



THE PATH TO SUCCESSFUL PROBLEM SOLVING

5 Steps To Use In Your School



How do we get our students engaged?

How do we get our students engaged in mathematics today? How do we get them excited to learn and play with the concepts we're teaching? These are questions every educator has to consider. And these days, finding answers seems more challenging than ever.

BEST PRACTICES

From close-reading strategies, to collaborative protocols, to self- and peer-assessment, we'll guide you to create the most successful and impactful problem-solving practice in your classroom.

RESEARCH-BASED EVIDENCE

We're applying everything from research on the brain to effect size of assessment practices to make sure your students achieve the best possible outcomes.



It's No Secret - Problem Solving is Powerful

For decades, leading voices in education and assessment have touted the power of problem solving and performance tasks for creating deep, lasting understanding and evaluating student skills and knowledge.

“Assessment is authentic when we anchor testing in the kind of work real people do, rather than merely eliciting easy-to-score responses to simple questions. Authentic assessment is true assessment of performance because we thereby learn whether students can intelligently use what they have learned in situations that increasingly approximate adult situations, and whether they can innovate in new situations.”¹

Utilizing mathematics to solve real-world or authentic tasks requires more than the foundational skills of arithmetic and calculation. Authentic tasks require the thoughtful application of multiple mathematical concepts. To solve these tasks, a person or team must decide on a strategy, choosing which math skills and tools to use and in what order. Once the team has determined their strategy and arrived at a solution, they must then design a clear explanation of their solution path, demonstrate and explain their thinking, and articulate the reasonableness of their solution. In essence, students must learn to develop persuasive mathematical arguments using precise mathematical language and evidence to support their thinking.

Creating opportunities for students to practice authentic problem-solving skills within their classrooms, in safe and supportive environments, provides incredible opportunities to learn to create real solutions to real problems. In this way they can develop the ability to tackle the complex challenges of the 21st Century.

1. Grant Wiggins, *Educative Assessment: Designing Assessments to Inform and Improve Student Performance* (San Francisco: Jossey-Bass, 1998), 21.





So, What's the Holdup?

Effectively delivering powerful problem-solving opportunities to students is difficult! It requires authentic tasks written to allow for flexibility, a teaching style that trusts students to lead and discover, and plenty of time for self-, peer-, and teacher assessment. It requires a process that's reliable enough for students to lean on in a variety of situations, but flexible enough to allow for independent, creative, and critical thinking.

In the pages that follow, we're proud to share a problem-solving process that you can use with students starting tomorrow. Just select a task within their Zone of Proximal Development and stand back to let the magic happen. Soon enough, they'll have the confidence to solve any problem - in class, on assessments, and in life.

Step 1: How to Unpack a Problem-Solving Task

For students to realize the full benefits of authentic problem-solving tasks, you need strategies to help them successfully read and unpack these rigorous problems. There are several elements Exemplars has learned and tested over the last 30 years that have proven to be effective in helping students better understand these types of problems.

1 - Solve the Task Yourself

It's important that a teacher spends time solving the selected task before giving it to students. As you're solving the task for yourself, envision all of the different strategies students could use.

- What manipulatives might they utilize?
- What representations might help them visualize the math concepts in the task?
- What prior knowledge do you believe your students have that they can bring forward to help solve a task?

Anticipate any challenges your students may have while solving the task and plan specific questions that will elicit understanding without necessarily giving them the answers.



2 - Use Engagement Images

Carefully selected images that avoid making students think they show an answer can be used to pique student curiosity. In some cases, they may help teachers discuss the vocabulary and themes within a task. Find and display the image and ask questions like:

- What do you notice?
- What do you wonder?
- What kind of math questions could you ask about this image?



3 - Apply the 3-Reads Protocol

We recommend the 3-Reads close reading protocol, which puts an emphasis on taking the necessary time to read for understanding.

- First Read - Read the problem out loud to your students. The main question to ask your students is, "What is this problem about?"
- Second Read - Invite a student volunteer to read the problem again aloud. Ask students, "What question does this task ask us to solve?"
- Third Read - During the third read, invite your students to identify what relevant information is provided and not provided that will be needed in order to solve the task.

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Step 2: How to Think of a Plan

Try a Think-Pair-Share Framework

After you have unpacked the task and read for understanding using the 3-Reads Protocol, invite your students to spend a minute of private think time defining for themselves how they might solve this problem. Next, ask them to turn to a table partner or put them in small groups to share their plan/strategies for how they want to attempt to solve their problem. Finally, bring the class back together for a whole group conversation.

Encourage Flexibility and Creativity

Some students need support to slow down and think deeply. We can do this by encouraging students to brainstorm a wide variety of strategies they might use to solve the task. Honor all students' thinking by recording ideas for everyone to see.

