ScienceNews
EDUCATOR GUIDE

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March 27, 2021
Vaccine Inequity Will Prolong Pandemic

SOCIETY FOR SCIENCE

SN EDUCATOR GUIDE

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About this Guide

In this Guide, based on the online *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem," students will learn about challenges in vaccinating the world against COVID-19 as well as potential consequences of unfair vaccine distribution. Then, students will discuss the effects of varying vaccination rates on local and global scales before examining vaccination data in their own region, state or city.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem," which explores the scientific and economic impacts of the failure to fairly distribute vaccines globally. A version of the story, "Vaccine inequity will prolong pandemic," appears in the March 27, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-LS3; HE-ETS1.

Student Comprehension Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will think about how communities connect on local and global scales through the lens of COVID-19 vaccine distribution and consider why global collaboration in STEM is crucial for solving some large-scale issues. Related standards include NGSS-DCI: HS-LS3; HS-ETS1.

Student Discussion Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Activity — Students will analyze a graph to identify inequities in COVID-19 vaccine access among nations based on wealth, discuss how affluence affects access to and distribution of vaccines as well as how disparities in vaccine distribution affect global pandemic recovery. Students will then work in groups to research COVID-19 vaccine access and distribution in their state or local area, identify potential inequities in vaccine access and distribution and construct a graph of their own. Related standards include NGSS-DCI: HS-ETS1; HS-LS2; HS-LS4.

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Article-based Comprehension, Q&A

Directions for teachers: Ask your students to read the online *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem," which explores the scientific and economic impacts of the failure to fairly distribute vaccines globally, and answer the following questions. A version of the story, "Vaccine inequity will prolong pandemic," appears in the March 27, 2021 issue of *Science News*.

1. How have COVID-19 vaccines been distributed so far in wealthy countries and countries with lower incomes?

Wealthy nations such as the United States, Canada and the United Kingdom have purchased or reserved hundreds of millions to over a billion doses — many more than those countries need based on their population sizes. In the United States, about 16 percent of the country's 330 million residents have been vaccinated. Meanwhile, 80 less-wealthy nations have yet to administer a single dose. Out of the 350 million vaccine doses that have been given worldwide as of early March 2021, only 330,000 doses were administered in all of Africa.

2. What would a more equitable distribution of COVID-19 vaccines looks like?

An equitable distribution would prioritize healthcare workers and vulnerable people in all countries.

3. What is COVAX and what is its mission? What is one large hurdle that COVAX faces in accomplishing its mission?

COVAX is an international initiative that aims to provide equitable access to COVID-19 vaccines by securing deals that send doses to low-income countries free of charge. Funding for the initiative is currently short billions of dollars.

4. What is herd immunity? What is the threshold to reach herd immunity?

Herd immunity is the level at which enough people in a population are immune to a pathogen to slow its spread. About 60 to 90 percent of a population need to be immunized to reach herd immunity.

5. What are coronavirus variants? How do variants arise and why are scientists concerned about some coronavirus variants?

Coronavirus variants are strains of the coronavirus that causes COVID-19. Variants arise when a virus replicates and acquires genetic tweaks. Those tweaks can make some variants more dangerous to people, such as making a virus more transmissible.

6. How could variants worsen the pandemic? How would the equitable distribution of COVID-19 vaccines mitigate this threat?

The more opportunity the coronavirus has to spread, the more likely it is that variants could arise that can evade existing vaccines or people's immune responses to older variants. If most of a region remains unvaccinated, a new variant could spread rapidly through the region and make its way to other vulnerable areas. Prioritizing regions that are most vulnerable to COVID-19 for vaccination could help stop a variant from becoming widespread.

7. How does the inequitable distribution of COVID-19 vaccines threaten the global economy? How could that threat be averted?

Researchers estimate that extreme vaccine inequity could cost the global economy trillions of dollars in 2021. The world's economies and supply chains are interconnected. COVID-19 infections and restrictions in countries that make goods could diminish demand and affect the profits of other countries that sell those goods. Investing relatively less money in distributing vaccines globally and more fairly could avoid such disruptions.

