

Walking in Another's Shoes

Two Middle School Math Projects
about Diversity, Equity, & Social Justice

Liz Caffrey

@AsymptoticLiz

Atrium School, Watertown, MA

Thursday, April 4 - NCTM 2019



Link to slides:
bit.ly/NCTMSD19LizC

"Before you criticize someone, walk a mile in their shoes. That way, you're a mile away, and you have their shoes."

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Empathy

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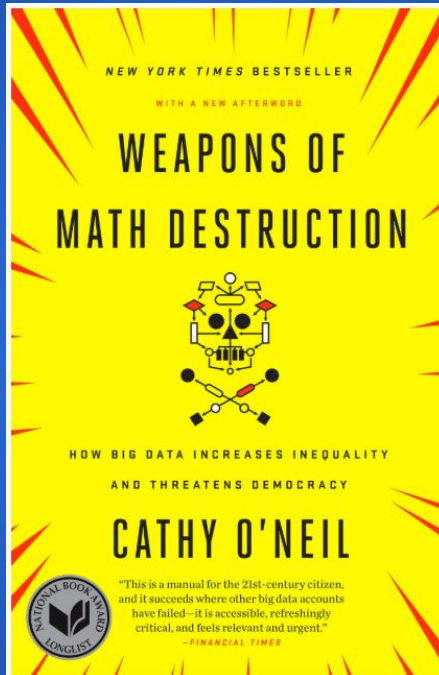






The way that we talk to our
students about race will have a
profound impact on them.

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ATRIUM SCHOOL

BEWARE!

May cause

- Joy
- Curiosity
- Kindness
- Friendship
- Leadership
- a sense of community

add ur
own!



Privilege

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We need to raise up the voices of people who are directly affected by the actions of the white majority. We need to hear from them how we should respond.

- Sofia Wollheim-Martinez

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Your turn

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Goals

- ❑ Present projects. How do I use math to help my students develop empathy?
- ❑ Offer tools. What resources exist?
- ❑ Do the work together. What do we need to do to prepare to do DESJ work with students?

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Norms

- Share openly and honestly
- “I” statements
- Ask questions
- Avoid judgement
- Say “ouch”

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NEW YORK TIMES BESTSELLER

"Conversational . . . easy to read, and best of all, it has the potential, at least, to change the way you think about yourself."
—LEONARD MLODINOW, *The New York Review of Books*

BLIND SPOT

HIDDEN BIASES
of
GOOD PEOPLE

MAHZARIN R. BANAJI
ANTHONY G. GREENWALD

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Goals

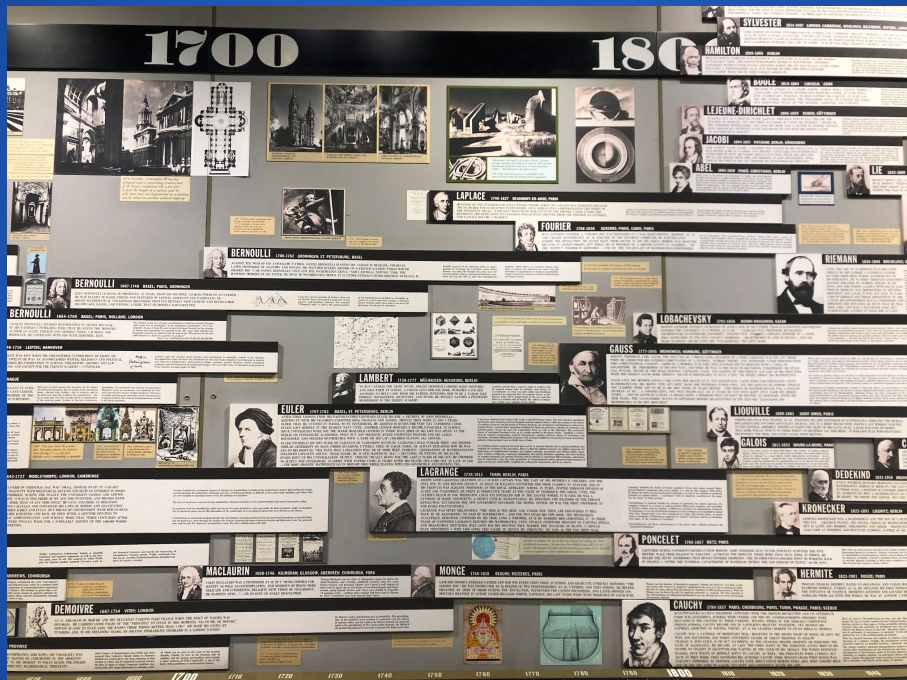
- ❑ Present projects. How do I use math to help my students develop empathy?


