TI STEM Exchange

Justice-Centered STEM Education

Using the Case of the COVID-19 Pandemic

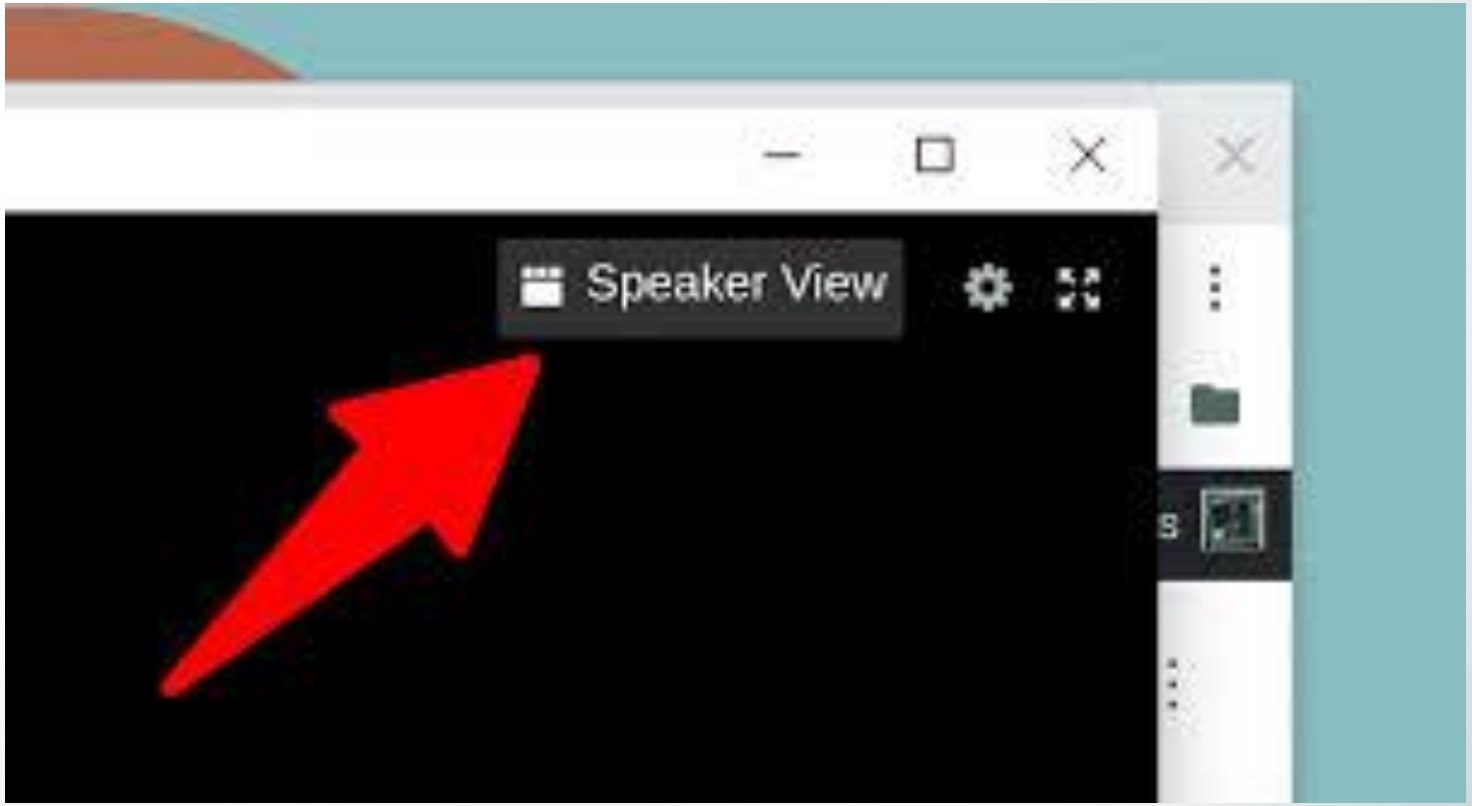
December 2, 2021 6:00 – 7:30 pm CT

TI STEM Exchange

Texas Instruments

Select speaker view

- **In the upper right of your Zoom window, select “Speaker View” to ensure you’ll always see the presenter’s video.**



Tonight's Agenda

STEM and Data Science

- How is data science reflected in math?
- How is data science reflected in science?

Justice-Centered STEM Lessons

- Consider ways educators can use COVID-19 data as a context to engage students in exploring societal challenges
- Explore an instructional framework which would allow educators to apply this model in their own settings

MODERATOR

Joleigh Honey

Mathematics Equity Specialist, Utah State Board of Education

Joleigh has 27 years experience as a classroom teacher, academic coach, K-12 mathematics and building administrator and STEM coordinator. Joleigh is the current president of the Association of State Supervisors of Mathematics (ASSM) and is influential in Utah and across the country in promoting equity and increasing inclusive practices in mathematics and STEM.

@Joleighhoney

Source: youcubed Data Science Big Ideas: https://www.youcubed.org/data-big-ideas/