8. When do scientists estimate low-income countries will achieve herd immunity to the virus that causes COVID-19? Explain.

Low-income countries won't see widespread vaccination until 2023 or 2024. These countries can't get doses because wealthy nations are making deals with pharmaceutical companies to buy up most of the vaccine supply.

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Student Comprehension Worksheet

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1. How have COVID-19 vaccines been distributed so far in wealthy countries and countries with lower incomes?

2. What would a more equitable distribution of COVID-19 vaccines looks like?

3. What is COVAX and what is its mission? What is one large hurdle that COVAX faces in accomplishing its mission?

4. What is herd immunity? What is the threshold to reach herd immunity?

5. What are coronavirus variants? How do variants arise and why are scientists concerned about some coronavirus variants?

6. How could variants worsen the pandemic? How would the equitable distribution of COVID-19 vaccines mitigate this threat?

7. How does the inequitable distribution of COVID-19 vaccines threaten the global economy? How could that threat be averted?

8. When do scientists estimate low-income countries will achieve herd immunity to the virus that causes COVID-19? Explain.

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Cross-curricular Discussion, Q&A

Directions for teachers:
Ask students to read and answer questions about the online *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem." A version of the story, "Vaccine inequity will prolong pandemic," appears in the March 27, 2021 issue of *Science News*.

Students should answer the first set of questions alone and then work with a partner to answer the second and third sets of questions.

Want to make it a virtual lesson? Post the online *Science News* article to your virtual classroom and use the questions to discuss the article with your class.

Vaccinating our global community

1. Are COVID-19 vaccines being distributed fairly around the world? Explain.

The distribution isn't equitable. Rich countries have secured many more doses of the vaccine than they need in advance, leaving fewer doses available for less-wealthy nations.

2. Which countries have had better access to COVID-19 vaccines? How does vaccine access affect countries' vaccination rates? What impact do vaccination rates have on countries?

Wealthy countries have had better access to vaccine doses and therefore have higher rates of vaccination than less-wealthy nations with poor access to vaccine doses. A country's vaccination rate can affect not only the health and social behaviors of its people, but also the health of its economy.

3. Choose one of the following quotes from the *Science News* article and discuss its meaning.

"The world is on the brink of a catastrophic moral failure, and the price of this failure will be paid with the lives and livelihoods in the world's poorest countries."

"No one is safe until all of us are safe, since an outbreak anywhere can become an outbreak everywhere."

"If we want to stop the spread we have to stop it everywhere, starting with the most vulnerable. Otherwise we're going to see continued outbreaks and suffering."

Student answers will vary but should highlight the need for a global solution to vaccinations.

4. Brainstorm communities of varying scales. Create a diagram that helps define the relative size and connectedness of the communities. One approach could be to use circles of relative sizes to define the different communities. Be sure to show how the communities are connected in your diagram.

Student answers will vary but should include individuals, families, town, county, state, national, continental, global.

Global and local impacts

1. What impact does vaccine inequity have on the global community in the short-term? What about the long-term?

In the short-term, some countries will have high vaccination rates and low numbers of COVID-19 cases. Countries that have poor access to vaccine doses will continue to have low vaccination rates and high numbers of COVID-19 cases and deaths. People in countries with high vaccination rates may have fewer social restrictions and travel would probably increase.

In the long-term, an uneven vaccination rate could cause coronavirus variants to arise that spread more easily and are potentially more infectious. As a result, COVID-19 cases could spike even in countries with high vaccination rates as the vaccines may be less effective against variants. Travel would decrease and the global economy would also probably be further interrupted.

2. Discuss what you know about the vaccination rate in your own community with your partner. How could the impact of COVID-19 vaccines in your local community change over time as a result of global vaccine inequity? Think through short-term and long-term effects.

Student answers will vary. Students may mention that as vaccination rates increase in their community, the number of cases of and deaths from COVID-19 will decline. However, an uneven global vaccination rate could spur more variants of the coronavirus. Current vaccines may be less effective against those variants, and if the variants spread to the local community, COVID-19 cases could spike again. That could lead to stricter social restrictions that could impact businesses, people's jobs and the economy.

