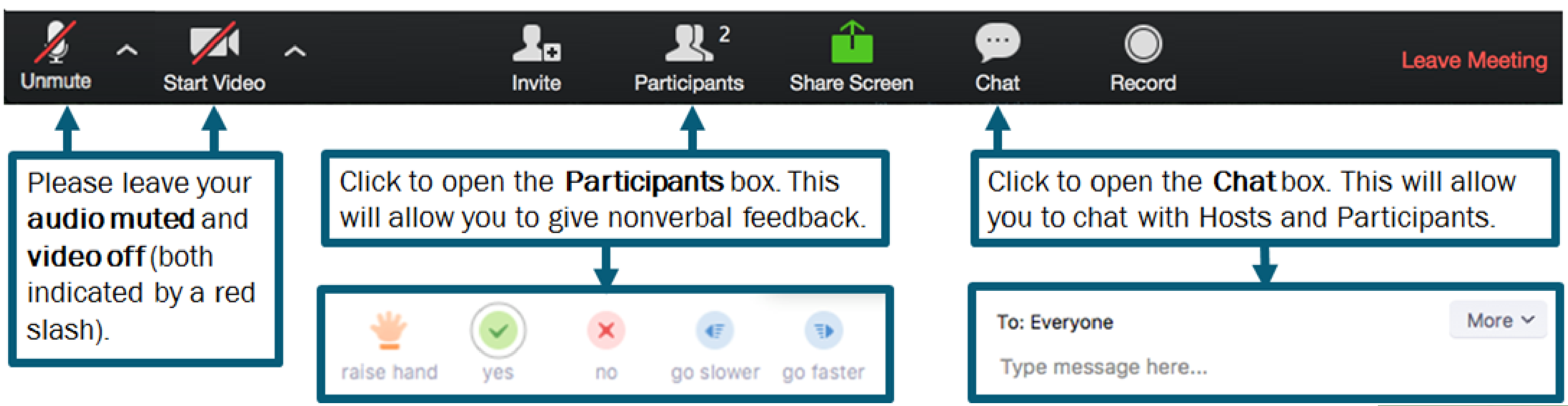
NGSS Webinar:

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

October 11, 2018
1:00 PM Pacific | 2:00 PM Mountain | 3:00 PM Central | 4:00 PM Eastern



Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

National Earth Science Teachers Association

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

October 11, 2018
1:00 PM Pacific | 2:00 PM Mountain | 3:00 PM Central | 4:00 PM Eastern

Organizers:
Aida Awad, NAGT Past President / Secretary/Treasurer
Ed Robeck, American Geosciences Institute
Carla McAuliffe, NESTA Executive Director
Jessica Bean, UCMP Berkeley
John McDaris, SERC/NAGT
Andrew Haveles, SERC/NAGT

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

National Earth Science Teachers Association

Webinar overview:

- Welcome and introductions
- Presenter:

  David Randle
  Anna MacPherson
  American Museum of Natural History

- Discussion and Q&A
- Discussion thread information
- Post webinar survey link: http://bit.ly/ngsspostwebinar10182

Center for Geoscience & Society
american geosciences institute

NAGT National Association of Geoscience Teachers

National Earth Science Teachers Association

Upcoming Events & Resources:

- Future Event:
  - November webinar: 11/8/2018 - Quickly Increasing Anthropogenic Global Warming Acceptance: Five Experimentally-Vetted Methods and HowGlobalWarmingWorks.org presented by: Michael Ranney, UC Berkeley
- Not too late … did you miss the September webinar?

Designing instructional units using the NGSS Storyline Approach to support student sensemaking

You can still view the archived version here:

  - http://bit.ly/92018webinar

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION

Please feel free to type your questions into the chat box during the webinar.

Today's presentation:

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

Presented by: David Randle,
American Museum of Natural History

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

National Earth Science Teachers Association

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

NAGT Webinar
October 11, 2018

David Randle
Anna MacPherson

BSCS SCIENCE LEARNING
AMERICAN MUSEUM of NATURAL HISTORY
K-12 Alliance WestEd
Carnegie CORPORATION OF NEW YORK

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

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 parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes 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.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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

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 and 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

Crosscutting Concepts

Patterns

- Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed 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)

Professional Learning

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

The *Next Generation Science Standards* (NGSS) challenge teachers to think deeply about learning and teaching with the goal of developing a clear vision of science education that is coherent, focused, and rigorous. The **Five Tools and Processes for Translating the NGSS** are designed to help professional development leaders work with teachers on curriculum, instruction, and assessment as they achieve this vision.

Sign up for updates.

For more information contact Dave Randle at drandle@amnh.org.

Goals for Today's Webinar

- Introduce the Five Tools and Processes as a way to design instruction and assessments consistent with the NGSS
- Discuss results from an evaluation of a Five Tools pilot with teachers and administrators
- Discuss ways that the Five Tools and Processes can be used with teachers and instructional designers

Goals and Outcomes of The Five Tools and Processes

- Deepen understanding of the NGSS and increase abilities to plan for coherent instruction based on the NGSS
- To design a NGSS-based unit of instruction and assessments for your students focused on a selected topic.

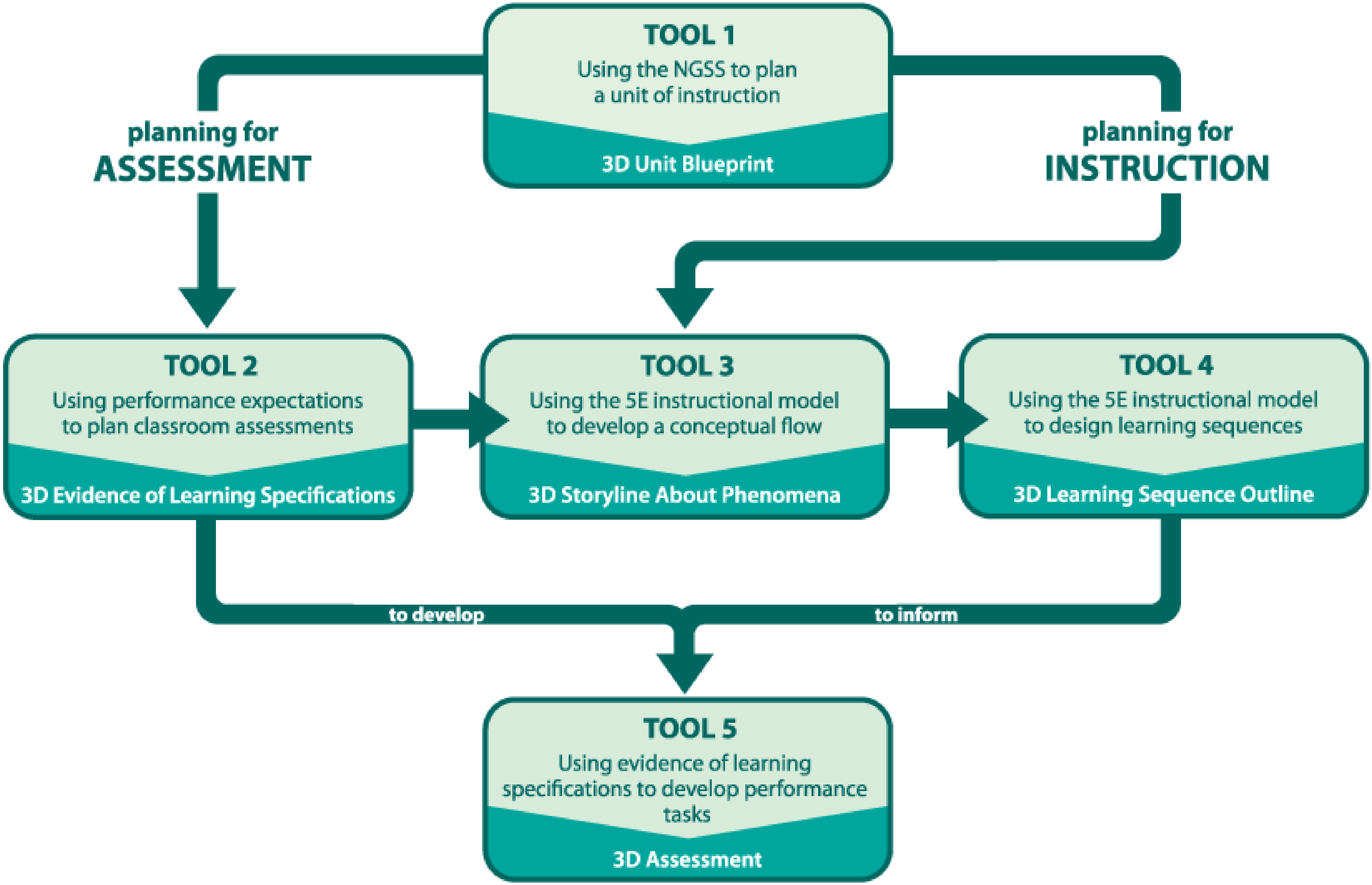
Post in the Chat

What do you think about when planning a unit of instruction for your classroom?

