



# Teacher's Guide to the Math Forum's *Problems of the Week*

<http://mathforum.org/pow/teacher/guide.pdf>

## Welcome!

Welcome to the Math Forum's Problems of the Week! Our program is built around a collection of inventive, out-of-the-ordinary problems that get your students thinking, talking, and doing mathematics. Your students will learn flexible, adaptive problem-solving skills and become better mathematical communicators. Working with these problems will help you analyze student thinking, design responsive instruction based on that thinking, and move your students toward becoming competent, independent problem-solvers.

This Guide is intended to help you use the Problems of the Week with your students. It describes the program's features, to familiarize you with the breadth of resources involved. It gives you strategies for beginning the program with your students, creating a problem-solving classroom culture, and fitting the program into your busy schedule. It also introduces the Math Forum's scoring rubric and feedback process. This will aid you in valuing student thinking and asking questions designed to take your students to the next step. The appendices offer complete, step-by-step instructions and more detailed information about our program.

We hope you find this a useful introduction to the Problems of the Week. We welcome your feedback on any aspect of the Guide. Please contact us using the page <http://mathforum.org/powcontact.html>.

## Program Overview

The Problems of the Week (PoWs) are creative, non-routine math challenges for elementary-, middle-, and high-school-level students. They are designed to stimulate students' interest in problem solving and to encourage them to communicate their mathematical thinking.

The Problems of the Week program is built around those PoWs. It's subscription-based, primarily for teachers, and offers tools and ideas for implementing the PoWs in the classroom. The basic subscription features four different levels of "Current Problems of the Week," while another level of subscription will give you access to a library of past problems, with archived student solutions and mentor commentary, that can expand the program's possibilities.

## Current PoWs

About

There are four services in the Current Problems of the Week (Current PoWs):

- Math Fundamentals (FunPoW), problems covering a range of upper-elementary content, including numbers, operations, measurement, geometry, data and chance, and algebraic thinking.
- Pre-Algebra (PreAlgPoW), problems that reinforce the content typically taught in late elementary through middle grades, including algebraic thinking, numbers and operations, measurement, geometry, data and chance.
- Algebra (AlgPoW), covering topics found in a formal Algebra I curriculum, and
- Geometry (GeoPoW), high-school-level problems.

Problems are posted every two weeks during the school year, with FunPoW and AlgPoW posted concurrently, and PreAlgPoW and GeoPoW posted concurrently the following week. So a middle-school teacher might choose one problem to work on for two weeks, or alternate weekly between FunPoW and PreAlgPoW.

## Current PoWs Features

From any page in our services where you see it, “Problems” takes you back to the main landing page for all our PoW services.

On any page within the Current PoWs, you can follow links to our Teacher Documents, Message Center, and FAQ.

- Teacher Documents links to all our Teacher Resources in one page (Activity Series, Online Resources, Enhanced Problem Packets—see page 3), as well as our Frequently Asked Questions, rubric and mentoring information, and links to Teacher Offices for the four services (and a fifth office for the Problems Library, if you have a subscription to that). This page also includes a series of articles about implementing problem solving and writing in the math classroom.
- The Message Center is a special web-based mail service with NO spam and NO other messages—only PoW messages. The most recently sent messages are at the top of the list. Your teacher account has its own Message Center, and each student you register will also have one, so no need to worry about email privacy issues when you register your students.
- FAQ means Frequently Asked Questions. These include topics such as how students’ usernames are created, setting up student accounts, use of student accounts, why students don’t need email, and links to the Teacher Offices.



From any specific Current PoW, you’ll also see Calendar, Latest Solution, and Teacher Office links.

- The Calendar lists “active” dates for each problem, solution posting date, and posting dates for comments and more solutions.
- Latest Solution is a direct link to sample solutions for the PoW most recently closed to submissions in a given service.
- The Teacher Office is your place to register your students and monitor their work, and mentor them if you are not using our free or paid mentoring services. It also gives you direct access to problems via their problem numbers, and links to the PoW discussion group and your own

personal Message Center. There's a Teacher Office within each of the four PoW services (and another for the Problems Library if you've subscribed to that).

Once you log in and view a specific problem, you'll see our scoring guide and mentoring information in the navigation bar at the left side of the page. You'll also see our "Print This Problem", Enhanced Problem Packet, Activity Series, and Online Resources pages linked at the top of the problem:



- The "Print This Problem" link takes you to a page with just the problem and a simple Math Forum header, so that you can print the problem cleanly and distribute it to your students.
- Enhanced Problem **Packets** include the problem and "answer check" (the answer we provide students after they submit their solution to a problem), an introduction to the problem, the solution we provide for the mentors, our problem-specific scoring rubric, tips about how to introduce the problem to students, and ideas about how to move students forward. When the problem is one from our Problems of the Week Library, we also include samples of student work and comments about the solutions based on a category from the scoring rubric. These Packets are also linked from the four main Current PoW pages, before you log in. Look for the link that reads "Enhanced Problem Packet for Teachers [PDF]".
- The Problem Solving and Communication **Activity Series** provides a framework and classroom activities for those who wish to enhance student competence and confidence in problem solving and communication, and to share best practices with other teachers. With each round of the Current PoWs, the Math Forum focuses on a particular strategy along with related communication skill development, organized in a coherent sequence throughout the year. Each unit contains strategy development activities that can be applied to any problem, and a section illustrating student use of those strategies for the Current PoW. The goal is for students to be able to move between multiple strategies flexibly as they attempt to solve interesting problems. Look for the link that reads "Activity Series [PDF]".
- **Online Resources** pages (formerly called Teacher Support Pages) describe the key concepts in the problem and link to similar problems in the Library, as well as associated resources such as questions and answers from our Ask Dr. Math service, conversations from the Teacher2Teacher archive with instructional tips, and tools from our Math Tools community library.

## Problems Library

About



The Problems of the Week Library (Problems Library) is an archive of all of the problems we have posted since the program's inception. Our first mentored Problem of the Week was the Geometry PoW, begun in 1993. Over the next six years, seven new Problems of the Week launched for new audiences:

- Elementary Problem of the Week (ElemPoW)
- Middle School Problem of the Week (MidPoW)
- Algebra Problem of the Week (AlgPoW)
- Trigonometry and Calculus Problem of the Week (CalcPoW)
- Discrete Math Problem of the Week (DMPoW)
- Math Fundamentals Problem of the Week (FunPoW)
- Pre-Algebra Problem of the Week (PreAlgPoW)

We've made all of these problems available through the Problems Library.

In addition to the problems themselves, the Problems Library contains a rich archive of student solutions to those problems, with highlighted solutions and mentor commentary on them. These can give you new insight into students' thinking, and help prepare you for what you might run into with your own students when you introduce a particular problem.

## Problems Library Features

As we have developed new features such as the Online Resources pages and Enhanced Problem Packets, we've added these to the Problems Library as well. This explains why you won't see these on every problem in the Problems Library. The green "ts" icon  indicates the presence of a Teacher Support page for that problem (indicating any of the three types of support pages, but predominantly Online Resources at this point, as that is the most established of the three). Our oldest problems were created before we developed the mechanism for students to submit their answers online! If you don't see the yellow "active" icon  next to the problem name, online submission is not available. You can always print a paper copy to use with students.

A level of difficulty rating is provided for each problem. It focuses on the mathematical challenges represented by the problem, the difficulty of the mathematical concept, and the difficulty of mathematical calculations for students at a given level of problem solving. You are invited to read the full Rubric for Coding Problem Difficulty, at <http://mathforum.org/library/problems/difficulty.html>

After each problem listing in the Problems Library category pages, you'll see a link labeled [more>>](#). This will take you to a page with a full listing of the problem's title, author, and description, as well as direct links to the main problem page and solution page, and if it exists, the Teacher Support Page.

## Problems Library Browsing

From the main Problems Library page, you can go directly to a problem using its problem number, if you know it.



Otherwise, you can browse through the problems in several different ways.

The Problems Library consists of four broad categories, as with the Current PoWs: Math Fundamentals, Pre-Algebra, Algebra, and Geometry. A typical single subscription to the Problems Library gives you access to two of those, generally the Elementary band of FunPoW and PreAlgPoW, or the Secondary band of AlgPoW and GeoPoW. In addition to the four current archives, there are static archives of our older Discrete Math and Trig & Calculus categories. These are presented the same way, except that new problems are not currently being added to these categories. The older ElemPoW is now categorized under FunPoW, and the Middle School PoW is now categorized under PreAlgPoW. The Trig/Calc and Discrete Math PoWs are included with both AlgPoW and GeoPoW, so that you see them if you purchase one or both Secondary PoWs. Once you log in, the content you've purchased will appear in green.

To browse by topic, select one of the six services shown at the top of each page. Then select a math topic; you will receive an alphabetical list of problems within that topic. Examples of math topics include: algebraic reasoning (math fundamentals, pre-algebra), factoring, graph theory (discrete math), pi, the Pythagorean theorem, and integration (trig/calculus). For the four current categories (FunPoW, PreAlgPoW, AlgPoW, and GeoPoW), we provide links at the top of the page to related resources in our Math Tools library, our Dr. Math area, and the NCTM Standard(s) addressed by each topic.