Project #1: The Mathematician Project **- History, culture, identity, privilege -**

- ❑ Do the work together. What do we need to do to prepare to do DESJ work with students?

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







LOBACHEVSKY
1793-1866 NIZHNI NOVGOROD, RUSSIA

REPRESENTED THE THESIS THAT IF IN SPACE, AT A POINT, THERE COULD BE MORE THAN ONE STRAIGHT LINE, A LINE COULD BE DRAWN PARALLEL TO ANOTHER LINE, AND THAT THE SUM OF THE ANGLES OF A TRIANGLE COULD BE LESS THAN 180 DEGREES.




GAUSS
1777-1855 MÜNCHEN, HANNOVER, GUTTENBERG

AMONG THE MOST IMPORTANT MATHEMATICIANS OF HIS TIME, GAUSS WAS A VERY FERTILE MIND. HE WAS THE FIRST TO PROVE THE FUNDAMENTAL THEOREM OF ALGEBRA, THAT EVERY POLYNOMIAL EQUATION OF THE FIRST DEGREE HAS AT LEAST ONE ROOT. HE ALSO DISCOVERED THE LAW OF GRAVITATION, WHICH STATES THAT THE FORCE OF GRAVITATION BETWEEN TWO POINTS IS INVERSELY PROPORTIONAL TO THE SQUARE OF THE DISTANCE BETWEEN THEM.




LILOUVILLE
1803-1882 SAINT OMER, FRANCE

AMONG THE FIRST TO BE TAUGHT BY AN ENGINEER, HE WAS PROFESSOR OF MATHEMATICS AT THE POLYTECHNIC SCHOOL IN PARIS. HE WAS ONE OF THE FIRST TO APPLY MATHEMATICS TO PHYSICS, AND HE WAS ONE OF THE FIRST TO APPLY MATHEMATICS TO ASTRONOMY.




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
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
KRONECKER
1823-1891 LICHTENFELD, PRUSSIA

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HERMITE
1822-1901 DIEZELLE, FRANCE