MODERATOR

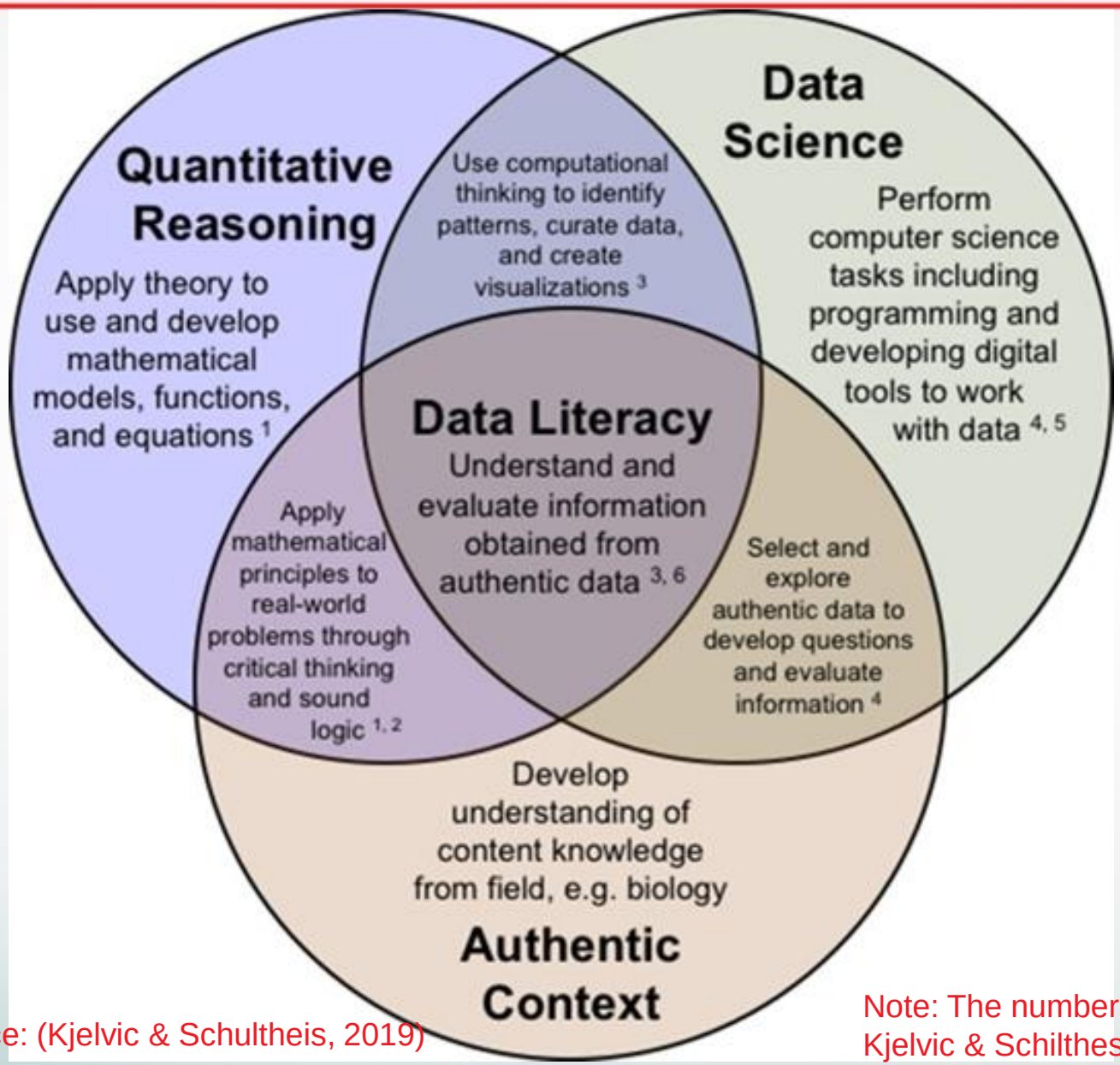
Michael Heinz

Science Coordinator, New Jersey Department of Education

Michael is a former middle and high school science teacher and the current President of the Council of State Science Supervisors (CSSS). He is deeply involved in the open-source science curriculum development, OpenSciEd, and the Advancing Coherent and Equitable Systems of Science Education (ACESSE) project, promoting equity and coherence in science education.

@TICalculators

Overlap Between the Fields of Quantitative Reasoning and Data Science



Source: (Kjelvic & Schultheis, 2019)

Note: The numbers in the Venn diagram refer to citations included in Kjelvic & Schilthesis, 2019.

Kastens, Kim. (2015, May). *Data Use in the Next Generation Science Standards* (revised edition) [White paper]. Waltham, MA: Oceans of Data Institute, Education Development Center, Inc. Retrieved from http://oceansofdata.edc.org/our-work/data-next-generation-science-standards

Kjelvik, M. K., Schultheis, E. H. (2019, 10 May). *Getting Messy with Authentic Data: Exploring the Potential of Using Data from Scientific Research to Support Student Data Literacy*. CBE—Life Sciences Education. Vol. 18, No. 2. Bethesda, MD. CBE – Life Science Education, Retrieved from https://www.lifescied.org/doi/pdf/10.1187/cbe.18-02-0023

Tonight's Presenters

PANELIST

Okhee Lee, Ph.D.

Professor, New York University

Dr. Lee is a professor in the Steinhardt School of Culture, Education, and Human Development at New York University. Her research involves integrating science, language, and computational thinking with a focus on English learners. She was a member of the NGSS writing team and served as leader for the NGSS Diversity and Equity Team.

@OkheeLee_

PANELIST

Todd Campbell, Ph.D.

Department Head and Professor, University of Connecticut

Dr. Campbell is the Department Head of Curriculum and Instruction and a Professor of Science Education in the Neag School of Education. His research focuses on cultivating imaginative and equitable representations of STEM activity. He partners with pre-service and in-service science teachers and leaders to collaboratively focus on supporting student use of modeling as an anchoring epistemic practice to reason about events in the natural world.

@TICalculators

Justice-Centered STEM Education

Tracking COVID-19 in the United States

A “Daily Do” Playlist

Purpose

- Propose our instructional framework for justice-centered STEM education to address pressing societal challenges

- Apply the instructional framework to the COVID-19 pandemic

Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions

Instructional Framework

Our instructional framework for justice-centered STEM education:

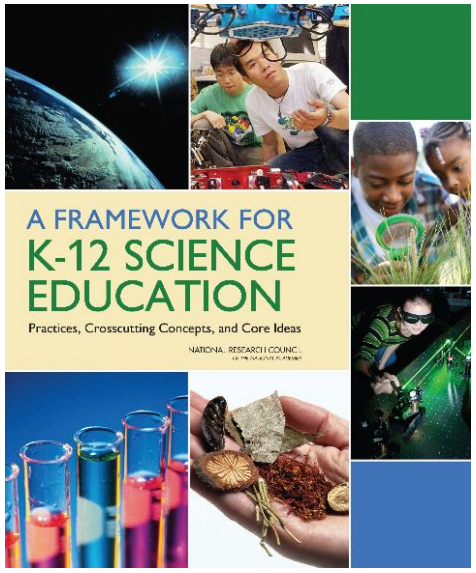
1) **addresses pressing societal challenges**

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions

Science Instructional Shifts: Contemporary

Our instructional framework for justice-centered STEM education builds on and extends instructional shifts:



NEXT GENERATION SCIENCE STANDARDS

Shift 1: Phenomena or problems – Explaining phenomena or designing solutions to problems

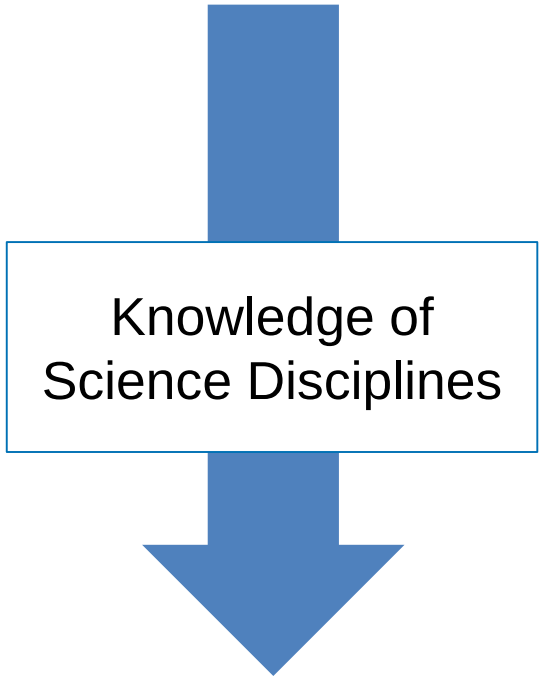
Shift 2: Three-dimensional learning – Blending science and engineering practices, crosscutting concepts, and disciplinary core ideas

Shift 3: Coherent science learning progressions – Building science understanding across time

Science Instructional Shifts: Contemporary

Traditional

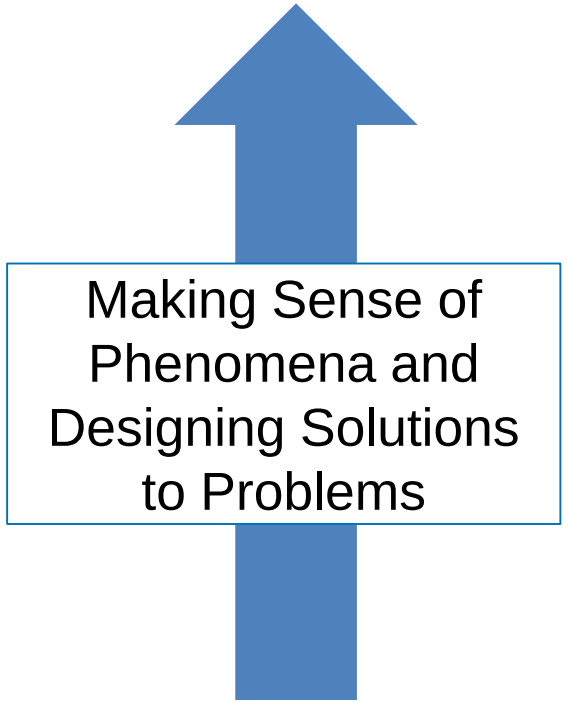
Scientists & Teachers



Some Students

Contemporary

Students as Scientists and Engineers



All Students

Science Instructional Shifts: Contemporary

Physical Science in Fifth Grade:
What happens to our garbage?

