Quantitative Literacy and the "Big Ideas" of High School Mathematics

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Themes of Quantitative Literacy

- Quantitative literacy involves real-life situations.
- Quantitative literacy involves problem solving.
- Quantitative literacy involves a synthesis of several skills.
- Quantitative literacy is not a separate skill in and of itself; rather, it is infused in mathematics, and indeed in most areas of curricula and everyday life.
- Quantitative literacy seems to involve responsible citizenship in some way, much as we would expect any citizen to be literate.

Why QL? Why Now?

- We've shifted from an industrial technology to information-age technology…Industrial technology required reading and writing literacy; information technology requires quantitative literacy.

  "When I was in Mississippi [in the 1960s], I saw very graphically how literacy mattered. Sharecroppers weren't literate, so they were outside the economic arrangement…We're growing young people who are outside the economic arrangements for the information-age technologies. It's not that they don't need reading and writing. They need higher levels of reading and writing because they have to communicate. But they also need the ability to encode and decode information, which is partially encoded with quantitative information." – Bob Moses, creator of *The Algebra Project*

Mathematical Illiteracy is a problem in the United States

- 78% of all adults cannot explain how to compute the interest paid on a loan
- 71% cannot calculate miles per gallon on a trip
- 58% cannot calculate a 10% tip for a lunch bill

(Phillips, AIR, 2007)

A few examples that could be used easily in a High School (math?) class

A very large number example

- A thousand seconds ago was:
- 16 2/3 minutes ago
- A million seconds ago was:
- 11 days, 13 hours and 47 minutes ago (about)
- A billion seconds ago was:
- May, 1979
- A trillion seconds ago was:
- 29,500 B.C. (give or take a few years)

Now, given that information, consider the following

- As of January 05, 2011, at 9:00 a.m. (Central Time), our National Debt was:

14,005,082,605,001.53

- On January 5th, 2000, the debt was 5.7 trillion
- On March 17th, 2009, the debt was 11 trillion
- At the current pace of growth, the debt will be over 22 trillion dollars by January 1st, 2015.
- Source: **http://www.usdebtclock.org/**

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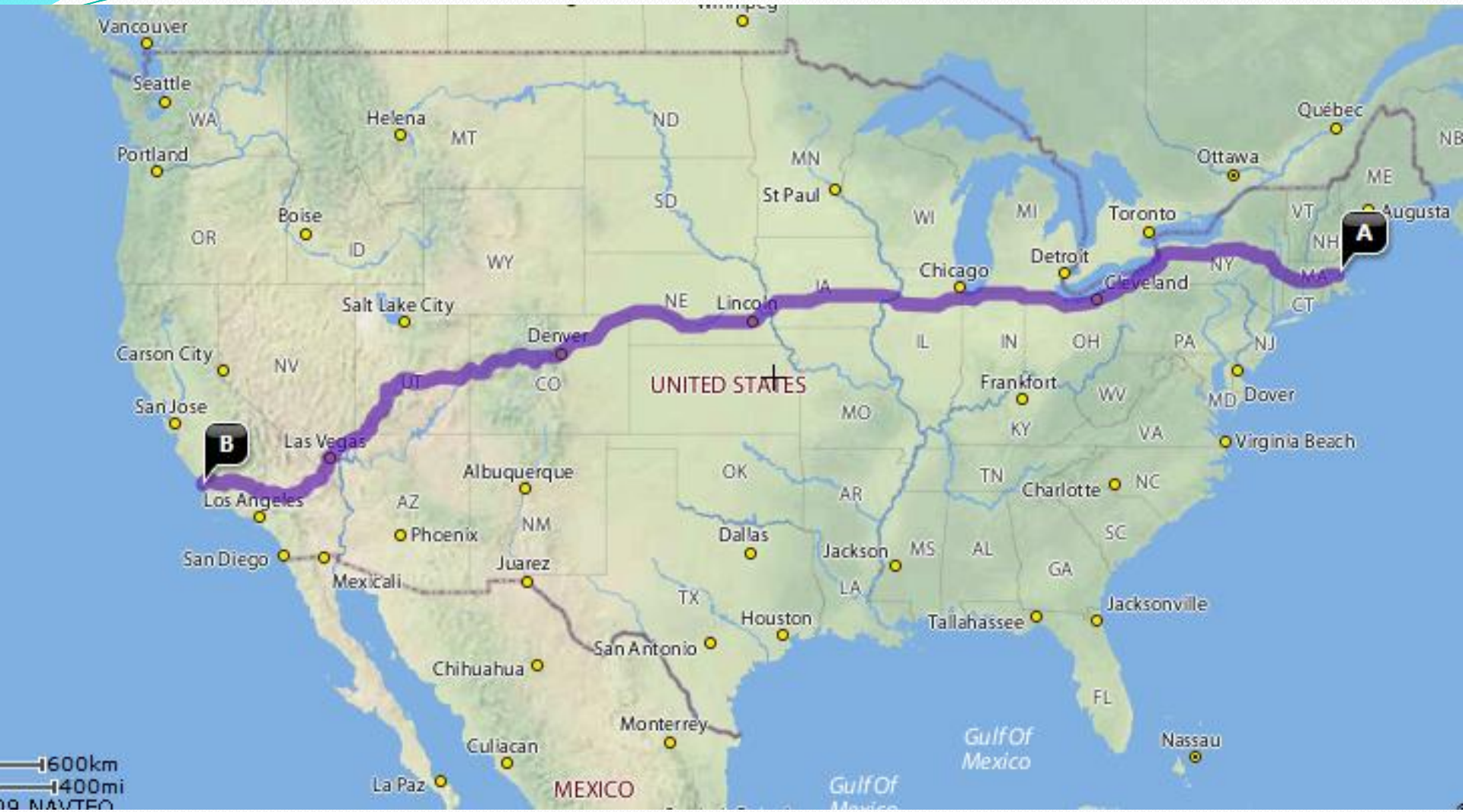
Example: very small numbers

