BSCS Tools Pilot Project: Developing NGSS Summative Assessment

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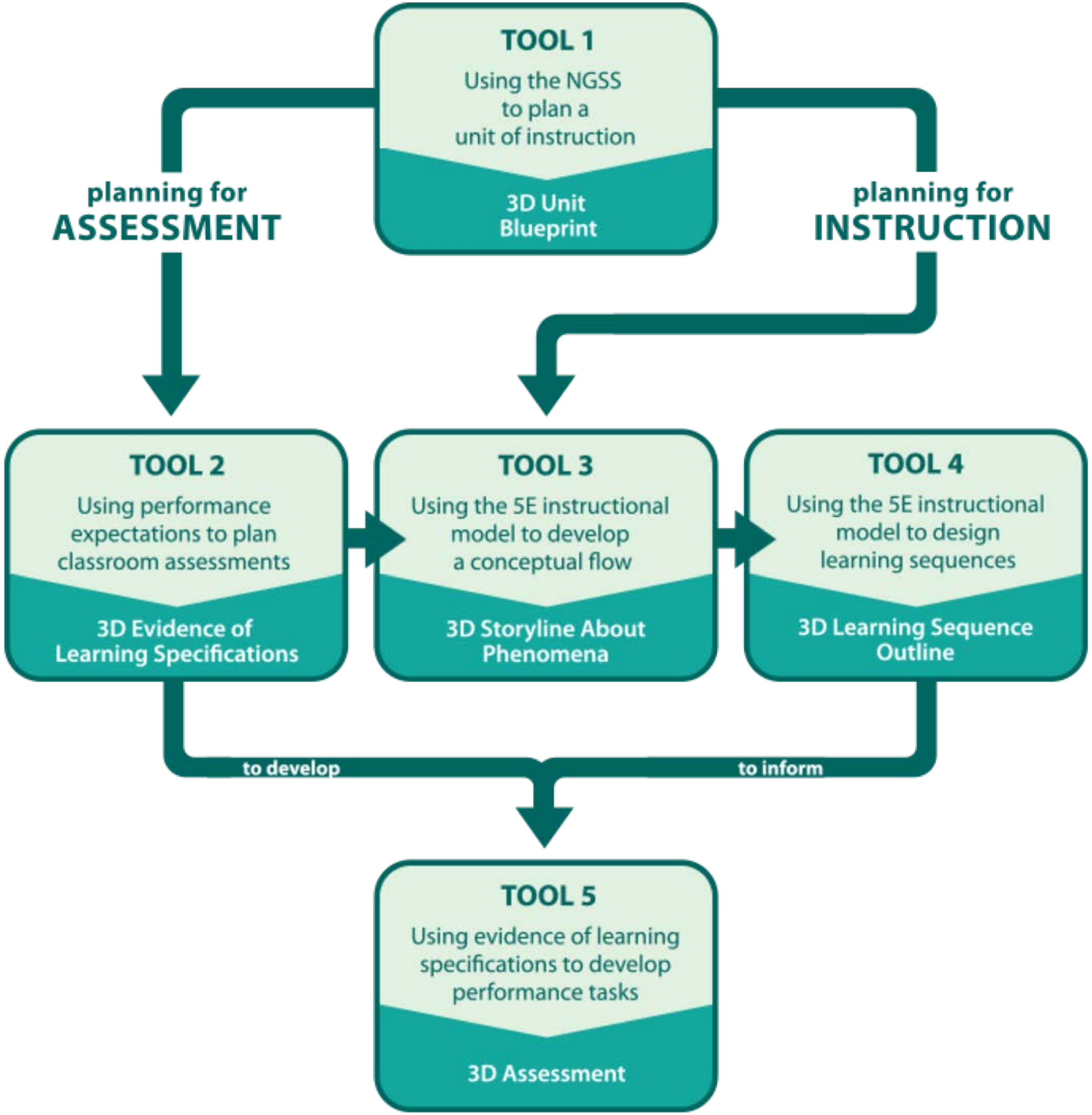
Session Overview

- Introduce the “5-tool model” developed by BSCS, West-Ed, and the American Museum of Natural History.
- Discuss recent pilot of “3 tools” approach used specifically to develop NGSS-aligned summative assessments.
- Learn how this professional development experience impacted NGSS curriculum planning for one of the participating pilot districts, West Windsor-Plainsboro School District.

