Getting Started with The Math Forum
Problems of the Week Library

TEACHER'S GUIDE

CONTENTS

T urn your classroom into a dynamic online community with the Math Forum Problems of the Week Library. This exciting new tool leverages the power of interactive technology to hold students' interest while increasing their success as strategic thinkers.

The Math Forum Library is an online source of non-routine challenges in which problem solving and mathematical communication are key elements of every problem.

Both teachers and students gain deep mathematical understanding through rich, real-world problems that require them to think creatively and to explain their mathematical reasoning and processes.

We believe that successful problem solvers are creative. They are also resourceful, able to identify and use an effective strategy and to communicate their process in writing to others.

Solving problems entails telling a story with a beginning, middle, and end. In order for your students to write that story, they must:

- **understand** the nature of the problem.

- **find a strategy** for tackling the problem.

- **explain** the steps they took to reach a solution.

- **reflect** on their solution in writing.

How does the Math Forum help students become successful problem solvers?

- Real-world problems spark students' interest.

- Students learn to communicate the process of problem solving in writing.

- Students on all levels and of all abilities will become confident and independent problem solvers.

- Students will learn to assess their own work using the Math Forum Scoring Rubric.

- All problems support the *Principles and Standards for School Mathematics* (NCTM, 2000), which calls for students to communicate effectively about mathematics and for students to write clear, thoughtful responses to non-routine problems a c ross grades K-5 (elementary) and grades 6-12 (secondary).

- Online mentoring, by the teacher or a trained mentor, gives students an exciting new way to increase their skills both in writing math and using technology.

WELCOME!

