

Mathematics Project

Resources, Ideas and Tools

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Mathematical
Society**

Contents

- Where are the **resources** for Mathematical projects?
- How to generate **interesting ideas** for Mathematical projects?
- How to use **IT tools** in Mathematical project investigation?

Where to find the problems?

- Internet resources on Mathematics
- Books on recreational Mathematics
- Mathematics Magazines
- Challenging Problems from Mathematics competitions
- Interesting Mathematics Questions from everyday life
- Mathematical Games, Magic and Puzzles

Internet – Project Ideas

- Mentored Research Projects for Young Mathematicians
www2.edc.org/makingmath/default.asp
- Math Forum: Math Ideas for Science Fair Projects
mathforum.org/teachers/mathproject.html
- Math Projects for Science Fairs
camel.math.ca/Education/mpsf/
- MegaMath Projects
www.cs.uidaho.edu/~casey931/seminar/projects.html

Internet – Games, Puzzles

- Mathematical Games, Toys, and Puzzles
compgeom.cs.uiuc.edu/~jeffe/mathgames.html
- MathPuzzle.com
www.mathpuzzle.com/
- PUZZLES. Can you believe it?
www.archimedes-lab.org/
- Math Forum: MathMagic!
mathforum.org/mathmagic/

Internet – Math Resources

- Mathematics Enrichment: NRICH Home Page
www.nrich.maths.org/public/index.php
- The Math Forum @ Drexel University
mathforum.org
- MathWorld
mathworld.wolfram.com/
- Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Main_Page

Books on Math

- Discovering Mathematics – The Art of Investigation by *A. Gardiner*
- The Investigations Books – A Resources Book for Teachers of Mathematics by *J. Holding*
- Geometry by Discovery by *D. Gay*
- Recreational Math books by *Martin Gardner, Ivars Peterson, Ian Stewart* etc.
- General and Popular Math books published by *Dover Publishing* and other publishers.

Math Magazines

- *Mathematics in School* published by the Mathematical Association (www.m-a.org.uk)
- *Math Horizons* and *Mathematics Magazine* published by The Mathematical Association of America (www.maa.org)
- *Mathematical Medley* published by the Singapore Mathematical Society (sms.math.nus.edu.sg)

What type of problems?

- The problem should be **easy to understand**, and must be **sufficiently interesting** for the student to want to solve it.
- The **solution** should **not be obvious**.
- The attempt to solve it should lead to some **interesting mathematics**.
- The mathematical **techniques** required to consider and solve the original problem should be **elementary**.

Examples

- **Examples** from winners of the Singapore Mathematics Project Festival (SMPF)
- Where the **ideas** come from?
- How to start from a **simple problems** and extend to an **interesting project**?
- How to use **IT tools** such as Excel, GSP, Java, Flash, etc in project **investigation**?

Example 1 - Applications of Pigeonhole Principle

- River Valley High School
Top Prize, SMPF (Senior) 2003
- Idea from **Magic Card Tricks**
- Many applications of the Pigeonhole Principle are **well known**.
- Main result: To prove the magic card tricks using the Pigeonhole Principle, which is **non-trivial** for high school students.

Example 2 - Excursions into the Moving Sofa Problem

- River Valley High School
Top Prize, SMPF (Senior) 2004
- Idea from the **daily life**:
[Moving object around an corner](#)
- The **original** Moving Sofa Problem is **too difficult** for high school students.
mathworld.wolfram.com/MovingSofaProblem.html

Easier variations and application to real-life problems

- Rectangle turning around corner which are not right-angled.
- Rectangle turning around curved bends.
- Consider objects moving with speed. This can be applied to real-life problem such as moving vehicles turning at corners or junctions.





Consider the hallway to the right. Which of the coffee tables at the far right would be able to turn the corner and make through the hallway.

Click on the coffee tables to find out.



Example 3 - Modification of the Marion Walter's Theorem

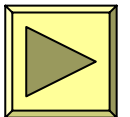
- Seng Kang Secondary School
Silver award, SMPF (Senior) 2004
- Idea from the following website
www2.edc.org/makingmath/default.asp
- How to **extend** and **modify**?
- How to use GSP to **explore**?



GSP

Example 4 - Frogs

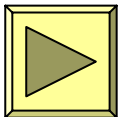
- Xinmin Secondary School
Silver award, SMPF (Senior) 2004
- Idea from the Leaping Frogs game.
- **Extend** to a (m, s, n) configuration, i.e. m frogs on the left, n frogs on the right and s spaces in the middle.
- Extend from 1-dimension to **2-dimension**.





Example 5 - Lights Out Puzzle

- Bowen Secondary School
Bronze award, SMPF (Junior) 2004
- Idea from the Lights Out game.
- The game can be solved using **binary matrix** but it may be **too difficult** for lower secondary school students.
- Consider some **special cases** and solve them.



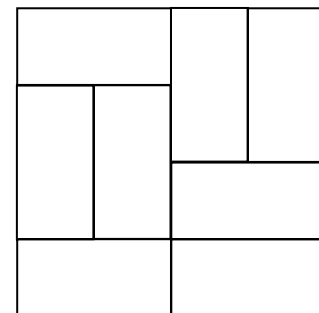
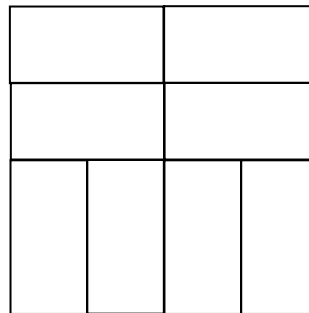
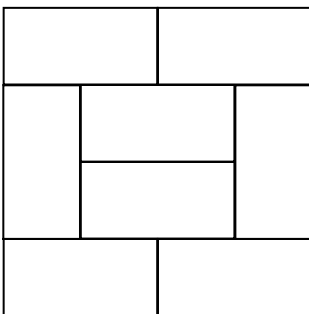
Example 6 - Raw Recruits

- Orchid Park Secondary School
Bronze award, SMPF (Junior) 2005
- Idea from the following website
www2.edc.org/makingmath/default.asp
- Try to find some **patterns** with different initial conditions.
- How to use Excel to **explore**?