Societal
Challenge

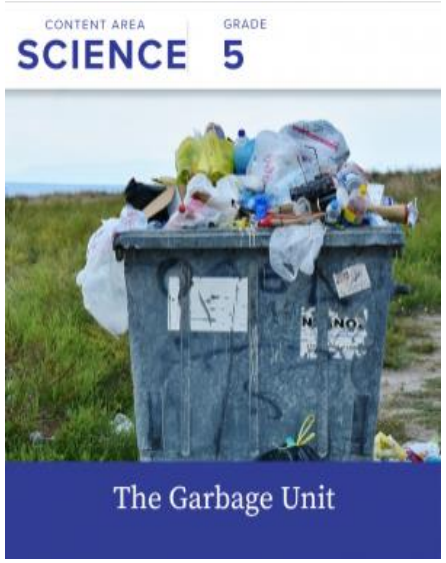
"Sanitized"
Phenomenon

Science Instructional Shifts: Future

Traditional	Contemporary	Future
Scientists & Teachers	Students as Scientists and Engineers	Students as ?
Knowledge of Science Disciplines	Making Sense of Phenomena and Designing Solutions to Problems	
Some Students	**All Students**	**All Students**

Science Instructional Shifts: Future

Traditional	Contemporary	Future
Scientists & Teachers	Students as Scientists and Engineers	Students as ?



STEM Education Needs to Address Pressing Societal Challenges

1. What are pressing societal challenges that affect our daily lives?

1. How do these pressing societal challenges disproportionally affect minoritized groups?

1. How do we design solutions to address these pressing societal challenges?

1. What is the role of STEM education?

Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions

Data Science

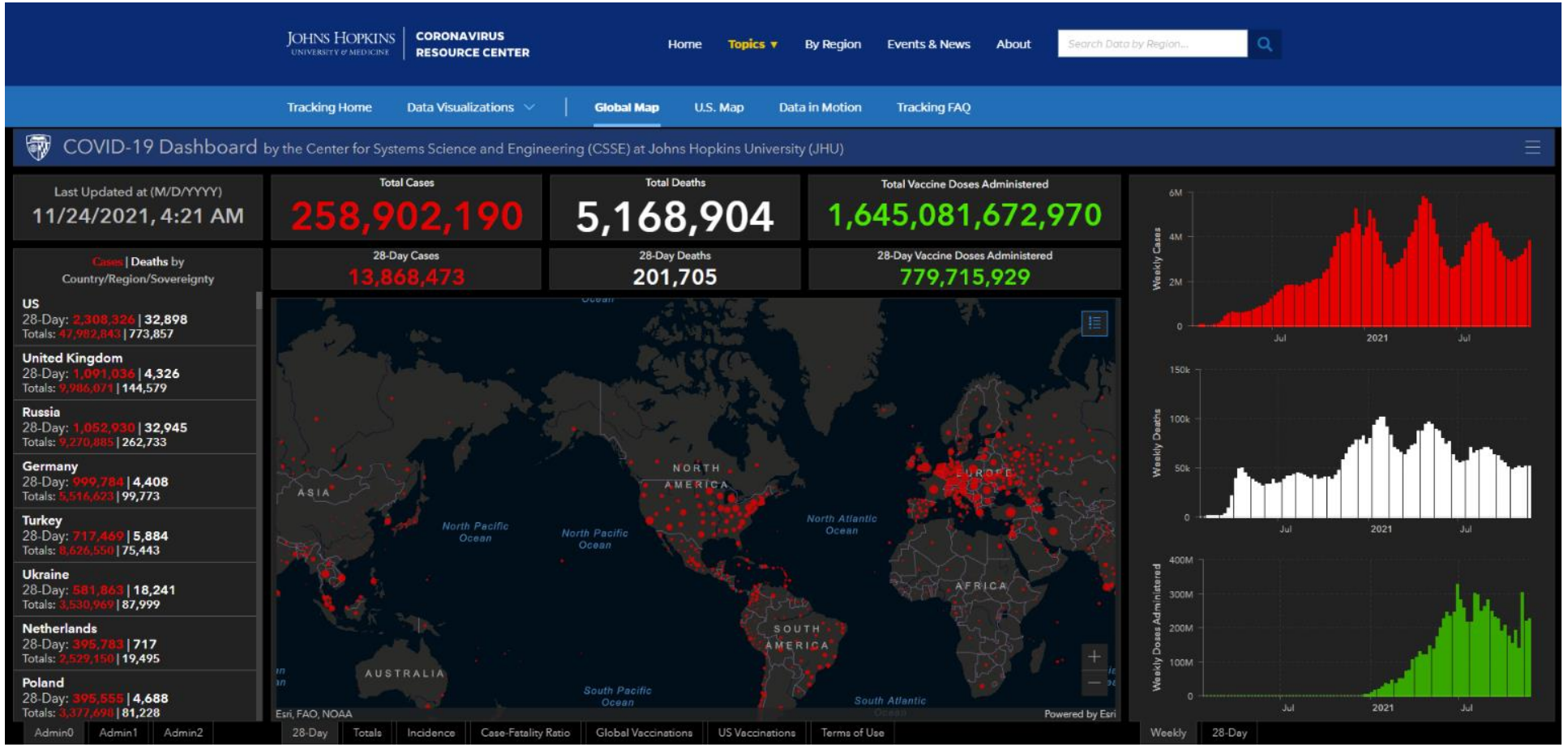
Data science enables K-12 students to make sense of pressing societal challenges

Johns Hopkins University
Coronavirus Resource Center
https://coronavirus.jhu.edu/map.html

Our World in Data
Coronavirus Pandemic (COVID-19)
https://ourworldindata.org/coronavirus

