

Science DOK Definitions

General Guidelines for Assigning DOK:

- In the context of science education, “knowledge” can refer both to content knowledge and knowledge of scientific processes. This meaning of knowledge is consistent with the *Next Generation Science Standards* (NGSS) recognition of three dimensions of science: Practices, Crosscutting Concepts, and Disciplinary Core Ideas.
- The DOK definitions can be applied to science standards, tasks, or activities.
- Consider the content complexity, not the difficulty for students.
- Consider the scientific experience (prior knowledge) and grade-level expectations of a typical student
- Do not rely on verbs (describe, explain, evaluate, etc.). Instead, consider the content complexity required for an adequate response.
- For multiple-choice assessment items, consider the item as a whole—including distractors—to judge complexity.
- An expectation or item that is confusing due to error or wording does not reflect increased content complexity—it simply means the statement needs revisions.

DOK 1 (Recall and Reproduction)

DOK 1 is defined by the recall of information, such as a fact, definition, or term, as well as performance of a simple grade-level-appropriate science process or procedure. DOK 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Simple word problems that can be directly translated into and solved by a formula are considered DOK 1.

A student answering a DOK 1 item either knows the answer or does not: that is, the item does not need to be “figured out” or “solved.” In other words, if the knowledge necessary to answer an item automatically provides the answer to it, then the item is at DOK 1. Some examples that represent, but do not constitute all of, DOK 1 performance are:

- Recall or recognize a fact, term, structure, or property.
- Represent in words or diagrams a scientific concept or relationship.
- Provide or recognize a standard scientific representation for simple phenomenon.
- Perform a grade level-appropriate routine procedure, such as measuring length or completing a basic Punnett square.

Verbs such as “identify,” “recall,” “recognize,” “use,” “calculate,” and “measure” generally represent cognitive work at the recall and reproduction level. Verbs such as “describe” and “explain” could be classified at different DOK levels, depending on the complexity of what is to be described and explained. Note, however, that verbs should not be the basis of DOK classification without considering what the verb is acting upon or the verb’s direct object.

DOK 2 (Skills and Concepts)

DOK 2 includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is more complex than in DOK 1. Items require students to make some decisions about how to approach the question or problem. Classifying and comparing are activities that are typically a DOK 2 as well as organizing and displaying data in tables, graphs, and charts. These actions imply more than one step. For example, to compare data requires first identifying characteristics of the objects or phenomena and then grouping or ordering the objects. Some action verbs, such as “explain,” “describe,” or “interpret,” could be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, requiring reading information from the graph, is a DOK 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at DOK 3. Some examples that represent, but do not constitute all of, DOK 2 performance, are:

- Specify and explain the relationship between facts, terms, properties, or variables.
- Describe and explain examples and non-examples of science concepts.
- Select a procedure according to specified criteria and perform it.
- Formulate a routine problem, given data and conditions.
- Organize, represent, and interpret data.
- Interpret or explain phenomena in terms of science concepts.
- Make basic predictions for cause-and-effect relationships.

DOK 3 (Strategic Thinking)

DOK 3 requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at DOK 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both DOK 1 and 2, but because the multi-step task requires more demanding reasoning. In most instances, requiring students to provide a rationale for their thinking is at DOK 3 (although a task requiring a very simple explanation or a word or two should be at DOK 2). An activity that has more than one possible answer and requires students to justify the response they give would most likely be a DOK 3. Experimental designs at DOK 3 may involve more than one dependent variable. Some examples that represent, but do not constitute all of DOK 3 performance, are:

- Identify research questions and design investigations for a scientific problem.
- Use concepts to solve non-routine problems.
- Draw robust conclusions from observations.
- Cite evidence and develop a logical argument.
- Develop a scientific model for a complex situation.
- Form conclusions from experimental data.

DOK 4 (Extended Thinking)

DOK 4 demands are at least as complex as those of DOK 3, but a main factor that distinguishes the two categories is the need to perform activities over days and weeks (DOK 4) rather than in one sitting (DOK 3). The extended time that accompanies this type of activity allows for creation of original work and requires metacognitive awareness that typically increases the complexity of a DOK 4 task overall, in comparison with DOK 3 activities. On-demand assessment instruments very rarely include assessment activities that could be classified as DOK 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. “Develop generalizations of the results obtained and the strategies used and apply them to new problem situations,” is an example of a grade 8 objective that is a DOK 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought over extended time will be DOK 4.

Note that the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. DOK 4 requires complex reasoning, experimental design and planning, as well as an extended period of time for completion. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a DOK 2 activity. However, if the student designs and conducts a river study that involves all aspects of a scientific investigation, from forming a testable question to communication of results, this would be a DOK 4. Some examples that represent, but do not constitute all of, a DOK 4 performance are:

- Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions.
- Analyze the results of multiple studies on a particular science topic to form an original conclusion about the subject.
- Evaluate strengths and weaknesses of an experimental design and develop a revised experimental design.

Webb, N. L. *Alignment study in language arts, mathematics, science, and social studies of state standards and assessments for four states*. A study of the State Collaborative on Assessment & Student Standards (SCASS) Technical Issues in Large-Scale Assessment (TILSA). Washington, D. C.: Council of Chief State School Officers, December 2002. Revised in 2014 by Norman Webb and Sara Christopherson.