EXPLORE TO AHA!

iExplore Academy

iExplore Science

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THANK YOU AGAIN!

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Module 1: Intro to the NGSS
Teacher Reflection

BEFORE	AFTER
What do you think/know about the NGSS right now? Consider the "spirit" of the NGSS, content, instructional strategies, and assessments.	Now that you have completed Module 1, how have your ideas changed?

Module 1: Intro To The NGSS

Pre-Course Survey

Directions: Complete the survey on paper or visit https://forms.gle/PSzQcnmrH2ryLmWX8 to submit your responses.

1. Name: ____

2. What grades/subjects do you teach? (Check all that apply.

_ MS Integrated Science   _ MS Earth and Space Science   _ MS Life Science   _ MS Physical Science

_ HS Biology   _ HS Earth and Space Science   _ HS Chemistry   _ HS Physics

_ K-3 Elementary   _ 4-6 Elementary   Other: _____________________________

3. On a scale of 1 (lowest) to 5 (highest), how would you rate your understanding of the NGSS? _____

4. How have you implemented the NGSS so far?

_ understanding the NGSS   _ designing lessons and units   _ designing assessments

_ using discovery-centered practices   _ grading/assessing student understanding   _ developing curriculum

_ classroom management   Other: ____

5. In terms of the NGSS, where are your strengths? Choose all that apply.

_ understanding the NGSS   _ designing lessons and units   _ designing assessments

_ using discovery-centered practices   _ grading/assessing student understanding   _ developing curriculum

_ classroom management   Other: ____

6. In terms of the NGSS, where are you struggling? Choose all that apply.

7. What are you most interested in learning about?

8. How did you find the iExplore Academy?

9. What are you hoping to gain from completion of the NGSS Your Science Class Course and membership in our community?

Module 1: Intro To The NGSS

Assessment

Directions: Complete the assessment on paper or to receive course credit, visit https://forms.gle/vs1je5gkgQYWtQGs5 to submit your responses.

1. The standards are written as Performance Expectations -- statements about what students should be able to DO by the end of the grade or grade band (6-8, 9-12). These statements combine the content knowledge (the DCIs) with the skills (the Science and Engineering Practices) and Crosscutting Concepts. Where can you go to "read between the lines" and determine exactly what skills and content ideas may be included in each Performance Expectation?

2. Describe how you can expect your content to change as you implement the NGSS.

3. What does the adoption of the NGSS mean for elective and advanced courses?

4. In an NGSS-aligned classroom, how are students introduced to the content (the Disciplinary Core Ideas)?

5. Where can you find a breakdown of the Science and Engineering Practices that can help you incorporate these into your instruction daily?

6. Based on your current understanding, describe how you might incorporate the Crosscutting Concepts into your daily lessons.

Module 2: Bundling The Standards

Choosing an Approach

Directions: If you are trying to decide between the Topic Model and the Phenomenon Model, consider the following questions and create a list of pros and cons for the approaches you are considering.

Questions to Consider:

>> Which approach do I understand better?
>> Am I working with a team or alone?
>> Is this an interim curriculum or a long-term solution?
>> How much freedom do I have to make changes to my current curriculum?
>> How much time do I have to invest?
>> Am I teaching an integrated curriculum or a disciplinary-based course?
>> What best meets my school, district, and state requirements?

TOPIC MODEL standards are grouped by topic	**PHENOMENON MODEL** standards are grouped around a phenomenon

Module 2: Bundling The Standards

Topic Model Approach

Directions:

1. List out all of the topics you teach in your current curriculum.
2. Examine the Next Generation Science Standards for your grade level or grade band. Match related Performance Expectations to your current topics.
3. Identify which Performance Expectations are not addressed in your current curriculum topics. List any you have chosen to (or are required to) incorporate in the Missing Standards box below
   a. Pro Tip: If you teach at a grade band level (6-8, 9-12), you will not address ALL Performance Expectations in a single year. You may have many Missing Standards. If, however, you have standards that you have been assigned – but are missing from the topics in your curriculum – record those in the Missing Standards box.
4. Identify which topics do not align to any of the Performance Expectations in your grade level or grade band. Note those topics in the Content To Cut box below. Determine whether you will continue to teach these topics or not by considering how you could incorporate the content into another related standard. (For example, teaching biomes through focusing on MS-LS2-1 related to resource availability.)
   a. Pro Tip: If you must teach topics that are not aligned to the NGSS, focus especially on Science and Engineering Practices and Crosscutting Concepts in those units.

