I-SMART

The I-SMART project: Creating multi-dimensional science assessments using principles of Universal Design for Learning and fine-grained learning maps

National Conference on Student Assessment
Monday, June 24, 2019
Orlando, Florida

I-SMART

Innovations in Science Map, Assessment & Report Technologies

Innovations in Science Maps, Assessment and Reporting Technologies (I-SMART)

- A multi-state project funded through the U.S. Department of Education's Enhanced Assessment Grants (EAG)
- Focused on Developing Innovative approaches to science assessments by using principles of Evidence Centered Design (ECD) and Universal Design for Learning (UDL)

Project Partners

- ATLAS (Accessible Teaching, Learning and Assessment Systems) at the University of Kansas
- CAST
- BYC Consulting

State Partners

- Maryland (Lead)
- New Jersey
- New York
- Oklahoma
- Missouri

Today's Presenters

- Michelle Shipman – Assessment Development
- Gail Tiemann – Cognitive Labs and Evaluation
- Bob Dolan – Reporting Dashboard Development
- Shaun Bates – Missouri Department of Elementary and Secondary Education

Assignment Design: Blending Evidence-Centered Design and Universal Design for Learning

Michelle Shipman

University of Kansas

Science Assessments for All Students

- Designing science assessments to engage higher-order thinking without increasing barriers
- Innovative design approaches are needed to develop science assessments linked to the Next Generation Science Standards (NGSS) that are accessible to all students

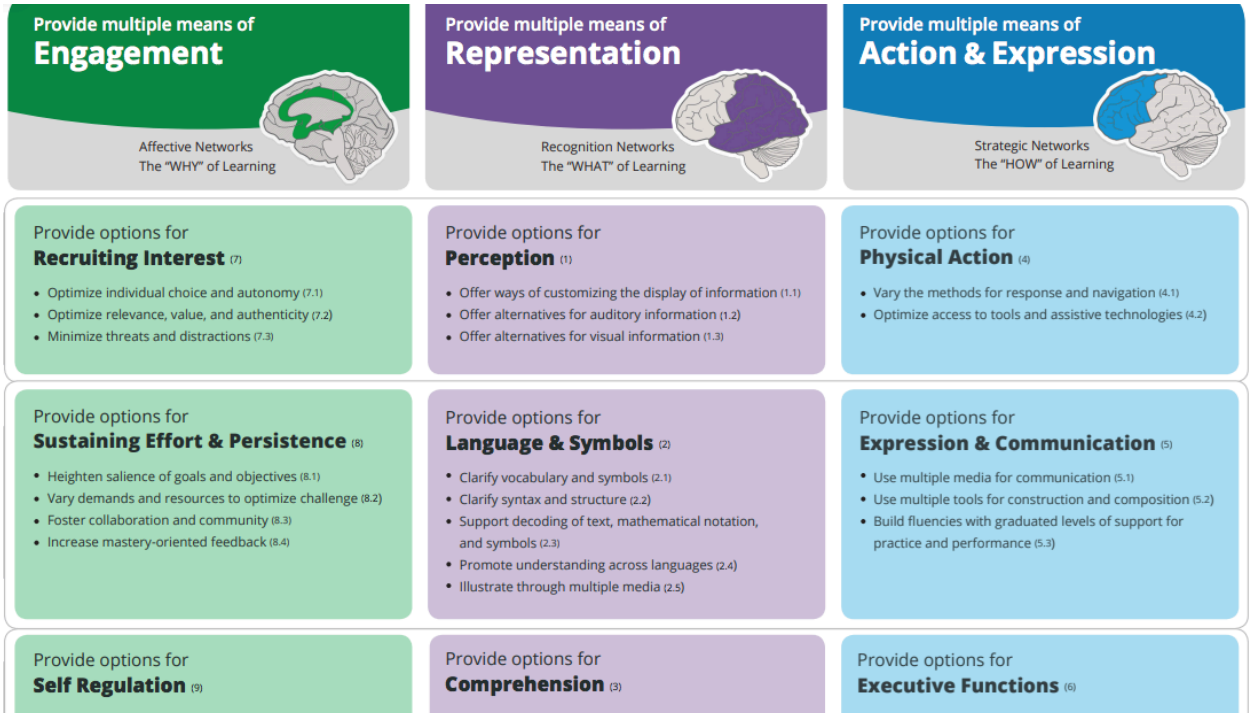
Testlet Design

- **Learning Map Models**
- **Evidence-centered design framework** (ECD: Mislevy, Steinberg & Almond, 2003)
- **Universal Design for Learning** (UDL: CAST, 2011)
- **Essential Element Concept Map (EECM)** is a document that specifies the connection between the content, a testlet's design elements, and student observations. (DLM, 2016, Bechard, et al., in press)

Innovative Testlet Design Features

- Both **Disciplinary Core Idea (DCI)** and **Science and Engineering Practice (SEP)** nodes are measured
- **Science phenomena** provides the contextual structure within the science narrative
- **12-16 items** that address **4 learning map nodes** within a single Essential Element and linkage level

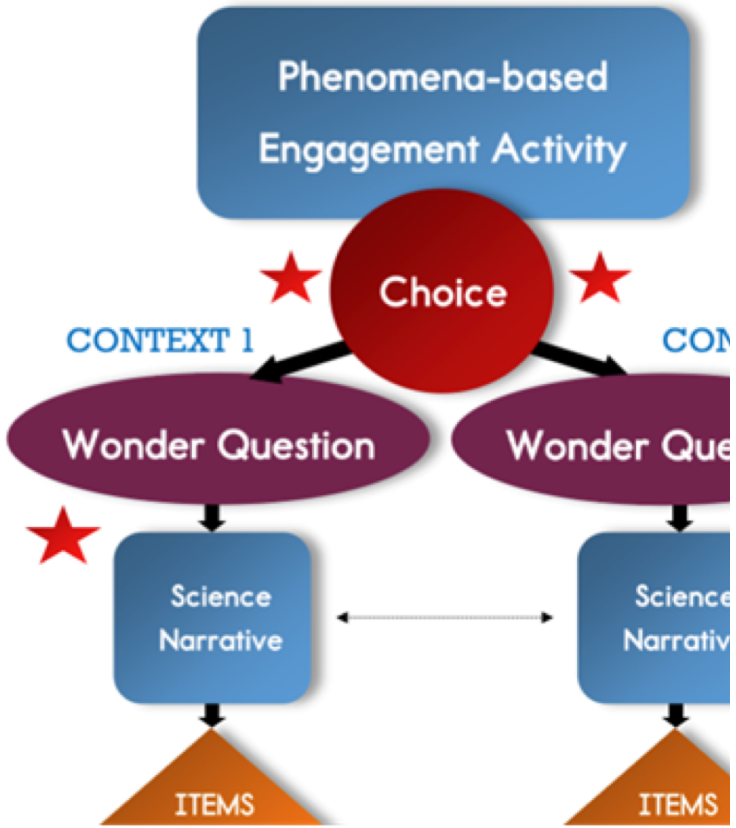
UDL-Guided Design



CAST (2018)

Embedded UDL Features

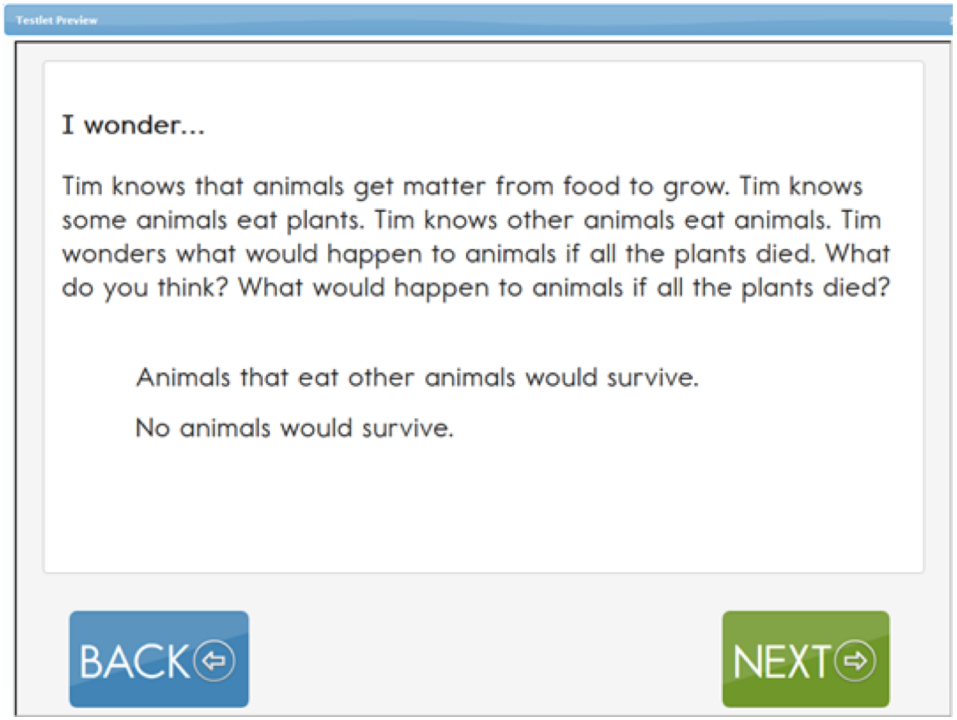
- Phenomena-based engagement
- Student choice
- Wonder Question
- Science narrative
- Embedded items