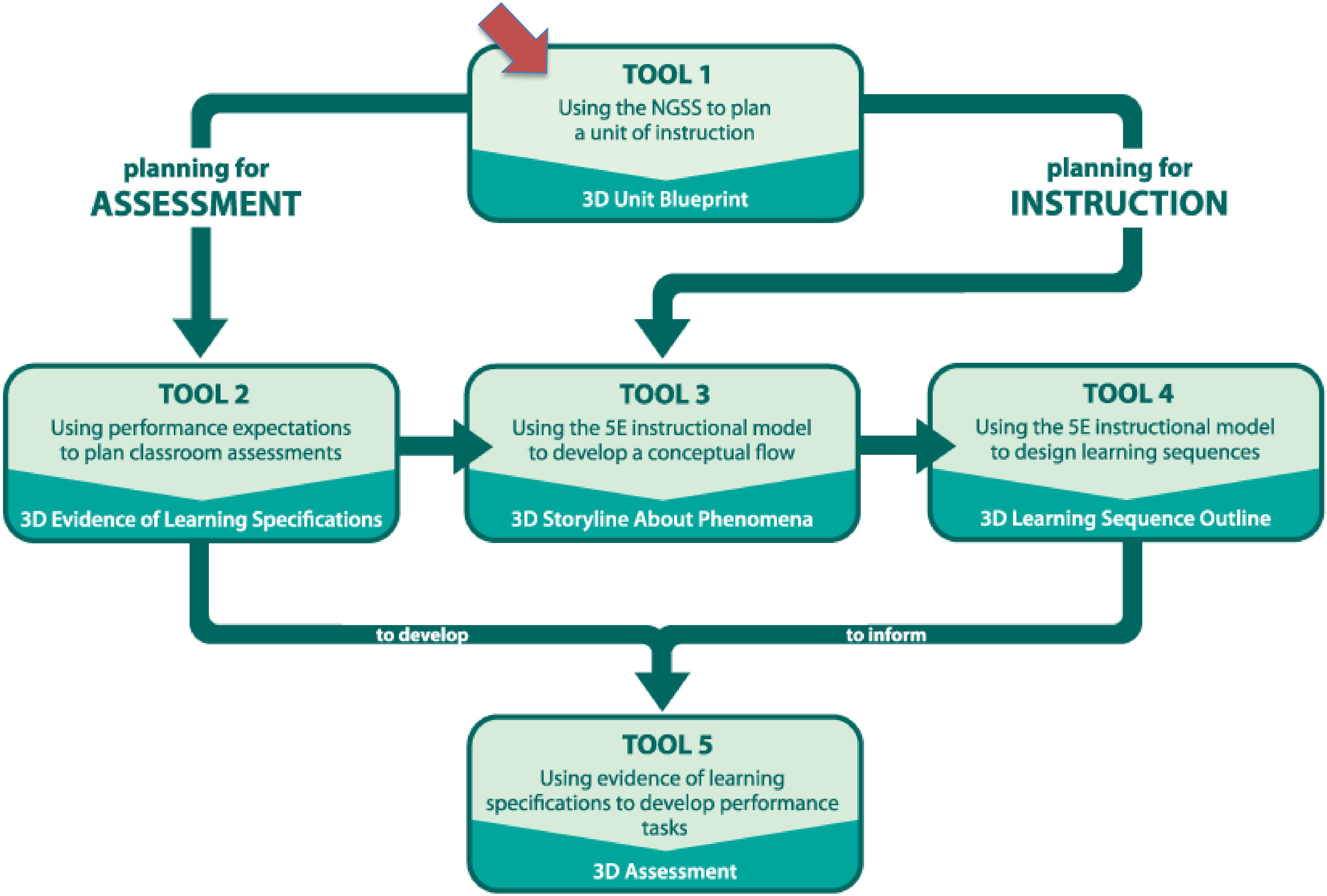
Conceptual Shifts Offered by the NGSS

1. K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.
2. The NGSS are student performance expectations, not curriculum.
3. The science concepts in the NGSS build coherently from K-12.
4. The NGSS focus on deeper understanding of content as well as application of content.
5. Science and engineering are integrated in the NGSS from kindergarten through twelfth grade.
6. The NGSS are designed to prepare students for college, careers, and citizenship.
7. The NGSS and Common Core State Standards are aligned.

Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment



Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment



Tool 1 Goals and Outcomes

- Help teachers translate an NGSS standards page into a blueprint for instruction.
- Begin to design a unit of instruction and classroom assessments for students focused on a topic.

- Participants first capture their own ideas about the concepts they would teach and work with their team to organize their concepts into a conceptual flow.
- Through a series of readings participants are introduced to DCI's, PE's, SEP's, CCCs, and connections to Common Core and Nature of Science connections. At each of these stages cards representing various elements of the standards are integrated into the conceptual flow.

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

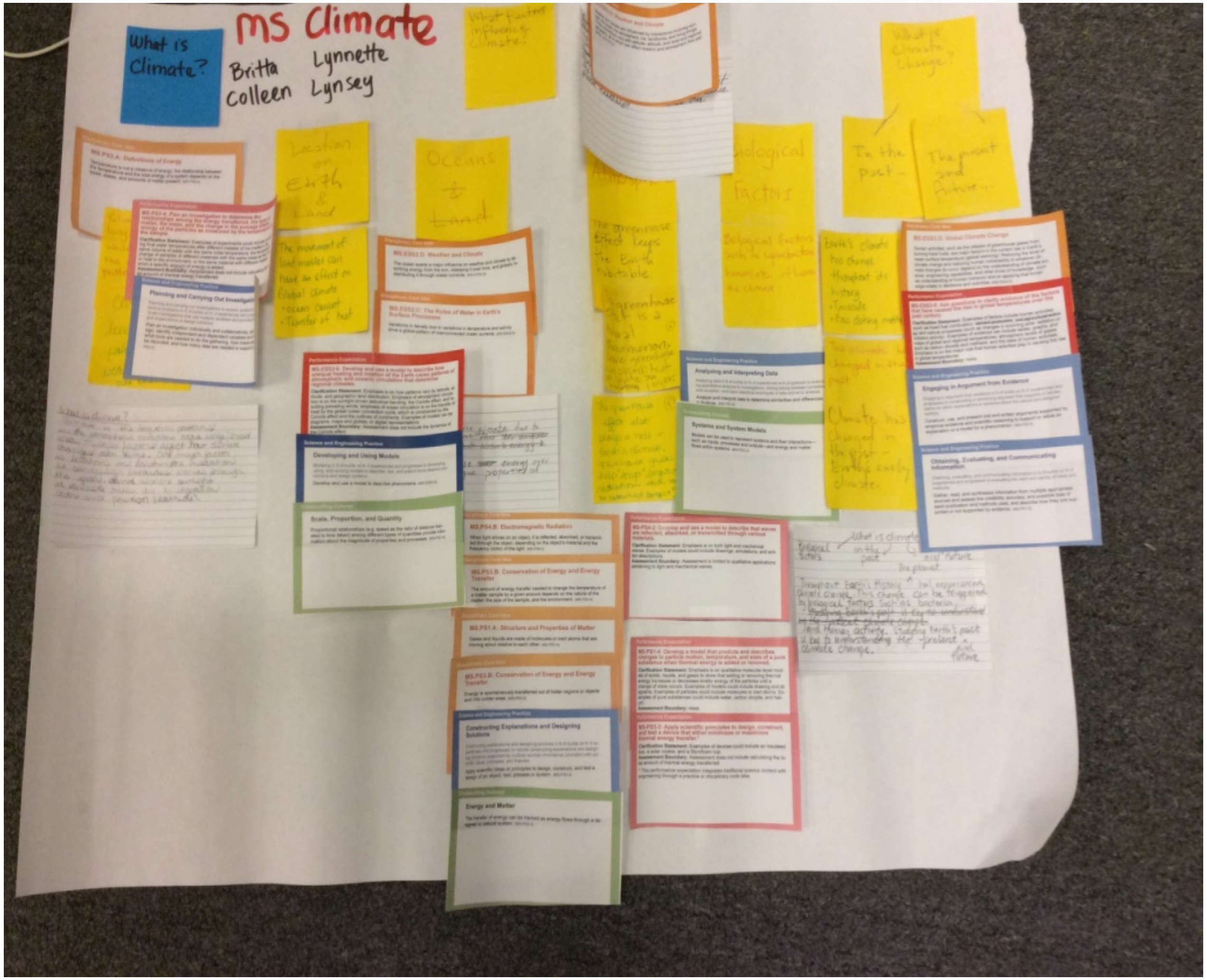
In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)

Performance Expectation

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.

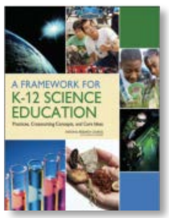
Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

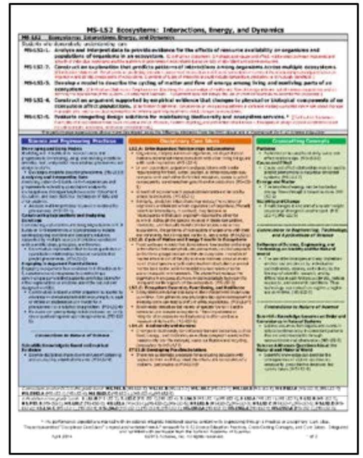
Assessment Boundary: none



The process looks messy

The process generates some amazing conversations





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)

Tool 1 Template Example – Unit Blueprint for MS-LS2 (Ecosystems: Interactions, Energy, and Dynamics)

