Are You Down with the DOK?

HOW TO **LIFT** YOUR MATH INSTRUCTION EVERY DAY!

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Learning Targets

Participants will:

- correlate DOK to CCSS Mathematical Practices
- consider ways to lift DOK 1 → DOK 2 → DOK 3 through task selection, worksheet adaptation, questioning and discourse
- link to everyday math instruction

Understand Depth of Knowledge

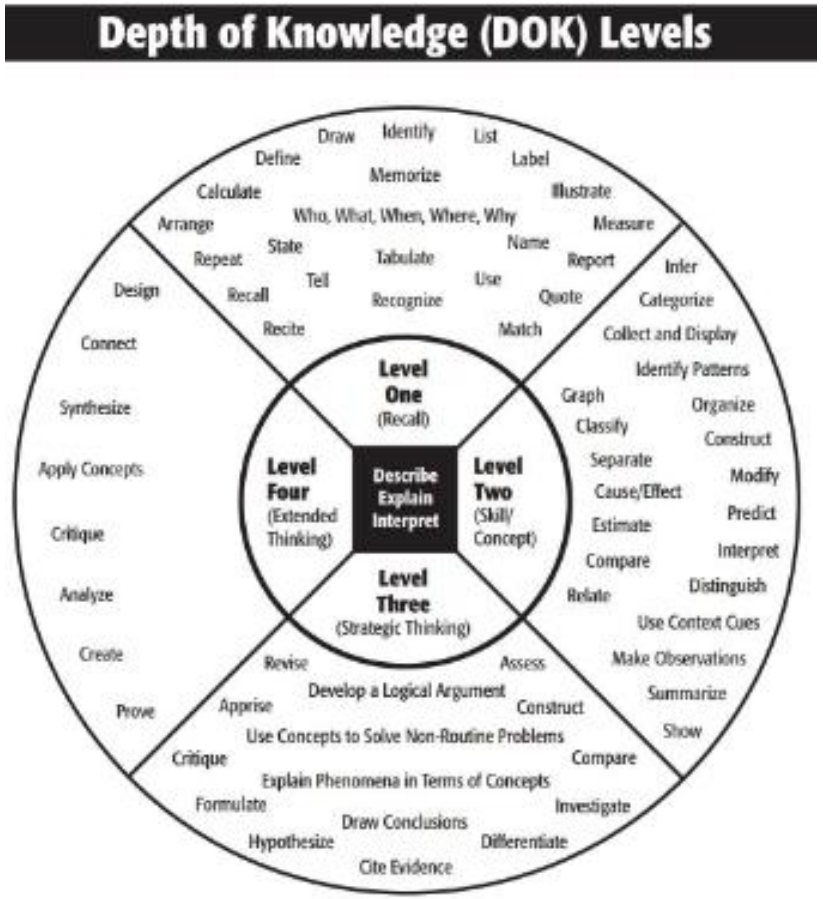
Go to Menti.com

Code: **70 46 87**

List your responses to these two questions as a word or short phrase:

- **What do you know about DOK/cognitive rigor?**
- **How do you increase rigor in your math classroom?**

What is DOK?



Is it this?

What is DOK?

DOK-1 – **Recall & Reproduction** - Recall a fact, term, principle, concept; perform a routine procedure – measure, calculate, apply rule (e.g., Problems that provide practice - “Doing the drills”)

DOK-2 - **Basic Application of Skills/Concepts** - Use of information, conceptual knowledge, select appropriate procedures for a task, two or more steps with decision points along the way, routine problems applying 2+ concepts, organize/display data, interpret/use simple graphs; categorize data; extend patterns (e.g., Word Problems)

DOK-3 - **Strategic Thinking** - Requires reasoning, developing a plan or sequence of steps to approach problem; requires some decision making and justification; abstract, complex, or non-routine; often more than one possible answer or approach (e.g., Performance Tasks; “playing the game”)

DOK-4 - **Extended Thinking** – Design & conduct an original investigation; requires more time to research, problem solve, and process and collect evidence across multiple conditions (real world); non-routine manipulations, across disciplines/content areas/multiple sources (e.g., Projects)

What is DOK?

