# Design and Use of Innovative Science Testlets for Struggling Learners

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# Agenda

1. Project Overview
2. Science Learning Maps
3. Innovative Testlets
4. Preliminary Cognitive Lab Findings

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# I-SMART Purpose

Improve achievement of multidimensional science standards for students with and without disabilities through accessible, learning map model-based assessments and reporting tools.

# I-SMART and Dynamic Learning Maps (DLM)

| DLM | I-SMART |
| --- | --- |
| • Operational alternate assessment<br>  • Students with significant cognitive disabilities | • Research & development<br>  • Inform future formative and summative assessments<br>  • Two populations |

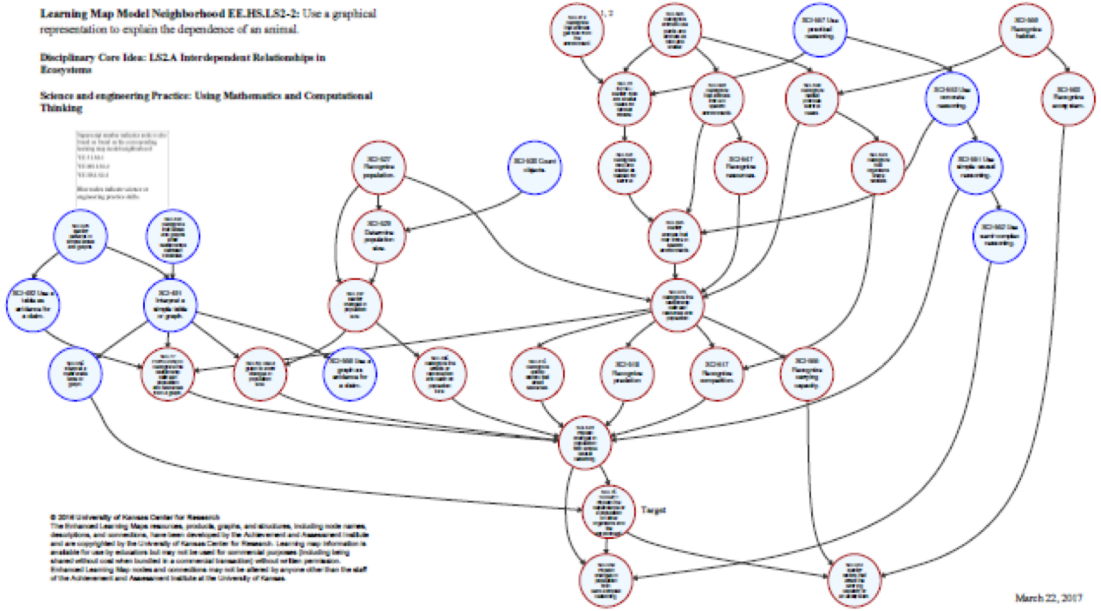
# Science Learning Maps

Lori Andersen, PhD

# Learning Map Models

- Interconnected representation of ways in which students can develop knowledge, skills and understandings
  - Nodes represent skills
  - Connections represent order of learning
- Expanded science maps for the I-SMART project are based on existing DLM science maps

# DLM Science Map Neighborhood

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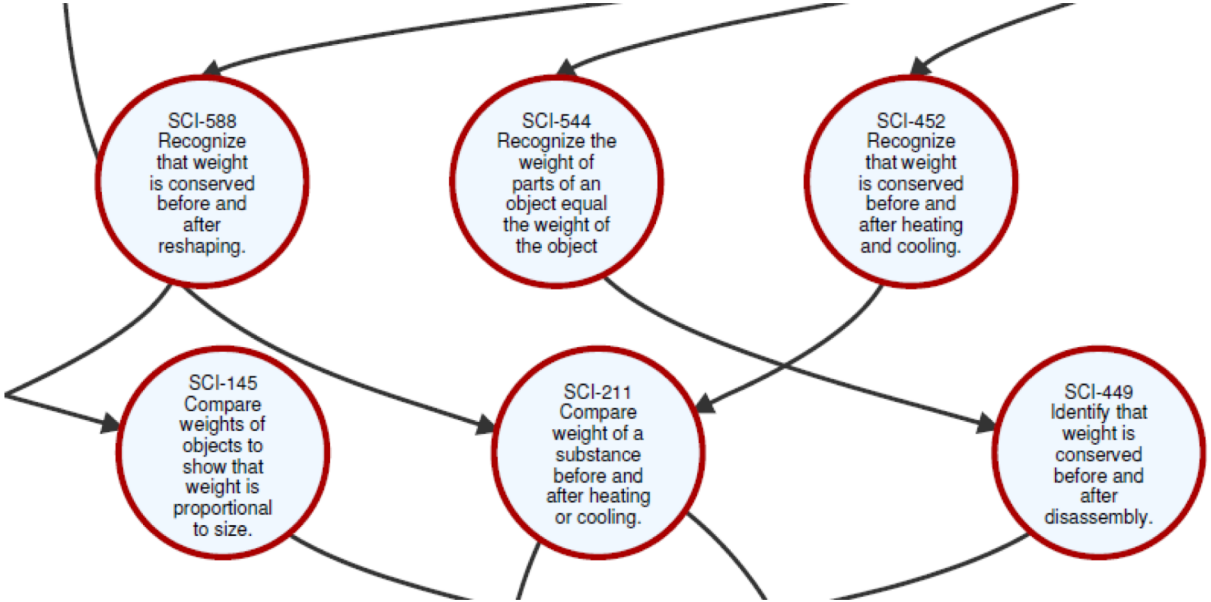
# Close-up Map View