Instructional Sequence 1	Instructional Sequence 2	Instructional Sequence 3	Instructional Sequence 4	Instructional Sequence 5
Performance Expectation 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.	Performance Expectation MS-LS2-3 *Develop a model to describe the cycling of matter and flow of energy among living and non-living parts of an ecosystem.* *Clarification Statement:* Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. *Assessment Boundary:* Assessment does not include the use of chemical reactions to describe the processes.	Performance Expectation MS-LS2-1 *Analyze and interpret data to provide evidence for the effects of resources availability on organisms and populations of organisms in an ecosystem.* *Clarification Statement:* Emphasis is on cause and effect relationships between resources and the growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.	Performance Expectation MS-LS2-4 *Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.* *Clarification Statement:* Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.	Performance Expectation MS-LS2-5 *Evaluate competing design solutions for maintaining biodiversity and ecosystem services.** *Clarification Statement:* Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations. *This performance expectation integrates traditional science content with engineering through a practice or disciplinary core idea.
Performance Expectation MS-ESS3-4 *Construct an argument supported by evidence for how increases in human population ~~and per-capita consumption of natural resources~~ impact Earth's systems.* *Clarification Statement:* ~~Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources~~ (such as freshwater, mineral, and energy). ~~Examples of impacts can include changes to the appearance,~~ composition, and structure of Earth's systems as well as ~~the rates at which they change.~~ The consequences of increases in human populations and consumption of ~~natural resources~~ are described by science, but science does not make the decisions for the actions society takes.	Performance Expectation MS-PS1-5 *Develop and use a model to describe how ~~the total number of atoms does not change in a chemical reaction and thus~~ mass is conserved.* *Clarification Statement:* Emphasis is on law of conservation of matter ~~and on physical models or drawings, including digital forms, that represent atoms.~~ *Assessment Boundary:* Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.	Performance Expectation MS-ESS3-4 *Construct an argument supported by evidence for how increases in human population ~~and per-capita consumption of natural resources~~ impact Earth's systems.* *Clarification Statement:* ~~Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural~~ resources (such as freshwater, mineral, and energy). ~~Examples of impacts can include changes to the~~ appearance, composition, and structure of Earth's ~~systems as well as the rates at which they change.~~ The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.	Performance Expectation MS-LS2-1 *Analyze and interpret data to provide evidence for the effects of resources availability on organisms and populations of organisms in an ecosystem.* *Clarification Statement:* Emphasis is on cause and effect relationships between resources and the growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.	Performance Expectation MS-ESS3-3 *Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.** *Clarification Statement:* Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).
	Performance Expectation MS-ESS2-1 *Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.* *Clarification Statement:* ~~Emphasis is on the processes of melting, crystallization, weathering, deformation, and~~ sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. *Assessment Boundary:* Assessment does not include the identification and naming of minerals.			Performance Expectation MS-ESS3-4 *Construct an argument supported by evidence for how increases in human population ~~and per-capita consumption of natural resources~~ impact Earth's systems.* *Clarification Statement:* Examples of evidence include grade-appropriate databases on human populations ~~and the rates of consumption of food and natural resources~~ (such as freshwater, mineral, and energy). ~~Examples of impacts can include changes to the appearance,~~ composition, and structure of Earth's systems as well as ~~the rates at which they change.~~ The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

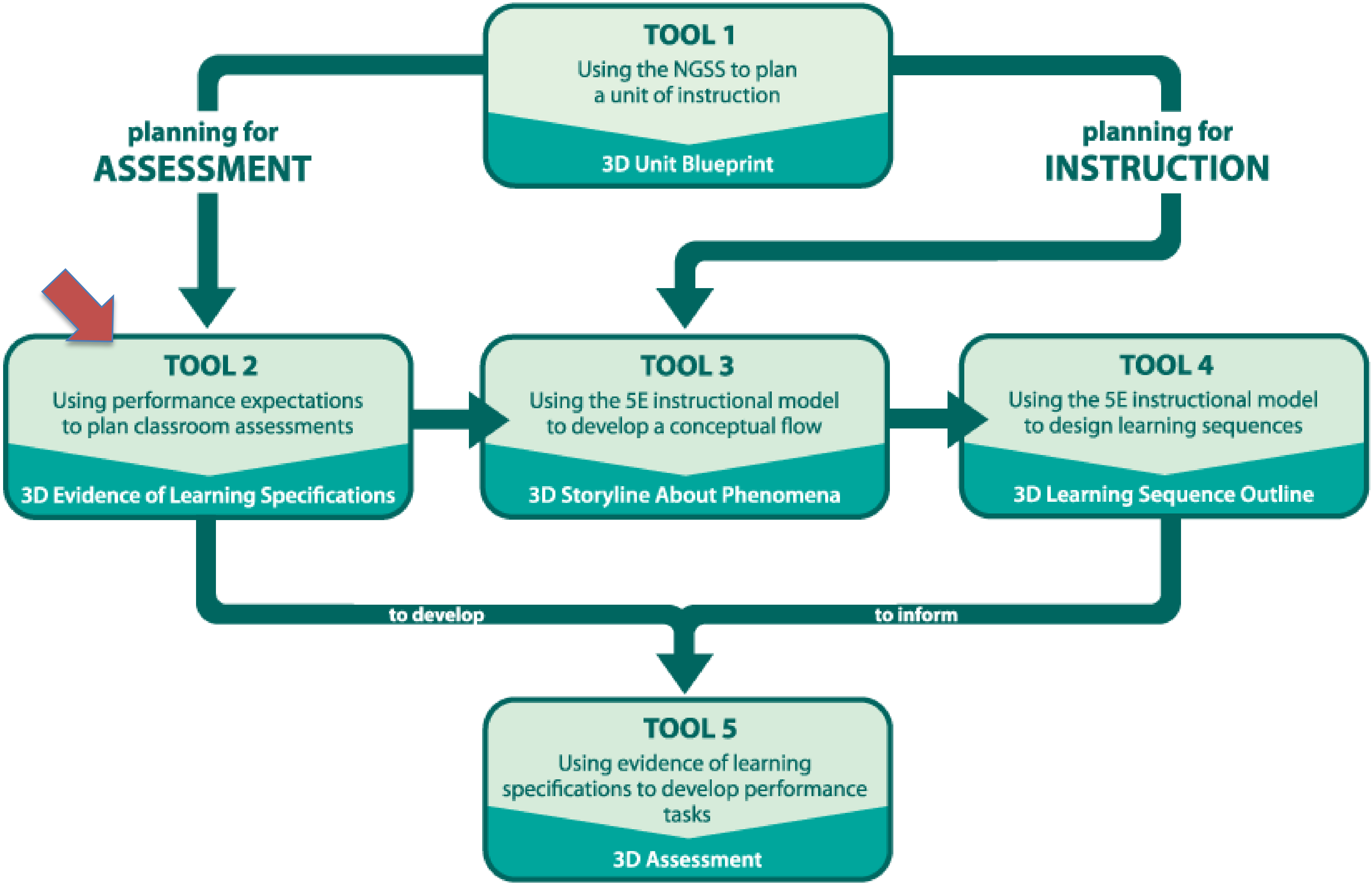
Copyright © AMNH 2016 — Page 1 of 4 — Five Tools and Processes for NGSS Tool 1

Instructional Sequence 1	Instructional Sequence 2	Instructional Sequence 3	Instructional Sequence 4	Instructional Sequence 5
MS LS2: Ecosystems: Interactions, Energy, and Dynamics LS2.A: Interdependent Relationships in Ecosystems *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)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.B: Cycle of Matter and Energy Transfer in Ecosystems *Food webs are models that demonstrate how matter and energy are 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 level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and non-living parts of the ecosystem. (MS-LS2-3)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems *Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with non-living factors. (MS-LS2-1)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.C: Ecosystem Dynamics, Functioning, and Resilience *Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.C: Ecosystem Dynamics, Functioning, and Resilience *Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)*
MS ESS3: Earth and Human Activity ESS3.C: Human Impacts on Earth Systems *Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise. (connection DCI to MS-LS2-1, MS-LS2-4 and MS-LS2-5)*	**MS ESS2: Earth's Systems** ESS2.A: Earth's Materials and Systems *All Earth processes are the result of energy flowing and matter recycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (connection DCI to MS-LS2-3 and MS-LS2-4)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems *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 constraints their growth and reproduction. (MS-LS2-1)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems *Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with non-living factors. (MS-LS2-1)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS4.D: Biodiversity and Humans *Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (MS-LS2-5)*
	MS PS1: Matter and Its Interactions PS1.B: Chemical Reactions *Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change. (connection DCI to MS-PS1-5)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems *Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems *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 constraints their growth and reproduction. (MS-LS2-1)*	**MS ESS3: Earth and Human Activity** ESS3.C: Human Impacts on Earth Systems *Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (connection DCI to MS-LS2-1, MS-LS2-4 and MS-LS2-5)*
		MS ESS3: Earth and Human Activity ESS3.C: Human Impacts on Earth Systems *Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise. (connection DCI to MS-LS2-1)*	**MS LS2: Ecosystems: Interactions, Energy, and Dynamics** LS4.D: Ecosystem Dynamics, Functioning, and Resilience *Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (MS-LS2-5)*	**MS ESS3: Earth and Human Activity** ESS3.C: Human Impacts on Earth Systems *Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (connection DCI to MS-LS2-1 and MS-LS2-4)*

Instructional Sequence 1	Instructional Sequence 2	Instructional Sequence 3	Instructional Sequence 4	Instructional Sequence 5
				MS LS2: Ecosystems: Interactions, Energy, and Dynamics ETS1.B: Developing Possible Solutions *There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)*
Science and Engineering Practices 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)*	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)*	Science and Engineering Practices 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)*	Science and Engineering Practices Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ***Construct an oral or written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.** (MS-LS2-4)*	Science and Engineering Practices Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ***Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.** (MS-LS2-5)*
Science and Engineering Practices Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ***Construct an oral or written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.** (MS-ESS3-4)*	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 a model to describe unobservable mechanisms.** (MS-PS1-5)*	Science and Engineering Practices Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ***Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.** (MS-ESS3-4)*	Science and Engineering Practices 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)*	Science and Engineering Practices Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ***Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.** (MS-ESS3-4)*
				Science and Engineering Practices 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. ***Apply scientific principles to design an object, tool, process or system.** (MS-ESS3-3)*