Topics I Teach	Related Performance Expectations
Missing Standards	Content to Cut

Module 2: Bundling The Standards

Phenomenon Model Approach: Creating

Directions:

1. After you have identified what standards you will be addressing for the entire year, print the relevant Performance Expectation cards included in the Workshop Resources.
2. Create preliminary groups by tying together the content that most obviously aligned. (For example, it makes sense that the two standards about cells will be addressed in the same unit. Group these.)
3. Examine what remains and consider how you can tie disparate ideas together with a phenomenon (at this point in your understanding, any real world connection). (For example, the carbon cycle could tie to changes in ecosystems when considered under the phenomenon-umbrella of climate change.)
4. Focus on integrating the disciplines. (For example, add a PS standard on chemical reactions into your heavily-LS unit on matter and energy in ecosystems.)
5. Use the space below to record your ideas. List the PEs each bundle will address, a few notes on the concepts covered, and potential phenomena (real world connections). (Note: Limit each bundle to 3-6 standards. I would suggest creating no more than 4-6 bundles per year.)

Module 2: Bundling The Standards

Graphic Organizer: Breaking Down a Bundle

Directions:

1. If you are struggling to determine the sequence of bundles (units) in your course, you can use this organizer to break down the bundle to better identify the prerequisite knowledge and skills.

Performance Expectations (List Codes Only.)		
What Students Will Learn (Content Ideas, DCIs)	What Students Will Do (Science and Engineering Practices)	What Students Should Already Know (Prerequisite Knowledge)
Notes		

Module 2: Bundling The Standards

iExploreScience Sample Bundling Exercise

iExploreScience Sample NGSS Bundles   www.iExploreScience.com

Course 1

Bundle 1: Metals at Work	**Bundle 2:** Chemical Kitchen: Baking Time	**Bundle 3:** Organisms and Their Environments	**Bundle 4:** Natural Disasters
Question: How do we use metals to improve our lives?	**Question:** What happens to food when we cook it?	**Question:** Why do organisms live where they live?	**Question:** How can we protect ourselves from natural hazards?
MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.	MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	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.	MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*	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.	MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*	MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.	MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	

Questions to Consider:

1. Why would I place the PEs and Bundle 1 before the PEs in Bundle 2?

2. How would understanding MS-PS1-1 and MS-PS1-4 (from Bundle 1: Metals At Work) provide background knowledge for students working in Bundle 3: Organisms and Their Environments?

3. There is no strong connection between Bundle 2 (Chemical Kitchen) and Bundle 3 (Organisms and Their Environments). How might YOU segue instruction from Bundle 2 to Bundle 3?

Module 2: Bundling The Standards

Phenomenon Model Approach: Ordering

Directions:

1. After you have outlined your basic bundles, determine in what order you will address these. (Note: Consider prerequisite knowledge, how closely the content connects across bundles, and the overall complexity of the concepts and skills.)
2. In the table below, record each bundle, identifying the Performance Expectations and some notes on the content you will cover and potential phenomena (real world connections) you may incorporate. In the small boxes, record the connection to the next bundle (IF one exists).

Performance Expectations	Notes on Content and Phenomena
1	
2	
3	
4	
5	
6	

Module 2: Bundling The Standards

Performance task: Creating Course Bundles

Directions:

1. To receive course credit, complete the Module 2 Performance Task: Creating Course Bundles digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Bundle 1:	Bundle 2:	Bundle 3:	Bundle 4:	Bundle 5:
Question:	Question:	Question:	Question:	Question:

Module 3: Anchoring Phenomena

Graphic Organizer: Brainstorming Your Anchor

Directions:

1. Examine the unit bundle you will be designing during the course. List out the concepts below, and then brainstorm where you can see this concept in action in the real world. Add to this list as you access the sources of ideas for phenomenon provided in the workshops.

Disciplinary Core Ideas/Unit Concepts	Where Can I See this in the Real World?

Reflection Questions to Consider:

Which concepts will cause the most confusion?
Which concepts are most important?
Which concepts are abstract or invisible?
Why do these concepts matter?

Module 3: Anchoring Phenomena

Recommended Resources: Anchor Inspiration

ScienceNews for Students

newsela

IFL SCIENCE!

MASSIVE SCIENCE

livescience

ScienceDaily®

iExplore Science

SCIENCE in the News

NewScientist

SN ScienceNews MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

NATIONAL GEOGRAPHIC

UNDARK

Truth, Beauty, Science.

BBC TWO Nature's Weirdest Events

Sources for NGSS Phenomenon:

#ProjectPhenomena - https://sites.google.com/site/sciencephenomena/
The Wonder of Science - http://thewonderofscience.com
Phenomena for NGSS - https://www.ngssphenomena.com/
The Teaching Channel - https://www.teachingchannel.org/blog/2016/09/22/phenomena

Module 3: Anchoring Phenomena

Graphic Organizer: Identifying Possible Anchors

Directions: Generate three ideas for anchor phenomenon that might work for your unit. Brainstorm questions your students may ask when presented with this phenomenon. You will use these questions to determine which anchor works best for YOUR unit.

Anchor Idea !	Questions it may generate
Anchor Idea 2	Questions it may generate
Anchor Idea 3	Questions it may generate

Module 3: Anchoring Phenomena

Reflection: Evaluating Your Anchor

Directions: Use the following questions to evaluate your anchor.

