in Personal & Social Perspectives

- **K-4, Students should develop understanding of**
  - Personal health
  - Characteristics and changes in populations
  - Types of resources
  - Changes in environments
  - Science and technology in local challenges
- **5-8, Students should develop understanding of**
  - Personal health
  - Populations, resources, and environments
  - Natural hazards
  - Risks and benefits
  - Science and technology in society
- **9-12, Students should develop understanding of**
  - Personal and community health
  - Population growth
  - Natural resources
  - Environmental quality
  - Natural and human-induced hazards
  - Science and technology in local, national, and global challenges

History & Nature of Science

- **K-4, Students should develop understanding of**
  - Science as a human endeavor
- **5-12, Students should develop understanding of**
  - Science as a human endeavor
  - Nature of science knowledge
  - History of science
  - Historical perspectives

Review of Studies with Students with Significant Cognitive Disabilities that Link to Science Standards

Courtade, G., Spooner, F., & Browder, D. (in press). A review of studies with students with significant cognitive disabilities that link to science standards. *Research and Practice for Persons with Severe Disabilities.*

Purpose

- To provide a comprehensive review of research that provides instructional interventions in science to students with SCD

Method

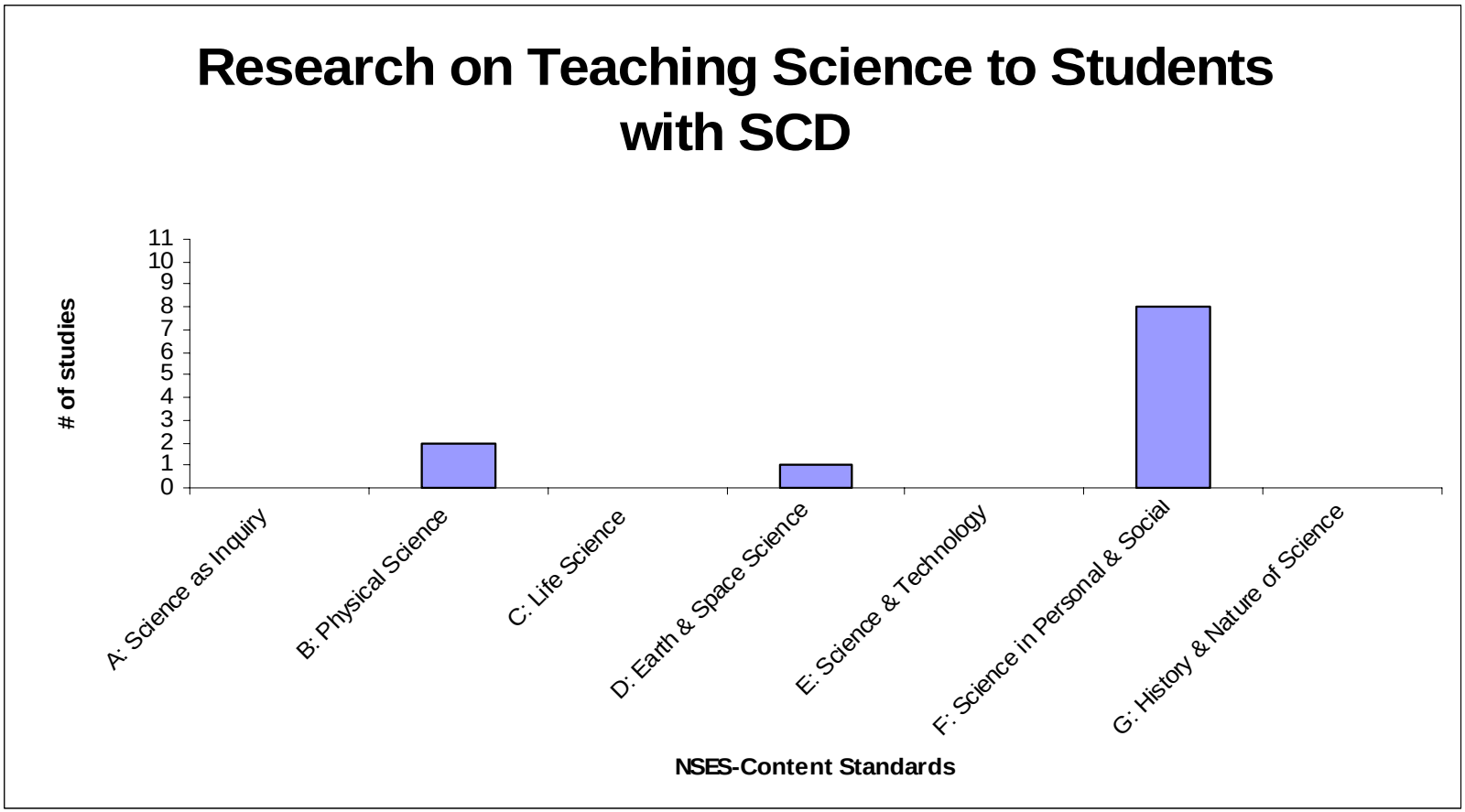
- 7 science content standards from NSES used to organize the literature
- Key terms used from each area (agreed upon by science content area expert & 2nd author)
- Student population descriptors
  - Moderate
  - Severe
  - Autism
  - Retardation
  - Handicapped
  - Disabilities
  - Developmental disabilities
  - Intellectual disabilities

