Teaching Strategies for Natural Resources and Environmental Science

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Welcome!

- **Who I am**
  - Ag Student → Ag Instructor → Ph.D. Student
  - Standards & Curriculum Writing
  - My Research – Three Circle Model & Sustainability in Agriscience
  - Visit wuhsag.weebly.com or NAAE CoP for curriculum.

- **Today's Schedule**
  - Overview of AFNR Standards Structure
  - NGSS Alignment
  - Sample Classroom Activity
  - Questions, Discussion, and Workshop Evaluation

Caveats

- **I'm not an expert.**
  - While what I will show you is based on evidence and best practices, it is more of "what worked in my classroom" than "what will work in every classroom."
  - Not all 'experts' agree on this – i.e. this is a way (not the only way) to view these ideas & philosophies.
- **You might do some of this already. If you do and it works, awesome.**
  - You might be able to do other things and still be effective. This is just *one* approach to effective teaching.
- **This will look different from what many are used to in agricultural education.**
  - All fields of science education are changing rapidly and dramatically – this is a sign we are starting to figure things out ☺

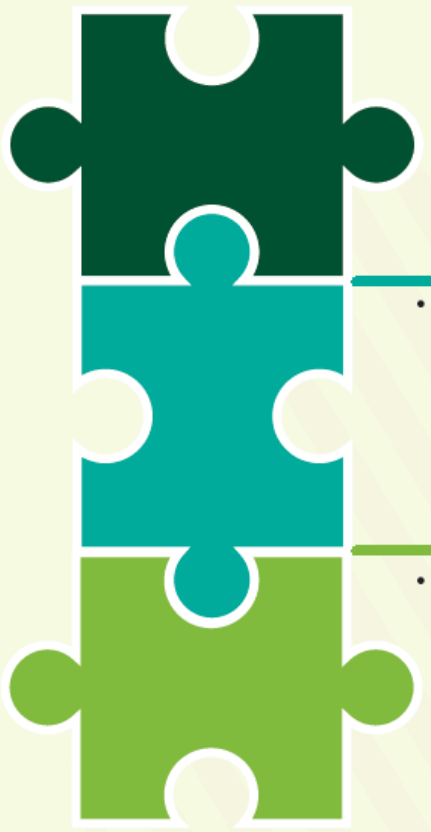
2015 AFNR Standards (Env. Systems)

PURPOSE: The career pathway content standards outline technical knowledge and skills required for future success within this discipline. The content standards are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the standards as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. Adoption and use of these standards is voluntary; states and local entities are encouraged to adapt the standards to meet local needs.

SCOPE: The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

SAMPLE CAREERS: Environmental Conservationist, Waste Management Specialist, Water Quality Specialist, Environmental Sampling Specialist, Naturalist, Hazardous Material Handler, Hazardous Material Technician, Toxicologist, Solid Waste Manager

DEFINITIONS: Within each pathway, the standards are organized as follows:



- **Common Career Technical Core (CCTC) Standards** – These are the standards for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- **Performance Indicators** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- **Sample Measurements** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CCTC's → P.I.'s → S.M.'s (A.I.M.)

S	**NRS.01. Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.**
I	**NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.**
M	Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.

NRS.01.01.01.a. Summarize and classify the different kinds of natural resources using common classification schemes (e.g., living versus non-living, renewable versus nonrenewable, native versus introduced, etc.).	**NRS.01.01.01.b.** Assess the characteristics of a natural resource to determine its classification.	**NRS.01.01.01.c.** Devise strategies for the preservation of natural resources based on their classification.
NRS.01.01.02.a. Summarize the components that comprise all ecosystems.	**NRS.01.01.02.b.** Analyze the interdependence of organisms within an ecosystem (e.g., food webs, niches, impact of keystone species, etc.) and assess the dependence of organisms on nonliving components (climate, geography, energy flow, nutrient cycling, etc.).	**NRS.01.01.02.c.** Conduct analyses of ecosystems and document the interactions of living species and non-living resources.
NRS.01.01.03.a. Summarize and classify different kinds of living species based on evolutionary traits.	**NRS.01.01.03.b.** Analyze how biodiversity develops through evolution, natural selection and adaptation; explain the importance of biodiversity to ecosystem function and availability of natural resources.	**NRS.01.01.03.c.** Evaluate biodiversity in ecosystems and devise strategies to enhance the function of an ecosystem and the availability of natural resources by increasing the level of biodiversity.

