Mathematics and 21st century skills: Creativity, Critical Thinking, Communication, Collaboration & Democracy

MICHAEL PEARSON

Math & Democracy

MICHAEL PEARSON

MATHEMATICS and DEMOCRACY: The Case for Quantitative Literacy (NCED 2001)

Quantitatively literate citizens need to know more than formulas and equations. They need a predisposition to look at the world through mathematical eyes, to see the benefits (and risks) of thinking quantitatively about commonplace issues, and to approach complex problems with confidence in the value of careful reasoning. Quantitative literacy empowers people by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently. These are skills required to thrive in the modern world.

-*Mathematics and Democracy* Design Team

www.maa.org/ql

Mathematics and our world

We must set forth the extraordinary way in which mathematics, springing from the soil of basic human experience with numbers and data and space and motion, builds up a far-flung architectural structure composed of theorems which reveal insights into the reasons behind appearances and of concepts which relate totally disparate concrete ideas.

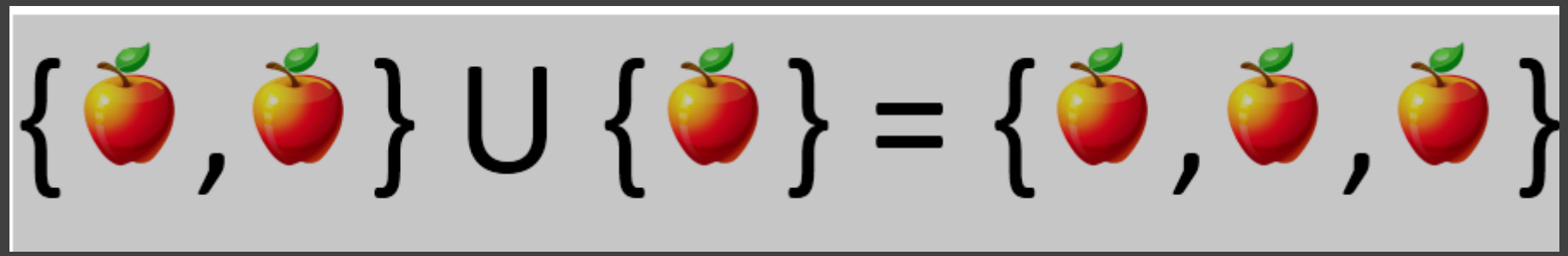
- Saunders MacLane, 1954 MAA retiring presidential address

Committee on the Undergraduate Program in Mathematics

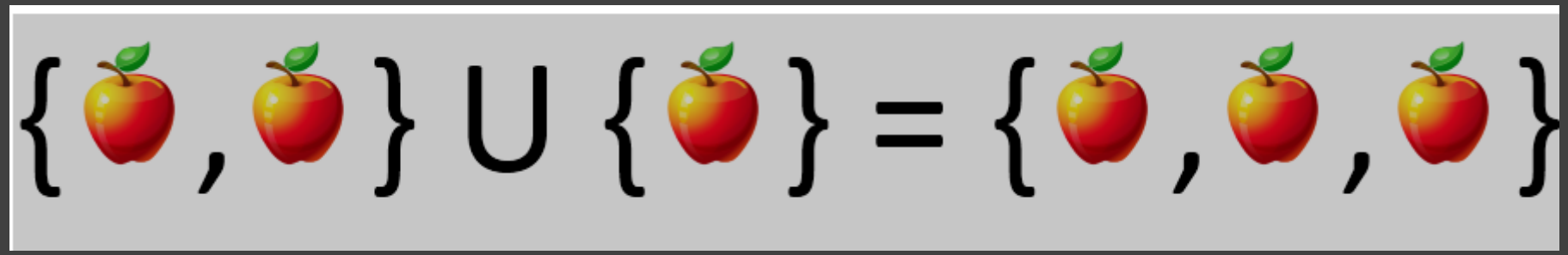
The curriculum should have a primary goal of developing attitudes of mind and analytical skills required for efficient use and understanding of mathematics. The development of rigorous mathematical reasoning and abstraction from the particular to the general are two themes that should unify the curriculum.