# I-SMART Neighborhood Maps

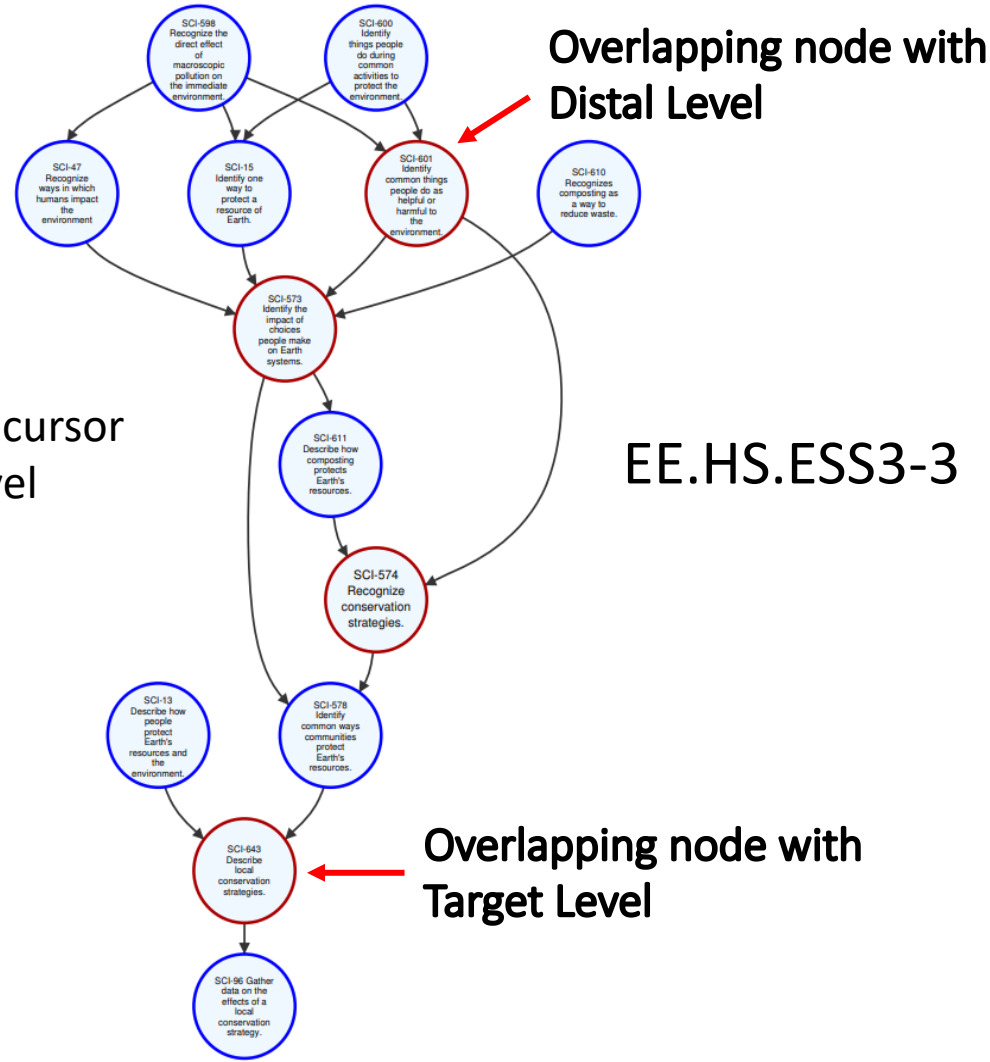
- Each DLM science map represents one alternate content standard.
- Each I-SMART map includes the DLM science map and is connected to foundational, English language arts, and mathematics nodes.

# Essential Elements

- Essential Elements (EEs) are alternate content standards that are linked to the *Framework for K-12 Science Education* and the *Next Generation Science Standards*
- Testlets measure EEs at four levels of complexity, known as linkage levels:
  - Initial
  - Distal (High school only)
  - Precursor
  - Target

# EE Learning Map Neighborhoods

- Each linkage level contains four nodes in a cluster or mini-progression.
- Adjacent linkage levels have one common (overlapping) node.

