Math Fairs – Thinking is Fun

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Paper presented at Makos 2005 in Čejkovice, Czech Republic,
October 7th, 2005

Abstract

Mathematics teachers are always on the lookout for ways to make their classes more accessible for their students, and to get them thinking. An interesting way to get a few steps closer to this goal is the concept of a Math Fair. This interactive and inclusive activity is not strictly a new idea, but it is currently being popularized by the newly founded international group SNAP, based in Alberta/Canada.
In this paper I present the basic ideas behind the concept of the Math Fair, give some tips for anyone interested in starting one, and present a few puzzles that can be used at a Math Fair.

1. What is a SNAP Math Fair?

In order to understand the concept, it is enough to consider what the initials SNAP stand for. The following is taken from the SNAP website at http://www.mathfair.com

Student-centered

In a SNAP math fair, the students are front and center. They are involved in the presentation. Their displays present problems, not solutions. Passers-by try the problems, and the students help them solve the problems. As well as standing for "**S**tudent-centered", the **S** in SNAP stands for "**S**uper-interactive".

Non-competitive

No first prize! No arguments about judging. No negative feelings by students who do not win a prize. No prizes are awarded at a SNAP math fair. No prizes are needed.

All-inclusive

The participation rate should be 100%, whether its for a single class, a single division or for an entire school.

Problem-based

Students present problems (*not the solutions*) to the spectators. They will help the spectators solve the problems. Of course, the students must first solve the problems themselves and prepare tabletop displays.

The basic idea is for students to choose an accessible mathematical problem (mathematical puzzles are very good, since they do not require any prior knowledge), find the solution, and prepare a presentation of the problem for other students/their teachers/their parents or others in a public forum. This can be in the school or in a public place, such as a shopping center. The students are then responsible for their own problems. They lead the visitors to their display toward finding a solution themselves, and explain the solution to them in case they cannot solve the problems themselves.

A number of internationally well-known mathematicians and educators are involved in the creation of this project, among them Andy Liu of the University of Alberta, Martin Gardner, Bill Ritchie of Thinkfun/Binary Arts, Wen-Hsien Sun of Chiu Chang Publishers, Taipei and Paul Vaderlind of Stockholm University.

2. Why hold a Math Fair?

There are many good reasons to hold a Math Fair. Probably the best reason is based in the well-known fact that many students are either afraid or bored of the mathematics they know from school. A Math Fair can make the subject more accessible and more interesting for these students. They can lose their fear of the subject and gain confidence in their own problem-solving abilities. If the participating students are allowed to choose their own projects, they are on the same level as their teachers during the working phase of the project, which can be a very stimulating experience for many students normally used to the teacher knowing everything, and themselves knowing nothing. (Some teachers may be afraid of giving up control of the classroom in this way, but all teachers who have organized such Math Fairs agree that the results are well worth the temporary personal insecurity.)
For students already at a high level of mathematical knowledge, such as students involved in mathematical olympiad programs, working on Math Fair presentations raises their general problem solving skills, independent of specific mathematical content such as geometry, number theory or similar typical topics. Of course, the Math fair concept is wide enough to also allow an "Olympiad Math Fair" with problems more typical at this level. Similarly, a Math Fair devoted to some specific aspect of the subject, such as mathematical modelling, is certainly possible. For most students however, the basic tenet of keeping the Math Fair all-inclusive will prevent such topics in practice.

3. What makes a good problem?

This is not an easy question to answer. There are many problems that have already been proven to be successful in Math Fairs. Some very nice examples can be found in "The Math Fair Booklet" by Ted Lewis, which can be purchased at http://www.mathfair.com/resources.html. Also available at http://www.mathfair.com is an interesting article by Tiina Hohn on puzzle games that can be played with an ordinary deck of cards, as well as links to a large number of other websites offering puzzle-type problems well suited to math fairs. Excellent sources are also http://www.puzzles.com (the website of Thinkfun/Binary Arts), http://www.johnrausch.com/PuzzleWorld/ and http://www.puzzlebeast.com. These are especially interesting for their interactive puzzles. It is possible to solve the puzzles on a computer if an internet connection is available, or alternately, students can build their own versions of the puzzles out of cardboard, wood, or other materials for presentation. Having students build solid versions of their puzzles is especially helpful in getting them to "own" their problems.
For younger students, easier puzzles may be better. In this case, a great treasure trove is given by the problems from the Kangaroo contest or its many relatives, such as the Australian Mathematics Competition, and problems can be found under http://www.kaenguru.at (in German) or http://www.matematickyklokan.net (in Czech).
The most important thing is for the problems used to be easily presentable, and to allow a solution that participants can find themselves and completely understand. The students presenting the problem must be able to "own" it, i.e. to be able to understand it so deeply that they feel comfortable explaining it to others who may not be able to solve it.

4. Evaluation

An important part of any classroom activity is evaluation. A teacher must have some idea of the work the student has done; whether the time was used well or wasted, whether the important concepts were understood by the student and whether or not the methods used in class turned out to be suited to the subject material. Also, teachers in nearly all schools are obligated to express their students' learning progress in terms of grades. The Math Fair concept allows many forms of evaluation, but aside from the obvious fact that teachers will check to see that their students do the expected work, students at a Math Fair will receive feedback from the other students (teachers/parents) solving their problems. This offers the opportunity for honest self-evaluation, which can lead to a much more thorough learning process than unreflected classroom work.
In deciding how to grade a student's work, such factors as display (posters, models), presentation (clear explanation of the problem to be solved), understanding (the presenting student's own depth of understanding in his or her chosen problem), coaching (helping the visitors solve the problem, explaining the solution to visitors not able to solve the problem themselves) and teamwork (if the students work on their projects in groups; this is the most commonly used method) can be considered. It seems to be generally agreed that the difficulty of the chosen problem should not be taken into account. Some examples of evaluation methods for Math Fairs that have been proven to work can be found at http://www.mathfair.com/eval.html.

5. A few interesting puzzles

These are just a few of the puzzle types that I have been particularly interested in recently. Of course, every reader will have his or her own favourites, but I welcome you to check these out. Perhaps you will enjoy them as much as I do.

- Sliding Block Puzzles

Many interesting sliding block puzzles can be found at http://www.johnrausch.com/SlidingBlockPuzzles/default.htm and at http://www.puzzlebeast.com/sliding block/sliding_irritating.html.

- Polyhedral Dissections

Three dimensional dissection puzzles are especially good for students aged 13-14, since this is the age in which the brain is most strongly developing its spatial cognition abilities. One such puzzle is shown in the following diagram, in which two identical blocks are to be put together to form a "pyramid" (in fact, a regular tetrahedron). While the solution looks very simple, most people (of all ages) find this puzzle very difficult if they are only given the two pieces.

Various Soma-type puzzles are also very good, and many interesting dissection puzzles can be found at

http://www.johnrausch.com/PuzzlingWorld/default.htm

- **Paper Folding Problems**

Very nice problems derived from simple paper-folding ideas can be found in my book **Geometric Constructions in Origami** (ISBN 4-627-01681-6) and in the book **The New Puzzle Classics** by Serhiy Grabarchuk (Sterling Publishing, 2005, ISBN 1-4027-1742-3), as well as at http://www.britishorigami.org.uk/fun/index.htm and http://www.origami-usa.org/puzzles/index.html .

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