Content:

1. An anchor is a specific event or process. What is your anchor phenomenon?

2. How does your anchor tie to your content? Describe how your targeted Disciplinary Core Ideas connect to the anchoring phenomenon you have identified. Which DCIs connect most easily and clearly?

3. Which targeted DCIs are less relevant to this anchor?

4. How will the questions generated by your anchoring phenomena lead students to your targeted Disciplinary Core Ideas (content)?

Engagement

5. Can students actually observe or investigate the phenomena? How? (Using models? Analyzing data? Watching a demonstration? Participating in a lab or simulation?)

6. Will students find explaining the phenomenon interesting and/or important? How will you emphasize the relevancy of this phenomenon?

7. Is the phenomenon related to real-world issues or the local environment? Does it connect to students' lives or experiences?

Learning

8. Will students NEED to understand the DCIs, Science and Engineering Practices, and Crosscutting Concepts to explain how/why the anchoring phenomenon occurred?

9. Does this anchoring phenomenon work within the constraints of your classroom and school? (Time, economic costs, etc.)

Module 3: Anchoring Phenomena

Performance task: Choosing Your Anchor

Directions: Now that you have generated some ideas, you will need to identify which anchor best fits your unit goals. Consider the questions your anchor will generate. This will be the deciding factor. Use the table below to describe each anchor, generate questions from the phenomenon, and ultimately, rank the options to identify the best phenomenon for YOUR unit. To receive course credit, complete the Module 3 Performance Task: Identifying Your Anchor digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

<table>
<tr><td>Bundle Name:</td><td>Guiding Question/Big ideas:</td></tr>
<tr><td colspan="2">target Performance Expectations:</td></tr>
<tr><td>top Choice Anchor Phenomenon:
Describe the anchor itself AND how you will present it to students. Lists any questions, prompts, information or observations you will share with students. (But remember, limiting the information YOU provide is best!)</td><td>Questions generated:
What questions will you expect students to ask when presented with the anchoring phenomenon?</td></tr>
</table>

Module 4: Creating Storylines

iExploreScience Sample Storylining Exercise 1

Directions:

1. Follow along in Module 4, Video 2 "A Close Read Of The Standards" to complete this exercise. Then, use the digital resource - Unit Objectives Organizer - found in the Workshop Resources to break down the standards relevant to YOUR unit bundle

MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]

Evidence Statement says...	My Notes...
1A From the given investigation plan, students describe* the phenomenon under investigation, which includes the relationships between air mass interactions and weather conditions	Students will: >> describe the phenomenon they are investigating (related to relationship between air mass interactions and weather conditions) from a provided investigation plan
1B Students identify the purpose of the investigation, which includes providing evidence to answer questions about how motions and complex interactions of air masses result in changes in weather conditions [note: expectations of students regarding mechanisms are limited to relationships between patterns of activity of air masses and changes in weather].	>> describe the purpose of the investigation (to provide evidence to answer questions re: how do the motions/interactions of air masses result in changes in weather conditions?)
2A From a given investigation plan, students describe* the data to be collected and the evidence to be derived from the data that would indicate relationships between air mass movement and changes in weather, including: - Patterns in weather conditions in a specific area (e.g., temperature, air pressure, humidity, wind speed) over time - The relationship between the distribution and movement of air masses and landforms, ocean temperatures, and currents. - The relationship between observed, large-scale weather patterns and the location or movement of air masses, including patterns that develop between air masses (e.g., cold fronts may be characterized by thunderstorms).	>> describe the data they will be collecting >> example: patterns in weather conditions in a specific area (temperature, air pressure, humidity, wind speed) >> example: relationship between distribution/ movement of air masses and landforms, ocean temperatures, and currents >> example: relationship between observed, large-scale weather patterns and the location/movement of air masses (ex/ cold fronts are characterized by thunderstorms)
2B Students describe* how the evidence to be collected will be relevant to determining the relationship between patterns of activity of air masses and changes in weather conditions.	>> describe why the evidence they are collecting is relevant to determining the relationship between air masses/changes in weather
2C Students describe* that because weather patterns are so complex and have multiple causes, weather can be predicted only probabilistically.	>> describe that weather patterns are complex and have multiple causes >> use this to explain why weather can only be predicted probabilistically
3A Students describe* the tools and methods used in the investigation, including how they are relevant to the purpose of the investigation.	>> describe the tools and methods that were used in the investigation >> describe how they helped students fulfill the purpose of the investigation
4A According to the provided investigation plan, students make observations and record data, either firsthand and/or from professional weather monitoring services.	>> follow the investigation plan to make observations and record data (first-hand OR from professional weather monitoring services)

Module 4: Creating Storylines

iExploreScience Sample Storylining Exercise 2

Directions:

1. Examine the table below for another example. Try breaking down the last section yourself.

HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]