-1981 Recommendations on a General Mathematical Science Program

Mathematics and our world



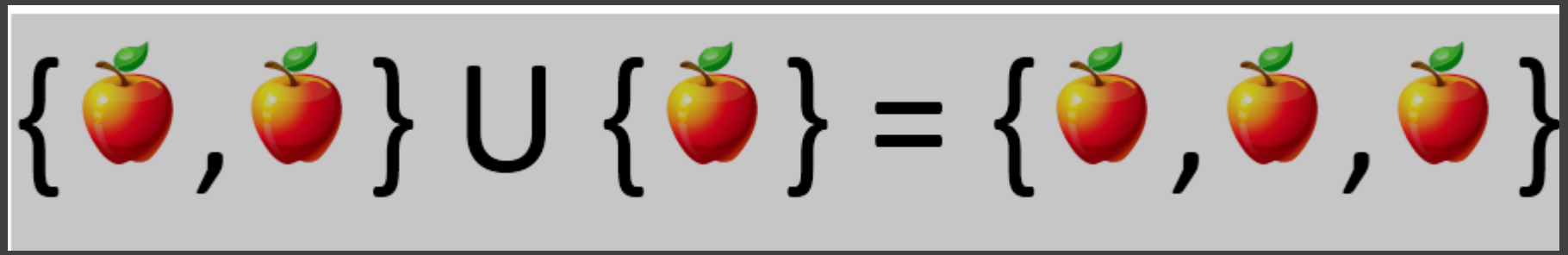
Mathematics and our world

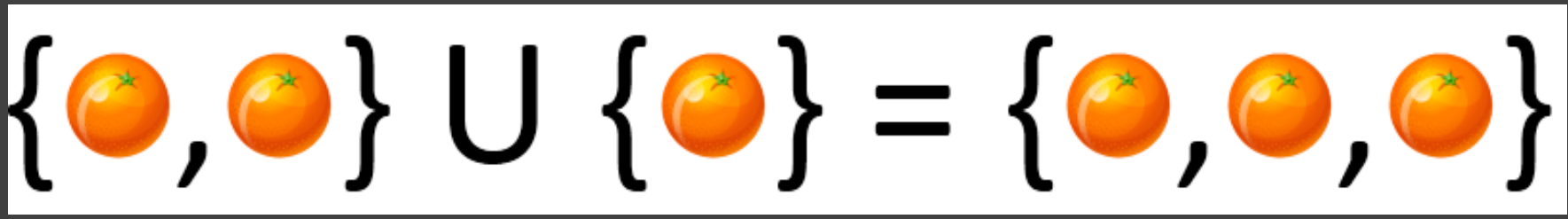


Steven Strogatz on the Elements of Math

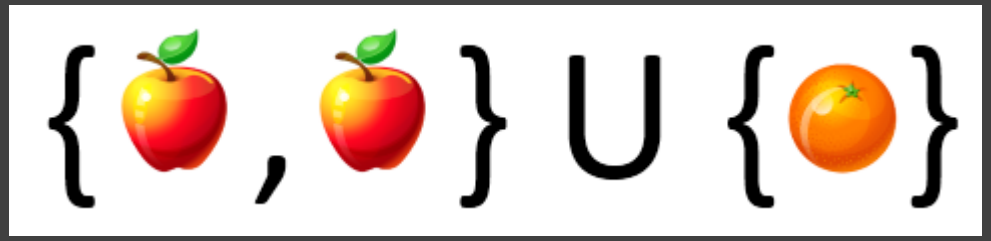
http://topics.nytimes.com/top/opinion/series/steven_strogatz_on_the_elements_of_math/index.html