USING YOUR MATH FORUM MEMBERSHIP
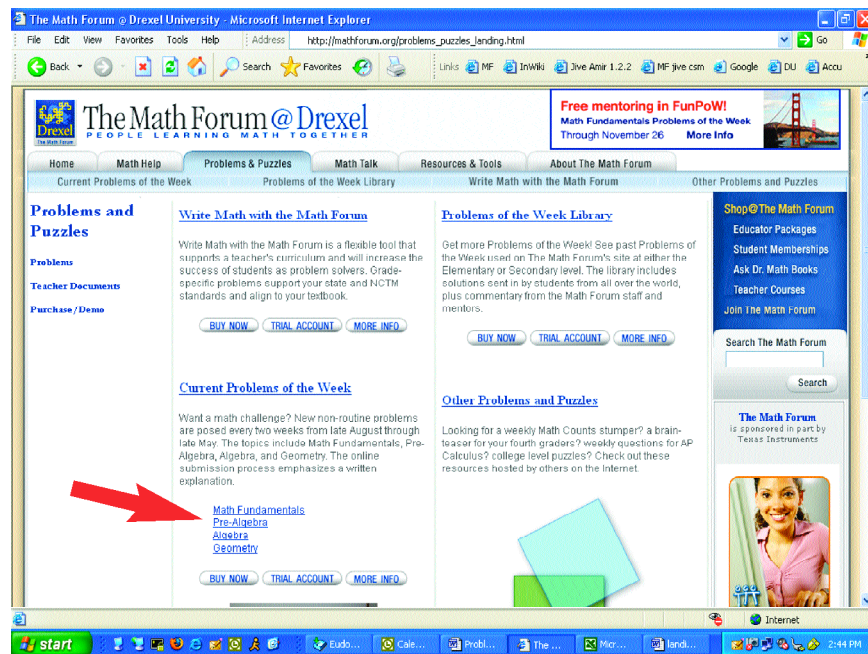
HOW TO MONITOR AND MENTOR
YOUR STUDENTS' WORK

1. Go to the Math Forum Home page: mathforum.org.

2. Click on "Problems of the Week."

USING YOUR
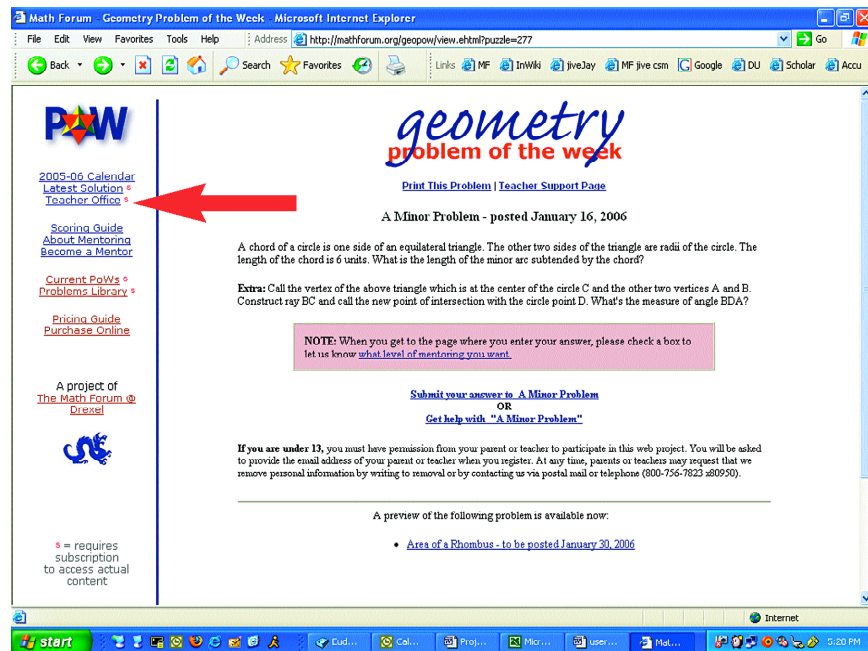
(See http://mathforum.org/pow/teacher/MFTeachersGuide.pdf
for the most recent version of this guide.)

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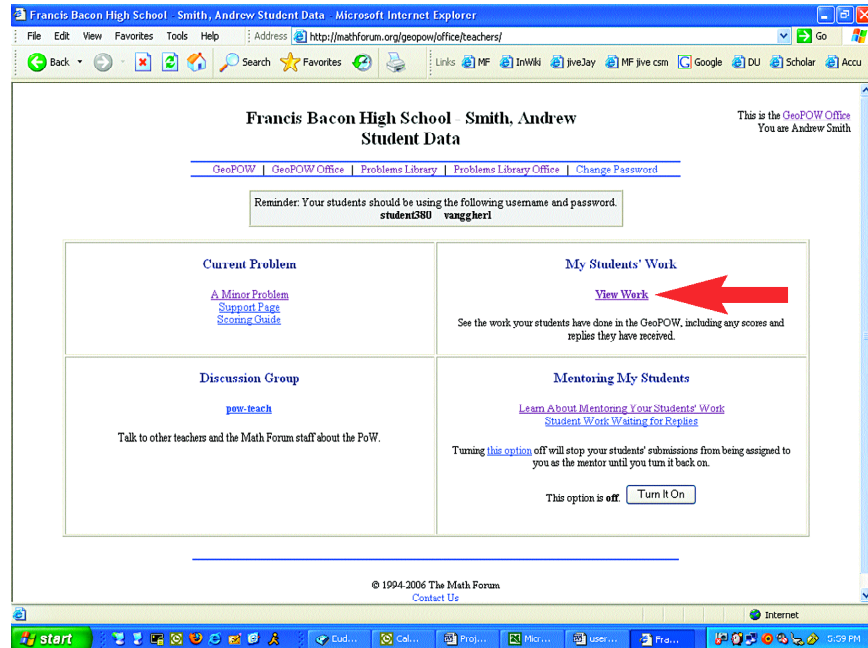   simply click the math category that you want.

MEMBERSHIP

4. To view students' work, click on "Teacher Office" and type in your Username and Password.

If you want to score and respond to student work, be sure that the option under "Mentoring My Students" is TURNED ON.

5. Click "View Work" under "My Students' Work"
   to check on your students' progress.

You can only score and respond to work that is submitted AFTER this option is active. To respond to prior submissions, contact the Math Forum Customer Service (see back cover).

MAKING ASSIGNMENTS FROM THE LIBRARY

1. You can select problems that fit your curriculum. Start at mathforum.org and click "Problems of the Week." For the full library, simply click "Problems Library" and then pick a category.

2. F rom here, you can search through the problems. You will input your Username and Password to view a problem.

3. Each problem has a number. You can note that number and have students go directly to that problem when they go to the Web site.

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.

WHAT YOUR STUDENTS DO
WHEN THEY USE THE LIBRARY

1. Students go to mathforum.org, then "Problems of the Week." To access a Current Problem of the Week, they just click on "Problem" for the category of math that they want. To access a problem using the problem's number, they enter it on the Problems of the Week page.

