

Media Literacy in the Age of COVID and Climate Change

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In March of 2020, the world of education was upended. Teachers and students across the globe abruptly left their classrooms. Once taught in abstraction, science concepts became national headlines, no longer relegated to textbooks. Misinformation began spreading faster than any virus, and for many science teachers, addressing scientific untruths became the primary focus of their profession. Telling students a source is not credible, or reviewing the Nature of Science is only a temporary fix—we must recognize the urgency of providing students the ability to make scientifically informed decisions by addressing data and media literacy.

Battling half-truths and conspiracy theories is not new to science education—as any climate science teacher can confirm—but the pandemic is unique to this generation. For the first time, a global crisis affects every student worldwide simultaneously, and its impacts are immediate. The slurry of misinformation students and communities believe, share, and politicize has prompted a team of seven teachers from six states—Georgia, Indiana, Michigan, Minnesota, Montana, and Texas—to develop a unit addressing media literacy.

It was essential to design the unit so that it could be taught virtually, blended, hybrid, or in-person, and could be applicable both to the pandemic and to other ongoing misinformation crises like climate change. For the sake of simplicity, we

will describe the unit in two parts, Media Literacy and Scientific Literacy. Linda Rost, our facilitator in Baker, Montana, conducted the unit primarily in-person, with some students participating virtually.

Part I: Media literacy

People often lament the loss of validity among media sources with the onset of 24-hour news programming. While that may be the case for previous generations, today's students face a constant deluge of algorithmically curated information systematically validated by clicks and shares. To ensure media relevancy, Rost obtained all media sources for this unit in a digital format.

The unit opens with an abridged version of “The Unraveling of America,” a political commentary by anthropologist Wade Davis featured in *Rolling Stone* (see Online Connections). Students reflect on ways the pandemic has affected them personally, and then expand their scope and describe the impact of epidemic on society at large. To scaffold student responses, Rost provided a table (see Table 1). Students submit responses anonymously in a Google Doc, allowing them to share their thoughts free from judgment while providing Rost with an awareness of misconceptions they may possess. Anonymous sharing is a useful way for teachers and students

TABLE 1

COVID-19 and climate change.

Reflections on “The Unraveling of America”

How has the pandemic affected you personally/as a society?

How have the changes due to the pandemic affected you/society?

Changes	You personally	Society
The virus		
Economy		
Culture		
Politics		
Personal interactions		

Reflections on “2020: A Critical Year for our Future and the Climate”

How has climate change affected you personally?

How has climate change affected society?

Changes	You personally	Society
Health Risks		
Food/Agriculture		
Water Resources		
Droughts/Storms		
Environment		

to communicate about topics that could be politically charged or uncomfortable to discuss in an open forum.

Rost found that many of the 10th-grade students had difficulty understanding the nature of COVID-19 and the extreme measures needed to reduce the spread of infection. However, most 11th- and 12th-grade students appeared to have a deeper understanding of the disease characteristics and expressed concern that too few measures had been enacted and enforced. Both groups struggled to understand how COVID may have affected society, but were able to explore those concepts more deeply after additional facilitation from Rost.

Correlation vs. causation

After the initial class discussion and anonymous responses, Rost recognized that many misconceptions students held were due to misinterpreted and biased data obtained from various media sources. This realization prompted her to provide a lesson focused explicitly on determining the difference between *correlation* and *causation*. Beyond merely defining the terms, Rost discussed lurking variables that, while unseen and unmeasured, could be the reason for the relationship between the measured variables. For example, an outside observer may see a group of people standing in the rain holding umbrellas and conclude that holding an umbrella will make it rain. However, we know the lurking variable in this scenario is atmospheric conditions.

The umbrella scenario is easy for students to understand, and it prepared them to understand complex relationships in the case of COVID-19. For example, according to one study, states with restaurant closures had a reduction in COVID-19 cases. From that information, one could conclude restaurants were causing outbreaks when, in fact, it was the act of people congregating indoors that increased the spread of the virus. Rost then provided

TABLE 2

Correlations do NOT imply causation. Words to watch for.

Correlation Words	Causation Words
Get	Cause
Have	Increase/Decrease
Linked	Benefits
Tied	Impacts
Connected	Enhances
Tend	Effect
Related	Affect
	Improves
	Boosts

students with a list of words shown in Table 2 to identify whether the author is describing a correlative or a causal relationship. Students practiced identifying the terms in headlines of articles and classified them as correlation or causation.