Evidence Statement says…	My Notes…
1A From a given model, students identify and describe the components of the model relevant for their illustration of cellular respiration, including: - Matter in the form of food molecules, oxygen, and the products of their reaction (e.g., water and CO2); - The breaking and formation of chemical bonds; and - Energy from the chemical reactions.	Students will be given a model. Students will be able to… >> identify and describe the important parts of cellular respiration: food molecules, oxygen, and the products of the reaction (water and CO2) >> identify and describe the breaking and forming of chemical bonds >> identify and describe what is happening in terms of energy in the chemical reactions
2A From the given model, students describe the relationships between components, including: - Carbon dioxide and water are produced from sugar and oxygen by the process of cellular respiration; and - The process of cellular respiration releases energy because the energy released when the bonds that are formed in CO2 and water is greater than the energy required to break the bonds of sugar and oxygen.	>> explain that CO2 and water are produced from sugar and oxygen during cellular respiration. >> explain that energy is released during this process >> explain that energy is released because there is energy "left over" (the energy required to break the bonds of sugar and oxygen is less than the energy that is released when the bonds are formed in CO2 and water)
3A Students use the given model to illustrate that: - The chemical reaction of oxygen and food molecules releases energy as the matter is rearranged, existing chemical bonds are broken, and new chemical bonds are formed, but matter and energy are neither created nor destroyed. - Food molecules and oxygen transfer energy to the cell to sustain life's processes, including the maintenance of body temperature despite ongoing energy transfer to the surrounding environment.	[try this one yourself]

Module 4: Creating Storylines

iExploreScience Sample Storyline Map

What Happens to Food When We Cook It?	
MS-PS1-1, MS-PS1-4, MS-PS1-2, MS-PS1-5, MS-PS1-6, MS-ETS1-3	PS1.A, PS1.B, ETS1.B, ETS1.C,
Anchor Phenomenon: (Describe the anchor phenomenon you plan to use.) SUGAR COOKIES! Students will examine and eat sugar cookies baked with ALL white sugar and ALL brown sugar.	Anchor Phenomenon Questions: (Identify some questions students may generate from your anchor.) Why are these cookies different? Why is the color different? Why is the taste and texture different? How is brown sugar different from white sugar? What happens during baking that causes these effects? What happens during baking that turns cookie dough into a cookie? Does baking temperature matter? What other ingredients impact cookie consistency?

Brown Sugar vs. White Sugar

Guiding Question: (What question will students be answering?) Why does matter (like white sugar and brown sugar) have different properties? What is matter made of?	Big Ideas: (What understandings do you want them to walk away with?) Matter is made of atoms. Atoms join together to form molecules. Atoms can join with the same type or different types (elements) to form molecules. Some molecules connect to others. Other atoms and molecules don't connect.
Activity Ideas: 1. Puzzle Piece Activity 2. Modeling Atoms/Molecules (Helium, Carbon Dioxide, Water, Sodium Chloride, Sucrose ("brown sugar" and "white sugar") 3. Modeling Sugar (Sucrose) 4. Brown Sugar vs. White Sugar (MIXTURES? Refining Process, Molasses Molecule)	Connection To Anchor: Stuff is made of different atoms with different properties. Brown sugar and white sugar may be made up of different atoms (elements).

Sugar vs Salt Dissolving

Guiding Question: (What question will students be answering?) Molecules have different structures... but how do these structures affect their properties?	Big Ideas: (What understandings do you want them to walk away with?) Molecules have different structures, which affect their properties.
Activity Ideas: 1. Salt vs. Sugar Dissolving Lab 2. Modeling Salt, Sugar, and Water 3. Water As A Universal Solvent 4. Extension: Graphite vs Diamond	Connection To Anchor: The properties we observe can be explained by the different structures of different molecules.

Sugar Dissolving at Different Temperatures

Guiding Question: (What question will students be answering?) What does adding or removing thermal energy (like heating during baking or chilling before baking) do to molecules?	Big Ideas: (What understandings do you want them to walk away with?) Adding or removing thermal energy impacts the motion of molecules. Adding thermal energy increases particle motion, measured by temperature (a measure of kinetic energy of particles). Removing thermal energy decreases particle motion.
Activity Ideas: 1. Food Coloring In Different Temp Water Demo 2. Sugar Dissolving Lab 3. PhET States of Matter Simulation 4. Notebook: Modeling Particle Motion and States of Matter 5. Changing States of Matter/Evaporation 6. Notebook: Cooking Popcorn Phenomenon 7. Changing States of Matter/Freezing	Connection To Anchor: Baking involves heating - and sometimes cooling - ingredients. This affects the particle motion of the molecules in the food. Some molecules may turn into a gas when heated enough - which explains why food generally dries out during baking.

