

# Cognitive Rigor Matrix

Bloom's Taxonomy and  
Webb's Depth of Knowledge

Fall 2012

# Bloom's Taxonomy

- Originally written in 1956 by Benjamin Bloom
- Educators often assign Bloom's Taxonomy levels according to the main action verb of a question/task
- Revised in 2001 by Anderson, Krathwohl, et al.
- Emphasized both the processes (verbs) and the knowledge (nouns)
- Changed the taxonomy levels from nouns to verbs
- The top two levels of the taxonomy exchanged places

*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.*

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</b> <i>(Previously Synthesis)</i>
<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>

# Bloom's Taxonomy

- It uses verbs to differentiate taxonomy levels—many verbs appear at multiple knowledge levels and do not clearly articulate the intended complexity.

Taxonomy Level	Verbs
Creating	
Evaluating	Compare
Analyzing	Compare, Research
Applying	Calculate
Understanding	Calculate, Describe, Give examples, Locate, Research
Remembering	Describe, Give examples, Locate

# Same Verb—Three Different Levels of Knowledge

- Describe 3 characteristics of metamorphic rocks.
- Describe the difference between metamorphic and igneous rocks.
- Describe a model that you might use to represent the relationships that exist within the rock cycle.

# Verbs

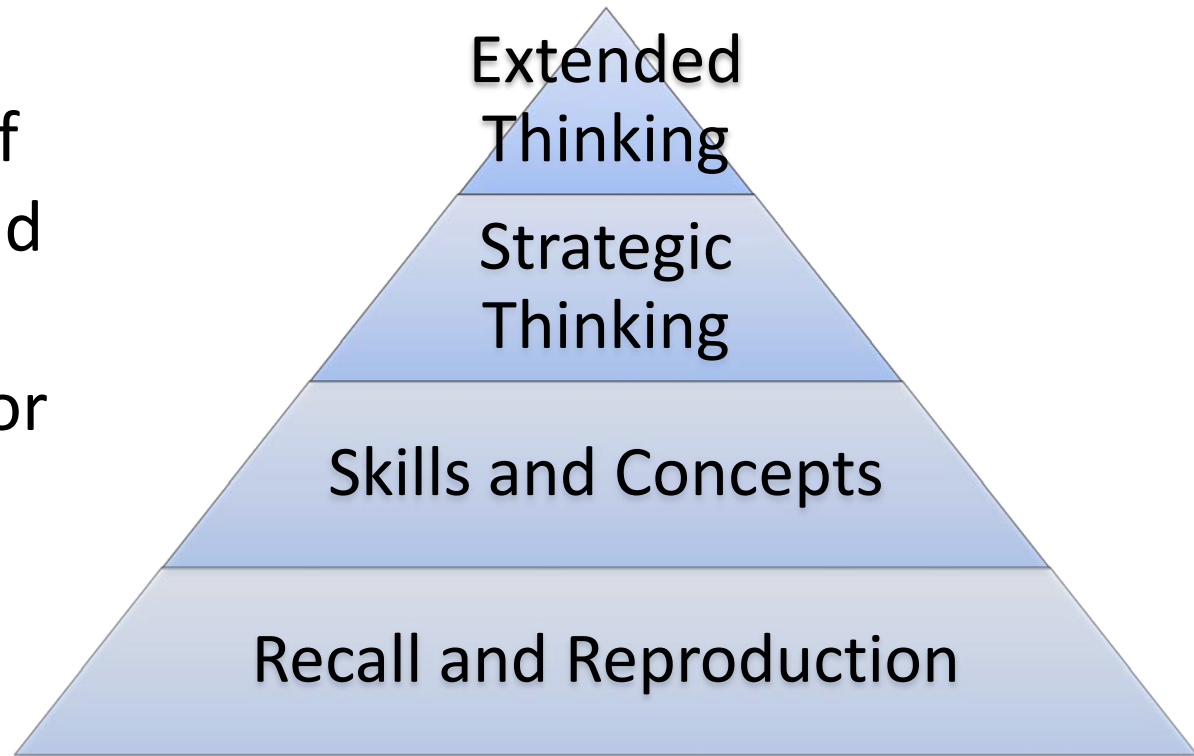
- Verbs must be considered in context
- What follows the verb is more important than the verb itself



"Analyze this sentence to decide if the commas have been used correctly."