Evaluating Scientific Studies Packaged for Public Consumption

Most people consume media from sources that describe scientific studies, but they rarely access the primary source itself. Studies published in reputable journals include pertinent information to address the validity of findings, while also recognizing a study's limitations. On the other hand, media sources tend to gloss over research details and present more conclusive

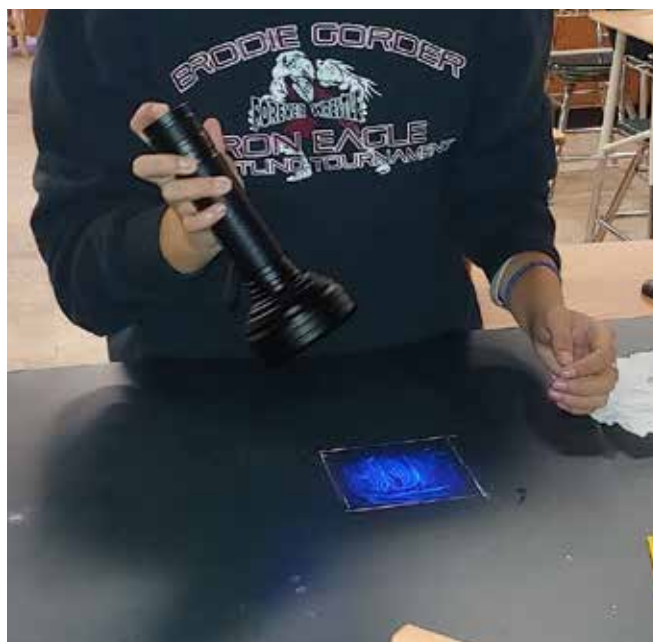
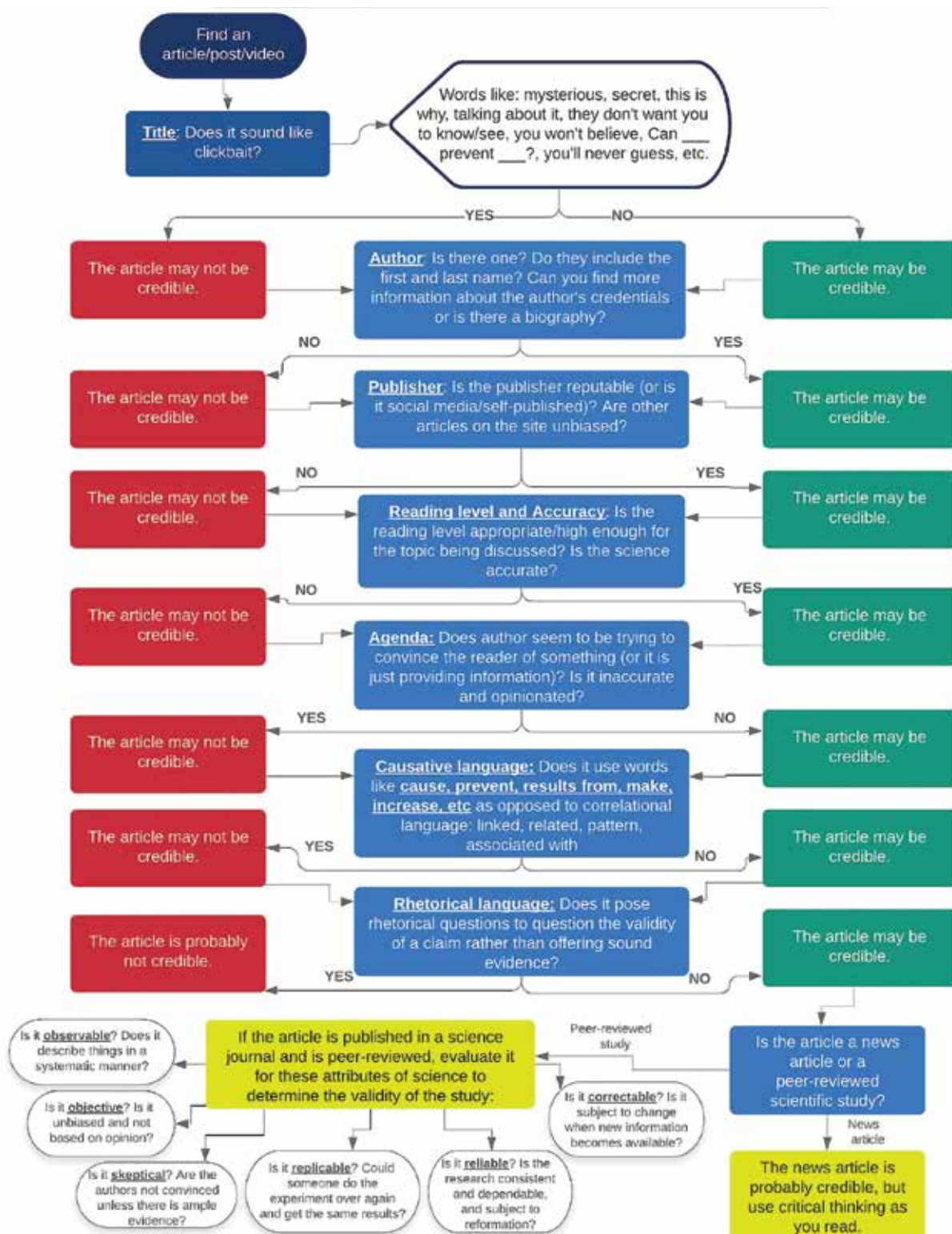
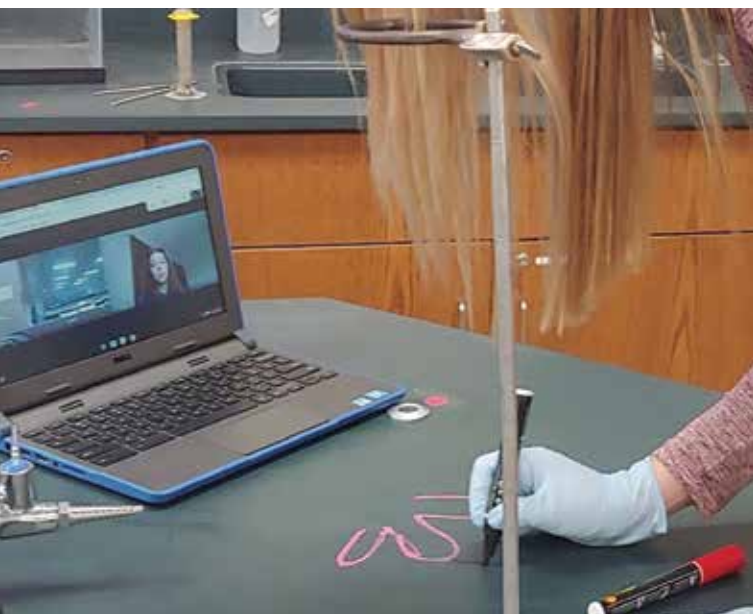