3. Explain one existing approach to help create a more equitable solution to global vaccination distribution. Propose an idea that would help support the current approach, or suggest a unique alternative solution.

COVAX is using funds from governments and charitable organizations to buy vaccine doses from pharmaceutical companies and distribute the doses to low-income countries for free. Other student-suggested solutions will vary.

Global STEM collaboration

1. Can you think of an example from your own life where disjointed approaches to a solving a problem ended up causing a larger issue? What would have been a more successful approach?

Student answers will vary but should highlight a personal example of when collaboration led to a more successful outcome.

2. What are other examples of global collaborations in STEM that exist for the good of the humankind? Explain.

Student answers will vary. Students might mention global monitoring networks like the Global Ocean Observing System to observe climate data, the United Nations Paris climate accord or the World Health Organization.

3. Is there a STEM issue facing the world that you think needs a global solution? Explain.

Student answers will vary but could include more global collaboration to stop climate change or preparation for a future pandemic, for example.

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Student Discussion Worksheet

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Vaccinating our global community

1. Are COVID-19 vaccines being distributed fairly around the world? Explain.

2. Which countries have had better access to COVID-19 vaccines? How does vaccine access affect countries' vaccination rates? What impact do vaccination rates have on countries?

3. Choose one of the following quotes from the *Science News* article and discuss its meaning.

"The world is on the brink of a catastrophic moral failure, and the price of this failure will be paid with the lives and livelihoods in the world's poorest countries."

"No one is safe until all of us are safe, since an outbreak anywhere can become an outbreak everywhere."

"If we want to stop the spread we have to stop it everywhere, starting with the most vulnerable. Otherwise we're going to see continued outbreaks and suffering."

4. Brainstorm communities of varying scales. Create a diagram that helps define the relative size and connectedness of the communities. One approach could be to use circles of relative sizes to define the different communities. Be sure to show how the communities are connected in your diagram.

Global and local impacts

1. What impact does vaccine inequity have on the global community in the short-term? What about the long-term?

2. Discuss what you know about the vaccination rate in your own community with your partner. How could the impact of COVID-19 vaccines in your local community change over time as a result of global vaccine inequity? Think through short-term and long-term effects.

3. Explain one existing approach to help create a more equitable solution to global vaccination distribution. Propose an idea that would help support the current approach, or suggest a unique alternative solution.

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Activity Guide for Teachers: A Fair Shot

Purpose: Students will work in groups to research and graph evidence of inequities in vaccine access and distribution based on demographic characteristics.

Procedural overview: After reading the *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem," students will analyze a graph that compares number of COVID-19 vaccine doses purchased and population to identify inequities in vaccine access among nations based on wealth. The class will discuss how the affluence of nations affects their access to vaccines and their ability to distribute those vaccines to citizens. The students will also cover why and how disparities in vaccine distribution affect global recovery from the pandemic.

Students will work in groups to research COVID-19 vaccine access and distribution in their state or local area. To identify whether there are inequities in access and distribution of the vaccines, students will gather information about how vaccines have been made available in different areas and how different groups of people have been vaccinated. Finally, students will use the data they gathered to construct a new graph to illustrate how different demographic groups in their area have accessed vaccines. After evaluating their findings, students will determine whether there are inequities in access.

Approximate class time: 2 class periods

Supplies:
Paper
Pencils
"A fair shot" student worksheet
"Understanding vaccine inequity" teacher background sheet
Computer with internet access
Interactive meeting and screen-sharing application for virtual learning (optional)
Simultaneous file-sharing application (optional)
Spreadsheet or database software (optional)
Graphing software (optional) or graph paper

Directions for teachers:
This activity can be conducted by remote learning, provided that students have internet access, interactive meeting software and file-sharing applications. Spreadsheet or database software and graphing software are recommended to simplify data graphing. Students will need internet access in order to research vaccine access and administration.

The setup
Assign students the *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem" to read as homework before class . As part of the homework, instruct students to analyze the graph in the section titled "Unequal Distribution" and answer the following questions.