Instructional Sequence 1	Instructional Sequence 2	Instructional Sequence 3	Instructional Sequence 4	Instructional Sequence 5
Crosscutting Concepts Patterns **Patterns can be used to identify cause and effect relationships.** *(MS-LS2-2)*	Crosscutting Concepts Energy and Matter ***The transfer of energy can be tracked as energy flows through a natural system.*** *(MS-LS2-3)*	Crosscutting Concepts Cause and Effect ***Cause and effect relationships may be used to predict phenomena in natural or designed systems.*** *(MS-LS2-1)*	Crosscutting Concepts Stability and Change **Small changes in one part of a system might cause large changes in another part.** *(MS-LS2-4)*	Crosscutting Concepts Stability and Change **Small changes in one part of a system might cause large changes in another part.** *(MS-LS2-5)*
Crosscutting Concepts Cause and Effect ***Cause and effect relationships may be used to predict phenomena in natural or designed systems.*** *(MS-ESS3-4)*	Crosscutting Concepts Energy and Matter ***Matter is conserved because atoms are conserved in physical and chemical processes.*** *(MS-PS1-5)*		Crosscutting Concepts Cause and Effect ***Cause and effect relationships may be used to predict phenomena in natural or designed systems.*** *(MS-LS2-1)*	Crosscutting Concepts Cause and Effect ***Cause and effect relationships may be used to predict phenomena in natural or designed systems.*** *(MS-ESS3-4)*
Connections of Nature of Science Science Addresses Questions About the Natural and Material World ***Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.*** *(MS-ESS3-4)*	Crosscutting Concepts Stability and Change ***Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.*** *(MS-ESS2-1)*	Connections of Nature of Science Science Addresses Questions About the Natural and Material World ***Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.*** *(MS-ESS3-4)*	Connections to Nature of Science Scientific Knowledge Is Based on Empirical Evidence ***Science disciplines share common rules of obtaining and evaluating empirical evidence.*** *(MS-LS2-4)*	Connections of Nature of Science Science Addresses Questions About the Natural and Material World ***Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.*** *(MS-LS2-5) (MS-ESS3-4)*
Connections to Engineering, Technology and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World ***All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.*** *(MS-ESS3-4)*	Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems ***Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.*** *(MS-LS2-3)*	Connections to Engineering, Technology and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World ***All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.*** *(MS-ESS3-4)*		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 on their use are driven by individual or societal needs, desires, and values; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time.*** *(MS-LS2-5) (MS-ESS3-3)*
Big Ideas Sequence 1	**Big Ideas Sequence 2**	**Big Ideas Sequence 3**	**Big Ideas Sequence 4**	**Big Ideas Sequence 5**
Students develop food webs to show the patterns of interactions in ecosystems. They construct explanations about community relationships such as predation, competition and symbiosis. They engage in argument about the impact of humans on ecosystems.	Students develop and use models of ecosystems to describe the transfer of energy and cycling of matter.	Students analyze and interpret data to explain the effect of limited resources on organisms and populations. They engage in argument about the impact of humans on populations in ecosystems.	Students analyze and interpret data to explore the impact of introducing a new species into an ecosystem and engage in argument about the positive and negative impact of the invasive species on the stability of the ecosystem.	Students design a process for reducing the impact humans have caused on the environment. Using criteria for sustainability, they evaluate different solutions to environmental problems.

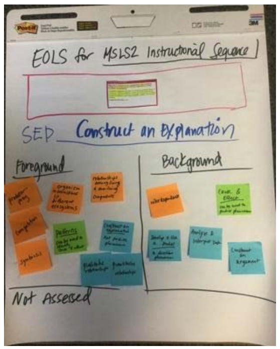
Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment

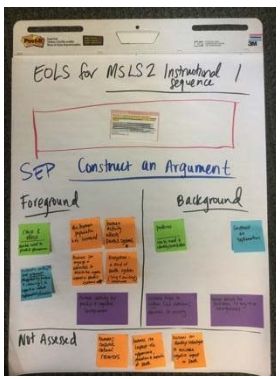


Performance Expectations → Evidence of Learning Specifications

TOOL 2
Using performance expectations to plan classroom assessments
3D Evidence of Learning Specifications

Tool 2 Template Example – Evidence of Learning Specifications





Middle School Ecology Unit | MS-LS2 Ecosystems: Interactions, Energy and Dynamics

Instructional Sequence 1

Performance Expectation 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.

Performance Expectation MS-ESS3-4

Construct an argument supported by evidence for how increases in human population ~~and per-capita consumption of natural resources~~ impact Earth's systems.

Clarification Statement: ~~Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change.~~ The consequences of increases in human populations ~~and consumption of natural resources~~ are described by science, but science does not make the decisions for the actions society takes.

Example from MSLS2 Instructional Sequence 1

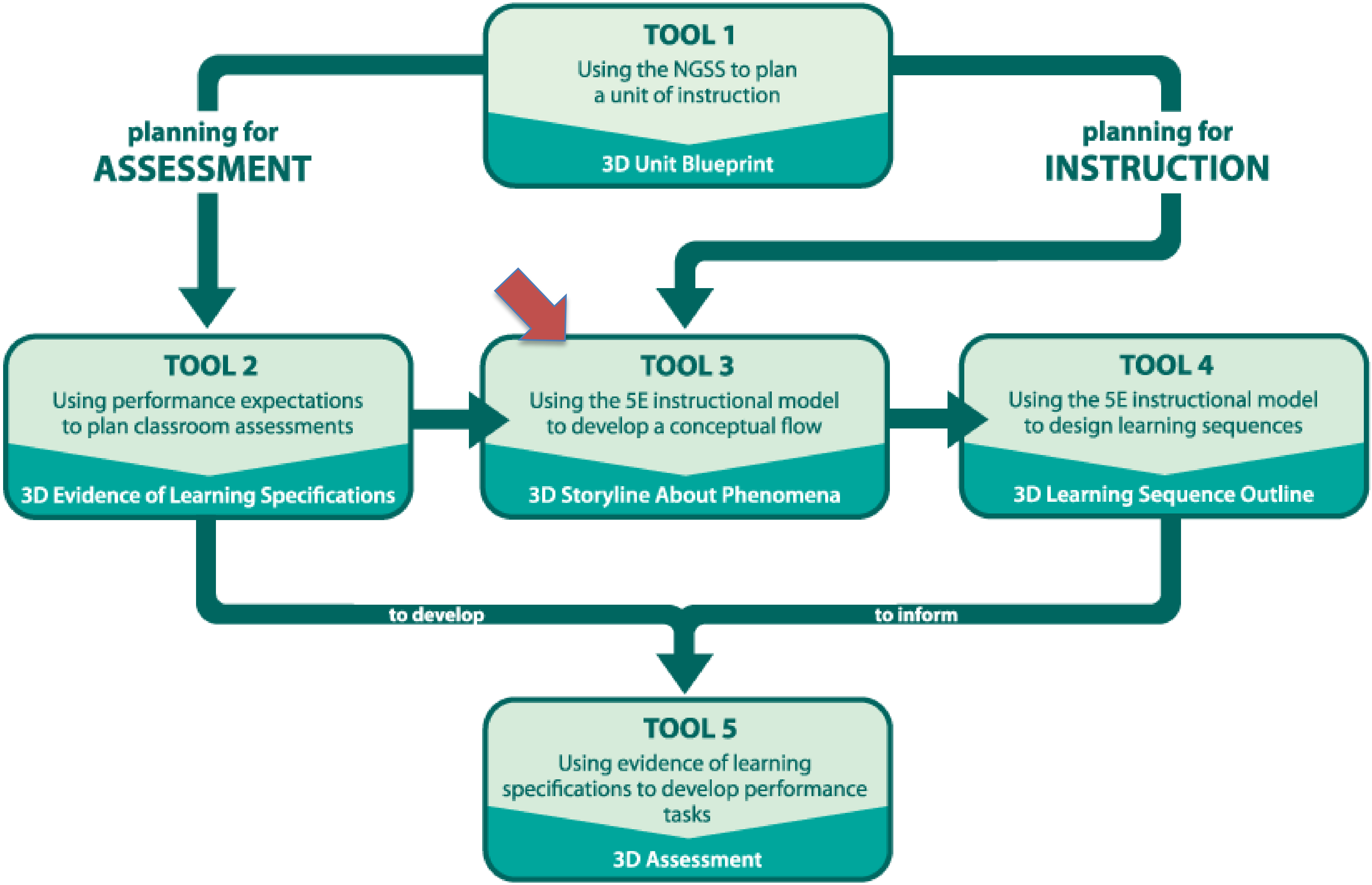
Construct an explanation that predicts:

1. consistent patterns of interactions between living and non-living parts of ecosystems
2. consistent patterns of types of interactions including competitive, predatory, and mutually beneficial

Construct an argument that:

1. is supported by evidence of interactions within the ecosystem (a type of Earth system) and scientific reasoning
2. supports or refutes how increases in human population cause negative impacts on the Earth

Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment



Classroom Scenario

Ms. Rivera

TOOL 3

Using the 5E instructional model to develop a conceptual flow

3D Storyline About Phenomena

Instructional Sequence
5E Model
Storyline
Anchor Phenomena

5E Model

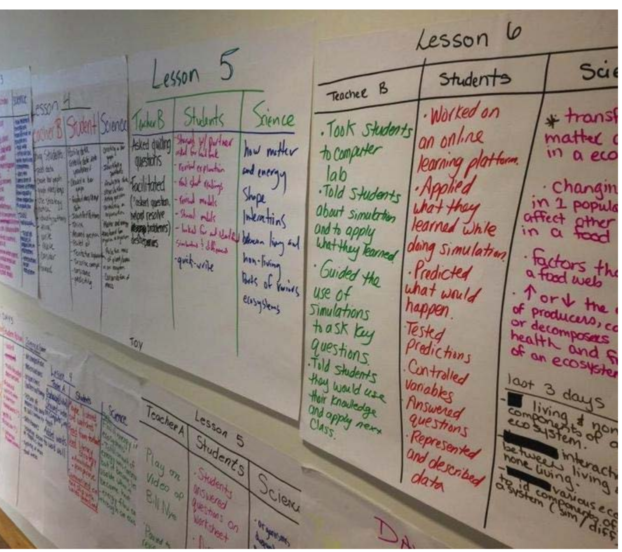
Engage

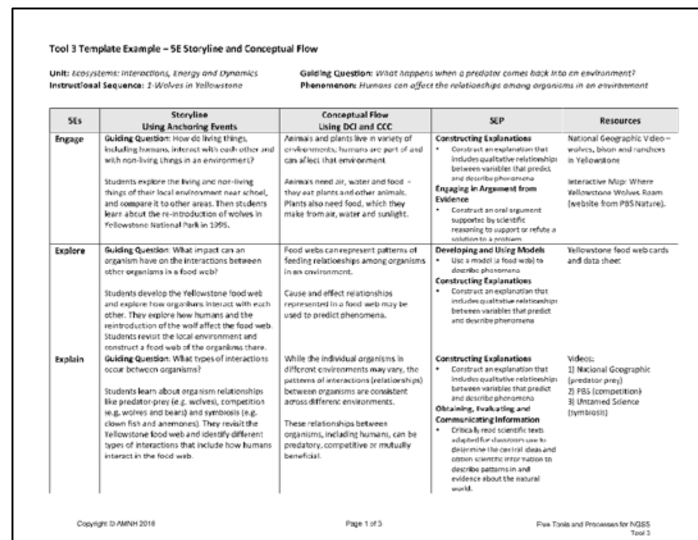
Explore

Explain

Elaborate

Evaluate





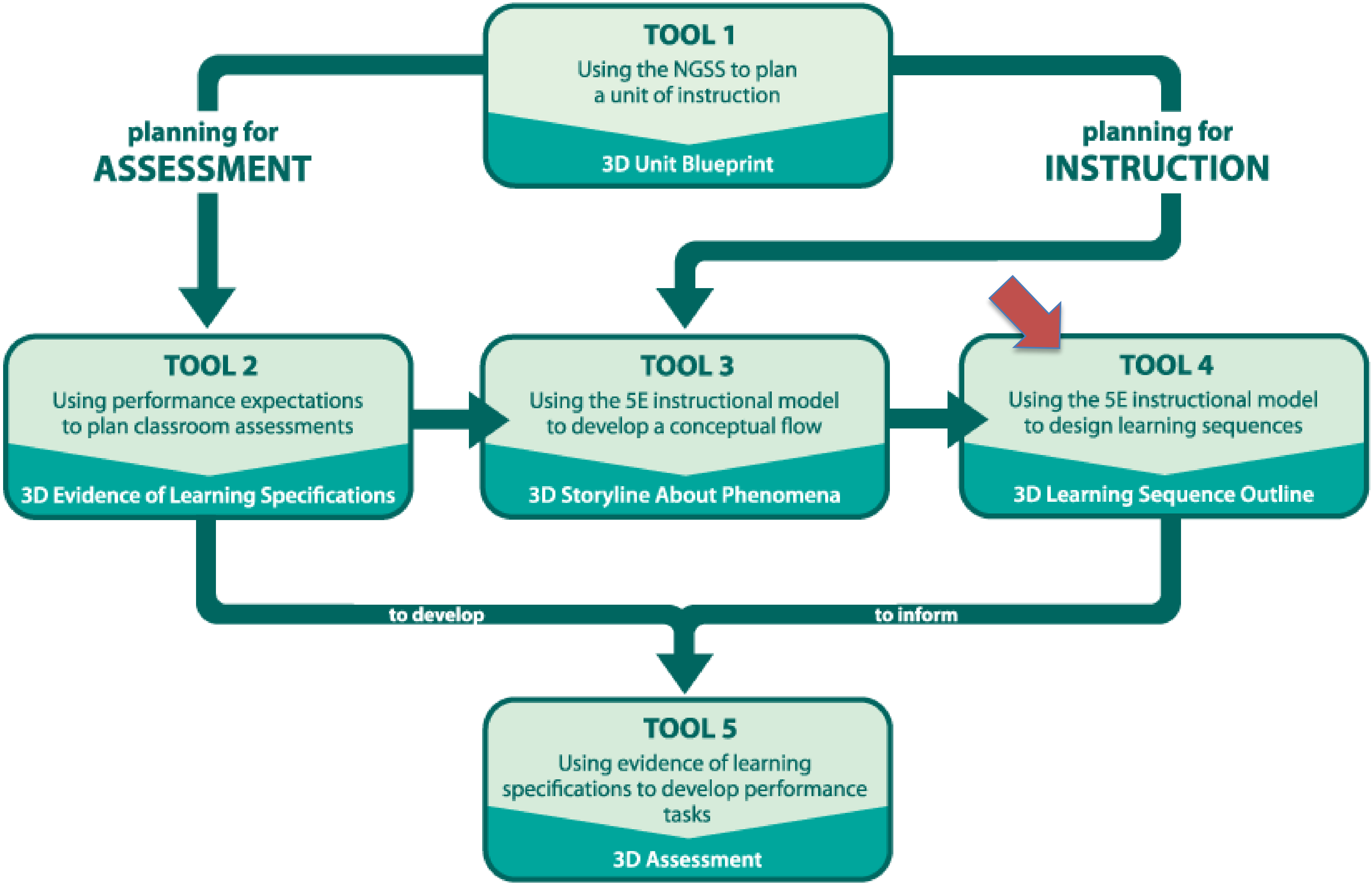
Tool 3 Template Example – 5E Storyline and Conceptual Flow

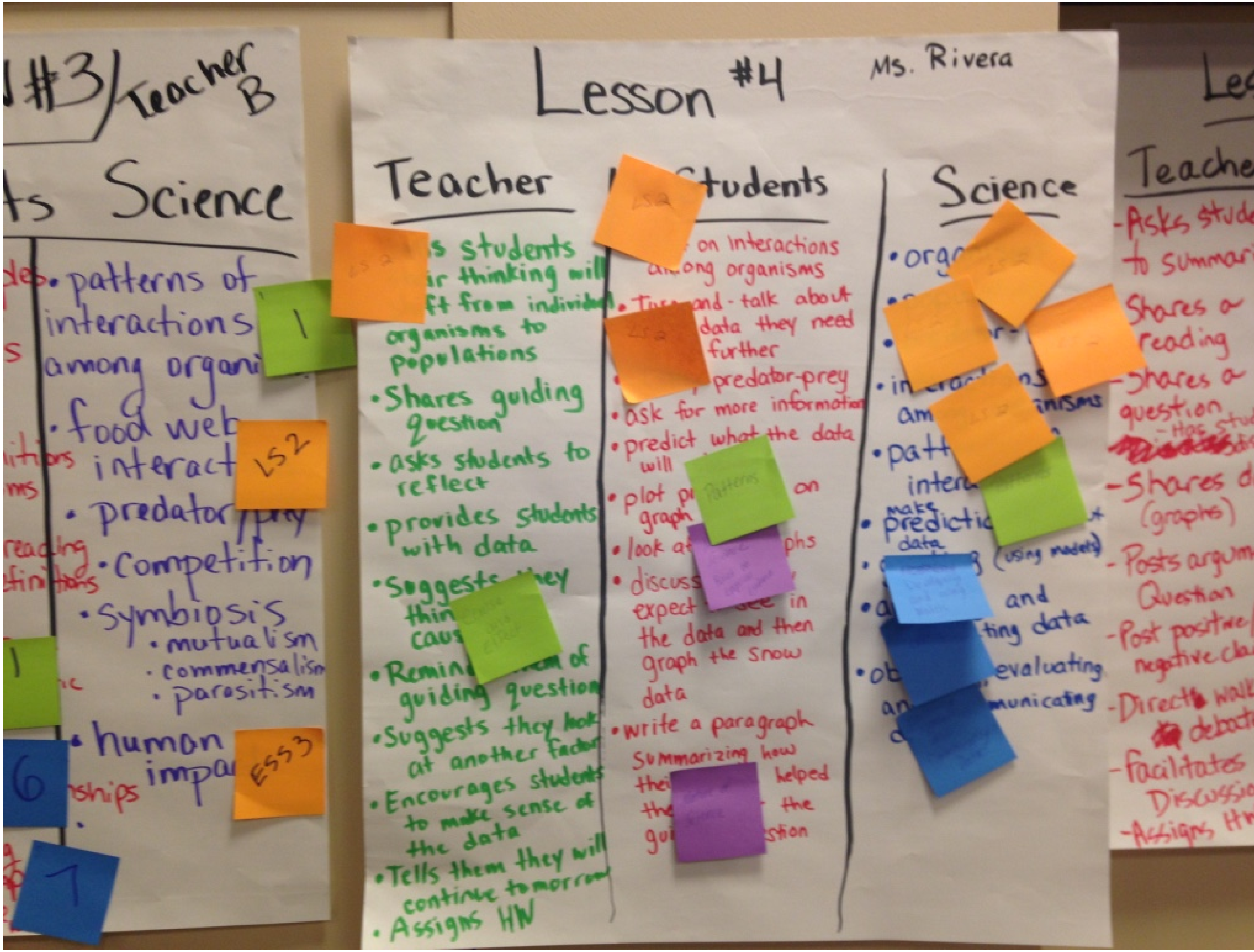
Unit: *Ecosystems: Interactions, Energy and Dynamics*
Instructional Sequence: *1-Wolves in Yellowstone*

Guiding Question: *What happens when a predator comes back into an environment?*
Phenomenon: *Humans can affect the relationships among organisms in an environment*