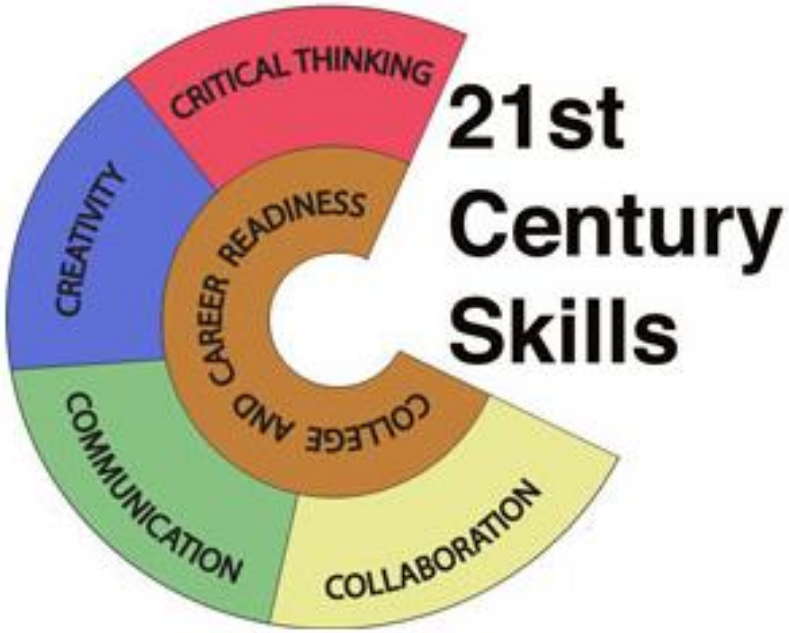
Hess' Cognitive Rigor Matrix & Curricular Examples: Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions – *M-Sci*

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	o Recall, observe, & recognize facts, principles, properties o Recall/ identify conversions among representations or numbers (e.g., customary and metric measures)			
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	o Evaluate an expression o Locate points on a grid or number on number line o Solve a one-step problem o Represent math relationships in words, pictures, or symbols o Read, write, compare decimals in scientific notation	o Specify and explain relationships (e.g., non-examples/examples; cause-effect) o Make and record observations o Explain steps followed o Summarize results or concepts o Make basic inferences or logical predictions from data/observations o Use models /diagrams to represent or explain mathematical concepts o Make and explain estimates	o Use concepts to solve non-routine problems o Explain, generalize, or connect ideas using supporting evidence o Make and justify conjectures o Explain thinking when more than one response is possible o Explain phenomena in terms of concepts	o Relate mathematical or scientific concepts to other content areas, other domains, or other concepts o Develop generalizations of the results obtained and the strategies used (from investigation or readings) and apply them to new problem situations
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	o Follow simple procedures (recipe-type directions) o Calculate, measure, apply a rule (e.g., rounding) o Apply algorithm or formula (e.g., area, perimeter) o Solve linear equations o Make conversions among representations or numbers, or within and between customary and metric measures	o Select a procedure according to criteria and perform it o Solve routine problem applying multiple concepts or decision points o Retrieve information from a table, graph, or figure and use it solve a problem requiring multiple steps o Translate between tables, graphs, words, and symbolic notations (e.g., graph data from a table) o Construct models given criteria	o Design investigation for a specific purpose or research question o Conduct a designed investigation o Use concepts to solve non-routine problems o Use & show reasoning, planning, and evidence o Translate between problem & symbolic notation when not a direct translation	o Select or devise approach among many alternatives to solve a problem o Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results
Analyze Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct	o Retrieve information from a table or graph to answer a question o Identify whether specific information is contained in graphic representations (e.g., table, graph, T-chart, diagram) o Identify a pattern/trend	o Categorize, classify materials, data, figures based on characteristics o Organize or order data o Compare/ contrast figures or data o Select appropriate graph and organize & display data o Interpret data from a simple graph o Extend a pattern	o Compare information within or across data sets or texts o Analyze and draw conclusions from data, citing evidence o Generalize a pattern o Interpret data from complex graph o Analyze similarities/differences between procedures or solutions	o Analyze multiple sources of evidence o analyze complex/abstract themes o Gather, analyze, and evaluate information
Evaluate Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique			o Cite evidence and develop a logical argument for concepts or solutions o Describe, compare, and contrast solution methods o Verify reasonableness of results	o Gather, analyze, & evaluate information to draw conclusions o Apply understanding in a novel way, provide argument or justification for the application
Create Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	o Brainstorm ideas, concepts, or perspectives related to a topic	o Generate conjectures or hypotheses based on observations or prior knowledge and experience	o Synthesize information within one data set, source, or text o Formulate an original problem given a situation o Develop a scientific/mathematical model for a complex situation	o Synthesize information across multiple sources or texts o Design a mathematical model to inform and solve a practical or abstract situation

Use Hess' Cognitive Rigor Matrix instead

Why does DOK matter?

