**NGSS MODELING-EXPLANATION-ARGUMENTATION UNIT DEVELOPMENT TEMPLATE**

*This unit planning template was developed in alignment with Stroupe and Windschitl’s (2015) framework for Ambitious Science Teaching that focuses on “1) planning a unit around a “big science idea”, 2) eliciting and activating students’ ideas about a puzzling phenomenon (for the purpose of adapting instruction), 3) helping students make sense of science activities, and 4) pressing students to construct evidence-based explanations” (p. 1). As such, each of these facets of AST are identified below.*

**Unit Authors:**

**PLANNING A UNIT AROUND “BIG SCIENCE IDEAS”**

Group Member Science Area Focus (e.g., Middle School Life Science, High School Chemistry):

**What do you want to teach?**

Disciplinary Core Idea(s) focus of Lesson: (Identify DCI at the bullet point(s) grade band progression)

**What are the Performance Expectations that you are working toward?**

**Performance Expectation(s): (Search by DCI)**

Why is/are this a core idea(s) in science? Identify the DCI in Framework for K-12 Science Education using the following links:

Physical Science: https://www.nap.edu/read/13165/chapter/9 Life Science: https://www.nap.edu/read/13165/chapter/10 Earth and Space Science: https://www.nap.edu/read/13165/chapter/11 Engineering, Technology, & Applications of Science: https://www.nap.edu/read/13165/chapter/12

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What does the Framework say about the core idea(s)?

Summary: After reading through the specific DCI focus/foci of your unit, write a summary in your own words that describes why this is a/these are core idea(s) in science, along with what facets of this core idea(s) are most important for students to understand:

Summary: (Guidance and Example of Unpacking)

**ANCHORING PHENOMENON**

Identify a scientifically rich, complex phenomena that will require students to use multiple principles that are central to the DCI(s) to explain (an occurrence or event that happens(ed) in the world) [This will serve as the reason for engaging in the unit.] Resources for identifying anchoring phenomena (What are phenomena, How Might I Identity a Phenomenon, What are some Possible Phenomena, What are some Possible Phenomena II, What are qualities of Good Phenomena? Additional phenomenon resource-Project Phenomenon)

Describe the Anchoring Phenomenon chosen to anchor the unit:

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Identification of Crosscutting Concept(s) that can also be used to understand/explain or focus mechanistic explanations of the phenomenon: (explain this connection):

Crosscutting Concepts:

Provide a Target Explanation of Phenomenon [Provide a written explanation of the phenomenon, being sure to consider how the role of the identified crosscutting concept(s) you identified above as part of the explanation] (Note: the explanation should identify how science principles are coordinated to explain the occurrence or event that happened in the world) (ex. target explanation for explaining ramps with models; target explanation of rocket launch):

Target explanation of phenomena:

Develop a Driving Question that will help bound the work of the unit and frame the anchoring phenomenon for the students. The question should be causal and not easily answered.

Driving question:

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Construct an example Final Model that you would expect your students to develop over the course of the unit. Be sure to include the components of the system, connections between those components, the “unseen” mechanisms at work, and labels. This will help you develop a template and/or conventions for the students’ models.

*Example Final Model [Example]: (insert drawing or image here)*

From your Target Explanation, identify concepts within the explanation that are central to students explaining the phenomenon [this can serve as an early ‘Gotta Have List’ that you go into the lesson considering, while also serving as a guide for identifying science activities students can engage in as part of the unit after initial modeling to work on developing more sophisticated explanations of the phenomenon] (Example):

**Concept A:**

**Concept B:**

**Concept C: . . .**

**For each science principle identified above, choose one activity, reading, video, simulation, or investigation that will help students understand this principle and begin to see its usefulness in**

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explaining the anchoring phenomenon. Do this for each concept below: [possible resources: Phet Simulations, NGSS Pathfinder, National Science Digital Library]

