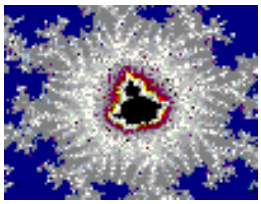

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Tied Up In Knots!

A Classroom Activity

by Marie Stroh

Certainly all of us here in the Mathematics Department want to be inspiring teachers. We want our students to want to come to class, to enjoy and find value in our lessons. For most courses, however, we often struggle just to fit all the course material into the quarter, and our non-classroom related responsibilities leave us little time to creatively develop new and exciting ways to present "old" material. If we are honest, we would admit that all the time required for preparation of an activity, coupled with the inconvenience of hauling all that stuff to our classroom, simply discourages us from implementing more classroom activities. Well, here is one activity that is easy as pie to plan and facilitate, but packs a walloping punch in terms of mathematical content. I have used a variation of this activity both in Math 142 and in Math 191, and plan to use it in my Math 102 class (special section for Visual Learners) spring quarter.

While beginning algebra students can make general connections between the abstract algebraic equations to the physical application, more advanced students discover the significance of y-intercepts, slope, and feasible domain and range. They see how the application restricts the domain and range of the abstract mathematical equation, since the graph of the equation crosses both the x-axis and the y-axis, but negative knots and zero or negative length of rope are not possible.

Another interesting aspect of this activity is that unlike most linear applications, this one involves a negative slope - the rope shortens as more knots are tied.

As I mentioned earlier, I have used this activity repeatedly and found it to be well received by my students. I have learned that students who regularly work together in groups jump right in and need little guidance. However, as is the case with any activity, initial instructions often prevent unwanted, more complex outcomes, such as students mixing up the dependent and independent variables on their graphs. When I introduce this activity, I show a rope which already has knots tied in it to demonstrate that the knots should not be tied one on top of the other.

I also have a shorter rope filled with knots, but for which seventeen knots is physically impossible to obtain. I hold this rope back to use during the summarization of the activity. I have learned that summarizing the activity **as a class** is absolutely vital to the success of any activity. This is the time to clarify terms and clear up any misconceptions that arose during the activity. Believe it or not, students actually appreciate it when I spell out the obvious from the activity. It acts as a confirmation for them - Yep, they "got it." *(Continued on Page 2)*

Tied Up in Knots!

Materials:

- Pieces of rope of different lengths and thicknesses
- Measuring tapes

Activity:

1. Measure the length of one of the ropes in centimeters, and record its length in a table like the one shown:

Number of Knots	Length of Rope (cm)
0	
1	
2	
3	
4	

2. Tie 6 or 7 knots, re-measuring the rope after each knot is tied. Record each new length in your table.

3. Graph the data with the number of knots on the horizontal axis, and the length of the rope on the vertical axis.

4. Write an equation that best fits your data points.

5. What is the slope from your equation? What does it mean in terms of this physical application?

6. What is the vertical intercept from your equation? What does it mean in terms of this physical application?

7. Use your equation to predict the length of your rope if 10 knots had been tied in it. THEN check your prediction by tying 10 knots and comparing your prediction with the actual length.

8. Use your equation to predict the length of your rope if 17 knots had been tied in it. THEN if possible check your prediction.

9. Where does your graph cross the x-axis? How does this relate to the knots and rope?

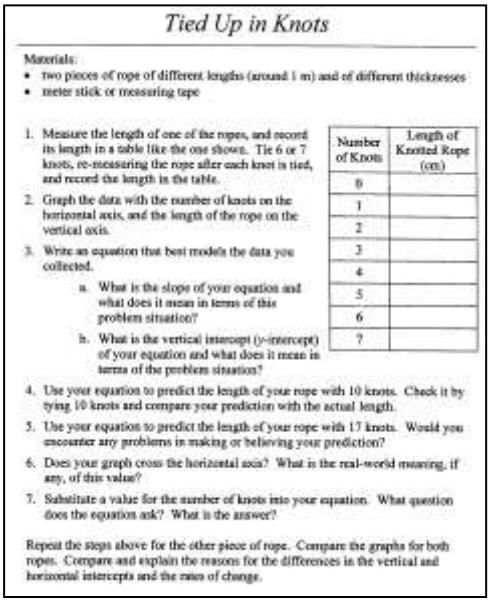
10. Where does your graph cross the y-axis? How does this relate to the knots and rope?

11. Compare your ropes, graphs and equations with that of another group.
a. How are the ropes different from each other?
b. What if anything is the same about your graphs?
c. What is different about your graphs?
d. What if anything is the same about your equations?
e. What is different about your equations?

12. If your rope had been longer, how would your equation be different? How would it be the same? If possible find a group with a longer rope to verify your answers.