Mathematics and our world

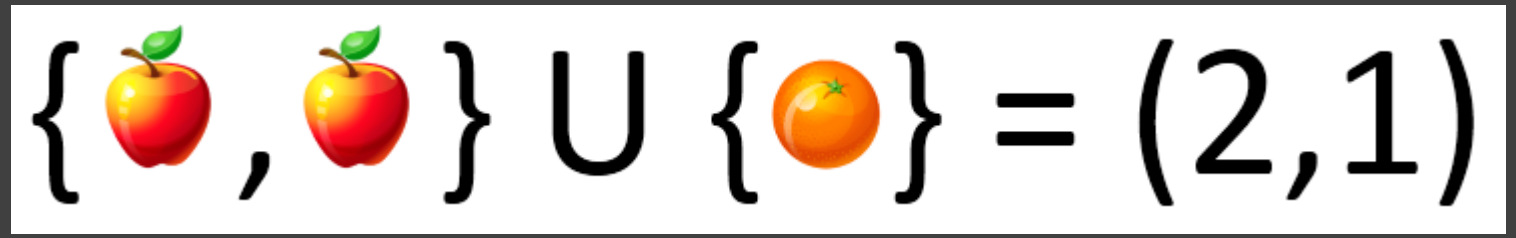




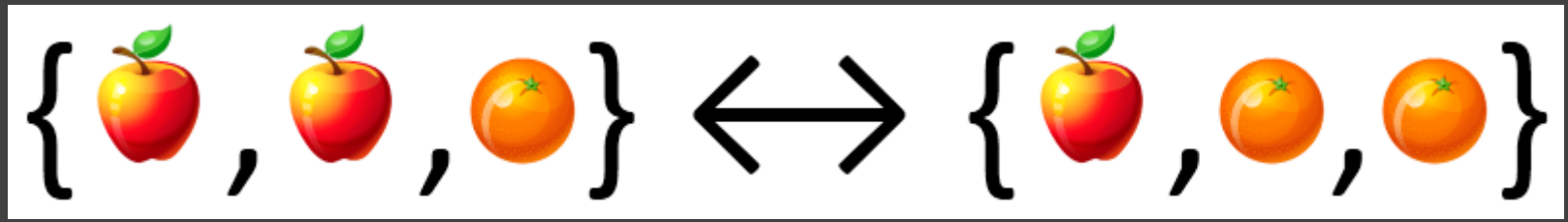
Mathematics and our messy world



Modelling complexity



Symmetry



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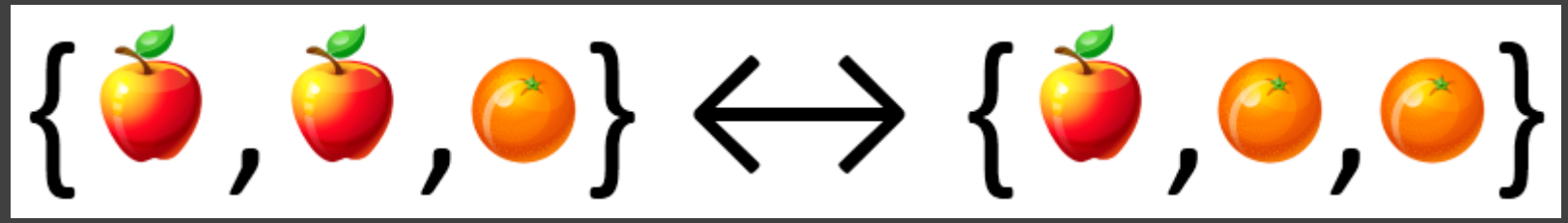
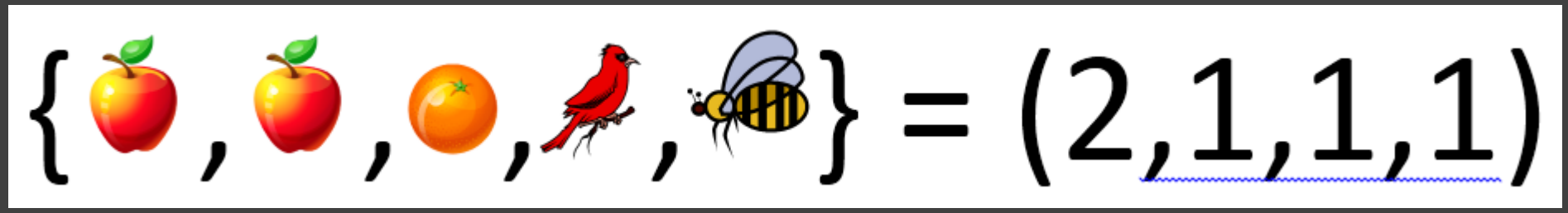


$$(2,1) \leftrightarrow (1,2)$$

Transformation

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

Generalization



Discrete models

Diseases spread when infected people come into contact with healthy but susceptible individuals.