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
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
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
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
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
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
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
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
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
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
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
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
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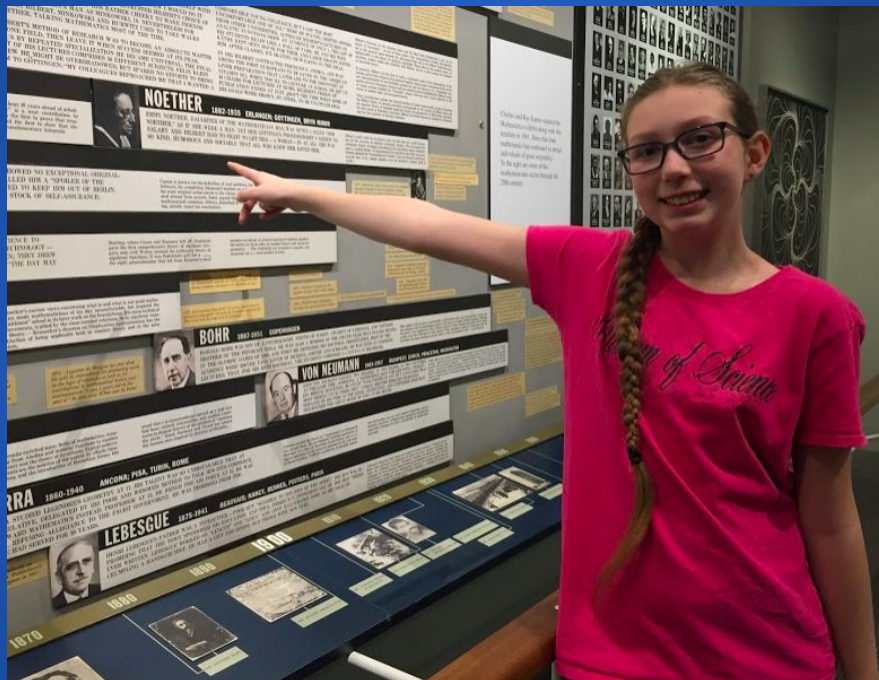
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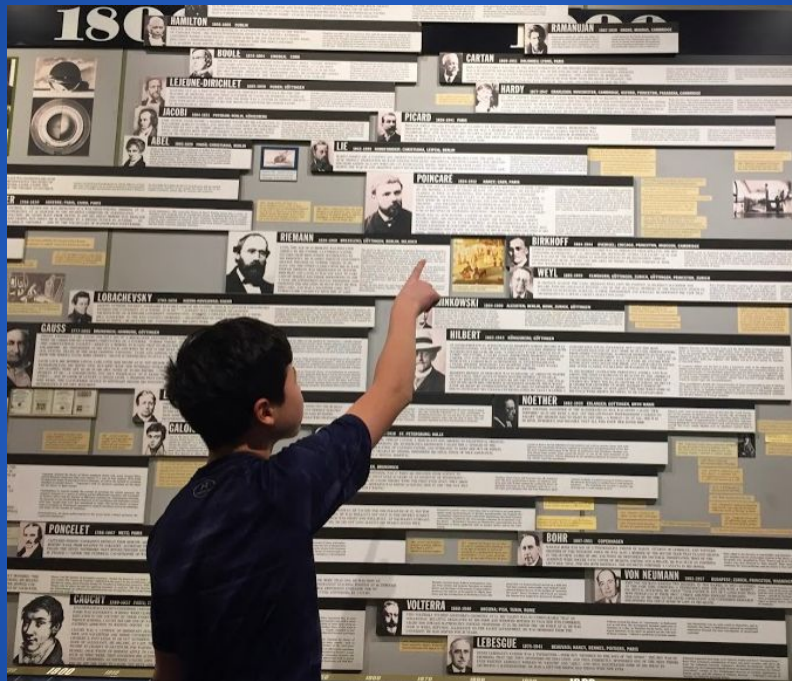
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Charles and Ray Eames created the Mathematica exhibit along with this timeline in 1961. Since that time mathematics has continued to attract individuals of great originality. To the right are some of the mathematicians active through the 20th century.



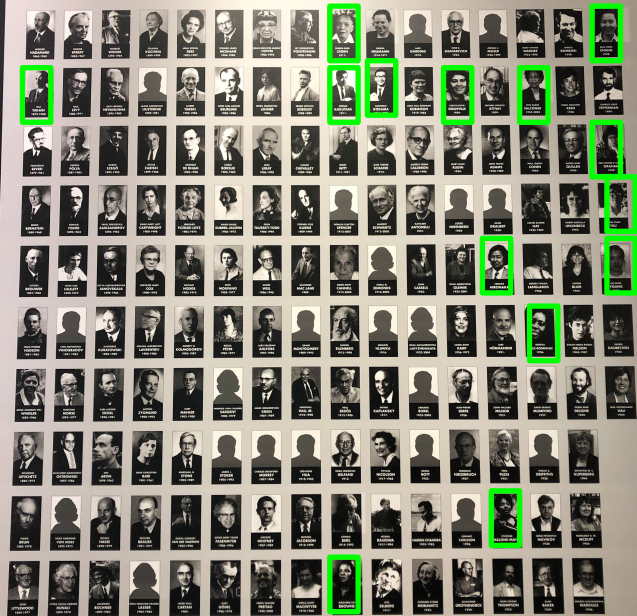
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How?

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Mathematician Project: Learning Goals