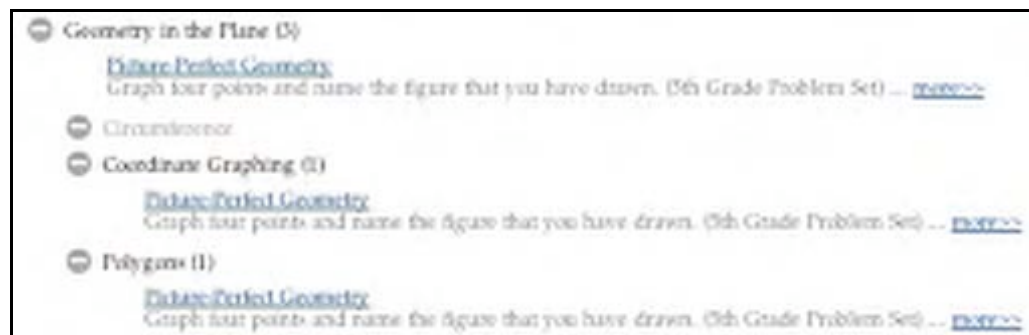
Once you're browsing through one of the six categories, you'll see a sidebar on the left side of the page. This provides a list of the main subject headings within that category. It also offers basic navigation links, such as to the main page of the Library. The link labeled "Browse all Algebra Problems" (or other service you're currently in) will take you to an alphabetical list of all the problems in that service—Algebra, in this case.

At the bottom of the introductory page for each service is a browsing area with topics of interest to teachers of that service, covering all of the problems in all of the services.

## Write Math with the Math Forum About

A subscription to our Write Math with the Math Forum (Write Math) service lets you find problems when you're searching for something to match a specific level or topic, state standard, or textbook topic. Your purchase entitles you to a specific grade band of problems. The main Write Math page lets you choose which way to search: by level/topic, standard, or textbook. Use those searches to see a "tree" of categories, and drill down through the "branches" to find a specific problem. (For details on how to use those searches, see Appendix I, on page 10 of this Guide.)

Problems are categorized in as many categories as apply to them, so the parenthetical numbers after a category do not necessarily reflect the number of actual problems in the category.



In this instance, the problem “Picture-Perfect Geometry” is aligned to both “Coordinate Graphing” and “Polygons,” as well as the parent category, “Geometry in the Plane.” It is those alignments that are counted in the numbers after each category: not the number of problems in each category, but the number of alignments of problems to that category.

## Mentoring About

The Math Forum provides mentoring to student submitters in several different forms. All mentors use the Math Forum's scoring rubric, which covers several components of problem solving and mathematical communication. They also provide feedback to students designed to help them improve one or two specific aspects of their work. It is our hope that students who receive mentoring of any kind will take advantage of it to revise and improve their work.

All mentoring options require a subscription.

**Free Mentoring** (Current PoWs only, requires Class Membership or higher to the Problems of the Week Library): For opportunities when mentors will be available to reply to student submissions, please consult the dates on How to Use Free Mentoring, linked at [http://mathforum.org/pow/free\\_mentoring.html](http://mathforum.org/pow/free_mentoring.html).

**Priority Mentoring** (Current PoWs only, requires Class Membership or higher to the Problems of the Week Library): Math Forum staff and trained mentors reply to each student's submission and subsequent revisions.

**Assess Your Own** (Class Membership or higher to the Problems of the Week Library): Teachers whose students are submitting solutions have the option to provide scoring and feedback to their own students at no extra charge. The Math Forum provides orientation to the scoring rubric, additional supporting material about the philosophy of mentoring, and, if desired, feedback on the teacher's initial mentoring efforts. For more in-depth help with our mentoring system, we offer various professional development opportunities. For more detail, see <http://mathforum.org/workshops/>.

**Local Mentor Development** (School or District Membership or higher to the Problems of the Week Library): Institutional members can designate mentors from their own organization. The Math Forum will provide online training and support, which the mentors are required to complete in order to participate.

## What the PoWs Can Do for Your Classroom

Through the process of working with the PoWs, your students have the opportunity to think through problems with a wide range of possible solution strategies; write explanations that develop their own understanding; and revise their work and develop as mathematics learners.

The Math Forum believes a key to increasing students' performance lies in writing math. When students write about their problem-solving process, they show their thinking. You as teachers can use that to see where students are experiencing difficulties, and help them unlock the door to better understanding—and ultimately to build both mathematics content knowledge and process skills on a solid foundation.



Research<sup>1</sup> on students who regularly participate in our PoWs shows that, regardless of students' initial level of math competence, after working with the PoWs, they make more connections to math, generate more effective strategies for solving problems, and work more independently on those problems.

The PoWs offer you new ways to gain valuable insights into student thinking. Use them to practice formative assessment, to address the NCTM Process Standards in your classroom, or to prepare your students for standardized tests using open-ended or constructed-response items.

## How to Start Using Your Subscription

Once you've received your login information, look over the Current PoWs, and pick one to work on for yourself, before you even take it to the classroom.

**Work the problem.** Read it over, think about it, and solve it as you think appropriate. Write up your solution as if you were a student: **write your answer** in a full sentence, and then **explain** how you arrived at that solution.

**Reflect on your solution.** Did you interpret the problem correctly? Did you choose an effective solution strategy? Was your work accurate? Was your explanation complete—did you do something to solve the problem that you left out of your explanation? Was it clear—did you provide enough explanation that another person with your math background could follow what you did?

**Revise.** Use your reflection to improve your earlier description of your solution process.

**Notice** your thoughts and reactions as you go through this process. What might your students learn if they went through the same process?

For more about the process of solving problems and writing up that solution, see <http://mathforum.org/pow/teacher/process.html>.

## Finding More Problems

browsing and searching the Problems Library and Write Math

Which problem will you give them to start with? If you have a Current PoWs subscription, you have four choices during any given week, and one topic or another will be most appropriate for your class. If you have a subscription to the Problems Library or Write Math with the Math Forum, you have hundreds of past puzzles to choose from. Here are a few thoughts on selecting an appropriate problem from this larger pool.

In the Problems Library, start by choosing a service. Which of them is most appropriate for your students? Within services, problems are organized by broad topic. You'll notice subtopics listed under some of the main topic headings—these can give you an idea of what we mean by a particular topic name. Even more helpful is the description once you click on a topic. For instance, if you teach middle school mathematics students, but you're coming up on a geometry unit, you might want to see what sorts of problems we include in the FunPoW geometry category. The description on the geometry page says "Problems in this category require students to classify and understand the relations that exist in two-dimensional and three-dimensional objects. They may require students understand concepts of congruence, similarity, symmetry, or tessellations." That gives you an overview of the category, without having to read through numerous problem descriptions.

Now look at the problem list within your chosen category. Say one catches your eye, right off the bat. But it's difficulty level 4—is that high or low, and what does it mean? At the top of the left side of the page, you'll see a link to "About Levels of Difficulty." This page describes the coding scheme for the service you're in. For Math Fundamentals, it will let you know that level 4 problems may involve repeated calculations that can be a challenge for students to keep track of. Use this to inform your choice: how well can your students handle repeated calculations? Would this problem be an appropriate challenge for them, or would it require scaffolding or other support to keep it in reach?

Take a good look at the problem itself, which may have a Teacher Support page. By all means look at previous student solutions and mentor commentary. These will let you know the sorts of reactions that students have had to the problem, common misconceptions and different solution strategies, and generally help you decide if a problem is right for your students.

If you subscribed to Write Math with the Math Forum, you can use the topic search to pull up problems using topics like those in the Problems Library, only geared precisely to the grade band you bought.

<sup>1</sup> Renninger, K. A., Farra, L., & Feldman-Riordan, C. (2000). The impact of The Math Forum's Problems of the Week on students' mathematical thinking. *Proceedings of ICLS 2000*. Mahwah, NJ: Lawrence Erlbaum Associates ([www.mathforum.org/articles/rennin2\\_2000.html](http://www.mathforum.org/articles/rennin2_2000.html))

You can also pull problems for your grade band from the Write Math state standards search, and from the textbooks search, if you're looking to address a particular standard or topic in your curriculum.

Appendix I (page 10) has detailed instructions for the Write Math searches.

## **“Print This Problem”**

taking the PoWs to the classroom

Because the PoWs rely so heavily on process to succeed, it's useful to model that process with your class. Here's one approach: begin using the PoWs in your class by throwing out the question!

You've chosen a problem from our Current PoWs or Problems Library or Write Math. Now erase the part of the problem that asks The Question. Read only the scenario through with your class. Ask them what they noticed about the scenario. What situation is being described? Is there anything else they can figure out based on those “noticings”? Something that isn't stated in the scenario, but that they can justify because of what it says? Is there something they're wondering about? Maybe one student drew a conclusion that another student doesn't see. Let the other students explain how they figured things out, and more than one student if possible, so that multiple approaches are heard.