- complexity matters
- depth of understanding matters
- transfer matters



7 Misconceptions

1. All kids can't do this; or kids don't need scaffolding to get "up" there.
2. Webb's DOK model is a taxonomy
3. Bloom verbs & levels = Webb DOK
4. DOK is about <u>difficulty</u>.
5. All DOK levels can be assessed with a multiple choice question
6. Higher order thinking = deeper learning
7. Multi-step or longer tasks, multiple texts, or complex texts always means deeper thinking

Instruction and assessment decisions

Selected Response | Constructed Response | Performance Tasks

	DOK 1 Recall and Reproduction	DOK 2 Skills and Concepts	DOK 3 Reasoning and Thinking	DOK 4 Extended Thinking
Remember	Recall basic math facts, definitions, rules, terms			
Understand	Evaluate an expression Locate points on a number line	Explain if-then relationships Summarize steps to solve problem	Explain, generalize or connect ideas using supporting evidence (diagrams, models, calculations)	Explain how statistics concepts specifically relate to other content domains.
Apply		Select a procedure according to the problem context and perform it	Use concepts to solve non-routine problems and justify solutions	Devise an approach among many alternatives to research a novel problem
Analyze			Analyze data to identify a pattern and generalize to a rule or formula	Analyze multiple sources of data to describe real-world phenomena
Evaluate			Develop a logical argument for conjectures or proof based on one concept or task	Evaluate relevancy, accuracy and completeness of information across sources
Create			Develop a complex model or approach for a given situation Develop an alternative solution	Synthesize across multiple sources/ data sets

Hess, K. "How to Go Deep to Meet the New Math Standards" http://media.wix.com/ugd/5e86bd_6db65a2fffc94f438439afe5a85051df.pdf

Roles of Teacher and Student

TEACHER/FACILITATOR

1. Build conceptual understanding, schemas
2. Probe for reasoning
3. Provide tasks requiring analysis of evidence
4. Strategically scaffold to advance thinking
5. Allow for reflection and "processing" time

STUDENT

1. Conceptual discourse (if-then; alike-different)
2. No canned answers
3. Persevere when challenged; seek alternatives
4. Generate deeper questions
5. Listen, probe, & respectfully challenge others with evidence

Correlation of DOK to Mathematical Practices

COMMON CORE
STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Math Content Standards & Math Practices

Depth + Thinking	Level 1 Recall & Reproduction	Level 2 Skills & Concepts (routine applications)	Level 3 Strategic Thinking (support with data, equations, models, etc.)	Level 4 Extended Thinking (across domains)
Remember	Know math facts, terms			
Understand	Attend to precision Evaluate expressions, plot point	Model with mathematics Estimate, predict, observe, explain relationships	Construct viable arguments Geometry proof	Integrate concepts across domains
Apply	Calculate, measure, make conversions	Make sense of routine problems	Make sense of non-routine problems	Design & conduct a project
Analyze	Identify a pattern Locate information in table	Use tools strategically Classify, organize data, extend a pattern	Reason abstractly Generalize a pattern	Analyze multiple sources of evidence
Evaluate			Critique the reasoning of others	
Create				Design a complex model

Hess, K. "How to Go Deep to Meet the New Math Standards" http://media.wix.com/ugd/5e86bd_6db65a2fffc94f438439afe5a85051df.pdf

Ways to lift

DOK 1 → DOK 2

DOK 2 → DOK 3

in everyday lessons

How do you increase rigor in your math classroom?

Marzano: Essentials for Achieving Rigor

Teacher behavior

Questioning

Complex Tasks

"The Marzano Center Essentials for Achieving Rigor model includes 13 strategies. Considered and implemented as a set, these strategies represent a dramatic shift from traditional classroom pedagogy and align directly with the goals of college and career readiness standards."