**Concept A:**

**Concept B:**

**Concept C: . . .**

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Identify Previous Ideas and Resources that might surface as students begin to reason about this phenomenon (use the AAAS Science Literacy Maps, NGSS Disciplinary Core Idea Progressions, and past experiences working with students around the principles (i.e., A, B, C...) above [these include ideas they may have learned previously or common ways students might think about one or more of these ideas]:

and

Identify Future Ideas and Resources that learning in this unit will support. Use the AAAS Science Literacy Maps and NGSS Disciplinary Core Idea Progressions to identify what students will be able to learn when they have developed facility with the principles focused on in this unit:

Identify Previous Ideas and Reasoning:

Identify Future Ideas and Resources:

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**THE TALK SCIENCE GOALS AND TALK MOVES IS A RESOURCE FOR RESPONSIVENESS TO STUDENT THINKING THROUGHOUT THE UNIT . Additional resources are the Talk Science Primer and the Ambitious Science Teaching Discourse-Primer referenced next:**

*Eliciting students’ initial scientific hypotheses in order to plan for further instruction. The goal of this discourse is to draw out students’ understandings of a phenomenon (e.g. a bicycle rusting in the backyard) that is related to an important scientific idea (in this case chemical change or conservation of mass). After the lesson we analyze students’ ways of talking about it in order to adapt upcoming learning experiences (AST Discourse-Primer, 2015, p. 7.)*

Day 1: Outline how you plan to engage students in creating/sharing their initial models that explain the anchoring phenomenon. How will you introduce the phenomenon and driving question? What is your plan for eliciting student initial models (e.g. group sizes, directions to students including some introduction to what a model is and what you want to be sure students do as they share their initial ideas-be sure to include where and how you will use ‘Gotta Have Lists’ (taken from ambitiousscienceteaching.org) to help focus students reasoning during this process. Include any videos, templates, webresources, etc. you might want to use. Describe how students will share their initial models with peers in small group and whole group discussions/sharing: (Example Day 1)

Outline Day 1:

**HELPING STUDENTS MAKE SENSE OF SCIENCE ACTIVITIES (WITH THE AIM**

**OF USING SCIENCE PRINCIPLES BEHIND ACTIVITIES TO EXPLAIN**

**ANCHORING PHENOMENON)**

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*AST Discourse Strategies*

*• Making sense of data/information. The goal here is to help students recognize patterns in data, critique the quality of data, and to propose why these patterns exist. What, for example, is going on at the unobservable level that explains our observations?*

*• Connecting activities with big scientific ideas. The goal of this practice is to combine data-collection activities with readings and conversation in order to advance students’ understanding of a broader natural phenomenon. This conversation is different from the previous one, in that students are not trying to explain the*

**ELICITING AND ACTIVATING STUDENTS’ IDEAS ABOUT A PUZZLING**

**PHENOMENON (FOR THE PURPOSE OF ADAPTING INSTRUCTION)**

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*outcome of an activity, but to relate the activity to a bigger science idea or puzzle that the unit is framed around. (AST Discourse-Primer, 2015, p. 7.)*

Day 2-5: (Include time needed for each activity included in Days 2-5) [use more or less days as needed for engaging students in science activities depending on what might be needed to explain the anchoring phenomenon]

Identify how you will ‘put on the table’ science principles (i.e., you identified above that are central to explaining the anchoring phenomenon (i.e., Principle A, B, C...) using science activities you identified for each principle above (e.g., activity, reading, video, simulation, investigation) that prioritizes students engaging in science and engineering practices to develop an understanding of the principle that will be helpful in later stages of the unit in explaining the anchoring phenomenon. Describe how you will use ‘Summary Tables [1, 2]’ or activities (taken from ambitiousscienceteaching.org) across these days/activities to help students keep a record of activities, ideas, and evidences that will be used to later in the unit to revise their initial models of the anchoring phenomenon. (Example Days 2-5)

Outline Day 2-5:

Construct a draft Summary Table that includes each activity, the intended understandings from the activity, and how the activity helps develop an explanation for the anchoring phenomenon. See examples above. Adapt the table based on the number of activities in the unit.

