TEACHING MATHEMATICS FOR SOCIAL JUSTICE (TMFSJ) AS A CONTEXT FOR CCSS

Enrique Ortiz
University of Central Florida
College of Education
Enrique.Ortiz@ucf.edu

NCTM & TODOS
2014 Annual Conference,
New Orleans, Louisiana

~~Agenda~~
List of Topics

- Defining TMfSJ
  - Examples
- Theoretical and Pedagogical "roots" of TMfSJ:
  - Brief overview of critical theory and critical pedagogy
- TMfSJ and the NCTM Standards
- TMfSJ and the CCSS Process Standards
- Activities:
  - The Hidden Grain
  - The Wealth Quiz
  - Unequal Distribution of Wealth in the United States
  - Mercator Projection and Peters Projection World Maps Activity
- References

Defining TMfSJ

Defining TMfSJ: Cont. …

In TMfSJ, students use mathematics as a tool to analyze injustices affecting marginalized peoples.

The injustices may come from students' communities, cultures and life experiences.

A good place to start

- Ask students:
  - What social issues are of interest to you? List the ones you want.
- What could be some possible examples for your students?
- poverty, financial literacy, sweat shops, racism, genocide, abuse, hunger, human trafficking, homelessness, profiling, …
- What are possible challenges to include topics like these if students are interested? Or not interested?

Working with Word Problems: 1

- How could traditional problems be turned into culturally and socially relevant problems that still address the mathematical concepts and skills needed, but have "value added" in the sense that they address real issues in our world.
- **Problem Version 1:** A group of youth aged 14, 15, and 16 go to the store. Candy bars are on sale for 43 cents each. They buy a total of 12 candy bars. How much do they spend, not including tax? (Gutstein & Peterson, 2006, p. 6).
- How can you make this problem have a social justice approach?
- **Problem Version 2:** Factory workers aged 14, 15, and 16 in Honduras make McKids™ children's clothing for Walmart. Each worker earns 43 cents an hour and works a 14-hour shift each day. How much does each worker make in one day, excluding any fees deducted by employers? (Gutstein & Peterson, p. 6).

Mathematics as a Tool

- Both of these problems address the same mathematical concept, but one deals with buying candy bars while the other connects directly to a critical global issue.
- When mathematics and social issues intertwine as they do in the second problem, not only does mathematics become "more lively, accessible, and personally meaningful" to students, but also mathematics becomes a tool "that helps students more clearly understand their lives in relation to their surroundings" (Gutstein & Peterson, 2006, p. 1).
- In order "to have more than a surface understanding of important social and political issues, mathematics is essential," and without it, "it is impossible to fully understand a government budget, the impact of a war, the meaning of a national debt, or the long-term effects of a proposal such as the privatization of Social Security" (Gutstein & Peterson, 2006, p. 2).
- REFERENCE
  - Gutstein, E. & Peterson, B. (Eds.). (2006). *Rethinking mathematics: Teaching social justice by the numbers*. Milwaukee, WI: Rethinking Schools.

Working with Word Problems … : 2

From Smart Bansho! (2013). Social justice in the math. Classroom: http://smartbansho.weebly.com/2/post/2013/06/social-justice-in-the-math-classroom.html

- **Problem Version 1: Activity – A Math Problem:** Examine the pizza party task:
  - Our class is having a pizza party. Here are the results of the what students want to eat:

    3/5 want pepperoni, 0.1 want Veggie, 25% want cheese.

    How many slices of each should we order for a class of 25?
- What are some challenges/questions/issues related to this problem?
- Possible challenges/questions/issues related to this problem
  - Who has food allergies in the class? (Gluten?)
  - Is the cheese halal?
  - Is the peperoni all beef or beef and pork?
  - Would any pizzas be ordered half cheese and half beef? (some won't eat this)
  - Do the pizzas meet TDSB nutritional guidelines for school lunches?
  - Who is going to pay for the pizza? (economy challenges)
- How can you make this problem have a social justice approach?

Working with Word Problems … : 2 cont. …

- **Problem Version 2:**

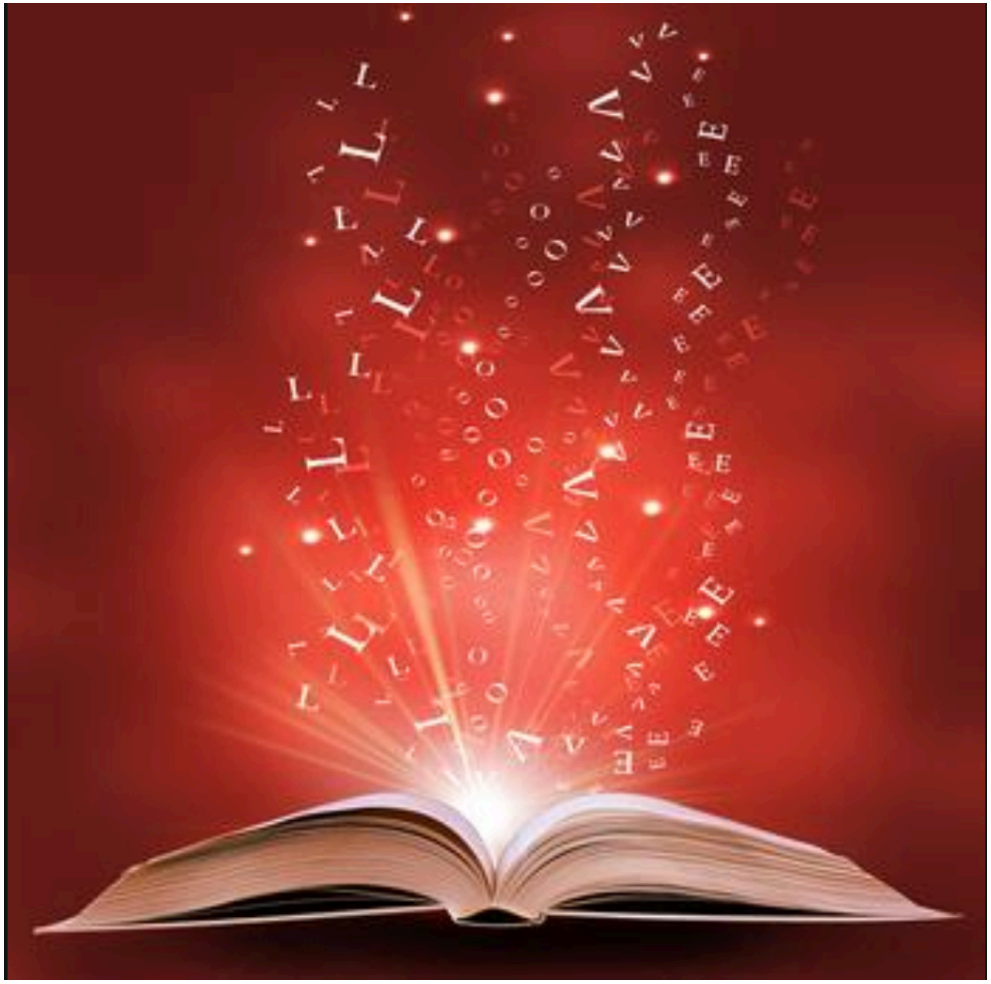
  A school collected data about the top languages spoken at home. Here are the results:

  3/5 speak Bengali 0.1 speak English 25% speak Urdu

  How many students speak each language, in this school population of 100 students? How many students speak each language, in a class with 25 students?