Provides Multiple Means of Engagement

Wonder Question

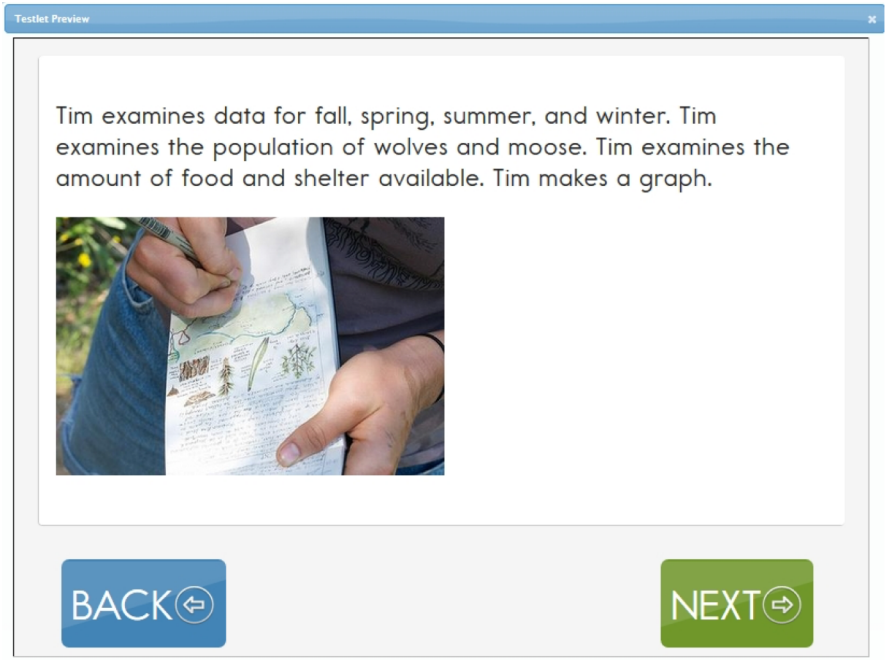
- Provides UDL option for self-regulation
- Found near the beginning of the testlet
- Unscored
- Students return to the Wonder Question at end of the testlet



Provide Multiple Means of Representation

Science Narrative

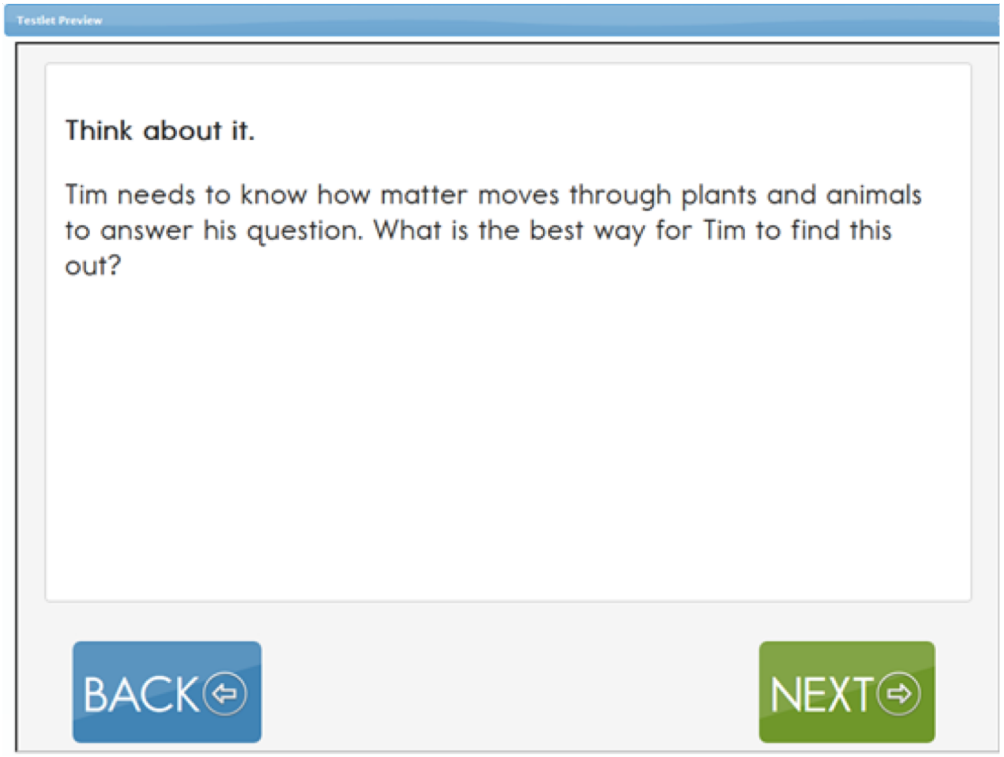
- Provides UDL options for
  - Comprehension
  - Language and symbols
- Includes the phenomenon



Provides Multiple Means of Action & Expression

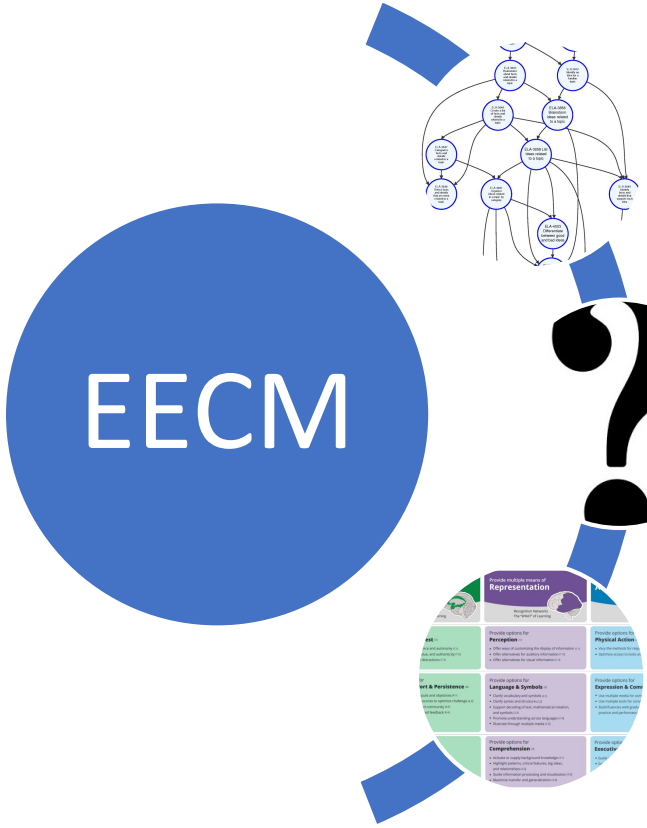
Think about it…

- Provides UDL option for executive function
- Used throughout the testlet
- Unscored
- Answer is provided on next screen



The EECM

- Built around a content standard
- Designed as a tool for item writers to integrate multiple frameworks



Example EECM Sections

EE.HS.LS2-2

Essential Questions for the Initial level

- Does the student understand that different objects can be members of the same category?
- Can the student identify common animals?
- Does the student recognize that different members of one type of organism comprise a population?
- Does the student recognize that food and shelter are needed for survival?

Initial Level Name	Initial Level Description
EE.HS.LS2-2.I	Identify common animals and populations, recognize their survival needs.

Vocabulary	
Concepts	habitat needs of a species
Words	food, shelter, survive

Misconceptions

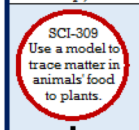
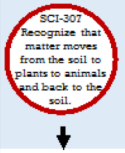
(F-66) The student does not distinguish categories of living things, such as animals.
(SCI-315) The student cannot identify common animals.
(SCI-527) The student does not recognize population. The student includes more than one type of organism when determining a population rather than only counting members of one species.
(SCI-501) The student does not recognize that food and shelter are needed for survival. The student indicates nonessential items as needed for survival. The student confuses the scientific usage of the word food with its common usage.

Information	Phenomenon	Wonder Question	Science and Engineering Practices
Plants and animals are categories of living things (LS2.A) → Identify common animals (LS2.A) → Recognize that groups of the same kind of living things live in the same area (population; LS2.A) → Recognize food and shelter as needed for survival (LS2.A)	General Mechanism – Organisms live together as populations in ecosystems. Example: A group of rabbits lives in the forest. Trees are in the forest.	Not used at the initial level.	Mathematics and computational thinking Students can count animals in a population. They understand how to use numbers with meaning and can use simple graphs to compare quantities or notice patterns.

Example EECM Sections

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**
	Linking node Integrated Node 4 items 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. Example Questions: What does the model show about how the [organism] gets matter? Which model shows how [organism] gets matter?
	Integrated Node 3 items 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. 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]?
	DCI Node 3 items 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.] Example Questions: What does the model show about how the [organism] gets matter? What does [character's] food chain show about matter?
	DCI Node 3 items 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. 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?