3D Learning in Next Generation Science

- **Practice**
  - Describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems
- **Crosscutting Concepts**
  - Crosscutting concepts have application across all domains of science
- **Disciplinary Core Ideas**
  - Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline

http://www.nextgenscience.org/three-dimensions

Next Generation Science Standards

Science and Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information.

Disciplinary Core Ideas

Physical Sciences
PS1: Matter and its interactions
PS2: Motion and stability: Forces and interactions
PS3: Energy
PS4: Waves and their applications in technologies for information transfer

Life Science
LS1: From molecules to organisms: Structures and processes
LS2: Ecosystems: Interactions, energy, and dynamics
LS3: Heredity: Inheritance and variation of traits
LS4: Biological evolution: Unity and diversity

Earth and Space Sciences
ESS1: Earth's place in the universe
ESS2: Earth's systems
ESS3: Earth and human activity

Engineering, Technology, and Applications of Science
ETS1: Engineering design
ETS2: Links among engineering, technology, science, and society

Crosscutting Concepts

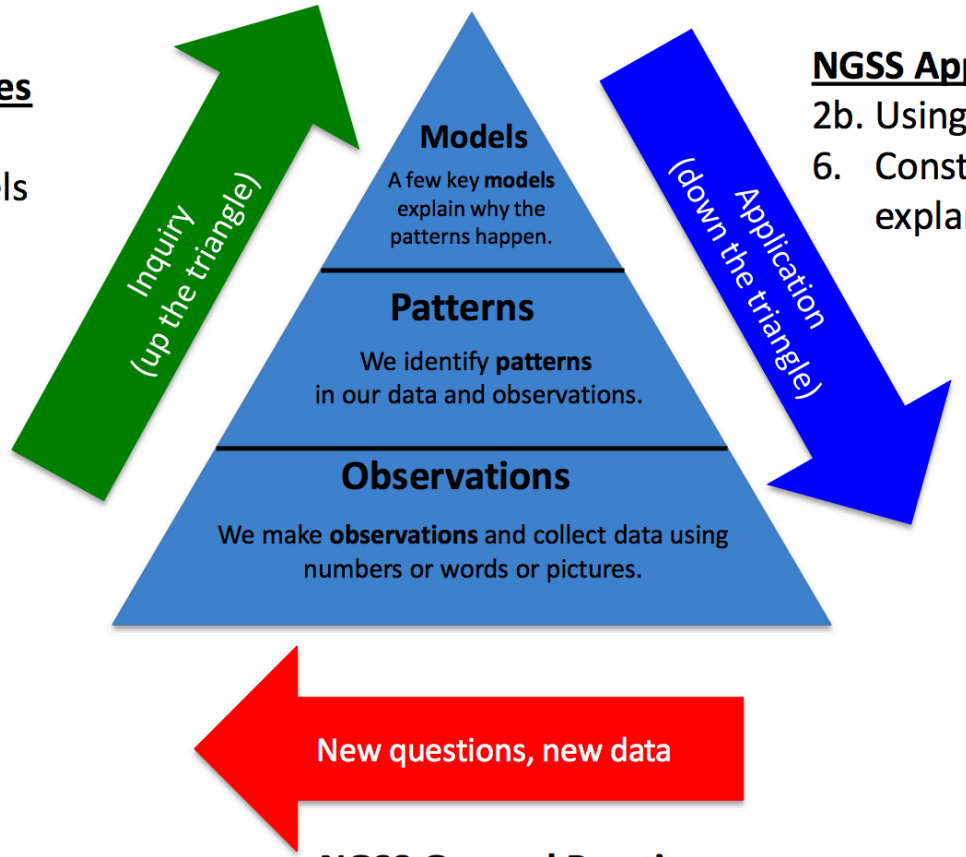
- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, conservation
- Structure and function
- Stability and change