Five Tools and Processes for Translating the NGSS into Instruction and Classroom Assessment

- Translate core ideas, practices, and performance expectations into multiple instructional sequences that form an NGSS unit.
- In-depth planning for one instructional sequence and assessment tasks to provide evidence of student learning focused on performance expectations.
- Focus on helping build conceptual coherence and the development of teacher generated “unit blue prints” that prepare students for select performance expectation.
- https://youtu.be/EU1RfziAG1o?t=174

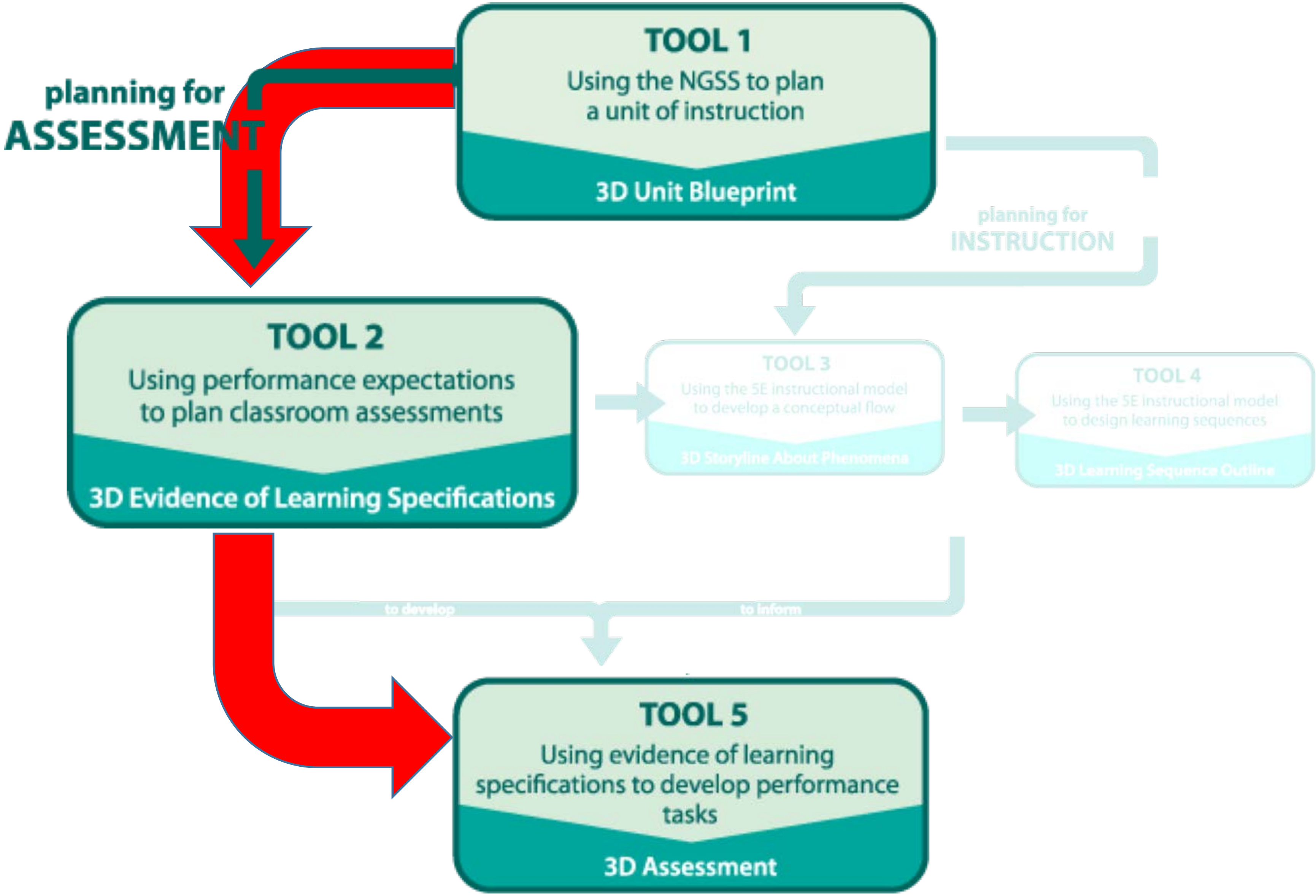

TOOL 1
Using the NGSS to plan a unit of instruction
3D Unit Blueprint
planning for ASSESSMENT
planning for INSTRUCTION
TOOL 2
Using performance expectations to plan classroom assessments
3D Evidence of Learning Specifications
TOOL 3
Using the 5E instructional model to develop a conceptual flow
3D Storyline About Phenomena
TOOL 4
Using the 5E instructional model to design learning sequences
3D Learning Sequence Outline
to develop
to inform
TOOL 5
Using evidence of learning specifications to develop performance tasks
3D Assessment

Advancing Tools and Processes for the NGSS (ATP-NGSS) Five Tools Field Test

- Three models consisting of different combinations of the Five Tools were field tested to meet the varying needs of districts and schools across the country.
  - ***Model C: Assessment -*** Develop a school- or district-based classroom assessment for one instructional sequence or for one unit of instruction.