1. What is the title of the graph?

COVID-19 vaccine doses purchased by countries, grouped by income

2. What type of graph is used to display the data?

Data are presented as a bar graph.

3. How many variables are plotted on the graph and what are they?

The graph shows three variables: Number of COVID-19 vaccine doses purchased, total population and countries grouped by income level.

4. What is shown on the *x*-axis, and what units are used?

The x*-axis is the horizontal axis. It shows countries grouped by income level. The units are income levels: high, upper middle, lower middle and low.*

5. What is shown on the *y*-axis, and what units are used? Explain how the units are distinguished in the bar graph.

The y*-axis is the vertical axis. The* y*-axis shows two variables: number of COVID-19 vaccine doses purchased and total population. Both variables have units in billions. Number of COVID-19 vaccine doses purchased is billions of doses and is displayed with red bars. Total population is billions of people, and is displayed using black bars.*

6. What is the source of the data in the graph?

The sources listed are Duke Global Health Innovation Center and the World Bank.

7. What initial questions do you have about the information displayed on the graph?

Student answers will vary. Students may mention that they would like to know how many countries are represented in each income-level category and what share of the vaccine doses have been reserved by each of the nations within each income-level category.

8. What comparisons are being made in the graph?

The graph compares the populations of countries in different wealth brackets with the number of COVID-19 vaccine doses those countries have purchased. The graph also allows comparisons between how many vaccines countries purchased and the number of vaccines needed to vaccinate their entire populations.

9. Summarize the trends between variables that are visible in the graph.

*High-income countries have purchased many more vaccine doses than less wealthy countries. In addition, high-income countries have purchased many more vaccine doses than they need to vaccinate their entire populations. Upper middle-income, lower middle-income and low-income countries have purchased enough vaccine doses to vaccinate only about one-quarter to one-half of their populations. In short, wealthy nations have purchased an unequal share of vaccine doses based on population***.**

Class discussion

Before beginning the class discussion about "Global inequity in COVID-19 vaccination is more than a moral problem," make sure students understand core concepts of equity, demographics and information and data literacy, some of which are presented in the teacher background sheet.

After students read "Global inequity in COVID-19 vaccination is more than a moral problem" and analyze the graph, you will lead a class in a discussion in which students will address the following questions about why equitable access to vaccines matter. If performing this activity remotely, make sure that students can communicate by speaking or using the chat or polling functions in the meeting software.

1. Why is it important to distribute vaccines worldwide and vaccinate as many people in as many locations as possible?

Lopsided distribution of vaccines is not only morally unfair, it could also ultimately prolong the pandemic, fuel the evolution of new, potentially vaccine-evading variants and drag down the economies of rich and poor — and vaccinated and unvaccinated — nations alike.

2. In the article, public health policy expert Gavin Yamey says that "An outbreak anywhere can become an outbreak everywhere." Explain what Yamey meant by this statement.

Viruses mutate. Mutation happens by chance as a virus replicates inside a host. The more the virus replicates, the more opportunity it has to evolve traits that enable it to overcome resistance caused by existing vaccines or natural immune responses to older variants. Large pockets of unvaccinated people can serve as incubators for new variants. The longer such pockets persist, the greater the chance that new variants will emerge, and those variants will spread around the globe as people travel.

3. How do new coronavirus strains affect the vaccination strategy developed by public health experts?

The more a virus spreads, the more opportunity that one or more mutations could result in a new, more threatening strain. In a vaccinated individual, mutations that even slightly evade the induced immune response can get a foothold. Unless that variant completely evades vaccines, its spread will be blunted by a well-vaccinated population. But if most of a region remains totally naïve to infection, that new variant could burn quickly through the largely unvaccinated population, fueling the changed virus' spread to other regions and producing even more dangerous variants. Eventually, such variants might invade well-vaccinated countries that were considered safe and where the populations are not strictly practicing other spread-reducing protocols such as isolation, mask-wearing and washing hands. If this occurs, nations will have to consider other tactics, such as going back into lockdowns and limiting public interactions to slow the spread of the virus until new vaccines or treatments can be developed.