# Webb's Depth of Knowledge (DOK)

- Written by Norman Webb (University of Wisconsin, 1997 and 1999) and the National Institute for Science Education.



# Webb's Depth of Knowledge (DOK)

- Is a scale of cognitive demand which aligns standards with assessments.
- DOK addresses the content being assessed and the depth to which we expect students to demonstrate understanding of that content.
- DOK is a reference to the complexity of mental processing that must occur to answer a question, perform a task, or generate a product.
- DOK is about cognitive complexity, not difficulty.

# DOK (Depth of Knowledge)

## Level 3: Strategic Reasoning

- A. Focus is on reasoning & planning in order to respond (e.g., write an essay, apply in new/novel situation).
- B. Complex and abstract thinking is required.
- C. Often need to provide support for reasoning or conclusions drawn.
- D. More than one "correct" response or approach is often possible.

## Level 1: Recall

- A. Focus is on specific facts, definitions, details, or using routine procedures (measure, divide, follow recipe, etc.)
- B. Explaining "that..."
- C. Can be "difficult" without requiring "deep" content knowledge to respond to item (memorize a complex theory without being able to explain its meaning or apply it to a real work situation)
- D. Combination of level ones does NOT = level 2.
- E. One right answer

## Level 4: Extended Reasoning

- A. Requires complex reasoning, planning, and thinking (generally over extended periods of time) for the investigation.
- B. Assessment activities have multiple steps with extended time provided.
- C. Students may be asked to relate concepts within the content area and among other content areas.
- D. Students make real-world applications in new situations.

## Level 2: Skill/Concept

- A. Focus is on applying skills and concepts (in a familiar/typical situation), relationships (compare, cause-effect), main ideas.
- B. Requires deeper knowledge than definition
- C. Explaining how or why
- D. Making decisions
- E. Estimating, interpreting in order to respond
- F. One right answer

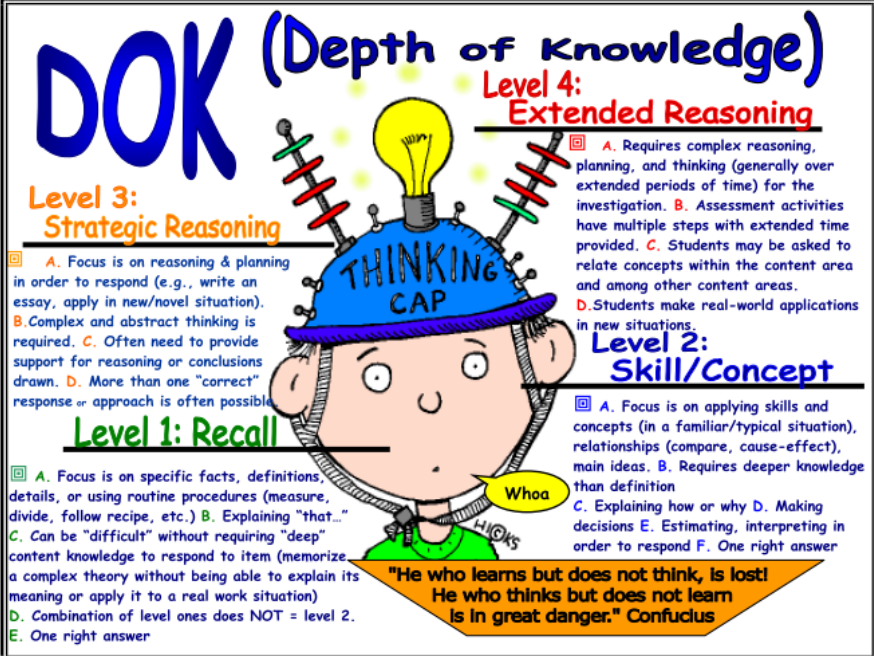


**"He who learns but does not think, is lost!  
He who thinks but does not learn  
is in great danger." Confucius**



# DOK Level 1

- Basic recall of concepts, definitions, facts, and processes
- Follow a simple formula
- Perform a routine procedure
- Simple skills and abilities