  - **Critical Literacy Link:**
    - Why is this data important for a school to know?
    - If the school office only printed newsletters in English, what would be the impact on the community?

Back to Defining TMfSJ:
TMfSJ as sliding signifier



Critical Theory

"In the most general sense, critical theory maintains sociopolitical critiques on social structures, practices, and ideology that systematically mask one-sided accounts of reality which aim to conceal and legitimate unequal power relations" (Bottomore, 1991)

Critical Pedagogy

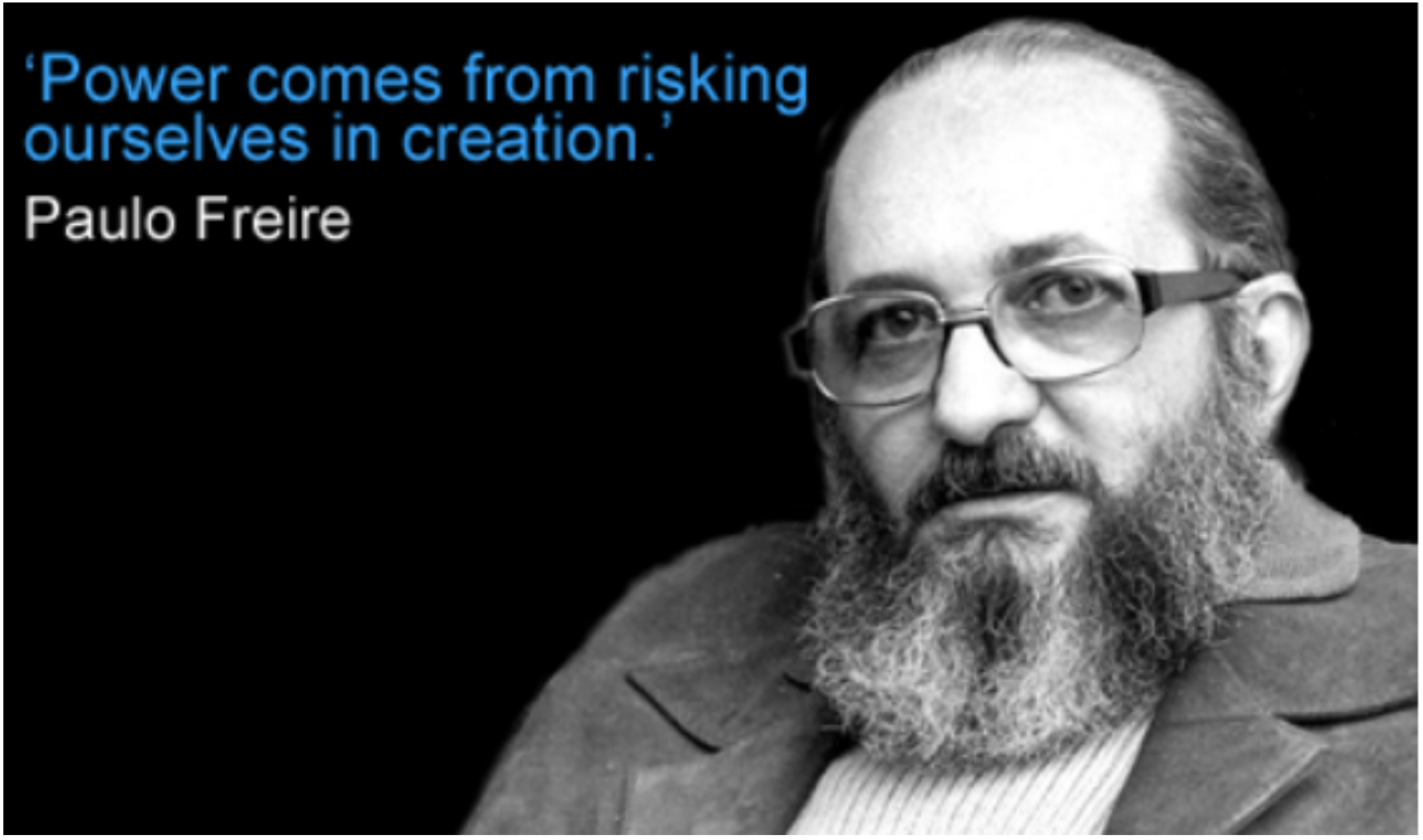
As teachers consider how to integrate social justice into our math programs, a question we can ask ourselves is this: ***"How can numbers be used to change the world and make it a better place?"***

Theoretical and Pedagogical "roots" of TMfSJ: Brief overview of critical theory and critical pedagogy

The origin of critical theory is often associated with the Frankfurt School (circa 1920s), which holds a Marxist theoretical perspective: to critique and subvert domination in all its forms (Bottomore, 1991).

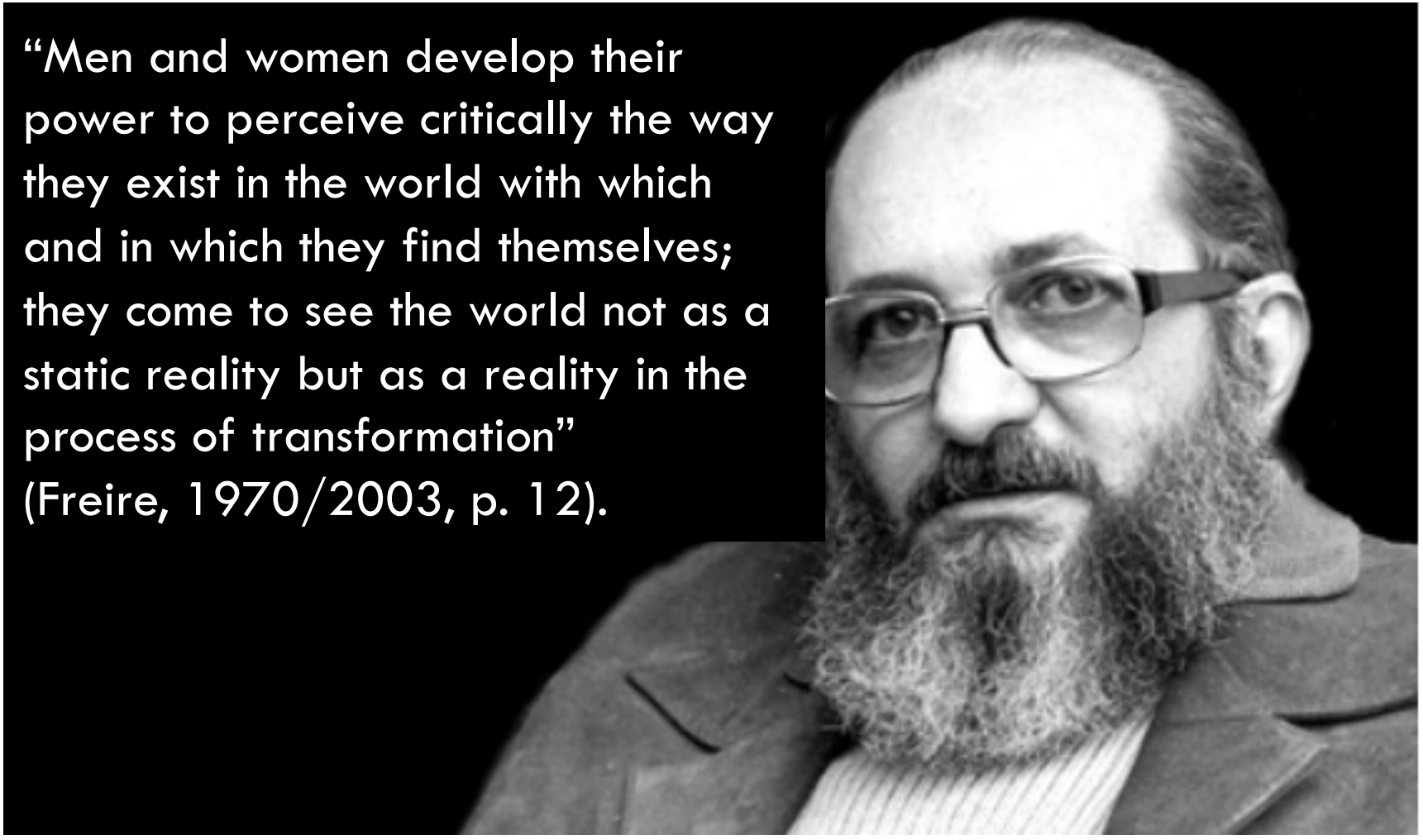
Although the Frankfurt School and the seminal works of Karl Marx (and Friedrich Engels) are foundational in its development, it is important to keep in mind that critical theory is not coextensive with either of these or with both of them together (Crotty 1998).