Next Generation Science Standards

Representing Scientific Knowledge and Practice

NGSS Inquiry Practices

1. Asking questions
2a. Developing models
3. Investigations
4. Analyzing & interpreting data
7. Argument from evidence



NGSS Application Practices

2b. Using models
6. Constructing explanations

NGSS General Practices

5. Using mathematics and computational thinking
8. Obtaining, evaluating, and communicating information

AFNR & NGSS: AIM vs. 3D Learning

- **Awareness:** Developing an awareness and comprehension of Disciplinary Core Ideas and Cross Cutting Concepts

- **Intermediate/Interaction:** Use of Cross Cutting Concepts and Scientific/Engineering Practices in guided application situations.

- **Mastery:** Seamless use of DCIs, CCCs, Scientific/Engineering Practices in an increasingly un-coached, unstructured, real-world setting.

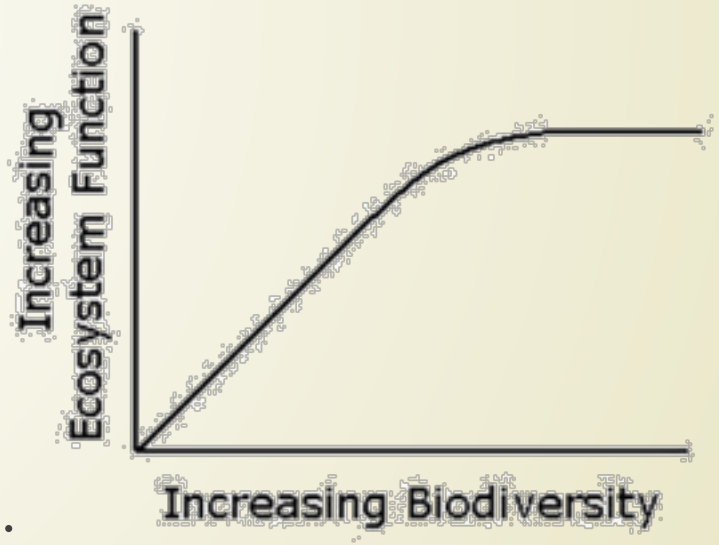
Scientific Literacy

- **The primary goal of NGSS is <u>scientific literacy</u>.**
  - Because 90% of students in general science courses do not become scientists or engineers, the shift in education is away from a 'mile wide, inch deep' curriculum to one that prepares all students to be able to think like scientists in their daily lives.
- **NGSS is about the mainline (literacy), not the pipeline (careers).**
  - General science courses are about preparing students to be future sense-makers and functionally literate in science.
  - Higher-level & elective science courses are still available for the pipeline science-career students.
- **AFNR is a mix of *mainline* (literacy) and *pipeline* (careers).**
  - Your classes might fall into both categories (e.g. *Intro Ag* may be about agriscience literacy, while higher level courses may be about pipeline agriscience-career students).

Example Activity – Bug Biodiversity

- **See handouts.**
  - Posted at http://wuhsag.weebly.com/natural-resources.html under Week 3.

- **BIG IDEA: The health of an ecosystem can be measured by its level of biodiversity.**
  - The greater the biodiversity, the healthier and more stable the ecosystem, and the more services that can be provided by that ecosystem (nutrient cycling, pollination, elimination of pollutants, etc.).
  - Greater biodiversity = greater sustainability.