**DOK (Depth of Knowledge)**

**Level 4: Extended Reasoning**

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# DOK Level 2

- Mental processing beyond recalling or reproducing a response
- Requires decisions as to how to approach the question or problem
- Perform two or more steps with decision points along the way
- Organize or display data
- Interpret or use simple graphs



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# DOK Level 3

- Reason or develop a plan to approach a problem
- Employ some decision-making and justification
- Solve abstract, complex, or non-routine problems
- Often allows more than one possible answer

**DOK (Depth of Knowledge)**

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THINKING CAP

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# DOK Level 4

- Requires high cognitive demand and is very complex
- Perform investigations or apply concepts and skills to the real world that require time to research, problem solve, and process multiple conditions
- Make connections, relate ideas within the content or among content areas, and select or devise one approach among many alternatives on how the situation can be solved

**DOK (Depth of Knowledge)**

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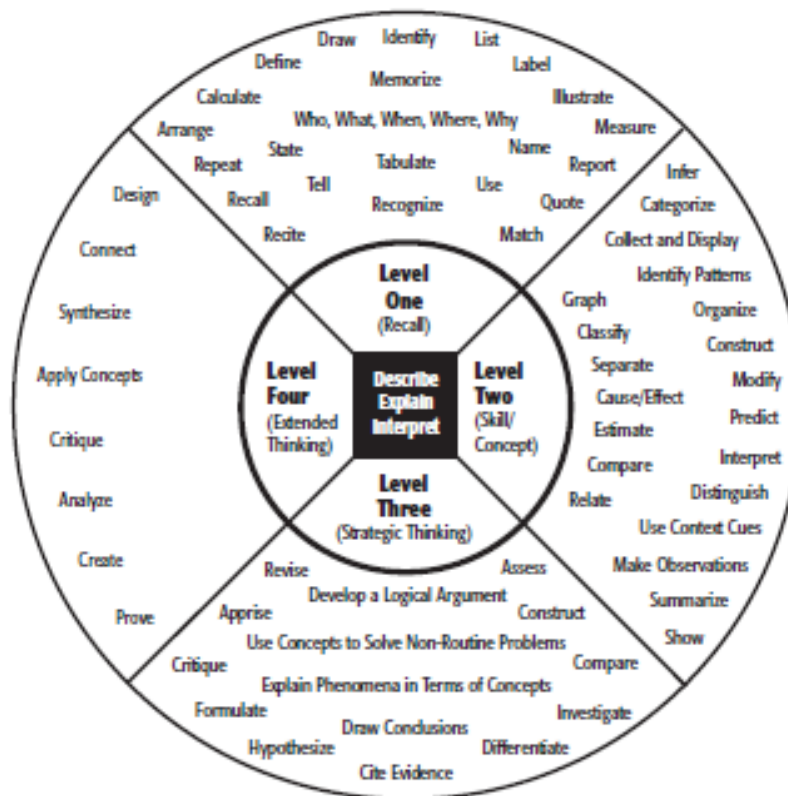
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# Depth of Knowledge (DOK) Levels