You could ask your students if they think they know what question we asked when we wrote this problem. Pose the actual question and talk about it as a group. First, have students list the “noticings” they think will be useful in answering the question. Then, if they seem ready, try answering the question, either as a whole group or in smaller groups or pairs.

Your goal here is to get students engaged in the process and participating in discussion. The activity itself is a model for how they should work on the problems later on, in whatever format you decide to present them.

Read more about the problem-solving process in the classroom in Appendix II, How to Start Problem-Solving in Your Classroom.

## **How to Start Your Students Using Their Subscriptions**

basic set-up

Once you've introduced the process to your students, and begun to develop a problem-solving culture in your classroom, you're ready to start your students off with their own subscriptions. This applies to teachers with Class memberships to the Problems Library or Write Math. Current PoW memberships do not include online student access. (Those of you without access to the following online services may still wish to use the ideas they involve.)

Please note that there's a complete how-to with screenshots in Appendix I, in case you get a little lost.

The first step for your students to use the PoWs is for you to **register** them. You'll need to decide whether to register each student individually, or in small groups, or as a whole class. That will depend on how you're using the PoWs with your students—but do note that students with individual accounts can still submit as a group.

Next, consider how to protect your students' privacy online. Please consult your school's Internet policy before you begin. We comply with the COPPA legislation that requires permission for students under 13. When you register students, you are indicating that you are authorized to grant this permission for your students. You'll need to consider how your students are listed on the Web, in order to create their username. If your students' names must not appear on a Web site, you'll need to choose nicknames or use initials judiciously. Please read our document on how usernames are created before you register your students. You can find it in our FAQ, at <http://mathforum.org/pow/teacher/howtheywork.html>.

Once you've decided how to name your students online, you're ready to register them. You can do that through the Teacher Office in any of your subscribed services—once you enter them once, that applies to all the services you subscribed to, whether that's the Current PoWs or the Problems Library or Write Math with the Math Forum. You can refer to the step-by-step walkthrough in Appendix I for details of the registration process.

Your students will need their login and password to view the problems. Once they've logged in, though, they won't need email to use the PoWs. Their online Message Center will record all messages sent from our program, with the most recent at the top of the list. See our online FAQ for more information about this feature, at <http://mathforum.org/pow/teacher/messagecenter.html>.

If you plan to mentor your own students, please make sure the Assess Your Own option is turned on in your Teacher Office. If you've signed up for free mentoring, or if you've bought a paid mentoring

option, you should make sure it's turned off. When you first sign up for an account, it's turned off by default. See Appendix I for step-by-step details.

Your next step is to **assign a problem** to your students. Once you've chosen a problem, you can give your students its problem number (with its title to make sure they've got the right one), and they can access it from the top of any Problems Library page. (See Appendix I for its location on the page.) You could also assign them any Current PoW. Just make sure you let them know how to access the problem.

Ask your students to **submit their solution** online. Your Teacher Office has a function for tracking their work: the "View My Students' Work" link. If your students need some guidance in submitting, they can view Appendix I, with step-by-step instructions.

## Monitoring Your Students' Work

Any time after your students have submitted to a problem, you can view their work. Check to make sure they're "getting" the process. If you've signed up for free or paid mentoring, you can see any mentors' replies as well as your students' revisions. All this is accessible through your Teacher Office—see Appendix I for details.

## Mentoring Your Students' Work

All mentoring options require a Class membership or higher. Priority mentoring requires a fee on top of your subscription. Free mentoring and the Assess Your Own option are provided with no extra fee.

**Free Mentoring.** A limited number of replies are mentored for free by mentors in training and Math Forum staff. This applies to Current PoWs only, with a limited schedule. Your students can improve their chance of getting a mentor's response by following our stated Guidelines as they submit their answers. For more details, see [http://mathforum.org/pow/free\\_mentoring.html](http://mathforum.org/pow/free_mentoring.html).

**Priority Mentoring.** For a separate fee, Math Forum staff and trained mentors will assess and respond to your students' work, walking them through the revision process. Again, this requires students to follow our Guidelines as they submit their answers.

**Assess Your Own.** You can provide scoring and feedback to your own students using our rubric and software. We have extensive documentation linked through the Teacher Office that introduces our scoring rubric, and describes and gives tips on our philosophy of mentoring and revision. All of those come with examples. If you're interested in pursuing this course, we recommend you go through those pages. But here's a quick outline to help you decide.

In order to provide the most helpful responses to our students, we developed two parts to each mentor reply. The first is the "score" of the submission, according to our rubric that breaks down a response into six categories of problem solving and communication (interpretation, strategy, accuracy, completeness, clarity, and reflection). This helps us tell students not whether they're "right" or "wrong", but exactly what they did well on and what parts of their submission could use improvement. We include scores last in our messages to students, since they are a guide, not a "grade."

The second part of a mentor's reply is a note to help the student reflect, revise, and improve their response in some way. We first try to comment on something they did well, from coming up with a creative solution to communicating clearly to formatting nicely, to attempting to answer at all. Then we focus on the one improvement we think will make the biggest difference to them. This is one place where the scoring may guide us—is there one category in which they were weakest? (We don't usually focus on reflection here, as that's a new concept to many students, and hard for them to grasp.) We try to give them something concrete to work on, and importantly, we try to make clear what they have to gain by working on that thing.

This should give you a taste of what mentoring is like in our system. For much more extensive philosophy as well as several examples of scoring and feedback, see <http://mathforum.org/pow/teacher/assessown/>—which is also linked from the Teacher Office.

## Become a Mentor

Interested in mentoring? Would you like more experience than with just your own students? Are you willing to commit to spending an hour or two each problem mentoring other students? If so, we're looking for you! If you'd like to learn more about our training process, please contact us using the form on this page: <http://mathforum.org/pow/contact.html>



**Moving beyond  
This Guide**  
the wider PoW  
community

Would you like to talk about the Problems of the Week with other users? We have a series of Web-based discussion groups just for PoW subscribers. They're linked from your Teacher Office, and they use the same login and password with which you access your regular PoW account. There's one for each of the four main services.

You'll see posts from PoW administrators letting you know when free mentoring is available, or asking for feedback on aspects of problem writing. You'll also see discussions among fellow teachers using the PoWs, primarily sharing what they're doing in the classroom, and looking for feedback or alternative ideas, but sometimes with questions for administrators, too.

**Moving beyond  
This Guide**  
questions and  
feedback

If at any point you're having difficulty with your account that you can't solve by checking this Guide or our FAQ online (accessible at <http://mathforum.org/pow/teacher/instructions.html>), please feel free to contact us. You can write to us using this page: <http://mathforum.org/pow/contact.html>. Or during regular business hours (9-5 EST), you can call 800-756-7823, option 2.

We welcome feedback at any time, as well, either about the program itself, or about this Guide. Please contact us using the page <http://mathforum.org/pow/contact.html>.

**Math Forum  
Professional  
Development  
Opportunities**

Our professional development offerings include courses focused both on problem solving and communication in general, and on using your PoW class membership effectively. The complete list of our offerings with full information, including syllabi, is on our site at <http://mathforum.org/pd/>.

We offer the following online courses:

- The Math Forum's Problem Solving Process
  - This course aligns well with the Math Forum's Problems of the Week but could also be used to develop techniques to use with problem solving prompts in general. Participants are not required to have a Problem of the Week (PoW) Membership, although at the end of the course, they may find value in considering that as a logical next step as a resource for their students.
- PoW Class Membership: Resources and Strategies for Effective Implementation \*
  - This course is designed for current subscribers of the Problem of the Week. After completing the six-week course, you will be familiar with all of the features and resources associated with your PoW membership access. You will be able to make an informed decision of how to start implementing PoWs with your students, and you'll have an idea of next steps to try when you are ready.
- Teaching Mathematics with the Problems of the Week \*
  - This course is designed for current subscribers of the Problem of the Week who want to make the most of their membership. Course activities include submitting your own answers to and analyzing math in the Math Fundamentals Problem of the Week (FunPoW), guiding your students through the solution and submission process, and sharing ideas and reflections with classmates.
- Problem Solving Strategies
  - Participants solve challenging middle school and high school algebra, geometry, and probability problems and develop a supplemental curriculum outline supporting the development of mathematical approaches to problems. We discuss how to support students developing high levels of competence and sophistication with a wide range of mathematical approaches from "guess and check" to "consider a simpler problem" to "analyze in terms of parity".
- Moving Students from Arithmetic to Algebra—One Step at a Time
  - In this course, we examine a continuum of student work from the Math Forum's Problems of the Week archive. Selected work includes a range of examples from "not knowing how to start" to "It's perfect. What could I possibly say to her?" We consider specific ways to move students' thinking along this continuum. Coursework includes assisting students in analyzing a problem quantitatively, using mathematical representations, and recognizing generalization in those representations.

\* Participation in either of these courses requires PoW membership at the Class level or higher.