- According to its web site (**www.powerball.com**), the probability of winning the Powerball jackpot is one in 195,249,054. How small is that?
- Well, imagine, if you will, that you were going on a trip from Boston, driving south and west. For some strange reason, you decide to drive 195,249,054 inches.
- How many miles is that?
- If you drove that many miles, where would you end up?



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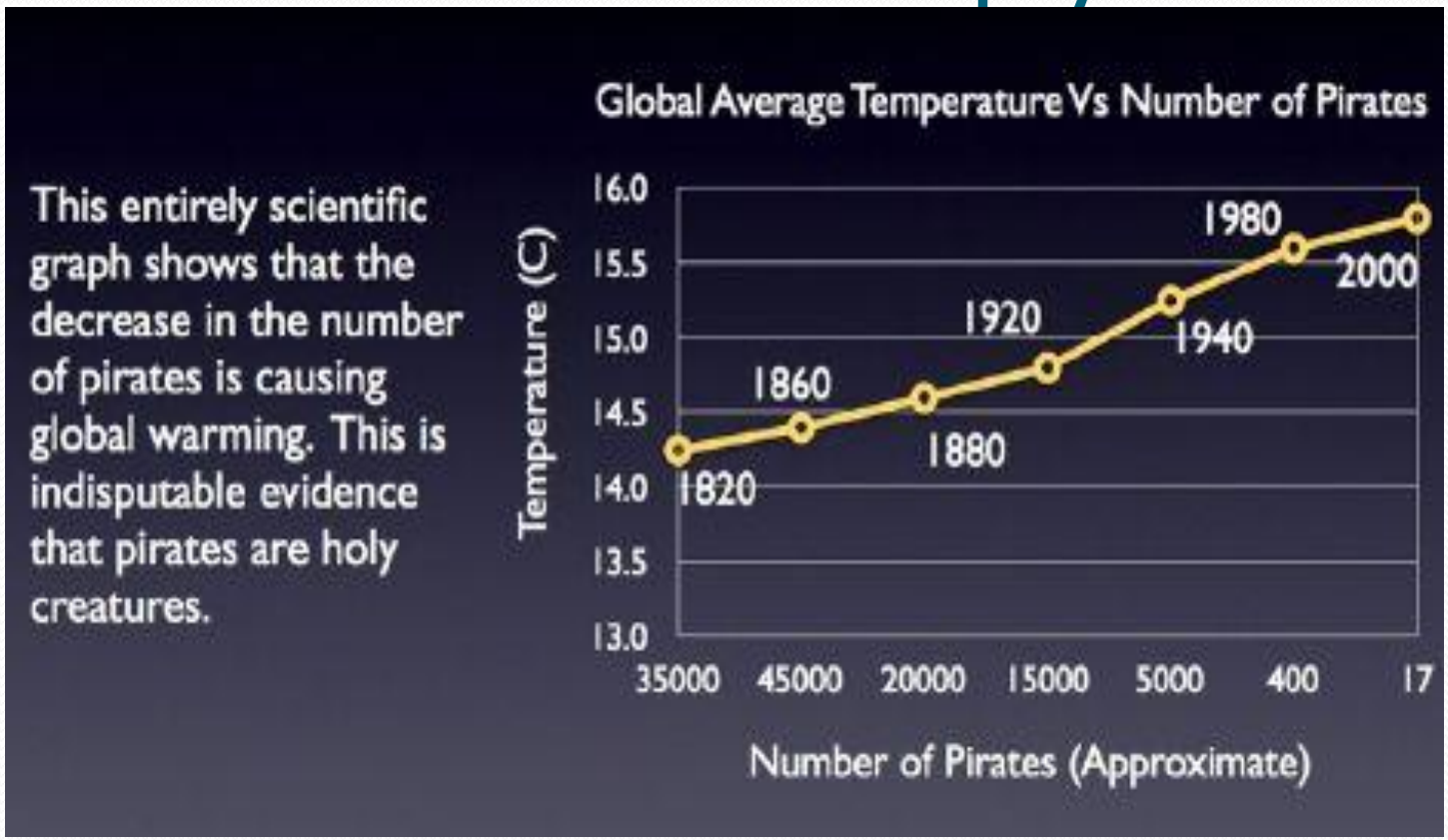
Surprised?

