# Planning Science Instruction and Assessment for Students with Significant Cognitive Disabilities

Ginevra Courtade
Claudia Flowers
UNC Charlotte

# 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. (2007). A review of studies with students with significant cognitive disabilities that link to science standards. *Research and Practice for Persons with Severe Disabilities*, *34 (1).*

# Purpose

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

# Method

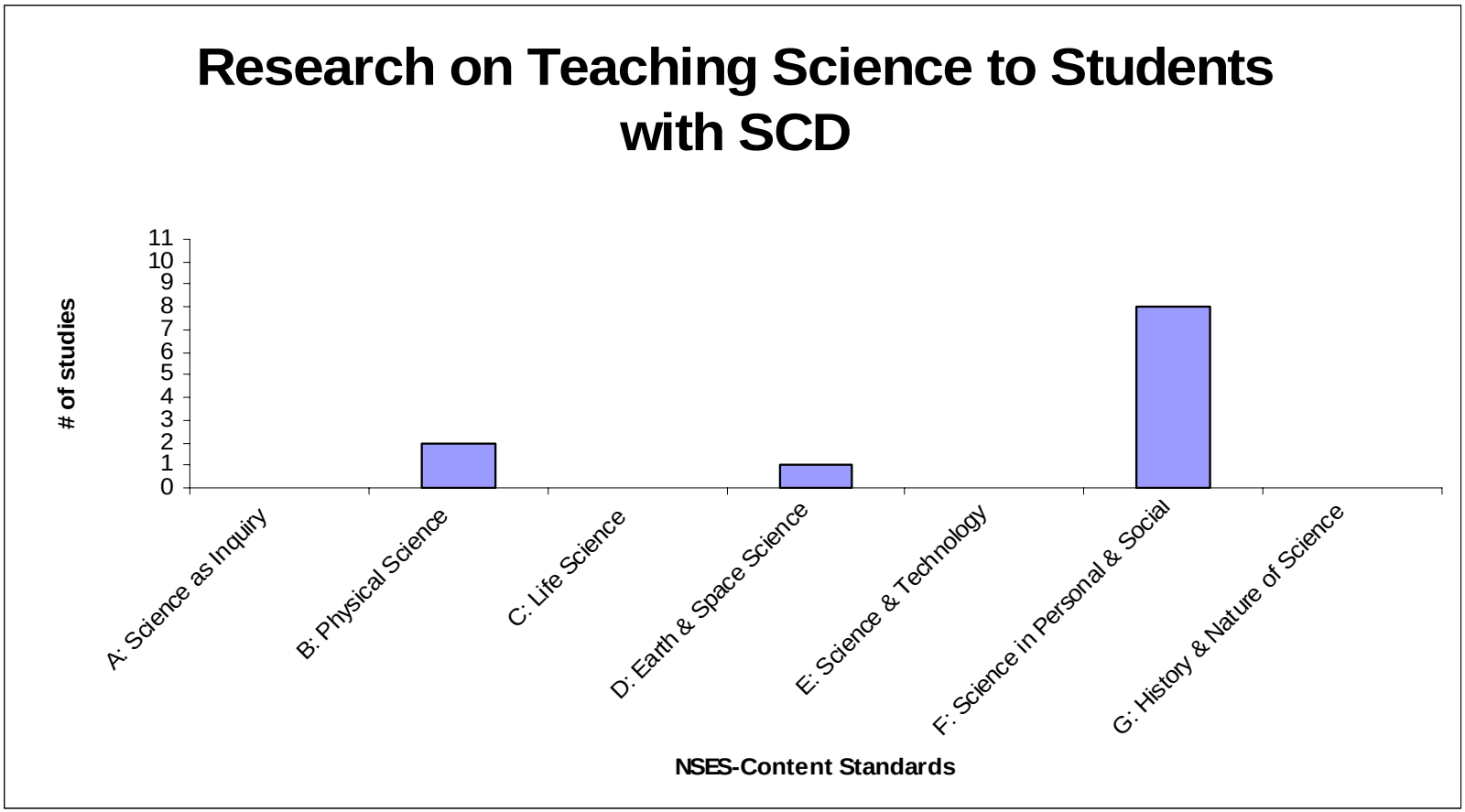
- 7 science content standards from NSES used to organize the literature
- Key terms used from each area (agreed upon by science content area expert & 2nd author)
- Student population descriptors
  - Moderate
  - Severe
  - Autism
  - Retardation
  - Handicapped
  - Disabilities
  - Developmental disabilities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