FIGURE 1

Article validity flowchart.





through the chart to address a series of yes or no questions, ranging from identifying clickbait terminology to recognizing biased and rhetorical language. The top portion of the flowchart is designed for assessing media sources written for a general audience. The lower part provides a specific set of questions relating to the experimental design and validity of a scientific study. Novice students are encouraged to begin their evaluative process at the top of the flowchart, regardless of the type of media they are assessing.

Rost then provides students with sets of media articles paired with a corresponding scientific study. The articles cover many scientific concerns related to COVID-19, including air circulation in classrooms, transmission in children, viral shedding and mask-wearing, and children as COVID-19 spreaders (Table 3; see Online Connections). For learners requiring additional support, Rost provides abbreviated versions of the research articles and one-on-one assistance as students encounter difficult or unfamiliar terminology.

Students use the Article Validity Flowchart and Table 4 provided in Google Slides to scaffold their evaluative responses. Students discovered that media articles make claims unsupported by evidence and use unwarranted causation language. The peer-reviewed studies are longer and contain more complex vocabulary, but do not make unsubstantiated claims without evidence obtained from the research or citations from

assumptions than intended by the researchers. High school students may find it challenging to recognize these differences.

To combat the confusion, Rost developed the Article Validity Flowchart shown in Figure 1. It provides a structured analytical approach to evaluating media. Students navigate

TABLE 4

COVID 19 and climate change article review.

Choose from the list of COVID articles with media version and scientific study version, then discuss how the main points are similar and different.

