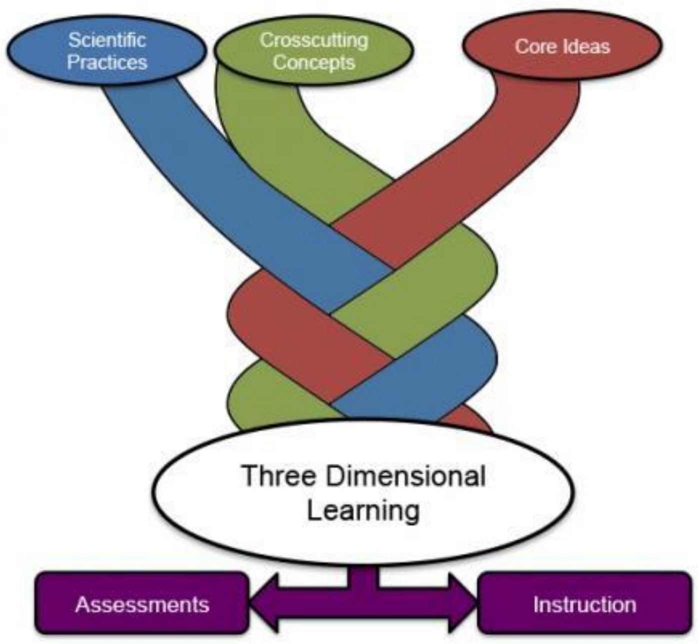
South Dakota Performance Level Descriptors—Science

The South Dakota Science Standards adopted in April 2024 are built upon three dimensions of the Next Generation Science Standards (NGSS) and A Framework for K–12 Science Education (NRC Framework): Science and Engineering Practices (SEP), Crosscutting Concepts in Science (CCC), and Disciplinary Core Ideas (DCI). One stated goal of these standards is that all students should be able to engage in scientific sense-making by integrating all three strands in both learning and assessment (see Figure 1).

Figure 1. Three integrated strands of the SD Science Standards and NRC Framework



The individual standards, or *performance expectations* as they were called in the 2015 version of the South Dakota Science Standards, describe how a single DCI, single SEP, and single CCC could be combined. These performance level descriptors (PLDs) are designed so that they can be applied to any scientific content (e.g., DCI cluster) and are appropriate across all courses rather than addressing specific content standards or performance expectations. They are based on suggestions from the NRC report Developing Assessments for the Next Generation Science Standards and validated by ACT's decades of empirical research linking science assessments to college and career readiness. Conclusion 2-4 of that report states that "effective evaluation of three-dimensional science learning requires more than a one-to-one mapping between the NGSS performance expectations and assessment tasks" (p. 46). They also state: "Thus, our third assumption is that developing assessments that validly measure the NGSS is more important than achieving strict comparability" (p. 145–146). Finally, Recommendation 7-2 states, "Because externally developed assessments cannot, by design, assess the full range and breadth of the performance expectations in the Next Generation Science Standards (NGSS), they will have to focus on selected aspects of the NGSS (reflected as particular performance expectations or **some other logical grouping structure**)" (p. 230, emphasis added). The logical structure of the ACT science test places Science and Engineering Practices (SEP) and Crosscutting Concepts in Science (CCC) into three reporting categories: Interpretation of Data (IOD); Scientific Investigation (SIN); and Evaluating Scientific Arguments and Models with Evidence (EMI). These reporting categories and the associated tasks can be applied to any disciplinary core idea (DCI) in any course. They add the flexibility of allowing the assessment of interdisciplinary scenarios appropriate to high school science education as well as college and career readiness. Therefore, this approach does not assign a PLD to each of the dozens of performance expectations or individual standards in the South Dakota Science Standards but rather identifies critical skills empirically linked to college and career readiness and identified by teachers in the National Curriculum Survey as being representative of what is taught in high school and needed for success in entry-level college courses or when entering a career. Many of the PLD statements are based on two dimensions of the SD Science Standards (SEP and CCC), while others require students to integrate all three dimensions (DCI, SEP, and CCC) when making sense of the presented scientific scenario. Because transferable skills in SEP and CCC are taught in all courses, all students should be able to engage in scientific sense-making regardless of the specific science courses they took before taking the test and provide evidence of what they know and can do.

What do "simple" and "complex" mean when describing data presentations and experiments in the performance level descriptors?

