

## Developing Higher Order Thinking Questions...

### Using Webb's Depth of Knowledge (DOK).

- A scale of cognitive demand (**thinking**) to align standards with assessments
- Defines the “**ceiling**” or **highest DOK level** for each Core Content standard for the state assessment
- Guides **item development** for state assessments

### Applying Webb's DOK Levels in Reading

#### Level 1: Recall

- Requires students to use simple skills or abilities to recall or locate facts from the text
- Focus on basic initial comprehension, not on analysis or interpretation
- Items require shallow/ literal understanding of text presented and often consist of verbatim recall from text or simple understanding of a single word or phrase

#### Level 2: Skill/ Concept

- Requires both initial comprehension and subsequent processing of text or portion of text
- Important concepts are covered but not in a complex way
- Items at this level may include words such as “paraphrase, summarize, interpret, infer, classify, organize, collect, display, and compare”
- Items may require students to apply skills and concepts that are covered in level 1

#### Level 3: Strategic Thinking

- Requires deep knowledge
- Students encouraged to go beyond text
- Students asked to explain, generalize, or connect ideas
- Students must be able to support their thinking, citing references from the text or other sources
- Items may involve abstract theme identification, inferences between or across passages, application of prior knowledge, or text support for analytical judgment about a text

#### Level 4: Extended Thinking

- Requires complex reasoning, planning, developing, and thinking most likely over an extended period of time, such as multiple works by the same author or from the same time period
- Students take information from at least one passage and are asked to apply this information to a new task.
- They may also be asked to develop hypotheses and perform complex analyses of the connections among texts. Some examples that represent but do not constitute all of Level 4 performance are:
  - ✚ Analyze and synthesize information from multiple sources
  - ✚ Examine and explain alternative perspectives across a variety of sources
  - ✚ Describe and illustrate how common themes are found across texts from different cultures.

### Applying Webb's DOK Levels in Math

**Level 1 (Recall)** includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics, a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify Level 1 include “identify,” “recall,” “recognize,” “use,” and “measure.” Verbs such as “describe” and “explain” could be classified at different levels, depending on what is to be described and explained.

**Level 2 (Skill/Concept)** includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. 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. For example, to compare data requires first identifying characteristics of objects or phenomena and then grouping or ordering the objects. Some action verbs, such as “explain,” “describe,” or “interpret,” could be classified at different levels depending on the object of the action. For example, interpreting information from a simple graph, or reading information from the graph, also are at Level 2. 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 visualization skills and probability skills. Other Level 2 activities include noticing or describing non-trivial patterns, explaining the purpose and use of experimental procedures; carrying out experimental procedures; making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

**Level 3 (Strategic Thinking)** requires reasoning, 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, a possibility for both Levels 1 and 2, 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 problem.

**Level 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. 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 Level 2. However, if the student is to conduct a river study that requires taking into consideration a number of variables, this would be a Level 4. 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 a finding and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs.

### Applying Webb’s DOK Levels in Science

**Level 1 Recall and Reproduction** requires recall of information, such as a fact, definition, term, or a simple procedure, as well as performing a **simple** science process or procedure. Level 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. A “simple” procedure is well defined and typically involves only **one-step**. Verbs such as “identify,” “recall,” “recognize,” “use,” “calculate,” and “measure” generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated

into and solved by a formula are considered Level 1. 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.

A student answering a Level 1 item either knows the answer or does not: that is, the answer 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 the item, then the item is at Level 1. If the knowledge necessary to answer the item does not automatically provide the answer, the item is at least at Level 2.

**Level 2 Skills and Concepts** includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is **more complex** than in level 1. Items require students to make some decisions as to how to approach the question or problem. 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**. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

**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 Level 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 Level 3.

**Level 3 Strategic Thinking** requires deep knowledge using reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are **complex and abstract**. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires **more demanding reasoning**. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. 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 using concepts to solve non-routine problems.

**Level 4 Extended Thinking** requires **high cognitive demand** and is **very complex**. Students are required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select or devise one approach among many alternatives on how the situation can be solved. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 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 Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be at a Level 4.

Level 4 requires complex reasoning, experimental design and planning, and **probably will require an extended period of time** either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, 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. 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 Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4.

### Applying Webb's DOK Levels in Social Studies

**Level 1 Recall of Information** asks students to recall facts, terms, concepts, trends, generalizations and theories or to recognize or identify specific information contained in graphics. This level generally requires students to identify, list, or define. The items at this level usually ask the student to recall who, what, when and where. Items that require students to "describe" and "explain" could be classified at Level 1 or 2 depending on what is to be described and explained. A Level 1 "describe or explain" would recall, recite or reproduce information. Items that require students to recognize or identify specific information contained in maps, charts, tables, graphs or drawings are generally level 1.

**Level 2 Basic Reasoning** includes the engagement of some mental processing beyond recalling or reproducing a response. This level generally requires students to contrast or compare people, places, events and concepts; convert information from one form to another; give an example; classify or sort items into meaningful categories; describe, interpret or explain issues and problems, patterns, reasons, cause and effect, significance or impact, relationships, points of view or processes. A Level 2 "describe or explain" would require students to go beyond a description or explanation of recalled information to describe or explain a result or "how" or "why."