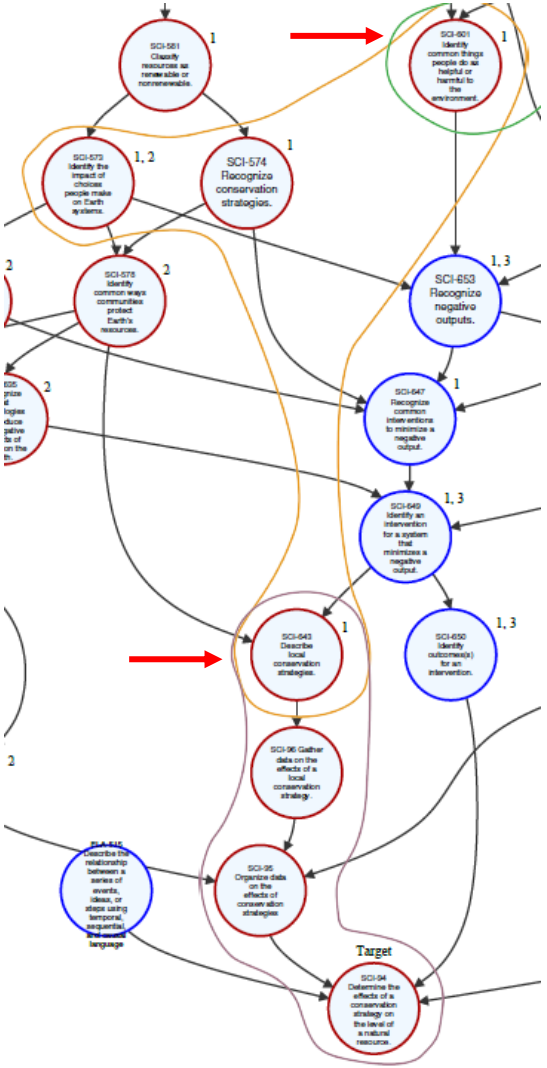



Overlapping node with Distal Level

Precursor Level

EE.HS.ESS3-3

Overlapping node with Target Level



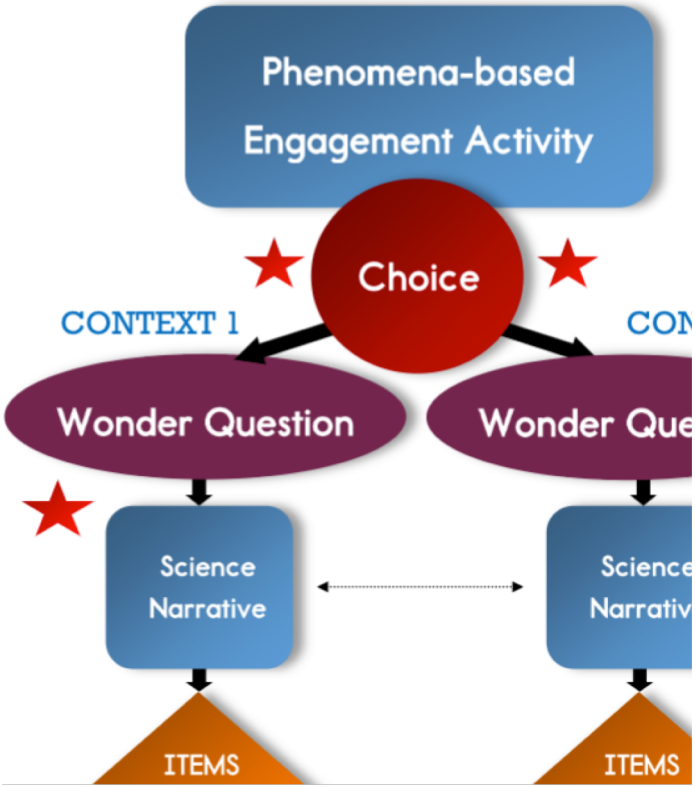
# Innovative Testlets

Michelle Shipman

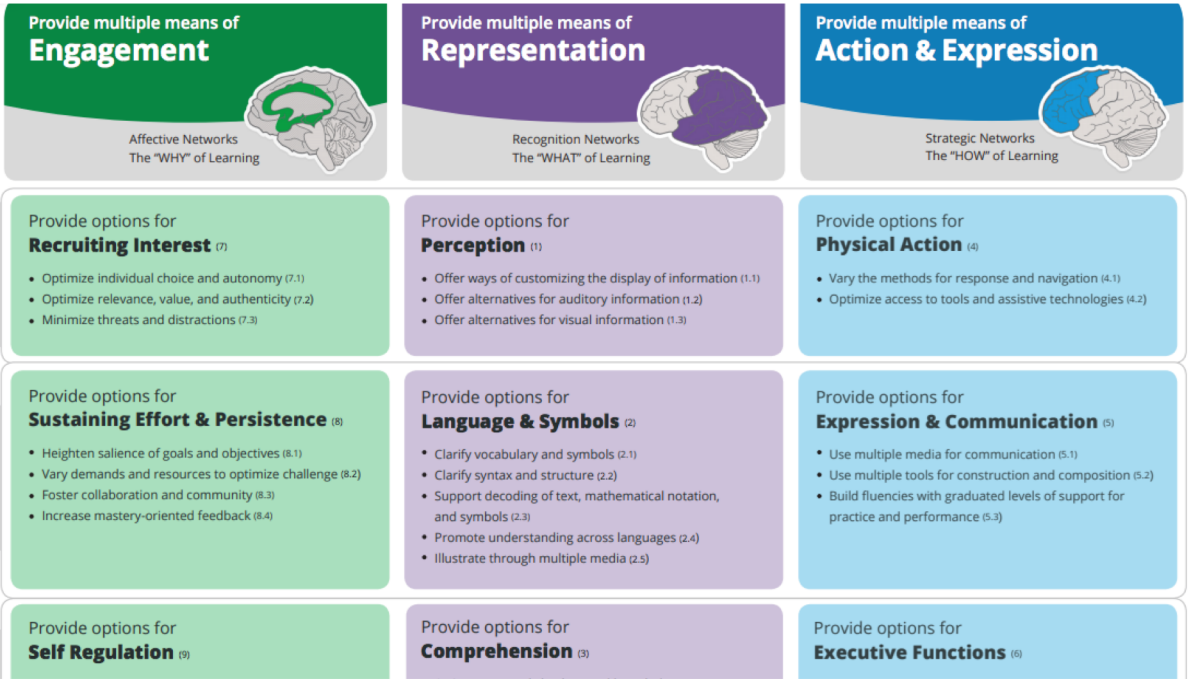
# Innovative Testlet Design

I-SMART testlets use innovative features that vary by linkage level:

- Embedded Universal Design for Learning (UDL) options
  - Phenomena-based
  - Choice
  - Wonder Question



# UDL-Guided Design




CAST (2018)

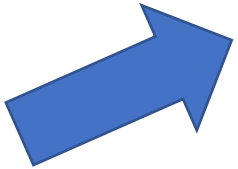
# Essential Element Concept Map

Clearly specifies the evidence-centered design-based approach which includes the intended connection between the **content**, a testlet's **design elements**, and student **observations**.

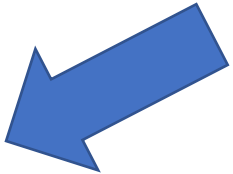
- Specifies the skills and content required by the nodes at each linkage level.
- Provides guidance to item-writers in developing testlets and incorporating UDL options.

# Essential Element Concept Map
# EE.HS.LS2-2.I

# Example of Phenomenon Section



| **Phenomenon** |
| --- |
| General mechanism: Plants get matter mainly from air and water. Plants get nutrients from soil (i.e., minerals). Matter moves through ecosystems as plants make their own food, plants are eaten by animals, animals eat other animals, and dead things are broken down by decomposers to make matter available to plants again. Not all matter is passed to the next level; some matter leaves at each level (e.g., excretion, breathing).<br><br>Examples of systems include specific organisms or ecosystems.<br><br>Example Phenomena: In a forest, oak trees grow. Oak trees make their own food with matter from air and water. Oak trees take in air through openings in their leaves. Oak trees also get nutrients from the soil. Squirrels eat leaves and acorns from the oak tree. Owls eat squirrels. |



# Multidimensional Design – Nodes and Observations

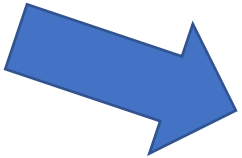


**Target linkage level nodes**

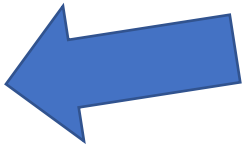
Nodes should be presented in the testlet in an order that creates a logical flow in inquiry activity, which may differ from the order that they occur in the map.