Students might come up with ideas like:

Start with simpler numbers

Use manipulatives

Act it out

Make a diagram

Make a number line

Organize into a table

Use a 10-frame

Look for a pattern



Step 3: How to Solve the Problem

Tackling a problem-solving performance task starts with establishing conceptual understanding. Conceptual understanding asks students to make sense of the problem for themselves, to see the connections between the problem and their own internal, prior knowledge. How can a student utilize what they've learned and practiced in the past to help them begin to solve this new, unfamiliar task?

Encourage Collaboration

Small groups of students (3 or 4) create terrific potential to discuss ideas for solving the problem, to build representations, to make sense of the challenges of the task and to work towards a collective solution.

Research shows dramatically more brain activity when students are working collaboratively versus students working in isolation. Some research indicates the difference is so potent that collaborative learning counts as a social activity.

The article "[Learning and the Social Brain](#)," published in Edutopia, states, "If the species is hardwired to work together, then our classrooms should continue to feature a healthy dose of activities that emphasize cooperation, teamwork, and peer-to-peer teaching."²

2. Stephen Merrill, "The Learning and the Social Brain," Edutopia, accessed June 25, 2025, <https://www.edutopia.org/package/learning-and-social-brain>.

Ask The Right Questions

An important role for teachers, as students work collectively to solve a task, is to ask probing questions without giving too much information away. The goal of this time for the teacher is not to tell your students how to solve the problem, or to give them significant hints to push them in the right direction. The goal for the teacher is to help students make sense of the problem right where they are in their process of solving it. So what does the student need to know? What questions can you ask to help them see for themselves what they might be missing?

PROBING QUESTIONS

- **What have you done so far?**
- **Can you tell me what you're working on?**
- **Where are you stuck?**
- **What do you know so far?**
- **Are there any parts you're unsure about?**

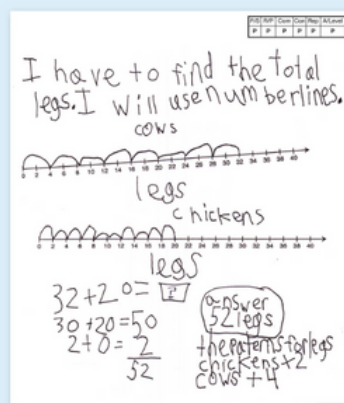
Step 4: How to Show Your Thinking

The goal of completing a problem-solving performance task is more than just arriving at a correct answer. The Exemplars Standards-Based Math Rubric states that in order to meet its standard of “Practitioner,” students must also communicate their thinking and reasoning, use formal math language, create representations to show conceptual understanding, and make mathematical connections.

Exemplars Standards-Based Rubric

	Problem Solving	Reasoning	Communication	Connections	Representation
Proficiency	Is a highly skilled solver, using a variety of strategies to solve the problem. Able to communicate the solution to others.	Is a highly skilled reasoner, using a variety of strategies to justify the solution. Able to communicate the reasoning to others.	Is a highly skilled communicator, using a variety of strategies to explain the solution. Able to communicate the solution to others.	Is a highly skilled connector, using a variety of strategies to relate the solution to other concepts. Able to communicate the connection to others.	Is a highly skilled representor, using a variety of strategies to represent the solution. Able to communicate the representation to others.
Approaching	Is a skilled solver, using a variety of strategies to solve the problem. Able to communicate the solution to others.	Is a skilled reasoner, using a variety of strategies to justify the solution. Able to communicate the reasoning to others.	Is a skilled communicator, using a variety of strategies to explain the solution. Able to communicate the solution to others.	Is a skilled connector, using a variety of strategies to relate the solution to other concepts. Able to communicate the connection to others.	Is a skilled representor, using a variety of strategies to represent the solution. Able to communicate the representation to others.
Emerging	Is a less skilled solver, using a variety of strategies to solve the problem. Able to communicate the solution to others.	Is a less skilled reasoner, using a variety of strategies to justify the solution. Able to communicate the reasoning to others.	Is a less skilled communicator, using a variety of strategies to explain the solution. Able to communicate the solution to others.	Is a less skilled connector, using a variety of strategies to relate the solution to other concepts. Able to communicate the connection to others.	Is a less skilled representor, using a variety of strategies to represent the solution. Able to communicate the representation to others.

Second Grade Student Solution - Sample



Problem-Solving Process

Both the NCTM Process Standards and the Mathematical Practices underscore the value of rich solutions. A student's solution provides valuable formative assessment insights for teachers into the student's grasp of math concepts and skills—insights that executing stand-alone calculations simply can't deliver.