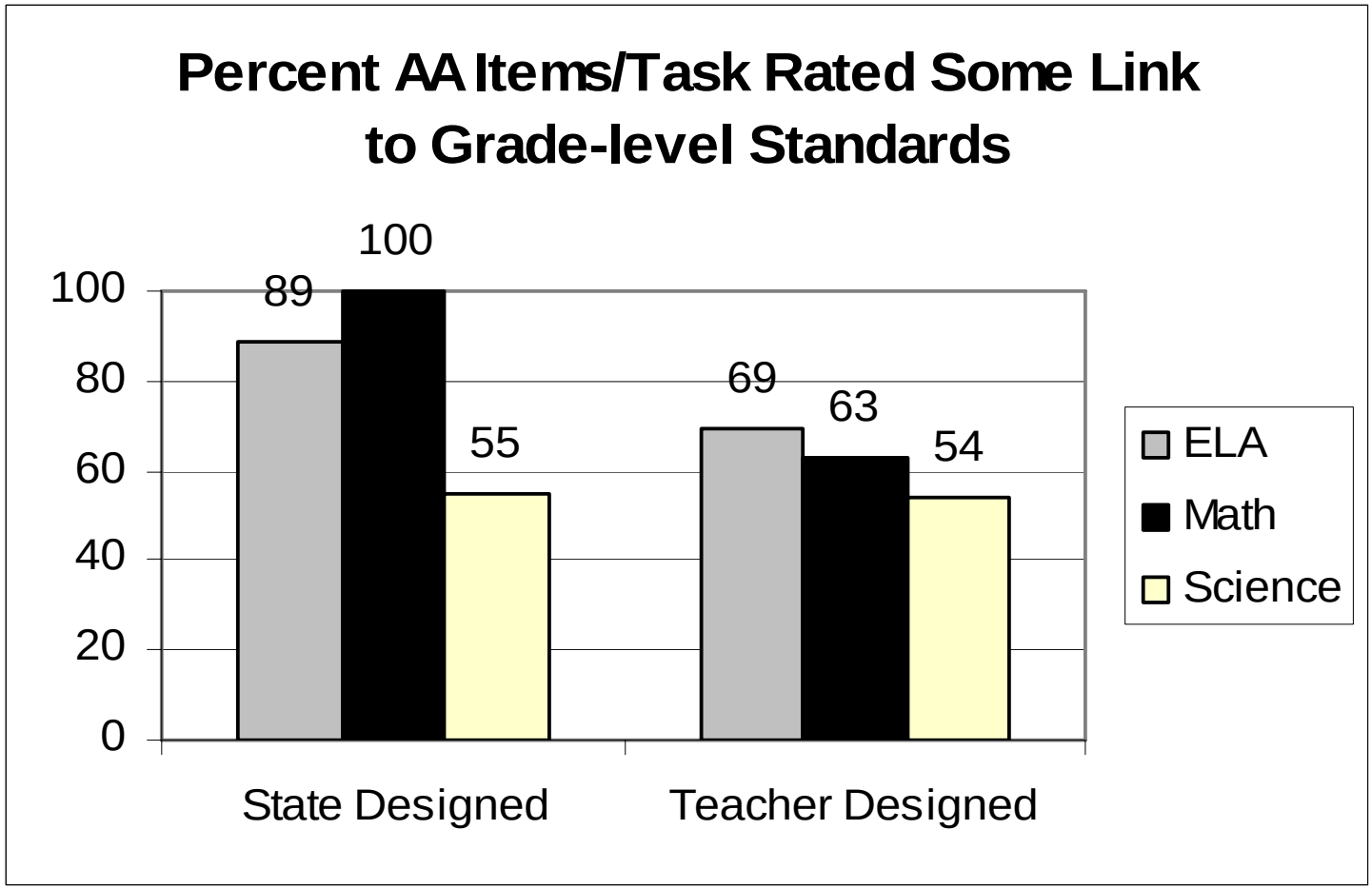
Part of the work of the National Alternate Assessment Center

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)