| **Nodes** (order from map) | **Description** | **Observation & Example Questions to Ask** |
|---|---|---|
| SCI-309 Use a model to trace matter in animals' food to plants. | Linking node<br>Integrated Node<br>4 items<br><br>Use a model to trace the matter in animals' food back to plants. | The student is presented with a simple food web (e.g., grass -> rabbit -> fox). The student identifies that the matter in the fox's food came from grass.<br><br>Example Questions: What does the model show about how the [organism] gets matter? Which model shows how [organism] gets matter? |
| SCI-7 Create a model that shows the movement of matter through living things. | Integrated Node<br>3 items<br><br>Create a model that shows the movement of matter (e.g. plant growth, eating, composting) through (three or more) living things. | The student is shown a partially complete food chain model (e.g., one organism or arrow is missing). The student is asked to fill in the missing item based on the description of the feeding relationships from an engagement activity story.<br><br>Example Questions: Which food chain shows how matter moves? Put the plants and animals in the correct box to show how matter moves [drag and drop item]. What goes between [organism1] and [organism2] to show how matter moves [AOs are types of arrows]? |
| SCI-307 Recognize that matter moves from the soil to plants to animals and back to the soil. | DCI Node<br>3 items<br><br>Recognize that matter moves from the soil to plants to animals and back to the soil. | When shown an example of a cycle food web (e.g., grass -> rabbit -> fox -> worm) the student identifies that food web shows that matter moves from grass to rabbit to fox to worm to soil. The student identifies that plants get nutrients from the soil, but not matter. [Note: Confusing food and nutrients is a misconception. Nutrients for plants are like vitamins for people.]<br><br>Example Questions: What does the model show about how the [organism] gets matter? What does [character's] food chain show about matter? |
| SCI-311 Recognize that plants get matter from the air. | DCI Node<br>3 items<br><br>Recognize that plants get matter from the air (i.e., carbon dioxide). | When asked, "How does a plant get material it needs to grow?", the student indicates that plants get matter (carbon dioxide) from the air. For example, when asked, "How does a tree get material it needs to grow?", the student indicates that trees take in air through their leaves to get the material they need to grow.<br><br>Example Questions: What helps a [plant] get matter? How does [plant] get matter to grow? How does a [plant type] take in the material it needs to grow? What is the material that [plant type] uses to grow? |

# Example of Wonder Question Section

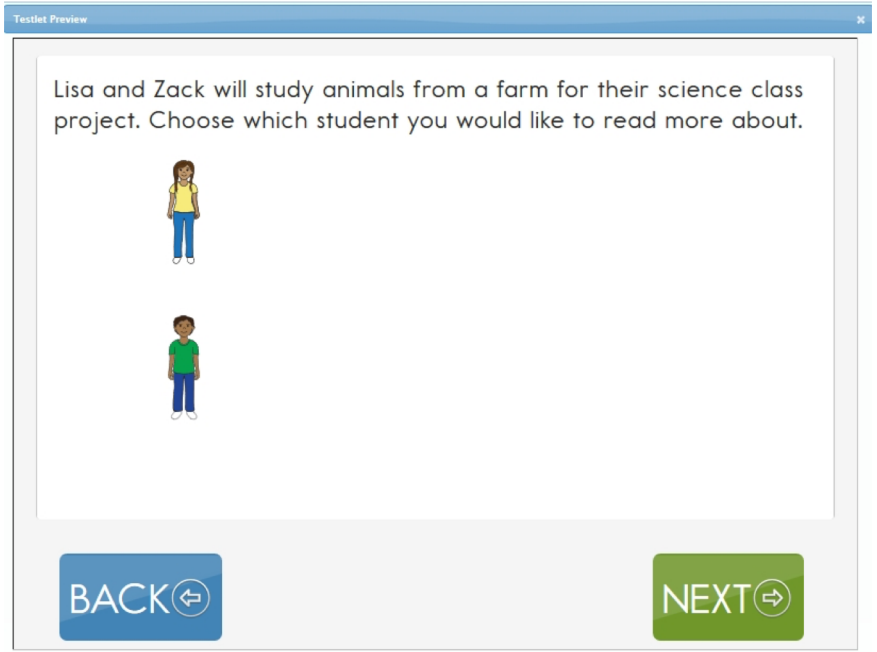


| **Wonder Question** |
| --- |
| The wonder question is presented at the beginning and revisited at the end of the testlet. The wonder question connects to a research-based misconception that can be resolved through inquiry activities in the testlet.<br><br>Example: What would happen to animals if all the plants died? Two answer options are presented, one of which is a common misconception.<br><br>Example: AO1 - Animals that eat other animals would survive. (misconception)<br>AO2 - No animals would survive.<br><br>Over the course of the testlet, students should gain information that will help them reevaluate the wonder question at the end of the testlet. The flow of items should build to |



