WHAT is a rich task?

1. *It must invite students to practice mathematics.*

If students immediately know the answer or solution path to a problem, they are robbed of the opportunity to persevere in solving it, which is a fundamental behavior of proficient mathematicians. When carefully chosen or designed, rich tasks ensure that opportunity. They produce an appropriate degree of cognitive struggle while making sense of them. When executed properly, they give rise to the coordination of strategies and precision of ideas in order to achieve a deeper shared understanding of the mathematics at hand.

2. *It must be appropriately challenging for all students.*

Not a single teacher has a homogeneous classroom of students. Yet we are charged with helping all of our students understand the same set of standards. Posing rich tasks is a powerful way for providing unique learners appropriate access to the same mathematics. They have mathematical stretch; they allow a range of learners to successfully attempt and solve the problem. That is because a rich task does not hinge on one solution, but rather several. Maybe there is only one answer, but the solution paths that lead to that answer are many. While one student is able to arrive at a single answer, another student who is ready for a greater challenge can consider further possibilities, generalize solutions and extend their curiosity with additional questions to investigate.

3. *It must be interesting…mathematically interesting.*

Interesting does not mean contrived. A rich task does not simply need a cute context or popular theme to lure students. On the contrary, a task is interesting if it makes students wonder. About the *mathematics*, that is. Once their curiosity takes hold, they are interested and the task is worth solving. As mathematicians, we expect things to have order and make sense. When they do not, we take notice and want to resolve the cognitive disturbance. Tasks that are potentially rich pose an intellectual challenge that creates the need for us to conquer it (Hiebert et al, 1997)! Be careful not to make the task too easy or difficult; students will lose interest.

4. *It must provide the teacher with useful formative data.*

Students must learn something in their attempt to solve the task, and the teacher must learn something about her students while they solve it. If not, the task is *not* worth the precious and limited time that we have. When implemented effectively, rich tasks serve as a clear window into students' minds. They give teachers the opportunity to notice what their students already know as well as how they demonstrate that understanding. It is not until this happens that teachers can accurately determine what to do next. However, if the task yields only a regurgitation of what students can already demonstrate, it is not considered mathematically rich. The teacher might feel confident in knowing that students mastered a particular skill, but has little information about the maturity level of her mathematicians. That is, the teacher has little information about how well her students can practice mathematics.

WHERE to Find Rich Tasks

The Mathematics Common Core Toolbox
Funded by the Bill and Melinda Gates Foundation, the Charles A. Dana Center at The University of Texas at Austin and education company Agile Mind, Inc. provides a wealthy toolbox of resources to support educators and leaders as they implement the mathematics standards. The website includes information about the standards, a gallery of animations and simulations of key mathematics concepts central to the new standards for middle and high school mathematics, assessment tools and tasks, K-Algebra II scope and sequence samples, and more.

Illustrative Mathematics Project
Funded by the Bill and Melinda Gates Foundation, this project aims to build a bank of example rich tasks that illustrate the CCSS-M. It creates a dynamic view of the CCSS-M. You can view only those standards that have examples posted at this time.

Inside Mathematics
This site has it all! Take the Video Tour to see what it can do for K-12 teachers, coaches and administrators.

Balanced Assessment
This ten-year assessment project, started at the Harvard Graduate School of Education, yields over 300 free and innovative mathematics assessment tasks for grades K-12.

Mathematics Assessment Resource Service (MARS)
This work out of University of Nottingham, Berkeley and the Shell Centre focuses on implementing rich mathematical experiences for K-12 students through performance assessments. It is built from earlier work with the Balanced Assessment Project, mentioned above. MARS also provides resources for curriculum design.

NCTM Illuminations
Funded by the Verizon Thinkfinity program, this NCTM site has been illuminating the standards for over a decade, and it just keeps getting better! From complete units to interactive games and applets to helpful videos, this is a teacher must-have.

Ohio Resource Center
The Ohio Resource Center strives to save Ohio teachers time. This site is a well-organized, one-stop shopping experience for various resources aligned to the OACS and more! CCSS-M alignments are coming soon. Only resources of "best practice" or "promising practice," scrutinized by a panel of professionals, are included. Be sure to check out:

- Stella's Stunners for grades 6-12 non-routine tasks.
- Problem Corner for 3-12 rich, inquiry-oriented problems and investigations.
- Mathematics Bookshelf for outstanding trade books to support K-12 math instruction.
- Technology Treasure Trunk for PreK-12 content resources that support standards-based instruction and appropriate use of technology

NRICH: Enriching Mathematics
The aim of this Cambridge University site is to provide resources designed "to develop subject knowledge, problem-solving and mathematical thinking skills." Check out the wealth of rich task offerings! The Curriculum Maps contain links to task resources that align to content written in simple language.