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$$I_{t+1} = I_t + aS_tI_t - bI_t$$

Mathematics sharpens but does not perfect language

Mathematical models are imprecise and flawed.

Can we capture dominant effects?

How long before shortcomings/second-order effects dominate?

CUPM Subcommittee on Curriculum Renewal and the First Two Years

College Algebra provides students a college level academic experience that emphasizes the use of algebra and functions in problem solving and modeling, provides a foundation in quantitative literacy, supplies the algebra and other mathematics needed in partner disciplines, and helps meet quantitative needs in, and outside of, academia. Students address problems presented as real world situations by creating and interpreting mathematical models. Solutions to the problems are formulated, validated, and analyzed using mental, paper and pencil, algebraic, and technology-based techniques as appropriate. (2007)

Recommendations: Sources

CUPM Guidelines: www.maa.org/cupm

NCTM Standards and Focal Points: http://www.nctm.org/standards/

Finding Common Ground: http://www.maa.org/common-ground/

CCSSM (Common Core): http://www.corestandards.org/

European University Association: http://www.eua.be/eua-projects/current-projects.aspx

Modeling in the Curriculum

How to Fix Our Math Education

By SOL GARFUNKEL and DAVID MUMFORD

Published: August 24, 2011

www.nytimes.com/2011/08/25/opinion/how-to-fix-our-math-education.html?

“Imagine replacing the sequence of algebra, geometry and calculus with a sequence of finance, data and basic engineering. … Science and math were originally discovered together, and they are best learned together now.”

More perspectives

The Measure of Reality: Quantification and Western Society, 1250-1600, Alfred W. Crosby

The Pleasures of Counting, T. W. Körner

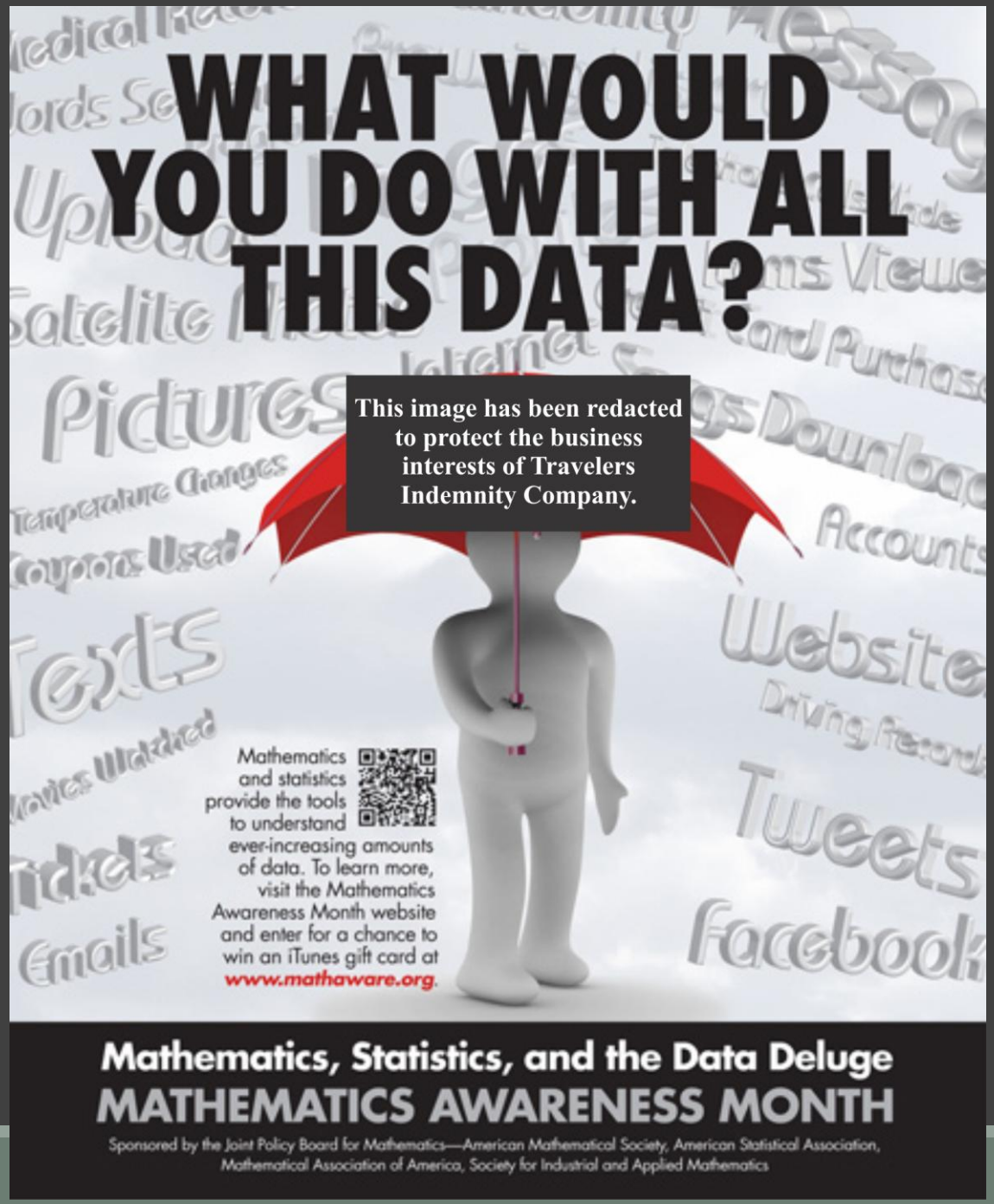
Writings of Lawrence Cremin on the history of education in the U.S.