Parts	Media Article	Scientific Study
Takeaways		
Claims		
Evidence		
Causation or biased language		

Choose from the list of climate change articles with media version and scientific study version, then discuss how the main points are similar and different.

Parts	Media Article	Scientific Study
Do scientists agree?		
Is it real?		
It is us?		
Is it bad?		
Is there hope?		
Causation or biased language		

previous studies. The studies occasionally use causation language, but only when explaining a controlled experiment performed by the researchers.

Midunit assessment

At the midpoint of the unit, students have the opportunity to show off their new investigative skills by assuming the role of media journalists. Students select a COVID-19-centric study from an academic journal and reframe the content so that it remains valid and also intelligible by members of the general public. Students produce news articles following the guidelines specified in Rubric 1 (see Online Connections). This mini project serves as a formative assessment, allowing Rost to address any misconceptions students may have before progressing to more in-depth applications of scientific literacy.

Part II: Scientific literacy in experimental design and research studies

The first half of the unit centered around media sources produced for the consumption of casual readers. The second half pivots to address the efficacy of experimental design described in research studies, and culminates in creating an open-ended, student-led research project. To ensure all students have a basic understand-

ing of experimental design, Rost facilitates a class discussion of a simple experiment shown in Figure 2. Students, working in small groups, produce a simple experimental design using a template (Figures 3A and 3B) and share their plans via Google Slides. Through peer collaboration, students gain practice in evaluating experimental designs and have the opportunity to gain insights from their peers to improve their experiments.

COVID-19 research and data interpretation

Using the investigative skills acquired in Part I of the unit, students explore publications concerning COVID-19 to produce an

FIGURE 2

Experimental design.

Hypothesis: The prediction. There is a difference between the control group and the treatment group.		Null Hypothesis: There is no difference between the control group and the treatment group.
Independent Variable: Variable you change Treatment Cause X Axis	Dependent Variable: Changes with independent variable Variable we measure Outcome Effect Y Axis	Control Group: Group without treatment Original Baseline Constants: All the other variables that we keep the same!

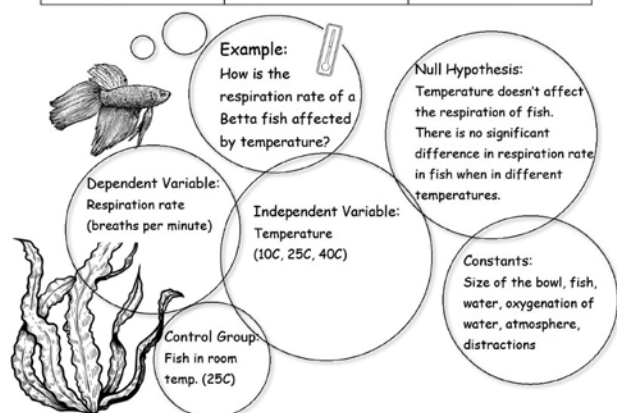


FIGURE 3

Student design template and example.

Figure 3A. Experimental Design Template

Design a sample experiment with masks or some other COVID topic.

Purpose: Hypotheses Null: Alternative: Independent Variable: Dependent Variable: Control:

Figure 3B. Student Created Example (COVID-19)

COVID-19 Experimental Design

- Purpose: Does alcohol-based hand sanitizer protect you from new bacteria after it is applied?
- Hypotheses Null: Alcohol based hand sanitizer does not protect you from new bacteria after application.
- Alternative: Alcohol-based hand sanitizer does protect you from new bacteria after application
- Independent Variable: After sanitizer
- Dependent Variable: The amount of bacteria after hand sanitizer
- Control: Before hand sanitizer

Climate Change Experimental Design

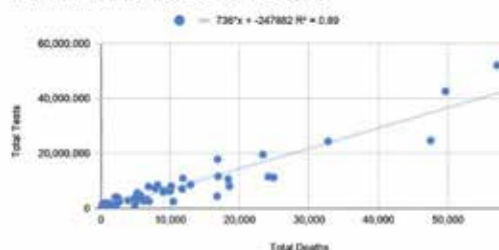
- Purpose: How does an increase in temperature affect the rate at which ice melts?
- Hypotheses Null: Ice will melt at the same rate for temperatures of 26°C and a temperature of 28°C.
- Alternative: Ice will melt at a faster rate when it is exposed to a temperature of 28°C compared to when it is exposed to a temp of 26°C.
- Independent Variable: Air temperature of 28°C.
- Dependent Variable: The rate that the ice melts.
- Control: The rate that ice melts at 26°C

FIGURE 4

COVID-19 data project.

