

**Science & Engineering Practices**  
**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 engineered systems. Measurements and observations are used to revise models and designs.



K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
<p>Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p>	<p>Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p>	<p>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.</p>	<p>Modeling in 9–12 builds on K–8 experiences and progresses 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).</p>
<ul style="list-style-type: none"> <li>• Distinguish between a model and the actual object, process, and/or events the model represents.</li> <li>• Compare models to identify common features and differences.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify limitations of models.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate limitations of a model for a proposed object or tool.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria.</li> <li>• Design a test of a model to ascertain its reliability.</li> </ul>
<ul style="list-style-type: none"> <li>• Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).</li> </ul>	<ul style="list-style-type: none"> <li>• Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.</li> <li>• Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.</li> <li>• Develop and/or use models to describe and/or predict phenomena.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed.</li> <li>• Use and/or develop a model of simple systems with uncertain and less predictable factors.</li> <li>• Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.</li> <li>• Develop and/or use a model to predict and/or describe phenomena.</li> <li>• Develop a model to describe unobservable mechanisms.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.</li> <li>• Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.</li> </ul>
<ul style="list-style-type: none"> <li>• Develop a simple model based on evidence to represent a proposed object or tool.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.</li> <li>• Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop a complex model that allows for manipulation and testing of a proposed process or system.</li> <li>• Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.</li> </ul>