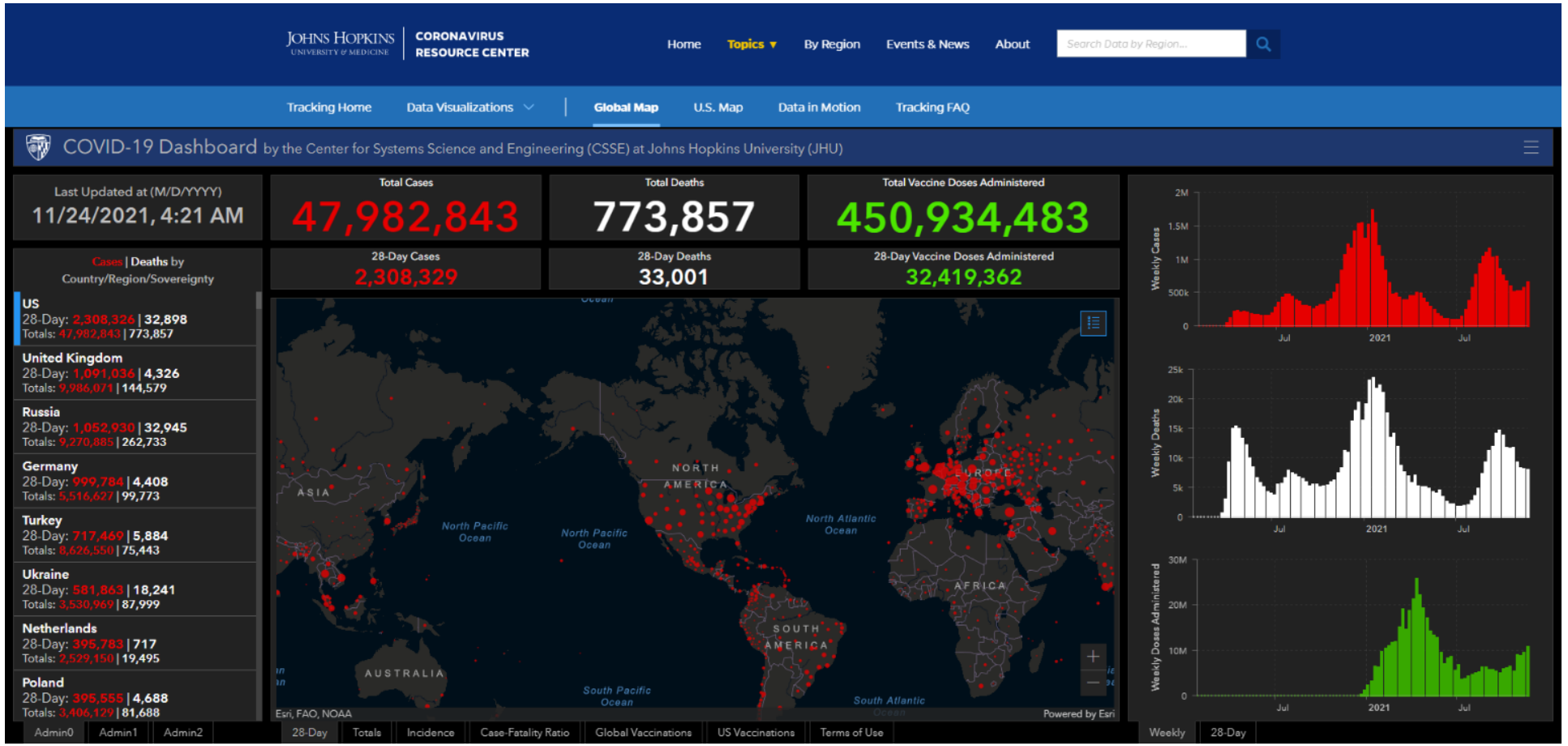
CDC Guidance

Data Science: Global Data



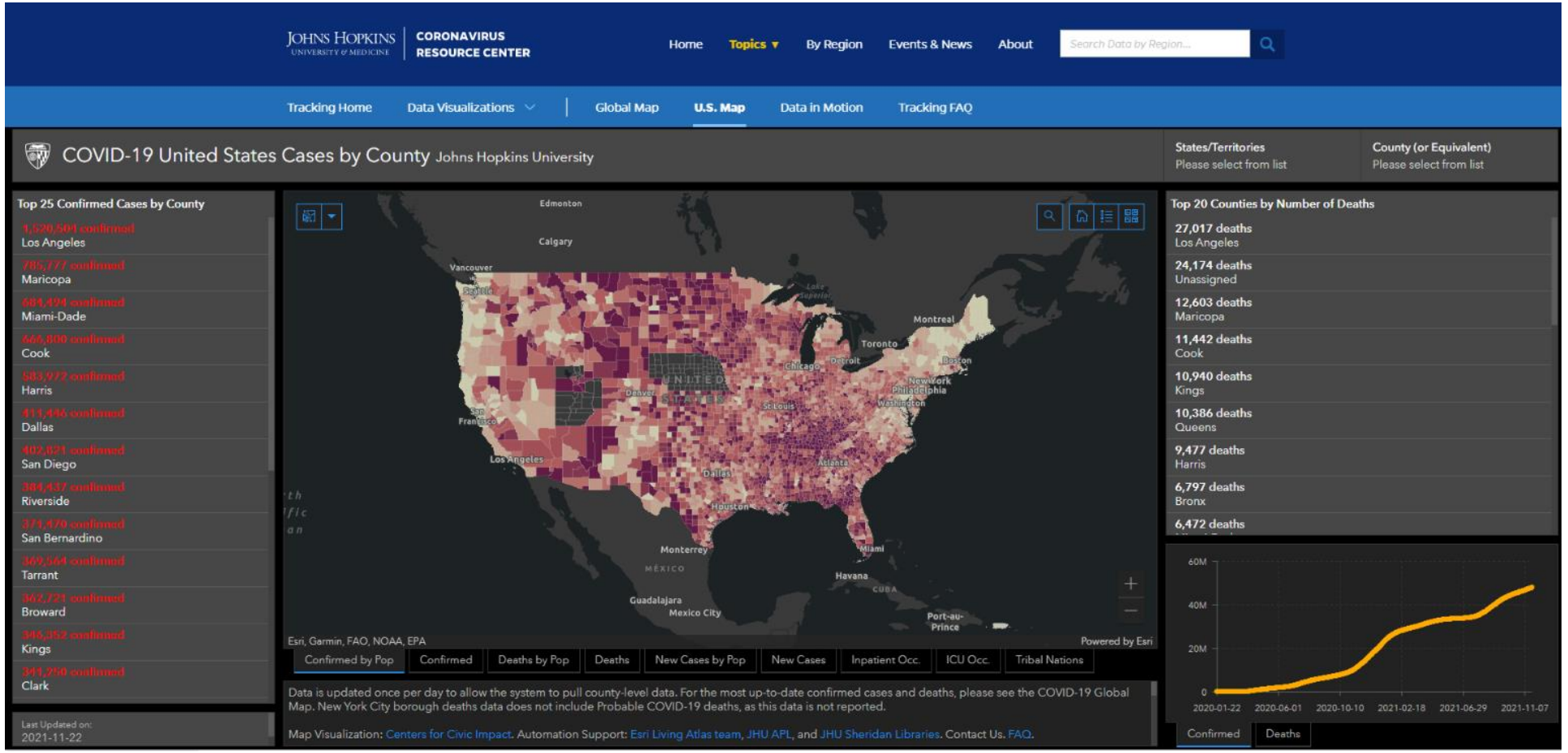
Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine
Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map

Data Science: Data by Nation – US



Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine
Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map

Data Science: Data by US County



Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine
Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map

Data Science

***Go To The Johns Hopkins University* Coronavirus Resource Center**
https://coronavirus.jhu.edu/map.html

Interpret the global and national data.

Consider how you could use the data for your teaching.

Enter your thoughts in the chatbox.

Share your thought with the whole group (1-2 volunteers).