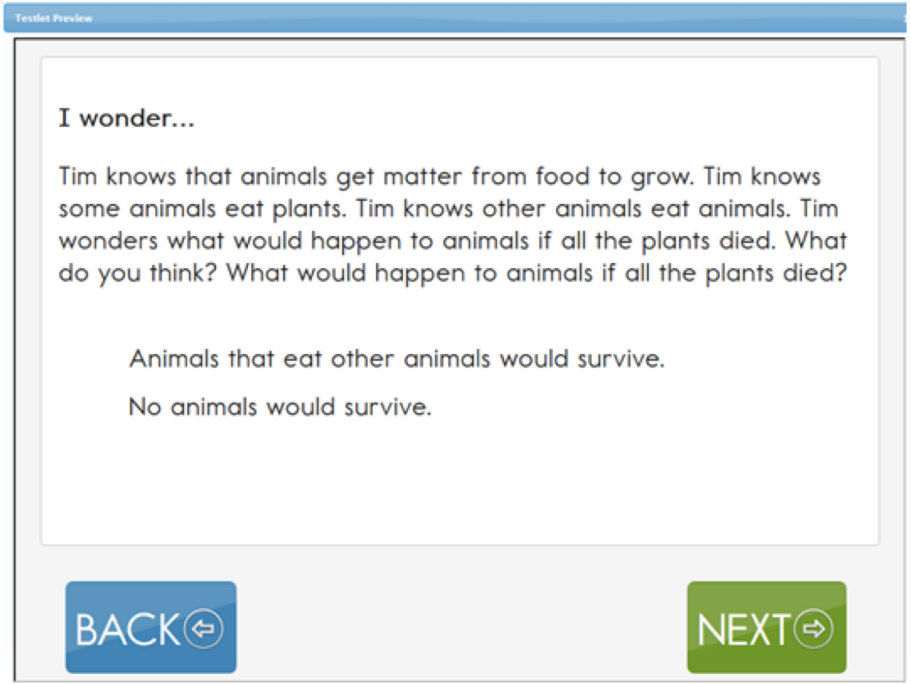
# Provide Multiple Means of Engagement

- **Choice of Context**
  - Provides an option for recruiting interest
  - Found at the beginning of the testlet
  - Unscored



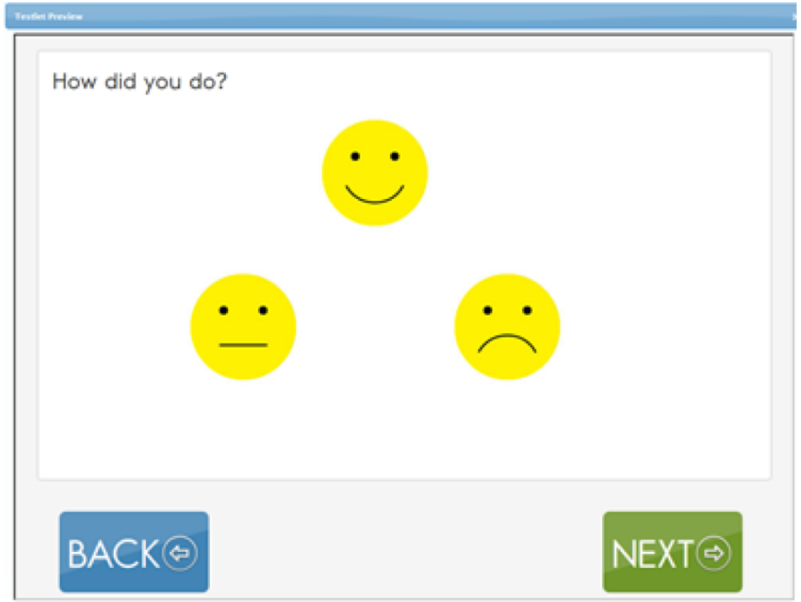
# Provides Multiple Means of Engagement

- **Wonder Question**
  - Provides option for self-regulation
  - Found near the beginning of the testlet
  - Unscored
  - Students return to wonder question at end of testlet



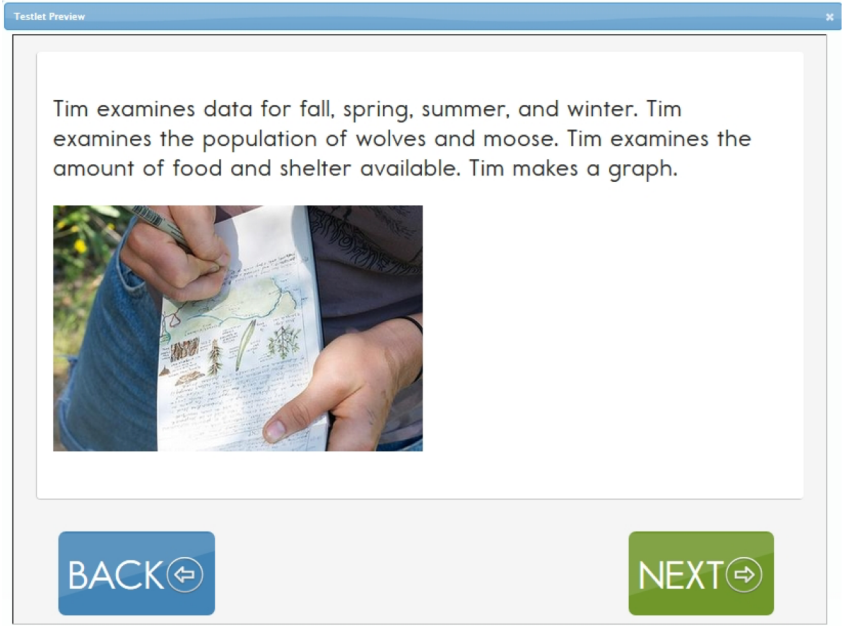
# Provide Multiple Means of Engagement

- **"How did you do?"**
  - Provides option for self-regulation
  - Last item in the testlet