**Level 3 Complex Reasoning** requires reasoning, using evidence, and a higher level of thinking than the previous two levels. Students would go beyond explaining or describing "how and why" to justifying the "how and why" through application and evidence. The cognitive demands at Level 3 are more complex and more abstract than Levels 1 or 2. Items at Level 3 include drawing conclusions; citing evidence; applying concepts to newsituations; using concepts to solve problems; analyzing similarities and differences in issues and problems; proposing and evaluating solutions to problems; recognizing and explaining misconceptions or making connections across time and place to explain a concept or big idea.

**Level 4 Extended Reasoning** requires the complex reasoning of Level 3 with the addition of planning, investigating, or developing that will most likely require 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 this level the cognitive demands should be high and the work should be very complex. Students should be required to connect and relate ideas and concepts within the content area or among content areas in order to be at this highest level. The distinguishing factor for Level 4 would be evidence through a task or product that the cognitive demands have been met. A Level 4 performance will require students to analyze and synthesize information from multiple sources, examine and explain alternative perspectives across a variety of sources and/or describe and illustrate how common themes and concepts are found across time and place. In some Level 4 performance students will make predictions with evidence as support, develop a logical argument, or plan and develop solutions to problems. Many on-demand assessment instruments will not include assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated so as to expect students to perform thinking at this level. On-demand assessments that do include tasks, products, or extended responses would be classified as Level 4 when the task or response requires evidence that the cognitive requirements have been met.

### DOK and Assessment

***“Firm evidence shows that formative assessment is an essential component of classroom work and that its development can raise standards of achievement.”***

P. Black & D. Williams (1998) inside the Black Box: Raising Standards Through Classroom Assessment. *Phi Delta Kappa*, 80(2)

DOK is ***NOT***...

- a taxonomy (Bloom’s)
- the same as difficulty
- about using “verbs”
- determined by the verb (Bloom’s Taxonomy), but by the context in which the verb is used and the depth of thinking required.

### **Verbs are not always used appropriately...**

Words like explain or analyze have to be considered in context.

- “Explain to me where you live” does not raise the DOK of a simple rote response.
- Even if the student has to use addresses or landmarks, the student is doing nothing more than recalling and reciting.

### **Same Verb— Three Different DOK Levels**

DOK 1- ***Describe*** three characteristics of metamorphic rocks. (Requires simple recall)

DOK 2- ***Describe*** the difference between metamorphic and igneous rocks. (Requires cognitive processing to determine the differences in the two rock types)

DOK 3- ***Describe*** a model that you might use to represent the relationships that exist within the rock cycle. (Requires deep understanding of rock cycle and a determination of how best to represent it)

### **DOK is about complexity**

- The intended student learning outcome determines the DOK level.
- Every standard in the NCSCOS has been assigned a DOK level.
- Instruction and classroom assessments must reflect the DOK level of the objective or intended learning outcome.

### **Suggestions for Drafting Questions at Higher Levels**

- Model Thinking Process Explicitly... for some students learning what is required will remain a mystery unless taught explicitly
- Use Advance Organizers... Using note-taking and graphic organizers BEFORE the lesson can cue students as to what to expect. Questions and agendas can also be used to help students anticipate what to look for in the coming lesson
- Use Concept Mapping ... Concept Mapping provides students with a framework for visualizing thinking.

### **Questioning Strategies That Provoke HOT**

- Require students to manipulate prior information •Why do you suppose.....? •“What can you conclude from the evidence?
- Ask students to state an idea or definition in their own words.
- Ask questions that require a solution to a problem. • Involve students in observing and describing an event or object... “What do you notice?” •“Tell me about this.” •“What do you see?”
- Ask students to compare or contrast.

## **Tips for Creating High-Level Questions**

The following simple tips can get ALL students involved in the lesson and help them gain a deeper understanding of the content by challenging them to think critically.

1. Create a **“HOT”** Question for Each Lesson
2. Require ALL students to answer the question (“all-write” strategy).
3. Require students to defend answers.
4. Differentiate questions as appropriate.
5. Promote examination of new and different perspectives.



# Levels of Thinking in Bloom's Taxonomy and Webb's Depth of Knowledge



Bloom's – Old Version (1956)



Bloom's - New Version (1990's)



Webb's DOK (2002)

Bloom's six major categories were changed from noun to verb forms in the new version which was developed in the 1990's and released in 2001. The knowledge level was renamed as remembering. Comprehension was retitled understanding, and synthesis was renamed as creating. In addition, the top two levels of Bloom's changed position in the revised version.

Norman L. Webb of Wisconsin Center for Educational Research generated DOK levels to aid in alignment analysis of curriculum, objectives, standards, and assessments.