Note: Find the complete storyline at **http://bit.ly/2ZiMoqZ**

Module 4: Creating Storylines

Performance task: Starting Your Storyline

Unit Question:	
Standards:	DCIs:
Anchor Phenomenon: (Describe the anchor phenomenon you plan to use.)	Anchor Phenomenon Questions: (Identify some questions students may generate from your anchor.)
Phenomenon 1:	
Guiding Question: (What question will students be answering?)	Big Ideas: (What understandings do you want them to walk away with?)
Activity Ideas:	Connection To Anchor:
Phenomenon 1:	
Guiding Question: (What question will students be answering?)	Big Ideas: (What understandings do you want them to walk away with?)
Activity Ideas:	Connection To Anchor:
Phenomenon 1:	
Guiding Question: (What question will students be answering?)	Big Ideas: (What understandings do you want them to walk away with?)
Activity Ideas:	Connection To Anchor:

Module 5: Assessment

Is it a Three Dimensional Assessment?

Traditional Assessment	Three Dimensional Assessment
Structure Traditional tests and quizzes are typically full of a bunch of questions in random order that address various unit concepts. One question has very little connection to the next (if any at all), and questions can really be completed in any order.	**Structure** In a three dimensional assessment, one or several scenarios are presented that students use to answer a series of questions that often build on each other (or at the very least, connect to each other).
Question Types Traditional quizzes and tests are full of true/false, fill-in-the-blank, multiple choice, short answer, or matching questions. While these questions may help you determine the degree to which students understand the disciplinary core ideas (or the "content" chunk), they do not provide students the opportunity to engage in the science and engineering practices.	**Question Types** Three dimensional assessments require students to apply the science and engineering practices to reveal their understanding about unit concepts (disciplinary core ideas) and crosscutting concepts (the big ideas that connect all the sciences together). A short answer, multiple choice, or true/false question simply cannot assess whether students know how to analyze and interpret data, construct explanations from evidence, or engage in argumentation.
Assessment Traditional quizzes and tests typically assign one point per question (or maybe a few points, if you have a short answer or essay). These types of questions don't gives students the opportunity to receive feedback (other than	**Assessment** A three dimensional assessment, by its very nature, requires some sort of rubric to assess student performance and understanding. You are assessing both the science and engineering practices (the skills) and disciplinary core ideas (the content), and students will demonstrate a range of performance for both of these. Rubrics can help you quantify student performance more easily and more accurately.

Evaluating Three Dimensional Assessments

Directions: When you have crafted your assessment, return to this checklist to reflect on your work.

The assessment…

- ☐ presents a phenomenon, investigation, or problem to frame questions/prompts.
- ☐ requires students to demonstrate their understanding* of the specific phenomenon/investigation OR to design solutions to the specific problem based on their understanding of the disciplinary core ideas.
- ☐ provides students the opportunity to <u>use</u> relevant elements of the Science and Engineering Practices. (See the NSTA's Science and Engineering Practices Matrix to identify the specific elements within each SEP.) Ideally, students are engaging in several Science and Engineering Practices within a single assessment, although one may be the primary focus.
- ☐ provides students the opportunity to demonstrate understanding of the relevant Disciplinary Core Ideas.
- ☐ provides students the opportunity to <u>use</u> Crosscutting Concepts to explain, predict, illustrate, etc.
- ☐ is coherent. Each question connects, to some degree, to previous questions and to the scenario presented.
- ☐ When appropriate, links are made across the science domains – Earth and space science, life science, and physical science.

*"Demonstrate understanding" can mean to express verbally, in writing, through a model, or by manipulating data – among other modes of expression.

Module 5: Assessment

Evaluating Your Assessment Scenario

Directions: Use the following checklist to evaluate your assessment scenario or phenomenon.

The phenomenon…

- ☐ is central to the task. Students cannot complete the assessment without engaging with (explaining, asking questions about, developing a model of, etc.) the phenomenon or problem.
- ☐ is relevant to students' interests and/or experiences. The phenomenon is authentic and meaningful. It is worth figuring out.
- ☐ is specific. Remember, "the water cycle" is not a phenomenon. Water evaporating from a puddle on a hot day IS a phenomenon.
- ☐ is grade-level-appropriate. The phenomenon can be explained using grade-appropriate DCIs, SEPs, and CCCs.

The scenario…

- ☐ is presented through multiple modalities - text, diagrams, data tables, etc. - in an easy-to-understand way.
- ☐ is presented as puzzling and sparks student curiosity.
- ☐ provides students real-world observations rooted in a specific event/instance.
- ☐ is not so text-heavy as to be overwhelming to struggling readers.
- ☐ provides students with "enough" information to complete the task but does NOT provide extraneous or irrelevant information.

Directions: Examine your unit objectives and overall storyline. Brainstorm potential scenarios that may work with your standards and objectives.