13 Essential Strategies

- Identifying Critical Content
- Previewing New Content
- Organizing Students to Interact with Content
- Helping Students Process Content
- Helping Students Elaborate on Content
- Helping Students Record and Represent Knowledge
- Managing Response Rates with Tiered Questioning Techniques
- Reviewing Content
- Helping Students Practice Skills, Strategies, and Processes
- Helping Students Examine Similarities and Differences
- Helping Students Examine Their Reasoning
- Helping Students Revise Knowledge
- Helping Students Engage in Cognitively Complex Tasks

Marzano, R. and Toth, M. (March 2014) "Teaching for Rigor: A Call for a Critical Instructional Shift", white paper, retrieved 11.28.16 from http://www.marzanocenter.com/files/Teaching-for-Rigor-20140318.pdf

Teacher behavior

INSTEAD OF… 

- Spend a lot of time talking during teaching
- Focus on the activity
- Teach explicitly all the time
- Jump in quickly to assist
- Provide yes/no, right/wrong questions and tasks

TRY… 

- Let students do the work and the talk
- Focus on the mental processing required for students
- Try an inquiry lesson
- Be less helpful
- Promote stamina and perseverance

Questioning

INSTEAD OF… 

- Ask most of the questions
- Move at fast pace
- Provide hints
- Being surprised by student responses

TRY… 

- Students generate questions (Question Formulation Technique)
- Provide wait time
- Give non-specific hints and general strategies (link to MPs)
- Anticipate student solutions

Questioning: Funneling or Focusing?

- Questions that “funnel” → to one answer or step in the processes

- Questions that “focus” → are more open-ended and lead to discourse; What do you notice? How would you describe…? Where could we start?

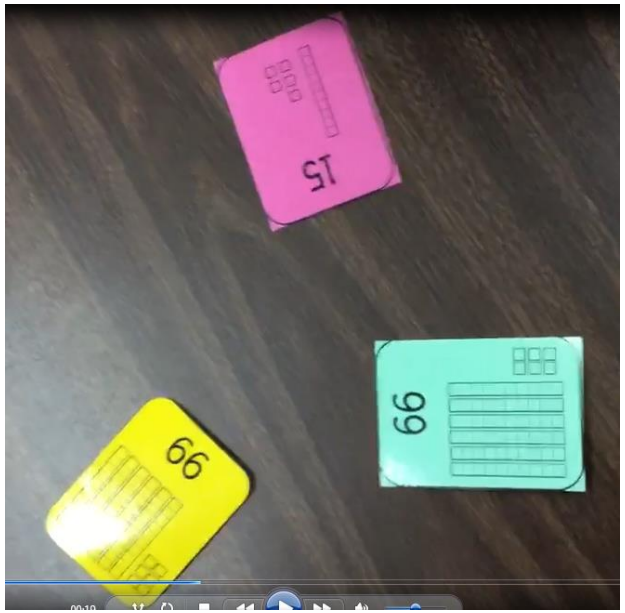
Questioning: Examples

Funneling question			*Focusing question*
DOK 1 Recall and Reproduction	**DOK 2 Application of skills and concepts**	**DOK 3 Strategic Thinking**	**DOK 4 Extended Thinking**
Who? Where? When?			
What?	What is the outcome? What can you do? What steps are needed to _? What do you notice about _?	What does it suggest? What is the reason? What is the relationship? What effect does _ have on _? What conclusions can you draw about _? What could be a theory about __? Justify. What would happen if __? What do you predict about _? What generalization can be made?	What is the impact? What if__? What if __ is given but __ is not? What could happen? What can you build, create, design or develop? What kind of problem could you present?
How?	How can you use it? How would you compare __? How are they alike? Different? How would you classify __? How would you summarize__?	How could you develop and use a model? How is _ related to _? How do you know? Defend your reasoning with evidence. How would you justify it? How would you test _?	How can we improve _? How many other ways can you _?
Why?		Why does it work? Will it always? Why is that the answer? Why is that the best answer? Why is it the outcome? Why do you suppose __?	

Questioning

Video: Listen to student and teacher talk.

What DOK are the teacher's questions?



Questioning Activity

QUESTION/STATEMENT	DOK
Tell me what you notice here.	
So, which one is greater?	
Why is 66 greater?	
So, what matters? Do the ones matter when we're looking at this?	
Now you two have to flip again. Who gets all these cards?	
Why? Why is 82 more than 34?	