Theoretical & Pedagogical "roots" of TMfSJ: Continued



Theoretical & Pedagogical "roots" of TMfSJ: Continued

"Men and women develop their power to perceive critically the way they exist in the world with which and in which they find themselves; they come to see the world not as a static reality but as a reality in the process of transformation"
(Freire, 1970/2003, p. 12).



Another Example

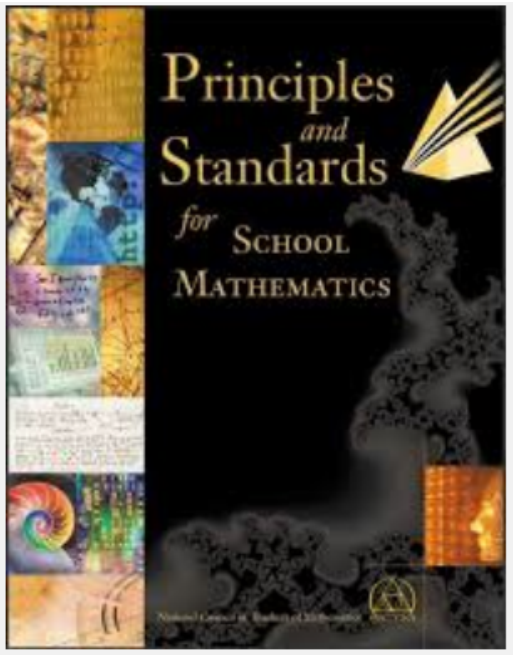
- You have $100 to donate towards hunger relief. To which organization in which country would you give it? Answer this question using any resources you wish. You must explain, justify and evaluate your opinion and resources.
- If you could live anywhere in the world, where would it be? Use data in your justification.
- What are the top rated jobs in your country? What required skills do these jobs have in common?

TMfSJ and the NCTM Standards

- "Critics of teaching mathematics for social justice—or mathematizing our conscious bodies (to use Freire's words)—are often concerned that the emphasis on controversial social issues and contradictory political ideologies during mathematics lessons take precedence over learning "rich," rigorous mathematics (e.g., Ravitch 2005)" (Stinson & Wager, 2012, p. 10).
- "On the contrary, the foundation of TMfSJ is rooted, in part, in the belief that all children should have access to rich, rigorous mathematics that offers opportunities and self-empowerment for them to understand and use mathematics in their world—in a word, *mathemacy (to use D'Ambrosio's word)*" (Stinson & Wager, 2012, p. 10).

TMfSJ and the NCTM Standards: Continued

- *Principles and Standards for School Mathematics (NCTM 2000), the NCTM signature document, opens with the statement:*
  - "Imagine a classroom, a school, or a school district where all students have access to high quality, engaging mathematics instruction" (p. 3).
- Many educators "… share this vision for school mathematics and suggest that TMfSJ is a powerful means to achieve these imagined classrooms and schools .



TMfSJ and the NCTM Standards: Continued

- Brief overview of some of the ways in which TMfSJ aligns with and extends (critically) the NCTM Standards:
  - NCTM Standards do not explicitly recommend teaching mathematics for social justice, they certainly are not inconsistent with it.
  - For instance, the *Principles and Standards (2000) explicitly calls for students'* understanding of the use of mathematics in everyday life and the workplace.
    - This call for mathematical competencies that offer access to opportunities is a crucial element of TMfSJ. Critical/social justice mathematics, however, extends this notion to prepare students to take action and use mathematics for social change—to read and rewrite their world into more humanizing possibilities with and through mathematics.
  - Moreover, a core value on which the *Principles and Standards is founded is unequivocally shared by teachers of mathematics for social justice:*
    - the Equity Principle holds that "all students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study—and support to learn—mathematics" (p. 12).

TMfSJ and the NCTM Standards: Continued

- To assist in achieving this core value of equity, NCTM for more than two decades has strongly recommended instruction not only in mathematical *content standards but also in* mathematical *process standards (NCTM 1989, 1991, 1995, 2000)*.
- *This blending of content and* process standards throughout mathematics instruction, however, demands the development of a different mathematics classroom—one different from the "traditional" mathematics classroom found in most U.S. schools (see Hiebert 2003).
  - In this different mathematics classroom, students are no longer passive, empty depositories awaiting the teachers's deposits–what Freire (1970/2000) criticized as "the "banking" concept of education–but rather active co-creators of classrooms "where students of varied backgrounds and abilitites work with expert teachers, learning important mathematical ideas with understanding, in environments that are equitable, challenging, supportive, and teachnologically equiped for the 21st century" (NCTM 2000, p. 4).
- The difference is that TMfSJ centers teaching and learning specifically around issues of social political justice and reform. TMfSJ or critical mathematics is understood as a means for student and teacher self-empowerment to organize and reorganize equitable social and political reform
- The suggestion here is "that TMfSJ not only meets many of the broad mathematical goals and objectives of NCTM but also critically extends and enhances them in significantly meaningful and humanizing ways for students teachers alike!" (p. 11).

TMfSJ Activities

- **The Hidden Grain** (by Stephanie Kempf, 1997, Finding solutions to Hunger, p. 171):

  One billion of the world's people do not get enough to eat, yet half the grain grown in the world is fed to livestock. Why? To fatten the cattle up for sale to people who can afford to buy meat. Chronically hungry people rarely have the money to buy meat.

  Most cattle today do not graze freely on pasture grasses – if they did, their meat would be leaner and healthier. Instead, they are penned up in crowded "feedlots" and given large quantities of grain. The meat from grain-fed cattle is higher in fat.