Module 5: Assessment

Rubric Examples

Traditional Rubric

Invasive Species Project

Community Action Plan Rubric

Disciplinary Core Ideas

Science & Engineering Practices

Crosscutting Concepts

	Description	Rationale	[illegible]n Plan	Evaluation
4	Describes how the invasive species has impacted biodiversity in the local community. Provides specific examples and evidence to support claims.	Defines biodiversity as the variety of species found in an ecosystem and explains its importance as an indicator of ecosystem health. Describes how changes to biodiversity can impact humans' resources (food, energy, medicine, ecosystem services). Provides specific examples and evidence to support claims.	[illegible] a specific, step by [illegible]ction plan to halt the spread of the invasive species and/or decrease its population in the region. Identifies the strengths and weaknesses of the plan in light of the constraints identified. (Examples: scientific, social, and economic considerations.)	Describes each plan examined. Analyzes each plan in detail to identify strengths and weaknesses in relation to the criteria and constraints identified. Final analysis demonstrates critical thinking and considerable thought and effort.
3	Provides somewhat complete and [illegible] information based on evidence. May not fully address the impacts of the invasive species on the new ecosystem.	Uses some text features to highlight information and improve readability. Overall orderly appearance. Images/graphics may not be entirely clear, relevant, or accurate.	Responds accurately to reflection questions but may not use specific examples or provide sufficient reasoning to fully explain connections between the introduction of native species and subsequent changes to native populations and ecosystem biodiversity.	Describes each plan examined. Analyzes each plan to identify strengths and weaknesses but may not refer to the criteria/ constraints identified. Final analysis is somewhat shallow and does not yet demonstrate significant critical thinking.
2	Provides general information but may not reference evidence collected during the research stage. May not include specifics. Does not address the impacts of the invasive species on the new ecosystem.	May not use text features or may use inappropriate text features. Images/graphics may not be relevant. May not be neat or orderly.	Provides general factual information but does not use reasoning to connect the ideas. May provide some inaccurate information.	Describes each plan examined. May not identify strengths and weaknesses as related to the criteria/constraints examined. Final analysis is somewhat incomplete or inaccurate.
1	Does not provide adequate information about the invasive species or its impacts on the ecosystem.	May be difficult to read or understand. Is not neat or orderly.	Provides vague or inaccurate responses to the questions.	Does not describe or analyze the plans presented. Final analysis is significantly incomplete or inaccurate.

Single Point Rubric

Sea Level Rise:

States of Matter & Thermal Energy Transfer

Science & Engineering Practices

Disciplinary Core Ideas

Crosscutting Concepts

NOT MET	CRITERIA	EXCEEDED
	Model ☐ Uses a model to illustrate the relationship between the states of matter, particle motion, and the average kinetic energy of particles in the system (as measured by temperature). ☐ Identifies water in each state of matter. ☐ Uses an illustration to describe the particles in each state of matter, including the different distances between particles and their motion. ☐ Identifies the temperature of the components of the system.	
	Relationships ☐ Uses the model to describe the relationships between: ☐ the motion of molecules and the kinetic energy of the particles. ☐ the average kinetic energy of the particles and the temperature. ☐ the transfer of thermal energy from ocean water to sea ice, and its effects on the kinetic energy of the particles that make up land ice and the resulting melting (change in state) of the sea ice.	
	Cause and Effect ☐ Uses the model to explain why warming oceans will result in sea level rise, specifically as a result of the ☐ thermal expansion of ocean water, and ☐ the melting of land ice resulting from thermal energy transfer.	
Additional Comments:		

Module 5: Assessment

Performance Task: Three Dimensional Assessment Organizer

Directions: To receive course credit, complete the Module 5 Performance Task: Three Dimensional Assessment digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Teacher Name:	**Grade Level:**
Bundle: Insert Title	**Guiding Question/Big Idea:** Insert Question/ Big Idea
Target Performance Expectations: List the PEs this unit will address.	
Top Choice Scenario: Describe the phenomenon/scenario itself AND how you will present it to students. Ex/ Students will read a short text that discusses/reviews sea level rise as a result of global warming/climate change and view a graph that predicts sea level rise in the 21st century (available https://www.carbonbrief.org/what-the-new-ipcc-report-says-about-sea-level-rise) Students will use their model to explain and support the cause/effect relationship between global warming and sea level rise (focusing on the changing state of land ice and the role of thermal expansion).	**Revised Unit Objectives:** Tie your unit objectives to your specific phenomenon/ scenario. Ex/ Uses a model to illustrate the transfer of thermal energy from ocean water to sea ice.

Module 6: Designing NGSS Aligned Lessons

5E Model Cheat Sheet

Engage

The purpose of the Engage stage is simply to catch the student's attention. It may be a situation or event, a problem or puzzle, or an interesting demonstration. The Engage activity, which may or may not be a full lesson in length, is designed to pique student interest and get them thinking about relevant content. It can also be a great opportunity for teachers to assess prior knowledge and identify misconceptions.

Key Points: student interest, activate prior knowledge, reveal misconceptions

Explore

In this phase, students are given the time and opportunity to "explore" their current understanding and demonstrate what they already know as they attempt to make sense of the Engage activity. Students are investigating phenomena, discussing their ideas, and beginning to formulate possible explanations. The teacher's role in this stage is to provide the appropriate background information and materials for students to carry out the activity. Then, the teacher becomes a facilitator -- listening, observing, and guiding students as they attempt to make sense of what they had observed.