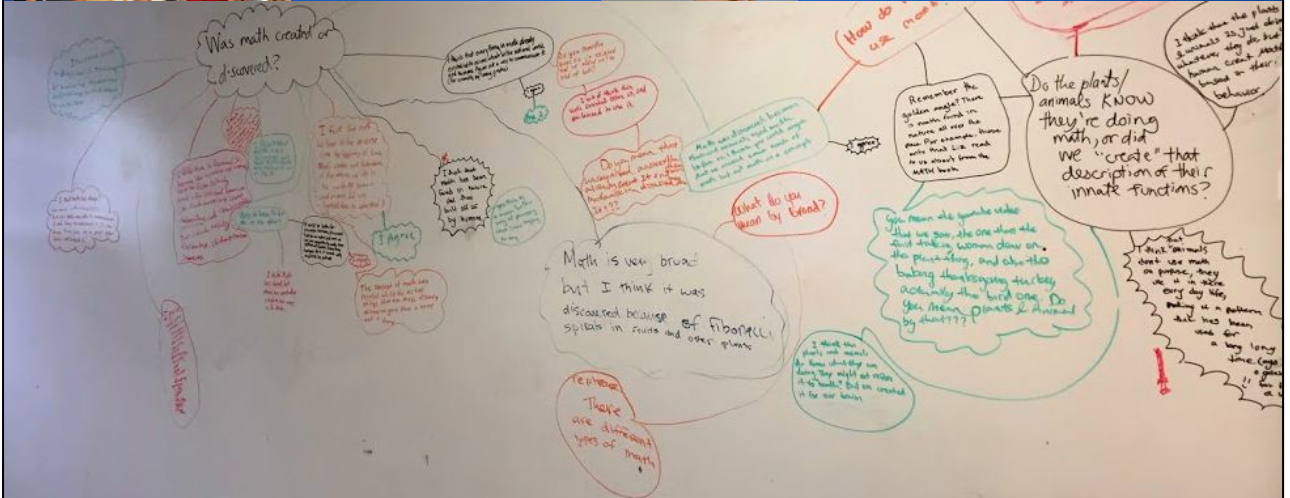


- identity shapes one's experiences
- math was/is contributed to throughout history by many people/cultures

TT ID3: Students will recognize that people's multiple identities interact and create unique and complex individuals.

TT D8: Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way.

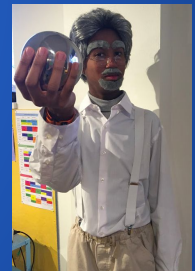
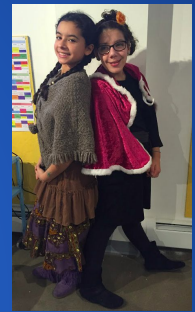
Mathematician Project Sequence



Mathematician List



Sonya Kovalevsky	Rene DesCartes
Maria Agnesi	Isaac Newton
Ada Lovelace	Gottfried Leibniz
Edna Lee Paisano	Euclid
Emmy Noether	Benjamin Banneker
Dorothy Vaughn	Archimedes
Sun-Yung Alice Chang	Srinivasa Ramanujan
Carl Friedrich Gauss	Benjamin Banneker
MC Escher	Hypatia
Pythagoras	Sophie Germain
al-Khwarizmi	Rosza Peter
Leonhard Euler	Maryam Mirzakhani
Alan Turing	Katherine Johnson
Zu Chongzhi	Omar Khayyam
Fibonacci	Mary Somerville



My thoughts and questions



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Goals

- ❑ Present projects. How do I use math to help my students develop empathy?

Project #2: Life on a Budget

- Equity, stereotypes, bias, injustice -

- ❑ Do the work together. What do we need to do to prepare to do DESJ work with students?

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Our clients

The following is data from the American Community Surveys conducted in 2014 and 2016. These are the mean earnings for people who fall into each race, gender, and education demographic. If there is a blank space, it is because there is not a statistically significant population in that demographic.

Education Level	White Male	Black Male	Asian Male	Hispanic Male	White Female	Black Female	Asian Female	Hispanic Female
Some high school (no degree)	\$ 33,724	\$ 27,384	\$ 27,792	\$ 28,577	\$ 17,825	\$ 20,231	\$ 20,373	\$ 17,940
Associate Degree (2 yr college)	\$ 55,602	\$ 40,924	\$ 46,087	\$ 46,837	\$ 37,750	\$ 34,852	\$ 38,498	\$ 34,757
Bachelor's Degree (4 yr college)	\$ 80,698	\$ 63,271	\$ 73,836	\$ 61,584	\$ 49,632	\$ 46,729	\$ 59,815	\$ 45,677
Professional Degree (PhD, JD, MBA)	\$ 164,853		\$ 174,377	\$ 141,594	\$ 115,512	\$ 68,936	\$ 116,691	

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What story does the data tell?

Culture

Racism

Sexism

Vague/incomplete story

Why are there race + gender disparities in income in America?

How could someone reading this data mistakenly create a stereotype about these demographics of people?

How does your understanding of data analysis help you avoid doing this?

