Intrepid Math FAQs

The Problems

What are the *Intrepid* Math problems?

Each *Intrepid* Math set contains eight problems for advanced learners that span four strands (number, geometry, algebra, and measurement and data) of the Common Core Standards. Every problem can be solved in many ways, and many problems have multiple solutions. Most problems have a less complex version called Testing the Waters that is accessible to more learners.

How challenging are the problems?

The problems are very challenging—and *differently* challenging.

What makes *Intrepid* Math problems different?

With traditional math problems, students *learn to solve*. With *Intrepid* Math problems, students *solve to learn*. Rather than applying learned skills to answer story problems, students solve problems in order to learn new concepts. Some problems may take days to solve, especially for younger students. The goals are not to finish quickly and get perfect scores, but to work hard, persist, and learn new things. Because the problems have high ceilings, many students will not finish them, but will continue as far as they are able.

Why did you make the problems so challenging?

The high level of challenge creates more opportunities for growth, and the high ceilings ensure that every student's thinking is stretched. The effective use of problems like these leads to deeper learning, a more productive mindset, and more flexible differentiation for advanced learners. See "The Benefits of Challenging Problems" at the end of these FAQs.

Why do the problems show a band of grade levels?

Students can solve *Intrepid Math* problems on many levels, making them flexible for use with different age groups. Fourth grade content knowledge (combined with plenty of ingenuity and creativity) is sufficient, yet the problems will stretch and extend the thinking of talented fifth and sixth graders as well. Every problem comes with suggestions for using it with all three grade levels.

What are the *Testing the Waters* questions?

Testing the Waters questions are less complex versions of *Intrepid* Math problems that are accessible to more students. These questions are also useful as "bridges" to the original problems for any student who is having trouble getting started.

What are the *Diving Deeper* questions?

Diving Deeper questions extend the problems by adding further depth or more advanced content. These questions are especially helpful for older students but may be attempted by others who complete the main problem and are interested in exploring further. Diving Deeper questions reinforce the idea that there are always new questions to ask.

How are the problems connected to the Common Core?

Every problem is aligned with Common Core Math Content Standards in grades 4, 5, and 6. Most problems extend the standards by increasing depth or complexity. More importantly, the problems support the Common Core Standards for Mathematical Practice (CCSMP), which deal with key *processes* involved in learning mathematics. The best way to address the CCSMP is to follow the suggestions in these FAQs for using the problems effectively.

Why do some problems have no standards listed at certain grade levels?

Some of the problems extend concepts outside the grade 4–6 band. For example, subtraction of whole numbers is emphasized in early elementary grades, yet some *Intrepid* Math problems extend these subtraction concepts in order to create deeper learning opportunities in grades 4 through 6. Additionally, the Common Core does not specify the continuous development of every concept. For instance, angle measurement appears in grade 4 and does not reappear in a focused way until grade 7, yet *Intrepid* Math includes opportunities to develop angle concepts in the intervening grades.

Why do some standards rarely appear in the problems?

Standards that focus on narrower learning goals are aligned with fewer problems. Also, standards that emphasize computational efficiency may show up less often, because *Intrepid* Math problems emphasize conceptual understanding. Students practice computational skills, but these skills are not usually a focus of the problems.

What if my students choose strategies that don't fit the listed standards?

Because *Intrepid* Math problems are rich and open-ended, there are many ways to solve them, and the standards that students experience will depend in part on the strategies that they choose. It is in keeping with the design and spirit of the Common Core to encourage students to develop and discuss strategies that make sense to *them*. The standards reflect learning *progressions*—big concepts that develop and deepen over time—not lists of isolated skills to acquire. You may ensure that your students are meeting their targeted learning goals by first listening to their ideas and gradually steering inquiry and discussion in the relevant directions.

Teaching with the Problems

Who should use the problems?

I recommend offering the problems to any adventurous student who wants to try them, even though they are written to challenge advanced learners. The problems use different skills than traditional classroom tasks do. You may have great thinkers who are not great test-takers!

What if advanced students want to opt out?

Advanced students should be expected to work on problems like these. While some may resist challenges due to a fear of failure (or what they perceive as failure), these students, more than anyone, need the experience of finding a way forward when they hit a wall.

How do I prepare for the problems?

The best way to prepare for a problem is to try it yourself! Even better, try it with a colleague and discuss the problem as you work. Think and talk about your strategies and, more importantly, the strategies that you think your students might use. After students have completed the problem, make some notes documenting what you have learned about their thinking. This will help you become more effective each time you use the problem.

Is it okay for students to work together?

Working together is a fun and effective way to learn from challenging problems. Be aware that some students may need time to think by themselves before beginning to collaborate.

It is okay for students to use calculators?

Most of the *Intrepid* Math problems are designed to be solved without calculators, though you and your students should feel free to use your own judgment. The main idea behind limiting the use of calculators is for students to develop their *own* computation and estimation strategies, especially when concepts are new to them.