13. If your rope had been thicker, how would your equation be different? How would it be the same? If possible find a group with a thicker rope to verify your answers.

Faculty members practice **Tied Up in Knots!** at the Departmental Retreat last summer in the Bergamo Center.



Tied Up in Knots

Materials:
- two pieces of rope of different lengths (around 1 m) and of different thicknesses
- meter stick or measuring tape

1. Measure the length of one of the ropes, and record its length in a table like the one shown. Tie 6 or 7 knots, re-measuring the rope after each knot is tied, and record the length in the table.
2. Graph the data with the number of knots on the horizontal axis, and the length of the rope on the vertical axis.
3. Write an equation that best models the data you collected.
   a. What is the slope of your equation and what does it mean in terms of this problem situation?
   b. What is the vertical intercept (y-intercept) of your equation and what does it mean in terms of the problem situation?
4. Use your equation to predict the length of your rope with 10 knots. Check it by tying 10 knots and compare your prediction with the actual length.
5. Use your equation to predict the length of your rope with 17 knots. Would you encounter any problems in making or believing your prediction?
6. Does your graph cross the horizontal axis? What is the real-world meaning, if any, of this value?
7. Substitute a value for the number of knots into your equation. What question does the equation ask? What is the answer?

Number of Knots	Length of Knotted Rope (cm)
0	
1	
2	
3	
4	
5	
6	
7	

Repeat the steps above for the other piece of rope. Compare the graphs for both ropes. Compare and explain the reasons for the differences in the vertical and horizontal intercepts and the rates of change.

You can find a printable copy of the Tied Up in Knots! activity on the Math Department's Angel web site. Look in the Mathematics group under Content, 2008 Department Retreat Material, Material from Lyn Keeler, and then Algebra Activities. (These are all Marie's handouts.)

DEPARTMENT COLLOQUIUM

We will have a Department Colloquium on Friday, May 15, 2009 at 2:30 p.m. in Room 1001. All members of our full- and part-time faculty are welcome, as well as students or anyone else interested in mathematics. The speaker and title are as follows:

Dr. Daniel Ortero,
Associate Professor of Mathematics
Xavier University
"The Pythagorean Theorem,
1000 Years Before Pythagoras"

Following the talk will be the presentation of the Mathematics Department Part-time Faculty Member of the Year Award, as well as recognition of winners in the Mathematics Department student competitions. Please encourage your students to attend.

Refreshments will be served.

WATCH OUT!

Just when we thought we had it figured out – that we knew how to clear the memories of our students' graphing calculators (even including the archived programs), along comes Brandon Wilson and his downloadable program FAKE. FAKE is a fake memory clear program for the 83+ and 84+ series graphing calculators. When we attempt to reset the calculator's memory, FAKE intercepts the instructions and fakes all of the steps so that it looks like the programs have actually been cleared. It even makes the memory usage screen show 0 bytes used. When the student enters a secret code, however, all of the programs are restored. There is even a You Tube video that demonstrates step-by-step how to use FAKE. Does anyone know how to circumvent this program?

Teachers Teaching with Technology

The Regional T3 Conference at the UC College of Applied Science was held in mid April. Conference attendees included Glen Lobo, Wendy Chang, David Stott, Brett Holland, Tony Ponder, Kinga Oliver, Najat Baji, Harmit Kaur, along with Bob Chaney and Ed Gallo (who are not pictured). David and Brett presented "Introduction to the TI-83/84 Plus," and Bob and Ed presented "Spice up Your Statistics Courses with Activities and Technology."

REMINDERS

- Tests should not exceed one hour in length.
- Please make sure all students attending class are on your roster. If you allow them to attend unregistered, it creates problems for them and for the college.
- Please do not skip material on the syllabus or modify the number of tests without consulting with the department.
- Please remember that students should memorize the course formulas (the ones included with the department syllabi) and should not be permitted to use formula sheets for them or store them on their calculator.
- Please do not cancel classes without first notifying the Math Department.

Congratulations!!!

Our congratulations go to Moez Ben-Azzouz and Richard Uchida for achieving Tenure, to Glen Lobo and Dave Hare for promotion to the rank of Associate Professor, and to Vickie Lair for promotion to Professor.

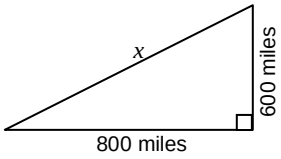
Harvey's Joke Corner

When the football team won 20-0, it accomplished a "score-score."

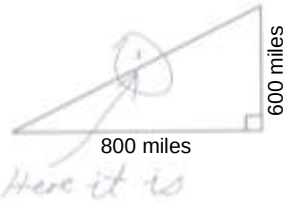
From Russ Marcks:

Exam Problem

Find x.



Student's Response



Instructor's Response: "A journey of 1,000 miles begins with a single step."