Questioning Activity

QUESTION/STATEMENT	DOK
Tell me what you notice here.	2
So, which one is greater?	1
Why is 66 greater?	3
So, what matters? Do the ones matter when we're looking at this?	3
Now you two have to flip again. Who gets all these cards?	1
Why? Why is 82 more than 34?	3

Tasks: Task Predicts Performance

"What predicts performance is what students <u>are actually doing</u>… the instructional task is the actual work that students are asked to do during the process of instruction…" ~City, Elmore et al.

student engagement with tasks that demand active struggle to find the connections and apply mathematical practices

Does this look familiar?

Rewriting Addition to Multiplication

Name : _____

Teacher : _____

Rewrite each addition problem into a multiplication problem.

Ex) 2 + 2 + 2 + 2 + 2

1) 2 + 2 + 2 + 2 + 2 + 2 + 2

2) 3 + 3 + 3

3) 3 + 3 + 3 + 3 + 3 + 3 + 3

$ 13.18	$ 79.36	$ 11.13
+ $ 40.56	+ $ 17.77	+ $ 68.69

Name _____ Date _____

Find the Least Common Multiple of each number pair.

10, 4 _____ 14, 6 _____

3, 27 _____ 25, 5 _____

Tasks: Modify

INSTEAD OF…

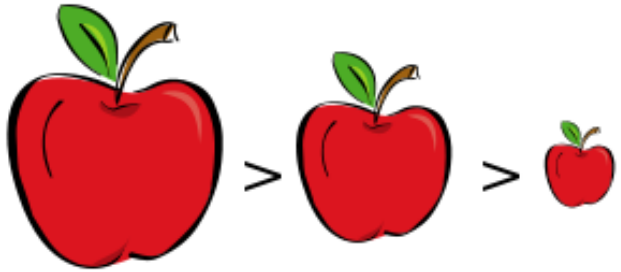
- Use worksheets and tasks in original form most of the time
- Use closed tasks
- Focus on small skills
- Look for right/wrong

TRY…

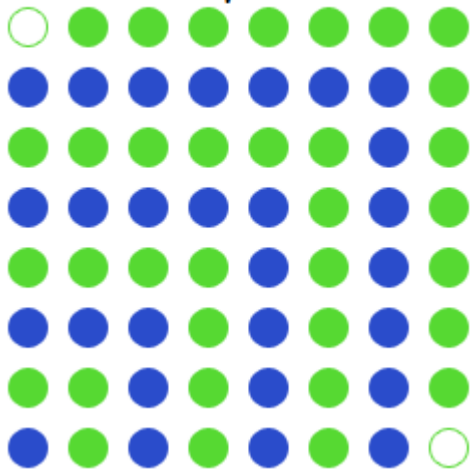
- Add a layer, generalize, flip the known/unknown, ask to defend thinking
- Introduce ambiguity by providing incomplete info and inviting student questions
- Link to other domains
- Offer a worked example: Is it correct or not? Explain.

Tasks: Examples

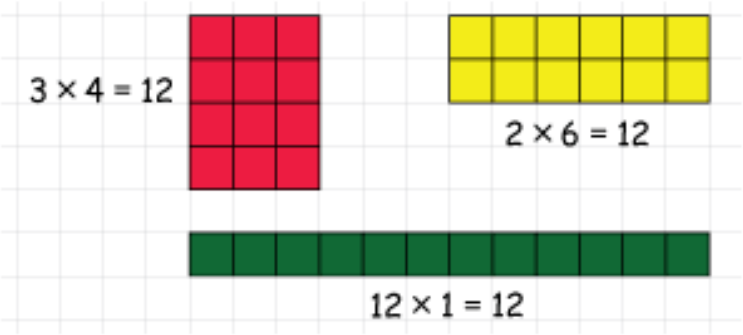
What could > mean?



What do you notice?

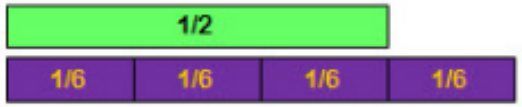


What do you notice? What else?

