CCSS Mathematical Practices illustrated in our Morning Mathematics Sessions

1. Make sense of problems and persevere in solving them

Recall the "8 perfect Faro shuffles" video?

http://www.youtube.com/watch?v=7lNk7bfkFq8

Opener

Let's watch a video. Don't worry, it's only like 2 minutes long.

Wait *what?* Figure out what you can about this.

- consider analogous problems, special cases and simpler forms
- transform algebraic expressions or change viewing window to obtain information needed
- use concrete objects or pictures to help solve a problem
- explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends
- make conjectures about the form and meaning of the solution and plan a solution path rather than jumping into a solution
- check answers to problems using a different method
- monitor and evaluate progress and change course if necessary
- understand and compare different approaches

2. Reason abstractly and quantitatively

8. Jason handed us a cute blue Post-It that said:

$$10^2 + 11^2 + 110^2 = 111^2.$$

a. Surely the numbers 10, 11, 110, and 111 in the note are in base 2. Check to see if the statement is true in base 2.

b. Hey wait, maybe those numbers are in base 3. Check to see if the statement is true in base 3.

c. Oh, hm, maybe it was in base 4.

d. Sorry, it was actually in base n. What!

- represent a given situation symbolically and manipulate the representing symbols
- stop and think about what the symbols represent in the context
- reason with quantities and about relations among quantities
- consider the units involved
- attend to the meaning of quantities, not just how to compute them
- knowing and flexibly using different properties of operations and object

3. Construct viable arguments & critique the reasoning of others

We overheard Sara and Joe still yelling about whether or not the number .99999… was equal to 1. Is it? Be convincing.

- make conjectures and build a logical progression of ideas
- use stated assumptions, definitions and previously established results in constructing arguments
- determine domains to which an argument applies
- analyze situations by breaking them into cases
- recognize and use counterexamples
- compare effectiveness of two plausible arguments
- distinguish correct reasoning from that which is flawed and explain any flaws
- justify conclusions and communicate them to others

4. Model with mathematics

No specific "problem," but woven throughout: conjecturing formulas for the number of shuffles required for n cards, using powers of 2 mod *n* as a representation of card positions, determining when those formulas worked, when they didn't, defining what "*n*" represents in your formula, establishing conditions (under which kind of shuffle)

- write an equation to describe a situation
- apply mathematics to solve problems arising in everyday life, society, and the workplace
- identify important quantities in a practical situation and map their relationships using diagrams, two-way tables, graphs, flowcharts and formulas
- make assumptions and approximations to simplify a complicated situation
- interpret mathematical results in the context of the situation and reflect on whether the results make sense, improving the model as necessary

5. Use appropriate tools strategically

Woven throughout: The use (and abandonment) of playing cards, flash cards, sticky notes, spreadsheets, and calculator programs to aid in the process of shuffling, checking conjectures, detecting errors, deepen understanding of ideas.

- make sound decisions about using tools, recognizing both the insight to be gained and their limitations
- use technology to visualize the results of varying assumptions, explore consequences, and compare predictions with data
- use technological tools to explore and deepen understanding of concepts
- identify relevant external mathematical resources and use them to pose or solve problems
- analyze graphs, functions and solutions generated by technology
- detect possible errors by using estimation and other mathematical knowledg

6. Attend to precision

1. What's the difference between *mod 7* and *base 7*? Write a brief explanation (with a numerical example) that a middle-school student could understand.

- communicate precisely to others
- use clear definitions in discussion and in reasoning
- state the meaning of symbols used, specifying units of measure, and labeling axes
- calculate accurately and efficiently
- note the assumptions made
- express answers with an appropriate degree of precision

7. Look for and make use of structure

Find the units digit of each annoying calculation. Put those calculators away!

a. $2314 \cdot 426 + 573 \cdot 234$
b. $(46 + 1)(46 + 2)(46 + 3)(46 + 4)(46 + 5)$
c. $71^4 \cdot 73^4 \cdot 77^4 \cdot 79^4$

- look closely to discern a pattern or structure
- see complicated things (such as algebraic expressions or functions or a histogram) as single objects or being composed of several objects
- recognize and use the strategy of drawing auxiliary lines to support an argument

8. Look for regularity in repeated reasoning

1. Complete this table.

n	Powers of 2 in mod n	Cycle Length
7	$1, 2, 4, 1, 2, 4, 1, \ldots$	3
9		
11		
13		
15		
17		
19		
21		
23		
25		
27		

- notice if calculations are repeated
- look for general methods and for shortcuts
- evaluate the reasonableness of intermediate results