2. Students will be asked for the class Username and Password.

Note: Teachers get this information when their class is set up.

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3. Students submit their work by:

    A – Choosing "Submit your Answer"

    B – Selecting "Who are you?" (to work alone or in groups) and the name of their state, then "On to next step"

    C – Selecting the name of their school under "Where do you go to school?" then "On to next step"

D – Filling in personal information (first time only) and "On to next step"

E – Typing in a solution and "Submit solution"

Notes: *They will receive an e-mail with a link allowing them to revise their work. Teachers can see students' revisions, and if "Assess Your Own" is turned on, make comments through "View Work" in the Teacher's Office.*

After students submit their solutions, they can use the "Check Answer" function to see right away if they were on the right track, and proceed to revise if they choose.

Step 2

GETTING AROUND THE SITE

The Math Forum is a rich online community with links to many exciting math-related sites. Here are some of the areas of interest you'll find in your Library for you and your students:

Current Problems of the Week

Every two weeks, one new problem is posted in each of the four categories: Math Fundamentals, Pre-Algebra, Algebra, and Geometry. Each problem accepts submissions for two weeks. After the problem is closed, students can see a full solution to it.

Students can work in groups to meet the challenge. Give them the excitement of responding online, working with a mentor to revise their solutions, and striving to see their names posted on our gold or silver list of expert problem solvers!

Active Problem Library

Your purchase of the Elementary or Secondary Math Forum Problems of the Week Library will give you access to two of these four categories:

- Math Fundamentals

- Pre-Algebra

- Algebra

- Geometry

Look for the yellow "active" icon, which indicates problems that accept submissions from students. Depending on your membership, students may be able to submit to an online mentor, and they can revise their responses as many times as they want. You can score your students' submissions online, viewing and tracking all responses and revisions. Alternatively, students can work with pencil and paper.

Mentoring Feedback to Student Responses/Revisions

Mentoring is a key that opens the door to an exciting new world of mathematics online learning. Mentoring supports your teaching while offering students a challenging relationship with a trained mathematics mentor who will guide and support their efforts. Struggling students, high-performing students, special-needs students—all will benefit from the experience and enjoy using their computer skills to advance their math and communication skills.

You may prefer to mentor students yourself or have an assistant or teaching aid review students' responses and provide feedback to them online or in person. All you need to do is use the Scoring Rubric to assess their work. You can view their work anytime from your Teacher's Office page, and they can submit solutions and revisions at school, at home, in technology class, or anywhere there is Internet access.

This gives you many different ways to use the Problems of the Week and to embed them in your lesson planning and student assignments. Of course, small groups can combine efforts and compose responses for submission, discussion, or online mentoring.

For more information about mentoring, go to mathforum.org/pow/mentoring.html

Teacher Support Pages

Check the Teacher Support Pages to see specific topics that students will review when solving the problems. Problems will vary in difficulty. You might select problems that challenge your students. Or you might choose easier problems that address topics they are comfortable with and focus on the writing and communication of mathematics. You can tailor the selection to fit your purpose in using the problems.

Find additional Problems of the Week that relate to the one you are using in class. The selections allow you to choose simpler problems to use as warm-ups to help your students get started in this process or more challenging problems for students who are ready for more. Also, find Ask Dr. Math questions and answers, which explore your math content in more depth.

Find alignments to the NCTM standards and Math Tools with links to all sorts of great online tools so that you can enrich your math classroom with technology support.

Walk through the steps to scoring your students' work using the Math Forum Rubric, which is based on national and state standards for assessing problem-solving strategies and communication skills.

GETTING AROUND

Ask Dr. Math

Ask our Dr. Math experts and professional volunteers your questions! Responses are thoughtful and supportive – and fun! The archive of Dr. Math FAQs (Frequently Asked Questions) offers comprehensive explanations in every area and on every level of mathematics.

Teacher2Teacher

Join in online discussions about math-related topics with your colleagues.

Check out the Teacher2Teacher FAQs for in-depth exploration of topics that may challenge your students.

Teacher Exchange

Save time planning lessons with innovative lesson plans written by your colleagues on a wide array of math topics and levels.

Math Tools

Find a catalog of online math tools to use when solving Problems of the Week and bring technology into your classroom.