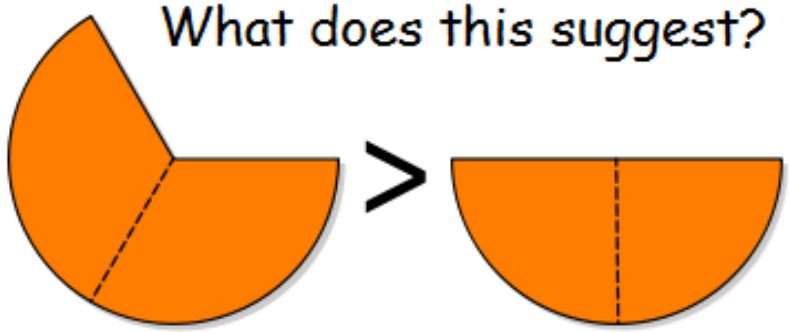


What do you think?

$\frac{1}{2}$ $\frac{4}{6}$



What is the reason?
What does this suggest?



Tasks: Re-Sequence

INSTEAD OF… 

- Begin concepts with literal, factual knowledge (DOK 1)

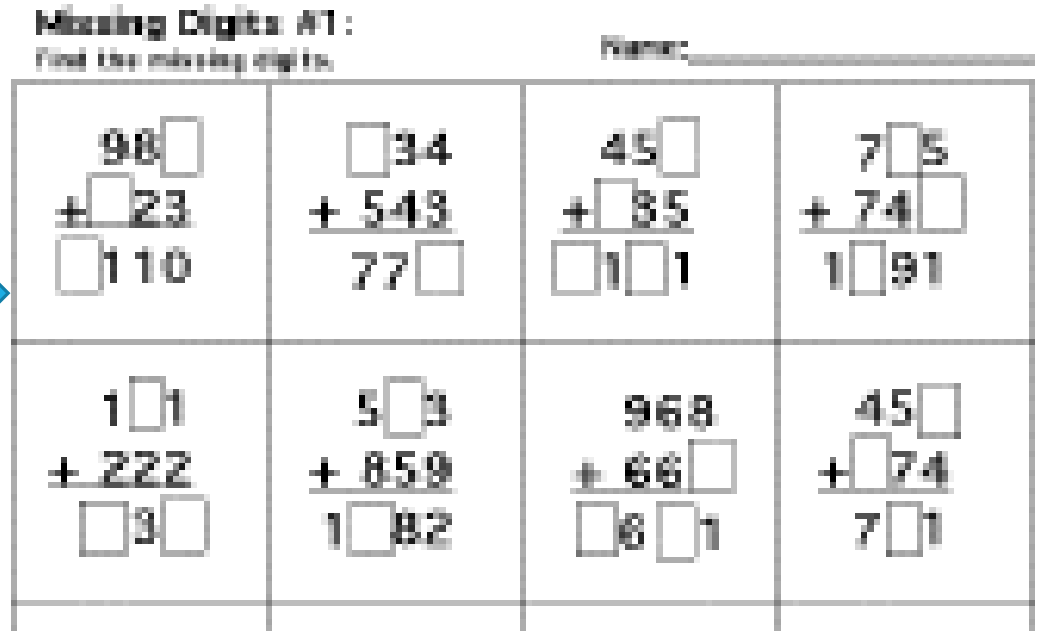
TRY…

- Launch with an inquiry or challenging problem (DOK 2 or 3)
- Lead with a visual (photo, video, graph, data) and time to think
- Lead with a worked example (correct or erroneous) and time to make sense of it

Task Activity

- Here's a task and how we modified it

605 + 516	616 + 831	553 + 576	625 + 670	171 + 608
156 + 961	575 + 105	376 + 949	439 + 114	123 + 775



Missing Digits #1:

Find the missing digits.