Goals of Model C:

- Increase understanding of how to develop assessments based on phenomena-focused three dimensional teaching and learning.
- Increase understanding of phenomena and how to use phenomena as a basis for classroom assessments.
- Increase understanding of how to better assess student learning through the use of evidence of learning specifications.
- Focus on the use of Tools 1, 2, and 5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Tool 1: Using the NGSS to plan a unit of instruction

Our ideas
- What do students need to know/understand about the topic?

DCIs
- How can we build from what we know and the disciplinary core ideas to ensure coherent instruction?

PEs
- What can we learn by studying the performance expectations?

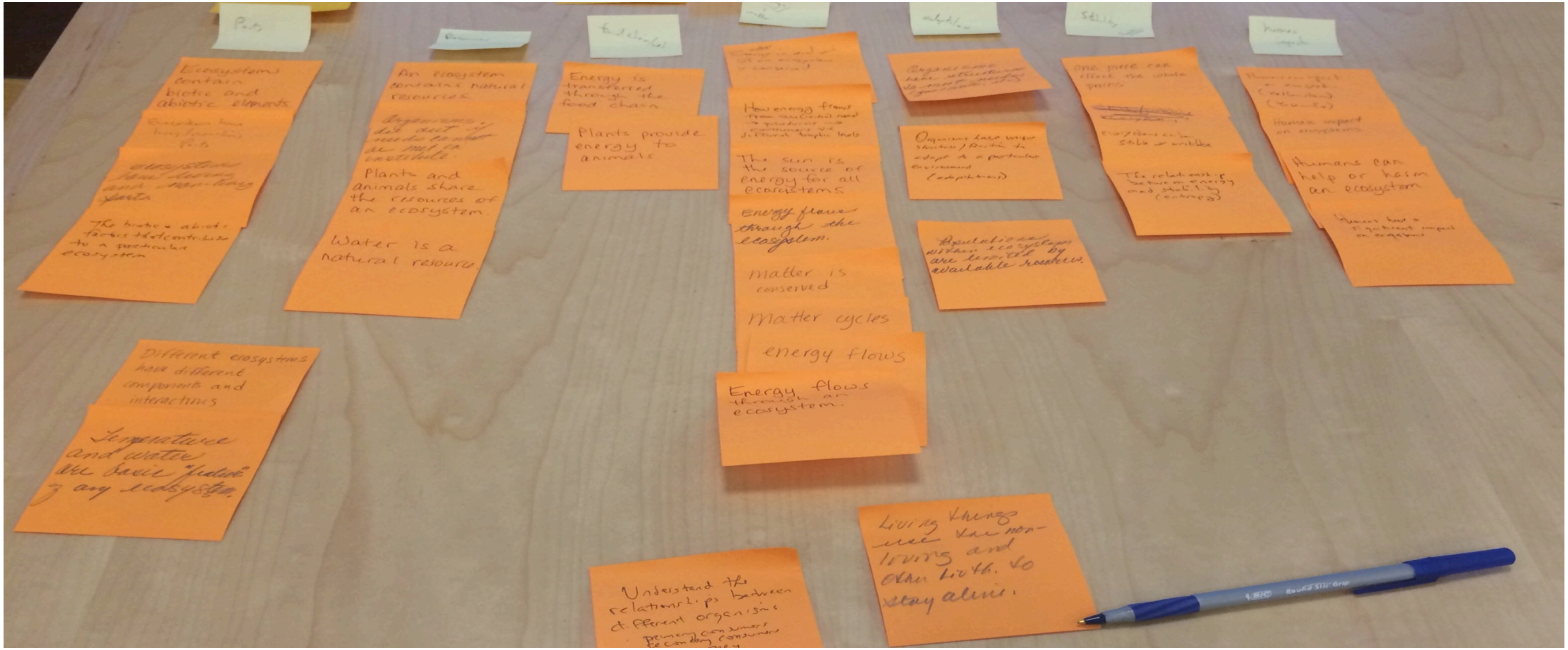
SEPs & CCCs
- How can we build coherence using the science and engineering practices and crosscutting concepts?

Connections
- How do ideas about the nature of science, engineering, and common core influence our sequence?