**Appendix I**  
illustrated page  
how-tos

When you buy a subscription to the Problems of the Week, we'll send you a confirmation email including your login name and password. That email has lots of other useful information in it. Hang on to it for future reference! Here's where to go next.

**Current PoWs and Problems Library**  
basic access

**Current PoWs and Problems Library:**

1. Go to the Math Forum Home page: mathforum.org.
2. Click on "Problems of the Week."



3. To access the Current Problems of the Week, simply click the service that you want.



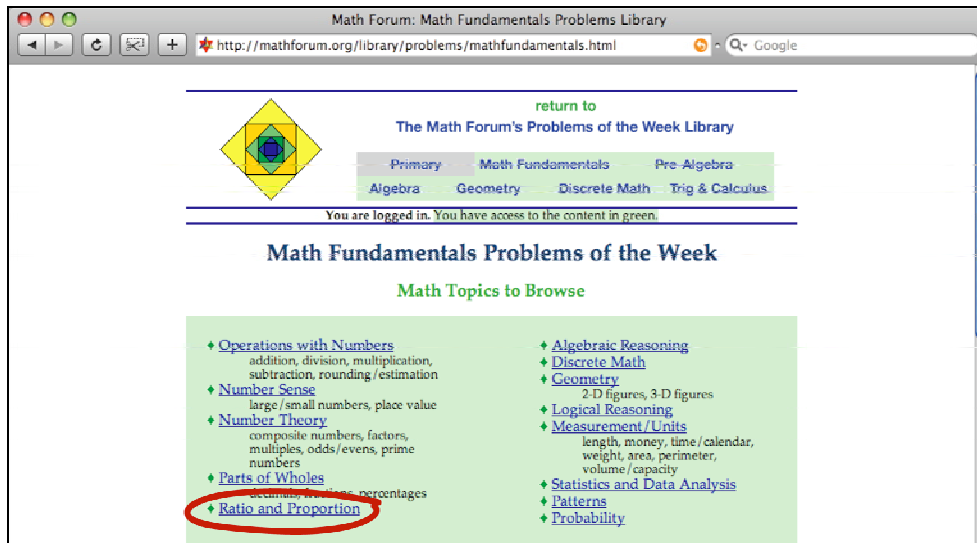
4. You may also have access to the library of previous Problems of the Week. To access this, go to mathforum.org, click on “Problems of the Week”, and “LibraryPoW.”



5. Log in at any point in your browsing, using the login button at the top of the screen. If you choose not to log in yet, you'll be prompted for your username and password when you come to subscriber-only material.



6. Choose the service in which you'd like to browse, and you'll be presented with a list of topics within that service. Click on one in which you're interested.



7. Within that topic, you'll find a list of problems.



Students can submit answers online to any problem with a yellow “active” icon. Problems with a green “ts” icon have a Teacher Support page (see page 3 above). Each problem has a level of difficulty rating—for more on how those are created and what they mean, see “About the PoW Library”, linked on the left side of this page. “About the PoW Library” has more ideas about browsing by math topic, browsing across services, and seeing all the problems in one service.



**Write Math  
with the Math  
Forum**  
basic access

1. Go to the Math Forum Home page: mathforum.org.
2. Click on “Problems of the Week.”



3. Click on “Write Math.”

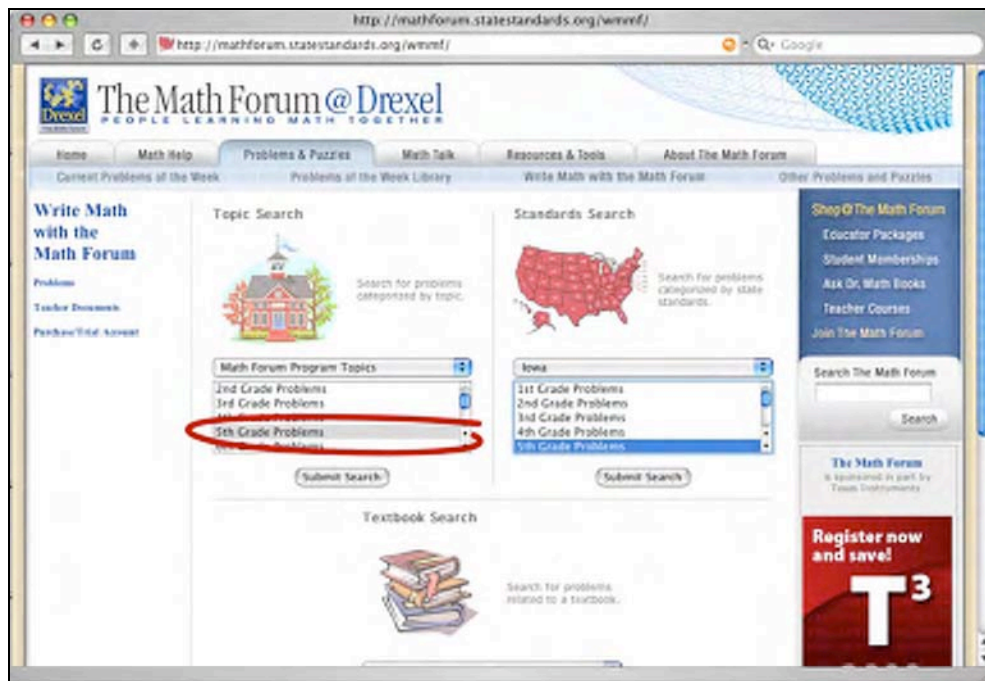


4. You purchased a particular set of Math Forum problems. The searches of Write Math enable you to see how those problems are aligned to standards, textbooks, or Math Forum’s program topics. If you bought the 5th grade Math Forum problem set, there may be problems in it that align to some 4th grade standards or 6th grade standards in some states. Similarly, there may be problems aligned to your state’s grade five standards that come from the Math Forum’s 4th grade or 6th grade problem set.

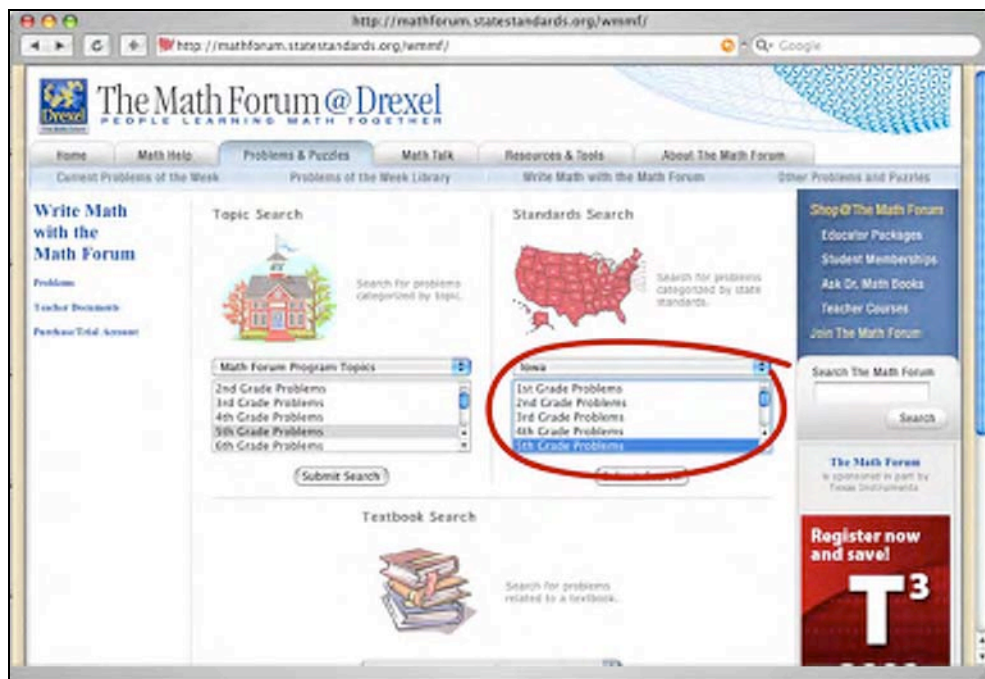
You can see the complete distribution of problems by leaving the default selection of All Problems in the scrolling list for each search. As you browse the problems, their descriptions will indicate which problem set they come from. You may purchase additional problem sets at any point if you find that you don’t have access to problems that align to particular standards or textbook sections of importance to you.

If you wish to search for alignments for only the problems valid for your membership, then start your search by selecting the appropriate grade level(s)/course(s), as illustrated. You can select multiple grades by holding down the command key (Mac) or the control key (Windows) while you click.