By following the Exemplars Problem-Solving Process, students will be guided to show all phases of their thinking, from restating the question to making a mathematical connection.

PROBLEM-SOLVING PROCESS

UNDERSTAND the problem:

- Read the task.
- What do you need to find out?
- Write an "I have to..." "I need to..." "The question is..." sentence.
- Identify important information.

THINK of your plan:

- Consider possible strategies.
- Choose the strategy you want to use.
- Write an "I will..." "My strategy is..." "My plan is..." sentence.

SOLVE the problem:

- Use your strategy to solve the problem.
- Show your answer.

REVIEW your solution (all your work including your answer):

- Did you show your thinking?
- Did you state an answer(s)?
- Did you use at least 2 terms and/or math symbols?
- Did you make an accurate representation?

MAKE a connection (some examples include):

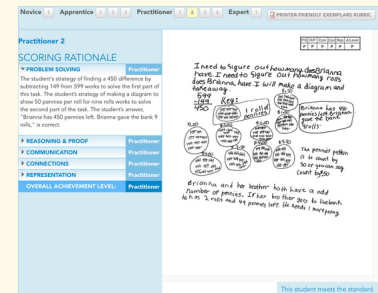
- Make an observation(s).
- Find a pattern(s).
- Recreate or continue the problem.
- Use a different strategy to solve the problem.
- State a phenomenon (something that is always true).
- Discover a rule.

Step 5: How to Review Your Solution

Self- and peer-assessment are essential practices in modern education, fostering critical thinking and problem-solving skills among students. In an era where independent reasoning is highly valued, these assessment methods empower students to reflect on their work, understand their strengths, and identify areas for improvement. By integrating self- and peer-assessment into the classroom, educators can help students become more self-aware and engaged in their learning processes.

Build Understanding With Anchor Papers

Exemplars provides student work samples, also referred to as anchor papers, along with scoring rationales at the four performance levels of its Standards-Based Assessment Rubric. When you present students with a specific anchor paper from an Exemplars task, and discuss it with them in conjunction with the rubric criteria, you help students internalize what success does — and doesn't! — look like.



Idea #1

Give students a task to try and then share the corresponding anchor papers. Discuss and critique the anchor papers and score them as a class using the Exemplars rubric.

Idea #2

Group discussion of an anchor paper at the Practitioner level (meets the standard) encourages students to reflect on the process of developing strong solutions as they evaluate their own work or that of a math partner.

Idea #3

Examining an Apprentice-level (below standard) anchor paper as a class creates a teaching opportunity, encouraging students to identify incomplete or incorrect solutions and to explore and justify alternative approaches.

Student-Friendly Rubric

Rubrics present students with important information about what is expected and what kind of work meets (and doesn't meet) the standard. Exemplars' student rubric mirrors the expectations and performance levels of the assessment rubric, but is written in kid-friendly language and uses illustrations. This is designed to develop a learner's ability to self- and peer-assess.

Exemplars' Student Rubric					
Level	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice	Did not understand the problem.	My work is not correct.	Used no math language.	Did not notice anything about the problem or the numbers in my work.	Did not use a math representation to help solve the problem and explain my work.
Apprentice	Only understood part of the problem. My answer is not part of the problem.	Some of my math language is correct.	Used some math language and numbers.	Used some math language and numbers.	I tried to use a math representation to help solve the problem and explain my work, but it was not correct.
Practitioner	Understand the problem and my answer is correct.	All of my math is correct.	Used math language and numbers accurately throughout my work.	Used math language and numbers accurately throughout my work.	I used a math representation to help solve the problem and explain my work, and it was correct.
Expert	Understand the problem. My answer is correct. I used a rule, and I can explain my answer.	I know that I have more about math than most. I used my plan. I can explain my work.	Used a lot of specific math language and numbers accurately throughout my work.	Used math language and numbers accurately throughout my work.	I used a math representation to help solve the problem and explain my work, and it was correct.

Looking for More Support?

If you don't already have a reliable source for rigorous, standards-aligned, real-world tasks, we encourage you to check out one of the Exemplars problem-solving libraries. Inside, you'll find time-saving resources like differentiated versions, engagement images, lesson planning sheets and scored student work samples (anchor papers) that clearly show what expert problem solving looks like.

Library subscribers receive personal onboarding support in order to make the most of these resources and ensure success for all students, from the most hesitant to those needing enrichment and everyone in between.

Bibliography

Merrill, Stephen. "The Learning and the Social Brain." *Edutopia*. Accessed June 25, 2025.
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Wiggins, Grant. *Educative Assessment: Designing Assessments to Inform and Improve Student Performance*. San Francisco: Jossey-Bass, 1998.

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