**Activity Patterns Observed Explanation for Patterns How it helps us explain**

**the phenomenon**

Identify how students will Test their Models using primary or secondary data they collect or are provided. Be sure to list the sources of data if they are provided:

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How will students test their models?

**PRESSING STUDENTS TO CONSTRUCT EVIDENCE-BASED EXPLANATIONS**

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*AST Discourse Strategies*

*• Pressing students for evidence-based explanations. This discourse is designed to happen near the end of a unit, but elements of this conversation can also happen any time the teacher is trying to get students to talk about evidence. The goal of this discourse is to assist students in using multiple forms of evidence, gathered during a unit, to construct comprehensive explanations for a phenomenon that has been the focus of the unit.*

Day 6-7: (Include time needed for each activity included in Days 2-5)

Part 1. In this part of the unit, students will engage in revisiting and negotiating (with the teacher) the Gotta Have List to be sure that it represents what they think should be included in the final models. Additionally, students should engage in refining their initial models by both referring to the finalized ‘Gotta Have List’ and ‘Summary Table’ that was developed across the unit. You might also consider having groups of students comment on other groups’ initial models with ‘Sticky Notes’ prior to students making final revisions to their group models (see ‘Sticky Notes [1, 2]’ taken from ambitiousscienceteaching.org). Once students are ready to revise their models based on what they learned across the unit, be sure to identify how you will ensure that they use the Gotta Have Lists and Summary Tables as resources for supporting their final revisions. Be sure to include your complete plan for supporting student groups in revisiting their initial models (e.g. directions to students. Include any templates or resources you will use). (Example Days 6-7)

Outline Day 6-7:

Part 2. Sharing revised models to work at reaching class consensus model. Describe plan for students sharing their revised model and for engaging in consensus model building (see ‘Tips for Facilitating a Consensus Discussion’ resource from NGSX project) as a whole class.

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Plan for students sharing revised model and for engaging in consensus model building:

Part 3. Individual Student Evidence-Based Explanation. As a final summative assessment of the unit, consider asking students to develop a written evidence-based explanation of the anchoring phenomenon. In this, consider asking them to ensure they include reference to all important ideas included in the final class Gotta Have List and Summary Table. And, consider asking them to ensure they use all evidence chronicled in the rows of the summary tables (e.g., patterns and explanations for patterns) in their written explanations.

Plan for individual student evidence-based explanation:

**ASSESSMENT OF STUDENT LEARNING**

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Resource-Rubric EXAMPLE as Possible Resource for Summative Assessment of Group Consensus Models or Individual Student Evidence-Based Explanations. This rubric was developed by using the principles identified above that were important for explaining the anchoring phenomenon and using these as indicators for the rows. The levels of each indicator is then assessed by considering the extent to which students or groups models or explanations are useful in explaining the anchoring phenomenon using the principle of each row.

Identify Formative Assessment techniques you will employ throughout the unit. Please provide specific examples.

What formative assessment techniques will you use?

Provide a Final Evidence-Based Explanation at a level you would expect from your students at the end of the unit. The evidence-based explanation builds on the causal explanation by including specific evidence from the activities.

Final Evidence-Based Explanation:

Provide a Rubric for the evidence-based explanation that includes the concepts identified above.

Rubric:

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EXTENSION (Optional) APPLICATION OF NEW IDEAS TO NEW PHENOMENON Identify a new phenomenon for students to explain that will allow them to demonstrate to themselves and you that they have a solid understanding of process of modeling/explanation/argumentation and the disciplinary core ideas and crosscutting concept at the heart of the lesson. Consider using the following template for constructing this as an assessment: NGSS Assessment Development Template (ex. HSLS1 Snails and Football Helmets; MSPS1-4: Water Defying Gravity)

New phenomenon:

Target explanation of new phenomenon:

Plan for engaging students in modeling their understanding of new phenomenon and how students will be pressed to include science principles central to the lesson in their explanation:

Plan for engaging students:

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**References**

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