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Life on a Budget: The Challenge

You are a financial advisor from the firm of Math for Life, Inc. Your job is to create a monthly budget spreadsheet for your new client, accompanied by a pie chart and a one-page written summary of your spending recommendations.

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Life on a Budget: Learning Goals

- understand the economic privilege / income gap in the US
- see beyond the numbers to empathize with an individual's experience
- use formulas in spreadsheets to do percent operations

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TT D10: Students will examine diversity in social, cultural, political and historical contexts rather than in ways that are superficial or oversimplified

TT J11: Students will recognize stereotypes and relate to people as individuals rather than representatives of groups

TTA16: Students will express empathy when people are excluded or mistreated because of their identities

Discuss the history
and causes of wealth
inequality in the U.S.

Find apartment; do
other financial
research

Write up budget
recommendations

3 periods

2 periods

1 period

1 period

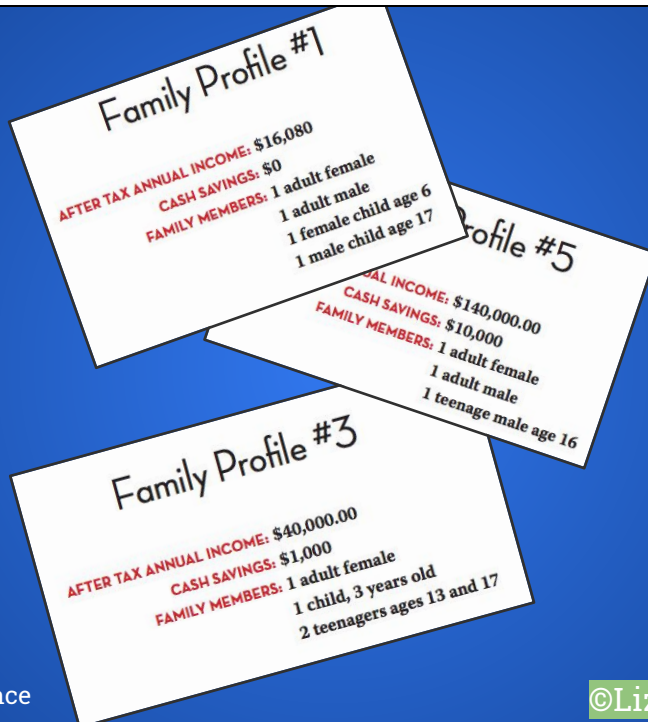
2 periods

Assign client; do
their taxes

Make monthly budget,
including spending pie
chart

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Role Playing...



Source: Teaching Tolerance

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Click on the source text for the link to the activity!

Life Happens...

The grandparents are moving in. Both require constant medical care from a nurse. Budget for medical care, as well as the necessary food, clothing and shelter arrangements. Assume the grandparents add \$1,050 in family income from Social Security.

Wealth Matters
UPPER GRADES ACTIVITY

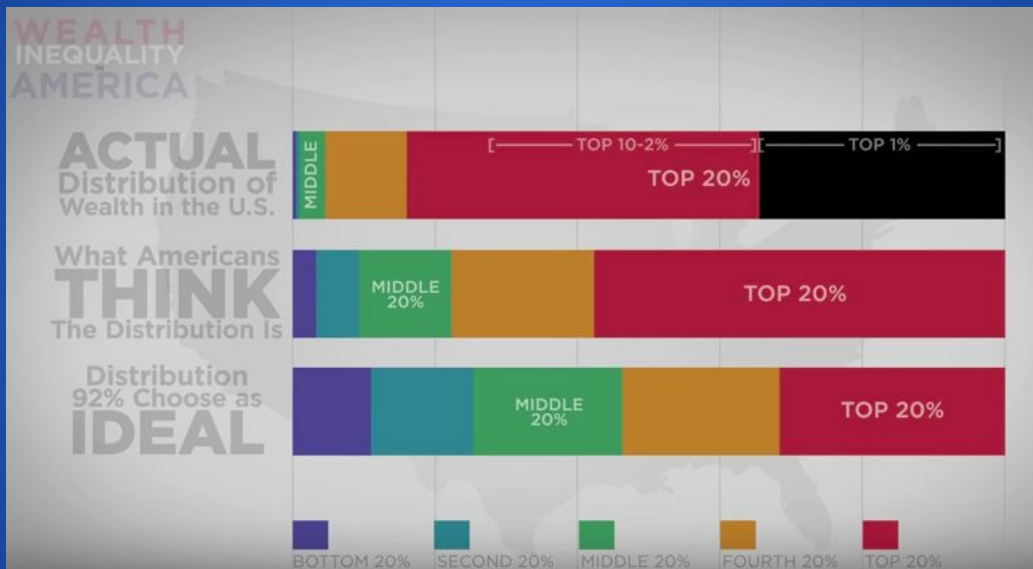
TEACHING
TOLERANCE 

Life Happens...