First Steps

- Begin to design a blue print for instruction and assessments for middle school students focused on ecosystems
- Write a paragraph to share your ideas about what students should know about ecosystems
- Transfer each individual idea to a sticky note
- Confer with your colleagues about these ideas and begin to create a **conceptual flow or instructional sequence**
  - How do ideas build on one another?
  - Do the ideas build from concrete to abstract?
  - How can you tell a story with the sequence of ideas?

Example of a Conceptual Flow



Mapping of Conceptual Flow or Unit Blue Print

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How well do your grouped ideas match the ideas from the Framework?

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

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Students who demonstrate understanding can:

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving p… ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ec… defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the pro…

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological com… ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted infer… in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Cla… Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design so… include scientific, economic, and social considerations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework fo…*

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe phenomena. (MS-LS2-3)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every

…tting

…ems can be used to … effect relationships. (M…

Cause and Effect
- Cause and effect relati… predict phenomena in n… systems. (MS-LS2-1)

Energy and Matter
- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Stability and Change
- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- The use of technologies and any limitations

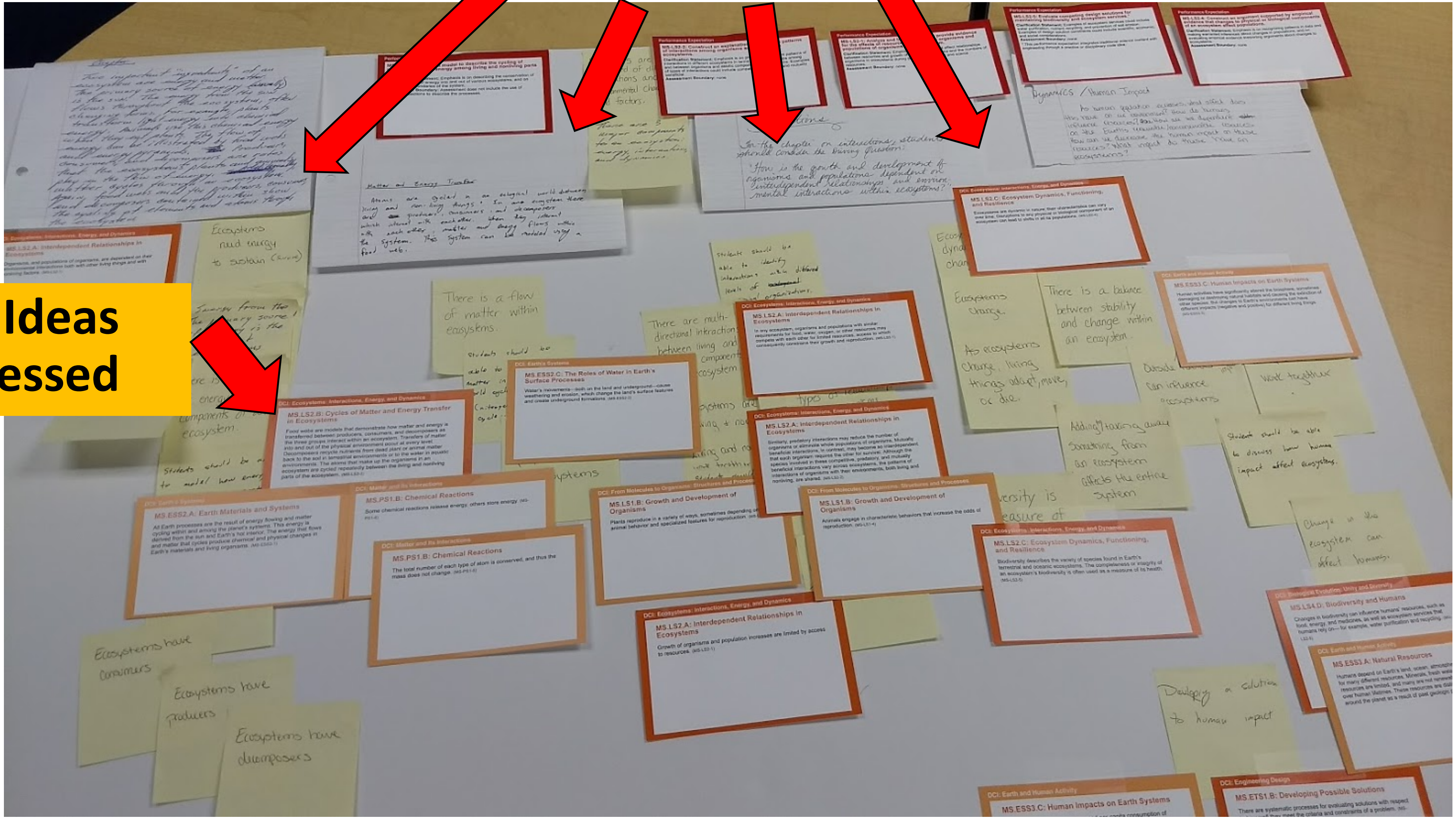
DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)

