



Problem Solving: A 21st Century Education

Richard Rusczyk
www.artofproblemsolving.com

MATH PRIZE FOR GIRLS

NOVEMBER 14, 2009



Result of relying on the Standard Curriculum

“I certainly wish your website and materials existed when I was in high school. I went through junior high and high school without ever missing a question on a math test, and then took [Math] 103 and 104 at Princeton, which was one of the most unpleasant and bewildering experiences of my life and poisoned me on math for years.”

-Princeton University alum

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Three general areas in which the standard curriculum is not designed to allow students to reach their full potential:

- Depth
- Delivery
- Subject Coverage

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Lack of Depth in the Standard Curriculum

- Problems are too easy
- Tyranny of 100%
- Encourages memorization

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Poor Delivery in the Standard Curriculum

- Little exposition, lots of fluff
- Drill and kill is boring
- Drill and kill is counterproductive
- Lesson – problem structure is backwards

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Inadequate Subject Coverage in the Standard Curriculum

- Discrete math almost entirely ignored
- Calculus over-emphasized
- Problem solving treated as a supplemental topic

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“While challenging and improving the mathematical problem-solving skills of high-performing students are surely every-day objectives of those who teach such students, it is not a problem, relatively speaking, of major import in American education.”

-Department of Education Grant Reviewer

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Acceleration Alone is Not the Answer

- It doesn't solve the problem
- Solving hard problems is more important than using advanced tools

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Why Challenging Problem Solving is Important

- Presents challenges like the ones students will face in college
- Prepares students for the intellectual challenges of many different careers

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Keys to Developing Strong Problem Solving Skills in the Early Years

- Read



- Play



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Two Strategies for High-performing Middle and High School Students

- Extracurricular Programs
- Independent Study

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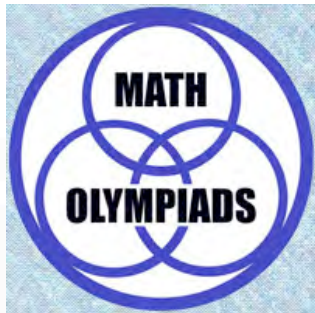
Benefits of a Math Club

- Offers more challenging mathematics
- Signals the importance of math to students
- Establishes a culture of excellence
- Provides social interaction among students with common interests

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Contests



MOEMS
Math Olympiads in
Elementary and Middle School
www.moems.org

Grades 4-8.
Emphasis on problems with many solutions.

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Contests



www.mathcounts.org

- Premier contest for students in grades 6-8
- School, Chapter, State, National levels
- Annual training packet of 300 challenging problems
- Club program with group activities

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Contests



American Mathematics Competitions

www.unl.edu/amc

AMC 8

AMC 10 and AMC 12

American Invitational Math Exam (AIME)

USA Math Olympiad (USAMO)

Math Olympiad Summer Program (MOSP)

China Girls Math Olympiad

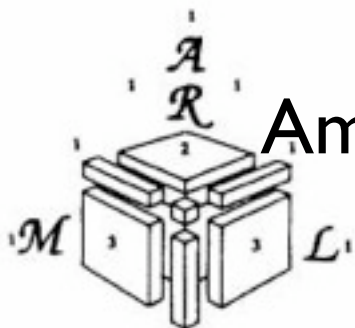
International Math Olympiad (IMO)

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Contests



ARML
American Regions Math League
www.arml.com

Mandelbrot Competition
www.mandelbrot.org

USAMTS

USA Mathematical Talent Search
www.usamts.org

Purple Comet
www.purplecomet.org

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MIT Application

10 If you have taken the AMC 10, AMC 12, or AIME exams, list dates and scores. (If you haven't taken these exams or don't know what they are, don't worry about it.)

| AMC 12/ AMC 10 | Date | Score | AIME | Date | Score |
|-------------------|------|-------|------|------|-------|
| | | | | | |
| | | | | | |

CalTech Application

| AMC | Score | Test Date |
|-----|-------|-----------|
| | | |
| | | |

| AIME | Score | Test Date |
|------|-------|-----------|
| | | |
| | | |

Many colleges ask for AMC scores and some even offer scholarships.

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Math Circles

Local opportunities for students
to learn outside their schools

Cities with Math Circles include:

Albany, Austin, *Berkeley*, Boston, **Boulder**, Charlotte, DALLAS,
Los Angeles, Mobile, New York, Palo Alto (Stanford), Salt Lake City,
SAN DIEGO, San Francisco, San Jose, *Seattle*, Tucson

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Merits of Independent Study

- Structured more like college and careers
- Removes the ceiling of the standard curriculum
- Less likely to bore students into losing interest in math
- Creates more mature learners
- Gives students time to indulge their academic passions

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Summer Programs

MathPath

www.mathpath.org

AwesomeMath

www.awesomemath.org

MathZoom

www.mathzoom.org

PROMYS/Ross

www.promys.org

www.math.ohio-state.edu/ross

MathCamp

www.mathcamp.org

Hampshire

www.hcssim.org

RSI

www.cee.org/rsi

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Research Competitions

- Siemens Competition (www.siemens-foundation.org)
- Intel Science Talent Search (www.intel.com/education/sts)
- Davidson Fellows Scholarship Program (www.davidsongifted.org)
- International Science & Engineering Fair (www.sciserv.org/isef/)

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Other Olympiads

- USA Computing Olympiad (www.usaco.org)
- USA Physics Olympiad (www.aapt.org/Contests/olympiad.cfm)
- USA Chemistry Olympiad (url too long to list)
- USA Biology Olympiad (www.cee.org/programs/usabo)
- North American Computational Linguistics Olympiad (www.naclo.cs.cmu.edu/)

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Challenges to Serving the Top Students

- Convincing schools there's a problem
- Equity issues
- Convincing students there's a problem
- Calculus! Calculus! Calculus!