Key Points: explore current understanding, attempt to make sense of concepts, vocabulary is NOT assigned

Explain

In the Explain phase, the concepts introduced in Engage are made clear and understandable. At this phase, scientific vocabulary is applied and the explanations formulated in the Explore phase are refined. The teacher's role is to guide students' attention to key aspects and elicit their explanations. The goal is to guide students to construct an accurate understanding independently, but when that is not possible, the teacher should clearly and explicitly present the key concepts. This can be done verbally or through videos, readings, websites, or other technologies.

Key Points: students construct explanations, scientific terminology is used

Elaborate

The goal of the Elaborate phase is for students to apply their understanding of the basic concepts to similar but new situations. The activities should be challenging but still within their reach. This is also the stage where students independently practice and apply what they have learned.

This stage is NOT intended as “extra fluff” or “side projects.” It is the stage where students expand and cement their understanding through repeated practice and additional examples.

Key Points: students practice independently,

Evaluate

In the Evaluate phase, students are engaging in activities that are consistent with those presented in prior phases but with the goal of assessing their explanations. As with all assessment, teachers should have a clear understanding of evidence of student learning and what to "look for" in student work.

Key Points: formative and summative; both teachers AND students assess student ideas; evidence and “look fors” are important

Module 6: Designing NGSS Aligned Lessons

How am I using the 5E Model?

Engage: When you begin a new instructional sequence…		
Activity provides opportunities to… ▫ catch student's interest and attention. ▫ access prior knowledge.	As the teacher, you… ▫ raise questions. ▫ encourage students to discuss what they already know.	Your students… ▫ show interest by listening attentively. ▫ ask questions.
Explore: When you introduce new content…		
Activity provides opportunities to… ▫ experience key concepts. ▫ discover new skills. ▫ question prior knowledge and examine thinking.	As the teacher, you… ▫ set the framework for the activity. ▫ observe and listen as students interact. ▫ ask questions to redirect student thinking. ▫ provide enough time for students to work through problems and confusions.	Your students… ▫ make predictions and hypotheses. ▫ test their predictions. ▫ record observations, ideas, and data. ▫ share ideas with peers. ▫ ask relevant questions.
Explain: As you are working through content…		
Activity provides opportunities to… ▫ connect prior knowledge to new observations. ▫ communicate current understandings. ▫ apply scientific language to their informal explanations.	As the teacher, you… ▫ ask students to explain concepts and terms in their own words. ▫ ask for students to provide evidence to support their explanations. ▫ clarify concepts and definitions when necessary. ▫ base your explanations on student experiences and examples.	Your students… ▫ listen to others' explanations and provide their own. ▫ question others explanations. ▫ refer to previous activities in their discussions. ▫ assess their current understanding.
Elaborate: After students have learned new content…		
Activity provides opportunities to… ▫ apply learning to new situations. ▫ extend the concepts being explored. ▫ communicate using scientific language.	As the teacher, you… ▫ encourage students to apply and extend concepts and skills. ▫ encourage students to use appropriate scientific language.	Your students… ▫ use scientific language. ▫ use what they have learned to ask questions and draw appropriate conclusions. ▫ record new, relevant observations and explanations. ▫ work with peers to check understanding.
Evaluate: When it is time to check student understanding…		
Activity provides opportunities to… ▫ self-assess level of current understanding. ▫ demonstrate understanding through open-ended responses or observable actions. ▫ apply skills or knowledge in a problem situation.	As the teacher, you… ▫ assess student knowledge and skills through observation. ▫ encourage students to assess their own learning. ▫ ask open-ended questions.	Your students… ▫ demonstrate their understanding. ▫ evaluate their own progress. ▫ provide appropriate responses and draw reasonable conclusions about events or phenomena.

Module 6: Designing NGSS Aligned Lessons

5 Signs it's NOT the 5E

1 It's completed in one class.
This is just not possible. The 5E Model was designed for instructional sequences. Explore activities alone may take one, two, or maybe even three classes!

2 Explore is not synonymous with student-led.
Student-led means "independent." Students cutting out vocabulary and recording their own definitions could be student-led, but it's not truly an Explore activity. Explore activities require students to grapple with questions and problems with the goal of forming their own explanation. In an NGSS-aligned classroom, the Explore stage occurs as students investigate the anchoring and investigative phenomena they are presented with throughout the unit. Their goal is to make sense of the phenomena. They may come to an accurate understanding, or they may not. That doesn't matter that much in the Explore phase - they are just generating and testing their ideas, trying to figure out what works. Your job is to guide them through this process, pointing out things they missed and questioning their ideas to help them dive deeper.

3 Explain is not teacher-driven.
The focus of the Explain phase is for students to construct their explanations about phenomena based on what they discovered during the Explore activities. It is NOT where the teacher starts teaching. If the Explain phase is just a PowerPoint and notes, it is probably not the 5E.