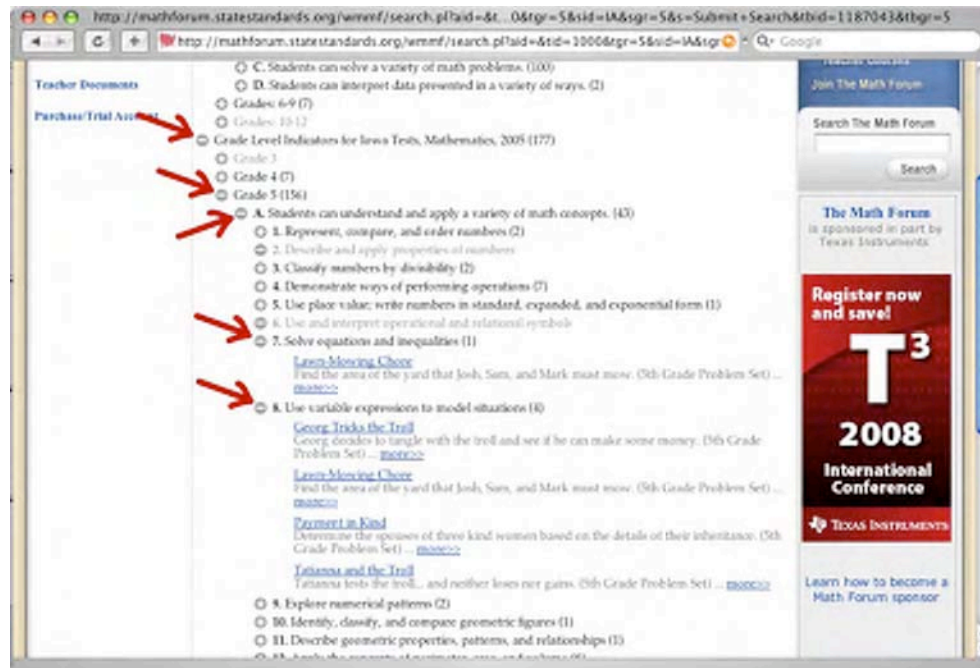


5. If you are using the Standards or Textbook search, remember to pick your state or textbook from the corresponding menu. The Standards search is illustrated here.



6. Click on the “plus” symbol to expand the section of alignments in which you are interested. Bold topics with numbers in parentheses after them have alignments associated with them. Some of these have sub-topics you can explore as well.

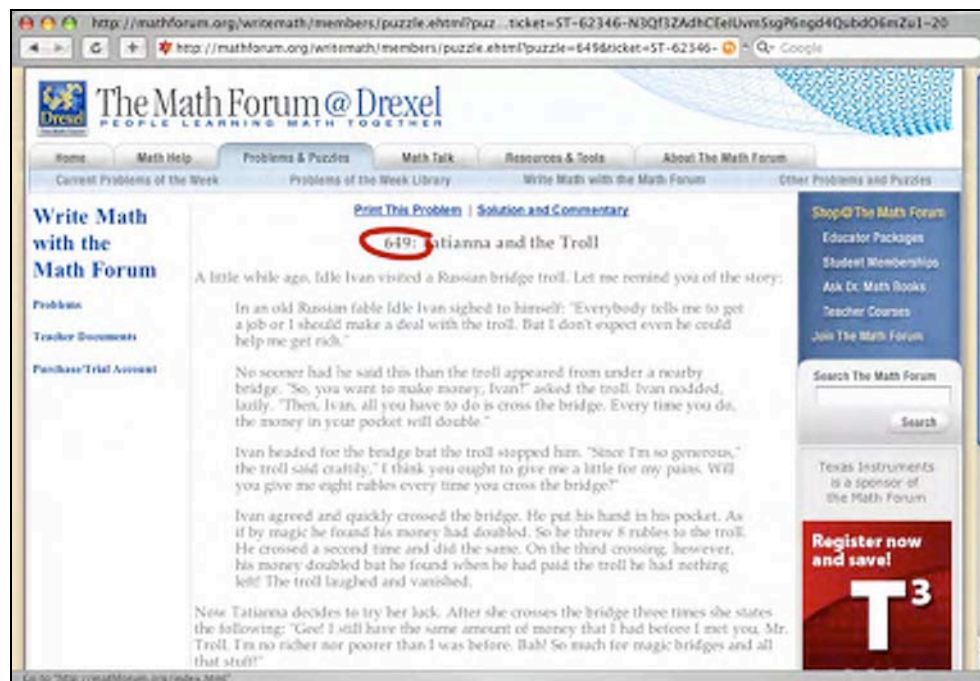
Note: Problems are categorized in as many categories as apply to them, so the parenthetical numbers after a category do not necessarily reflect the number of actual problems in the category. In this instance, the problem “Lawn-Mowing Chore” is aligned to both “Solve equations and inequalities” and “Use variable expressions to model situations.” It is those alignments that are counted in the numbers after each category, not the number of problems in each category.



**Making Assignments**  
from the  
Problems  
Library or Write  
Math

1. Once you find a problem you’re interested in through the searches described above, enter your Username and Password to view the problem, if you haven’t already logged in.

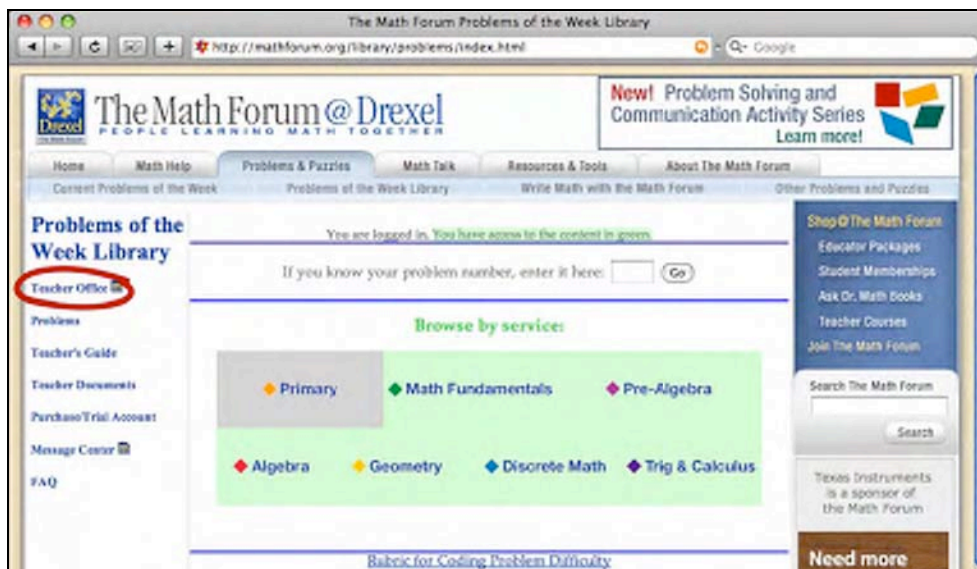
2. Each problem has a number. You can note that number and have students go directly to that problem when they go to the Problems Trail. This problem is number 649.



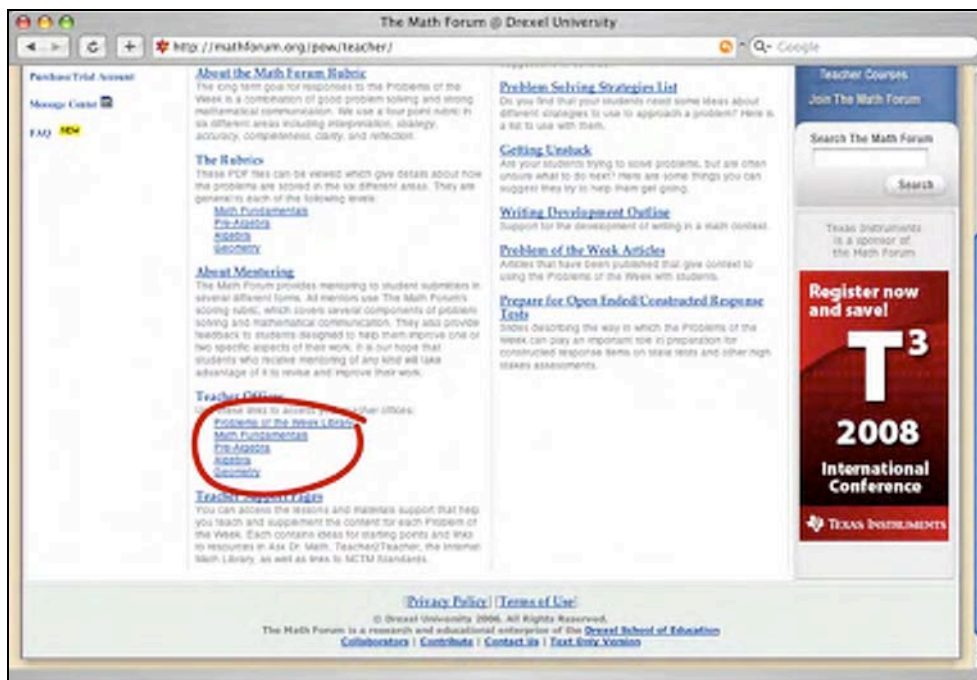
Note: As part of your license, you may also print out any problem and distribute it to your class at any time during the membership term.

## Registering Your Students

1. From <http://mathforum.org/>, click on Problems of the Week. Click on “Problems Library” or any of the four Current Problems of the Week. You’ll see a link to “Teacher Office” on the left side of all of those pages.

