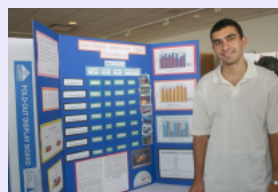
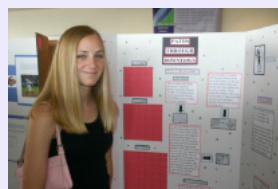
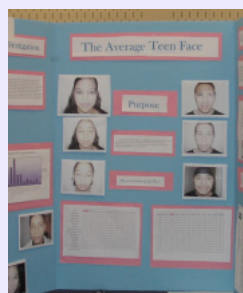


FOCUS ON MATHEMATICS

MATH EXPO!

WWW.FOCUSONMATH.ORG

The *Focus on Mathematics* partnership is sponsoring expositions of student research projects on topics in mathematics. The Mathematics Exposition, to be held on June 10, 2006 at the Boston Museum of Science, will encourage and support student research in each of the *Focus on Mathematics* school districts. This is a yearly event in which students develop projects and are mentored by teachers and mathematicians from Boston University, UMass Lowell, Worcester Polytechnic Institute, and EDC, Inc. Students then present their results to peers, educators, and panels of mathematicians at poster sessions in the districts.



REMEMBER THESE DATES!

- **FEBRUARY/MARCH** – Students work on projects.
- **APRIL/MAY** – Math Fairs are held in schools.
- **JUNE 10, 2006** – Selected projects will be presented at the Math Expo.

This effort is being coordinated by mathematicians

Art Heinricher (Worcester Polytechnic Institute) and Glen R. Hall (Boston University).

Students are encouraged to come up with their own ideas, but other project ideas are available. A preliminary list is available now at <http://www.focusonmath.org/FOM/resources/math/mathexpo/>
All project ideas are welcome!
For mathematical mentoring or help with project ideas, email: HardMathCafe@focusonmath.org

SOME PROJECT SUGGESTIONS:

MATHEMATICAL KNOTS

Take a length of string and tie the ends together. The resulting loop is called a "knot" in mathematics. If the loop can be deformed (without cutting the string) to a circle then it is called the "trivial" knot. If the loop has twists and turns that can not be removed without cutting the string, then it is a non-trivial knot.

Given a loop of string, how can we tell if it can be untwisted to a circle (that is, it is a trivial knot) or not. One idea is to flatten the loop against a table, follow the string around the loop and keep count of the times the string crosses itself. If the piece you are following passed under another piece of the string, add 1 to the count. If the string crosses over another piece of string, subtract 1 from the count. This is called the "crossing number".

Getting Started

Does the crossing number tell you anything about which loops of string are really trivial knots. Make some trivial knots, twist them up, put the on a table and count? What do you notice and why does it work?

Going Deeper

What if you make the loop into a non-trivial knot. What do you notice about the crossing number? How does the crossing number depend on how you place the tangle on the table? Are there other ways to assign integers to the knot that tell you things about how tangled the knot is?

Submitted by G. Hall

AVERAGE RAINFALL IN THE STATE

Suppose you want to compute the average rainfall in Massachusetts, but the only data you have is from official rain gauges are in Boston, Lawrence, Worcester and Pittsfield. Suppose 42.1 inches of rain fell in Boston, 40.5 inches of rain fell in Lawrence, 43 inches of rain fell in Worcester and 50 inches of rain fell in Pittsfield in a particular year. How can you figure out the average rainfall for the state?

Getting Started

The gauges in Boston, Lawrence and Worcester are all in the Eastern half of the state while the gauge in Pittsfield is only one in the west, so the gauge in Pittsfield represents the rainfall in more of the state than any of the other three. So each of the readings has to be "weighted" depending on what fraction of the state it represents.

Going Deeper

Where would you locate two rain gauges in Idaho in order to determine the average rainfall in that state? Justify your choice.

Submitted by A. Heinricher

WHAT IS THE "CENTER" OF MASSACHUSETTS?

Getting Started

1. How would you define "center" of an oddly shaped region like Massachusetts?
2. How would you find the center?

Going Deeper

Are there other ways of defining the "center" of the state? How many reasonable definitions can you think of and how would you find these centers?

Submitted by A. Heinricher