Internet Mathematics Library

Search an online library of the best sources of information on mathematics and mathematics education.

Step 3

CLASSROOM TIPS

TIPS

You can tailor your use of these problems to enrich your classroom in many different ways:

- Students can work online in groups or as individuals from home, in computer class, or in the library.

- You can print out the problems and have students work in groups, pairs, or individually with paper and pencil.

- Start by showing the class a sample problem and walking through the process together: first, understanding the problem; then planning a strategy; and finally, explaining the solution. Don't forget to reflect on the solution the class has reached. Was it the best strategy? Are there other strategies that would have been quicker, simpler?

- Solve your first Problem of the Week in a few large groups or as an entire class.

- Explore different processes for arriving at a solution.

- Ask students to write out how they thought through the steps to reach their conclusions.

- Discuss the Scoring Rubric as a way of measuring the success of the process, as well as the results. Have students score responses themselves and discuss them as a class.

- Give students their own copies of the Rubric and create a large rubric on poster board to put on the wall as a readily available reference and reminder for you and the class when discussing problem solving.

- Move from working in large groups, to small groups, and then as individuals.

- Create groups in which students' abilities vary. Encourage stronger students to mentor the others. This usually happens as a natural result of cooperative learning.

- Select problems that relate to the week's work.

- Problems related to a single topic are at a variety of difficulty levels so that you can meet the needs of struggling, grade-level, and more advanced students at the same time.

- Schedule a routine time frame for solving problems. For example, give students one week to write their responses. The second week will give them time to receive mentoring feedback from you or another approved mentor online or in class. You can adjust the time frame to suit your other classroom activities, depending upon how well your students are able to complete the assigned problem.

- Multiple problems may be assigned, but it is best to start with one problem to ensure that students are adequately oriented in the process and rubric.

- Create competitions among groups, classes, even schools—and post your winners! Let the winners from last week become the "Math Doctors" for the next one.

ASSESSING STUDENT RESPONSES

Here are a few simple guidelines for writing solutions to non-routine problems:

1. **Understand the problem.** Reinforce literacy strategies to help students understand what is being asked. Read the problem aloud in class, and check for understanding.

2. **Form a strategy.** Students may work in groups or with a partner initially to develop a strategy for solving the problem. Students must explain how they solved the problem, not just how they got the final numerical answer, even if it's right! Students need to know that they may select different strategies to find the correct solution. Whichever strategy they select, they must explain it step-by-step, writing the calculations they used to find the solution.

3. **Communicate the problem-solving process.** Students must explain in writing why they chose a certain strategy and how they used calculations to arrive at their solution. Students should then reflect on their own solution and share their explanations verbally and in writing. Was it a good strategy? Could they have arrived at the same solution another way? Is there a preferred, or best, strategy for this problem?
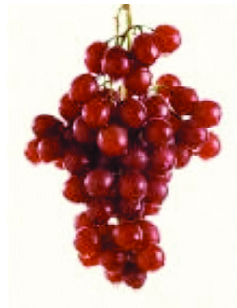
SAMPLE PROBLEM OF THE WEEK

Take a look at this sample problem and responses in which students find the solution using multiple strategies:

Puzzle 3247: Eating Grapes

On Monday Angela ate some grapes. On Tuesday she was hungrier and ate six more grapes than she ate on Monday. Each day that week she ate six more grapes than the day before. After she had eaten her grapes on Friday she had eaten 100 grapes in all.

How many grapes did she eat on Monday?

Aj applied a guess-and-check strategy and adjusted his guesses based on the results of his test. He used his understanding of odd and even numbers (parity) to make better guesses.

From: Aj

Angela ate eight grapes on Monday. The answer to extra was on a Wednesday.

The stategy I used to figure out the problem was guess and check. I started out with 14 grapes on Monday. I had started out with an even number because I knew that when you add six the next number number would be even. I also knew that the ones digit would end with 0, 2, 4, 6, and 8 which would equal. The answer was 130 so I knew I had to have a lower number. This time I chose 4, but that equaled up to 80. So then I knew that I had to have a higher number that is less than 14. So I chose 8. This was then the correct answer.

8+6=14, 14+6=20, 20+6=26, 26+6=32, 8+14+20+26+32=100

SAMPLE PROBLEM OF THE WEEK

Oliver used a direct strategy. He found the sum of all the extra grapes eaten beginning on Tuesday, subtracted it from the total of 100 grapes, and knew the remaining grapes needed to be distributed equally among the five days.