4 Elaborate is not fluff.
The Elaborate phase is a vital part of the 5E Model. It is where students independently practice the same concepts. They apply their understanding to similar situations or scenarios, solidifying what they have learned. If the Elaborate phase is unrelated to core content, if it is a "choice board" with no rhyme or reason, if it is not vital to the learning process -- it is NOT the 5E.

5 Engage is not just for fun.
The Engage phase is not just a fun demo to hook students in. Yes, it should hook students, but it should hook them intellectually. It should activate prior knowledge, it should introduce a problem or mystery or phenomenon that students can explore throughout the instructional sequence, and it should ideally formatively assess where students are now.

Directions: Reflect on the 5 signs above. Which "sign" is most surprising to you?

Module 6: Designing NGSS Aligned Lessons

Identifying Objectives Organizer

Engage Objectives & Notes:
Explore Objectives & Notes:
Explain Objectives & Notes:
_______________ Objectives & Notes:
_______________ Objectives & Notes:

Module 7: Engage Activities

Designing Your Engage Activity

Directions: To receive course credit, complete the Module 7 Performance Task: Designing Your Engage Activity digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Teacher Name:	**Grade Level:**
Bundle: Insert Title	**Guiding Question/Big Idea:** Insert Question/Big Idea
Target Performance Expectations: List the PEs this unit will address.	
Engage Objectives:	**Engage Phenomenon:** Describe the phenomenon itself AND how you will present it to students.
Questions Generated: What questions will you expect students to ask when presented with the phenomenon?	**Science Engineering Practices:** What Science and Engineering practices will students use to interact with the phenomenon? (See NSTA Science and Engineering Practice Matrix for ideas.)
Crosscutting Concepts: What tasks/ questions will you ask students to help them view the phenomenon through a Crosscutting Concept lens? (See NSTA Crosscutting Concepts Matrix for ideas.)	**Prior Knowledge:** How will you help students access and activate prior knowledge?

Module 8: Explore Activities

Designing Your Explore Activity

Directions: To receive course credit, complete the Module 8 Performance Task: Designing Your Explore Activity digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Teacher Name:	**Grade Level:**
Bundle: Insert Title	**Guiding Question/Big Idea:** Insert Question/Big Idea
Target Performance Expectations: List the PEs this unit will address.	
Explore Objectives:	**Explore Task:** Describe the Science and Engineering Practice students will utilize to discover the content objectives.
Explore Phenomenon: What phenomenon will you use to make this content tangible?	**Crosscutting Concepts:** What Crosscutting Concept will help your students understand the phenomenon? How will you explicitly address this concept?
Guiding Questions/Prompts: What questions/prompts will you provide to guide and support student exploration?	**Student Instructions:** What instructions will you give your students? What information will you provide? What information will you withhold?

Module 9: Explain Activities

Designing Your Explain Activity

Directions: To receive course credit, complete the Module 9 Performance Task: Designing Your Explain Activity digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Teacher Name:	**Grade Level:**
Bundle: Insert Title	**Guiding Question/Big Idea:** Insert Question/Big Idea
Target Performance Expectations: List the PEs this unit will address.	
Explain Objectives:	**Explain Part 1:** List the questions and/or tasks you will engage students in to facilitate their meaning-making. Include observations or prompts you may use if/when they get stuck.
Explain Part 2 Resources: What activity/ activities will you engage students in to clarify and reinforce their understanding? Provide descriptions/links of the resources you will utilize.	**Explain Part 2 Prompts:** What questions, prompts, or tasks will you pose to students as they interact with your Explain activities and resources?
Formative Assessment: How will you assess student understanding at this point? How might that inform your next steps?	

Module 10: Elaborate Activities
Designing Your Elaborate Activity

Directions: To receive course credit, complete the Module 10 Performance Task: Designing Your Elaborate Activity digital organizer. Find the organizer linked in the Workshop Resources section of the workshop page.

Teacher Name:	**Grade Level:**
Bundle: Insert Title	**Guiding Question/Big Idea:** Insert Question/Big Idea
Target Performance Expectations: List the PEs this unit will address.	
Elaborate Objectives: What are the goals of this task? To provide independent practice? To deepen or expand understanding? To differentiate for student interests? To differentiate for modes of expression?	**Elaborate Task:** Describe the task, including the Science and Engineering Practices students will utilize.
Crosscutting Concepts: What Crosscutting Concept(s) will students utilize in this activity? How will they help students deepen, expand, or reinforce their understanding?	**Instructions & Prompts:** Provide the instructions and questions/prompts that you will give your students.
Formative Assessment: How will you assess student understanding at this point? How might that inform your next steps?	

FINAL REFLECTIONS

BEFORE	AFTER
What do you think/know about the NGSS right now? Consider the "spirit" of the NGSS, content, instructional strategies, and assessments.	Now that you have completed Module 1, how have your ideas changed?