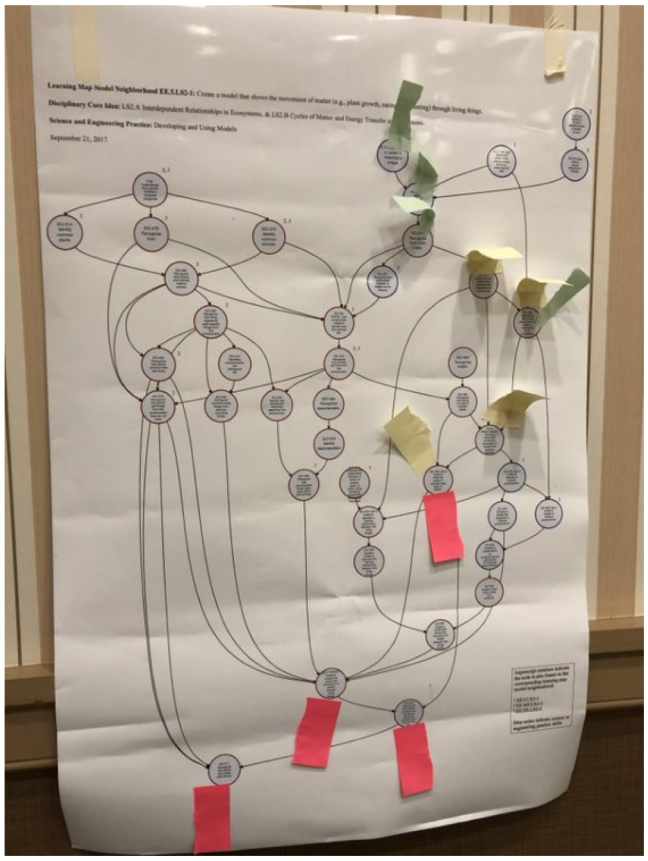
Use of EECMs in Item Writing

Item writers were able to:

- Synthesize information for each linkage level in their assigned Essential Element
- Narrow their focus and become familiar with the skills and content required by the nodes in their assigned linkage level.
- Choose a phenomenon to explore in their testlet
- Create a Choice or a Wonder Question

The Item Writing Process

- Advance and in-person training
- Using the EECM as a guide
- Peer brainstorming and collaboration
- Storyboarding a testlet
- Peer review
- Drafting content



Item Writer Evaluation

- 83% of item writers rated the EECM as a "very effective" tool
- 83% of item writers rated brainstorming with colleagues "very effective"
- 100% of item writers rated feedback from staff as "very effective."

The External Review Process

- Advance training and in-person training
- Individual ratings on assigned criteria
  - Content
  - Accessibility
  - Bias and Sensitivity
- Group discussion and recommendations

External Review Findings

- Panelist Recommendations
  - Most were concise and explicit
  - Many recommendations mentioned changing aspects of the testlets that were outside of the test design
- Trends in the data were used to inform decisions regarding item and testlet revisions
  - Clarify vocabulary
  - Accessible graphics
  - Accurate content within the science text

Panelist Evaluation

- 100% rated the following as effective or very effective:
  - Online Advance Training
  - Guide to External Review
  - Discussion with other panelists
- 100% rated the following as "agree" or "strongly agree":
  - Staff were knowledgeable about the academic content
  - Experience was valuable as professional development
  - Would participate in future events

Summary

- Using the UDL guidelines and checkpoints across the test development process was a valuable tool for staff to self-assess
- Integrating UDL and learning maps into an ECD based approach requires significant front-end effort

I-SMART Cognitive Labs: Validity Evidence to Evaluate Innovative Test Features

Gail Tiemann, PhD

University of Kansas

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' responses represent the science performance expectations the items were designed to measure?
4. What are students' and teachers' perceptions of students' experiences with the new testlets?

Prototype Testlets

- Rich science narrative following an inquiry process and a science phenomenon
- Elementary, middle school, and high school grade bands

Prototype Testlets

- One essential element per testlet
- Four learning map model nodes
- 3-4 scored items per node

Features based on UDL Framework

- Choice of Topic
  - Initial and Precursor Linkage Levels only
  - Construct-relevant or character-based choice
- Media, unscored items to engage interest, self-assessment

Students

- Group 1 – students eligible for Dynamic Learning Maps alternate assessment
- Groups 2 and 3 – students with and without disabilities who are consistently not successful with grade-level content

Students

- Received instruction on the content
  - Teacher survey probed this information
- Any grade in the grade band
- Initial level – communicate an answer through any response mode

Students

- Precursor and Target Levels
  - Computer-based
- Initial Level
  - Facilitator administers 1:1
  - Answers entered into computer by facilitator
  - Teacher present to assist with administration and interpretation

Labs Completed

	Initial – Group 1	Precursor – Group 1	Target – Group 1	Target – Group 2/3
Elementary	6	NA	0	0
Middle School	NA	2	2	4
High School	5	NA	0	0

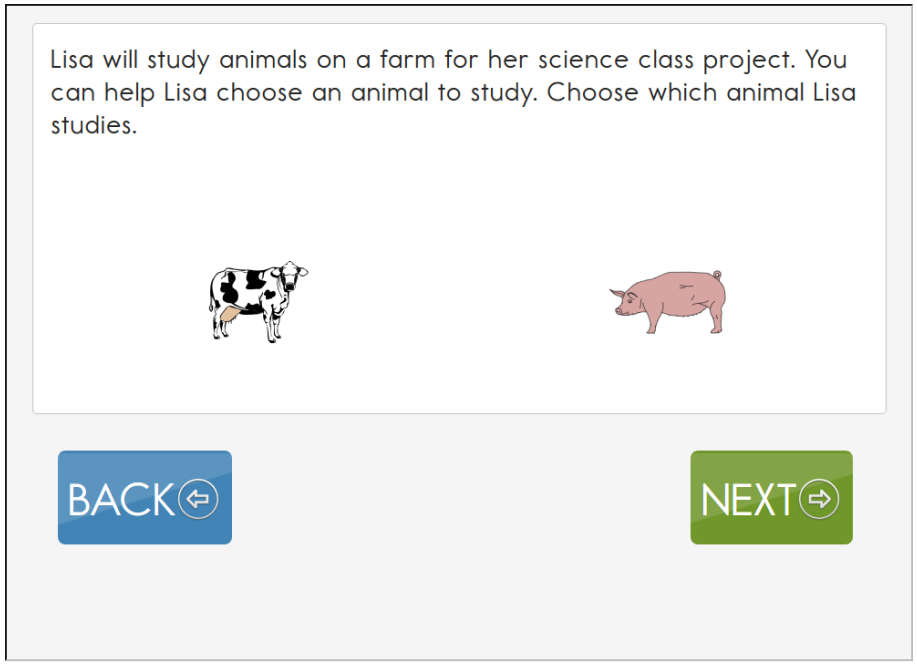
Total – 19 students

States – 2, Schools - 3

Results - RQ 1 Testlet features

Choice

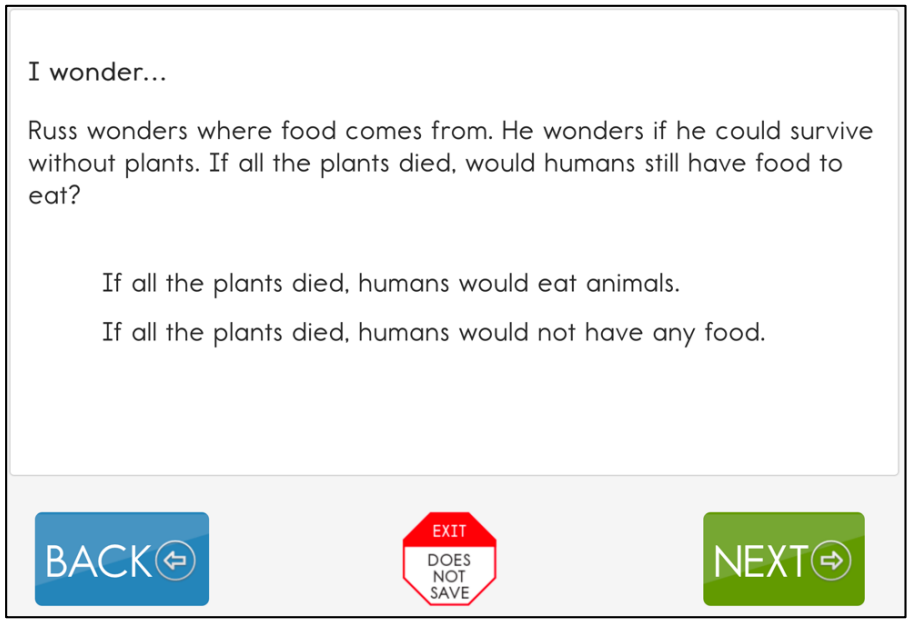
- Initial Level n=11
  - 8 of 11 students made intentional choice
- Precursor Level n=2
  - No difference in student engagement between two different choice options



Results - RQ 1 Testlet features

I Wonder (n=8)