Level One Activities	Level Two Activities	Level Three Activities	Level Four Activities
<p>Recall elements and details of story structure, such as sequence of events, character, plot and setting.</p> <p>Conduct basic mathematical calculations.</p> <p>Label locations on a map.</p> <p>Represent in words or diagrams a scientific concept or relationship.</p> <p>Perform routine procedures like measuring length or using punctuation marks correctly.</p> <p>Describe the features of a place or people.</p>	<p>Identify and summarize the major events in a narrative.</p> <p>Use context cues to identify the meaning of unfamiliar words.</p> <p>Solve routine multiple-step problems.</p> <p>Describe the cause/effect of a particular event.</p> <p>Identify patterns in events or behavior.</p> <p>Formulate a routine problem given data and conditions.</p> <p>Organize, represent and interpret data.</p>	<p>Support ideas with details and examples.</p> <p>Use voice appropriate to the purpose and audience.</p> <p>Identify research questions and design investigations for a scientific problem.</p> <p>Develop a scientific model for a complex situation.</p> <p>Determine the author's purpose and describe how it affects the interpretation of a reading selection.</p> <p>Apply a concept in other contexts.</p>	<p>Conduct a project that requires specifying a problem, designing and conducting an experiment, analyzing its data, and reporting results/solutions.</p> <p>Apply mathematical model to illuminate a problem or situation.</p> <p>Analyze and synthesize information from multiple sources.</p> <p>Describe and illustrate how common themes are found across texts from different cultures.</p> <p>Design a mathematical model to inform and solve a practical or abstract situation.</p>

# Smarter Balanced Assessments

- There are content specification documents for both English language arts/literacy and mathematics.  
<http://www.smarterbalanced.org/smarter-balanced-assessments/>
- These documents provide a blueprint of how the CCSS will be assessed.
- Each content specification document references Depth of Knowledge (DOK).

# Content Specifications for Mathematics, page 30

## Operations and Algebraic Thinking

**Target A [m]: Represent and solve problems involving multiplication and division.**<sup>6</sup> (DOK 1, 2)  
Items/tasks for this target require students to use multiplication and division within 100 to solve straightforward, one-step contextual word problems in situations involving equal groups, arrays, and measurement quantities such as length, liquid volume, and masses/weights of objects. These problems should be of the equal-groups and arrays-situation types, but can include more difficult measurement quantity situations. All of these items/tasks will code straightforwardly to standard 3.OA.3. Few of these tasks coding to this standard will make the method of solution a separate target of assessment. Other tasks associated with this target will probe student understanding of the meanings of multiplication and division (3.OA.1,2).<sup>7</sup>



# Content Specifications for ELA/Literacy, page 23

**4. REASONING & EVALUATION:** Use supporting evidence to justify/ explain inferences (character development /actions/traits; first or third person point of view; theme; author's message)  
**Standards: RL-2, RL-3, RL-6** (DOK 3, DOK 4<sup>2</sup>)

**CCSS standards (or parts) that relate to the ability to make inferences and analyze** – assesses deeper understanding and use of text-based evidence to support analysis and reasoning  
**(DOK 3 – support interpretation with explanation and text evidence)**  
-- What lesson did \_\_\_ learn as a result of \_\_\_? Use details and evidence from the text to support your response.

**RL-2** Determine a theme of a story, drama, or poem from details in the text; summarize the text.  
**RL-3** Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions).  
**RL-6**<sup>3</sup> Compare and contrast the point of view from which different stories are narrated, including the difference between 1st- and 3rd-person narrations.



# Hess' Cognitive Rigor Matrix

- **Depth + Type of Thinking (verbs)**
- Explains to teachers how Bloom's Taxonomy and Webb's DOK levels are alike, yet different
- Tool for examining the depth of understanding required for different tasks that initially seem to be at comparable levels of complexity
- **Is included in the appendices of the content specification documents**
  - Mathematics, pages 92 & 93
  - ELA/Literacy, page 79



Table 3

Cognitive rigor (CR) matrix with curricular examples.