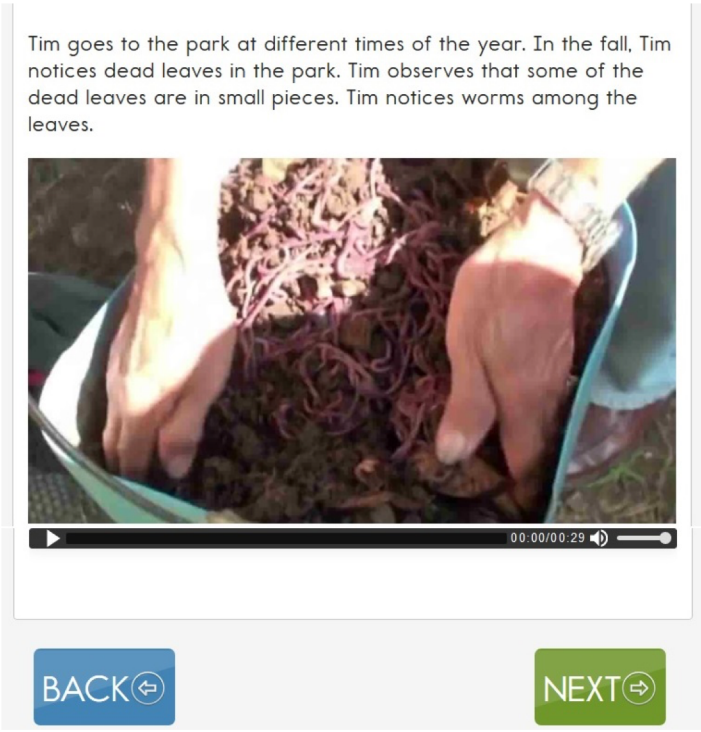
# Provide Multiple Means of Representation

- **Science Narrative**
  - Provide options for
    - Comprehension
    - Language & Symbols
    - Recruiting Interest
  - Includes the phenomenon



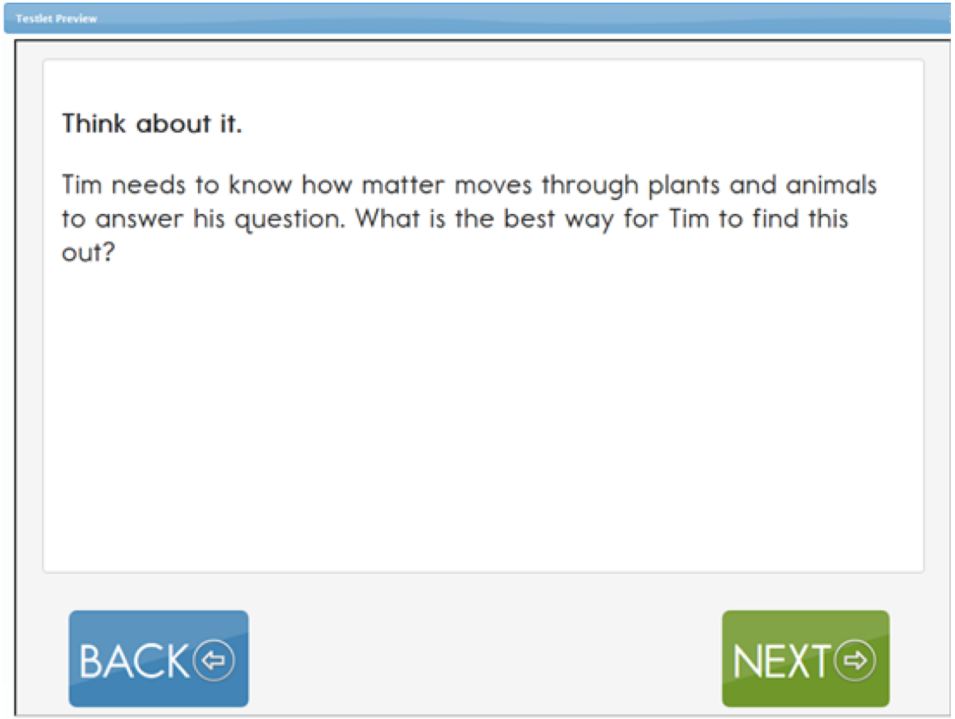
# Provides Multiple Means of Representation

- Use of **Videos and/or Images** to support decoding
  - Provides option for Language & Symbols



# Provides Multiple Means of Action & Expression

- **Think about it…**
  - Provides option for executive function
  - Used throughout the testlet
  - Unscored
  - Answer is provided on next screen



# I-SMART Cognitive Labs

Gail Tiemann, PhD

# Research Questions

1. **How do students interact with the features of innovative item types and with innovative testlets?**
2. **How much time is required to complete a testlet?**
3. Do students interpret testlet contents as intended?
4. Do students' responses represent the science performance expectations the items were designed to measure?
5. What are students' and teachers' perceptions of students' experiences with the new testlets?