Instructional Sequences

Core Ideas Addressed



Tool 2: Planning for Assessment

PE

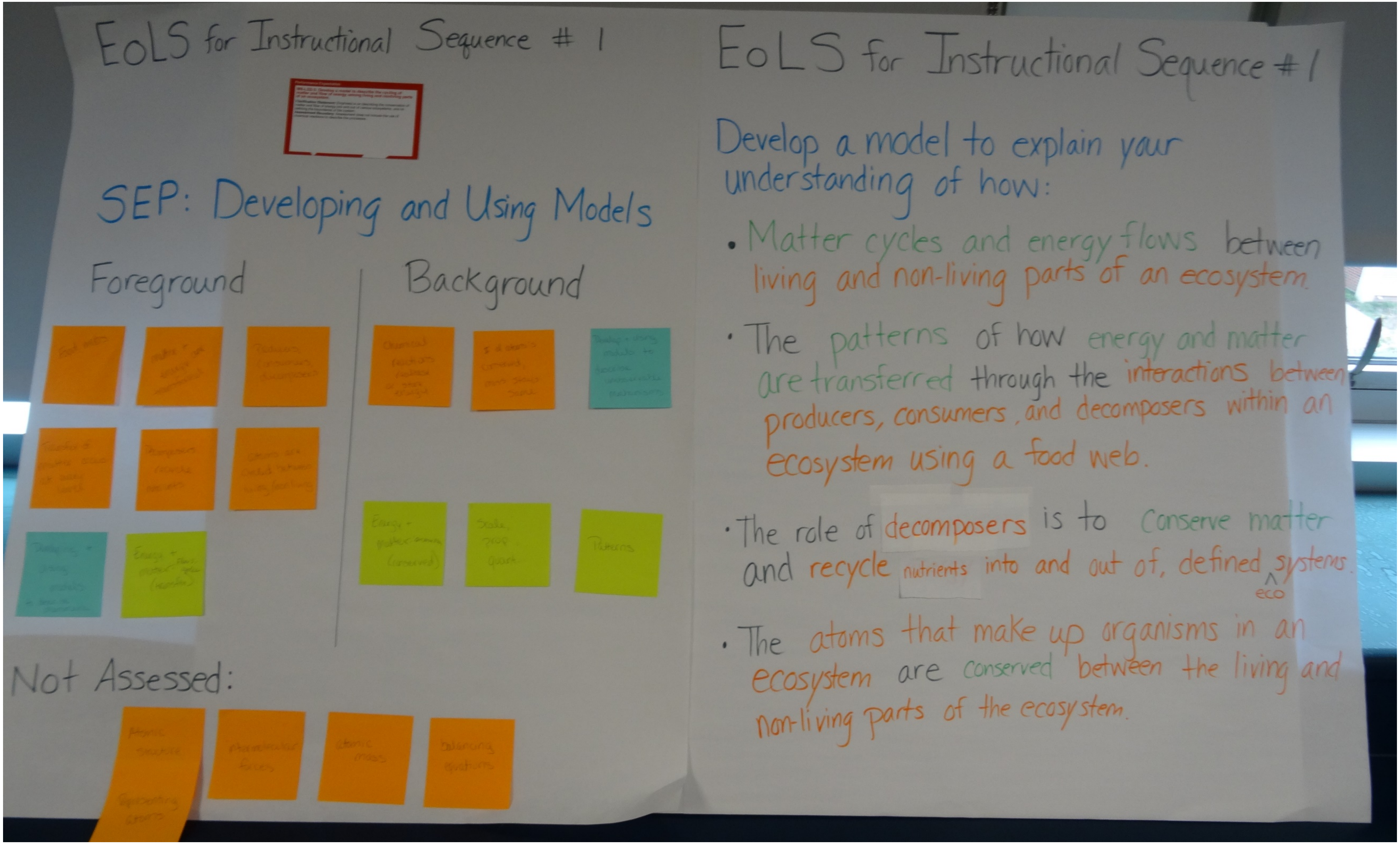
- What are the performance expectations?