Is it important for students to show their work?

Yes. For work that they turn in, students should use words, numbers, and diagrams as needed to express their ideas clearly. (Each problem is placed on a page by itself in order to leave students plenty of room to do this.) Even more importantly, students need to record their ideas as they work. I suggest using "thinking paper" for this.

What is thinking paper and how do students use it?

Thinking paper is an alternative to scratch paper. Students should use it for working on problems that take a long time to solve. Thinking paper is not turned in. It is a safe place for students to record and test ideas, make notes, make mistakes, look for patterns, and remember what they have already tried. It only has to be neat and organized enough for the problem-solver to read. Students should save their thinking paper from day to day as they work and use it to help them write their final explanation on the handout, choosing the most important ideas and leaving the rest out.

What about students who don't know how they got their answers?

Intrepid Math problems help students learn to bring their thoughts to the surface and analyze them critically (especially when they use thinking paper). Make this an expectation, but ensure that the communication you require from them is purposeful. Strike a balance between acknowledging and respecting your students' thinking styles and helping them learn to pay attention to their own thought processes.

How can I help students who are struggling with putting their thoughts on paper?

Have them speak their ideas aloud to you and then transfer them to paper. They may have to revise what they write, but this often helps them make the mind-to-paper connection.

How do I respond when my students get stuck?

Getting stuck or off-track is a normal part of problem-solving. Resist the urge to rescue your students. Teach them to rescue themselves by asking what they already know, what they still need to know, what they are thinking, what they have tried, what specific questions they have, and what they can learn from their false starts.

What if a problem involves skills that I have not taught yet?

This will happen mostly with younger students, especially early in the school year. Consider assigning the problem anyway, but do not pre-teach the skills. These problems encourage students to develop their own computation methods, often through visual models. For example, students who have not learned rules for adding fractions but who do understand equivalent fractions can use number lines and other models to find answers. This is part of the process of *solving to learn*. (See "What makes the problems different?" above.) The solutions show examples of strategies that students are likely to use at different stages of development.

What if I am not available when students need my support?

This may be less an issue as your students gradually become more independent, but it is always good to have fallback activities that they can turn to. Also, try to check in with them regularly and to find some predictable times when they know it is okay to approach you.

Should students take the problems home?

If you send the problems home, be sure to communicate clearly with parents about the goals of the problems and how you are using them. Parents also like to know what their role is. By and large, it is great for them to help with time management, emotional support, and mathematical communication, but not as much with the problems themselves. Remember that an important goal of the problems is to develop independent thinkers.

How can I tell when it is time for students to stop working on a problem?

Consider how long and hard they have been trying, and assess their chances for making further progress. Struggle should be productive, not pointlessly frustrating. If they have been trying for a long time and are being held up by something small, consider dropping a hint. When you decide that it's time to stop, acknowledge their progress and effort, and reinforce what they have learned.

How should I assess the problems?

Written comments related to students' thinking are great. If you need a number score, consider using a rubric like the one at http://www.5280math.com/miscellaneous for scoring concept-based problems. Ask students to self-assess as well.

How can I assess students individually when they are working together?

After the group has finished discussing the problem, ask each student to submit her or his own written explanation. These explanations should be written independently.

The Benefits of Highly Challenging Problems

On the first page of the FAQs, I mention three ways that students benefit from the effective use of highly challenging problems: deeper learning, a more productive mindset, and more flexible differentiation.

What do you mean by deep learning?

Deep learning in math means understanding why, not just how. Students who learn deeply make connections between concepts. They can apply their learning in unfamiliar situations, because they know more than the steps. They know what the steps mean.

What do you mean by a productive mindset?

Students with *productive mindsets* are confident, self-reliant, curious, and persistent. For these students, success means thinking deeply more than thinking quickly, learning something new more than getting a perfect score, and asking an interesting question as much as getting a correct answer. When students with productive mindsets get frustrated, they don't quit. They take a break, ask for support if they need it, and try again.

How do the *Intrepid* Math problems provide flexible differentiation for students?

Students rarely "top out" of these problems. There are always new questions to ask and new things to try. The problems are self-differentiating, because students work until they reach their limits.

How do I use the problems most effectively?

Allow and expect students to be as independent as possible. Instead of modeling procedures and strategies for them, help your students learn to

- Clarify the problem.
- Record their ideas on thinking paper as they work.
- Make predictions and test them.
- Discuss and critique each other's ideas.
- Justify their answers.
- Persevere when things get hard.
- Explain their thinking clearly (orally and in writing).

After they have made as much progress as they can, help your students to

- Reflect on what they have learned.
- Think of new questions to ask.

Comment on any written work that you ask them to submit.

Notice that learning to think mathematically is not all that different from learning to think in general. These teaching techniques are similar to instructional "best practices" in other content areas.