CCSS for Mathematics

Mathematical Practices

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

(CCSS Math, 2010, pp. 6-8)

Mathematical Concepts

K-5
- Counting & Cardinality (K)
- Operations & Algebraic Thinking
- Number & Operations
  - Fractions (3)
- Measurement & Data
- Geometry

6-8
- Ratios & Proportional Relationships
- Number System
- Expressions & Equations
  - Functions (8)
- Geometry
- Statistics & Probability

9-12
- Number & Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics & Probability

NGSS

Science & Engineering Practices

1. Ask questions (for science) and define problems (for engineering)
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations (for science) and design solutions (for engineering)
7. Engage in argument from evidence
8. Obtain, evaluate, and communicate information

*Framework for K-12 Science Education (*National Research Council, 2012)

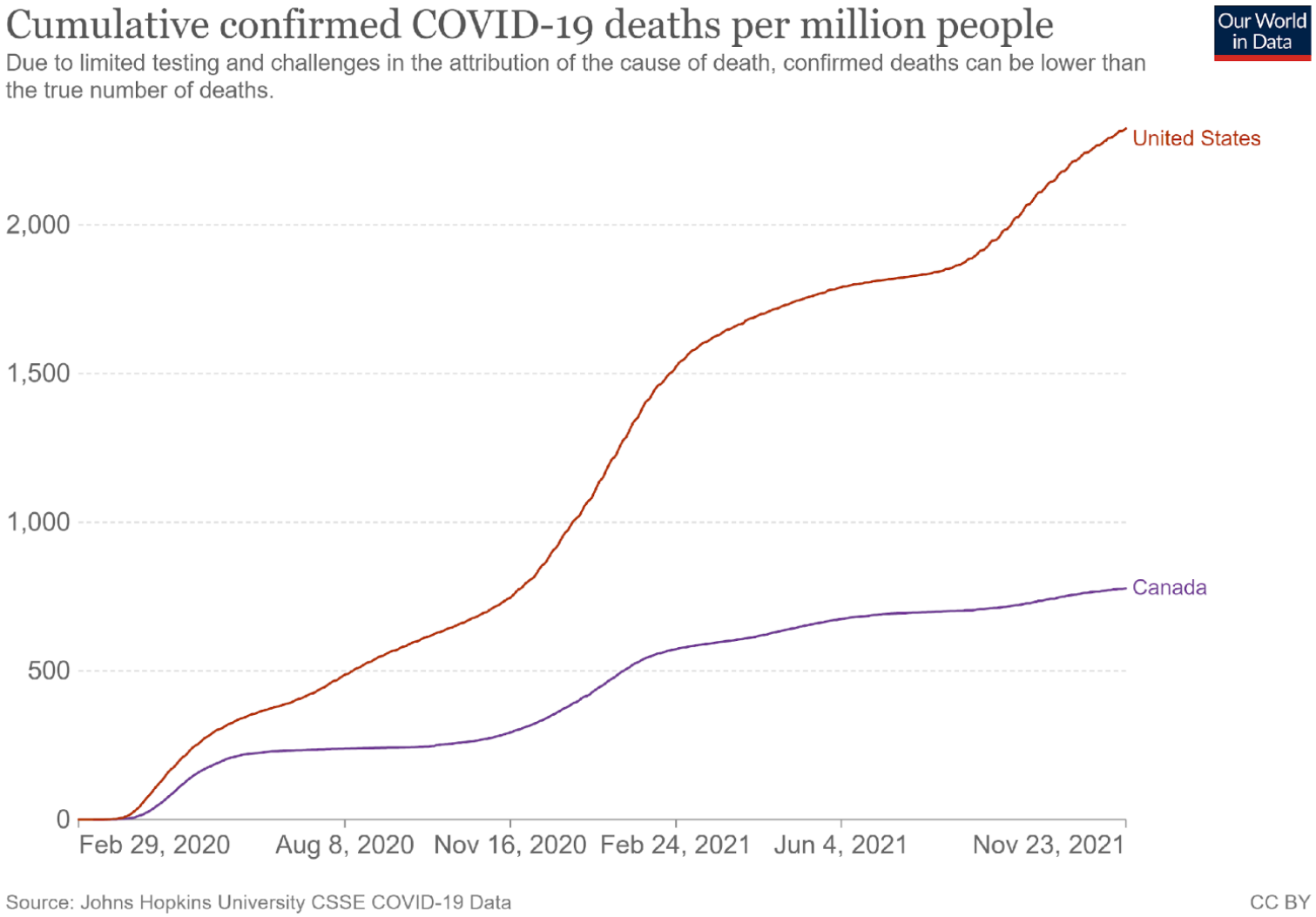
Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

Disciplinary Core Ideas

1. Physical Sciences
2. Life Sciences
3. Earth and Space Sciences
4. Engineering, Technology and Applications of Science

Data Science: Data by Nation



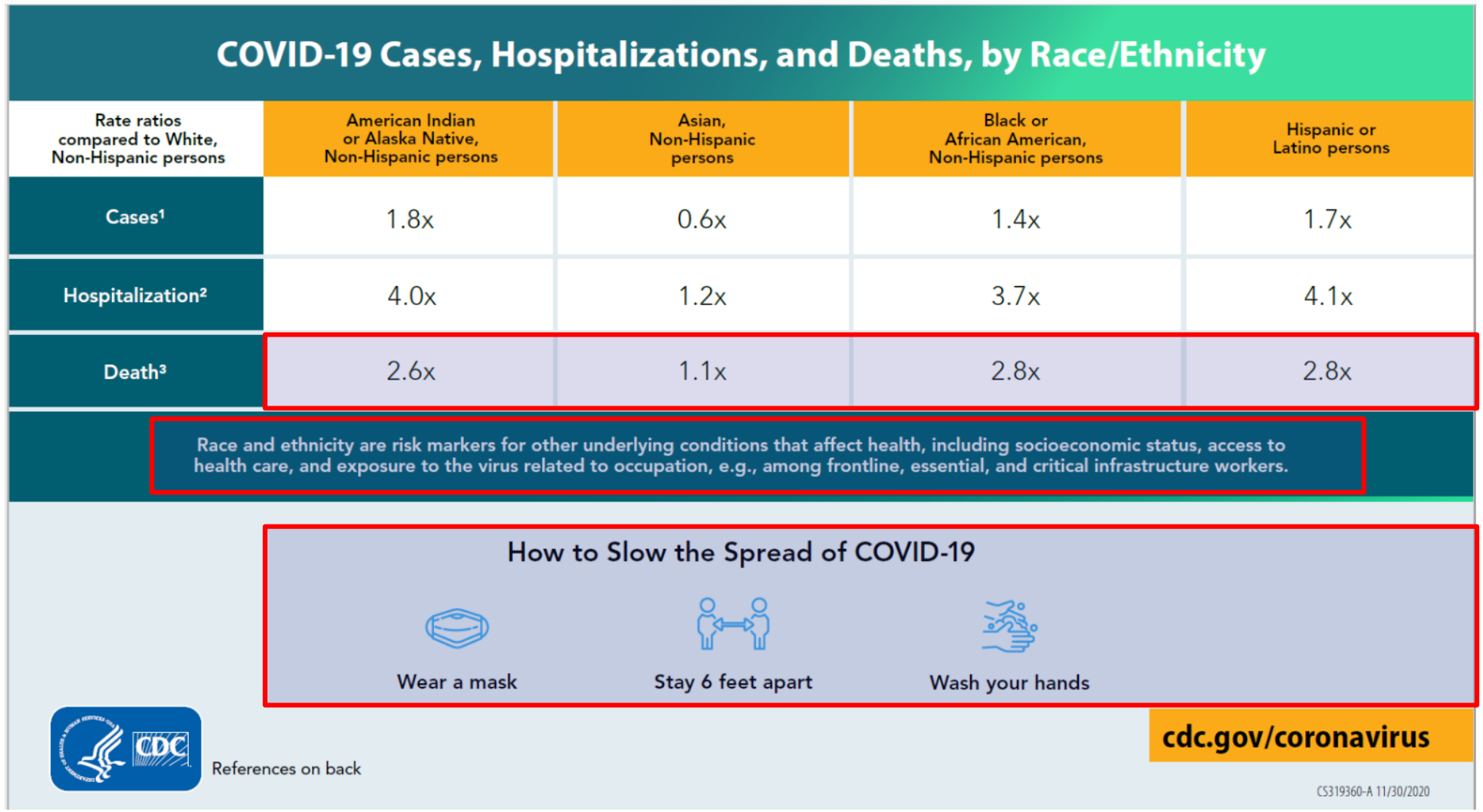
Our World in Data "Coronavirus Pandemic (COVID-19)," by M. Roser, H. Ritchie, E. Ortiz-Ospina, and J. Hasell, 2021
https://ourworldindata.org/coronavirus