Concepts/quantities represented by a simple data presentation or in a simple experiment	Type/nature of a simple data presentation	Experimental design and methods of a simple experiment
These concepts are likely to be familiar to, or readily understood by, high school students regardless of their exposure to rigorous science instruction; examples include temperature, rainfall, density, and concentration (even if understood only qualitatively); newly introduced but readily understood quantities (e.g., percentage of offspring, angle of reflection); or numbers of things—or a simple quantity—per a familiar quantity like rotations per minute or number of lightning strikes per storm event.	The type and nature of these data presentations are likely to be familiar to high school students regardless of their exposure to rigorous science instruction; examples include tables with one to three columns and single headings, bar graphs with clusters of one or two bars, line graphs with one or two plot lines (with a legend when needed), pie charts, and flow diagrams (e.g., a food web).	These experiments are likely to be familiar to high school students, even those who have not had consistent and well-guided opportunities to engage in science investigations; examples include field studies involving several test plots and experiments having one to three steps, some basic and some intricate, in which the number of variables measured and controlled is four or fewer; methods and tools include performing simple dilutions to vary concentration, using instrumentation (like a pH meter), and sorting soils by particle size.

Concepts/quantities represented by a complex data presentation or in a complex experiment	Type/nature of a complex data presentation	Experimental design and methods of a complex experiment
Some concepts are likely to be familiar to high school students who have had rigorous science instruction (but may not be to students lacking this instruction), such as momentum, freezing point depression, and reaction rate (even if understood only qualitatively); other concepts may include newly introduced but readily understood quantities (e.g., genetic frequency, work). In some cases, the concepts may be unfamiliar to high school students, even those who have had rigorous science instruction; examples include heat (enthalpy) of reaction ($\Delta H°$) or torque and concepts specific to complex scenarios that are fully explained in the text but will be challenging to many high school students. For those concepts, students of all levels will likely need to rely heavily on the explanations and definitions provided.	Many of the data presentations will be familiar to high school students who have had exposure to rigorous science instruction but challenging to other high school students; examples include histograms, Venn diagrams, bar graphs with clusters of three or more bars and a legend, line graphs with three or more plot lines and a legend, line graphs with two *y*-axes, flow diagrams with multiple outcomes, and data tables with several levels of nesting (e.g., an RNA codon conversion table). Other data presentations may be unfamiliar to high school students regardless of their exposure to rigorous science instruction, such as phase diagrams, combination bar/line graphs with two *y*-axes, and graphs having logarithmic scales.	Some experiments are likely to be familiar to, or readily understood by, high school students who have had consistent and well-guided opportunities to engage in science investigations (but may not be to students lacking this experience); examples include experiments having several intricate steps, with five or more variables being measured and controlled, and that employ methods and tools such as burets, paper chromatography, or simple circuits. Some experiments may be challenging for high school students to follow regardless of their level of experience engaging in science investigations, such as experiments having several intricate steps and six or more variables being measured and controlled, with two or more of those variables being measured simultaneously; the experiments may employ unfamiliar, newly introduced methods and tools.

It is important to understand that some skills applied to complex scenarios are not *consistently* applied even at Level 4, which is how students at advanced levels are differentiated by the assessment.

References

Pellegrino, J. W., Wilson, M. R., Koenig, J. A., & Beatty, A. S. (Eds.). (2014). *Developing assessments for the Next Generation Science Standards*. National Academies Press. https://doi.org/10.17226/18409

Reporting category	Level 1	Level 2	Level 3	Level 4
	Students at Level 1 are working toward being able to demonstrate the skills identified in Level 2. Students at this level *inconsistently* apply the following skills to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 2 are able to *consistently* apply the skills in Level 1 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 3 are able to *consistently* apply the skills listed in Levels 1 and 2 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 4 are able to *consistently* apply the skills listed in Levels 1, 2, and 3 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:
Interpretation of Data (IOD)	• Select up to two pieces of data from a simple or one piece of data from a moderately complex data presentation • Compare data in a simple data presentation (e.g., find highest or lowest) • Identify a basic feature of a simple data presentation (e.g., units of measurement, axis labels) • Find information in the passage that describes or explains a simple data presentation • Understand common scientific terminology, symbols, and units of measurement used in a simple scientific context	• Select one piece of data from a complex data presentation • Find information in the passage that describes or explains a moderately complex data presentation • Identify features of a moderately complex graphic	• Find information in the passage that describes or explains a complex data presentation • Select two or more pieces of information from a moderately complex or complex data presentation • Identify features of one or more complex data presentations	
		• Order data in a simple data presentation • Combine data from a single simple data presentation (e.g., sum data from a table, calculate differences between data points) • Determine how the value of a variable changes in response to another variable in a simple data presentation • Determine or use a mathematical relationship that exists between data in a single simple data	• Compare data in a moderately complex data presentation • Determine how the value of a variable changes in response to another variable in a moderately complex data presentation • Determine or use a mathematical relationship that exists between data in a moderately complex data presentation • Translate information from one type of moderately complex graphic to another simple or	• Determine how the values of several variables change in response to other variables in a data presentation of any complexity • Compare data from a complex data presentation • Compare data from two or more data presentations where at least one data presentation is complex • Determine or use a mathematical relationship that exists between data in a complex data presentation