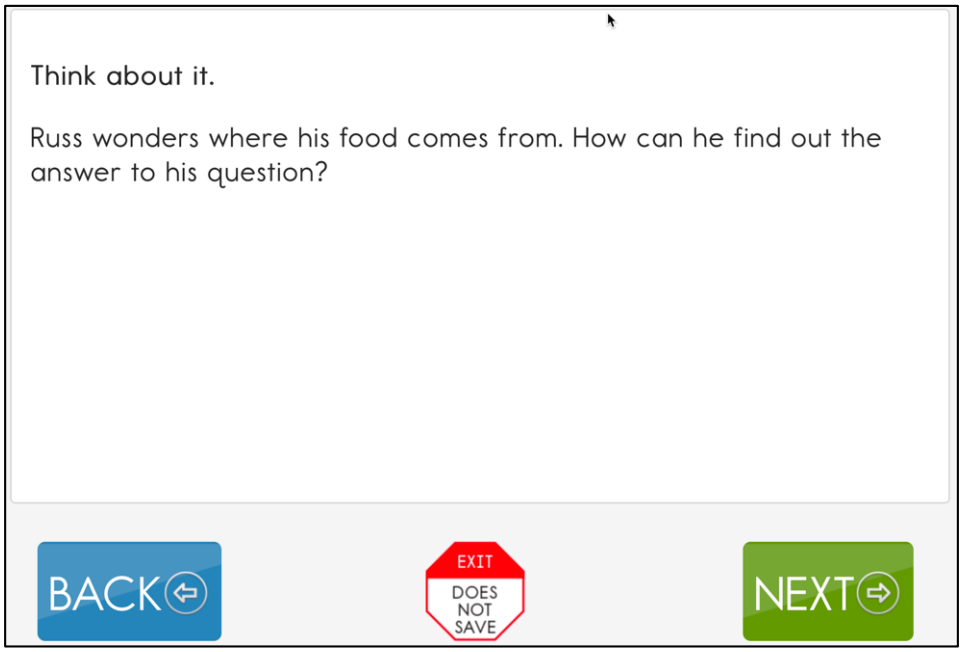
- Middle School Target and Precursor
- Presented twice
- 1 changed correct to misconception
- 3 retained misconception
- 2 changed misconception to correct
- 2 correct both times



Results - RQ 1 - Testlet features

Think About It (n=6)

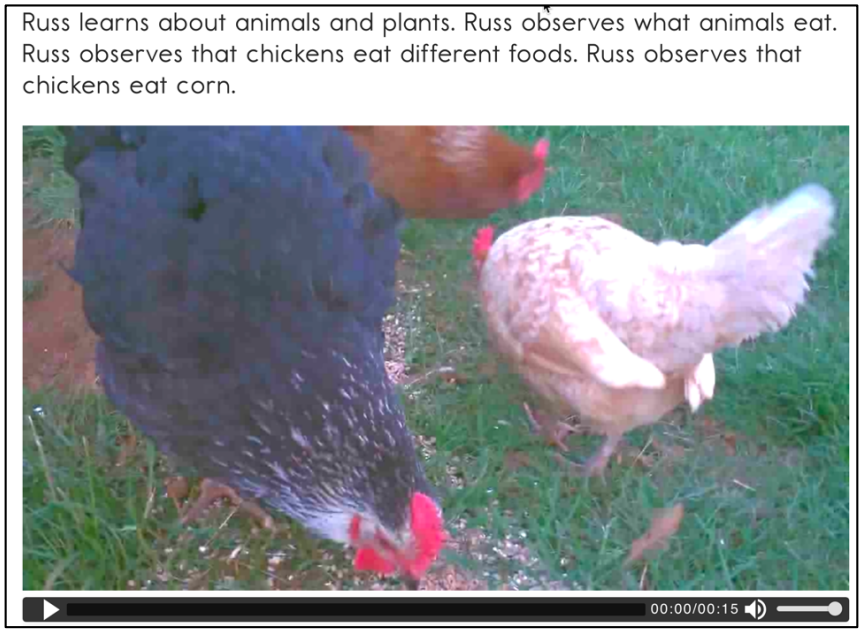
- Middle School Target and Precursor
- Question followed by answer
- Occurs twice in testlet
- Mixed responses
- Second instance, 5 paused to answer out loud



Results - RQ 1 - Testlet features

Video (n=8)

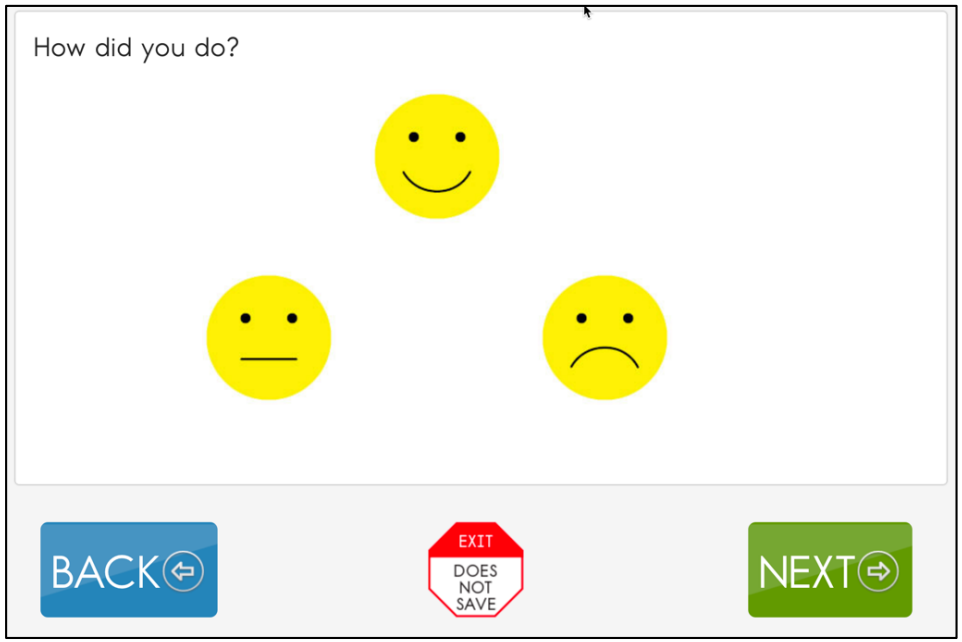
- Middle School Target and Precursor
- Encourage interest, not required for answers
- 6 needed help to play
- Delayed loading startled students
- Tech concerns addressed



Results - RQ 1 - Testlet features

Self-assessment (n=8)

- Middle School Target and Precursor
- All 8 answered ☺



Results – RQ 2 Testlet Time

	Group	N	Item Count	Time Range
Choice-based	1	13	14-17	11:47 – 25:00
Extended Narrative - Target	1	2	16	17:41 – 18:20
Extended Narrative - Target	2/3	4	16	12:21 – 29:28

Middle School students delivered substantial think aloud and retrospective comments.

Results – RQ 3 Content & Performance Expectations

	Group	N	Construct-Relevant Responses	Number of Scored Items
Choice-based-Precursor	1	1	8	14
Extended Narrative - Target	1	2	10,11	14
Extended Narrative - Target	2/3	4	5, 10, 10, 14	14

Analysis based on item specifications – intended response process, misconceptions, guessing, unknown process

Results – RQ 3 Content & Performance Expectations

	Group	N	Students with Evidence of Construct-Relevant Responses
Elementary - Initial	1	6	1
High School - Initial	1	5	3

Construct-irrelevant evidence included picking items based on position, not looking at all choices, random choices. Construct-relevant evidence included teacher interpretations, instruction received, clear answer choices, answer options in variety of positions.

Results – RQ 4 Perceptions

- Length
  - 3 of 8 students too long, 5 just right or normal
  - Teachers did not comment
- Difficulty
  - 3 of 6 students at target-level felt too easy
    - 2 described repetition as a dislike
  - 3 teachers felt content too advanced at initial level
  - Concern about accessibility for students who do not eat

Results – RQ 4 Perceptions

- Media
  - Students liked - 1 suggested more pictures
  - Teacher suggested more realistic, larger pictures
  - Teachers of students at initial level, pictures were unfamiliar
- General Usability
  - Teacher – good flow of content from screen to screen.
  - Some unfamiliar layouts

Discussion

- Results and exploratory and formative
- Two additional, small rounds of data collection to be added to results.

Discussion

- UDL features were novel, evidence generally suggests features are engaging without adding barriers
  - Difficulty with I Wonder – potential lack of exposure to inquiry
  - Think About It – need more evidence, better probes

Discussion

- Longer than usual tests, but times within acceptable limits
- Students generally interpreting content as intended
  - Students at initial level did make correct selections, especially with more familiar content.
  - Two teachers concerned with difficulty, more item difficultly will be explored during pilot

Discussion

- Students generally liked content
- Media was a favorite, suggestions for improvement addressed in testing platform
- Teacher involvement critical for cognitive lab success, especially at initial level

Design of an Online, Learning-map-based Reporting Dashboard to Support Formative Assessment

Robert P. Dolan, Emma L. Starr, Cara Wojcik, Kim Ducharme, and Jose Blackorby

CAST, Inc.

CCSSO NCSA
June 24, 2019

I-SMART

Innovations in Science Map, Assessment & Report Technologies

Agenda

- Project Background
- Brief Introduction to Universal Design for Learning
- Teacher Dashboard Co-Design Methodology
- Design Findings
- Next Steps

Project Background

Goal

Design and evaluate a prototype **dashboard** to support teacher use of testlet results to inform instructional decision making, co-designed with teachers through a UDL lens

June 26, 2017

Learning Map Model Neighborhood EE.MS.LS2-2: Use models of food chains/webs to identify producers and consumers in aquatic and terrestrial ecosystems.