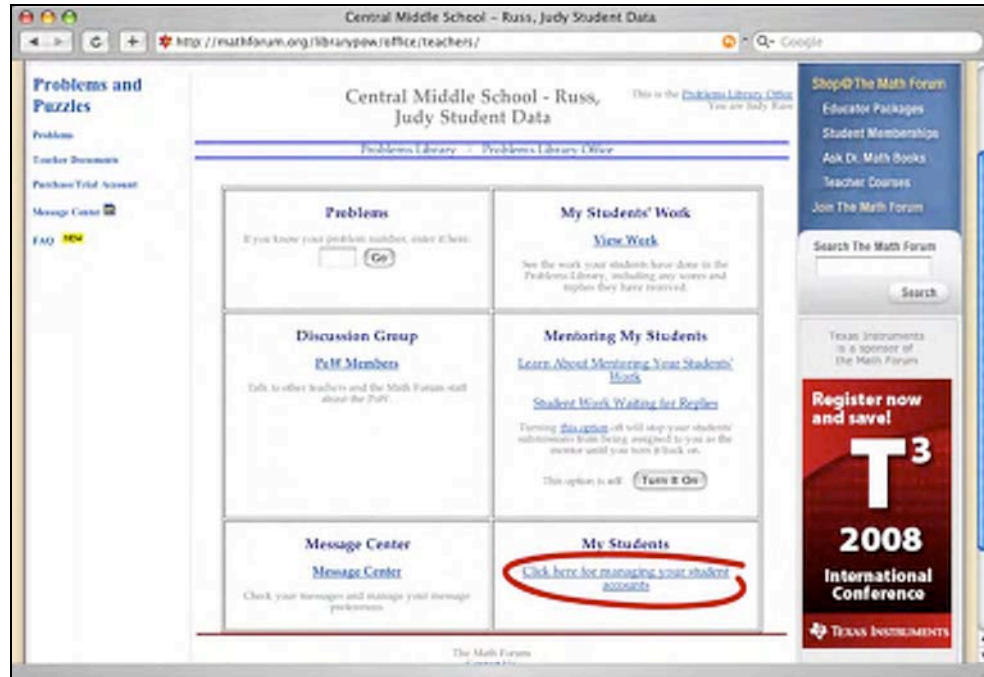


You can also click on “Teacher Documents,” linked from the left side of many pages in these services. At the bottom of the Teacher Documents page is a set of links to Teacher Offices.





2. At the lower right corner of the office, under “My Students”, click on the link that says “Click here for managing your student accounts.”



3. For privacy reasons, please read our FAQ on generating student usernames before you register your students: <http://mathforum.org/pow/teacher/howtheywork.html>

Please also review your school’s Internet policy before you register your students. We comply with the COPPA legislation that requires permission for students under 13. When you register students, you are indicating that you are authorized to grant this permission for your students. You’ll need to consider how your students are listed on the Web, in order to create their username. If your students’ names must not appear on a Web site, you’ll need to choose nicknames or use initials judiciously. Please read our document on how usernames are created before you register your students. You can find it in our FAQ, at <http://mathforum.org/pow/teacher/howtheywork.html>.

You can choose to register students one-at-a-time or in batches of ten. Passwords will be generated automatically, but you may alter them (we recommend looking them over before you give them to your students). You will not need to enter email addresses for your students, as there is a Message Center online for their Problem of the Week communications. For example, if students submit to Math Fundamentals, they can go to <http://mathforum.org/funpow/>. If they look on the left side of the page, they’ll see the link for the **Message Center**.

When they click on **Message Center** they can view any email that the Math Forum Problem of the Week program has sent. It’s a special web-based mail service with NO spam and NO other messages—only PoW messages. The most recently sent messages are at the top of the list.

If you register students one-at-a-time, the screen options look like this:

If you register multiple students at once (up to 10), the screen options look like this:

	First Name*	Last Name	Email	Password*
1.	Jason	S		crimbbur
2.	Ellen	C		cinquimp
3.	Mai	S		pimono1
4.	Zoe	P		cytham
5.	Josh	S		swernburg
6.	Jose	M		slandcor
7.	Lesley	T		sisystr7
8.	Paul	V		frisloc
9.	Akira	K		fousald
10.	Aclara	P		shandbray

Once you have registered your students, you will see a list with their names, usernames, and passwords, and a blank field with which to change their passwords if you wish to do so. Students will need their username and password to access the problems online and to submit their answers. Please remember that passwords are case sensitive: “CRIMPBUR” is not the same as “crimbpur”.

You can return to the main Teacher Office page using the link at the left side of the page, labeled “PoW Teacher Offices”.

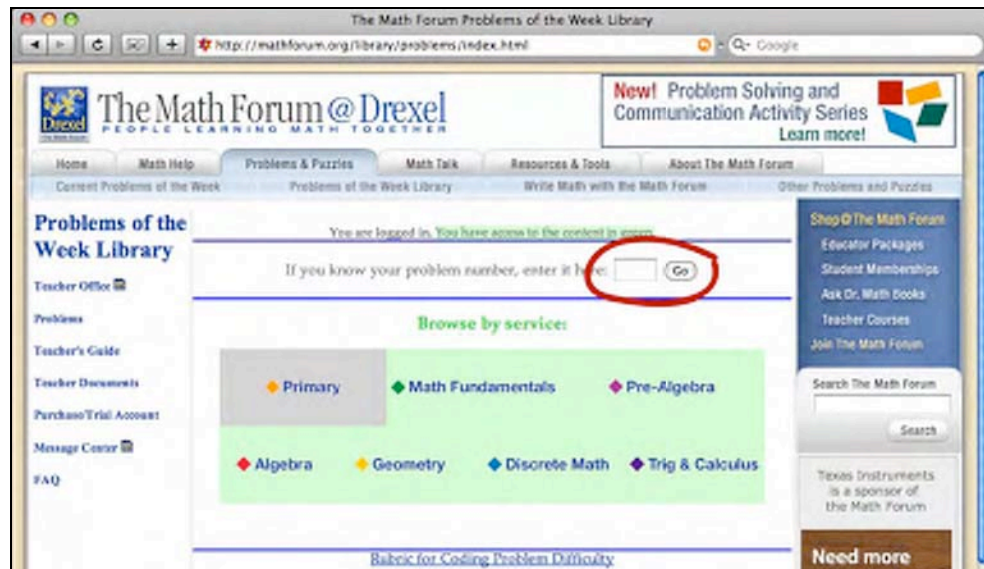
If you want to be able to mentor your own students’ replies in the Office later, look at the bottom of the “Mentoring Your Students” box in the Teacher Office. Make sure that option is “on”. If it is not, turn it on. If it is off, your students work will be visible to you (through the “View Work” link in the “My



Students' Work" box at the top right of the Teacher Office page), but you will not be able to use our software to respond to them.

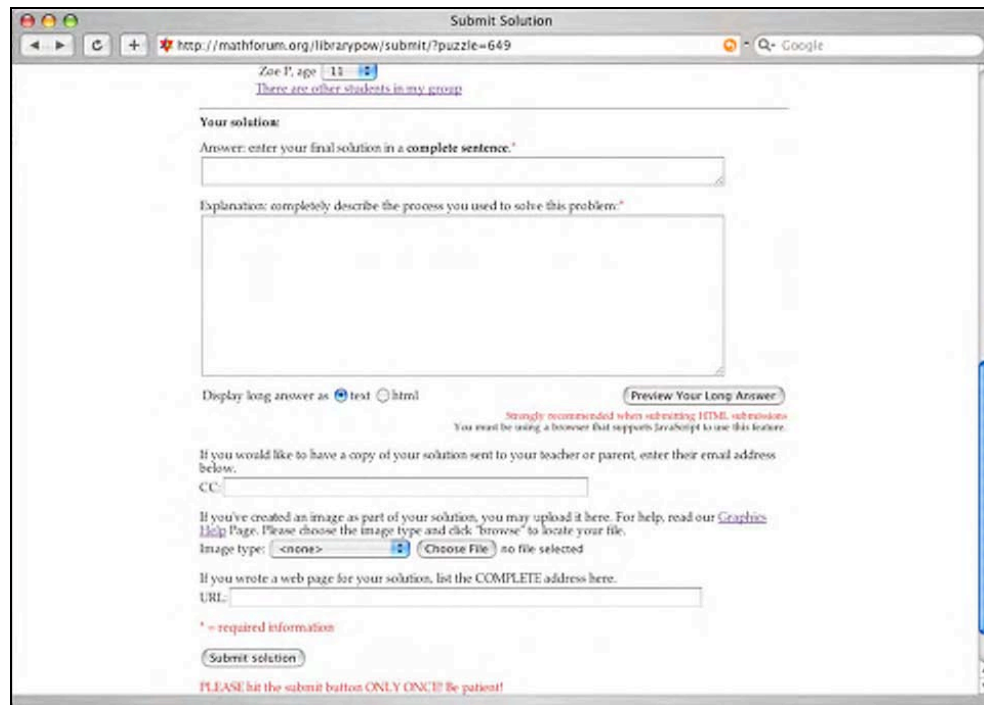
## What Your Students Do When They Use the Library

1. Students go to mathforum.org, then "Problems of the Week" and then Problems of the Week Library. (See page 11 above.) There is a field where they can enter the problem number on the Problems of the Week Library page.