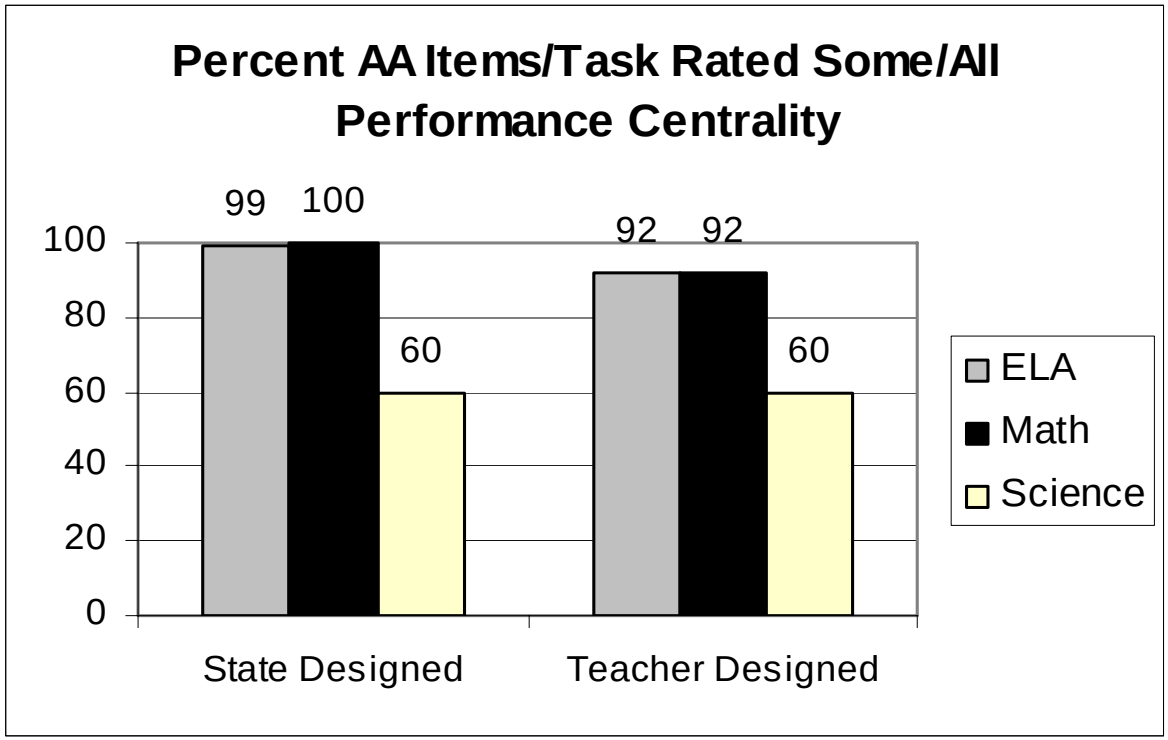
# Content Centrality



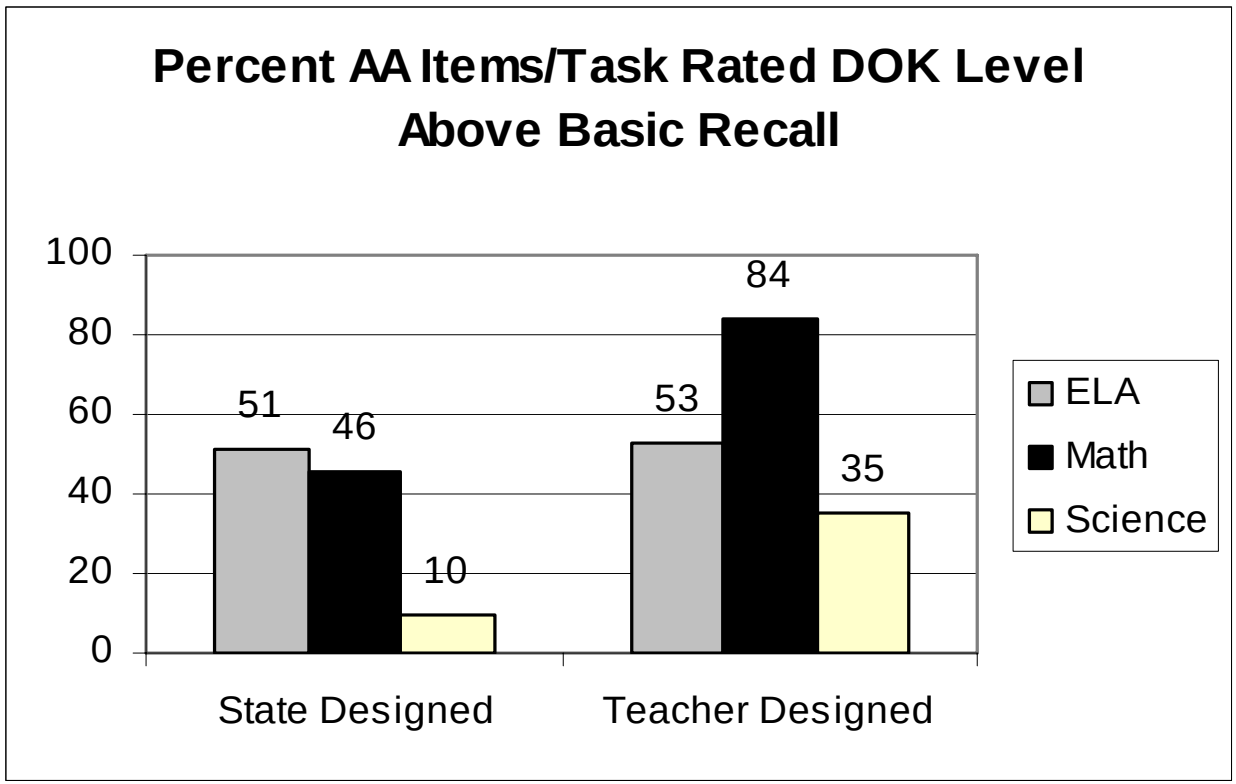
# Content Centrality

- 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

- Ginevra Courtade
  - grcourta@uncc.edu
- Claudia Flowers
  - cpflower@uncc.edu