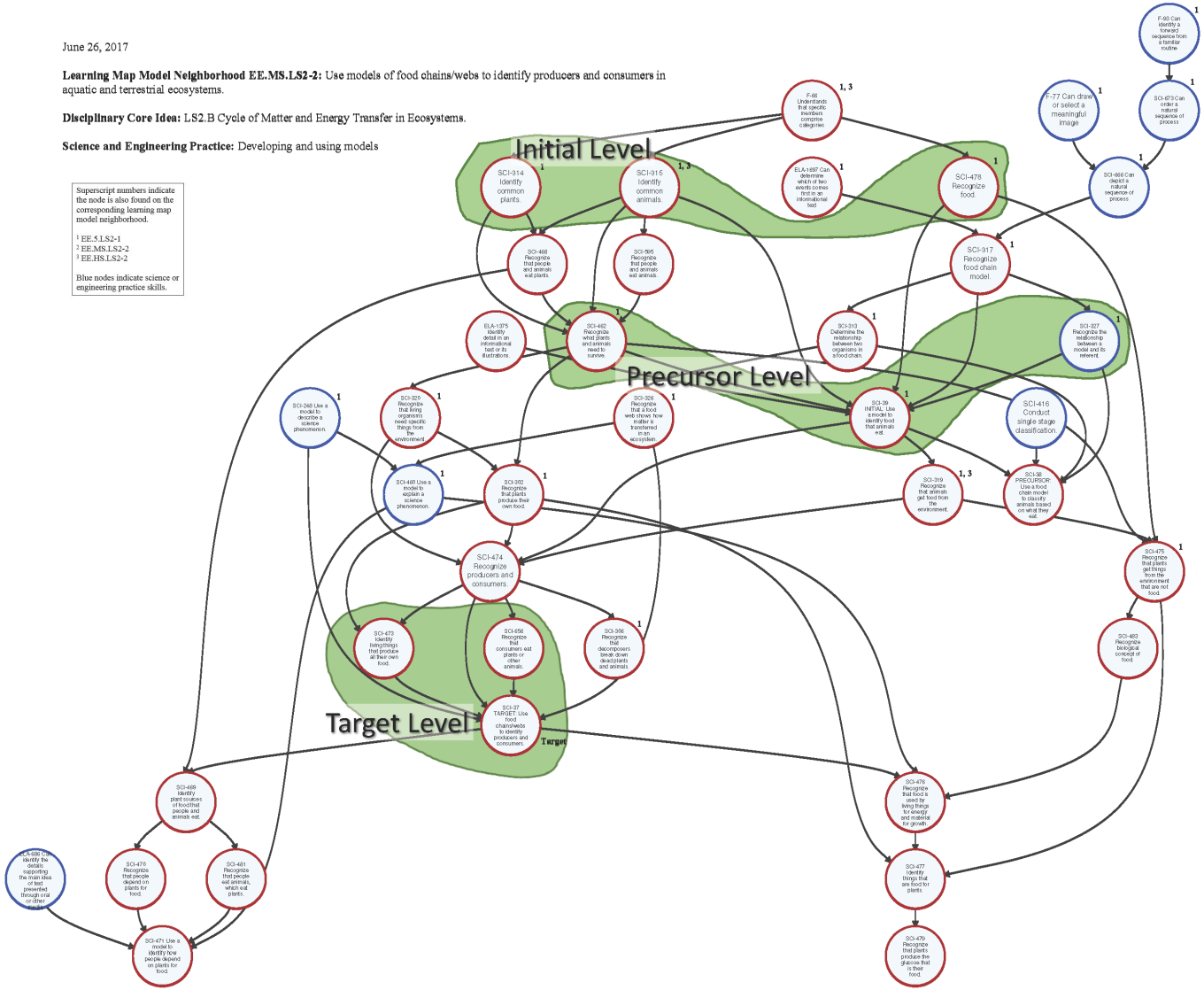
Disciplinary Core Idea: LS2.B Cycle of Matter and Energy Transfer in Ecosystems.

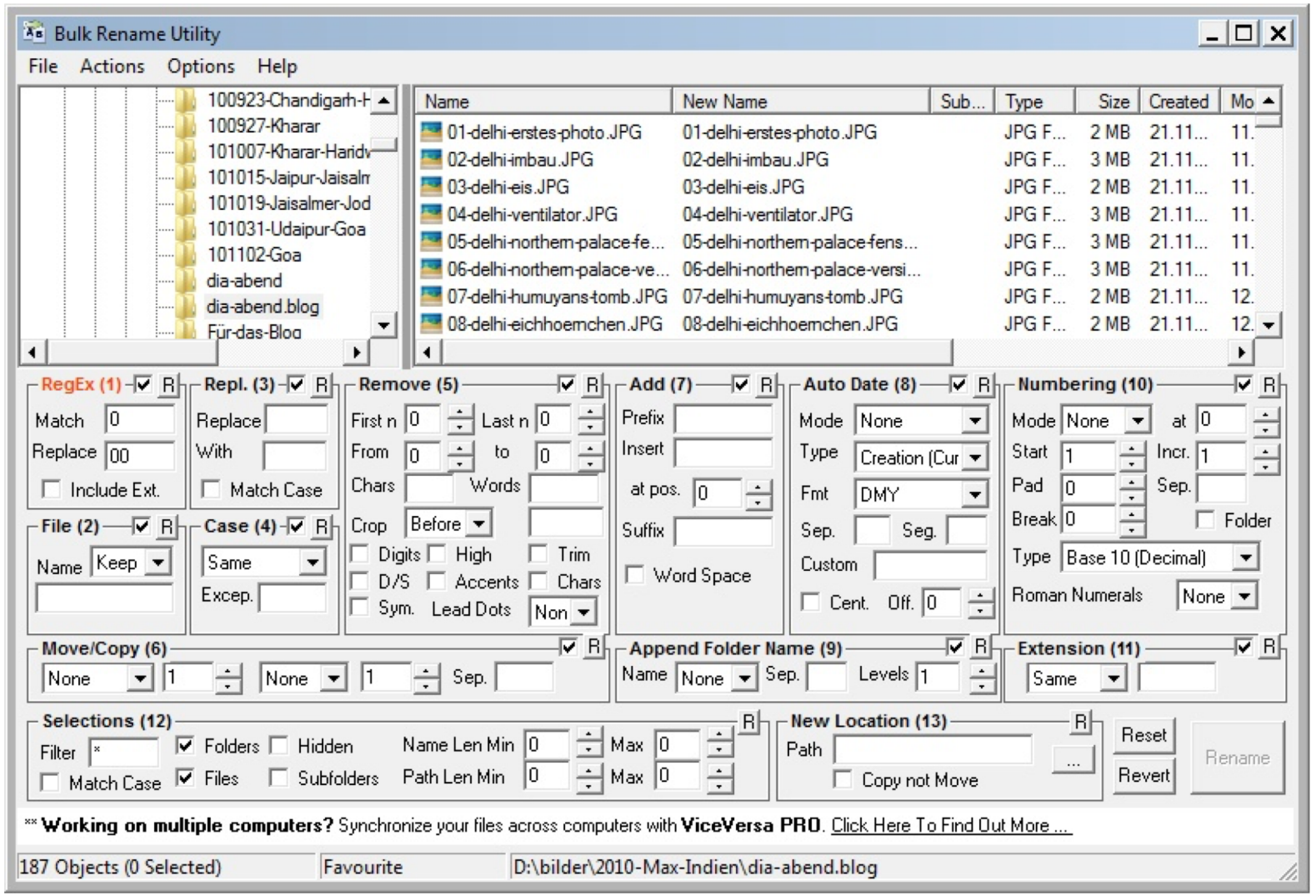
Science and Engineering Practice: Developing and using models

Superscript numbers indicate the node is also found on the corresponding learning map model neighborhood.

[1] EE.5.LS2-1
[2] EE.MS.LS2-2
[3] EE.HS.LS2-2

Blue nodes indicate science or engineering practice skills.




Bulk Rename Utility
File Actions Options Help
100923-Chandigarh-H
100927-Kharar
101007-Kharar-Haridv
101015-Jaipur-Jaisalm
101019-Jaisalmer-Jod
101031-Udaipur-Goa
101102-Goa
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dia-abend.blog
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01-delhi-erstes-photo.JPG
02-delhi-imbau.JPG
03-delhi-eis.JPG
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05-delhi-northern-palace-fe...
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07-delhi-humuyans-tomb.JPG
08-delhi-eichhoernchen.JPG
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RegEx (1)
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Replace 00
Include Ext.
Repl. (3)
Replace
With
Match Case
Remove (5)
First n 0
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From 0
to 0
Chars
Words
Crop Before
Digits High Trim
D/S Accents Chars
Sym. Lead Dots Non
Add (7)
Prefix
Insert
at pos. 0
Suffix
Word Space
Auto Date (8)
Mode None
Type Creation (Cur
Fmt DMY
Sep. Seg.
Custom
Cent. Off. 0
Numbering (10)
Mode None at 0
Start 1 Incr. 1
Pad 0 Sep.
Break 0 Folder
Type Base 10 (Decimal)
Roman Numerals None
File (2)
Name Keep
Case (4)
Same
Excep.
Move/Copy (6)
None 1 None 1 Sep.
Append Folder Name (9)
Name None Sep. Levels 1
Extension (11)
Same
Selections (12)
Filter *
Folders Hidden
Files Subfolders
Match Case
Name Len Min 0 Max 0
Path Len Min 0 Max 0
New Location (13)
Path
Copy not Move
Reset
Revert
Rename
** Working on multiple computers? Synchronize your files across computers with ViceVersa PRO. Click Here To Find Out More ...
187 Objects (0 Selected)
Favourite
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The problem

Teachers are swimming (drowning) in student data, too often presented in unusable & non-actionable ways.

How can we make data displays—and the way they are used—more empowering and effective for teachers?