Ask a question: What is the correlation between the amount of tests taken in a state compared to the amount of deaths?

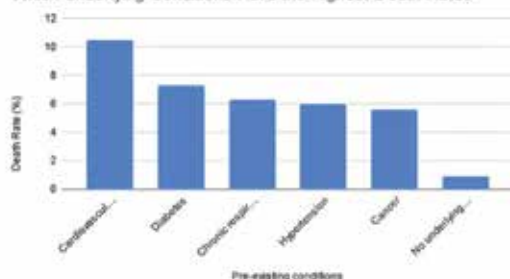
The Correlation Between the Total Amount of COVID-19 Cases to the Total Amount of COVID-19 Deaths



I chose to look at what the correlation between the amount of tests taken in a state compared to the amount of deaths. There is a strong positive correlation between deaths and tests. The graph also shows that California is leading in number of tests and deaths.

Ask a question: What is the death rate of people with underlying health conditions due to Covid.

Which Underlying Conditions Have the Highest Death Rates



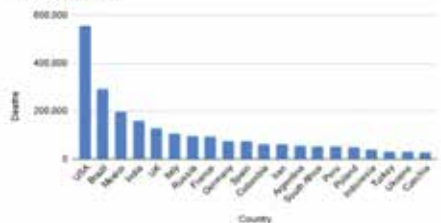
Underlying health conditions play a part in how covid affects you. More serious diseases can affect you worse than others. Heart diseases such as Cardiovascular Disease and Hypertension have higher death rates than no underlying health conditions. Respiratory disease also have a more higher death rate than others such as cancer and no other health conditions. Overall the worse heart and lung conditions they were most affected by Covid-19.

FIGURE 5

COVID-19 data project.

Ask a question: How many deaths have there been in different countries?

Total Number of COVID Deaths in Different Countries as of March 21, 2021



The United States has the highest number of deaths at 554,989 deaths. Brazil has the second highest at 292,856 deaths. Mexico is third with 197,827 deaths, followed by the India with 160,003 and India with 126,155. Italy has 104,942 deaths. Russia, France, Germany, Spain, Colombia, Iran, Argentina, South Africa, and Peru all have between 50,000 and 100,000 deaths. Poland, Indonesia, Turkey, Ukraine, and Czechia all have between 24,000 and 49,000 deaths.

informative slide. Some groups were provided with structured questions linked with an associated article, while others were encouraged to identify problems and address them in an open-ended format. Students enter their information into a template to better standardize the content and increase accessibility for all students. Upon completion, all groups present their findings to the class. Examples of student slides are shown in Figure 4.

While many scientific studies of COVID-19 mention the use of clinical trials or laboratory experiments, some refer to public health data, a publically-available raw data source. Public health databases provide a unique opportunity for high school students to analyze and manipulate real and relevant data, look for patterns, and form hypotheses. We provided links for two COVID-19 data sources (The COVID Tracking Project and Worldometers) and Rost created a screencast video to ensure



FIGURE 6

Student posters.

Testing the Effectiveness of Masks on Stopping Bacteria from Passing Through

Purpose
To see how effective different masks are at stopping particles.

Null hypothesis: There will be no difference between masks.
Alternative hypothesis: Cloth and disposable masks will be similar in how effective they are. KN95 should be the most effective and gaiters should be the least effective.

Methods

1. Get *Mycobacterium smegmatis* and petri dishes to find out how much bacteria comes through the mask.
2. Spray *Mycobacterium smegmatis* directly onto petri dish with squirt bottle for control.
3. Spray *Mycobacterium smegmatis* onto mask.
4. Repeat steps 2 and 3 for each mask.
5. Incubate dishes to see the amount of bacteria that grew.
6. Repeat steps 2-5 with a spray bottle rather than a squirt bottle to replicate human output of germs.

Pictures of Results
The picture on the left is the bacteria that grew from the bacteria that was sprayed onto the mask. The second picture is the bacteria that grew from a spray bottle spraying the bacteria on the mask. The second picture more accurately represents a human wearing the mask.

Data and Results

Test One: Squirt Bottle

- The gaiter had a less bacterial growth than the control, but not by much.
- The disposable, cloth, and KN95 had no bacterial growth.