Data Science

Go to Our World in Data
https://ourworldindata.org/coronavirus

- Scroll down to “Deaths” and explore different data representations.
- Consider how you could use the data for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).

Data Science



COVID-19 Cases, Hospitalizations, and Deaths, by Race/Ethnicity

Rate ratios compared to White, Non-Hispanic persons	American Indian or Alaska Native, Non-Hispanic persons	Asian, Non-Hispanic persons	Black or African American, Non-Hispanic persons	Hispanic or Latino persons
Cases[1]	1.8x	0.6x	1.4x	1.7x
Hospitalization[2]	4.0x	1.2x	3.7x	4.1x
Death[3]	2.6x	1.1x	2.8x	2.8x

Race and ethnicity are risk markers for other underlying conditions that affect health, including socioeconomic status, access to health care, and exposure to the virus related to occupation, e.g., among frontline, essential, and critical infrastructure workers.

How to Slow the Spread of COVID-19

Wear a mask

Stay 6 feet apart

Wash your hands

References on back

cdc.gov/coronavirus

CS319360-A 11/30/2020

(as of 11/30/2020)

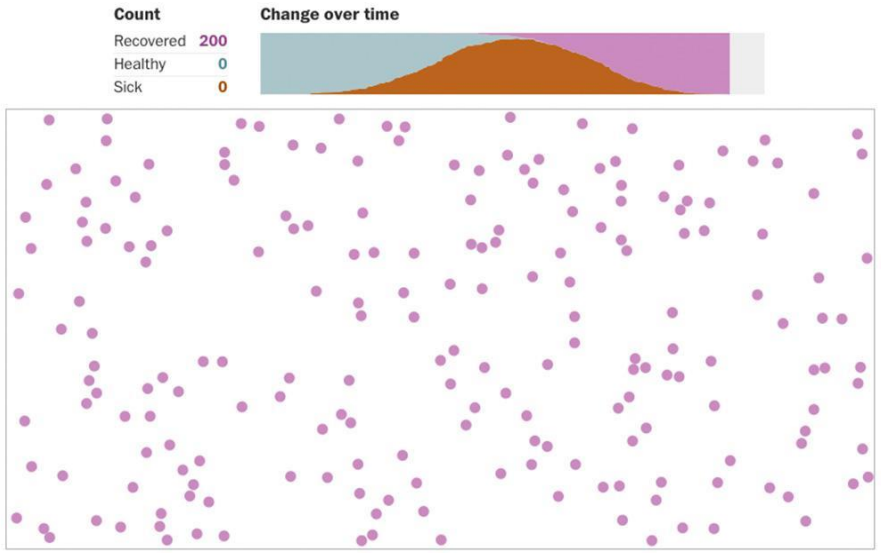
Data Science

Go to CDC Guidance
https://bit.ly/CDCGuidanceTI

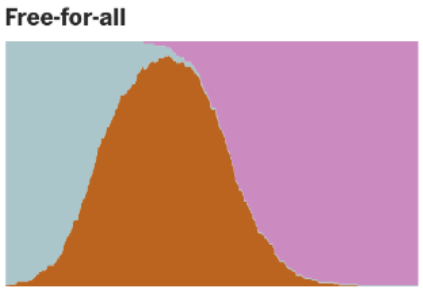
- Interpret the data in the CDC Guidance.
- Consider how you could use the data for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).

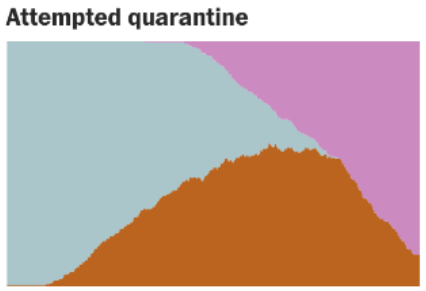
Computer Science

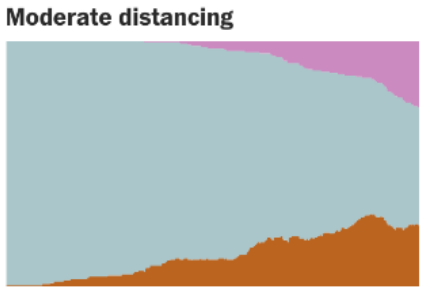
Example of Publicly Available Computer Simulations Using COVID-19 Data

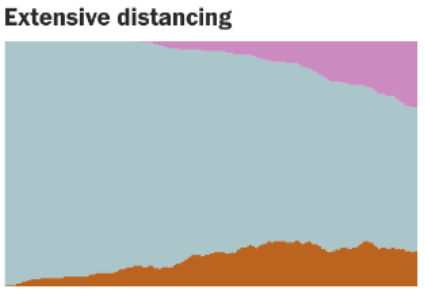


December 29, 2020
In the early days of the pandemic, we created a simple simulation demonstrating how social distancing can help slow the spread of the virus. It was translated into 13 languages and became the most-viewed story in the history of *The Post.*









The Washington Post
"Why Outbreaks Like Coronavirus Spread Exponentially, and How to 'Flatten the Curve'"
https://www.washingtonpost.com/graphics/2020/world/corona-simulator/

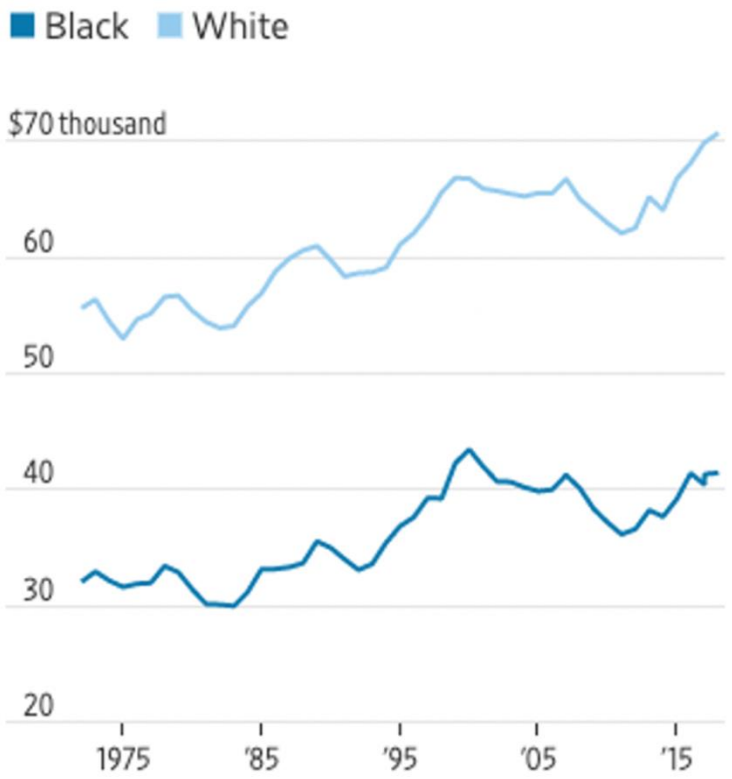
Computer Science

The Washington Post
"Why Outbreaks Like Coronavirus Spread Exponentially, and How to 'Flatten the Curve'"
https://www.washingtonpost.com/graphics/2020/world/corona-simulator/