Excel

Example 7 - Tiling for Maths

- Deyi Secondary School
Bronze award, SMPF (Senior) 2005
- Idea from the following **competition problem**:
How many different ways are there to tile a 4 by 4 square using 2 by 1 tiles? e.g.



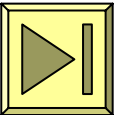
From sample to complicated

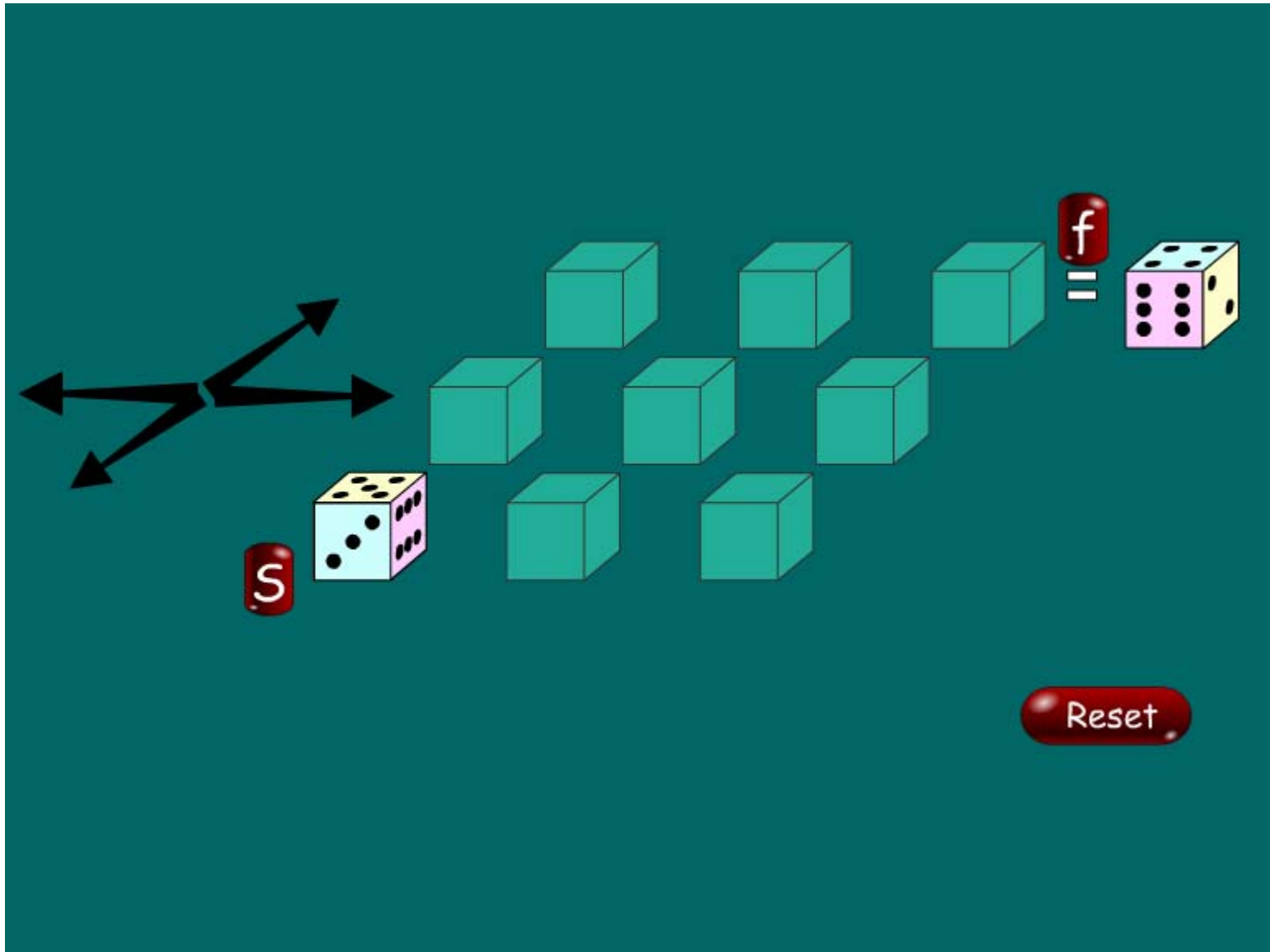
- Tiling of 2 by n rectangle using 2 by 1 tiles
- Tiling of 3 by n rectangle using 2 by 1 tiles
- Tiling of 4 by n rectangle using 2 by 1 tiles
- Tiling of 3 by n rectangle using 3 by 1 tiles
- Tiling of 4 by n rectangle using 3 by 1 tiles
- etc

Example 8 - Dice Roller

- Xinmin Secondary School
Silver award, SMPF (Junior) 2006
- Idea from [Rolling a Dice](#)
- Try to look for **rules and patterns**.
- How to **represent** the rolling **mathematically**?
- How to use Excel to **explore**?

Excel





Thank You

The image features the text "Thank You" in a bold, sans-serif font. Each letter is filled with a different color from a rainbow spectrum: 'T' is magenta, 'h' is red, 'a' is orange, 'n' is yellow, 'k' is lime green, 'Y' is blue, and 'u' is purple. The letters are rendered with a slight 3D effect, casting soft, grey shadows on the white background below them.