4. How could inequitable vaccine distribution imperil global economic recovery from the pandemic?

An inequitable distribution of vaccines could imperil a robust and quick recovery from the economic downturns experienced by all nations. The economies of all nations are connected by trade. No nation is entirely self-sufficient; all nations rely on other nations for raw materials, manufacturing, production and shipping of goods around the globe. Disruptions to one link in the supply chain ripple throughout the interconnected global economy. Diminished demand for goods in countries saddled with coronavirus restrictions will affect the bottom line of companies headquartered in wealthy nations. If extended outbreaks, lockdowns, sickness and deaths continue in countries with less access to vaccines, all economies will continue to suffer.

5. What is the benefit of getting 60 to 90 percent of the total world population vaccinated as quickly as possible? What potential problems could occur if large populations remain without protection from the virus?

Vaccinating 60 to 90 percent of the populations of all nations on Earth would decrease the virus's access to populations hosts in which it could replicate and mutate. If this level of immunity could be reached, the likelihood of new and dangerous variants developing would be much lower. This would, in turn, reduce the potential disruptions in global supply chains and the damage to economies caused by travel restrictions.

If large populations are left without protection from the virus, in addition to more sickness and death, there will be more disruptions to global supply chains and travel, which will slow down economic recovery from the pandemic.

Group research

Divide the students into groups and have the groups select a region to investigate. The choice could be your county, a group of adjacent counties, your state or your city. Students will use internet resources to research how the COVID-19 vaccines have been administered in the selected area. Encourage students to ask questions about the data they find, including how to read graphs or how to determine what variables are included in a dataset. Be aware that many of the vaccine trackers available are living sites and the data are updated regularly, even daily.

Students performing this activity in or after mid- to late-2021 might need to seek out additional data that records the vaccination data over time, so that they can reconstruct the vaccine rollout over time to identify inequities, or they may wish to look for inequities in the final vaccination numbers. Because the data are continually updated on online databases, encourage students to capture screenshots, save pages as web archives, or otherwise document the data as it is presented on the day they performed their research. This process will allow you to reconstruct the data and verify their sources as you check their work.

In addition to your state's or county's Department of Health, the following list contains resources that have tracked coronavirus vaccine access, distribution and administration statistics, as well as general population and demographic information about the United States. These links are recommended as starting points for student research and many provide additional links to more detailed datasets compiled by local authorities.

U.S. Centers for Disease Control and Prevention. COVID Data Tracker.
U.S. Centers for Disease Control and Prevention. COVID-19 Integrated County View.
U.S. Centers for Disease Control and Prevention. Vaccinations in the US.
Johns Hopkins University. Coronavirus Resource Center
J. Holder. Tracking Coronavirus Vaccinations Around the World. The New York Times.
U.S. Census Bureau. National Demographic Information Quick Facts.

Encourage student groups to choose different locations so that the discussion at the end of the activity will involve a larger-scale analysis of vaccination rates and inequities. This could be as simple as having students choose a group of adjacent counties in your state, or students could choose to look at entire states or regions of the country.

As students analyze the data they discover, they should evaluate the evidence to determine whether there is inequity in vaccine distribution and administration in their area. Inequities will likely show up as a demographic group that has disproportionately low or high vaccination rates compared to their proportion of the population in the researched area.

Students should answer the following questions to guide their research and data analysis. Sample answers are provided for Washington, D.C.

1. What area have you chosen to investigate?

We chose to investigate the District of Columbia.

2. Identify and list at least three resources that provide you with information about COVID-19 vaccinations in your chosen area.

We used information from the CDC COVID Data Tracker, the U.S. Census Bureau, the D.C. COVID-19 Vaccination Data and D.C. State Data Center Visualization Portal.

3. What variables do the resources present data about with regards to COVID-19 vaccination? Possible variables include number of vaccines purchased, number of vaccines administered, percentage of population that has received at least one dose, number or percentage of people who are fully vaccinated, vaccination rates by race or ethnicity, vaccination rates by age or occupation, median income or percentage of households in poverty.

