

MthT 491 Problem Based Activities

DRAFT September 13, 2014 jlewis

A core part of the course is a set of problem based activities which lead to understanding concepts of algebraic thinking including

1. Patterns
2. Variables, expressions, and equations
3. Functions
4. Multiple Representations

(NCTM Algebraic Thinking Yearbook 1999)

1. Candle Problem (Driscoll, pp. 9, 95–97 and related materials). Cf. 491candle.pdf. Mathematics includes variables, rates, linear functions, solving equations. Multiple representations - tables, physical representation, graphing lines, symbolic representation.

Related problems: NCTM Year Book - Quinn and Larson) When Does a Dog become older than its Owner? From a student in Fall 2003 When does the Tortoise Catch the Hair?

2. Tooth Pick Squares (Driscoll, p. 9, 160, and related materials). Cf. 491tooth.pdf. Mathematics includes points and lines, and developing formulas. Patterns, chunking the problem, developing a function/formula.

Related problems: 491node.pdf - toothpick squares and triangles from the point of view of graph theory. Article on constructing tubes (cf. Fall 2003 Blackboard Announcements, September 30, 2003).

Title: DEVELOPING ALGEBRAIC REASONING THROUGH GENERALIZATION.
Author(s): Lannin, John K. Source: Mathematics Teaching in the Middle School; Mar2003, Vol. 8 Issue 7, p343, 7p, 2 diagrams, 1c Document Type: Article Subject(s): ALGEBRA

3. Golden Apples ((Driscoll, p 22–24, 26 and related materials) Mathematics includes predictions, repetitive processes, linear functions, determining input from output, possible inputs for whole number output. Patterns, developing rules, describing steps.

Related problems: Baldwin IMP

4. Racetrack. Cf. 491roma.pdf Two cars traveling at constant speed on a track are side by side every 56 minutes. If, with the same speeds, one of the cars were traveling in the opposite direction, the two cars would meet every 8 minutes. How long does it take the faster car to complete one lap on the track?

Mathematics includes variables, velocity, distance. Trials, Introducing variables(including variables not stated explicitly), solving equations.

5. Digits and Multiplication. (Cf. 2003 Blackboard October 27, 2003 Announcement and 491place.pdf) Discussion of Multiplication and your carefully written solution of "reversed digits" problem. Discussion of: Liping Ma, Multidigit Number Multiplication: Dealing with Students' Mistakes, Chapter 2 of Knowing and Teaching Elementary Mathematics, QA135.5.M22, 1999, pp. 28–54. (Cf. October 21, 2003).

Mathematics includes representation of integers and chunking into 1's. 10's 100's, . . .

Related problem: Multiplication of Binomials (Cf. October 21, 2003).

The next three problems are related. Note by Baldwin:

A proposal is to do first the orangey problem and then the Crystal task - making them write about both and trying to clarify how one thinks about proportions. The water-wine problem fits into this since teachers must come to grips with whether more means 'more dense' or just 'more'.

I think 'puzzle' problems have to be handled with care. Just because it is a stimulating and fun problem doesn't mean it will help teachers teach better or deepen a students understanding of mathematics. But water/wine for example has algebraic solutions and forces one to think about which data is really germane.

6. Orangey Problem cf. orangey.pdf (**Connected Mathematics -Comparing and Scaling?**) Mathematics includes ratios, proportions, percentages, scaling, and comparing representations. There are "two solutions".
7. Crystal Task. (From SGMM - large pdf file and crystalmgm1.pdf) Is there additional material from Small Group Mathematical Modeling (SGMM) Project? Mathematics includes proportion, diameter, area, density, scaling, data interpretation.

Related Problem: Proportion (Baldwin proportion.pdf).

8. Water and Wine (Cf. Baldwin and 491place.pdf and H20.pdf or 420h20wine.pdf). Mathematics includes careful computation, units, proportion, and a descriptive solution.

Related Problem: Bread Problem (Baldwin's H20.pdf or 420h20wine.pdf)

9. Ratio and Proportions (Baldwin LaTeX ratio1.pdf) Mathematics includes proportion, compound proportion, rates, units, work, and solving equations.
10. Replacement Problems (Baldwin 491replace.pdf) Mathematics includes variables, symbols, two equations.

Related problem: Finding Prices (Driscoll p. 129)

Other Problems

11. Weinzweig on Factors of 1000 !
12. Postage Stamp and Lattices (Also Driscoll pp. 24–26, 93, 125–126, 148–149)
13. Medicare Drug Benefit - jlewis work in progress on percentages, piecewise linear relationships and expected value.
14. Cooperative Learning (Baldwin, Dees, Foulser, Tartakoff `coopprob.pdf`) - the cooperative problems paper. It includes the density jigsaw which I (JB) think is good although the teachers may object that density is too abstract and so another jigsaw maybe should be developed where one approximates a rate.