Use the triangle to assess your findings:

Representing Scientific Knowledge and Practice

NGSS Inquiry Practices

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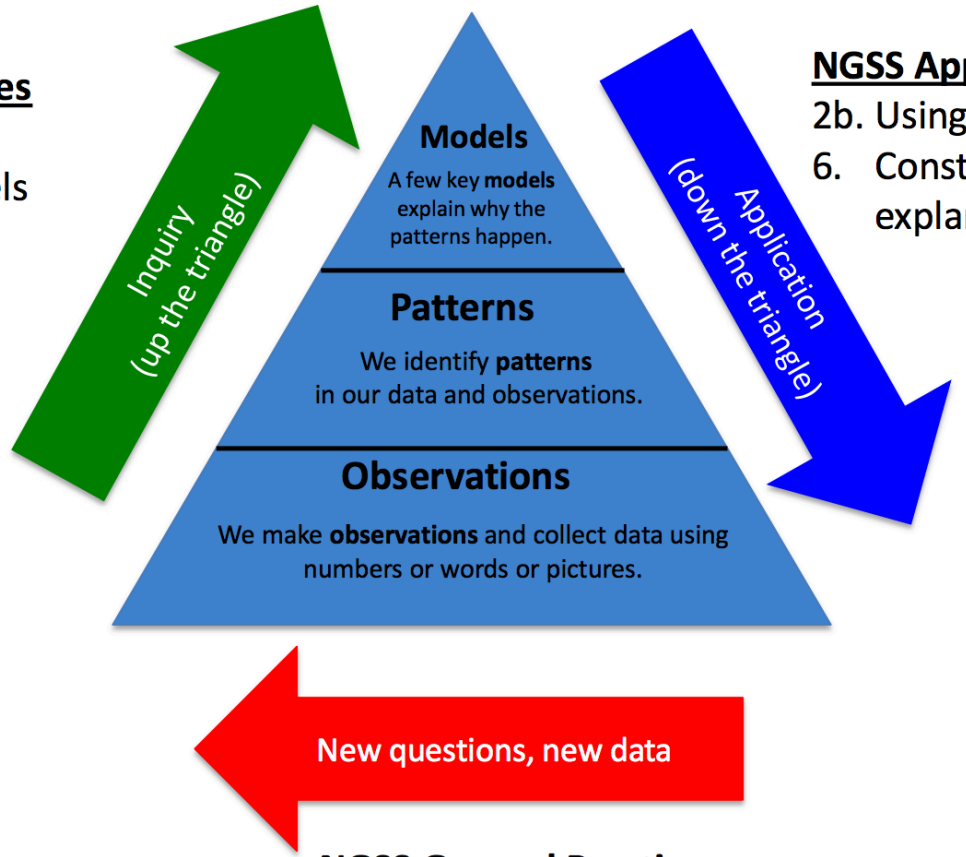

NGSS Application Practices

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Sustainability

- **Sustainability refers to choosing practices that allow for needs to be met without compromising the ability of future generations to meet those needs.**
  - A concern to agriculture due to the effects of modern lifestyles.
  - E.g. temps in eastern Africa have increased by 1.5 ℉ in the past century, resulting in a 15% decrease in rainfall (National Geographic, 2016). (*Dust Bowl II?)*
  - Farming in this region has become difficult as yields continue to decrease by an estimated 20%.
- **BIG QUESTION – what practices and changes can we adopt in ag, forestry, and science to ensure that our lifestyle can continue for many more years?**

Questions & Discussion

Future Work

- **Research by Redman & Redman (2014) also came to the conclusion that teaching about sustainability alone does not result in behavioral changes; procedural and social knowledge are vital to this goal.**
  - Chawla and Cushing's 2007 concluded that the most effective sustainability education had extended duration of time, allowed for opportunities to learn and practice skills, and resulted in the accomplishment of a specific goal.
  - These instructional models are similar to the 3-circle model of ag ed, leading to the submission of a Graduate Research Fellowship application with the National Science Foundation (NSF).
- **Michigan State University and the NSF has fully funded my research for 5 years on this topic.**
  - Current intention is to draft a curriculum next year, implement a pilot test in 2017-18, and implement a full version in 2018-19.
  - If interested in being a part of this project, please visit wuhsag.weebly.com.