Test Two: Spray Bottle

- The gaiter was somewhat better than the control, but a lot of bacteria still came through.
- Overall, the gaiter was better than no mask at all, but was the least effective of all the masks that we tested.
- Disposable, cloth, and KN95 masks are the best choices for a mask.

Conclusion

- Our results from the experiment supported the alternative hypothesis.
- The gaiter was the least effective, having a large amount of bacteria coming through the mask.
- The cloth, disposable, and KN95 were all effective and stopped any bacteria from coming through the masks.

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Effectiveness of Killing Germs in Different Hand Sanitizers

Purpose
The purpose of this experiment is to see which type of hand sanitizer is the most effective in killing germs.

Hypothesis
Null hypothesis: There is no difference between the effectiveness of the hand sanitizers.
Alternative hypothesis: There is a difference between the effectiveness of the hand sanitizers.

Methods

1. Rubbed in 0.5 g glo-germ on hands and photographed with UV light.
2. Placed 1 g hand sanitizer on germ filled hands and photographed.
3. We repeated steps 3-5 for 3 different hand sanitizers.

Pictures of Procedures

Data and Results

- We failed to reject our null hypothesis and showed that there is no difference in hand sanitizers.
- The data showed that all hand sanitizers are equally effective in spreading glo-germ around.
- The hand sanitizer spread the glo-germ around rather than "killing it".
- Glo-germ is an ineffective way to determine how well hand sanitizers work against germs.

Conclusion
We failed to reject our null due to the hand sanitizers not working effectively against the glo-germ. The pictures show the amount of area covered by the glo-germ stayed the same after the sanitizers were applied. We concluded that using glo-germ and hand sanitizer is an inadequate way to see how well hand sanitizers work. In the future we would find a different substance to play the role of the germ to get more accurate results.

Arika Pionger and Emily Shumaker

students were competent in accessing, filtering, and graphing data. The video allows students to watch at their own pace, re-watch, and return to it if they have questions.

Students explore the data sets and generate questions. Some chose to investigate county-level data, while others focused on state and national data. Advanced students investigated correlations between variables and considered possible relationships. In addition to a class presentation, students share their findings on Google Slides in a standardized template, which allows them to be accessible to every class member. Examples of student slides are shown in Figure 5.

Open-ended COVID-19 research project

As a culminating project and summative assessment for the unit, students engage in open inquiry with the freedom to choose to conduct an experiment or a research project about