CDC COVID Data Tracker: total doses administered or delivered, percentage of residents who received vaccines or have been fully vaccinated, presented as a count or as a rate per 100,000 people

U.S. Census Bureau: population data and demographic data describing race/ethnicity, sex, age, and income

D.C. COVID-19 Vaccination Data: total number of doses administered and percentage of population vaccinated (partially or fully) by date, race/ethnicity, gender/sex and age

D.C. State Data Center Visualization Portal: median household income by ward in Washington, D.C.

4. How are the data presented by each resource? Are the data presented as verbal statements, tables, charts, maps, graphs, infographics or some other way?

CDC COVID Data Tracker: map with pop-up or hover labels and that links to individual state or entity trackers

U.S. Census Bureau: tables and charts

D.C. COVID-19 Vaccination Data: graphs, charts, maps and tables

D.C. State Data Center Visualization Portal: map with pop-up or hover labels

Communicating information through graphs
In this phase, students will review the information they gathered from the sources they located during the research phase. You may need to help students identify key information and discard extraneous information and explain what should be in graphs.

The title of their graph should convey essential information about what the graph shows. Graphing conventions recommend listing the dependent or *y*-axis variable(s) first, followed by the independent or *x*-axis variable(s).

Because the data about COVID-19 vaccines will change as vaccinations continue, students should include the date the data were gathered or provide a date range from which the data were gathered. Including a date or date range in the title enables a reader to immediately understand to what time period the data presented apply.

Students should also include the geographic region in the title. If the state or region described by the graph is not stated in the title, anyone who views the graph will not know whether the data are global, national or based on some other subset of the population.

Make sure students cite their data sources.

Once students have identified a trend they would like to explore visually, students will use the information to develop a graph that illustrates how COVID-19 vaccines have been distributed or administered according to their chosen demographic category.

Have the students begin their graphing work by answering the following questions.

1. What relationship or trend do you want to investigate, or what comparison do you want to make visually? Record the variables you will show on your graph.

We want to show how rates of vaccination relate to income by neighborhood or ward in Washington, D.C.

2. Construct a data set that organizes your data by variable so that it can be plotted on the graph. This can be done electronically by using spreadsheets or database software, or you can construct a table on another sheet of paper.

Mean income and percentage of population vaccinated, by ward, Washington, D.C., March 22, 2021

Ward	*Median household income (U.S. dollars)*	*Percentage of population fully vaccinated (%)*
1	*99,358*	*7*
2	*108,670*	*7*
3	*126,184*	*11*
4	*87,487*	*8*
5	*68,375*	*7*
6	*108,967*	*7*
7	*41,438*	*5*
8	*34,034*	*3*

Sources: D.C. Health, U.S. Census Bureau, American Community Survey (ACS) 5-Year Estimates

3. What type of graph will best display the data you have gathered? Explain why you have chosen this type of graph.

A double-axis bar graph, similar to the one shown in the Science News *article will best illustrate how the two variables compare.*

4. Set up your graph.

5. Which variable goes on each axis of your graph?

Ward will go on the x*-axis, because it is the dependent variable and is common for both of the other variables. The left* y*-axis will be median household income, and the right* y*-axis will be percentage of the population that was fully vaccinated as of March 22, 2021.*

6. What are your axis labels?

X-axis: Ward
Left-axis: Median household income
Right y*-axis: Percentage of population fully vaccinated*

7. What units will you use on each axis?

X-axis: numerals 1–8
Left y*-axis: U.S. dollars*
Right y*-axis: percent*

8. Does your graph need a key or legend? If so, what will it contain?

Yes, because we are including two variables as bars, we will need to use different colors or patterns to indicate which bar represents each variable. The key will list Median household income as blue and Percentage of population fully vaccinated as red.

9. What will you title your graph?

Percentage of population fully vaccinated for COVID-19 and median household income by ward, Washington, D.C., March 22, 2021

10. How will you cite the source(s) for your data?

Sample answer: Source: D.C. Health, U.S. Census Bureau, American Community Survey (ACS) 5-Year Estimates

11. Construct your graph from the data you gathered. Write a short caption that summarizes the data and trends in your graph.