- Consider how the computational models about social distancing relate to CDC Guidance for frontline and essential workers.
- Consider how you could use computational models for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).

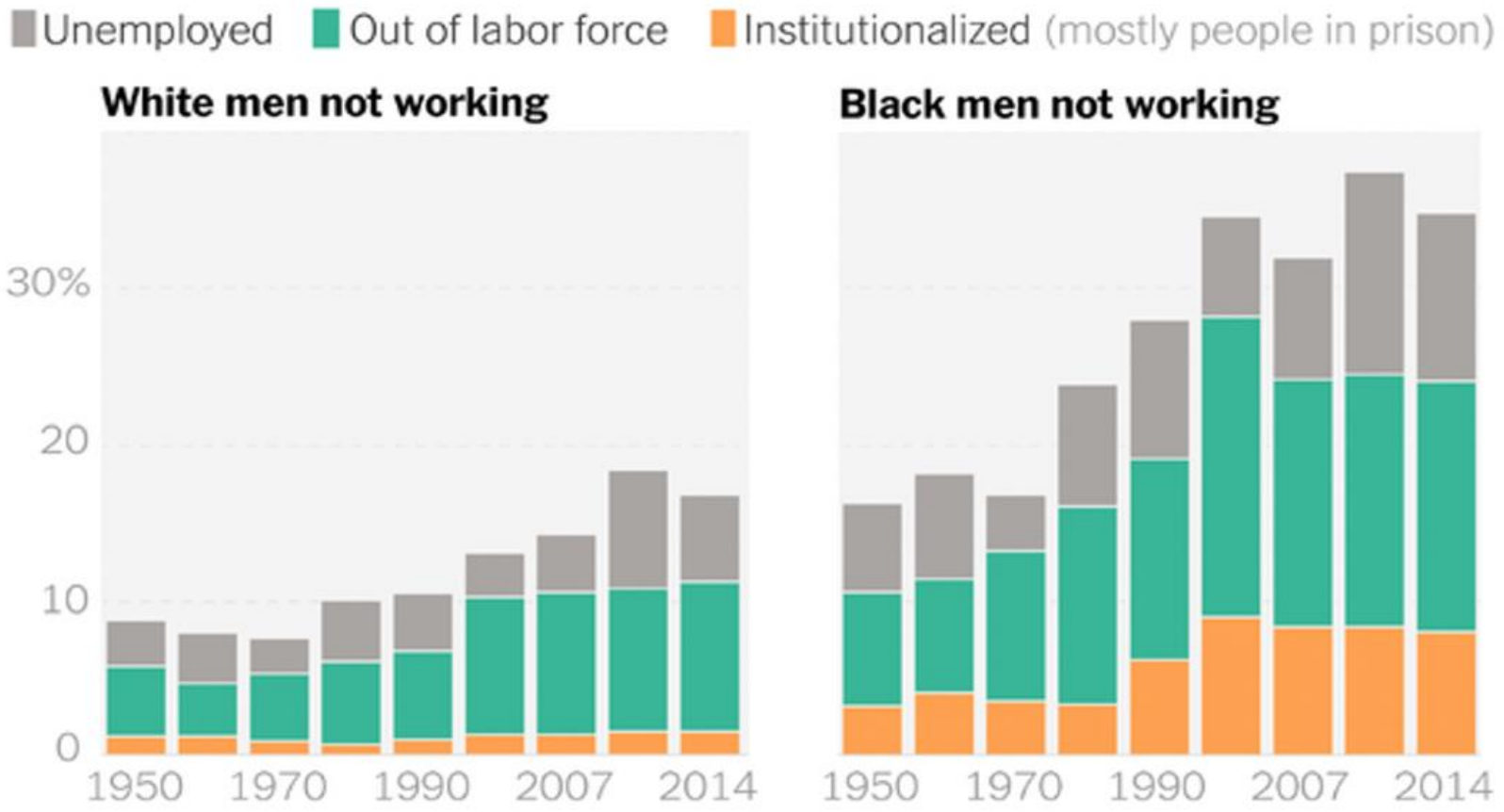
Equity and Justice

Income Gap Between Black and White Households



The Wall Street Journal
"For African-Americans, a Painful Economic Reversal of Fortune," by G. Ip, 2020
https://www.wsj.com/articles/for-african-americans-a-painful-economic-reversal-of-fortune-11591176602?st=6peib0558gnq91l

Equity and Justice



The New York Times
"The Enormous Black-White Wage Gap," by D. Leonhardt, 2020
https://www.nytimes.com/2020/06/25/briefing/coronavirus-ahmaud-arbery-hamilton-your-thursday-briefing.html

Equity and Justice

Income and Employment Gaps

The Wall Street Journal

"For African-Americans, a Painful Economic Reversal of Fortune," by G. Ip, 2020
https://www.wsj.com/articles/for-african-americans-a-painful-economic-reversal-of-fortune-11591176602?st=6peib0558gnq91l

The New York Times

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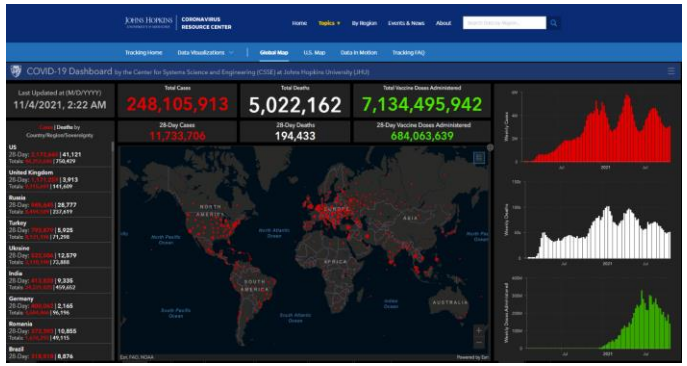
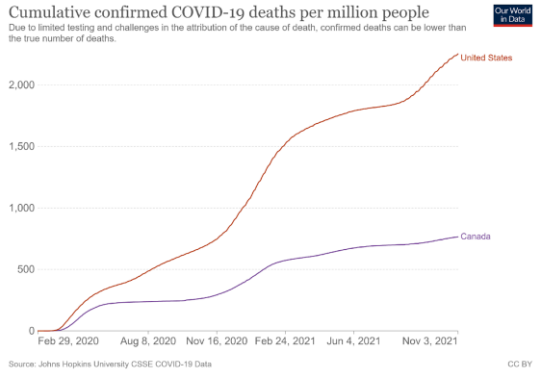
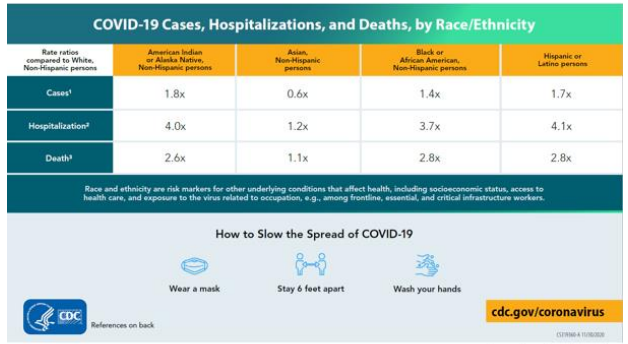
https://www.nytimes.com/2020/06/25/briefing/coronavirus-ahmaud-arbery-hamilton-your-thursday-briefing.html

- Consider how you could use the data for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).