From: Oliver

Angela ate 8 grapes on Monday.

On Monday Angela ate 8 grapes. To get this answer I started by knowing that each day she eats 6 more grapes than the previous day. From this information I know that on Tuesday she ate 6 more grapes than on Monday, on Wednesday she ate 12 more, on Thursday she eats 18 more, and on Friday she eats 24 more grapes than on Monday. Next I added 6 + 12 + 18 + 24. This equals 60.

This tells me that if she ate 0 grapes on Monday then on Friday she would have eaten 60 grapes. Then I subtracted 60 from 100. This equals 40. Then since I had already added the six more for each day all I had to do was divide 40 by 5. This equals 8. Next I added 8 grapes to each day. That told me that on Monday she ate 8 grapes, on Tuesday 14 grapes, on Wednesday 20 grapes, on Thursday 26 grapes, and on Friday she ate 32 grapes. Then I added all these numbers together and got 100 grapes.

Jake used informal algebra. By counting all the sixes, he made his calculations easier.

From: Jake

Angela ate 8 grapes on Monday. For the extra the answer is the 10th day, the second Wednesday. This is how I solved the main question:

Monday she ate G.   Tuesday she ate G+6.
Wednesday she ate G+6+6.   Thursday she ate G+6+6+6.
Friday she ate G+6+6+6+6.

During the week all together she ate 100 grapes. If you add each of the days above you get 100.

 (5xG)+(10x6)= 100   (5xG)+(60)= 100   100-60=40
 5xG=40   5x8=40   so G=8

Sam used algebra, writing clear explanations for each step he took.

From: Sam

She ate eight grapes on Monday. Problem Solving Approach: Express the un-known in terms of the known

Un-known: M = number of grapes eaten on Monday
Known Facts:
100 = total amount of grapes eaten by Friday
6 = the number of additional grapes eaten each day

Formula:
Monday M   Tuesday M+6   Wednesday   M+12
Thursday M+18   Friday M+24   Total   5M+60 =100 grapes
Take 60 away from both sides. 5M = 40
To even it out divide both sides by 5. M = 8

RESPONDING TO STUDENTS ONLINE

RESPONDING

ASSESSING RESPONSES USING
THE MATH FORUM SCORING RUBRIC:

- provides an overview of the Math Forum's assessment for the student

- makes it easy for mentors and teachers to quickly review a student's work

- helps mentors and students understand expectations

The rubric has two major categories:

Problem Solving

- Interpretation: Interpret the problem correctly and attempt to solve all of the parts.

- Strategy: Pick a good strategy and apply it well – achieve success through skill instead of luck.

- Accuracy: Get the calculations and details correct, including writing correct statements and equations.

Communication

- Completeness: Explain all the steps taken to solve the problem.

- Clarity: Explain the steps in such a way that a fellow student would understand, and make an effort to check formatting, vocabulary, and spelling.

- Reflection: Check the answer, reflect on its reasonableness, summarize the process, and connect it to prior knowledge and experience.

In each category, you choose the category that best describes the student's work. Short descriptions of the levels are:

▼ **Novice:** "Just starting out"

▼ **Apprentice:** "On the right track, but not quite there"

▼ **Practitioner:** "Got it"

▼ **Expert:** "Wow! Above expectations in some way"

For more information on the rubric, go to:
mathforum.org/pow/scoring.html

REPLYING TO STUDENTS
TO HELP THEM REVISE AND REFLECT:

• Can they describe the process they used to arrive at their solution?

• Did they find a good strategy but lack complete understanding of the problem?

• Can they think of another way in which they could have reached the same solution?

To learn more about how Problems of the Week are scored, go to:
mathforum.org/pow/teacher/assessown/scoreandreply.html

About The Math Forum@Drexel University

The Math Forum is a leading center for mathematics and mathematics education on the Internet. Established in 1993, The Math Forum with the support of Drexel University has helped more than 100,000 students through our online mentoring programs to excel in mathematics. Our community includes teachers, students, researchers, parents, educators, and citizens with an interest in mathematics and math education. We provide state-of-the-art resources, materials, activities, person-to-person interactions, and educational products and services that enrich and support teaching and learning in an increasingly technological world.

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