5Es	Storyline Using Anchoring Events	Conceptual Flow Using DCI and CCC	SEP	Resources
Engage	**Guiding Question:** How do living things, including humans, interact with each other and with non-living things in an environment? Students explore the living and non-living things of their local environment near school, and compare it to other areas. Then students learn about the re-introduction of wolves in Yellowstone National Park in 1995.	Animals and plants live in variety of environments; humans are part of and can affect that environment. Animals need air, water and food – they eat plants and other animals. Plants also need food, which they make from air, water and sunlight.	**Constructing Explanations** • Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena **Engaging in Argument from Evidence** • Construct an oral argument supported by scientific reasoning to support or refute a solution to a problem	National Geographic Video – wolves, bison and ranchers in Yellowstone Interactive Map: Where Yellowstone Wolves Roam (website from PBS Nature).
Explore	**Guiding Question:** What impact can an organism have on the interactions between other organisms in a food web? Students develop the Yellowstone food web and explore how organisms interact with each other. They explore how humans and the reintroduction of the wolf affect the food web. Students revisit the local environment and construct a food web of the organisms there.	Food webs can represent patterns of feeding relationships among organisms in an environment. Cause and effect relationships represented in a food web may be used to predict phenomena.	**Developing and Using Models** • Use a model (a food web) to describe phenomena **Constructing Explanations** • Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena	Yellowstone food web cards and data sheet
Explain	**Guiding Question:** What types of interactions occur between organisms? Students learn about organism relationships like predator-prey (e.g. wolves), competition (e.g. wolves and bears) and symbiosis (e.g. clown fish and anemones). They revisit the Yellowstone food web and identify different types of interactions that include how humans interact in the food web.	While the individual organisms in different environments may vary, the patterns of interactions (relationships) between organisms are consistent across different environments. These relationships between organisms, including humans, can be predatory, competitive or mutually beneficial.	**Constructing Explanations** • Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena **Obtaining, Evaluating and Communicating Information** • Critically read scientific texts adapted for classroom use to determine the central ideas and obtain scientific information to describe patterns in and evidence about the natural world.	Videos: 1) National Geographic (predator prey) 2) PBS (competition) 3) Untamed Science (symbiosis)

Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment



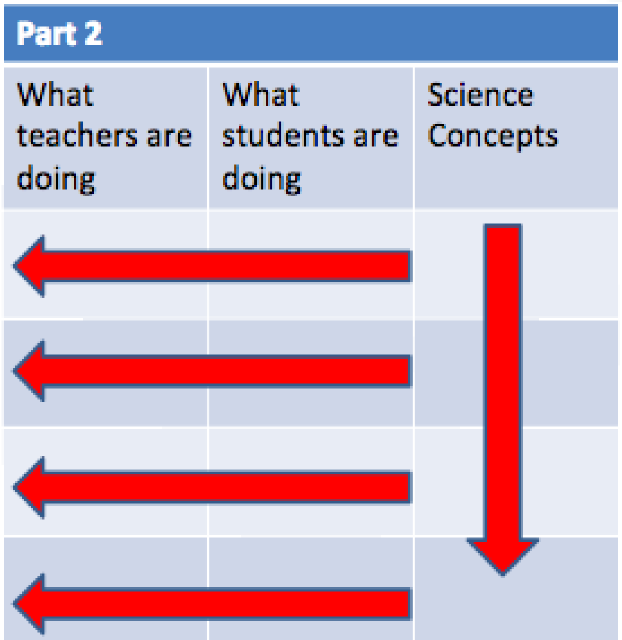


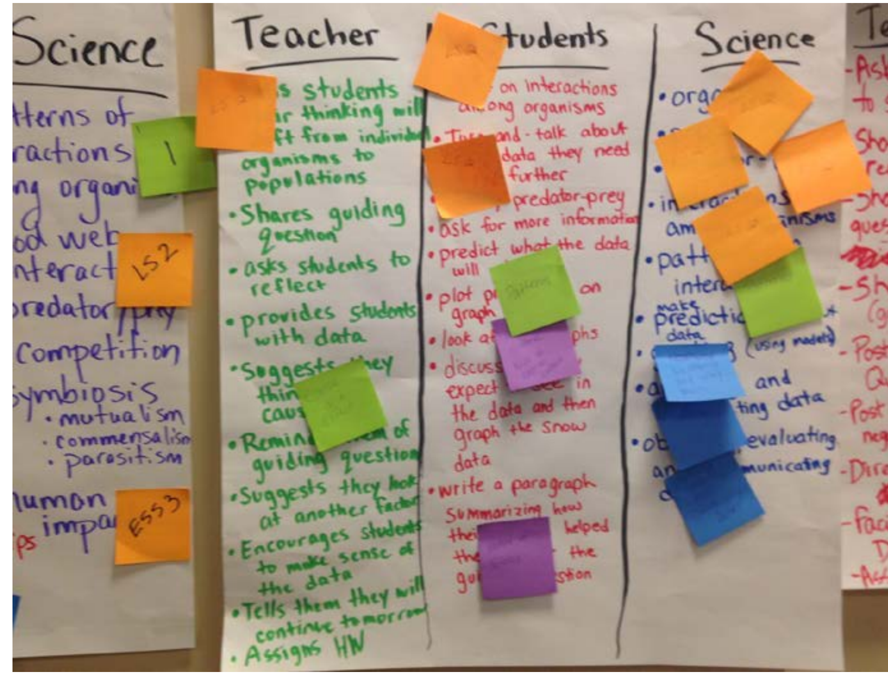
Teacher B
Science
patterns of interactions among
food web
predator/prey
competition
symbiosis
mutualism
commensalism
parasitism
human
LS2
ESS3
Lesson #4
Ms. Rivera
Teacher
Students
Science
Shares guiding question
asks students to reflect
provides students with data
Suggests they look at another factor
Encourages students to make sense of the data
Tells them they will continue tomorrow
Assigns HW
on interactions among organisms
predator-prey
ask for more information
predict what the data will
look at graphs
the data and then graph the snow data
write a paragraph summarizing how
helped
the
Patterns
(using models)
and
evaluating
Teacher
Asks students to summarize
Shares a reading
Shares a question
Shares data (graphs)
Posts argument Question
Post positive/negative claim
Directs walking debate
facilitates Discussion
Assigns HW

TOOL 4

Using the 5E instructional model to design learning sequences

3D Learning Sequence Outline





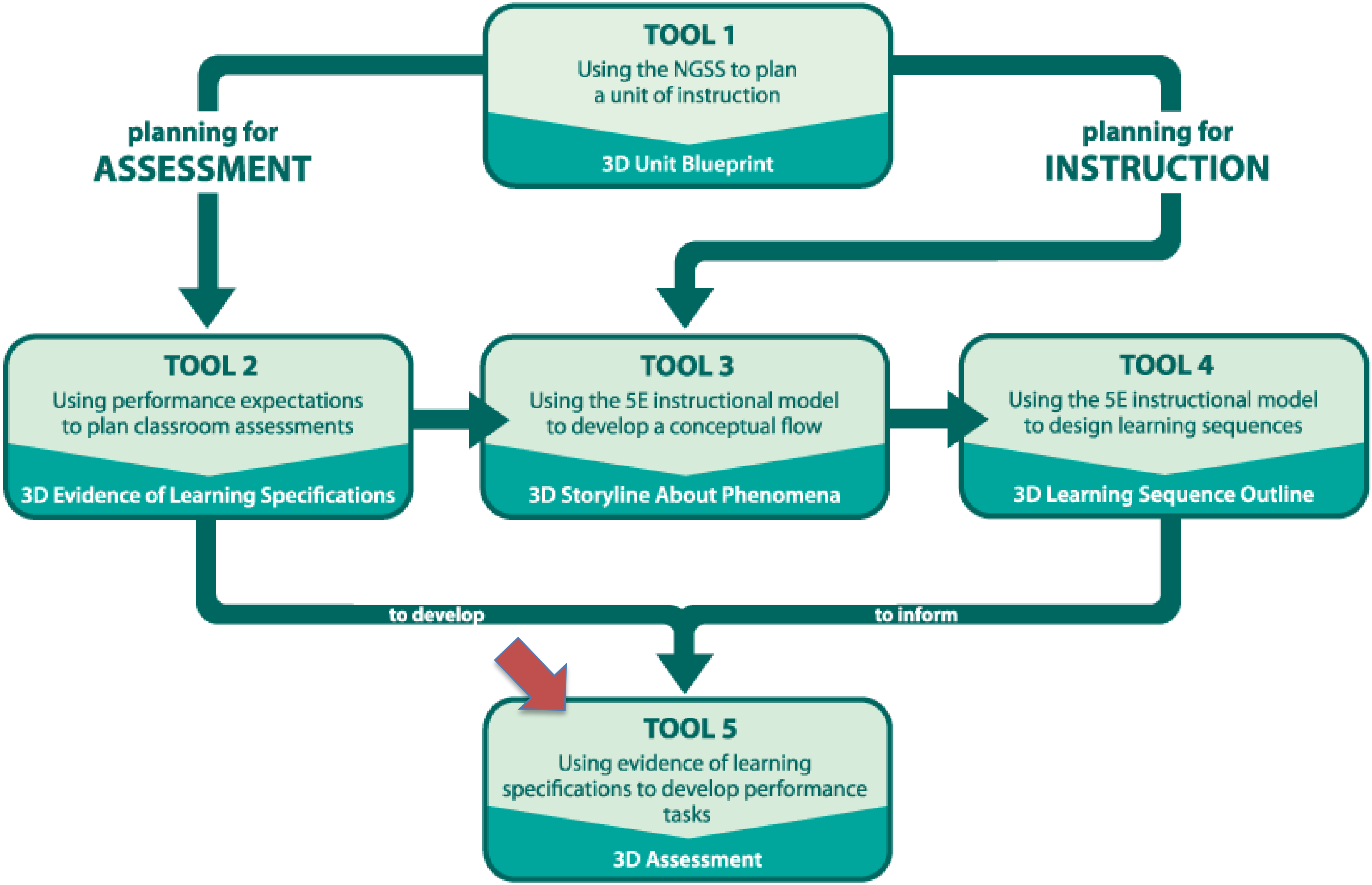
HO2

Tool 4 Template Example – 5E Learning Sequence Outline

Explore: Experiences in the Explore phase provide students with a common base of activities within which students wrestle with their current conceptions about a natural phenomenon through the science and engineering practice identified in the performance expectation. Learners may complete activities that help them use prior knowledge to generate new ideas, explore questions, and/or design and conduct an investigation.

