Hess Cognitive Rigor Matrix & Curricular Examples: Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions

Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/ Reasoning	Webb's DOK Level 4 Extended Thinking
Remember Retrieve knowledge from long-term memory, recognize, recall, locate, identify	a. **Recall, observe, & recognize facts, principles, properties** b. **Identify conversions among representations or numbers (e.g., customary and metric measures)-*attend to precision***	The Hess CRM uses descriptors for mathematics that integrate Bloom-Webb frameworks. **BOLD TEXT** indicates commonly assessed content and ***practices***.		
Understand Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match like ideas, explain, construct models	c. **Evaluate an expression** d. **Locate points** on a grid or number on number line - ***attend to precision*** e. **Represent math relationships in words, pictures, or symbols)-*attend to precision*** f. **Read, write, compare decimals in scientific notation - *attend to precision*; *repeated reasoning***	a. **Specify & explain relationships** (e.g., non-examples/examples) – ***abstract reasoning*** b. **Summarize results, procedures followed, or concepts applied** c. **Make and explain estimates, inferences, or logical predictions** using data – ***abstract reasoning*** d. **Use models /diagrams to explain concepts-*modeling***	a. **Use concepts to solve non-routine problems- *problem solving*** b. **Explain, generalize, or connect ideas** with supporting data, ***models*** c. Make and justify conjectures – ***math argument; critique reasoning*** d. **Explain reasoning** when more than one solution or approach is possible- ***math argument; critique reasoning of others*** e. **Explain phenomena** in terms of concepts - ***abstract reasoning***	a. Determine whether /or how a mathematical concept relates to another content area or other mathematical domain, using evidence - ***math argument; problem solving*** b. Utilize generalizations, results and the approach(es) (e.g., from an investigation or problem) to solve a novel, more complex problem -***problem solving***
Apply Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task	g. **Follow routine multi-step procedures** (e.g., long division) h. **Calculate, measure, apply a rule** (e.g., rounding) i. **Apply algorithm or formula** (e.g., area, perimeter) j. **Solve linear equations** k. **Make conversions** among representations or numbers, or within and between customary and metric measures- ***attend to precision***	e. **Select and use a *tool* or procedure according to criteria** f. Solve routine problem applying multiple concepts or decision points-***problem solving*** g. **Retrieve information (table, graph, figure) and use it solve a problem** requiring multiple steps h. Translate between tables, graphs, words, and symbolic notations (e.g., graph data from a table) i. **Construct models given criteria**	f. Design investigation for a specific purpose or research question g. Conduct a designed investigation, drawing conclusions from data h. **Use concepts to solve non-routine problems- *problem solving*** i. Explain reasoning & planning using concepts/evidence - ***math argument; critique reasoning*** j. Translate between problem & symbolic notation when not a direct translation - ***abstract reasoning***	c. Select or devise approach among many alternatives to solve a problem with real-world constraints - ***problem solving; abstract reasoning*** d. Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results based on data/evidence - ***problem solving; abstract reasoning***
Analyze Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct	l. **Retrieve information from a table or graph to answer a question** m. Identify whether specific information is contained in graphic representations (e.g., table, graph, T-chart, diagram) n. **Identify a pattern/trend – *look for structure***	j. **Classify materials, data, figures by characteristics *structure*** k. Compare/ contrast figures or data l. **Organize, order data** m. Select appropriate graph and organize & display data n. **Interpret data** in a simple graph o. **Extend a pattern - *abstract reasoning; look for structure***	k. **Analyze and draw conclusions from data within a data set,** citing evidence - ***math argument; critique reasoning*** l. **Generalize a pattern- *structure*** m. **Interpret data** in complex graph n. Analyze similarities/differences among procedures/approaches - ***critique reasoning of others***	e. Draw conclusions based on analysis of multiple sources of evidence or multiple data sets - ***math argument; critique reasoning***
Evaluate Make judgments based on criteria, detect inconsistencies or fallacies, judge, critique			o. **Verify reasonableness of solutions for the same problem,** using concepts and evidence - ***argument; critique; abstract reasoning***	f. Apply understanding in a novel way, with justification for the application- ***math argument***
Create Reorganize elements into new patterns/structures, designs	o. Brainstorm ideas, concepts, or perspectives related to a topic	p. **Generate conjectures or hypotheses** based on observations or data- ***abstract reasoning***	p. Develop a mathematical model or an original problem for a complex situation/scenario – ***modeling; abstract reasoning***	g. Design a model using input/constraints from multiple sources - ***modeling; abstract reasoning***

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Coding of DOK levels with Mathematics Standards and Sample Assessment Items/Tasks				
Mathematics Standards	**DOK 1** Routine, basic applications and procedures	**DOK 2** Concepts or procedures within routine word problem context	**DOK 3** (1 math concept/source) Deeper interpretation & supporting evidence/justification	**DOK 4** (multiple sources, concepts, or conditions) Deeper interpretation & supporting evidence/justification
Sample standards that could address multiple DOK levels depending on the assessment task prompts		**2d.** Use models /diagrams to explain concepts-***modeling*** **2f.** Solve routine problem applying multiple concepts or decision points- ***problem solving*** **2h.** Translate between tables, graphs, words, and symbolic notations (e.g., graph data from a table)	**3a.** Use concepts to solve non-routine problems- ***problem solving*** **3b.** Explain, generalize, or connect ideas with supporting data, ***models*** **3c.** Make and justify conjectures – ***math argument; critique reasoning*** **3d.** Explain reasoning when more than one solution or approach is possible- ***math argument; critique reasoning of others*** **3o.** Verify reasonableness of solutions for the same problem, using concepts and evidence **-** ***argument; critique; abstract reasoning***	NOTE: Generally, standards are not written to address DOK 4 content complexity. DOK 4 is possible when the test prompt/context combines a standard with other standards/another domain of math/other content area
Grade 5 Mathematics Standard 5.NF-6: Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.	NA	• *Use a fraction model and equation to solve the following problem:_____* • *Explain how a fraction model can be used to answer the following question:_____*	• *Nine friends will equally share some muffins. Each muffin is the same size. Each friend gets one and one-third muffins. How many muffins are there altogether? Show and explain all of your mathematical thinking.* *(adapted from Exemplars.com)* • *Two students solved this fraction problem and got different answers. Who is correct? Or are they both correct? Use what you know about fraction models and equations to support your reasoning.*	*Create a fractions game applying the following conditions to a real-word context (e.g., candy store, rain forest, sport event):* • *Use of linear, area, and set models;* • *Some "moves" require math operations (add, subtract, multiply, divide);* • *Mixed numbers must also be used.*
Grade 8 Mathematics Standard 8.F-2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.	NA	• *Use the table of values provided for function #1 and the graph for function #2 to determine and compare rates of change for each function.* • *Use the information provided for two different functions to determine which one has a negative slope.* • *Which of these has a slope of 1?*	*Mark and Marcia are neighbors. They are filling their empty swimming pools with water for the summer. The graph and equation below show the amount of water, w, in gallons, in Mark's pool h hours after starting.* *(adapted from PARCC sample items)* a. What is the rate for Mark filling his pool? b. How many gallons of water will Mark have in his pool after eight hours? Show work and explain how you know. c. Marcia fills her empty pool for 1 hour at an average rate equal to the rate for Mark's pool. The number of gallons of water in Marcia's pool is increasing, but the rate of flow of water into the pool is not constant. Construct a possible graph that shows the number of gallons of water in Marcia's pool during that hour.	