The approach

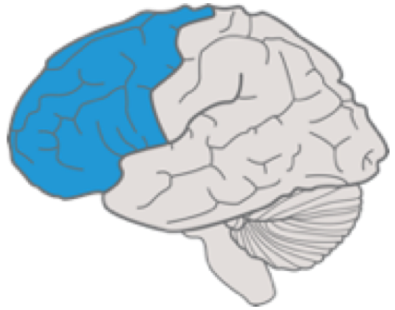
Apply UDL to co-design with teachers an interface that supports their leveraging of learning map models in using student test results for instructional decision-making

Brief Introduction to Universal Design for Learning

Innovations in Science Map,
Assessment & Report Technologies

Universal Design for Learning (UDL)

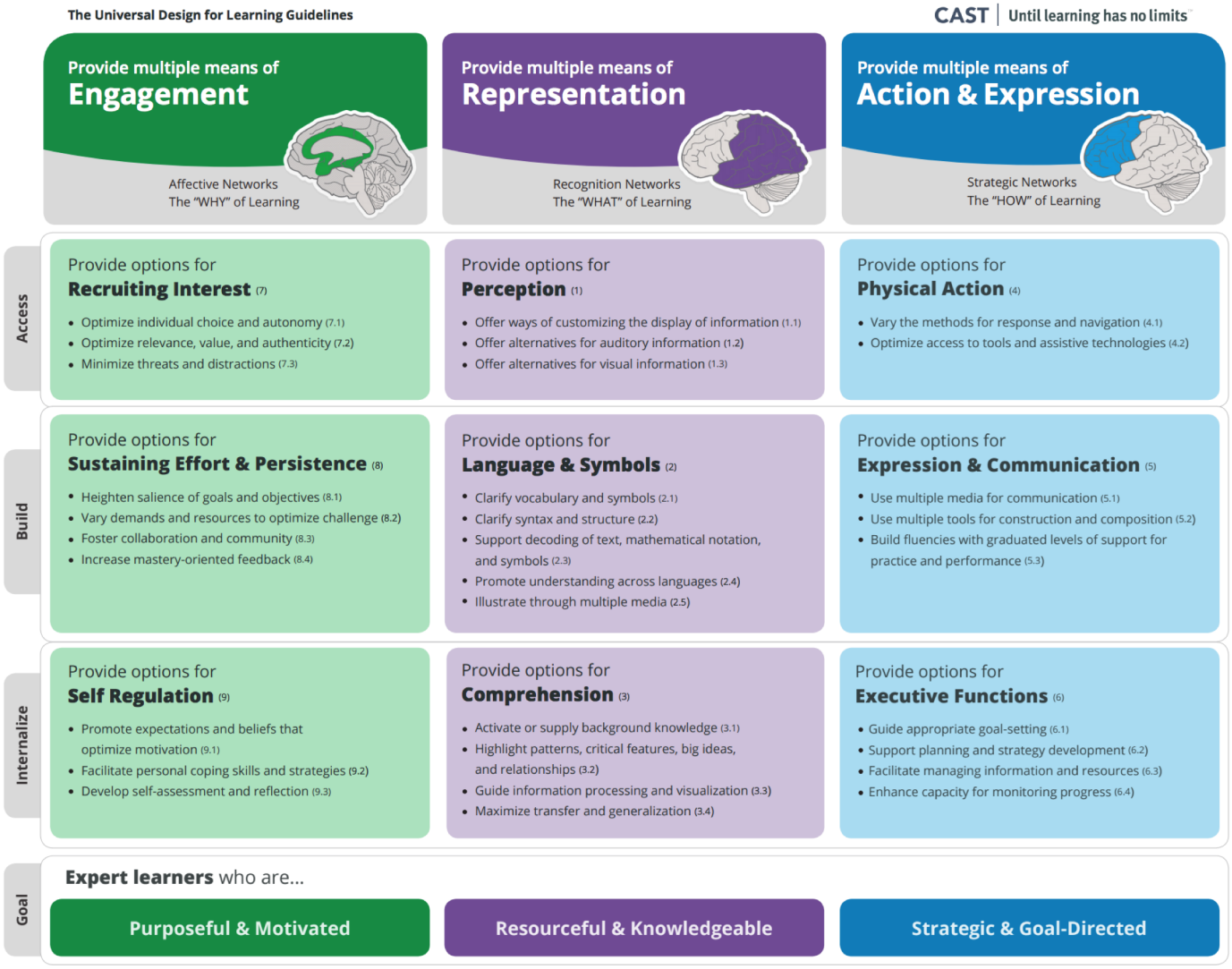
A **framework** for embedding options and supports into curricula and learning experiences to expand learning opportunities for *all* learners



Access

Build

Internalize



Dashboard Development

Teacher Co-Design Cadres

Main Cadre:

- 11 educators from four DLM partner states
- 4 sets of meetings
- Meetings of 1-5 cadre members, 2-4 I-SMART team members
- 90 minutes
- Video conferencing

Gen Ed Focus Group:

- 1 meeting
- Same format as above
- 2 gen ed science teachers (grades 6 & 8) from a MA school

Iterative Discovery / Design Process:

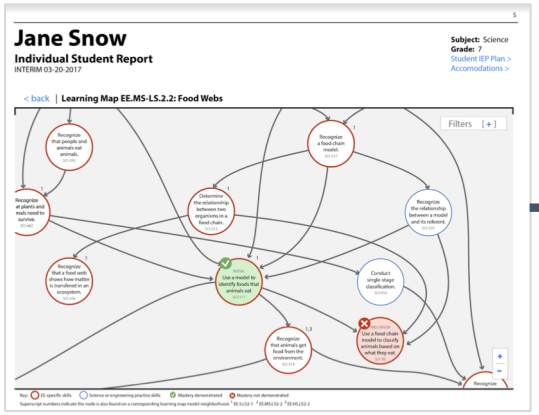
Cadre Meetings 1-3

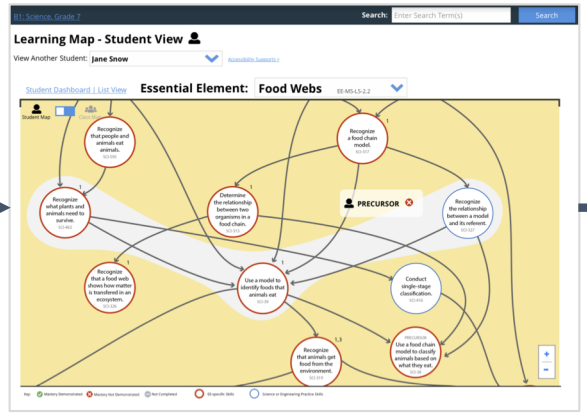
- Recap of the previous design's principal elements and features
- Walk-through of newly introduced screens and functions spotlighting design solutions resulting from teacher-generated feedback
- Facilitated discussion of prototype focusing on areas of clarity/confusion, features to change/add, most/least useful functions, and "Five Ws"

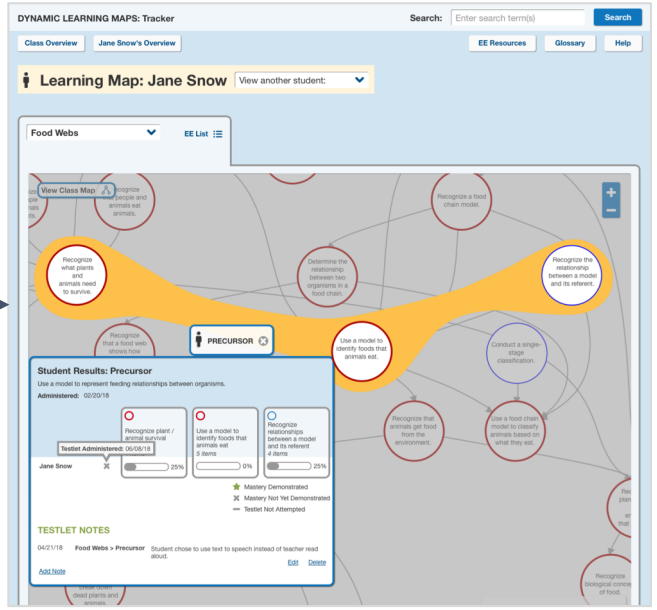
Cadre Meeting 4

- "Scavenger Hunt" usability testing session - teachers completed usability tasks to uncover any areas needing further refinement
- Cadre process reflection