One of your children receives straight
A's on his or her report card. It's family
tradition that you all go out to eat on
such an occasion.

Life Happens...

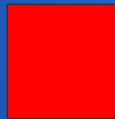
Your oldest child has been accepted into three colleges — one community, one private and one Ivy league — and is ready to enroll. Budget for this educational expense.



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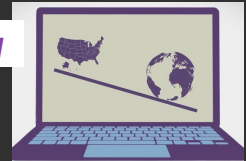
Click on the image to link to the video.

Articles



Education Gap Between Rich and Poor Is Growing Wider

Global Wealth Inequality



Even College Doesn't Bridge the Racial Income Gap

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Click on each article image for a link to the article or video. Click on the shapes for the discussion routine we used.

Taxing your income:

- Federal tax
- State tax (5.1%)
- Social security (6.2%)
- Medicaid (1.45%)



10 % pot



12% pot



22% pot

2018 Income Tax Brackets

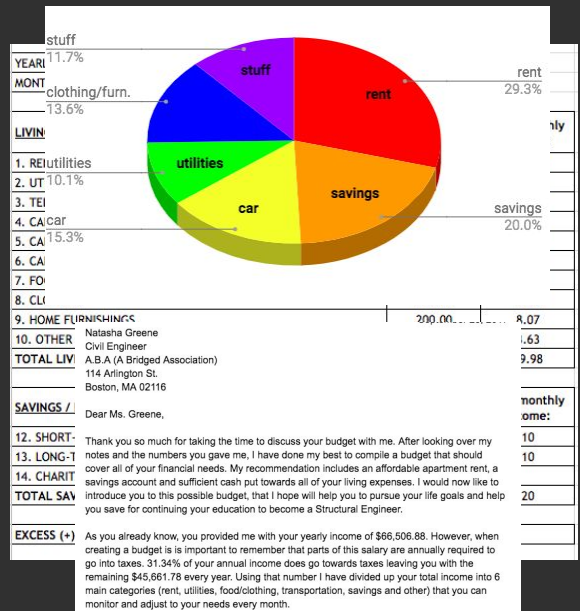
Rate	Individuals	Married Filing Jointly
10%	Up to \$9,525	Up to \$19,050
12%	\$9,526 to \$38,700	\$19,051 to \$77,400
22%	38,701 to \$82,500	\$77,401 to \$165,000
24%	\$82,501 to \$157,500	\$165,001 to \$315,000
32%	\$157,501 to \$200,000	\$315,001 to \$400,000
35%	\$200,001 to \$500,000	\$400,001 to \$600,000
37%	over \$500,000	over \$600,000

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Next steps:

Monthly budget

Business letter



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than a third of the rent. They seem like good friends! The \$300 you will be spending on your apartment is 17.48% of your monthly income. The apartment is only a nine-minute walk from your job at Comella's Pizza. You mentioned that your life is so busy, and it feels as if you don't have any time to yourself to exercise or be outside. This walk to work will allow you to spend time outside and get exercise every day, even if you are busy. If you want to go to other places outside of Belmont, the T is also just a short walk away. You can get a T-pass for \$84.50 a

high quality pieces of clothing each month that will last. Fourth, home furnishings, which is 1.6% of your monthly income. This category is fairly self-explanatory, as you have just moved into a new apartment, you will need furniture and supplies. Lastly, I have allocated a category of your budget for pets, which is 0.8% of your monthly income. I think that one female canary would be a suitable and enjoyable pet for you. The savings in this category will eventually allow you to purchase and care for one female canary.

Takeaways



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Goals


- ☒ Present projects. How do I use math to help my students develop empathy?
- ☐ Offer tools. What resources exist?
- ☐ Do the work together. What do we need to do to prepare to do DESJ work with students?