2. Students will be asked for their individual Username and Password. (Please remind them that capitalization matters, as passwords are case sensitive.)

3. When students are ready to submit an answer, they click on "Submit your answer" at the bottom of the problem page. This is the result:

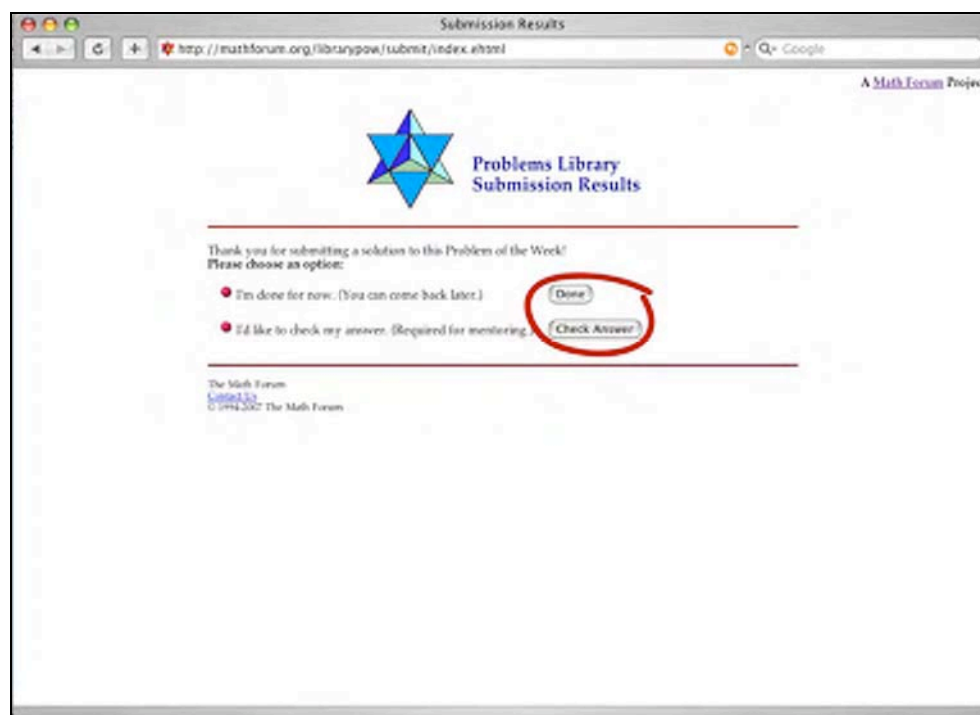


If students are submitting in groups, they may add other students to their submission using the link below their name.

Students should type in their summary answer in the field labeled “Answer,” and their explanation of how they arrived at that answer in the field labeled “Explanation.” Then they have the option of sending a teacher or parent their answer via email; uploading an image\*; or linking to a web page about their solution. (They should not change the default choice on “Display long answer as [text/html]” unless they have formatted their whole answer in HTML, including paragraph tags.) Then they should click on “submit solution” only once.

\*Graphic images can be uploaded with a student’s solution. This is useful for conveying visual representations that do not translate easily to text. Follow the instructions on the submission page. Files saved as .jpg and .gif work best. They can be digital photos, screen shots, computer generated drawings, or scanned images of a drawing on paper. For best results try to size them at no more than 600 pixels wide.

4. The results screen has two options:

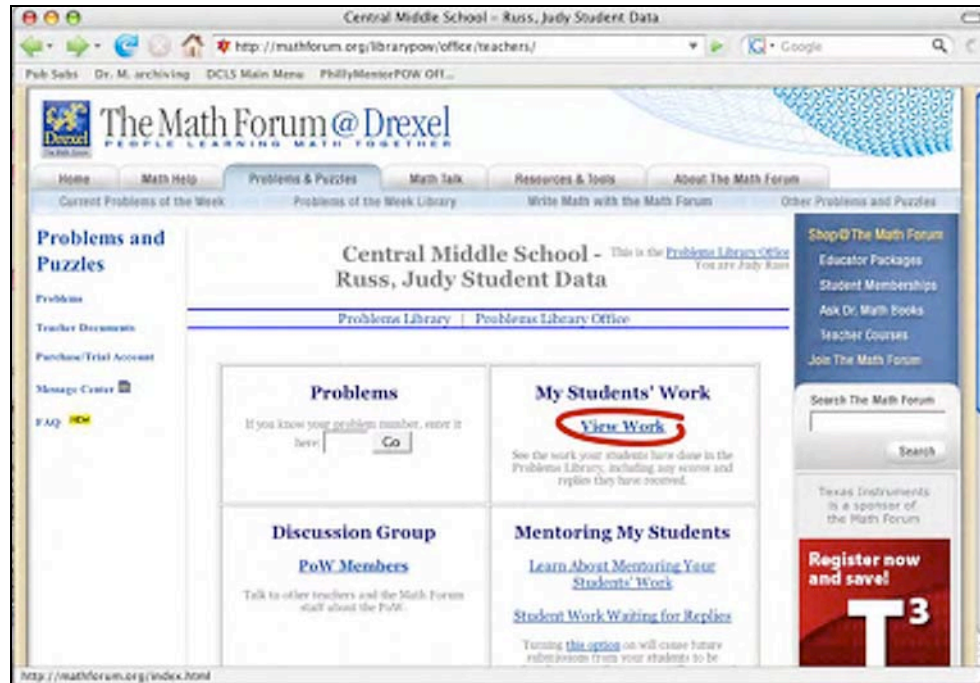


Students may choose “Done.” Their answer is queued for mentoring by you if you have turned on the Assess Your Own option, or by free or paid mentors if you’re using those services. It will also show up in your “View my students’ work” link in your Teacher Office. To revise recent submissions, students should go to their Message Center on the site, and follow the link in the confirmation message they received there.

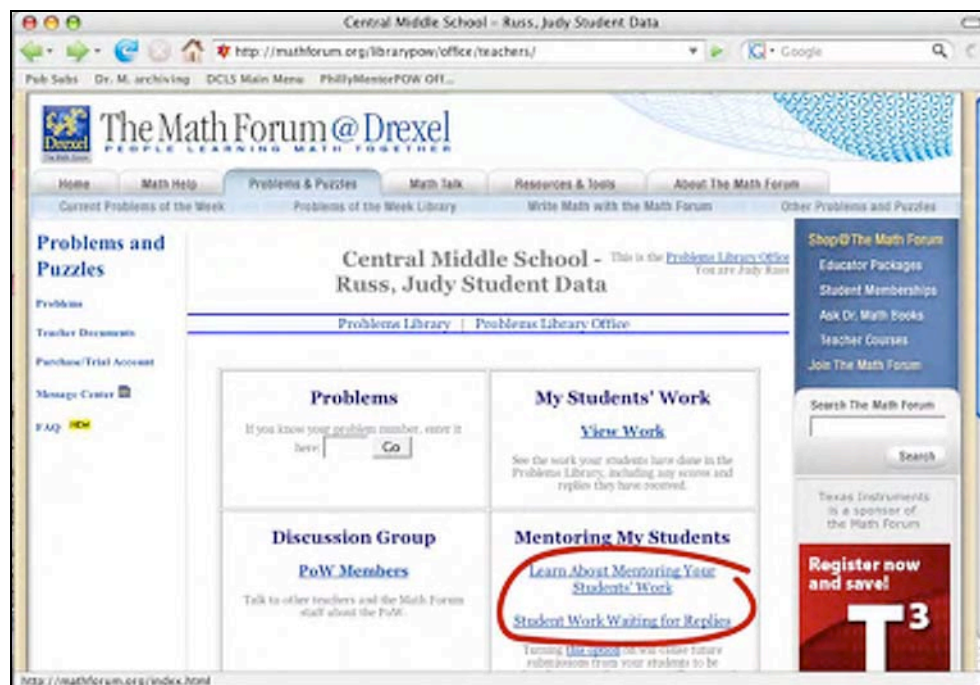
Students may instead choose “Check Answer”—this will give their answer priority for mentoring if you’re using a free or paid mentor. Students may still revise their answer after this step.

**Monitoring and Mentoring**  
your students' work

You can see any work your students have submitted, whether or not they're ready for mentoring, by clicking on "View Work" under "My Students' Work" at the top right section of the Teacher Office.



You can mentor your students' work, too: look for "Mentoring My Students" in the Teacher Office. We have an introductory guide to the Math Forum scoring rubric there, as well as guidelines for mentoring, suggested responses, sample student responses with replies, and more. That's under "Learn About Mentoring Your Students' Work." Once you're ready to mentor, use the link under that, "Student Work Waiting for Replies."