Method

- Used only studies that had a recognized research design and were published in refereed journals; 1985-2005
- Must include 1 student with moderate to severe/profound disabilities (IQ of 55 or below)
- Ages 5-21

Results

- 11 studies found
- 8-Content Standard F: Science in Personal and Social Perspectives
- 2-Content Standard B: Physical Science
- 1-Content Standard D: Earth Science
- All single subject design


Research on Teaching Science to Students with SCD
# of studies
11
10
9
8
7
6
5
4
3
2
1
0
A: Science as Inquiry
B: Physical Science
C: Life Science
D: Earth & Space Science
E: Science & Technology
F: Science in Personal & Social
G: History & Nature of Science
NSES-Content Standards

Foci of Instruction

- Content Standard F:
  - Read and respond to safety words
  - Perform first aid skills
  - Safe handling and disposing of materials
  - % correct on health tests
  - Self-protective behavior
- Content Standard B:
  - Relative position
- Content Standard D:
  - Read weather related words

Discussion

- Research is sparse
- Mainly falls into one area (content standard F)
- Field must begin to think about how to teach science to this population

Critical Issues

- Need for special educators to understand more about general science and the contexts in which it is typically taught
- Lack of focus in past could be due to:
  - Low expectations for this population
  - Lack of strategies for engaging students with communication challenges in this instruction
  - Lack of model for how to adapt science for this population

Ideas

- Collaboration with a team of educators
- Use of known instructional strategies to teach concepts
- Use of inquiry-based instruction to teach science

Why inquiry-based instruction?

- Recommended by the National Research Council
- Used successfully in general education
- Used successfully for students with mild disabilities
- Promotes communication and problem-solving skills
- Can be adapted to meet the needs of students with SCD

Adaptation of Guided Inquiry Instruction

Courtade, G. (2006). *The effects of inquiry-based science instruction on teachers of students with significant disabilities*. Doctoral Dissertation. University of North Carolina at Charlotte.

Courtade, G., Jimenez, B., Trela, K., & Browder, D. M. (2007). *Teaching to science standards: An inquiry based approach for middle and high school students with moderate and severe disabilities.* Manuscript in preparation.

Engage

- Teacher shows object/picture
  - Give student opportunity to look at objects/ pics or respond, “What is it?”
- Teacher asks, “What do you think it is?”
  - Give students opportunity to respond verbally or using a response board
- Teacher asks, “What do we know about it?”
  - Gives students opportunity to respond & records responses on K-W-H-L chart
- Teacher asks, “What do we want to know about it?”
  - Give students opportunity to respond & records responses on K-W-H-L chart

Investigate and Describe Relationships

- Teacher asks, “How can we find out?”
  - Give students opportunity to respond using a sensory response board & records responses on K-W-**H**-L chart
- Teacher guides students to explanations
  - *What will you show them?*
  - *What are you asking them to predict?*
  - Give students an opportunity to predict what will happen based on relationships and concepts
- Teacher provides cues to conduct experiment
  - *What will you tell them to do?*
  - Gives students opportunity to participate in conducting experiment

Investigate and Describe Relationships

Students experiment with materials

- Teacher asks, “What is same about objects?”
  - *Examples of what it the same:*
  - Give students opportunity to respond using descriptor board
- Teacher asks, “What is different about objects?”
  - *Examples of what is different:*
  - Give students opportunity to respond using descriptor board