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Tool #1:

Standards for Student Mathematical Practice

1 **Make sense of problems and persevere in solving them.**



Keep on going!

2 **Reason abstractly and quantitatively.**


Write a story for the mathematical equation

$\frac{1}{2} \times 4$

DeJuan exercises 1/2 hour a day for 4 days. How many total hours does he exercise?

Think what makes sense.

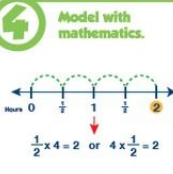
3 **Construct viable arguments and critique the reasoning of others.**



$\frac{2}{4} = \frac{1}{2}$

Talk and explain.


4 **Model with mathematics.**



$\frac{1}{2} \times 4 = 2$ or $4 \times \frac{1}{2} = 2$

Show your thinking.

5 **Use appropriate tools strategically.**



$3 \times 2 = 6$

Use the right tools.

6 **Attend to precision.**

symbol: equals (the same as)

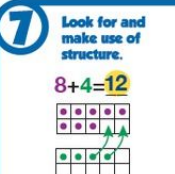
120 minutes = 2 hours

units of measure

Check your work.


7 **Look for and make use of structure.**

$8 + 4 = 12$



See the pattern or connection.

8 **Look for and express regularity in repeated reasoning.**



See the pattern or connection.

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COMMON CORE
Mathematics Grade 4-5

image source: Michigan RESA

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Tool #2: Social Justice Standards



source: tolerance.org

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<https://www.tolerance.org/frameworks/social-justice-standards>

Tool #3: PBL Design Elements

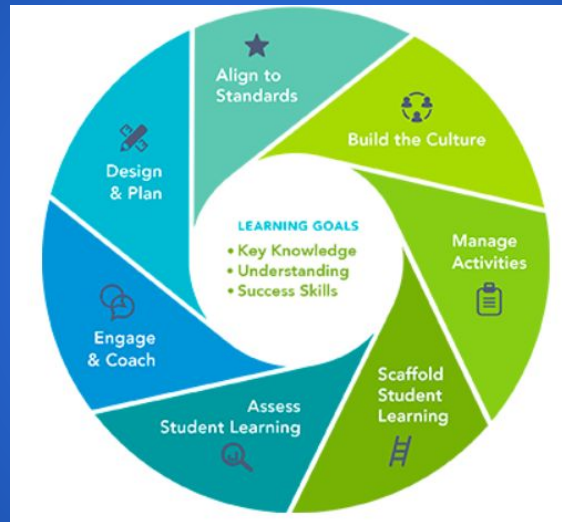


source: Buck Institute

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<https://www.tolerance.org/frameworks/social-justice-standards>

Tool #4: PBL Teacher Practices



source: Buck Institute

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Goals

- ☒ Present projects. How do I use math to help my students develop empathy?
- ☒ Offer tools. What resources exist?
- ☐ Do the work together. What do we need to do to prepare to do DESJ work with students?

You do not have to go it alone.

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Places to get started:

<https://www.nytimes.com/column/whats-going-on-in-this-graph>

<http://www.radicalmath.org/>

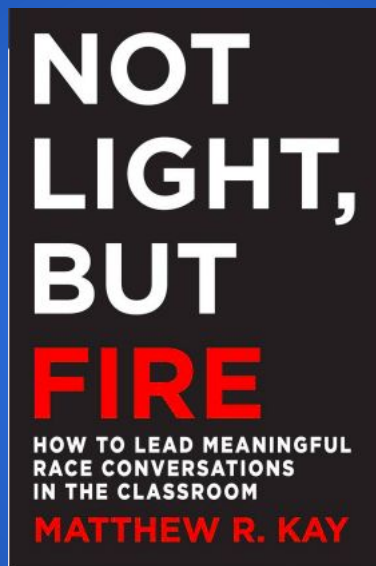
#cleartheair on Twitter

The way that we talk to our
students about race will have a
profound impact on them.

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The way that we talk to our
students about **all aspects**
of identity will have a
profound impact on them.

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Source: Jessica Wolf

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Slides: bit.ly/NCTMSD19LizC

www.atrium.org/summer-math-institute

We'd love to have you! Come develop projects with me, or work on Desmos with Jess, or do Visual Algebra with Henri.