Iterative co-design cycles







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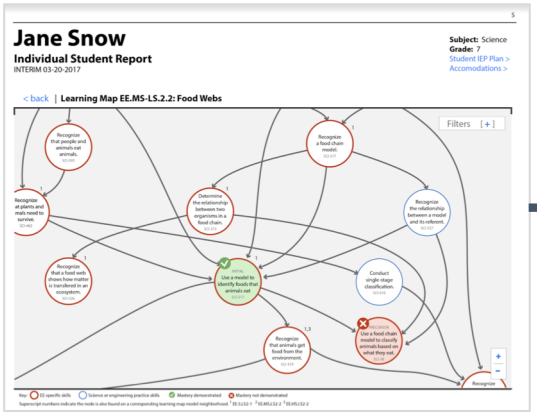
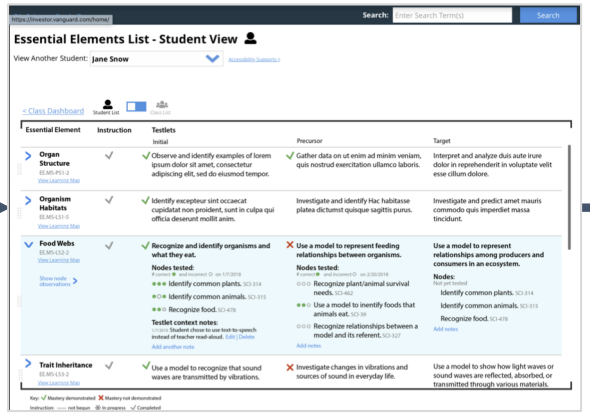
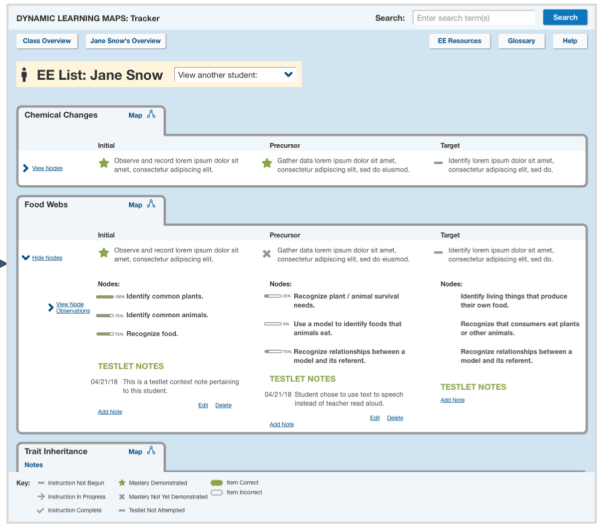
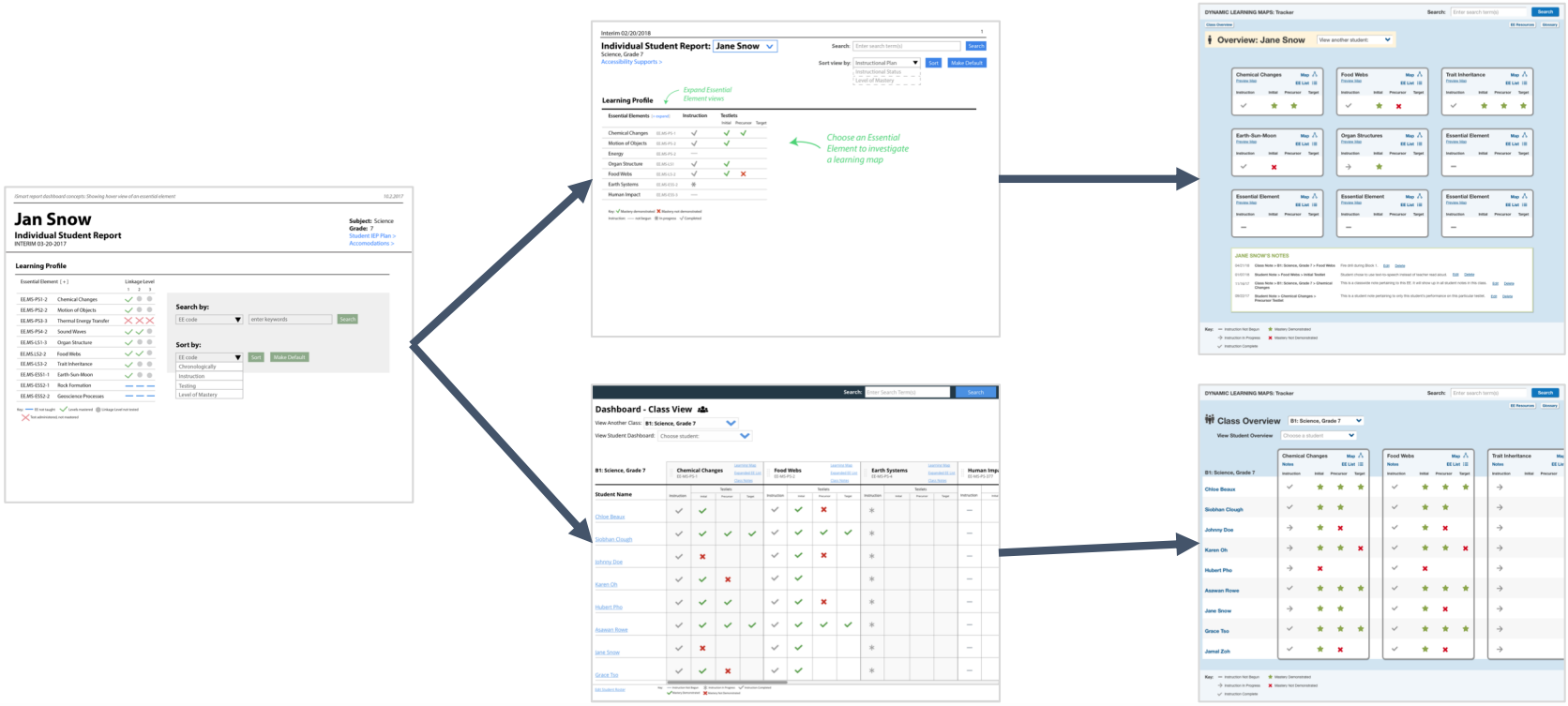
Iterative co-design cycles