		presentation (e.g., find an average, make a simple unit conversion) • Compare data from two simple data presentations (e.g., compare the value of a variable in two similar graphics) • Translate information from one type of simple data presentation to another type of simple data presentation (e.g., convert data from a table to a graph)	moderately complex graphic (e.g., convert data from a table to a graph) • Combine data from a complex data presentation (e.g., sum data from a table) • Combine data from two or more simple or moderately complex data presentations (e.g., use data from one graphic to find data in another table or graph)	
		• Perform a simple extrapolation or interpolation using data in a simple data presentation (e.g., make a prediction based on a trend) • Analyze presented data when given new information (e.g., defined parameters for a related phenomenon, additional data from another trial) related to a simple data presentation (e.g., reinterpret a graph when new findings are provided)	• Perform an extrapolation or interpolation using data in a moderately complex data presentation • Analyze presented data when given new information related to a moderately complex data presentation (e.g., reinterpret data in a graphic when new findings are provided)	• Perform an extrapolation or interpolation using data in a complex data presentation • Analyze presented data when given new information (e.g., reinterpret a graph when new findings are presented) where at least one of the two sources of information is complex

For the Scientific Investigation (SIN) reporting category, an investigation refers to one or more experiments or studies on a scientific phenomenon or scenario. Some of these investigations may involve Engineering and Design Thinking (EDT), using science to solve real-world problems or to evaluate the problem. For example, an EDT investigation might measure the amount of a pollutant in groundwater at a variety of locations (evaluating the problem) or determine how effectively a certain treatment removes or mitigates groundwater pollution (solving the real-world problem).

Reporting category	Level 1	Level 2	Level 3	Level 4
	Students at Level 1 are working toward being able to demonstrate the skills identified in Level 2. Students at this level *inconsistently* apply the following skills to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 2 are able to *consistently* apply the skills in Level 1 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 3 are able to *consistently* apply the skills listed in Levels 1 and 2 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 4 are able to *consistently* apply the skills listed in Levels 1, 2, and 3 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:
Scientific Investigation (SIN)	• Find basic information in a passage that describes a simple investigation • Identify the similarities and differences between simple experiments	• Find basic information in a passage that describes a moderately complex investigation • Identify the similarities and differences between moderately complex experiments	• Find basic information in a passage that describes a complex investigation • Identify the similarities and differences between experiments in which at least one is a complex experiment	
	• Identify the independent or dependent variable in a simple experiment • Identify a tool that would be used in a simple experiment • Determine the hypothesis of a simple experiment	• Identify the independent or dependent variable in a moderately complex experiment • Understand tools and the functions of tools that would be used in a simple or moderately complex experiment • Understand experimental methods that would be used in a simple or moderately complex experiment • Determine the hypothesis of a moderately complex experiment • Identify goals, constraints, and tradeoffs in a simple investigation designed to test an engineering and design thinking scenario	• Identify the independent or dependent variable in a complex experiment • Understand tools and the functions of tools that would be used in a complex experiment • Understand experimental methods that would be used in a complex experiment • Determine the hypothesis of a complex experiment • Evaluate the design and methods used in an experiment (e.g., find possible flaws) in a simple or moderately complex investigation • Identify goals, constraints, and tradeoffs in a moderately complex investigation of an engineering and design thinking scenario	• Identify goals, constraints, and tradeoffs in a complex investigation of an engineering and design thinking scenario

		• Predict the results of an additional trial or measurement in a simple investigation • Determine the experimental conditions that would produce specified results in a simple investigation	• Predict the results of an additional trial or measurement in a moderately complex investigation • Determine the experimental conditions that would produce specified results in a moderately complex investigation • Determine an alternate method for testing a hypothesis or design solution in a simple investigation • Predict the effects of modifying the design or methods of a simple investigation • Determine which additional trial or experiment could be performed to enhance or evaluate experimental results in a simple investigation • Use background science knowledge and presented information about a scientific experiment to demonstrate three-dimensional understanding of a simple scientific investigation	• Predict the results of an additional trial or measurement in a complex investigation • Determine the experimental conditions that would produce specified results in a complex investigation • Evaluate the design and methods used in an experiment (e.g., find possible flaws) in a complex investigation • Evaluate precision or accuracy errors in a simple or moderately complex investigation • Determine an alternate method for testing a hypothesis or design solution in a moderately complex investigation • Predict the effects of modifying the design or methods of a moderately complex investigation • Determine which additional trial or experiment could be performed to enhance or evaluate experimental results in a moderately complex investigation • Use background science knowledge and presented information about a scientific experiment to demonstrate three-dimensional understanding of a moderately complex scientific investigation

For the Evaluating Scientific Arguments and Models with Evidence (EMI) reporting category, the term *model* refers specifically to a scientific explanation (or viewpoint) with causal (mechanistic) reasoning used in a Conflicting Viewpoints passage.

