

Got Math?

Southern Nevada
Regional Professional
Development Program

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A Newsletter from the Secondary Mathematics Team

Mathematics Proficiency Revisions, DOK for Cognitive Coding

Presently, students taking the Nevada High School Proficiency Exam (NHSPE) are exposed to an exam where approximately 45% of the items are coming from the 7th and 8th grade standards. In the spring of 2010, the sophomores taking NHSPE will experience a different exam. All of the mathematics questions on the exam will reflect the 2006 revised math standards at the 9th -12th grade levels.

In addition, the NHSPE will reflect the Nevada Department of Education's change to the use of **Depth of Knowledge (DOK)** cognitive coding. This will require the students to answer 10% of the 60 questions at a DOK Level 3, 47% at a DOK Level 2 and 43% at a DOK Level 1. It is vital for student success that the teachers are aware of these changes and exposing their

students to at least all three of the levels of Depth of Knowledge if not all four levels. The four levels of DOK are used to represent a hierarchy based on complexity rather than difficulty. This difference takes some time to ponder and refine.

This publication provides sample mathematics activities based on Depth of Knowledge levels. Some problems or tasks have a low depth-of-knowledge level because the knowledge required is commonly known and students with instruction at that grade level should have had the opportunity to learn how to routinely perform what is being asked.

Consider the Mathematics DOK Descriptors when identifying depth of knowledge levels or when writing questions at the various levels.



DOK Resources

www.rpdp.net

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Mathematics DOK Descriptors

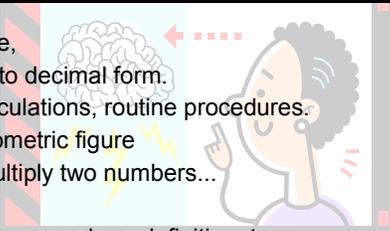
1 - Recall includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm, reading an uncomplicated data display, or applying a formula. A one-step, well-defined, and straight algorithmic procedure should be included at Level 1. Some key words that could signify Level 1 include "identify," "recall," "recognize," "use," and "measure." The action verbs "describe," "interpret," or "explain" could be classified at different DOK levels, depending on the complexity of the task.

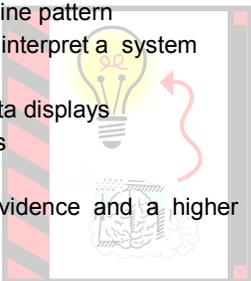
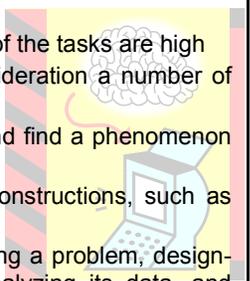
2 - Skill/Concept includes the engagement of some mental processing beyond a habitual response. A Level 2 task should require students to make some decisions as to how to approach the problem or task. Some keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply more than one step. Interpreting information from a simple graph, or reading information from the graph, also is at Level 2. However, interpreting information from a complex graph that requires some decisions on what features of the graph need to be considered and how information from the graph can be aggregated is at Level 3. Level 2 activities are not limited only to number skills, but may involve probability skills.

3 - Strategic Thinking requires the use of reasoning, justifying, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is at Level 3. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does not result from the fact that there are multiple answers, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be at Level 3. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and deciding which concepts to apply in order to solve a complex non-routine problem.

4 - Extended Thinking requires complex reasoning, planning, developing, and thinking, most likely over an extended period of time. 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. At Level 4, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select one approach among many alternatives on how the situation should be solved, in order to be at this highest level. Level 4 activities include designing *and* conducting experiments and projects; developing and proving conjectures, making connections between results and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs.

DOK SAMPLE ACTIVITIES

DOK 1: Recall and Reproduction Level 1 Activities	DOK 2: Basic Reasoning, Skill/Concept Level 2 Activities
<ul style="list-style-type: none"> • Find the area of a rectangle, • Convert scientific notation to decimal form. • Do basic mathematical calculations, routine procedures. • Identify a diagonal in a geometric figure • Do basic computations, multiply two numbers... • Measure an angle • Recall of a fact, information, procedure, definition, term • Perform a simple algorithm • Follow a set procedure • Apply a formula • Perform a clearly defined series of steps • Habitual response: can be described; can be explained • Use a routine method • Recognize patterns • Retrieve information from a graph • Includes one step word problems • Use appropriate tools • Identify, recognize, measure 	<ul style="list-style-type: none"> • Basic application of a skill or concept • Classify quadrilaterals • Determine a strategy to estimate • Solve routine multiple-step problems. • Identify patterns in events or behavior • Formulate a routine problem given data and conditions • Make observations • Collect, organize, classify, display, represent, compare data • Explain purpose and use of experimental procedures • Explain, describe or interpret • Organize and display data in tables, charts and graphs • Perform more than one step or procedure • Demonstrate conceptual knowledge through models and explanations • Extend a pattern • Explain concepts, relationships, and non-examples • Demonstrate visualization skills • Demonstrate probability skills 

DOK 3: Strategic Thinking, Complex Reasoning Level 3 Activities	DOK 4: Extended Thinking/Reasoning Level 4 Activities
<ul style="list-style-type: none"> • Write a mathematical rule for a non-routine pattern • Determine the equations and solve and interpret a system • Provide a mathematical justification • Interpret information from a series of data displays • Support ideas with details and examples • Apply a concept in other contexts • Requires reasoning, planning using evidence and a higher level of thinking • Explain/Justify your thinking • Make conjectures • Cognitive demands are complex and abstract • Conjecture, plan, abstract, explain • Draw conclusions from observations • Interpret information from a complex graph • Cite evidence and develop logical arguments for concepts • Explain phenomena in terms of concepts • Use concepts to solve problems • Provide justification when more than one possible answer • Exhibits strategic thinking • Analyze, synthesize 	<ul style="list-style-type: none"> • Project-based assessment • Performance tasks; cognitive demands of the tasks are high • Collect data over time taking into consideration a number of variables and analyze the results • Develop a rule for a complex pattern and find a phenomenon that exhibits that behavior • Complete a unit of formal geometric constructions, such as nine-point circles or the Euler line. • Conduct a project that requires specifying a problem, designing and conducting an experiment, analyzing its data, and reporting results/solutions • Apply mathematical models to a problem or situation. • Design a mathematical model to inform and solve a practical or abstract situation • Include complex reasoning, planning, and thinking • Students make connections within the content area or among content areas • Select one approach among alternatives • Design and conduct experiments • Combine and synthesize ideas into new concepts • Critique experimental designs 

NOTE: The hierarchy is based on two main factors:

- 1) sophistication and complexity
- 2) the likelihood that students at the grade level tested would have received prior instruction or would have had an opportunity to learn the content