Graphs will vary depending on the data and variables students' research. Sample caption: Data indicate that wards with the highest median household income also have the highest rates of full vaccination. Lower-income wards have significantly lower rates of vaccination than higher-income wards do.

Class discussion
When student groups have completed their graphs, groups should share their graphs with the class. Allow enough time for each group to briefly present their graph and read their caption. Then, act as a facilitator as students conduct a class discussion about the commonalities and differences among the different graphs and trends.

If time is limited, groups' graphs and captions could be posted online to a shared folder that students can access outside of class, and analysis of the different graphs and completion of the following questions could be assigned as homework.

1. Were there any common trends in the graphs presented to the class?

Several graphs indicated that higher-income states, counties or areas have higher vaccination rates than lower-income regions. Some graphs also indicated that vaccination rates tend to be higher for white people than for other races or ethnicities.

2. What does the graph indicate about equitable access to vaccines in your area or in the United States?

The trends in the graphs indicate that there are systemic inequities in vaccine access and administration based on income and race or ethnicity.

3. What might explain the trends you noted in how COVID-19 vaccines have been distributed or administered in your area or in the United States?

Determining causes of inequities in vaccine access and administration is complex, and several factors affect how different groups of people access vaccine doses. Many vaccine clinics are open only during standard business hours when lower-income individuals are working and may not be able to take time off to get vaccinated. The locations of vaccine administration sites might not be convenient, and lower-income individuals may have less access to transportation to and from vaccine administration sites. In addition, many appointments for vaccinations are being made only online, and lower-income individuals may have less access to the Internet or computers that can be used to set appointments. Median household income is generally higher for white people and lower for other races and ethnicities, so Black people and other people of color may be more likely to face these barriers to getting vaccinated.

Additional resources

Science News articles:
E. Garcia de Jesús. How coronavirus variants may pose challenges for COVID-19 vaccines. Published online January 27, 2021.

E. Garcia de Jesús. Could delaying a second vaccine dose lead to more dangerous coronavirus strains. Published online January 14, 2021.

Lambert and T.H. Saey. Coronavirus cases are skyrocketing. Here's what it will take to gain control. Published online November 11, 2020.

S. Gupta. Why African Americans may be especially vulnerable to COVID-19. Published online April 10, 2020.

Scientific articles:
C. Çakmakli *et al*. The economic case for global vaccinations: An epidemiological model with international production networks. National Bureau of Economic Research Working Paper Series. Published online January 25, 2021. doi: 10.3386/w28395.

M. Voysey *et al*. Single dose administration, and the influence of the timing of the booster dose on immunogenicity and efficacy of ChAdOx1 nCoV-19 (AZD1222) vaccine. *Preprints with the Lancet.* Posted online February 1, 2021.

K. Wu *et al*. mRNA-1273 vaccine induces neutralizing antibodies against spike mutants from global SARS-CoV-2 variants. bioRxiv.org. Posted January 25, 2021. doi: 10.1101/2021.01.25.427948.

D.A. Collier *et al*. Impact of SARS-CoV-2 B.1.1.7 spike variant on neutralization potency of sera from individuals vaccinated with Pfizer vaccine BNT162b2. medRxiv.org. Posted January 20, 2021. doi: 10.1101/2021.01.19.21249840.

Z. Wang *et al*. mRNA vaccine-elicited antibodies to SARS-CoV-2 and circulating variants. bioRxiv.org. Posted January 19, 2021. doi: 10.1101/2021.01.15.426911.

Other resources:
H. Ritchie et al. Coronavirus (COVID-19) Vaccinations. Our World in Data.
J. Holder. Tracking Coronavirus Vaccinations Around the World. The New York Times.
Launch & Scale Faster: Vaccine Procurement.
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SN EDUCATOR GUIDE

March 27, 2021

Vaccine Inequity Will Prolong Pandemic

Activity Guide for Students: A Fair Shot

Directions:
In this activity, you will analyze a graph to determine how it is used to display and communicate information about inequities in vaccine access and distribution. As a class, you will discuss why there are inequities in global COVID-19 vaccination, and you will explain why such inequities endanger global recovery from the coronavirus. You will work in groups to research COVID-19 vaccine access and distribution in your local area, graph that data and identify potential inequities.