  For every 16 pounds of grain fed to a cow, we get only one pound back in meat on our plates. Producing that pound of meat requires 2,500 gallons of water. In many areas of the world, people do not have access to even a small amount of clean drinking water and must walk miles a day to get it.

  Do the Math

  If your entire class went to McDonald's and each student ate one Quarter-Pounder, how much grain was used to produce the class's lunch? How much water was used?

  Explain why you think this is or is not a problem. If it is a problem, what are possible solutions?

Grain and Water for Quarter Pounders

Quarter Pounder	Grain (Pounds)	Water (Gallons)
1	4	625
4	16	2,500
24	96	15,000
100	400	62,500
1,000	4,000	625,000

Facts About McDonald's

- In 1992 when Rutgers professor Benjamin Barber coined the term "McWorld," there were 12,700 McDonald's worldwide. Today there are over 33,000.The relentless spread of McDonald's over the past 61 years is an incredible business success story. In some markets the burger chain is just getting started, with plans to 200 stores in China this year.
- McDonald's serves 1% of the world's population every day. *Source: Société Générale. About how many people is that?*
- McDonald's sells more than 75 hamburgers every second. Source: McDonald's Operations and Training Manual via Side Dish.
- McDonald's' $24 billion in revenue makes it the 90th-largest economy in the world. *Source: Yahoo Finance.*
- Counting $32 billion in revenue from franchise stores, McDonald's claims the 68th biggest economy, bigger than Ecuador. *Source: 2009 Annual Report.*
- Americans alone consume one billion pounds of beef at McDonald's in a year -- five and a half million head of cattle. Source: John Hayes, McDonald's senior director of U.S. food and packaging, via Side Dish.
- McDonald's hires around 1 million workers in the US every year. This estimate from Fast Food Nation assumes a 700,000 domestic workforce with 150% turnover rate.

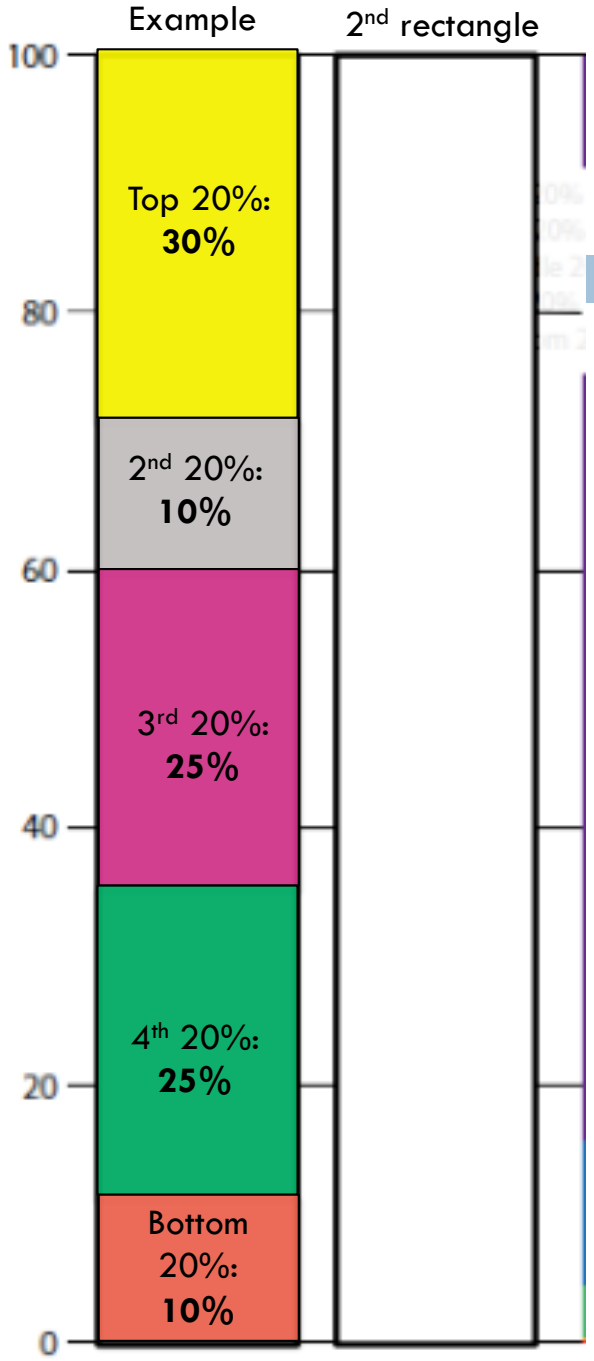
TMfSJ and the CCSS Process Standards

- **Mathematical Practices (CCSS, 2012):**
  1. Make sense of problems and persevere in solving them.
  2. Reason abstractly and quantitatively.
  3. Construct viable arguments and critique the reasoning of others.
  4. Model with mathematics.
  5. Use appropriate tools strategically.
  6. Attend to precision.
  7. Look for and make use of structure.
  8. Look for and express regularity in repeated reasoning.

Wealth Distribution

TOP 20%	2nd 20%	3rd 20%	4th 20%	BOTTOM 20%

- In terms of wealth, divide the first rectangle (representing 100% of the wealth in U.S.) into five groups representing the current wealth distribution: from wealthiest fifth (top 20%); next wealthiest (second 20%), down to poorest fifth (bottom 20%). This will be your estimate of wealth distribution for each group.
- Similarly, in the second rectangle, estimate what you think should be the ideal wealth distribution in the U.S.
- How do the two charts compare?
- Compare your charts with another person. How do they compare.
- We will come to this one later.

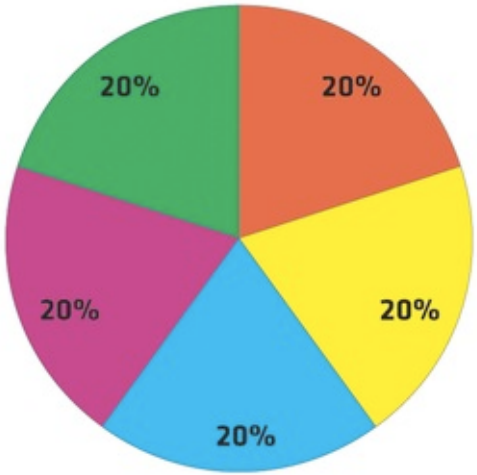


Wealth Quiz: How Does the U.S. Slice the Pie?

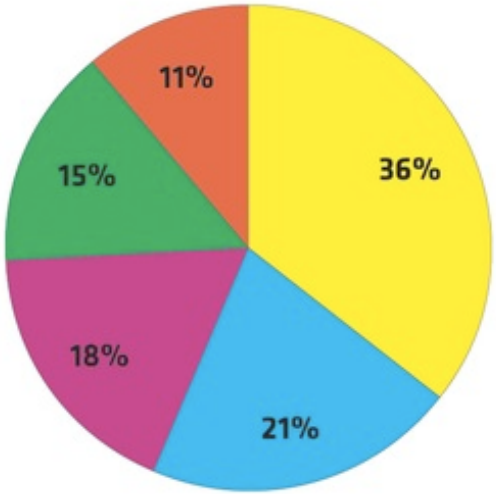
TOP 20%	2nd 20%	3rd 20%	4th 20%	BOTTOM 20%

These pie charts represent the distribution of wealth in three different places. Each slice of the pie chart represents the proportion of wealth held by one fifth of the population in the country: the yellow slice, by the wealthiest fifth; the blue slice by the next wealthiest, down to the red slice, which represents the poorest fifth, in terms of wealth. Which nation do you think the pie charts for Country A, Country B, and Country C represent? Which place would you like to live in and why?