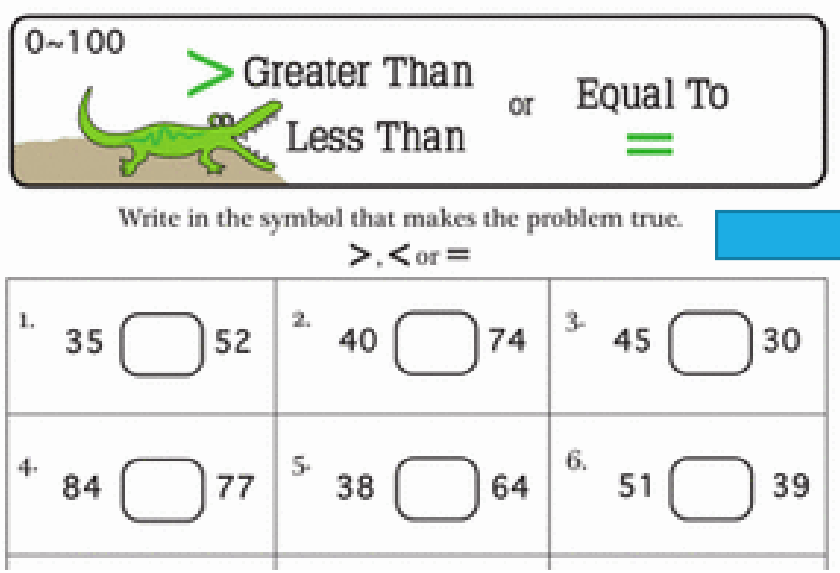
Name:

98□ + □23 □110	□34 + 543 77□	45□ + □35 □1□1	7□5 + 74□ 1□91
1□1 + 222 □3□	5□3 + 859 1□82	968 + 66□ □6□1	45□ + □74 7□1

Math-Aids.Com
Addition Worksheets

Task Activity

- Here's a task and how we modified it



Look at the comparisons below. Cross out all that are **not** true.

71 > 17	40 < 4	80 > 18
35 < 33	26 > 16	64 < 74

Write your own comparisons.

True _____ > _____	Not true _____ > _____

Task Activity

- You try it!:
  - Think of a task you've asked your students to work on recently OR Choose a Task (Tasks A-F provided)
  - Work together at your table to lift the DOK
  - How could you revise or reframe the tasks to require a higher level of cognitive demand?
  - Share out, chart it, gallery walk…

Implications for Teachers

- Consider task selection

- Plan for questioning

Implications for Coaches

- Coach into task selection through collaborative planning for authentic rich tasks…
- Coach questioning skills through planning, scripting, tagging to DOK, shifting, whispering in…
- Coach into discourse through video, prompt cards, sentence stems…

Handouts

Implications for Administrators

- In evaluation - CCT…domain 2 and domain 3
- In standardized testing - SBAC…considers DOK on question stems
- Hess Walk-Through Tool

Proficient

Plans instructional strategies, tasks and questions that promote student cognitive engagement through problem-solving, critical or creative thinking, discourse[11] or inquiry-based learning[12] and / or application to other situations.

The Hess Walk-Through (Observation-Reflection) Tool: Looking for Rigor in all the Right Places

The teacher…	*All students…*
1. Provides accurate conceptual information, examples, models; asks questions that reflect substantive understanding of the concepts & builds overall schemas (e.g. parts of the whole, essential criteria/characteristics). (DOK 2)	1. Engage in substantive discourse about concepts, relationships, observations, predictions (e.g., if- then; compare- contrast, cause-effect). (DOK 2)
2. Models probing questions and allows adequate wait time for all students (e.g., what makes you say that? Can you	2. Provide responses that reflect real thinking, not just recall of "canned answers" or basic procedural

Smarter Balanced Assessment Consortium

Grade 3 Mathematics Item Specification C1 TF

Task Model 2a
 	
Response Type: Equation/Numeric
 	
DOK Level 2
 	
3.NF.A.2
Understand a fraction as a number on the number line; represent fractions on a number line diagram.
a. Represent a fraction 1/*b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each
	Prompt Features: The student is prompted to identify the numerical fraction represented by a given point on a number line.
	
	Stimulus Guidelines:
	• Denominators are limited to 2, 3, 4, 6 and 8.
	• Follow any stated guidelines on allowable number ranges.
	• Item difficulty can be adjusted via these example methods:
	  ○ Identify a fraction represented by a labeled point on a number line; number line is from 0–1 and divided into increments.
	  ○ Identify a fraction represented by a labeled point on a number line; number line is from 0–1 and **not** divided into increments.
	
	TM2a
	Stimulus: The student is presented with a fractional number line where a fraction is designated by a point on the number line.
	
	Example Stem:
	 

Reflection

- *How can you lift the DOK of your tasks?*
- *What question stems speak to you? Why?*
- *What will you go back and quickly implement in your classroom or school?*
- *What ideas will you share with your colleagues?*
- *What new questions or thoughts do you have?*

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