Mathematics, Statistics, and the Data Deluge

Massive amounts of data are collected every day, often from services we use regularly, but never think about. Scientific data comes in massive amounts from sensor networks, astronomical instruments, biometric devices, etc., and needs to be sorted out and understood. Personal data from our Google searches, our Facebook or Twitter activities, our credit card purchases, our travel habits, and so on, are being mined to provide information and insight. These data sets provide great opportunities, and pose dangers as well.

-Math Awareness Month 2012 (Joint Policy Board for Mathematics)

www.mathaware.org


WHAT WOULD YOU DO WITH ALL THIS DATA?
This image has been redacted to protect the business interests of Travelers Indemnity Company.
Mathematics and statistics provide the tools to understand ever-increasing amounts of data. To learn more, visit the Mathematics Awareness Month website and enter for a chance to win an iTunes gift card at www.mathaware.org.
Mathematics, Statistics, and the Data Deluge
MATHEMATICS AWARENESS MONTH
Sponsored by the Joint Policy Board for Mathematics—American Mathematical Society, American Statistical Association, Mathematical Association of America, Society for Industrial and Applied Mathematics

Mathematics Awareness Month - April 2013

Mathematics of Sustainability

Balancing needs and seeking solutions for a complex changing world

To learn more about the connections between mathematics and sustainability, visit

www.mathaware.org

Joint Policy Board for Mathematics: American Mathematical Society, Mathematical Association of America, Society for Industrial and Applied Mathematics, American Statistical Association

www.mpe2013.org

The instinctual shortcut that we take when we have “too much information” is to engage with it selectively, picking out the parts we like and ignoring the remainder, making allies with those who have made the same choices and enemies of the rest.

-Nate Silver, “The Signal and the Noise: Why So Many Predictions Fail-but Some Don't “

Behavior: Understanding, Predicting—and Controlling

We are all Keynesians now.

Behavior: Understanding, Predicting—and Controlling

We are all Bayesians now.

Behavior: Understanding, Predicting—and Controlling

Predictably Irrational: The Hidden Forces that Shape Our Decisions, Dan Ariely

Traffic: Why We Drive the Way We Do (and What it Says About Us), Tom Vanderbilt

Nudge: Improving Decisions About Health, Wealth, and Happiness, Richard Thaler and Cass Sunstein

In 1991 the population of a town was a perfect square. Ten years later, after an increase of 150 people, the population was 9 more than a perfect square. Now, in 2011, with an increase of another 150 people, the population is once again a perfect square. Which of the following is closest to the percent growth of the town's population during this twenty-year period?

(A) 42 (B) 47 (C) 52 (D) 57 (E) 62

amc.maa.org

www.JamesTanton.com