Using the PoWs: Introduction
What are the Problems of the Week and Why Should I Use Them?

The Math Forum's Problems of the Week (PoWs) were started in 1993 to give geometry students an opportunity to use the newly–available Internet and its electronic mail to practice written communication about their mathematical problem solving. In the years since, problems in other areas of math have been added and teachers have used the problems in many different ways, but our goals have remained the same: to encourage the application of mathematical knowledge and the development problem solving strategies, and to create an environment in which students explore, discuss, start and start over, and communicate about mathematics.

> *I was observing students work out a problem together. When they finally "got" it, one of the students exclaimed, "We are so smart!" Isn't that what we are striving for? Not "the teacher is so smart," not "they are so smart," but "we are." In that statement, I heard both confidence and community.*
> —Cynthia Lanius, former high school teacher

At its most basic level, a "Problem of the Week" is an open-response math problem that can be printed out and handed to the students. But there's a lot more available in the online environment!

For teachers, the PoWs offer:

Enhanced Problem Packets: These guides for our Current PoWs include: the problem text and the answer check for students after they submit, an introduction to the problem, the solution that we write for our mentors, a problem-specific scoring rubric, tips about how to introduce the problem to your students, ideas about how to move students forward in their thinking and writing, and a list of the common mistakes. About half of the problems in each service are drawn from our Library, which enables the packet to also include sample student solutions from previous rounds with those problems. These solutions are accompanied by brief comments and a score from one dimension of our rubric (for example, we might give the Strategy score for each of the solutions so that teachers can see examples of the progression from Novice to Apprentice to Practitioner to Expert).

Problem Solving and Activity Series: This year-long, coherent sequence of activities is designed to help students develop and deepen their use of mathematical problem-solving and communication. These lessons can be used in coordination with each round of the Problems of the Week, but are developed for more general use. The first section of the document contains activities that can be used with any problem and the second section illustrates possible student responses based on the Current Problem of the Week.

Online Resources: Through these web pages we offer: online starting points for the key concepts in the problem and links to similar PoWs in our Library, helpful questions and answers from our Ask Dr. Math archives, tips on teaching the content from our Teacher2Teacher service, and applets from our Math Tools library. We have made these pages for all of the problems we've written in the last six years and a few of the earlier problems.

Past Solutions: problems in our Library are accompanied by highlighted student solutions and commentary on those solutions, the different methods students used, and the common mistakes we saw.

Teacher Office: teachers can view their students' work online and see whether or not students viewed the answer check, revised their work, or left a comment. Teachers can also choose to mentor their students' work using our scoring rubric and online messenging center.

For students, the PoWs offer:

The Answer Check: after students submit their solution online, they can choose to check their answer, which means to look at the answer that we provide (we don't tell them how we got that answer, just what it is). Along with that, we provide hints and questions for students whose answer doesn't agree with ours, as well as for those whose does.

Revision: students can revise their work, either after viewing our answer check, or at any time after that, for up to 17 days (it's unlimited in our Library problems).

> *I liked being able to do it and revise it. The hints were really helpful. You don't want to look at the answer before you try it yourself. But after you try it, you look at the answer and see if the hints will help. You don't read all of them, because they won't all help, but you find the ones that do. Then you might be able to figure it out.* —Tahira, age 14

Why Should You Use PoWs in Your Classroom?

One can look at the Problems of the Week as merely another source of good problems for students to work on to supplement the curriculum. However, there are some specific issues in math classrooms that have shaped the design and use of the PoWs by teachers over the years, enabling them to play a significant role in students development as mathematical thinkers.

We all know adults who say they were "never any good at math". It's likely that math never made sense to them. Their experience with math was that they learned to discount their own thinking and instead to focus on and try to remember the ideas and techniques someone else had already figured out. Math didn't come "naturally" to them, because it was never about their ideas. It was about getting the right answer as quickly as possible, to be over and done with it.

The PoWs' particular combination of non-routine, supplemental problems, an asynchronous online system, a two-week time frame (in the Current PoWs), and the expectation of written explanations makes for certain opportunities for students. The more obvious are:

- to be challenged
- to apply concepts
- to use higher order thinking skills

> *The one with crickets, or grasshoppers. That was hard! Maybe it's because it was the first problem we did. Maybe if we had the same problem now, we'd be able to do it.*
> —Keairra, age 15

The less obvious but equally important include:

- There's no one right way: Connect to your own way of thinking. Build from your ideas and experience
- Persistence: Develop confidence in the ability to do problem-solving, to come up with ideas when you didn't think you could.
- Learn mathematical habits of mind: Use an understanding of number to test cases, systematically explore for patterns, generalize, transform to recognizable representations, efficiently name and organize for manipulation, prove (explain), multiple representations, explore and look for variation and constants, etc.
- Appreciate the value of writing for learning as well as for communicating. Move from description to explanation to reflection.

> *Don't think you're gonna get it right the first time. Be conscious of the fact that hardly anyone will get it right the first time.*
> —Jazmine, age 14

The PoWs and the NCTM Process Standards

PoWs are an effective vehicle for learning and reinforcing mathematical concepts and skills. The problems address the Process Standards proposed by the NCTM and promoted by many states in their mathematics standards.

Problem Solving

PoWs support the general process of problem solving, which goes beyond the math classroom. Students analyze the given information and apply knowledge and skills in different ways.

Reasoning and Proof

Justifying one's thinking and procedures, both orally and in writing, is fundamental to mathematics. PoWs provide the opportunity for students to develop this habit of mind and learn that mathematics makes sense.

Communication

Writing is an important component of PoWs. The process of putting thoughts into writing serves to clarify and organize the student's mathematical thinking.

Connections

The variety of topics used in the PoWs helps students make connections with other mathematical ideas and with contexts outside of mathematics.

Solving a broad range of PoWs helps students identify different problem situations and choose appropriate strategies for solving them.

Representation

PoWs invite students to use a variety of forms of representation. Students often use manipulatives, tables, graphs and diagrams in the process of solving the problem as well as in communicating their results. These representations can help some students move from arithmetic calculations toward algebraic generalizations as a natural next step in their mathematical growth.