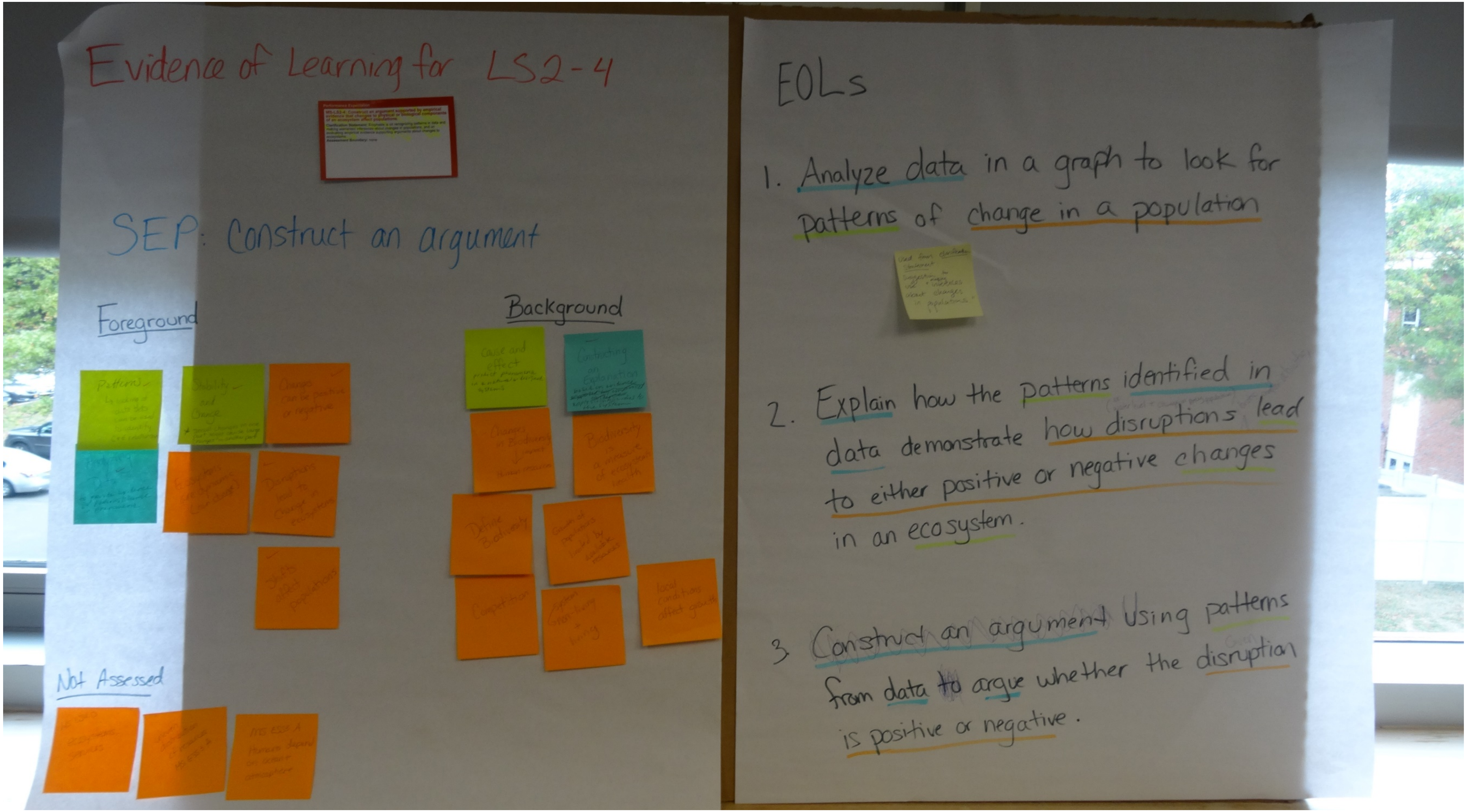
Evidence of Learning Specs

- What evidence of learning specifications will guide assessment task(s) development?

Next Steps

- Using a backwards design approach, teachers use the NGSS performance expectations from their unit “blue print” and develop ***Evidence of Learning Statements***.
- Evidence of Learning Statements describe what qualifies as evidence for students’ proficiency.
    - What will qualify as evidence of learning at the end of instruction?
    - What should students be able to do and what science ideas should they be able to apply?


EoLS for Instructional Sequence # 1
SEP: Developing and Using Models
Foreground
Background
Not Assessed:
EoLS for Instructional Sequence # 1
Develop a model to explain your understanding of how:
• Matter cycles and energy flows between living and non-living parts of an ecosystem.
• The patterns of how energy and matter are transferred through the interactions between producers, consumers, and decomposers within an ecosystem using a food web.
• The role of decomposers is to conserve matter and recycle nutrients into and out of, defined ecosystems.
• The atoms that make up organisms in an ecosystem are conserved between the living and non-living parts of the ecosystem.