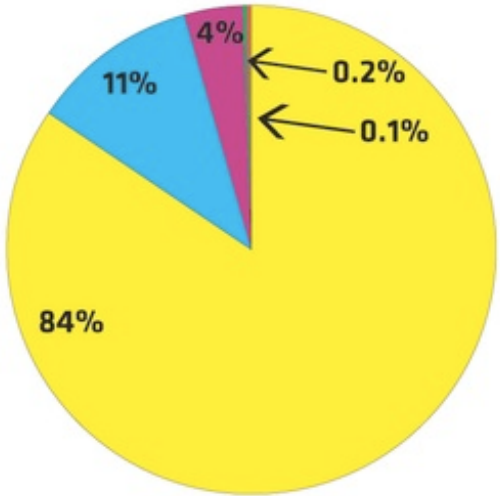
Country A



Country B



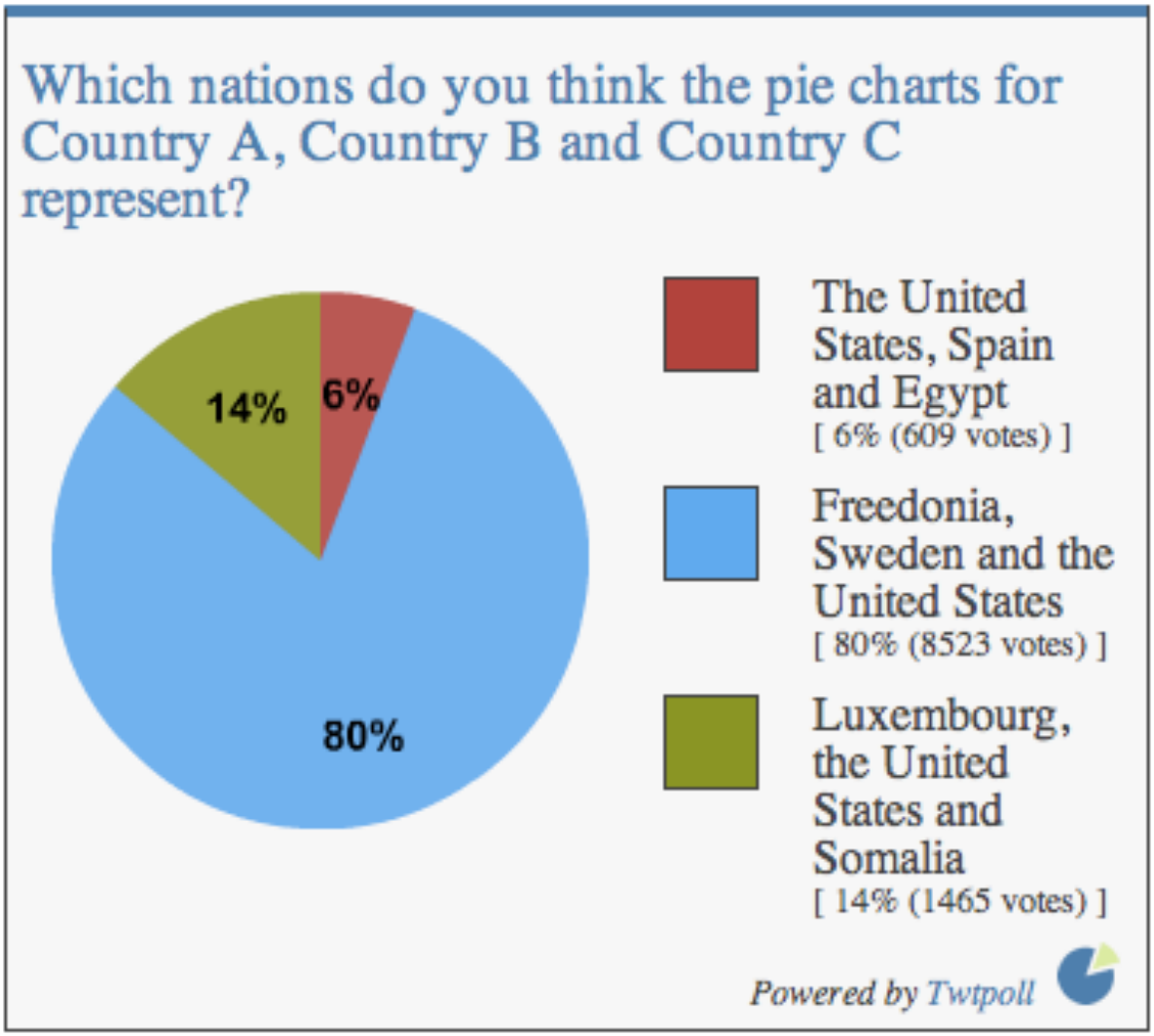
Country C



Correct Answer:

- The correct answer was 'Freedonia' (an equality utopia that does not exist), Sweden and the United States. Were you surprised?
- Were you surprised by the results? Why?
- Only 9 percent of people who took the survey said they wanted to live there.

Results from NPR Survey:



Reactions to findings:

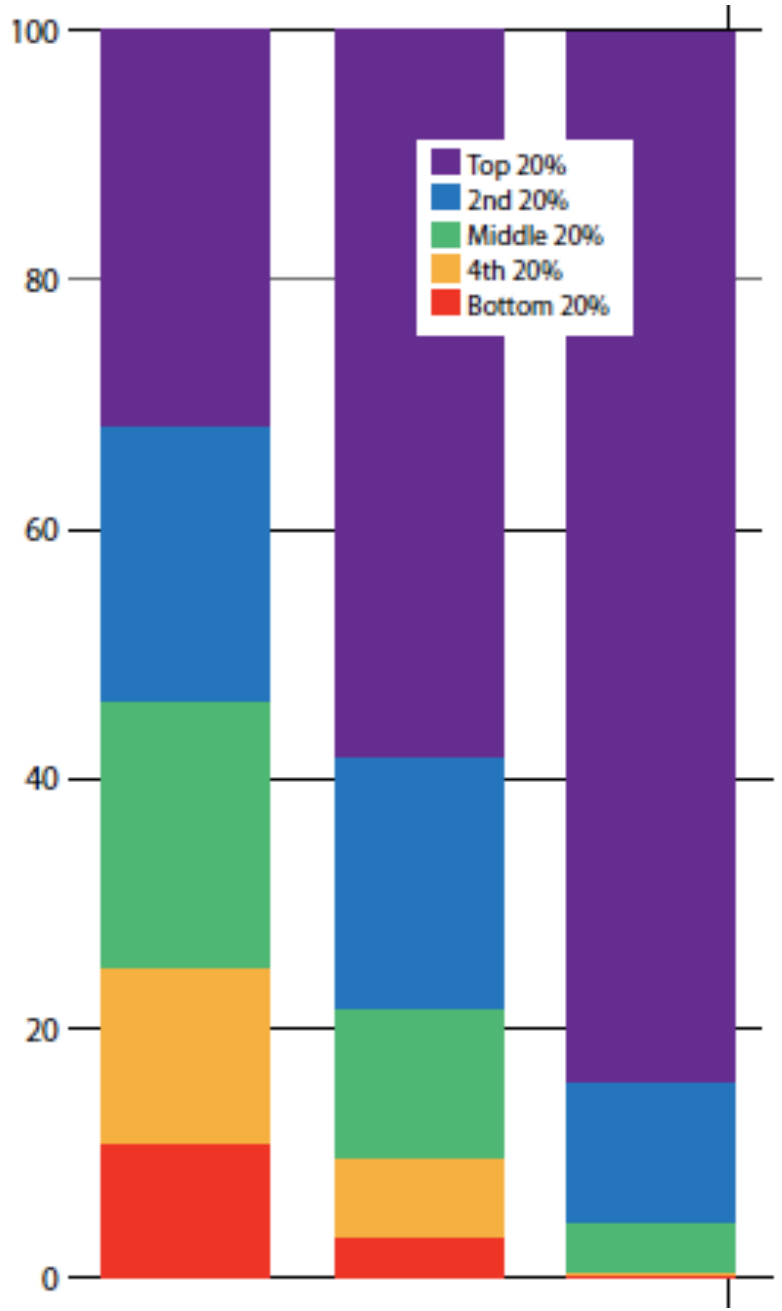
- Is it good that we don't seem to know much about wealth distribution?
- "It's probably a good thing that the public underestimates how much wealth inequality there is," Bryan D. Caplan of George Mason University told Business Week back in 2010, since "they tend not to understand the ways that wealth inequality is good."
- Norton and his coauthor, Dan Ariely, believe that one reason perceptions are so skewed is because the easy availability of credit masks people's real financial situation. If your neighbors own the same make and model of car that you own, Norton points out, there's no way to know whether they paid cash for theirs or took out a loan for the full amount. It's easy, he says, to think, "I have a car and you have a car, so I guess wealth is equally distributed." This perception is reinforced by the fact that people tend to interact primarily within their own social stratum. What is surprising given these circumstances, says Norton, is that Americans at all income levels--the very rich as well as the very poor--said they would like wealth to be more evenly distributed.
- People tend to assume, says Norton, that wealth correlates with talent or hard work—that it is deserved.
- Do you support wealth redistribution to reduce inequality?
- Health inequality, on the other hand, is correlated with income inequality: on average, the poor are less healthy, and countries with higher income inequality perform less well on health measures (see "Unequal America," July-August 2008, page 22).
- "We don't know, normatively, which distribution is right," he says. "We only know what people want it to look like."

Back to Wealth Distribution

- **Skewed Preferences**

  From left to right the wealth distribution that Norton's respondents said would be ideal; how they estimated wealth was currently distributed; and the actual distribution of wealth in the United States.

  Gudrais, Elizabeth (November-December 2011). Loaded Perceptions: What We Know About Wealth 2013 Harvard Magazine Inc. Retrieved May 6, 20013 from http://harvardmagazine.com/2011/11/what-we-know-about-wealth

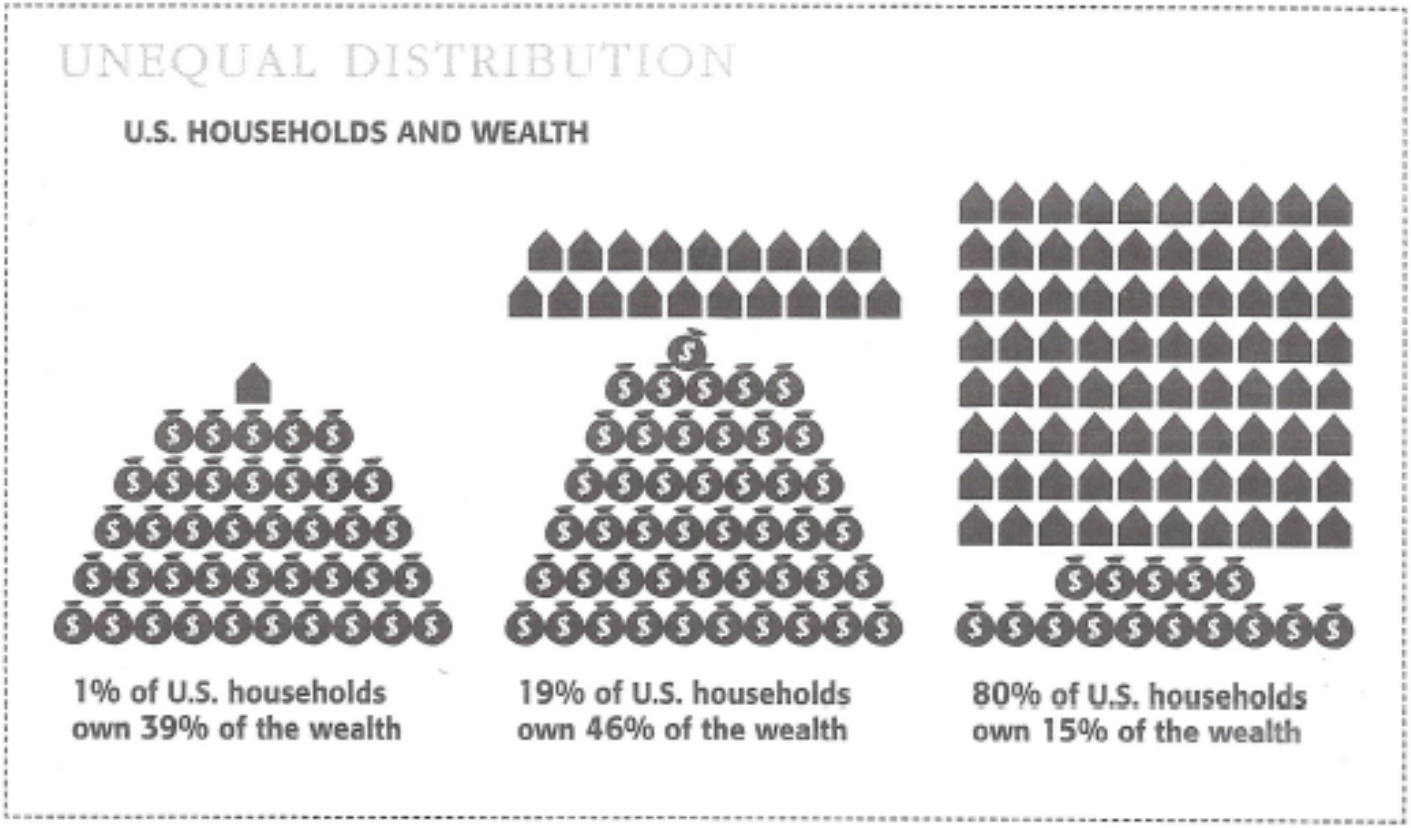


TMfSJ Activities

(Gutstein & Peterson, 2006)

- **Unequal Distribution of Wealth in the United States**

  What do these data tell us about the distribution of wealth in the U.S.?