Webb's Depth-of-Knowledge Levels				
Revised Bloom's Taxonomy levels	Level 1 Recall and Reproduction	Level 2 Skills and Concepts	Level 3 Strategic Thinking/ Reasoning	Level 4 Extended Thinking
<b>Remember</b> Retrieve knowledge from long-term memory, recognize, recall, locate, identify	Recall, recognize, locate basic facts, ideas, principles Recall or identify conversions: between units of measure Identify facts/details in texts			
<b>Understand</b> Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion, predict, compare/contrast, match like ideas, explain, construct models	Compose/decompose numbers Evaluate an expression Locate points on a grid Symbolize math relationships Write simple sentences Describe/explain how or why	Specify and explain relationships Give non-examples/examples Make and record observations Summarize results, concepts, ideas Infer or predict from data or texts Identify main ideas	Explain, generalize, or connect ideas using supporting evidence Explain phenomena in terms of concepts Write full composition to meet specific purpose Identify themes	Explain how concepts or ideas specifically relate to other content domains or concepts Develop generalizations of the results obtained or strategies used and apply them to new problem situations
<b>Apply</b> Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task	Follow simple/routine procedures Solve a one-step problem Calculate, measure, apply a rule Apply an algorithm or formula Represent in words or diagrams a concept or relationship Apply rules or use resources to edit spelling and grammar	Select a procedure according to task needed and perform it Solve routine problem applying multiple concepts or decision points Retrieve information from a graph and use it solve a multi-step problem Use models to represent concepts Write paragraph using appropriate organization, text structure	Use concepts to solve non-routine problems Design investigation for a specific purpose or research question Conduct a designed investigation Use reasoning, planning, and evidence Revise final draft for meaning or progression of ideas	Select or devise an approach among many alternatives to solve a novel problem Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results Illustrate how multiple themes (historical, geographic, social) may be interrelated
<b>Analyze</b> Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)	Retrieve information from a table or graph to answer a question Identify or locate specific information contained in maps, charts, tables, graphs, or diagrams	Categorize, classify materials Compare/ contrast figures or data Select appropriate display data Extend a pattern Identify use of literary devices Identify text structure of paragraph	Compare information within or across data sets or texts Analyze and draw conclusions Generalize a pattern Organize/interpret data Analyze author's craft or viewpoint	Analyze multiple sources of evidence or multiple works by the same author, or across genres Analyze complex/abstract themes Gather, analyze, and organize information Analyze discourse styles
<b>Evaluate</b> Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique			Cite evidence and develop a logical argument for concepts Describe, compare, and contrast solution methods Verify reasonableness of results Justify conclusions made	Gather, analyze, and evaluate relevancy and accuracy Draw and justify conclusions Apply understanding in a novel way, provide argument or justification for the application
<b>Create</b> Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	Brainstorm ideas, concepts, or perspectives related to a topic or concept	Generate conjectures or hypotheses based on observations or prior knowledge	Synthesize information within one source or text Formulate an original problem Develop a complex model for a given situation	Synthesize information across multiple sources or texts Design a model to inform and solve a real-world, complex, or abstract situations

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Remembering</b>	<ul style="list-style-type: none"><li>-Recall or identify conversions, terms, facts</li> <li>-Recall or locate basic facts, definitions, details, events</li><li>-Identify facts/details in text</li></ul>			

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Understanding</b>	<ul style="list-style-type: none"> <li>-Evaluate an expression</li> <li>-Locate points on a grid or number on number line</li> <li>-Solve a one-step problem</li>   <li>-Select appropriate words</li> <li>-Write simple sentences</li> <li>-Describe/explain how or why</li> </ul>	<ul style="list-style-type: none"> <li>-Explain relationships</li> <li>-Use models or diagrams to explain concepts</li> <li>-Make basic inferences or logical predictions from data or observations</li>   <li>-Explain relationships</li> <li>-Summarize</li> <li>-Identify central ideas</li> </ul>	<ul style="list-style-type: none"> <li>-Use concepts to solve non-routine problems</li> <li>-Explain reasoning when more than one response is possible</li>   <li>-Explain, generalize, or connect ideas using supporting evidence</li> </ul>	<ul style="list-style-type: none"> <li>-Relate math concepts to other content areas</li> <li>-Develop generalizations and apply to new situations</li>   <li>-Explain how concepts or ideas specifically relate to other content domains or concepts</li> </ul>