Evidence of Learning for LS2-4
SEP: Construct an argument
Foreground
Background
Not Assessed
EOLs
1. Analyze data in a graph to look for patterns of change in a population
2. Explain how the patterns identified in data demonstrate how disruptions lead to either positive or negative changes in an ecosystem.
3. Construct an argument using patterns from data to argue whether the disruption is positive or negative.

Tool 5: Developing Classroom Assessments

Task

- How will students demonstrate their achievement of the performance expectations?

Final Step

- Teachers use the evidence of learning statements developed in Tool 2 to create **performance tasks** and **rubrics** as a summative assessment for their instructional sequence.

- The tasks are written as three-dimensional assessments to ensure NGSS alignment.

Tool 5 Template Example – 3D Assessment

Evaluate: Experiences in the Evaluate phase encourage students to assess and reflect on their conceptual understanding and use of the science and engineering practices. The Evaluate phase includes both an activity and performance task that together allow teachers to evaluate student progress toward achieving the performance expectation(s).

Evidence of Learning Specifications

1. Construct an explanation that predicts:
   a. Consistent patters of interactions between living and non-living parts of ecosystems
   b. Consistent patterns of types of interactions including competitive, predatory, and mutually beneficial
2. Construct an argument that:
   a. Is supported by empirical evidence of interactions within the ecosystem (a type of Earth System) and scientific reasoning
   b. Supports or refutes how increases in human population cause negative impacts on the Earth

Alignment with EoLS	Performance Task to address EoLS List questions/prompts	Ideal Student Responses Use to guide rubric development
EoLS 1b - Construct an explanation that predicts: Consistent patterns of types of interactions including competitive, predatory, and mutually beneficial	Graybirds and whitebirds live on North Island. Both types of birds eat the berries of the berry bush. The seeds of the berry bush grow best after the berries are eaten by birds and dropped elsewhere around the island. Whitebirds are also found on nearby South Island. The white birds on South Island eat berries and the nuts of the nut tree. Rats are found on both islands. Berries and bird eggs are favorite foods of the rats. 1a. Predict the patterns of interactions between species on North and South Islands. Identify 3 relationships on each island. Use words: competition, predatory-prey, and mutualism. Write a paragraph describing the relationships.	*On **North Island**:* • *A predator-prey interaction between the rats and the birds (or, rats are predators, bird eggs are their prey)* • *A mutually beneficial interaction (or mutualism) between the birds and the berries* • *Competition between the two kinds of birds and between the birds and the rats for berries.* *On **South Island**:* • *Rats are predators of the whitebird eggs (or rats are predators, bird eggs are their prey)* • *Rats and whitebirds compete for berries* • *The whitebirds and berries have a mutually beneficial interaction (mutualism)*

WWP 7th Grade Science Unit Title: Ecosystems

- In this unit, students will explore factors such as the introduction of **invasive species, natural disasters, and human intervention** that can **impact the health and biodiversity of an ecosystem**. Students will be able to understand the role that humans play in preserving ecosystems and how to best **mitigate the damage that humans and invasive species do to varying ecosystems** in New Jersey. Students will work to analyze the **cause and effect** relationship between the **introduction of selected invasive species as well as the use of biodiversity to predict the relative stability of ecosystems**. Students will **plan and carry out investigations** regarding invasive species at state parks, and **analyze their collected data** to aid in **constructing rational solutions** to improve the health of New Jersey ecosystems.

Performance Expectations – Phase I

- Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Performance Expectations – Phase II

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Turnkey Unit Development

Questions and Answers

Brainstorm and Plan For Implementation

Performance Tasks – Unit Specific

- Design a solution to one of the problems caused by an ecosystem impacts in New Jersey parks and predict how their proposed design will impact the ecosystem in a positive way.

- Refine their solution to one of the problems facing a specific New Jersey park using feedback from an expert as evidence and justification for their changes.

Performance Tasks – Lesson Specific

- Define a problem in a local ecosystem by developing and use models to decrease the cause and effect relationship from the problem that the ecosystem faces.
- Obtain and evaluate information in a local ecosystem by constructing explanations to decrease the cause and effect relationship from the problem that the ecosystem faces.

What Should This Look Like in Your Classroom?

- QFT – “Change Impacts Ecosystems”

- Students working with an on-site expert to learn about the local ecosystem.