TMfSJ Activities: Continued:

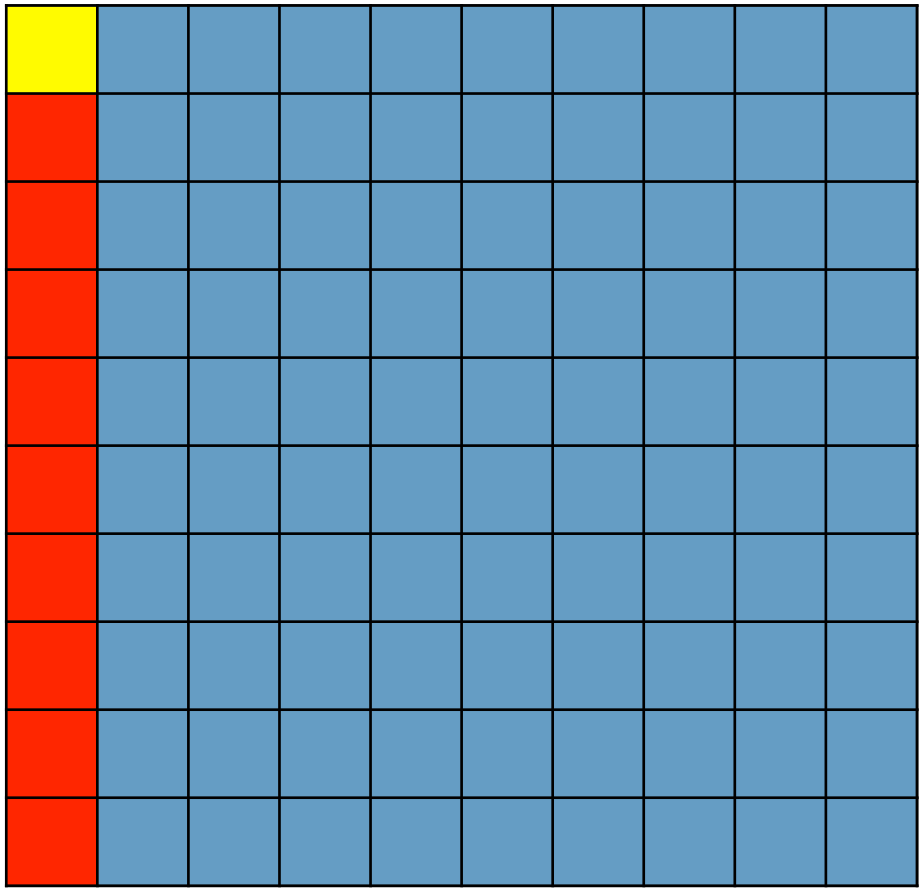
Unequal Distribution of Wealth in the United States

1. First divide the 10 x 10 grid in three regions by coloring each with different colors:

    - 1 square = richest 1%
    - 19 squares = the next richest 19%
    - 80 square = the remaining 80% of families

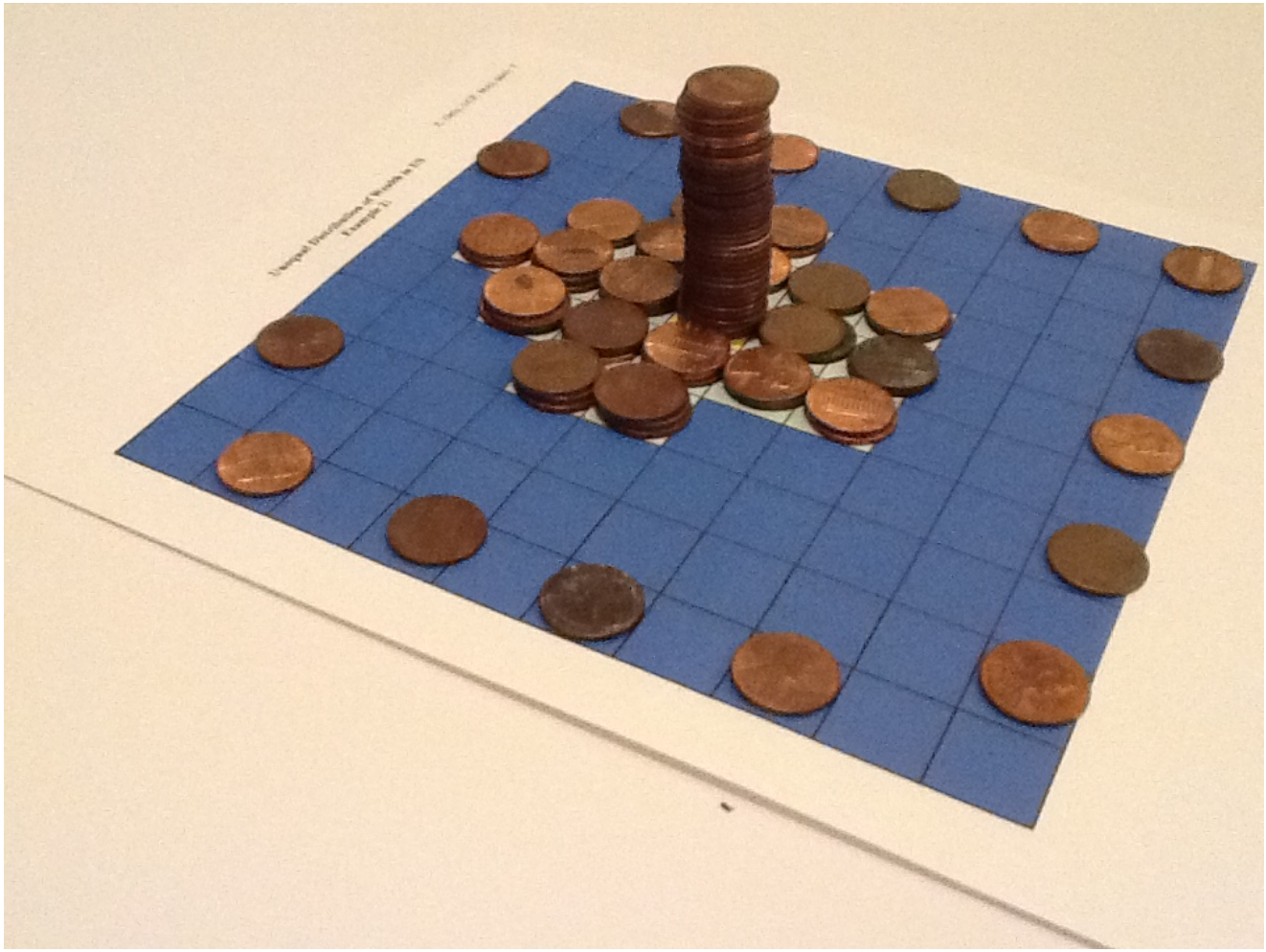
2. Next divide the pennies into three piles: 39 for the richest region, 46 pennies for the next region, and 15 pennies for the third region.