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Applying</b>	<ul style="list-style-type: none"> <li>-Follow simple procedures</li> <li>-Calculate, measure, apply a rule</li> <li>-Apply a formula</li> <li>-Solve linear equations</li> <li>-Make conversions</li>   <li>-Use language structure (pre/suffix) or word relationships (synonym/antonym) to determine meaning</li> </ul>	<ul style="list-style-type: none"> <li>-Select a procedure and perform it</li> <li>-Solve routine problems applying multiple concepts or decision points</li>   <li>-Use context to identify word meanings</li> <li>-Obtain and interpret information using text features</li> <li>-Write paragraph using appropriate organization, text structure</li> </ul>	<ul style="list-style-type: none"> <li>-Design an investigation for a specific purpose or research question</li> <li>-Use reasoning, planning, and supporting evidence</li>   <li>-Use concepts to solve non-routine problems</li> <li>-Revise final draft for meaning or progression of ideas</li> </ul>	<ul style="list-style-type: none"> <li>-Initiate, design, and conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results</li>   <li>-Devise an approach among many alternatives to research a novel problem</li> </ul>

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Analyzing</b>	<ul style="list-style-type: none"> <li>-Retrieve information from a table or graph to answer a question</li> <li>-Identify a pattern/trend</li>   <li>-Identify the kind of information contained in a graphic, table, visual, etc.</li> </ul>	<ul style="list-style-type: none"> <li>-Categorize data, figures</li> <li>-Organize, order data</li> <li>-Select appropriate graph and organized &amp; display data</li> <li>-Extend a pattern</li> <li>-Interpret data from a simple graph</li>   <li>-Compare literary elements, facts, terms, events</li> <li>-Analyze format, organization, text structures</li> </ul>	<ul style="list-style-type: none"> <li>-Compare information within or across data sets or texts</li> <li>-Analyze and draw conclusions from data, citing evidence</li> <li>-Generalize a pattern</li> <li>-Interpret data from complex graph</li>   <li>-Analyze or interpret author's craft (literary devices, viewpoint, potential bias) to critique a text</li> </ul>	<ul style="list-style-type: none"> <li>-Analyze multiple sources of evidence or data sets</li>   <li>-Analyze multiple sources or multiple texts</li> <li>-Analyze complex or abstract themes</li> </ul>

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Evaluating</b>			<ul style="list-style-type: none"> <li>-Cite evidence and develop a logical argument</li> <li>-Compare/contrast solution methods</li> <li>-Verify reasonableness</li>   <li>-Cite evidence and develop a logical argument for conjectures based on one text or problem</li> <li>-Justify conclusions made</li> </ul>	<ul style="list-style-type: none"> <li>-Apply understanding in a novel way, provide argument or justification for the new application</li>   <li>-Evaluate relevancy, accuracy, &amp; completeness of information across texts or sources</li> <li>-Draw and justify conclusions</li> </ul>

# Cognitive Rigor Matrix

Revised Bloom's Taxonomy Levels	DOK 1	DOK 2	DOK 3	DOK 4
<b>Creating</b>	-Brainstorm ideas, concepts, problems, or perspectives related to a topic or concept	-Generate conjectures or hypotheses based on observations or prior knowledge and experience	-Develop an alternative solution -Synthesize information within one data set	-Synthesize information across multiple sources or data sets -Design a model to inform and solve a practical or abstract situation
	-Brainstorm ideas, concepts, problems, or perspectives related to a topic or concept	-Generate conjectures or hypotheses based on observations or prior knowledge and experience	-Develop a complex model or approach for a given situation -Develop an alternative solution	-Synthesize information across multiple sources or texts -Articulate a new voice, alternate theme, new knowledge or new perspective

*"Learning is optimized when students are involved in activities that require complex thinking and the application of knowledge."*

*Hess, Carlock, Jones, & Walkup, 2009*



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