Information for Teachers

The Julia Robinson Math Festival day prize problems on the next few pages are designed for your grade students. They are hard problems that your students might find interesting. If they do find them interesting, they have accomplished their purpose. Students to not have to work these problems to be successful. In fact, we would like you to pick a prize-winning student even if your students do not solve these problems. We hope you will register your prize winner at the website `http://education.uncc.edu/oeo/jrmf/`, and then urge them to attend. You can ask them which of the prizes they would like, a book prize or a t-shirt prize and you can let us know by means of the online web registration. At that time we hope you will agree to help us that day March 27, 2010. We also ask that you estimate the number of your female students you expect to attend the JRMF Day. Only female middle school students are invited to take part that day.

1. **The Four 4's problem.** We have four copies of the digit 4 to use in this problem. The idea is to combine them in different ways to count to 100. We'll try to construct each number, 1, 2, 3, etc. up to 100 using four 4's, and when we can't construct a number, we'll allow ourselves to use five 4's. The operations we can use are the usual arithmetic operations, plus, minus, times, and divides $+, -, \times, \div$. We also allow ourselves *concatenation* . For example, we can build the number $4 * 4 = 44$ from two 4's. Also, note that $(4 \times 4) * 4 = 164$. When there is not possible confusion, we write just 44 instead of $4 * 4$. Here are a few examples to get you started. $1 = 44 \div 44$, $2 = (4 \div 4) + (4 \div 4)$, and $3 = (4 + 4 + 4) \div 4$. Be sure you use parentheses to make your expressions clearly defined. The important thing here is to see which numbers cannot be constructed with four 4's.

2. **X'ing digits.** Consider the number

   $$N = 1234567891011121314151617181920212223242526272829 30 \ldots 5960$$

   obtained by writing the numbers from 1 to 60 next to one another. What is the largest number that can be produced by crossing out 100 digits? You are not allowed to rearrange the digits that you don't cross out.

3. Juan and Thu are both smart chocolate-lovers. There are four bars of chocolate of sizes 250 grams, 300 grams, 400 grams and 600 grams. Juan chooses first and starts eating at a uniform (=constant) rate. As soon as Juan chooses, Thu gets to chose which chocolate bar to start on, and she eats at the same uniform rate as Juan. As soon as one of them finishes, that person chooses again and again eats at the same rate. Who gets the most chocolate. Explain how they can achieve it.

4. A rectangular block of size $3 \times 4 \times 5$ is built from 60 unit cubes. How many of the 60 cubes can be seen from the outside?

5. Find four different digits selected from the set $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ to build two fractions each with a single digit numerator and single digit denominator so that the sum of the two fractions is less than 1 but as large as possible otherwise.

6. The 8×10 grid below has numbers in half the squares. These numbers indicate the number of mines among the squares that share an edge with the given one. Use this information to find the exact location of all the mines.

	1		1		2		2		1
1		2		3		2		3	
	3		2		3		2		2
1		3		2		1		3	
	3		2		1		1		2
2		4		1		1		2	
	3		3		2		3		1
1		2		2		3		2	