Example



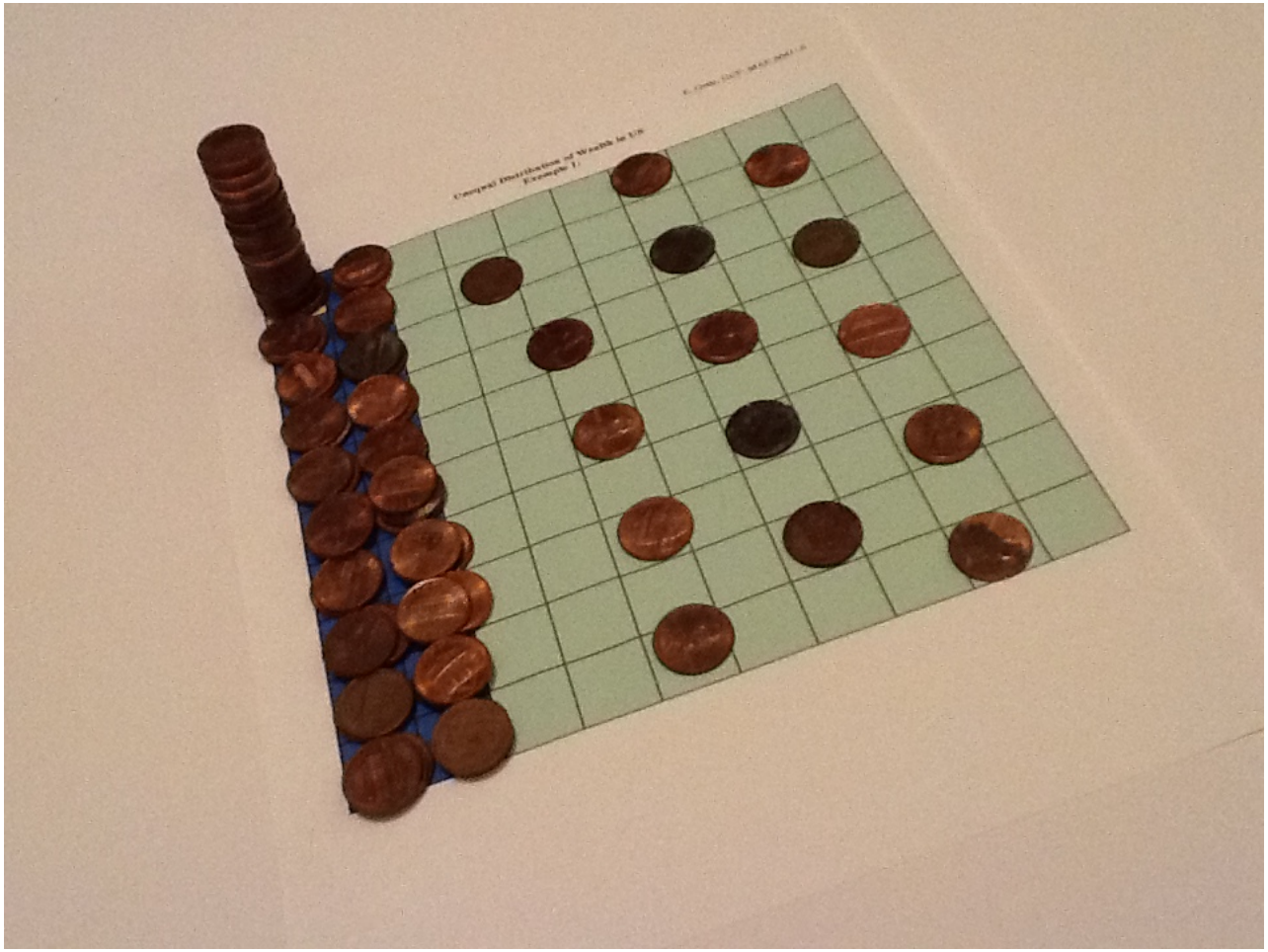
TMfSJ Activities: Continued: Example 1:

Unequal Distribution of Wealth in the United States:



TMfSJ Activities: Continued: Example 2:

Unequal Distribution of Wealth in the United States



YouTube Video

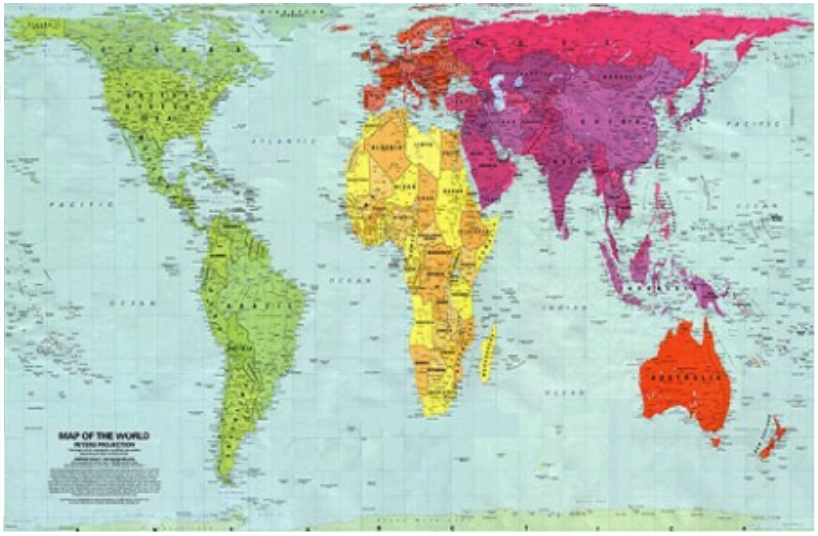
- Politizane (November 20, 2012). Wealth Inequality in America. Retrieved May 6, 2013 from
- http://www.youtube.com/watch?v=QPKKQnijnsM

TMfSJ and the CCSS Standards: Continued

- **Not everybody is in favor of this connection between TMfSJ and CCSS: See the following:**
  - ERIC (RICO) GUTSTEIN, **COMMENTARY: The Common Core State Standards Initiative: A Critical Response Eric (Rico) Gutstein,** *Journal of Urban Mathematics Education, July 2010, Vol. 3, No. 1, pp. 9–18. ©JUME.* ***http://education.gsu.edu/JUME*.**

TMfSJ Activities: Continued:

Mercator Projection and Peters Projection World Maps Activity



(Rethinking Schools, 2001; Gustein, n.d.)

West Wing - Why are we changing maps?

- http://www.youtube.com/watch?v=eLqC3FNNOaI
- From season 2 - episode 16 "Somebody's Going to Emergency, Somebody's Going to Jail"
- Stuart McArthur's Universal Corrective Map
- http://www.youtube.com/watch?v=QYuV4eOVz38#aid=P8e7HJk4Q3Q

Children's Books

- http://www.leeandlow.com/books/379/hc/the_can_man

Children's Books

- http://www.amazon.com/Uncle-Willie-Kitchen-Reading-Rainbow/dp/0688152856/ref=pd_bxgy_b_img_y

Children's Books

- http://www.amazon.com/Those-Shoes-Maribeth-Boelts/dp/0763642843/ref=pd_bxgy_b_img_z

Questions

- When students are engaged with rich, big topics like racism, sexism, poverty …, are they distracted from the more overt curriculum goals?
- If we focus on familiar tools or topics to teach difficult mathematical concepts, are the students any more likely to learn said concepts, and if so, then when DO we teach through Equity and Social Justice?

The Challenge

- So, the next time you pick up a textbook and consider giving your students a mathematics story problem, ask yourself this question: Is this the context I want my students to explore, or is there a more meaningful way for me to address the mathematics while deepening students' understandings of both the world they live in and the role this subject plays in it?