Bowland Maths
This is another excellent resource! Funded by Bowland Charitable Trust in the UK, its "materials look very different from most maths teaching materials. They consist of innovative case study problems, each taking 3-5 lessons, designed to develop thinking, reasoning and problem solving skills" for students aged 11-14. The aim is to improve students' confidence in mathematics, while also encouraging new ways of teaching mathematics.

Check out more resources for understanding and implementing the Common Core Standards for Mathematics at
ccssmresources.wikispaces.com.

Sara Good, Greater Cleveland Council of Teachers of Mathematics

WHY pose rich tasks?

They build understanding that has residue.

"What you have been obliged to discover by yourself leaves a path in your mind which you can use again when the need arises" (G. C. Lichtenberg). We have long assumed that we must teach students the content and skills before they can understand and apply them. Yet understanding is what comes naturally when students solve mathematical problems, and not something we can teach directly (Brownell, 1946). While the typical instructional sequence postpones potentially rich tasks until after demonstrations are presented and example problems worked, some contend *beginning* instruction with problems, letting students model the problem as they choose, and recognizing that students' efforts lead to deeper and sustained understanding. The learning that results from students solving problems--discovering relationships, communicating, reflecting and revising ideas--is referred to as "residue" (Davis, 1992).

They naturally differentiate instruction.

One teacher's efforts to translate knowledge cannot possibly make sense to all learners at any given time. "...No matter how lucidly and patiently teachers explain to their students, they cannot understand for their students" (Schifter & Fosnot, 1993). Differentiation simply means giving students multiple options for taking in information (Tomlinson, 1999), and then noticing and responding to how they learn. When students solve worthwhile tasks collaboratively with their peers, they are naturally taking in information in multiple ways. And since teachers are not consumed with demonstrating the lesson, they can instantly notice how each student is thinking. Teachers can respond at once to observed needs, or plan future methods for intervening. Many times, it is the immediate response that eliminates any need for elaborate intervention plans, once again saving teachers precious time and energy.

They improve students' perception of mathematics.

If someone asked you to define mathematics, you would most likely call upon your experiences in the math classroom. In fact, you might depend upon them exclusively to conjure up a definition. Typical responses include words like *addition, subtraction, multiplication, long division, formulas*, and *solving for x*. And far too many people in our society react with groans, believing it is "something I was never good at." Yet these responses have little to do with true mathematics. Mathematics is for all. It makes sense, and all can make sense of it. Mathematics does not prepare students for the real world or develop reasoning skills; it IS reasoning (Mindshift, 2013). The more access we have to reasoning through worthwhile mathematical problems, the more creative we become in making sense of our world. And the more creative we become, the better we realize ourselves as mathematicians.

Our students deserve them.

If mathematics is for all, and if we all can make sense of it, then every student in every classroom has the right to practice mathematics every day. If executed properly, rich tasks spur curiosity and require students to reason because the solution is not immediately apparent. Rich tasks encourage students to formulate conjectures and test these ideas. They cultivate creativity as students design their own plans for modeling their solutions. They encourage patient debate and equitable exchange of ideas. They develop confident, productive citizens as students learn to respect one another as unique learners, as well as value the improved understanding that results from collaborating with diverse learners. If we are all mathematicians, we deserve to do mathematics. Rich tasks are a powerful vehicle for steering that mathematical thinking.

Sara Good, Greater Cleveland Council of Teachers of Mathematics

HOW to Keep Rich Tasks… *Rich*

There are many things to consider when selecting a mathematical task, implementing it, and then reflecting upon the results of students' efforts to solve it. Fortunately, there are many print and online resources to help with these considerations. The following, however, highlights strategies that keep the mathematical behaviors a priority for our students and, as a result, keep the *richness* in the rich task:

Notice cultural barriers to productive learning, and do not surrender to them!

Not ethnic culture, but *classroom* culture. Mathematics classrooms in our country do not traditionally require students to practice mathematics. It is not common for students to embrace ambiguity as an intellectual challenge to tackle, or to seek the input of their peers to improve their own understanding. Our society typically values instant gratification without reflection, and dismisses any efforts that ultimately yield powerful, yet delayed results. In turn, students may conclude that mathematics is supposed to come quickly and easily to them, that it is something that cannot be done without the help of the teacher or, even worse, that mathematics is simply not for them. As a result, students suffer from "public performance anxiety" in the classroom (Jacobsen, 2013). They will do anything to avoid looking dumb in front of their peers. Any teacher could list the symptoms for this society-afflicted disorder—cheating on tests, immediately giving up and raising their hand to elicit teacher's help, misinterpreting a teacher's question as an indicator that they are wrong, etc. The best remedy is to support students' belief that they are born capable mathematicians and, therefore, to expect them to embrace ambiguity and seek input from their peers. This remedy is not easy to concoct. It cannot cure the disorder with a single dose. We have our own culture in which we all live working against us! **Think of the strategies that follow as a few powerful ingredients to this remedy:**