- Students research what is currently being done to solve a problem and evaluate.

Or

- Design a solution to an independently identified problem.

Reasoning

- Solve problems in a local ecosystem by developing and use models to present ways to decrease the cause and effect relationship from the problem that the ecosystem faces.

- Communicate a problem in a local ecosystem by developing and use models to present ways to decrease the cause and effect relationship from the problem that the ecosystem faces.

What Should This Look Like In Your Classroom?

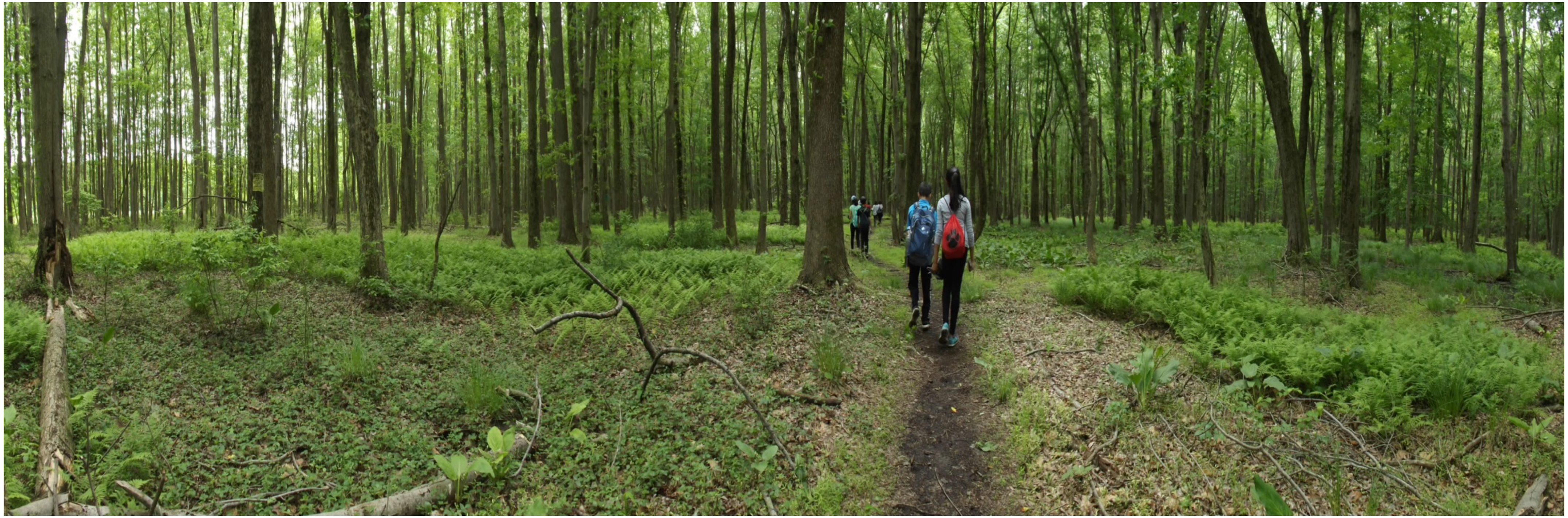
- Students will also partake in a trip to the Plainsboro Preserve and analyze the data they gathered on water and soil quality, succession and macroinvertebrates within the preserve.
- They will come back to the classroom and analyze the data they gathered at the preserve.
- With the data, they will develop a solution to the problem they saw or know about at the preserve.
- Students will have to do additional research to find out all aspects of their design solution (cost, funding, manufacturing, impact, model of prototype, etc.).

Task and Solution Statements Developed

- **Task:**
  - Students in 7th grade will reflect on the question that they want to know most about.
  - They will modify their question as they learn about ecosystems and more importantly the Plainsboro Preserve.
  - Students will take a field trip to the Plainsboro Preserve in order to conduct field work around their identified problem.
  - After their fieldwork is complete, they will come back to the classroom and design competing solutions to solve a problem or prevent future problems in the Plainsboro Preserve.

- **Solution:**
  - Students will conduct research on their defined problem and review existing solutions.
  - From here, they need to design a new solution to the defined problem and have a prototype to explain what will happen.
  - Students should have significant research and test competing solutions and refine as needed.

Students begin field work (Engage)



Identifying flora and fauna (Explore)

Learning how the targeted ecosystem works (Explain)

Taking a closer look (Elaborate)

Making observations…

Narrowing down the possibilities…

Developing solutions (Evaluate)

Envisioning a better ecosystem…

Becoming young scientists…

Acknowledgements

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