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Resources for a Math Problem Solving Education

BOOKS

CLASSES

WEBSITE

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Resources for a Math Problem Solving Education

BOOKS

Art of Problem Solving Intermediate Series

Intermediate Algebra by Richard Rusczyk and Mathew Crawford

Intermediate Counting & Probability by David Patrick

Precalculus by Richard Rusczyk

Calculus Expected January, 2010

- Modern mathematics curriculum for high-performing math students
- Integrates problem solving with the mathematics curriculum
- Includes over 2000 problems, many chosen from prominent contests

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Resources for a Math Problem Solving Education

BOOKS

Awards won by the authors of Art of Problem Solving textbooks:

- National MATHCOUNTS Test Champion
- National MATHCOUNTS Team Champion
- Two perfect scores on the AMC exam
- Three perfect scores on the AIME exam
- Two USAMO winners
- 9 invitations to the Math Olympiad Program

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Resources for a Math Problem Solving Education

BOOKS

Art of Problem Solving Volume 1 and 2

by Richard Rusczyk and Sandor Lehoczky

- Emphasis on problem solving and contest preparation
- Used by top MATHCOUNTS and AMC students and teams for over 16 years
- Authors earned the only perfect scores on the AIME in 1989 (Rusczyk) and 1990 (Lehoczky)

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Resources for a Math Problem Solving Education

BOOKS

Mathematical Circles by Fomin, Genkin, Itenberg

Art and Craft of Problem Solving by Paul Zeitz

Problem Solving Strategies by Arthur Engel

Olympiad problem books and preparation texts
by Titu Andreescu and/or Zuming Feng

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Resources for a Math Problem Solving Education CLASSES

Online classes for problem solving available at:

- Art of Problem Solving
- Belin-Blank
- CTY
- EPGY
- TIP

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Resources for a Math Problem Solving Education WEBSITE

www.artofproblemsolving.com

- Books
- Classes
- Articles on problem solving topics
- LaTeX tutorial for typesetting mathematical writing
- AoPSWiki
- Lists of and links to many other resources, such as books, programs, contests, scholarships, and more!

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Resources for a Math Problem Solving Education
WEBSITE

www.artofproblemsolving.com

AoPS For the Win!

A FREE online multi-player game.

Thousands of MATHCOUNTS and AMC problems.

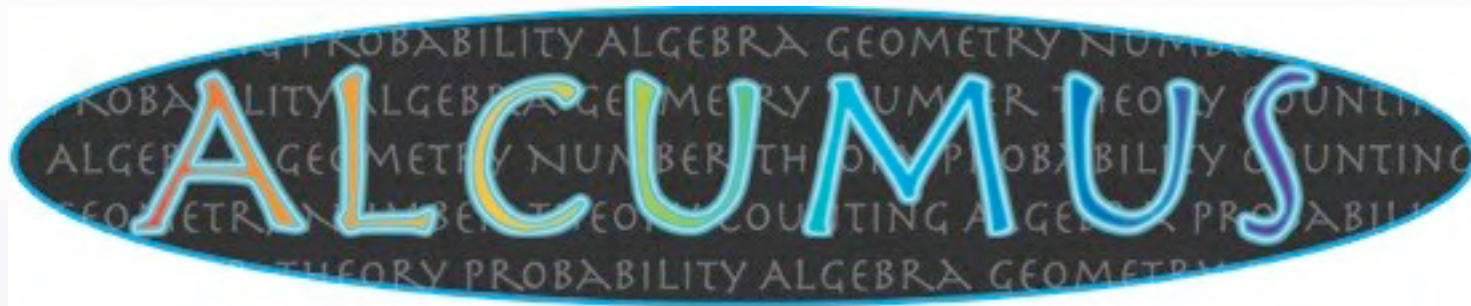
Countdown Round format.

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Resources for a Math Problem Solving Education WEBSITE

www.artofproblemsolving.com



A New Online Adaptive Learning System

FREE!

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Resources for a Math Problem Solving Education WEBSITE

www.artofproblemsolving.com

Largest online community of problem solvers in the English-speaking world

Tens of thousands of members

Over one million posts

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Opportunities in College

- Internships
- Research Experiences for Undergrads (REUs)
- Budapest Semesters in Mathematics
- Work for Art of Problem Solving

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Developing Problem Solving Skills Strategies for Parents

ORGANIZE

AGITATE

CONTRIBUTE

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**TECHNOLOGY NOW ALLOWS US TO
LEVERAGE THE EFFORTS OF A FEW
TO THE BENEFIT OF THE MANY.**



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Our tomorrow
is in the hands of the
best students today.

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