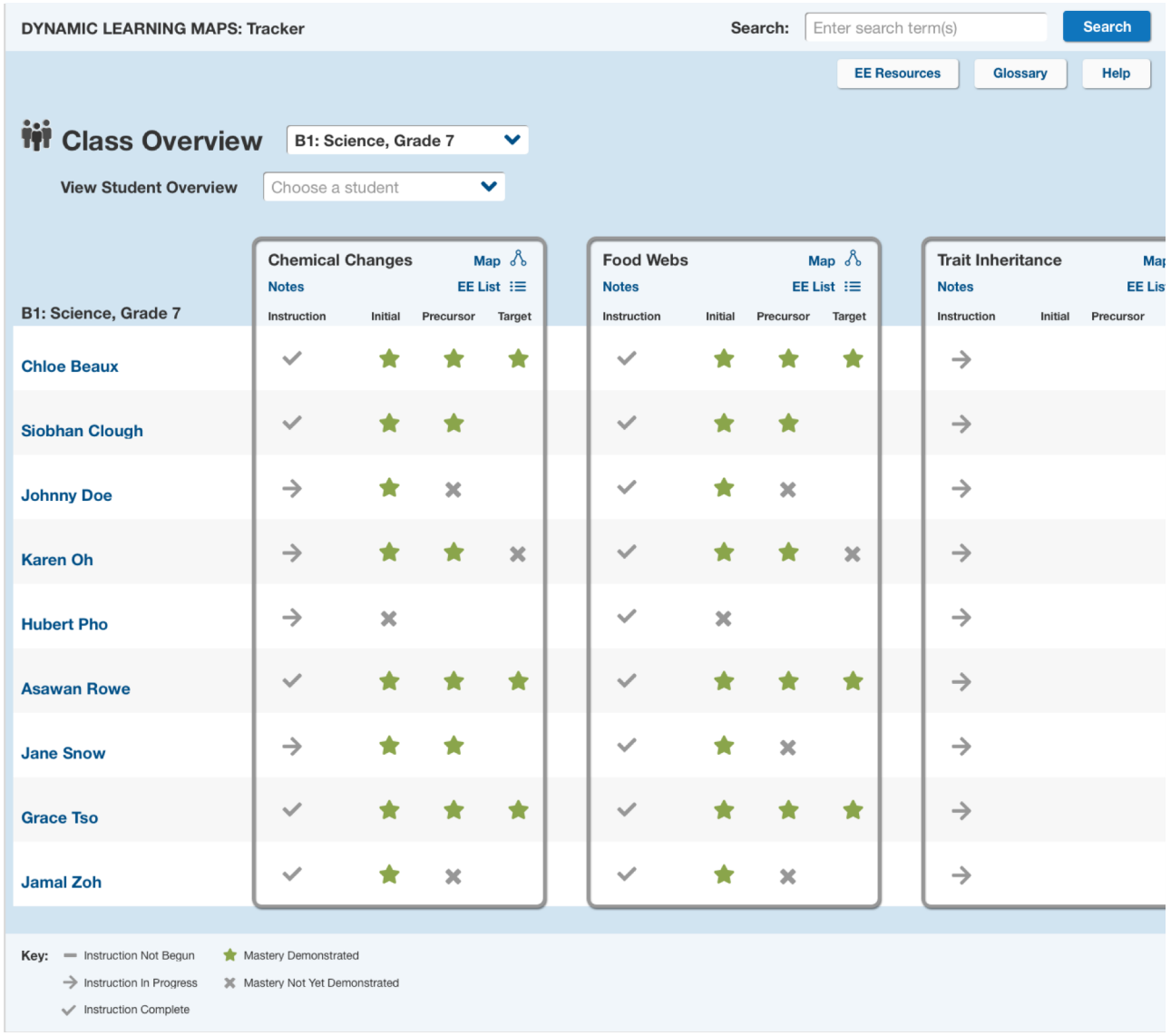




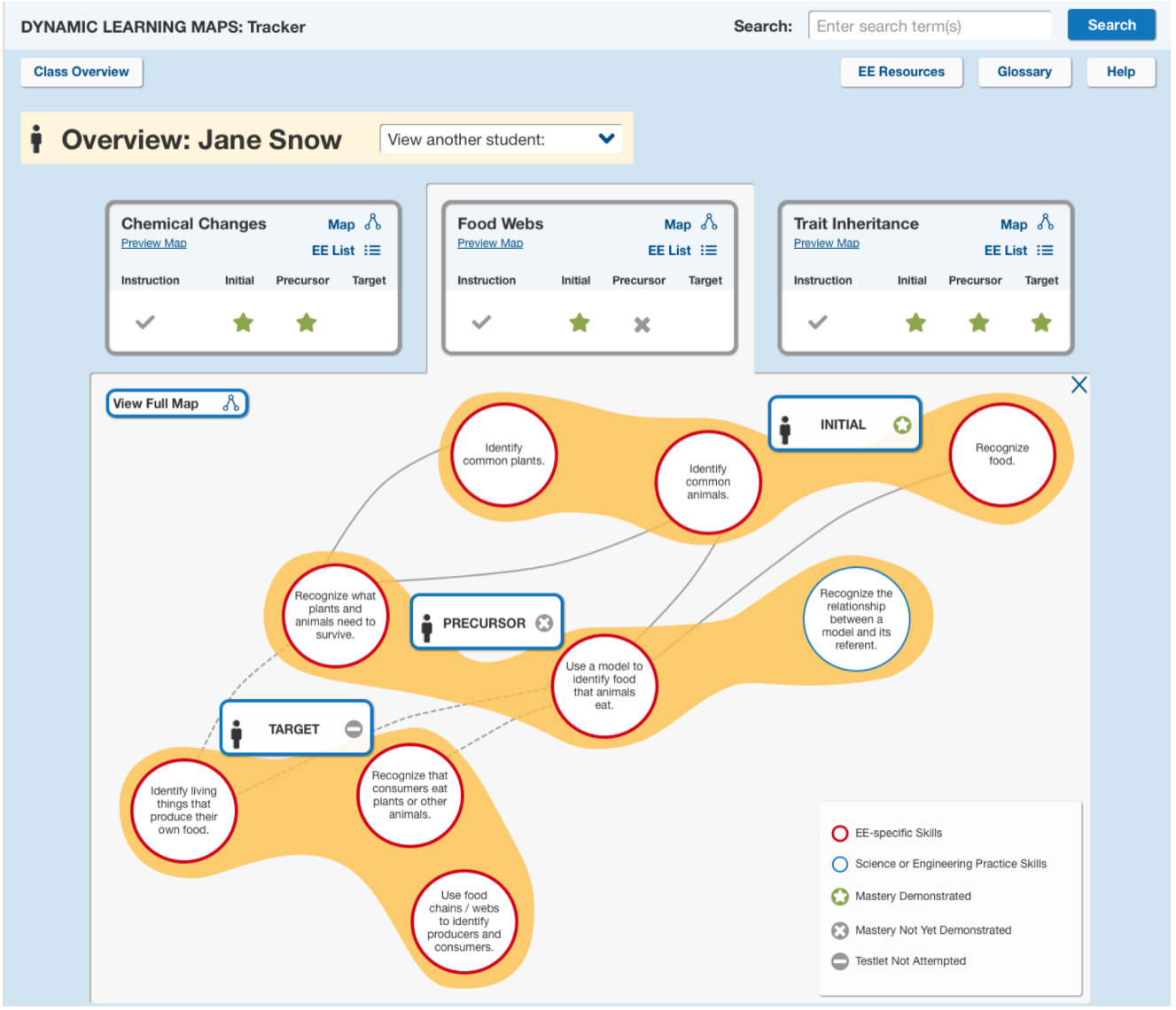
Iterative co-design cycles



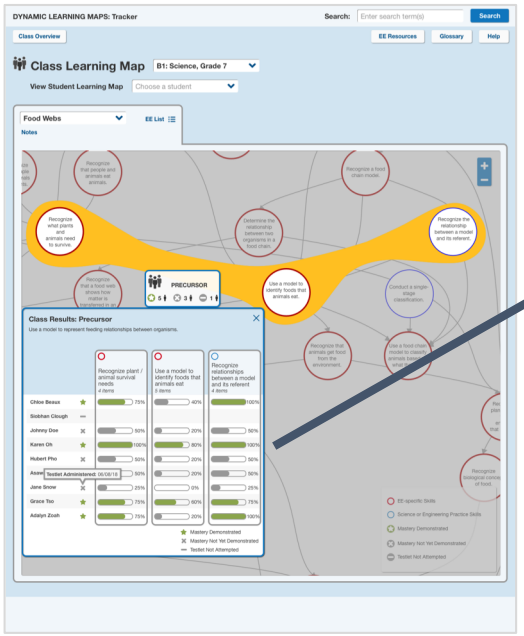
Test results: class overview

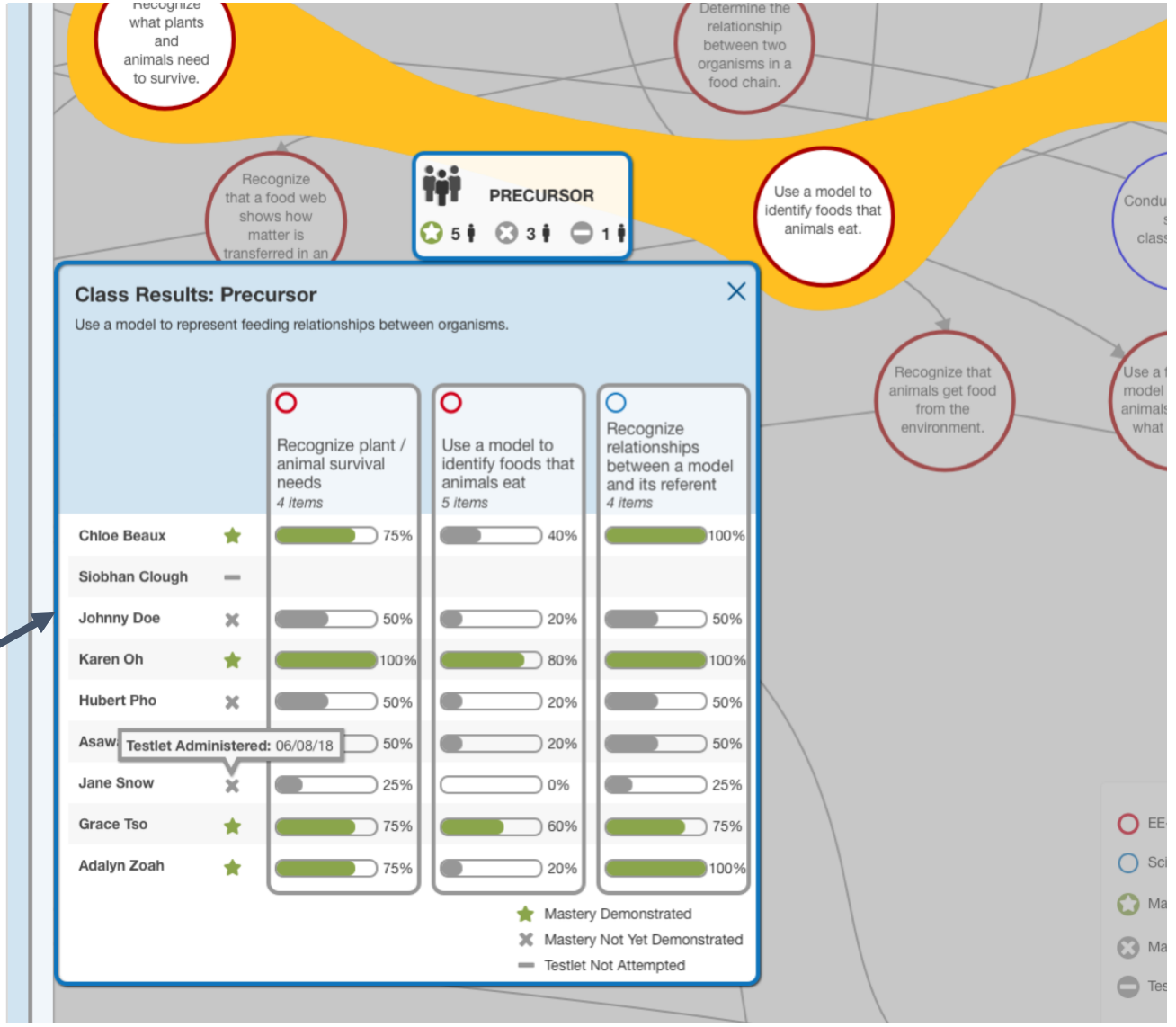


Test results: student overview



Test results: detail view by class





Summary of Design Findings

- Teachers found the learning maps valuable for understanding student progress and supporting instructional decisions
- However, scaffolding teacher's use of the map is necessary; there is a learning curve that can be supported through multiple representations of the same data
- Necessary to include aggregate view of class data to meet teachers' instructional needs

Final Cadre Findings

- In final usability/interpretability testing, cadre members were able to complete tasks effectively
- Feedback from cadre about final design was positive
- In final reflection, cadre members reported that they felt positive about the process, including that their ideas were used and that they developed professionally through participating

Next Steps

Upcoming Research Study

- Pilot study of science assessment system in 2020
  - Including evaluation of teacher dashboard through …
    - Interpretability and usability studies
    - Teacher interviews and focus groups

Comments & Questions

- State Partner Perspective

- Q&A

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