## Webb's Depth of Knowledge & Corresponding Verbs

*\*Some verbs could be classified at different levels depending on application.*

### Recall and Reproduction Correlates to Bloom's 2 Lowest Levels

*Recall a fact, information, or procedure.*

arrange, calculate, define, draw, identify, list, label, illustrate, match, measure, memorize, quote, recognize, repeat, recall, recite, state, tabulate, use, tell who- what- when- where- why

### Skill/Concept

*Engages mental process beyond habitual response using information or conceptual knowledge. Requires two or more steps.*

apply, categorize, determine cause and effect, classify, collect and display, compare, distinguish, estimate, graph, identify patterns, infer, interpret, make observations, modify, organize, predict, relate, sketch, show, solve, summarize, use context clues

### Strategic Thinking

*Requires reasoning, developing plan or a sequence of steps, some complexity, more than one possible answer, higher level of thinking than previous 2 levels.*

appraise, assess, cite evidence, critique, develop a logical argument, differentiate, draw conclusions, explain phenomena in terms of concepts, formulate, hypothesize, investigate, revise, use concepts to solve non-routine problems

### Extended Thinking Correlates to Bloom's 2 Highest Levels

*Requires investigation, complex reasoning, planning, developing, and thinking probably over an extended period of time. \*Longer time period is not an applicable factor if work is simply repetitive and/or does not require higher-order thinking.*

analyze, apply concepts, compose, connect, create, critique, defend, design, evaluate, judge, propose, prove, support, synthesize

Bloom's Taxonomy	Revised Bloom's Taxonomy
<b>Knowledge</b>	<b>Remembering</b>
	<i>Recall appropriate information.</i>
<b>Comprehension</b>	<b>Understanding</b>
	<i>Grasp the meaning of material.</i>
<b>Application</b>	<b>Applying</b>
	<i>Use learned material in new and concrete situations.</i>
<b>Analysis</b>	<b>Analyzing</b>
	<i>Break down material into component parts so that its organizational structure may be understood.</i>
<b>Synthesis</b>	<b>Evaluating</b>
<i>Put parts together to form a new whole.</i>	<i>Make judgments based on criteria and standards.</i>
<b>Evaluation</b>	<b>Creating (Previously Synthesis)</b>
<i>Judge value of material for a given purpose.</i>	<i>Put elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.</i>

# ***DOK Question Stems***

## **DOK 1**

- Can you recall\_\_\_\_\_?
- When did \_\_\_\_\_ happen?
- Who was \_\_\_\_\_?
- How can you recognize\_\_\_\_\_?
- What is\_\_\_\_\_?
- How can you find the meaning of\_\_\_\_\_?
- Can you recall\_\_\_\_\_?
- Can you select\_\_\_\_\_?
- How would you write\_\_\_\_\_?
- What might you include on a list about\_\_\_\_\_?
- Who discovered\_\_\_\_\_?
- What is the formula for\_\_\_\_\_?
- Can you identify\_\_\_\_\_?
- How would you describe\_\_\_\_\_?

## **DOK 2**

- Can you explain how \_\_\_\_\_ affected \_\_\_\_\_?
- How would you apply what you learned to develop \_\_\_\_\_?
- How would you compare \_\_\_\_\_?  
Contrast\_\_\_\_\_?
- How would you classify\_\_\_\_\_?
- How are\_\_\_\_\_alike? Different?
- How would you classify the type of\_\_\_\_\_?
- What can you say about\_\_\_\_\_?
- How would you summarize\_\_\_\_\_?
- How would you summarize\_\_\_\_\_?
- What steps are needed to edit\_\_\_\_\_?
- When would you use an outline to \_\_\_\_\_?
- How would you estimate\_\_\_\_\_?
- How could you organize\_\_\_\_\_?
- What would you use to classify\_\_\_\_\_?
- What do you notice about\_\_\_\_\_?

## **DOK 3**

- How is \_\_\_\_\_ related to \_\_\_\_\_?
- What conclusions can you draw \_\_\_\_\_?
- How would you adapt\_\_\_\_\_to create a different\_\_\_\_\_?
- How would you test\_\_\_\_\_?
- Can you predict the outcome if\_\_\_\_\_?
- What is the best answer? Why?
- What conclusion can be drawn from these three texts?
- What is your interpretation of this text?  
Support your rationale.
- How would you describe the sequence of\_\_\_\_\_?
- What facts would you select to support\_\_\_\_\_?
- Can you elaborate on the reason\_\_\_\_\_?
- What would happen if\_\_\_\_\_?
- Can you formulate a theory for\_\_\_\_\_?
- How would you test\_\_\_\_\_?
- Can you elaborate on the reason\_\_\_\_\_?

- DOK 4
- Write a thesis, drawing conclusions from multiple sources.
- Design and conduct an experiment. Gather information to develop alternative explanations for the results of an experiment.
- Write a research paper on a topic.
- Apply information from one text to another text to develop a persuasive argument.
- What information can you gather to support your idea about\_\_\_\_\_?
- DOK 4 would most likely be the writing of a research paper or applying information from one text to another text to develop a persuasive argument.
- DOK 4 requires time for extended thinking.