Reporting category	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	Students at Level 1 are working toward being able to consistently demonstrate the skills identified in Level 2. Students at this level *inconsistently* apply the following skills to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 2 are able to *consistently* apply the skills in Level 1 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 3 are able to apply the skills listed in Levels 1 and 2 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:	Students at Level 4 are able to apply the skills listed in Levels 1, 2, and 3 as well as to apply the following skills *consistently* to scientific scenarios involving data presentations, scientific experiments and investigations, and presentations of conflicting scientific models (viewpoints) explaining a phenomenon:
Evaluating Scientific Arguments and Models with Evidence (EMI)	• Determine which conclusion or claim is or is not consistent with a simple data presentation or piece of information in a text	• Determine which conclusion or claim is or is not consistent with a moderately complex data presentation or experiment (e.g., Did a design solution meet certain criteria? Are the data consistent with a presented conclusion?) • Determine which experimental results support or contradict a conclusion or claim for a moderately complex scenario • Make a prediction and explain why it is consistent with a simple data presentation or experiment • Use background science knowledge and presented data to evaluate a scientific claim or argument to demonstrate three-dimensional understanding of a simple scientific scenario	• Determine which conclusion or claim is or is not consistent with a complex data presentation or experiment (e.g., Did a design solution meet certain criteria? Are the data consistent with a presented conclusion?) • Determine which experimental results support or contradict a conclusion or claim for a complex scenario • Determine which conclusion or claim is or is not consistent with two or more simple data presentations and/or pieces of information in text • Make a prediction and explain why it is consistent with a moderately complex data presentation or experiment • Make a prediction or evaluate a claim and explain why it is consistent with two or more data presentations and/or pieces of text with the most complex component being simple or moderately complex • Determine whether and why presented information, or new information, supports or contradicts a conclusion or claim for a simple scientific scenario • Explain why presented information, or new information, supports or contradicts a	• Determine conclusion or claim is or is not consistent with two or more moderately complex data presentations and/or pieces of information in text • Make a prediction and explain why it is consistent with a complex data presentation or experiment • Make a prediction or evaluate a claim and explain why it is consistent with two or more data presentations and/or pieces of text with at least one complex component • Determine whether and why presented information, or new information, supports or contradicts a conclusion or claim for a moderately complex or complex scientific scenario • Explain why presented information, or new information, supports or contradicts a ~~s~~ conclusion or claim based on data from a moderately complex scientific scenario • Use background science knowledge and presented data to evaluate a scientific claim or argument to demonstrate three-dimensional understanding of a complex scientific scenario

			conclusion or claim based on data from a simple scientific scenario • Use background science knowledge and presented data to evaluate a scientific claim or argument to demonstrate three-dimensional understanding of a moderately complex scientific scenario	
	• Find basic information in a simple or moderately complex model (e.g., one conflicting viewpoint) • Identify implications and assumptions of a simple model • Identify similarities and differences between two simple models	• Identify implications and assumptions of a moderately complex model	• Identify implications and assumptions of a complex model • Identify similarities and differences between two moderately complex models	• Identify similarities and differences between two complex models
		• Determine which conclusion or claim is or is not consistent with a moderately complex model • Determine which conclusion or claim is or is not consistent with two or more simple models • Identify the strengths and weaknesses of simple models • Determine which simple models are supported or weakened by new information • Determine which simple models support or contradict a conclusion or claim • Determine whether and why presented information, or new information, supports or weakens a simple model • Use new information to make a prediction based on a simple model	• Determine which conclusion or claim is or is not consistent with a complex model • Determine which conclusion or claim is or is not consistent with two or more moderately complex models • Identify the strengths and weaknesses of moderately complex models • Determine which moderately complex models are supported or weakened by new information • Determine which moderately complex models support or contradict a conclusion or claim • Determine whether and why presented information, or new information, supports or weakens a moderately complex model • Use new information to make a prediction based on a moderately complex model • Make a prediction and explain why it is consistent with one or more simple models	• Determine which conclusion or claim is or is not consistent with two or more complex models • Identify the strengths and weaknesses of complex models • Determine which complex models are supported or weakened by new information • Determine which complex models support or contradict a conclusion or claim • Determine whether and why presented information, or new information, supports or weakens a complex model • Use new information to make a prediction based on a complex model • Make a prediction and explain why it is consistent with one or more moderately complex models