What **teacher** is doing (including a brief description of the activity and key questions)	What **students** are doing (including ideal student response to selected questions/tasks) Identify **SEP** as appropriate Identify CCSS (ELA/literacy and math) as appropriate	Anchor Phenomenon Guiding Question Science Concepts DCI , CCC, PE
Ask students to brainstorm and review the list of Yellowstone organisms they had generated in the previous lesson. As animal interactions are described, draw food chain, and then a food web on the board (based on student ideas). Distribute Yellowstone cards for bison, beaver, coyote, elk, cowbird, bear, snowshoe hare, and winter tick. After students have had time to predict the food web, give students an information sheet that lists what the various organisms in the food web eat. Key Questions: • Which organisms play a similar role? Describe these roles. • What do you predict would happen to the food web if all the plants died?	**Use a model (a food web) to describe phenomena** Students receive Yellowstone Food Web cards for certain organisms and are asked to sort the cards into groups and explain their groupings to each other. Students arrange the cards into a food web, and predict what each animal might eat, and record it in their science notebooks. They compare their food webs with those of other groups and reflect on similarities and differences. Using the information sheet, students revise their food webs, according to the new information and record their revisions. In their groups they discuss the patterns of interaction among the organisms in the food web **(SL.8.1)**. Ideal Student Responses: • The beaver, the elk, the hare and the bison all eat plants • If all the plants died, animals like the hare wouldn't have food, and then animals like the coyote, that eat small animals like the hare, might also die. **Construct an explanation that includes qualitative relationships**	**Anchor Phenomenon:** The population of wolves in Yellowstone affects the population of many other organisms, not just the ones they eat. **Guiding Question:** *What impact can an organism have on the interactions between other organisms in a food web?* Food webs can represent patterns of feeding relationships among organisms in an environment.

Five Tools and Processes For Translating the NGSS Into Instruction and Classroom Assessment

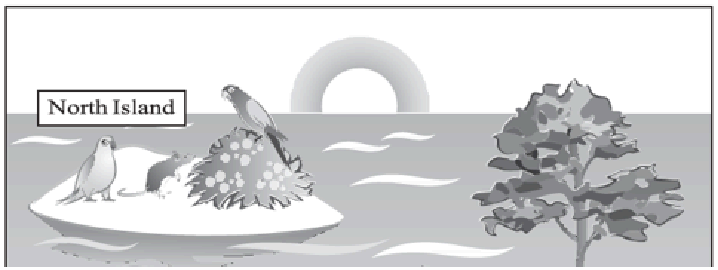


Performance Task for Instructional Sequence 1

1. 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.



TOOL 5

Using evidence of learning specifications to develop performance tasks

3D Assessment

1b. Make an X in the box next to the graph below that best predicts what would happen to the populations on the North Island during a 10-year period of decreasing rain."

Explain why the other two graphs are not the best predictions of what would happen during the period of decreasing rain.

Level 4: Advanced	Level 3: Proficient	Level 2: Developing	Level 1: Beginning	Level 0: Not evident
Selects Graph B AND Explains that A can't be correct because the birds should follow the same pattern as the rats and bushes, since birds also eat berries AND Explains that C can't be correct because rats would decrease as the birds decreased, since rats eat bird eggs	Selects Graph B AND Partially explains what is wrong with Graphs A and C	Selects Graph A AND Partially explains what is wrong with Graph C	Selects Graph C OR Selects any graph but does not explain anything	Student does not select a graph or provide an explanation

Use the Guide to Developing a Performance Task and Rubric to complete Tool 5 and design a performance task, scoring rubric, and student checklist for the Evaluate lesson in your learning sequence from Tool 4.

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	*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**:*

Implementation of the Five Tools and Processes

- Leadership Institutes
- Carnegie Corporation funded pilot
- BSCS work with school districts
- Design Middle School Ecology curriculum (Disruptions in Ecosystems)
- AMNH Climate and Weather MAT course
- Design of online course for teachers about Marine Biology
- Online Tool 1 Pilot

- Implementations Models

Evaluation of Five Tools and Processes for NGSS Professional Development

2016-2017

American Museum of Natural History

New York, NY

Evaluation Questions

- What happened during the PD?
- What did teachers learn about NGSS-aligned instruction and assessment in the PD?
- How do teachers implement what they learned in the PD experience in their classrooms?
- How do non-classroom teachers' knowledge of NGSS and teachers grow or change?

Participants

- 15 middle school teachers;
- 4 non-classroom teachers (1 NYCDOE admin, 3 PD providers)

Table 4: Groups

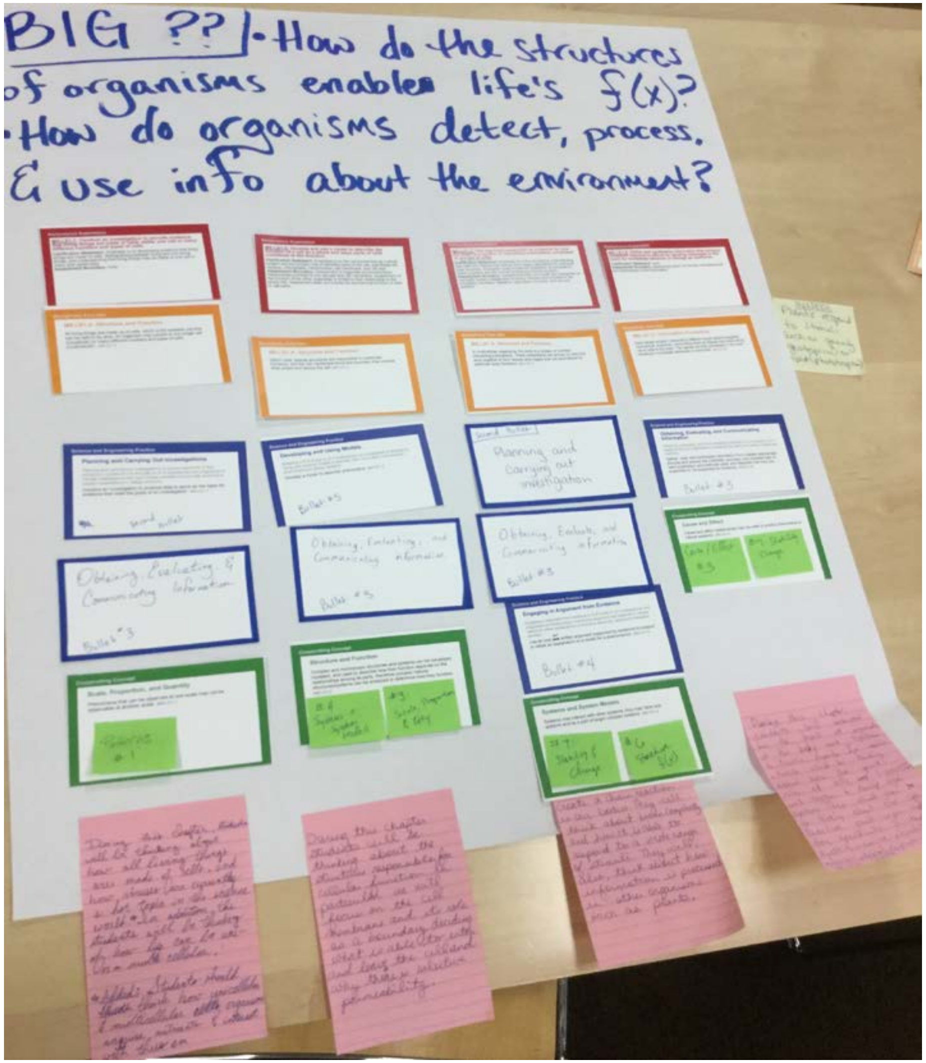
Unit	Forces and Interactions	Energy	Space Systems	Human Impact	Structure, Function and Information Processing
Group Participants	3 teachers, 1 non-classroom teacher	3 teachers, 1 non-classroom teacher	3 teachers, 1 non-classroom teacher	3 teachers, 1 non-classroom teacher	3 teachers

Data sources

- Observations of PD sessions
- Surveys at the end of each day and at the conclusion of the PD
- Classroom observations and interviews (n=10)
- Interviews
- Teacher artifacts from PD
- Student artifacts from classroom
- Focus groups

Feedback from the PD

- Teachers entered the project with a wide range of prior exposure and initial understandings of the NGSS
- Teachers' awareness and understanding of the NGSS increased.
- Teachers gained a deeper understanding of the vision of NGSS.
- Teachers learned about a variety of tools, processes, and resources that can be used to develop an NGSS-aligned lesson sequence.
- Teachers participated in the development of a lesson sequence.



Participant at the end of Tool 3:

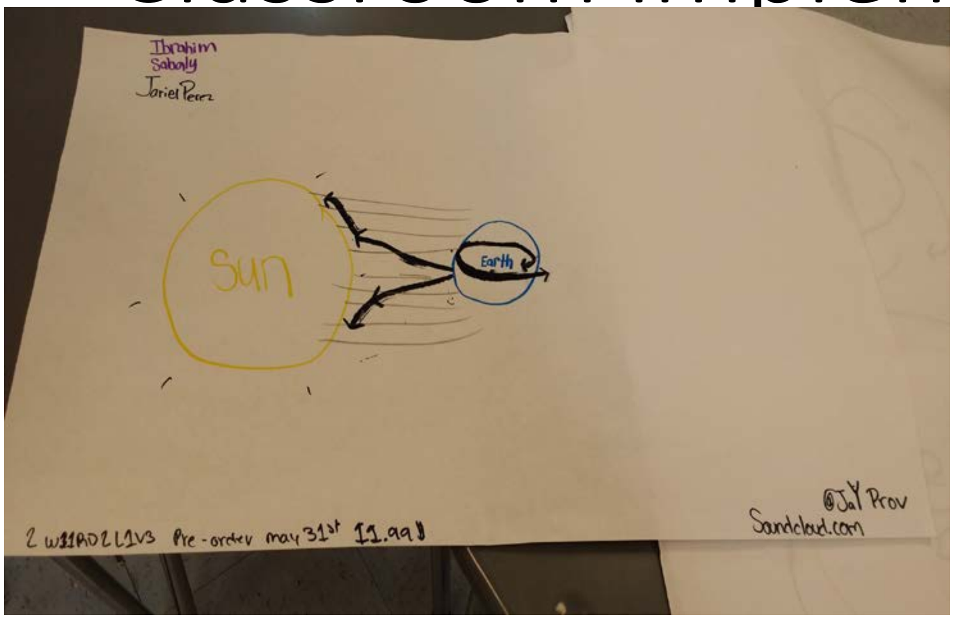
". . . when I was first learning about the 5Es I assumed the Explain was where the teacher stands up and gives the info. I changed my view - it's the students that are explaining concepts in their own words. I started looking at verbs of what the teacher is doing. It really moves the classroom into a student-centered experience in a way they can participate."