Summary:
Justice-Centered Data Science





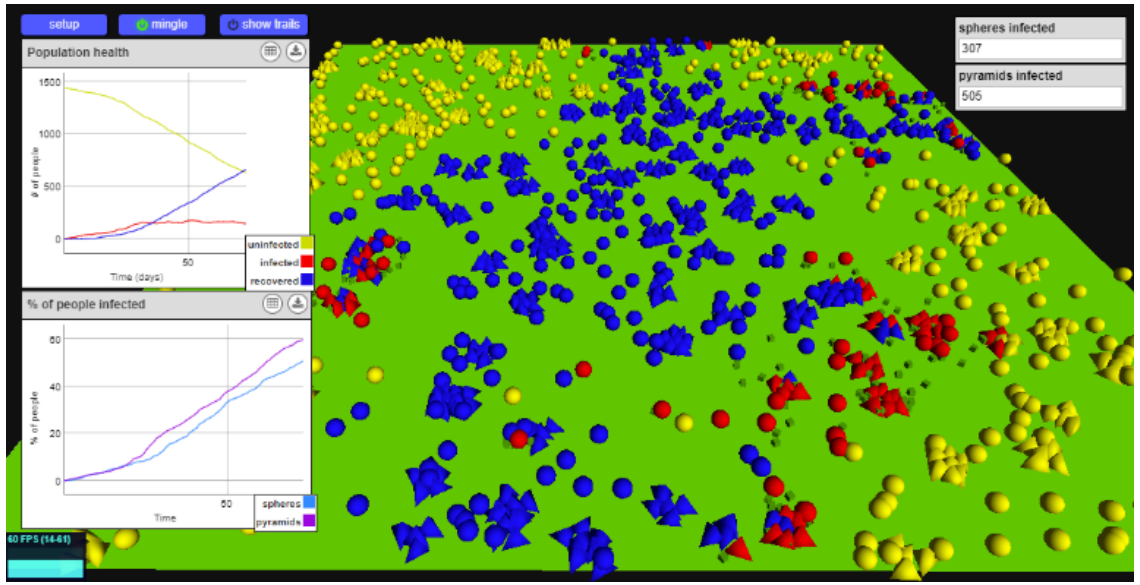


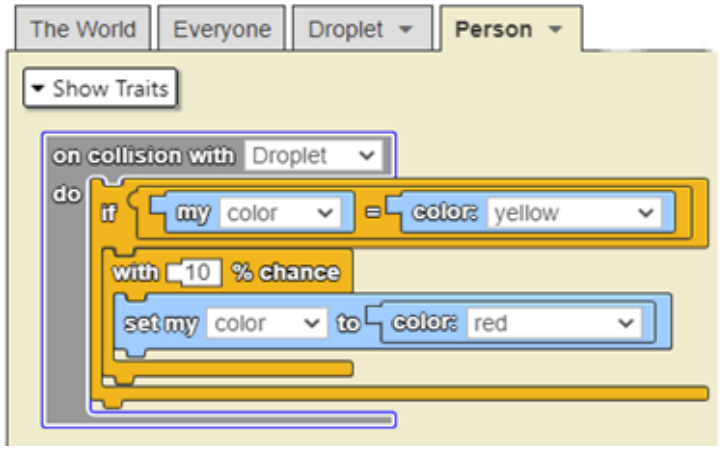
(as of 11/30/2020)

- Students analyze data about COVID-19 cases and deaths from
  - ✔ Johns Hopkins University Coronavirus Resource Center and
  - ✔ Our World in Data by Oxford University.

- Students observe racial and ethnic disparities in the data from the U.S. Centers for Disease Control and Prevention.

Summary:
Justice-Centered Computer Science





- Using StarLogo Nova (slnova.org), students explain underlying causes for disparities in COVID-19 cases.
  - ✔ These underlying causes include the overrepresentation of racial and ethnic minorities in crowded housing and in frontline work
  - ✔ Both causes create challenges for following CDC guidance based on STEM disciplines, e.g., keep 6 feet apart and stay at home.
- Students design solutions to promote justice in society.

Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions

Justice-Centered Design Solutions

Introduce the handout for breakout rooms

https://bit.ly/Lee-CampbellHandout

Work with your colleagues in your breakout room to discuss the questions (in red) and be prepared to share your responses.

Share your thoughts with the whole group (1-2 volunteers).

https://www.nsta.org/playlist/tracking-covid-19-united-states

Playlist

Daily Do: How Can We Make Informed Decisions to Keep Ourselves and Our Communities Safe During the COVID-19 Pandemic?

In this first playlist lesson, students experience the phenomenon of the spread of COVID-19 varying among U.S. counties and use computer simulations (mathematical models) to begin to make sense of the patterns in the spread of COVID-19 they observe. Students apply their new understandings to make recommendations for their school to keep themselves, their families, and their community safe.

VIEW LESSON PLAN

Daily Do: Are There Differences in How People Are Affected by the COVID-19 Pandemic in the United States? If So, Why Are There Differences, and What Should We Do About the Disproportionate Impact of COVID-19?

In the second lesson on the playlist, students observe the phenomenon of differences in the number of COVID-19 cases and deaths by race and ethnicity in their state and in others. Students engage in science and engineering practices to explain these differences, then propose justice-centered solutions for addressing the disproportionate impact of COVID-19.

VIEW LESSON PLAN

Daily Do: What Causes the Disproportionate Impact of COVID-19 on Racial and Ethnic Minority Groups?

In the third playlist lesson, students identify and explain the causes of the disproportionate impact of COVID-19 on racial and ethnic minority groups. Then they consider why the CDC guidance for how to slow the spread of COVID-19 is necessary but insufficient to address the causes that have led to the disproportionate impact of COVID-19. Finally, they propose system-level solutions for addressing the disproportionate impact of COVID-19.

VIEW LESSON PLAN

TI STEM Exchange

Closing Comments

Justice-Centered STEM Education

TI Education Technology is transforming the way teachers teach and students learn STEM (science, technology, engineering and mathematics) subjects.

Vince O'Connell

Director of School Partnerships | *Texas Instruments*

TI STEM Exchange

Texas Instruments

TI STEM Exchange

2022 sessions begin in February

More information and registration will be available at https://education.ti.com/en/resources/ti-stem-exchange

TI STEM Exchange

Thank you!

Texas Instruments