## How to Start Problem Solving in Your Classroom

by Annie Fetter, the Math Forum @ Drexel

When you start doing problem solving in your classroom, keep in mind that one goal should be to create an environment that supports problem solving as an extended process. The intent is to engage students in the process, so the short term goal should be process over product. Don't worry about whether or not your students are solving all the problems correctly or completely. Are your students engaged? Are they all participating? Are they asking questions? Are they talking about math? If so, then the process is happening, and the product will follow.

### Forget "The Question"

To put the focus more on the process, introduce the class to the problem by removing The Question. This can be done as a whole class (which is how I might start) or in small groups. The students must analyze the situation and focus on reading and interpretation instead of coming up with The Answer. (For an example of what this looked like in one class I taught, see the next page.)

1. Give students the text of the problem without the question (the overhead works great for this) or draw the associated picture on the board and tell them only what they need to know to understand the situation.
2. Go around the group and have each person list one thing they "notice". Responses might be as simple as "the lines go up", or even "there is one blue line and one red line", or as complex as "the blue line is going up twice as fast as the red line". Everyone can contribute something, and all the "noticings" are recorded for the group (on the class data pad or whiteboard, etc.) with minimal discussion.
3. Ask the students which items on the list they are wondering about (we often use the language of "wondering" instead of asking them what they don't understand). For example, a student might ask, "I'm wondering how you know that the blue line is going up twice as fast as the red line." Let the students respond to these questions. "Who would like to try to explain?" If possible or necessary, have more than one student explain each idea so that more student voices get heard.
4. At this point, I often ask students to pose a question for the situation presented. You might learn that sometimes math is pretty predictable—in my experience, kids almost always come up with a question that is a lot like the actual question!
5. Pose the actual question and talk about it as a group.
  - Have students list the observations they think will be helpful in answering The Question.
  - Let some kids take a stab at answering The Question. Depending on the readiness of your students, you may do this as a whole class or have students work in pairs.

Remember that the goal is to get your students engaged in the process of thinking mathematically and about how to solve problems. It is not about finding the solution, at least not initially. You will be able to judge the success of this activity as you listen to the buzz in the classroom and see how many more students are participating.

### Other Ideas for Introducing Problems and Problem Solving

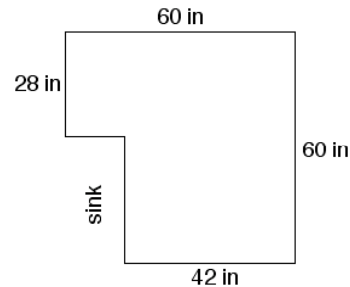
- Read the problem aloud.
- Talk about any vocabulary that students are wondering about (or that you are pretty sure they haven't seen recently).
- Have students retell the problem in their own words. Let them read it again if they're having trouble remembering.
- Make lists with questions such as what we know about the problem, what we want to figure out, and what questions we have.
- Talk about the questions and how we might figure out the answers.
- Draw pictures or a table or chart if it might help.

**Appendix II**  
An Example of  
“Forgetting the  
Question”

**Teresa’s Tiles in an 8th Grade “Lowest Level” Class**

In the spring of 2007, I presented “Teresa’s Tiles” to a “lowest level” eighth grade class. I chose the problem because it is similar to problems on that state’s Grade 8 assessment.

I drew this picture on the board and described to the students what we were about to do. “This is a picture of Teresa’s bathroom floor. We’re going to list as many things as we can about the picture. I’m going to ask each of you to offer one thing that you notice. Anything at all.” Here’s what they said:



- two sides are equal inches
- one side is 28 inches
- one side is 42 inches
- your lines aren’t very straight
- the sink is a rectangle
- you can find the area of the whole thing by making it two pieces
- two sides are 60
- they are longest
- it used to be a square
- the short side of the sink is 18"
- the long side of the sink is 32"

I was excited—that was a great list! I picked out the items I figured were most likely to be both important in eventually solving the problem and potentially confusing and asked for volunteers to explain them to me and the rest of the class. The following responses came from many different students.

AF: What does it mean to say that it used to be a square?

Student: The floor is like a square, but the sink is in the way.

AF: How do you know it is a square?

Student: Because all of the sides are 60 inches. That’s a square.

AF: But all the sides in the picture aren’t 60 inches long. Could someone show us on the board what you mean?

Student: *[drawing figure 1]* If the sink wasn’t there, they would all be 60 inches.

AF: Okay. How do we know that the short side of the sink is 18 inches?

Student: Because it’s 60 take away 42.

AF: How did you know to do 60 minus 42?

Student: ‘Cause 60 is all the way and only want part of it.

AF: Would someone like to come up and show us what that means on the board?

Student: *[drawing figure 2]* That part is 42 because it is just like the bottom. So you do 60 take away 42.

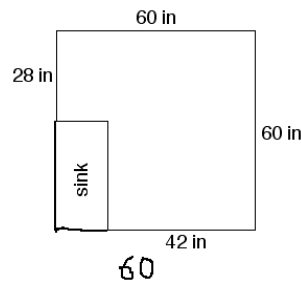


Figure 1

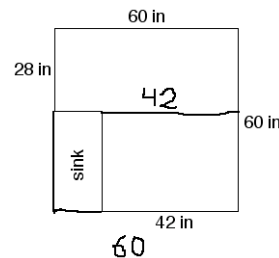


Figure 2

We went through a similar process with the ideas that the long side of the sink is 32" and that the area can be found by splitting the floor into two pieces. Then I explained that Teresa was going to put down new tiles, and that the new tiles are squares that are 4 inches by 4 inches. I drew a small tile on the board and labeled it 4" on each side. Then I said, “What can we say now?”

- the tiles are smaller than the floor
- it will take a lot of them!
- 15 tiles will fit across the top and the side
- each tile is 16 square inches
- 7 tiles will fit across the 28" side
- tiles won’t fit across the bottom

At this point, we had reached the end of the class period. I gave each student a copy of the full text of the problem and told them that for tomorrow’s class, they were to write down everything they remembered from our conversation. I told them that they should not to worry about solving the problem. I also told them that they had done an awesome job and that I had had a lot of fun!

I told the teacher that I had been really impressed with her students. Turns out she had been too! She was surprised by the number of things they had come up with and by how many of them had participated. A few days later I got an email saying that almost all of them had done their homework, and most had remembered more than half of what we talked about in class. A couple of the students had gone on to solve the problem, and when they worked on it in class the next day, many of them were engaged in the process. Not bad for their “first time”!



## Appendix III

### Frequently Asked Questions

#### Why can't I log in?

This could be due to a number of factors:

- ◆ If you're trying to access the Problems Library, you must have a class-level or higher membership. A \$25 teacher account does not include access to this service. We'd be happy to upgrade your account for you, and apply any money previously paid for the lower-level account towards your new account. Class-level memberships start at \$89.
- ◆ Have you just upgraded from a trial account? Your browser may be remembering the wrong password. Please clear your cookies and try again; see the next point for details.
- ◆ Your browser may have stored an outdated or incorrect username or password. Please clear your cookies and try again. The simplest way to clear cookies is to restart your browser. If that doesn't work, we recommend this site to guide you through clearing your cookies: <http://www.aboutcookies.org/>
- ◆ You may have misremembered your username or password. Please check that you are using the correct combination, and that you are using correct capitalization, as these are case-sensitive. And then make sure that your cookies are clear; see above.

#### How do I change my password?

##### I don't remember my password.

Please go to this page: <http://mathforum.org/pwd/password.jsp> (You can also find this link at the bottom of our login screen, below where you enter your username and password.) There's a form at the bottom of the page for you to enter your username or your email, and we'll send you a new password.

#### I signed up for a trial account, but never got to use it. Can it be extended?

Sure, we'll be happy to extend it once for you. Please write to us using the form at <http://mathforum.org/powcontact.html>

#### How do you come up with the Problems of the Week? Do you accept suggestions? Our class just created one...

We have a team of mathematicians and math educators who get together each week to hash out the problems and their wording. (They actually do the math for everything!) They're always happy to have suggestions—you can send yours in to us using the form at <http://mathforum.org/powcontact.html>. Be sure to include accurate contact information so we can get back in touch with you about it!

#### If I enter my students' first and last names when I'm setting up their accounts, will those names appear anywhere on the Internet?

Potentially, yes, depending how you choose to set them up. Please read our page on how students' usernames are generated, before you set up their accounts: <http://mathforum.org/pow/teacher/howtheywork.html>

#### I didn't put in any email address for my students. How do they get back to their solution to revise?

Since August of 2007, we've featured an individual Message Center for students and teachers. Students can access their Message Center from the left side of any Current Problem page, or the main page of the Problems Library, or the Write Math pages. Teachers have access from the same locations, as well as from any of their Teacher Offices. The Message Center is a special Web-based email service with no spam and no other messages—only PoW messages, with the most recent at the top.

#### I have another student account question.

See our online FAQ, at <http://mathforum.org/pow/teacher/instructions.html> for more answers about using student accounts.