

Facilitation Guide

Strategies to Increase Access to Mathematics...and the SAT:

Implement Rich Mathematical Tasks

The video can be viewed by individuals or to generate collaborative conversations and inquiry within departments. This guide provides suggestions for facilitating group discussion and action items including places in the video where viewers might pause for collaborative conversations and think time. In some cases, additional questions are provided to prompt dialogue. When the video doesn't suggest predicted responses to these questions, the guide provides predicted responses that a facilitator might listen for during discussions.



Additional discussion questions are included at the end of the guide.

Facilitation Notes	Slide
[Pause at 1:20]: Viewers may wish to have a short conversation or stop and jot around the strengths and weaknesses of their current mathematics instructional resource. <i>Does it provide a balance between adaptive and routine expertise or is it heavier in one type of expertise? In what ways, might you better utilize sections of the materials to better represent both kinds of expertise?</i> (This might be left as an open question to consider throughout the module.) This video assumes that your curriculum is heavier on routine expertise and will suggest ways to increase the adaptive expertise in your classroom. http://www.nctm.org/store/Products/Achieving-Fluency--Special-Education-and-Mathematics/	Mathematical proficiency implies: cultivating adaptive expertise, and routine expertise NCTM p.17
[Pause at 1:30] The video first asks participants to answer “<i>What do you notice about the item?</i>” Allow colleagues the opportunity to answer this question individually and then with the whole group. The video suggests several details that viewers might notice about the problem including the inclusion of an exponential expression and a linear equation. Viewers might also connect to the introduction of adaptive and routine expertise required to show mathematical proficiency. If not, the facilitator might choose to ask the question about expertise before pressing play. <i>“What kinds of expertise does this task require?”</i>	

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[Pause at 3:11] Allow time to have dialogue around the question on the slide:
"In what ways might experience with rich mathematical tasks increase students' aptitude on similar tasks?"

Anticipated responses:

- Rich tasks provide opportunities for students to:
 - build perseverance in problem solving as in looking for entry points into problems
 - build the habit of using routine skills in non routine ways
 - examine and make use of structure in expressions and equations

Additional questions to prompt dialogue:

- What standards of mathematical practice do students have an opportunity to build?
- How might building standards for mathematical practices equip students on nonroutine problems
 - in general?
 - on assessments like the SAT?

In what ways might experience with rich mathematical tasks increase student aptitude on similar items?

If $3x - y = 12$, what is the value of $\frac{x^3 - y^3}{3}$?

A) 2^{12}
 B) 4^6
 C) 8^2
 D) The value cannot be determined from the information given.

SAT practice test #1 page 38 (no calculator)

[Pause 4:00]

The video suggests that resources have “problems that could be emphasized as a classroom exploration and discussion.”

Dialogue prompts:

- Discuss what implications this suggestion might have on a “typical” mathematics class period.
- What teaching practices might a teacher plan to utilize for explorations and discussion?

Opportunities in Instructional Materials

Tell whether each statement is sometimes, always, or never true.

78. If n is a positive integer, then $x^{-n} = \frac{1}{x^n}$. always
 79. If n is positive, then x^{-n} is negative. never
 80. If n is even, then x^{-n} is 1. sometimes
 81. If n is a negative integer, then $x^{-n} = 1$. sometimes
 82. If n is even, then x^{-n} is 1. never
 83. If n is an integer, then $x^{-n} > 1$. sometimes

[Pause 4:29] Allow colleagues an opportunity to follow the modified directions “Looking at question numbers 3-18 and 21-36, classify the problems into two or more categories. Explain the defining characteristics of each category and simplify at least one problem from each category to illustrate your reasoning.”

You might also pause with the highlighted slides and allow viewers the opportunity to hypothesize the sorting before the video explains the categories.

SIMPLIFYING EXPRESSIONS. Simplify the expression. Write your answer.

3. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	4. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	5. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	6. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
7. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	8. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	9. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	10. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
11. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	12. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	13. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	14. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
15. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	16. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	17. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	18. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
19. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	20. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	21. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	22. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
23. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	24. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	25. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	26. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
27. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	28. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	29. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	30. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
31. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	32. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	33. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	34. $\frac{1}{x^2} \cdot \frac{1}{x^3}$
35. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	36. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	37. $\frac{1}{x^2} \cdot \frac{1}{x^3}$	38. $\frac{1}{x^2} \cdot \frac{1}{x^3}$

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[Pause at 6:21]: In what ways will implementing rich tasks, like those described in the video, increase accessibility for all students?

Anticipated responses:

- Questions asked in this way, often characterized as “low floor, high ceiling”, provide multiple entry points and varying levels of sophistication. (For more information about such tasks see: <http://nrich.maths.org/7701> or <https://www.youcubed.org/grade/low-floor-high-ceiling/>.) Most students could identify a pattern, from which the teacher can ask questions to scaffold to deeper levels of thinking.
- It allows the “hard” work of mathematical thinking to be done inside the classroom with a teacher available to support students.
- Allows students to understand the structure behind the mathematics, leading to long term understanding.
- Students see the connections between mathematical concepts rather than in isolation, leading to a more solid understanding of each concept.

Additional questions to prompt dialogue:

- *How might tasks with multiple solutions strategies increase students access to the mathematics?* (It allows them multiple entry points with strategies that make sense to them.)

In what ways will implementing rich tasks increase accessibility for all students?



Follow up activities when viewers have 30-60 minutes to collaboratively plan a lesson.

- Choose a rich mathematical task to use collaboratively in a modified lesson study cycle. Use a planning tool (e.g., http://shiwasseeresd.glk12.org/pluginfile.php/4159/mod_resource/content/1/thinkingthroughalessonprotocolplanningtemplate.pdf) to facilitate conversations and issues related to using rich tasks. Implement the task with students and reflect on implementation with colleagues.
- Modify directions to increasing students opportunities to pay attention to structure (like the sorting activity).
- Collaboratively explore a problem set that you will be teaching soon. Anticipate ways students might sort the set. What mathematics does each sort create opportunities to practice/discuss/learn?

Sources for Rich Mathematics Tasks

- MAISA Math Units <https://gomaissa-public.rubiconatlas.org/Atlas/Public/View/Default>
- EMATHS – Embracing Mathematics, Assessment, & Technology in High Schools <http://www.emathsnl.com/resources.php>
- MAP – Mathematics Assessment Project <http://map.mathshell.org/>