

## Science & Engineering Practices Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.



K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
<p>Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p>	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p>	<p>Planning and carrying out investigations in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.</p>	<p>Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p>
<ul style="list-style-type: none"> <li>• With guidance, plan and conduct an investigation in collaboration with peers (for K).</li> <li>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.</li> </ul>	<ul style="list-style-type: none"> <li>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.</li> </ul>	<ul style="list-style-type: none"> <li>• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.</li> <li>• Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.</li> </ul>	<ul style="list-style-type: none"> <li>• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation’s design to ensure variables are controlled.</li> <li>• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.</li> <li>• Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.</li> </ul>
<ul style="list-style-type: none"> <li>• Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate appropriate methods and/or tools for collecting data.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate the accuracy of various methods for collecting data.</li> </ul>	<ul style="list-style-type: none"> <li>• Select appropriate tools to collect, record, analyze, and evaluate data.</li> </ul>
<ul style="list-style-type: none"> <li>• Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.</li> <li>• Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.</li> <li>• Make predictions based on prior experiences.</li> </ul>	<ul style="list-style-type: none"> <li>• Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.</li> <li>• Make predictions about what would happen if a variable changes.</li> <li>• Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.</li> </ul>	<ul style="list-style-type: none"> <li>• Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.</li> <li>• Collect data about the performance of a proposed object, tool, process, or system under a range of conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.</li> <li>• Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.</li> </ul>