Construct Explanation

- Teacher provides explanation of science concept ("is/is not").
  - *Explanation:*
  - Give opportunity for students to touch vocabulary word related to concept (Use time delay procedure)
  - *Vocabulary word(s):*
  - Give opportunity for students to touch picture symbol related to concept
  - Give opportunity for students to match word to picture symbol

Teacher conducts same experiment to reinforce concept-reviewing relationships and concepts

Report

- Teacher asks “What did we learn?”
  - *Teacher provides students with a means to report what they have observed.*
  - *Fill in the blank sentence:*
  - Give students opportunity to report what they learned & record on K-W-H-**L** chart
- Teacher asks summarizing question about lesson
  - *Summarizing questions should be about the concepts (not the specific experiment).*
  - Give students opportunity to respond using any one response chart : K-H-W-L; descriptor chart; response board; sensory response board

How will you involve your students in all steps of this inquiry-based process?

- Use of picture symbols/objects
- Use of augmentative communication devices
- Give students choice if they are not able to answer without
- Guide the students toward explanations
- Provide support using the system of least prompts

Alignment of AAS to Grade Level Content Standards

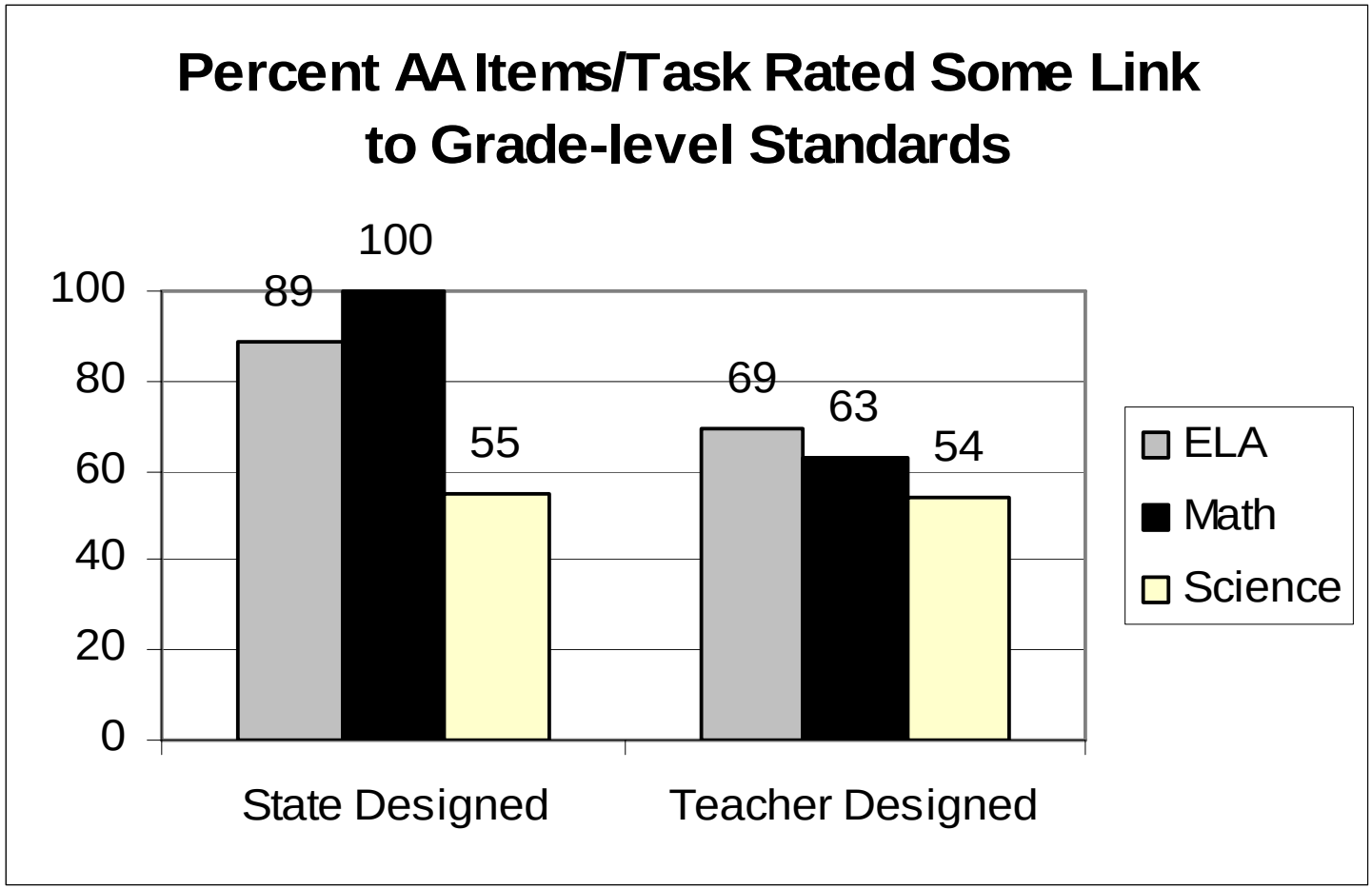
Part of the work of the National Alternate Assessment Center