# Phase 1

- Two target populations
- June 2018
- Two districts in two different states
- 15 sessions completed
- 5 teachers interviewed
- Video, audio, observation forms, screen capture recordings

# Phase 1 Labs Completed

Overall Goal – 36 students

Phase 1 Progress – 15 students

| | Initial – Group 1 | Precursor – Group 1 | Target – Group 1 | Target – Group 2/3 |
|---|---|---|---|---|
| Elementary | 4 | NA | 0 | 0 |
| Middle School | NA | 2 | 2 | 4 |
| High School | 3 | NA | 0 | 0 |

# Phase 2 Plan – Fall 2018

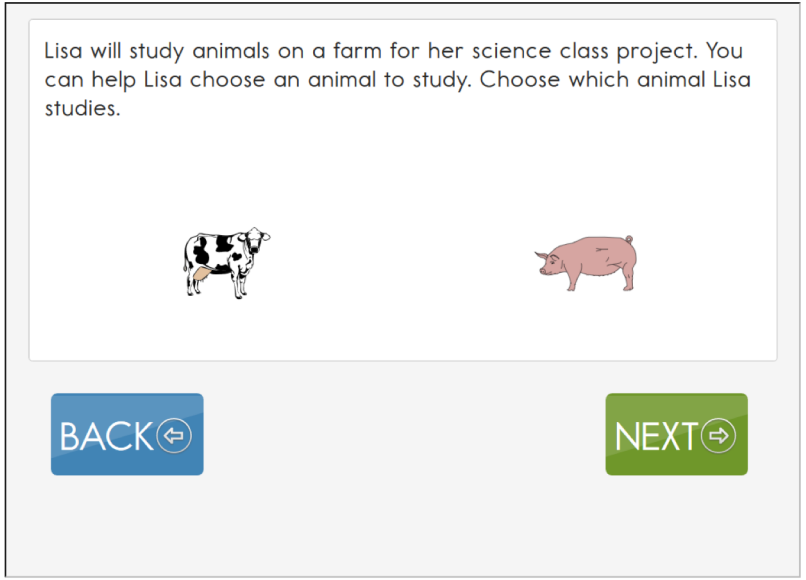
Phase 2 Goal – 21 students

| | Initial – Group 1 | Precursor – Group 1 | Target – Group 1 | Target – Group 2/3 |
|---|---|---|---|---|
| Elementary | 2 | NA | 2 | 4 |
| Middle School | NA | 4 | 0 | 0 |
| High School | 3 | NA | 2 | 4 |

# Preliminary Results – Informing Test Development

- **RQ 1 - Testlet features**
- Choice
  - Precursor and Initial Levels
  - Students were aware of choices, experienced choices frequently during instruction
  - No difference in student engagement between two different choice options

Middle School



# Preliminary Results – Informing Test Development

## RQ 2 - Testlet Time

| EL Initial | MS Precursor | MS Target | HS Initial | MS Target (Group 2/3) |
|---|---|---|---|---|
| 20:49<br>17:53<br>15:51 | 13:50<br>12:02 | 18:20<br>17:41 | 18:43<br>18:10<br>11:46 | 21:59<br>18:05<br>13:29<br>12:21 |

Middle School students delivered substantial think aloud and retrospective comments.

# Student comments re: choice

- Why did you pick that one?
  - Student 1: “Because pig is my favorite.” [Choice option pig or cow]
  - Student 2: "He's wearing a green shirt.” [Choice option Lisa or Zack]
    - Observer: “Do you like green?
    - Student 1: ”Yes"

# Preliminary Results - Informing Technology

- **RQ 1 – Testlet features**
  - Delayed load of chicken video surprised students
  - Chicken video overly large on screen
    - Video issues addressed by media team
  - Scrolling issue
    - After scrolling down, focus of next screen did not return to top
    - Issue addressed by technology team

# Item Tryout Next Steps..

- Recruit and complete phase 2
- Continue data analysis
- Disseminate results

# Panel Discussion

- How do these products compare to existing assessments?
- How can these products benefit teachers and students?
- What are the implications of these findings for classroom assessment?
- How can this research benefit science instruction and assessment for learners who fall below their grade-level expectations?