- And, the winning Powerball jackpot would be represented by what in our scenario?
- Do you now know why you never win the jackpot?

I bet you didn't know…

- In 1860, trees in the US covered 660 million acres. 1920, trees in the US covered 720 million acres. In 1990, trees covered 749 million acres.
- In 1860 the average global temperature was 58 degrees Fahrenheit. In 1920, the average global temperature was 59 degrees Fahrenheit. In 1990, the average global temperature was 60 degrees Fahrenheit.
- Therefore:
- Trees cause global warming.

Correlation doesn't imply Causation



Found at: http://montaraventures.com/blog/2007/09/14/pirates-cause-global-warming/

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These examples…

- Involve real life situations and real data
- Involve problem solving
- Synthesize several math skills, not a separate skill all to itself
- Many of them are important for us to truly understand a situation involving quantities
- Use mathematics that typically is found in the K-8 curricula; but uses it in a “different” way
- AND, I would dare to add:
- They are relevant, interesting, and fun!

What should numbers do?

Numbers should help students:

- Articulate their ideas.
- Ground their observations in evidence.
- Test claims and hypotheses.
- Participate in civil discourse.
- Represent what they may be ill-equipped to see.
- Recognize and weigh uncertainty.
- Inform critical thinking.
- My (rhetorical) question: how many high school courses effectively use numbers to do these?

Our Challenge as teachers in developing Quantitatively Literate students: How do we teach students to:

- Read and contextually understand quantitative information from a text, newspaper, TV, Internet, etc.?
- Penetrate below the surface level when reading those situations?
- Ask good questions using numbers?
- Identify critical ideas?
- Challenge conclusions?
- Develop number sense?

New Hampshire PreK-16 Numeracy Action Plan

- A project that began in April, 2008 and finished June, 2010
- The goal was to create a plan for the schools of New Hampshire to follow that help develop quantitative literacy in all high school/college graduates.
- Can find on-line copy at: http://www.education.nh.gov/innovations/pre_k_num/index.htm

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One big problem…one big solution

- With very little information & research about quantitative literacy and numeracy in grades K-12, the creation of this document was a daunting task.

To begin the process, the writers for each grade level were asked to address the following:

- Determine the 3 to 5 “big” math ideas for your grade level & why they are the “big” ideas
- Choose sample problems that illustrate a quantitatively literate approach to teaching those “big” ideas
- Think about ways teachers can help their students become quantitatively literate.

“Big Ideas” in High School Math

- Developing Number Sense
- Developing Problem Solving Skills
- Communicate Mathematically
- Represent Ideas Mathematically

Example from 9-12

- A survey sponsored by the Consumer Federation of America and Primerica (telephone survey of 1,010 adults 18 and older) revealed that 27% of those polled believe that their best chance of building wealth for retirement is playing lotteries. Among households with annual incomes of $35,000 or less, the percentage is 40%.
- People were also asked how much they could save by investing $25 per week for 40 years at an annual percentage rate of 7%. Fewer than one-third responded that more than $150,000 could be saved…

Example from 9-12 (continued)

- 1. What are the chances of winning the grand prize in a major lottery (like the Powerball)?
- 2. How much could you save by investing $25 per week for 40 years at an annual percentage rate of 7%?
- 3. Discuss your interpretation of these two calculations.

Also in this document:

- List of guiding questions to determine school/teacher's effectiveness in infusing QL into their lessons
- A step-by-step guide on how to create a Numeracy Action Plan for a school/district
- Examples of activities (for various grade levels) that infuse QL
- Examples of how to revise "traditional" mathematics questions emphasizing QL concepts
- Connections with state standards
- And much, much more!

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Questions?

- Brian Beaudrie – bbeaudrie@winona.edu
- New Hampshire's Numeracy Action Plan: **http://www.education.nh.gov/innovations/pre_k_num/index.htm**

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