Analyzing Cognitive Demand Activity
Facilitator's Quick Guide

1. Group formation by grade or grade band based on number of total participants
   - Pairs
   - Groups of three or four
   - Table groups

2. Do two math problems individually and silently
   - Martha's Carpeting
   - Fencing
   - allotted time: about 10 minutes

3. Table group discussion following completion of Martha's Carpeting Task and Fencing Task:
   - identify strategies and process standards
   - identify math concepts
   - identify similarities and differences
   - allotted time: about 10 minutes

4. Whole group share — pick up to three groups to share how they solved the problems
   Distribute a set of grade-band Math Tasks to each pair/group of teachers

5. Sort the Tasks using categories of their choosing (the purpose is to get the participants familiar with the sixteen tasks)
   - allotted time: about 5 minutes

6. Groups share sorting schemes
   - facilitator should eavesdrop and select pairs to share if there's not time for all groups to share
   - allotted time: about 5 minutes

7. Explain Task Analysis Guide
   - Memorization
   - Procedures without connections to understanding, meaning, or concepts
   - Procedures with connections to understanding, meaning, or concepts
   - Doing math
   - allotted time: about 5 minutes

8. How to use Task Analysis Guide
MMEF 2009

- For low level tasks:
  - What is the rule or procedure you would use to solve the task?
  - What have you memorized that you are being asked to recall?
- For high level tasks:
  - What is it you have to think about in order to solve the task?
  - What decisions or judgments do you have to make?
- allotted time: about 5 minutes

9. Use Task Analysis Guide to fine tune the categorization based on the four categories of cognitive effort

- Record the features of each task on the Features of Cognitive Demand Recording Chart
- Use questions in #10 above to help distinguish the different levels
- allotted time: about 15 minutes

10. Group share

- Share a task that was identified as Memorization
  - What were the features that made it so?
  - What adaptation(s) could be made to raise the level of cognitive demand?
- Share a task that was identified as Procedures without connections to understanding, meaning, or concepts
  - What were the features that made it so?
  - What adaptation(s) could be made to raise the level of cognitive demand?
- Share a task that was identified as Procedures with connections to understanding, meaning, or concepts
  - What were the features that made it so?
- Share a task that was identified as Doing Math
  - What were the features that made it so?
- allotted time: about 15 minutes

11. Summarize

- Does a particular feature indicate that the task has a certain level of cognitive demand?
- Is there a difference between "level of cognitive demand" and "difficulty?"
- What effect does context (e.g., setting in which the task is used, students' prior experience, grade level) have on the level of cognitive demand required by the task?
- allotted time: about 10 minutes
Martha's Carpeting Task

Martha was recarpeting her bedroom, which was 15 feet long and 10 feet wide. How many square feet of carpeting will she need to purchase?
Fencing Task

Ms. Alvarado's class will raise rabbits for their spring science fair. They have 24 feet of fencing with which to build a rectangular rabbit pen to keep the rabbits.

1. If Ms. Alvarado's students want their rabbits to have as much room as possible, how long would each of the sides of the pen be?

2. How long would each of the sides of the pen be if they had only 16 feet of fencing?

3. How would you go about determining the pen with the most room for any amount of fencing? Organize your work so that someone else who reads it will understand?
## Features of Cognitive Demand of Tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Level of Cognitive Demand</th>
<th>Explanation of Categorization</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cognitive Demands and Features of Tasks
(continued)

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Level of Cognitive Demand</th>
<th>Explanation of Categorization</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# THE TASK ANALYSIS GUIDE

## Lower-Level Demands

<table>
<thead>
<tr>
<th>Memorization Tasks</th>
<th>Higher-Level Demands</th>
</tr>
</thead>
</table>
| • involve either reproducing previously learned facts, rules, formulas, or definitions OR committing facts, rules, formulas, or definitions to memory.  
• cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure.  
• are not ambiguous—such tasks involve exact reproduction of previously seen material and what is to be reproduced is clearly and directly stated.  
• have no connection to the concepts or meaning that underlie the facts, rules, formulas, or definition being learned or reproduced. | • focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts.  
• suggest pathways to follow (explicitly or implicitly) 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 (e.g., visual diagrams, manipulatives, symbols, problem situations). Making connections among multiple representations helps to develop meaning.  
• require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding. |

## Higher-Level Demands

<table>
<thead>
<tr>
<th>Procedures with Connections Tasks</th>
<th>Doing Mathematics Tasks</th>
</tr>
</thead>
</table>
| • require complex and nonalgorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway 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 solution.  
• require considerable cognitive effort and may involve some level of anxiety for the student due to the unpredictable nature of the solution process required. |
This framework was used to analyze hundreds of lessons between 1990 and 1995. This research has yielded two major findings:

1) Mathematical tasks with high-level cognitive demands were the most difficult to implement well, frequently being transformed into less-demanding tasks during instruction.

2) Student learning gains were greatest in classrooms in which instructional tasks consistently encouraged high-level student thinking and reasoning and least in classrooms in which instructional tasks were consistently procedural in nature.

(Stein, Smith, Henningsen, and Silver, 2000)
MARTHA'S CARPETING

Martha was recarpeting her bedroom, which was 15 feet long and 10 feet wide. How many square feet of carpeting will she need to purchase?

FENCING

Ms. Brown's class will raise rabbits for their spring science fair. They have 24 feet of fencing with which to build a rectangular rabbit pen to keep the rabbits.

1) If Ms. Brown's students want their rabbits to have as much room as possible, how long would each of the sides of the pen be?
2) How long would each of the sides of the pen be if they had only 16 feet of fencing?
3) How would you go about determining the pen with the most room for any amount of fencing?