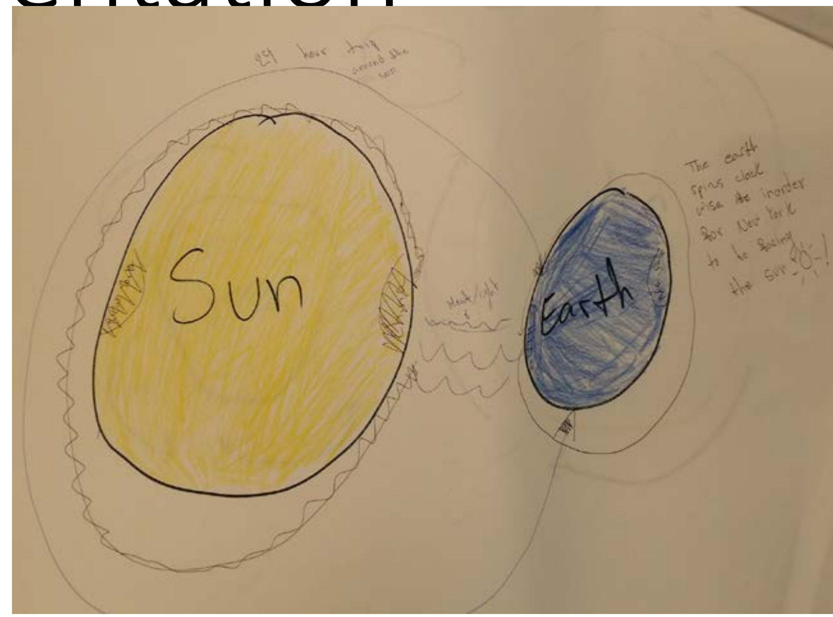
How many of the lesson sequences made it into the classroom?

Table 33: Implementation of the Lesson Sequence in the Classroom

	Implemented lesson sequence (includes entire, partial, and modified implementation)	Implemented lesson sequence	Partial / modified implementation	Did not implement	Unknown
# Teachers	11	6	5	3	1

Classroom implementation





- **7/9** teachers reported teaching the *content in a different way than they had in the past.*
- Teacher responses described instruction that included more opportunities for students to *re-visit and revise work* and more activities during which students were engaged in *sense-making* or *figuring out ideas in science.*

Professional Learning

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

The *Next Generation Science Standards* (NGSS) challenge teachers to think deeply about learning and teaching with the goal of developing a clear vision of science education that is coherent, focused, and rigorous. The **Five Tools and Processes for Translating the NGSS** are designed to help professional development leaders work with teachers on curriculum, instruction, and assessment as they achieve this vision.

Sign up for updates.

For more information contact Dave Randle at drandle@amnh.org.

Professional Learning

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

http://www.amnh.org/ngss-tools

or

Google: AMNH Five Tools

The *Next Generation Science Standards* (NGSS) challenge teachers to think deeply about learning and teaching with the goal of developing a clear vision of science education that is coherent, focused, and rigorous. The **Five Tools and Processes for Translating the NGSS** are designed to help professional development leaders work with teachers on curriculum, instruction, and assessment as they achieve this vision.

Sign up for updates.

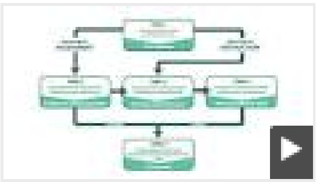
For more information contact Dave Randle at drandle@amnh.org.

Implementation Models for the Five Tools and Processes

- Model A
  - For formal and informal school leaders who need a deeper understanding of what phenomena-focused three-dimensional teaching and learning is and what it looks like in a classroom setting.
  - One full-day session (recommended) or two half-day sessions.
- Model B
  - Creating a plan for classroom instruction focused on the NGSS.
  - Three one-day face-to face sessions with work time in-between sessions (recommended) or three full-day sessions.
- Model C
  - Creating a plan for classroom assessment focused on the NGSS.
  - Three one-day face-to face sessions with work time in-between sessions (recommended) or three full-day sessions.

Teaching Channel Videos

How To Design Learning Sequences With NGSS ... - Teaching Channel
https://www.teachingchannel.org/video/design-learning-sequences-ngss



Aug 25, 2017
Translating the **NGSS**: Learning Sequences. Lesson Objective: Use an ... How do the **teachers** reflect on ...

How To Translate The NGSS - Using An Analysis ... - Teaching Channel
https://www.teachingchannel.org/video/translate-ngss

Aug 25, 2017
Learn about **tools** that will help you bring the **NGSS** to your classroom. In this video we discuss using an ...

Thank You

David Randle drandle@amnh.org

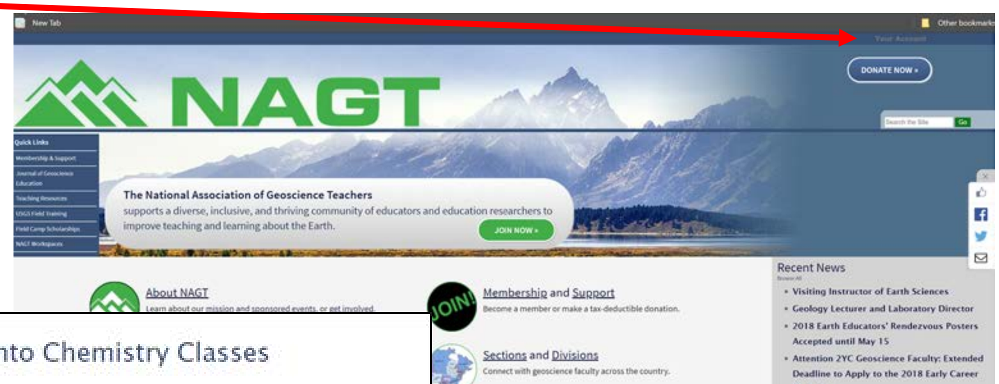
Anna MacPherson amacpherson@amnh.org

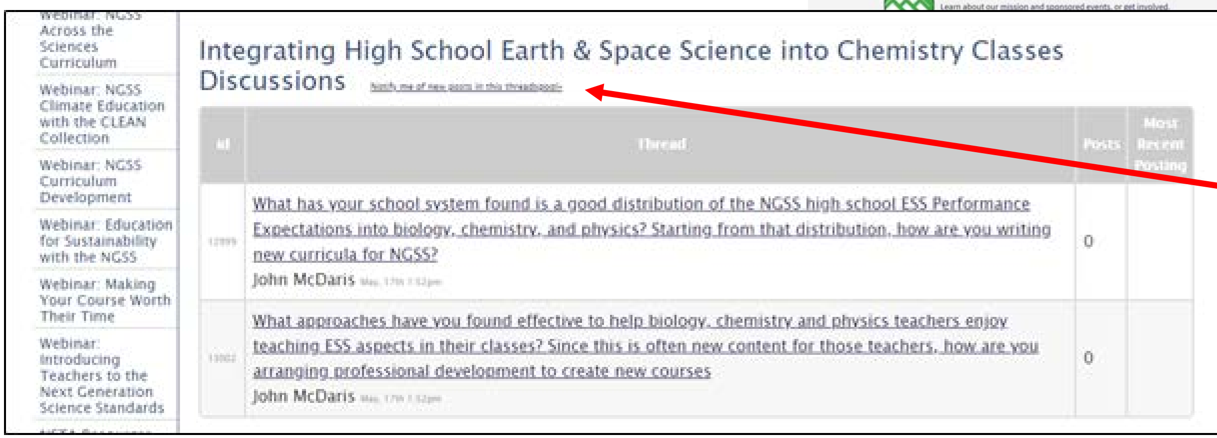
#FiveTools

Join us for discussion following today's webinar!

- Discussion forum access:
- http://bit.ly/102018webinar
- You must have & be signed into a SERC account to join in the discussion!

Sign-up for SERC account





Sign-up for new post notifications

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

National Earth Science Teachers Association

Join us for discussion following today's webinar!

- Discussion forum access:
- http://bit.ly/102018webinar
- What do you think? What are your experiences?

- Please join in the discussion:
  - How have you or will you use storylines in your work implementing NGSS?

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION

Post webinar survey:

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION

Upcoming Events & Resources:

- Future Event:
  - November webinar: 11/8/2018 - Quickly Increasing Anthropogenic Global Warming Acceptance: Five Experimentally-Vetted Methods and HowGlobalWarmingWorks.org presented by: Michael Ranney, UC Berkeley
- Not too late … did you miss the September webinar?

Designing instructional units using the NGSS Storyline Approach to support student sensemaking

You can still view the archived version here:

- http://bit.ly/92018webinar

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION

Thank you for participating!

Contact information:

Aida Awad: aawad@tothecloudedu.com

Edward Robeck: ecrobeck@agiweb.org

Carla McAuliffe: carla_mcauliffe@terc.edu

Jessica Bean: jrbean@berkeley.edu

Center for Geoscience & Society
american geosciences institute

NAGT
National Association of Geoscience Teachers

National Earth Science Teachers Association