The setup
After reading the article *Science News* article "Global inequity in COVID-19 vaccination is more than a moral problem," analyze the graph in the section titled "Unequal distribution." Then use the graph to answer the following questions.

1. What is the title of the graph?

2. What type of graph is used to display the data?

3. How many variables are plotted on the graph and what are they?

4. What is shown on the x-axis, and what units are used?

5. What is shown on the y-axis, and what units are used? Explain how the units are distinguished in the bar graph.

6. What is the source of the data in the graph?

7. What initial questions do you have about the information displayed on the graph?

8. What comparisons are being made in the graph?

9. Summarize the trends between variables that are visible in the graph.

Class discussion
Discuss the answers to the following questions as a class.

1. Why is it important to distribute vaccines worldwide and vaccinate as many people in as many locations as possible?

2. In the article, public health policy expert Gavin Yamey says that "An outbreak anywhere can become an outbreak everywhere." Explain what Yamey meant by this statement.

3. How do new coronavirus strains affect the vaccination strategy developed by public health experts?

4. How could inequitable vaccine distribution imperil global economic recovery from the pandemic?

5. What is the benefit of getting 60 to 90 percent of the total world population vaccinated as quickly as possible? What potential problems could occur if large populations remain without protection from the coronavirus?

Group research
As a group, select a state or region to investigate, such as your state or a group of nearby counties. Use Internet resources to research how the COVID-19 vaccines have been administered in your selected area. In addition to your state's or county's Department of Health, the following list contains resources that have tracked coronavirus vaccine access, distribution, and administration statistics, as well as general population and demographic information about the United States.

U.S. Centers for Disease Control and Prevention. COVID Data Tracker.
U.S. Centers for Disease Control and Prevention. COVID-19 Integrated County View.
U.S. Centers for Disease Control and Prevention. Vaccinations in the US.
Johns Hopkins University. Coronavirus Resource Center
J. Holder. Tracking Coronavirus Vaccinations Around the World. The New York Times.
U.S. Census Bureau. National Demographic Information Quick Facts.

As you analyze the data you discover, look for evidence of inequity in the vaccine distribution and administration in your chosen area. Answer the following questions to guide your research and data analysis.

1. What area have you chosen to investigate?

2. Identify and list at least three resources that provide you with information about COVID-19 vaccinations in your chosen area.

3. What variables do the resources present data about with regard to COVID-19 vaccination? Possible variables include number of vaccines purchased, number of vaccines administered, percentage of population that has received at least one dose, number or percentage of people who are fully vaccinated, vaccination rates by race or ethnicity, vaccination rates by age or occupation, median income or percentage of households in poverty.

4. How are the data presented by each resource? Are the data presented as verbal statements, tables, charts, maps, graphs, infographics, or some other way.

Communicating information through graphs

As a group, construct a graph that displays the data you gathered in the previous section. Answer the following questions to guide the construction of your graph.

1. What relationship or trend do you want to investigate, or what comparison do you want to make visually? Record the variables you will show on your graph.

2. Construct a data set that organizes your data by variable so that it can be plotted on the graph. This can be done electronically by using spreadsheets or database software, or you can construct a table on another sheet of paper.

3. What type of graph will best display the data you have gathered? Explain why you have chosen this type of graph.

4. Set up your graph.

5. Which variable goes on each axis of your graph?

6. What are your axis labels?

7. What units will you use on each axis?

8. Does your graph need a key or legend? If so, what will it contain?

9.What will you title your graph?

10. How will you cite the source(s) for your data?

11. Construct your graph from the data you gathered. Write a short caption that summarizes the data and trends in your graph.

Class discussion

Present your graph to your teacher and to the class. Listen carefully as other groups present their graphs. Then, as a class, discuss the graphs and any trends evident from the graphed data.

1. Were there any common trends in the graphs presented to the class?

2. What does the graph indicate about equitable access to vaccines in your area or in the United States?

3. What might explain the trends you noted in how COVID-19 vaccines have been distributed or administered in your area or in the United States?