

## Levels of Cognitive Demand

### **MEMORIZATION: Lower-level demands...**

- ... involve reproducing previously learned facts, rules, formulas or definitions OR committing facts, rules, formulas or definitions to memory.
- ... cannot be solved using procedures (either a procedure doesn't exist or the time frame is too short).
- ... involve exact reproduction of previously seen material is clearly and directly asked for.
- ... have no connection to the concepts or meanings that underlie the facts, rules, formulas, or definitions being used.

### **PROCEDURES WITHOUT CONNECTIONS: Lower-level demands...**

- ... use of procedure is either specifically asked for or is clearly evident from class experiences.
- ... require little cognitive demand; little ambiguity exists about what needs to be done and how to do it.
- ... have no connection to the concepts or meanings that underlie the procedure being used.
- ... are focused on producing correct answers instead of on developing mathematical understanding.
- ... require no explanations or explanations that solely focus on describing the procedure used.

### **PROCEDURES WITH CONNECTIONS: Higher-level demands...**

- ... focus students' attention on the use of procedures for the purpose of developing deeper levels of mathematical understanding.
- ... suggest explicitly or implicitly pathways to follow that are broad general procedures that have close connections to underlying conceptual ideas (as opposed to narrow algorithms that are opaque with respect to underlying concepts).
- ... usually are represented in multiple ways (such as visual diagrams, manipulatives, symbols, and problem situations), making connections among multiple representations to help develop meaning.
- ... require some degree of cognitive effort. Students need to engage with conceptual ideas that underlie the procedures to complete the task successfully and that develop understanding.

### **DOING MATHEMATICS: Higher-level demands...**

- ... require complex and non-algorithmic thinking. A predictable, well-rehearsed approach or pathway is not explicitly suggested by the task, task instructions, or a worked-out example.
- ... require students to explore and understand the nature of mathematical concepts, processes, or relationships.
- ... demand self-monitoring or self-regulation of one's own cognitive processes.
- ... require students to access relevant knowledge and experiences and make appropriate use of them in working through the task.
- ... require students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions.
- ... require considerable cognitive effort and may involve some level of anxiety for the student because of the unpredictable nature of the solution process required.