ASET Science & Engineering Practices (SEP) Tool: Developing & Using Models

Name or ID:

Lesson/Unit Title: **Intended grade:**

SEP 2	**Developing and Using Models:** A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineering systems. Measurements and observations are used to revise models and designs.

Components of SEP **In this lesson/unit plan, it is clear that *students* have a structured opportunity to:**	**Mark with "x" if present in lesson**	**What teacher actions were taken to facilitate this component for students?**	**What are the students doing?**
1) **Describe** components and characteristics of models			
2) **Develop** models consistent with prior evidence or theories to represent, explain, and/or describe a phenomenon			
3) **Use** models to describe relationships between components, predict outcomes, and/or test ideas to explain a phenomenon			
4) **Compare** and/or **evaluate** features and limitations of (a) model(s)			
5) **Revise** models based on additional evidence*			

Notes on Context/Special Considerations (part of school year, differentiation, student developmental considerations, etc.):

* This component is not required in K-2 or 3-5 grade bands

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ASET Grade Band Criteria *(Grade Bands: 6-8, 9-12)*

Science & Engineering Practices		
SEP 2: 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. In 9-12 they build on these K-8 experiences and progress to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).		
*By the end of the grade band **students** will have had a structured opportunity to develop an understanding of each of these. Individual lessons or units should include opportunities for **students** to practice one or more of the following components ……*		
	6-8 Grade Band	**9-12 Grade Band**
1) **Describe** components and characteristics of models	Using a model they developed, or an existing model, students: a. **specify/identify** observable and unobservable elements of the model (and their attributes) **needed to explain** the phenomenon or communicate the desired information b. **describe** the key relationships or interactions among model elements as they relate to the phenomenon or aspect of the phenomenon being addressed c. **describe** the correspondence between specific model elements and relationships, and the relevant components of the real world object or phenomenon that they represent	Using a model they developed, or an existing model, students: a. **specify/identify** observable and unobservable elements of the model (and their attributes) **needed to explain** the phenomenon or communicate the desired information b. **describe** the key relationships or interactions among model elements as they relate to the phenomenon or aspect of the phenomenon being addressed c. **describe** the correspondence between specific model elements and relationships, and the relevant components of the real world object or phenomenon that they represent d. identify differences between two different models of the same proposed tool, process, or mechanism, or system
2) **Develop** models consistent with prior evidence or theories to represent, explain, and/or describe a phenomenon	Students develop models that: • are **consistent with prior evidence and scientific theories** about the phenomenon • reasonably represent, explain, and/or describe both literal and unobservable features of scientific phenomena • include only components and relationships that are relevant to the purpose of the model Using these models students: a. define and clearly label all of the essential variables or factors (components) within the system being modeled, including uncertain and less-predictable variables b. describe/demonstrate the relationships among the components of the model, including relationships that are not directly observable, but predict observable phenomena	Students develop a complex model that: • are **consistent with prior evidence and scientific theories** about the phenomenon • reasonably represent, explain, and/or describe both literal and unobservable features of scientific phenomena • include multiple components and relationships that are relevant to the purpose of the model • allow for manipulation and testing of a proposed process or system Using these models students: a. define and clearly label all of the essential variables or factors (components) within the system being modeled, including uncertain and less-predictable variables b. describe/demonstrate the relationships among the components of the model, including relationships that are not directly observable, but predict observable phenomena c. predict the relationships between systems or among components of a system

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3) **Use** models to describe relationships between components, predict outcomes, and/or test ideas to explain a phenomenon	Using a model they developed, or an existing model, students: a. Correctly and completely describe the components and mechanisms of a scientific phenomenon providing a causal account including mechanisms that are not directly observable b. Generate new knowledge including: • **Construct** a correct and complete **prediction** about a phenomenon • **Generate data** to test ideas about phenomena • **Generate testable questions** about phenomena • **Make meaningful comparisons** between phenomena • **Support their own thinking** about and understanding of a phenomenon • **Apply models to related phenomena**	Using multiple types of models they developed, or that are existing, students: a. Correctly and completely describe the components and mechanisms of a scientific phenomenon providing a causal account including mechanisms that are not directly observable b. Generate new knowledge including: • **Construct** a correct and complete **prediction** about a phenomenon • generate data to support explanations, predict phenomena, analyze systems, and/or solve problems • **Generate testable questions** about phenomena • **Make meaningful comparisons** between phenomena • **Support their own thinking** about and understanding of a phenomenon • **Apply models to related phenomena**
4) **Compare** and/or **evaluate** features and limitations of (a) model(s)	Using a model they developed, or an existing model, students: a. **Identify**, **describe, and evaluate** the appropriate boundaries and limitations of a model with respect to explaining the phenomenon or communicating the desired information b. **compare** and **evaluate** the ability of different models to accurately represent and account for patterns in phenomena, and to **predict** related phenomena.	Using multiple types of models they developed, or that are existing, students: a. **identify**, **describe, and evaluate** the appropriate boundaries and limitations of each model with respect to explaining the phenomenon or communicating the desired information b. **compare** and **evaluate** the ability of each different model to accurately represent and account for patterns in phenomena, and to **predict** related phenomena. c. **evaluate the merits and limitations of these competing models** to select the model that best fits the evidence or design criteria d. **design a test of a model** to ascertain its reliability
5) **Revise** models based on additional evidence*	Using a model they developed, or an existing model, students: a. **Modify** a model – based on evidence – to match what happens if a variable or component of a system is changed b. **Revise** a model **to increase its explanatory and predictive power**, taking into account additional evidence or aspects of a phenomenon.	Using multiple types of models they developed, or that are existing, students c**reate a combined** model – based on evidence – that includes aspects of each original model to **increase its explanatory and predictive power**, taking into account additional evidence or aspects of a phenomenon.

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