1. Replace explanations with targeted questions.

When we immediately move in to correct a student's mistake or explain the answer to their question, we inadvertently support the beliefs that go against our goals as math teachers to support and develop the mathematicians in our classrooms. We unknowingly send the message that they are not capable of doing mathematics. Instead of explaining a solution, pause…and ask targeted questions, such as:

- *What do you understand so far?*
- *How does your neighbor's thinking compare to yours?*
- *What other representations might help you answer your question?*
- *How do you know when your answer is correct? Prove it to me so that I understand.*
- *If you continued your strategies with other numbers, will it always work?*

2. Slow down with increased wait time to speed up learning.

Many students are given less than a second to respond to a teacher's question. What results are short responses that require little thought. Decades of research suggest waiting 3-7 seconds after posing a question. Even more, a teacher should use the same wait time *after* a student has responded. Wait time benefits learners of all abilities. When done consistently, you will notice an increase in thoughtful responses, unsolicited responses, responses from less capable students, student-to-student interaction, and frequency of student questions. Use caution, however. Wait time should be matched with the level of cognitive demand that the question requires. Too much wait time for recall questions, or vice versa, can have negative results in student achievement and motivation (Anderson, 1978; Rowe, 1986).

3. Ensure equal status in the classroom.

Teachers possess more power than they realize. We have the power to equalize the *status* in our classroom in order to improve access to mathematics for all students. Students know the "smart" and "dumb" kids in every classroom. Some learners have *increased status* in the eyes of their peers. That is to be expected when our society values immediate versus mindful results, and almost abhors mistakes. It is our job to cultivate a productive learning environment for our students, one in which students feel safe to make mistakes and understand their value in refining their own and each other's understanding. We must first create frequent opportunities for our students to work together, and establish classroom norms that make productive group work possible. We then must make every effort to *assign competence* to our students, which is the practice of making public the intellectual contributions of a particular student to a group's problem-solving efforts (Featherstone et al, 2011). *Huddles* and *Participation Quizzes* are two ways to ensure equal status in the classroom and to make public the norms and contributions that you value most.

Some Strategies for Keeping Rich Tasks…*Rich*

CLASSROOM NORMS:

The following is a list of norms that middle school students generated to make sure productive discourse and learning takes place (Jean Krusi, *The Discourse Project*, 2009):

Everyone is listening.
Everyone is involved.
Everyone puts out ideas.
No one is left out.
Everyone is understanding—if not at the beginning, then by the end.

SMP LEARNING TARGETS:

Communicate to students the value of the Standards for Mathematical Practice (SMP) by making them the learning target at all times. By doing this, you also do not rob your mathematicians of the chance to discover for themselves the content understanding that is also the focus for the lesson.

Learning Target (SMP 1): *"I am learning to persevere in solving problems, even when they are difficult."*
Learning Target (SMP 3): *"I am learning to listen to understand how others are thinking."*

To conclude the lesson, have students revise the learning target by folding in the content that they learned:

Learning Target (4, 6): *"I am learning to show my thinking so that others can understand it."*
Revised Target (4, 6): A student might write, *"I learned that you need to include the 2 exponent to show square units when you measure areas."*

PARTICIPATION QUIZ:

1. Pick a group worthy task.
2. Tell students which norm you are focusing on.
3. Show teams how you are keeping track (overhead, posters, chalkboard, sticky notes, clipboard).
4. Record comments that exemplify the targeted norm while students are working.
5. Debrief as a class. (You do not need to record everything).

For the norm of collaboration, or "No one is left out," you might overhear and record:

Group 1: *"Wait. Not everyone is ready to move on."*

Group 2: *"I think we missed something. Let's go around and share what we've tried so far. Maybe we can figure out our mistake."*

Group 3: *"Listen, guys. Melissa has a great idea. Melissa, say that again."*

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Some *More* Strategies for Keeping Rich Tasks…*Rich*

THE HUDDLE:

1. Call upon one student from each cooperative group to the front of the class, particularly students with low confidence or decreased *status*.
2. Give students a helpful piece of information—definition, etc.—and check for understanding.

   Example: *"Your group might not remember what an integer is. Do you remember? That's right. It is any whole number, not a fraction, including zero. It can be positive or negative."*

3. Students return to their groups to share.

GALLERY WALK:

1. Student groups record their solutions to a task and post them around the room.
2. Student groups begin at their solution poster, and together rotate clockwise or counterclockwise to the next poster.
3. At each new solution poster, students compare and contrast models of thinking.
4. Repeat until students return to their original solution poster.

WHAT I NOTICE, WHAT I WONDER:

1. Students examine others' work, noting what they notice and what they wonder on sticky notes, for example.
2. Students first notice and record the positive elements of the work.
3. Students then note any critiques and questions they have about the work.
4. Return work to each student, and allow students to reflect on the notes and revise or justify their work as necessary.

   Note: Students can do this with a partner, cooperative groups, or during a Gallery Walk.

More Ideas:

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