Part of the work of Browder, Wakeman, Karvonen, & Flowers

Alignment Studies

- Content experts ratings of fidelity (content and performance) to standards
- Subject Areas
  - ELA
  - Math
  - Science
- AA Formats
  - Performance-based (state designed)
  - Portfolio (teacher designed)

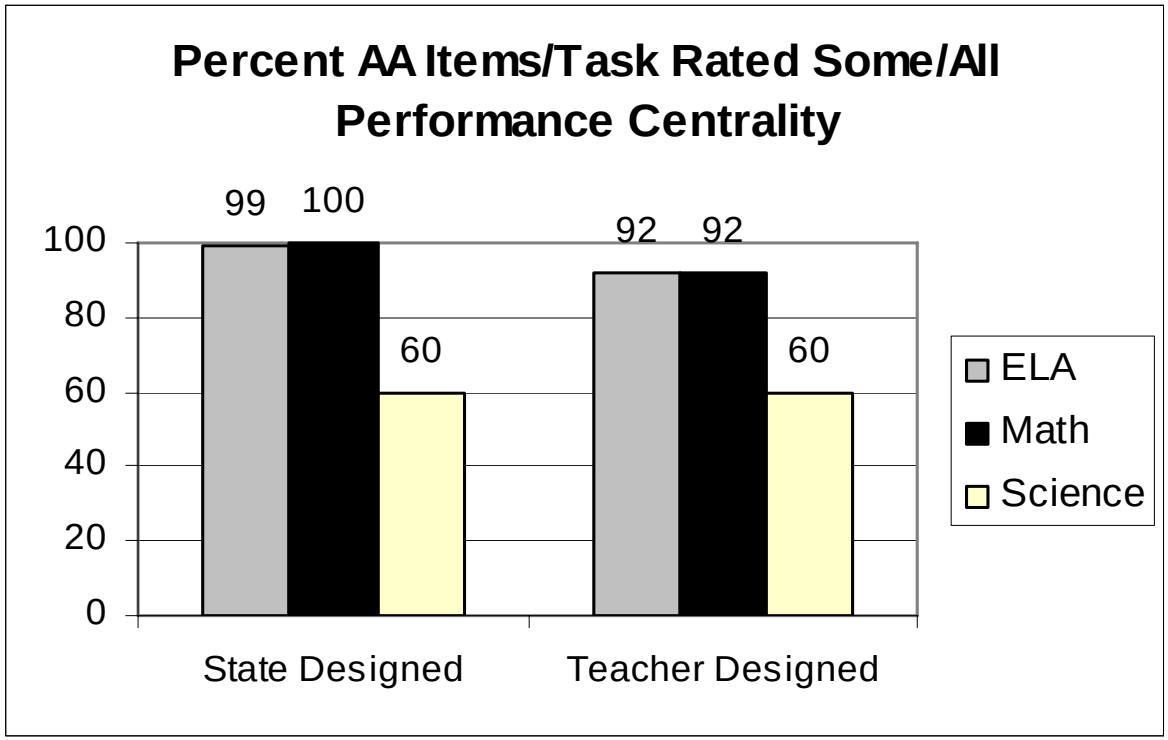
Content Centrality



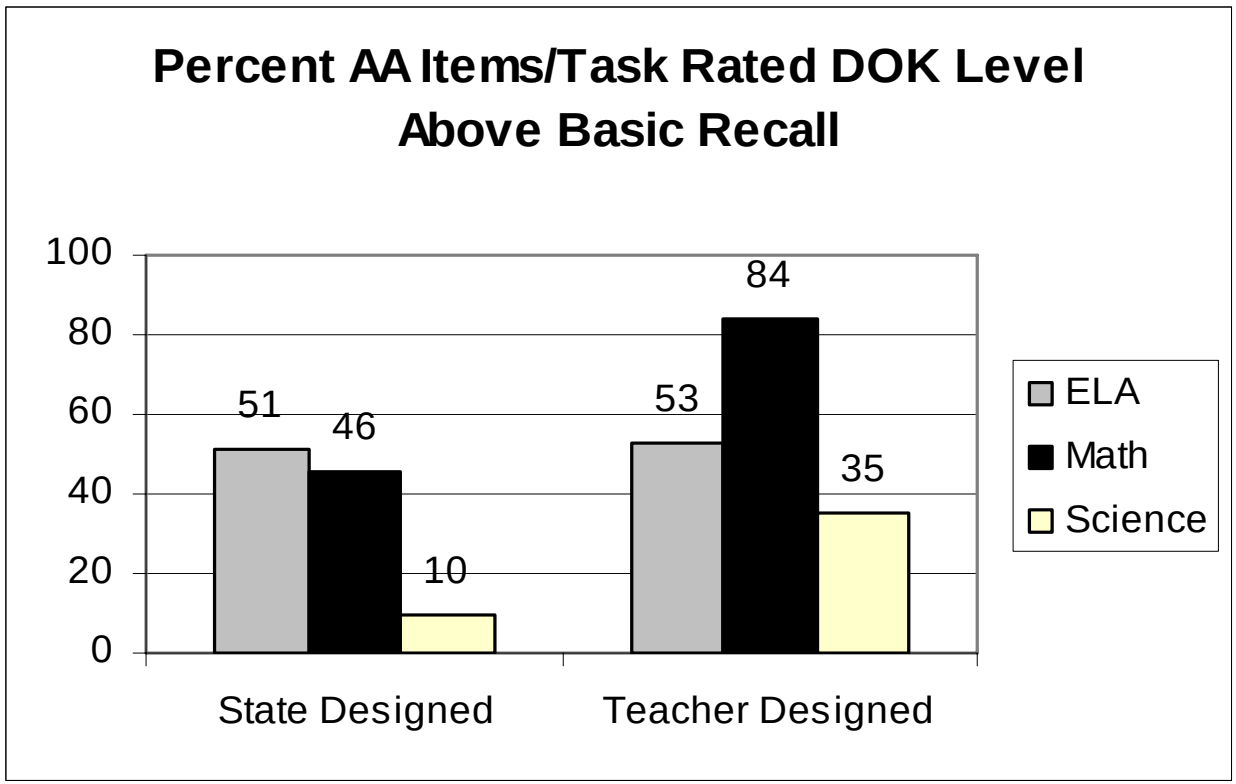
Content Centrality

- Inquiry Strand
  - Items with the most “not linked”
  - Problem at all grade levels with elementary grades having highest percentage of “not linked” items
- Weather
  - Items not linked

Performance Centrality



Depth of Knowledge Levels



Reasons for Lack of Fidelity

- Science content experts stricter?
- Was content more difficult?

- Secondary analysis of AA items not linked to grade-level content

Non-linking Items Cluster

- Misconception
- Backmapping
- Overstretching
- Mismatching

Misconceptions

- Clouds, fog, and shower-room mist are made of water vapor
- Clouds remain aloft because of water droplets are tiny
- Ben Franklin's kite was struck by lighting
- Lakes and oceans are blue because they reflect the blue sky
- Scientific inquiry uses the scientific method

Examples from William J. Beaty—*Recurring Science Misconceptions in K-6 Textboos*

Backmapping

- Take activities done in the classroom and align to grade-level standard
- Example
  - Extended Standard
    - Identify man made versus naturally made items
  - AA Task
    - Sort cans and paper into the correct recycle bin.

Overstretching

- The item/task has been extended too far and lost the fidelity to the standards
  - Standard
    - Describe the appropriate habitat for an animal
  - AA Task
    - Draw a picture of your pet

Mismatching

- Incorrect standard has been identified
  - Content Standard
    - Compare and contrast the basic needs of plants and animals
  - AA Tasks
    - Identify farm animals

Curriculum Indicators Surveys

- Surveys for Special Education Teachers
  - Based on the work of Surveys of Enacted Curriculum
  - ELA, Math, and Science
  - Long and short forms
- Requires parsing through the academic standards
  - Content Coverage
  - Performance expectations
- Validation work will be presented at AERA

Based on the work of Karvonen, Wakeman, Flowers, & Browder

Thank you

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