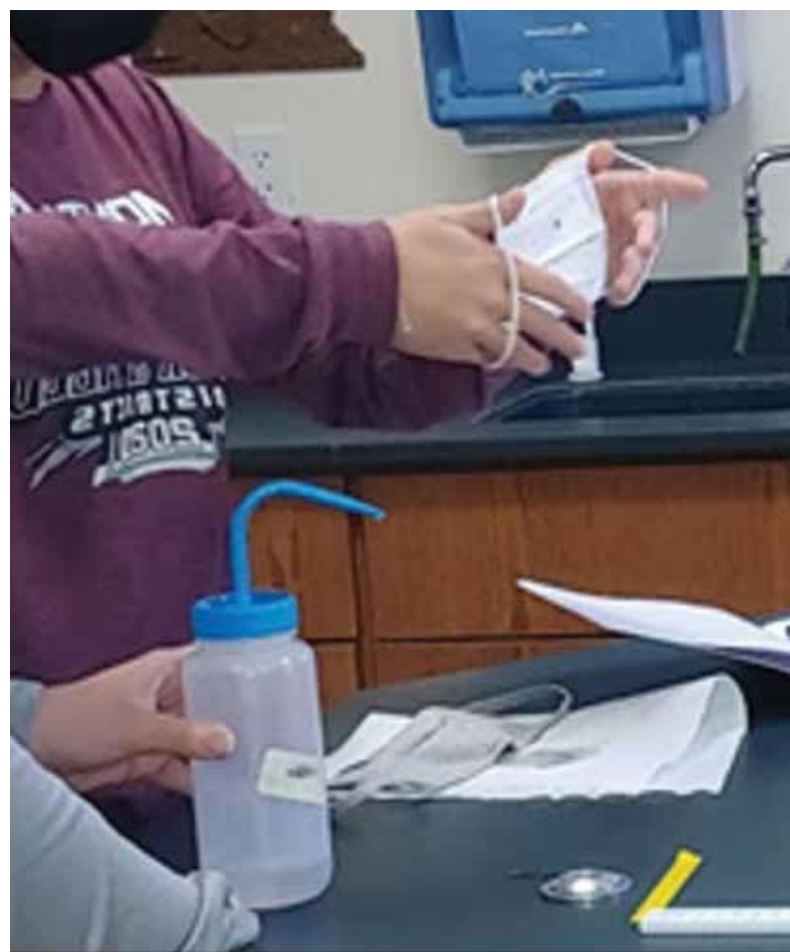
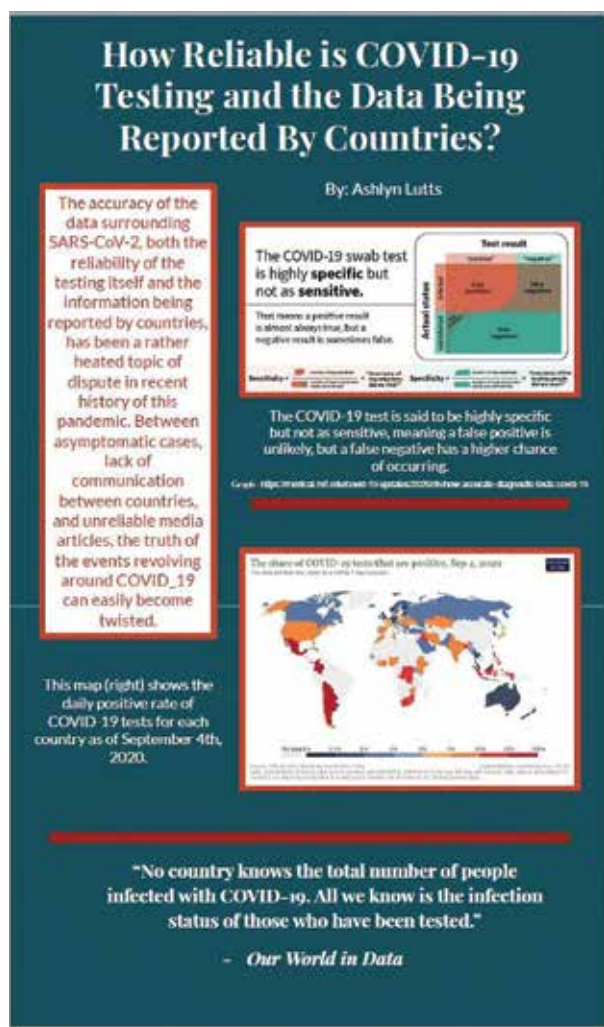


FIGURE 7

Sample argumentation discussion.



COVID-19. Students who choose the experimental design are expected to develop a purpose, null and alternative hypotheses, independent and dependent variables, the controls, and the constants. They then describe their procedures, provide graphs, and report their results. Most students choose to design an experiment to determine the efficacy of currently recommended preventative measures.

While students are free to develop their own experimental designs, they are required to adhere to lab safety standards, which include wearing both protective eye covering and, in some cases, latex gloves. Students share their experimental design and subsequent results by creating a poster that includes all aspects of the project. Student posters are shown in Figure 6. Rubric 2 (see Online Connections) helps scaffold student work and equitably assess the poster.

Students who choose the research option are expected to base their research on multiple sources. Like the experimental design group, students have to identify a question. However, instead of experimenting, the research students use data from at least three media and two peer-reviewed journal articles to form a scientifically accurate conclusion. Students who select this form of research tend to be interested in larger-scale aspects of the pandemic, like the impacts

of different responses on the spread within countries, and the rate of infectivity across various age groups. A sample student poster is shown in Figure 7, along with the corresponding Rubric 3 (see Online Connections).

Conclusion and impact

When Rost began this unit on the second day of school, she shared that students, like frontline workers, have an essential role during the pandemic. In her class, they would develop the knowledge to help their families and their community navigate this pandemic more safely. She explained that if they choose to engage in safe practices, not only will they prevent the spread of disease and save countless lives, but their actions will help keep the school open.

As science teachers, we often gauge our success by the number of our students who pursue careers in science, but the pandemic has taught us that scientists alone cannot combat the threats to modern society. Whether facing a pandemic or climate change, our success lies in the collective actions of a scientifically literate citizenry. Without explicitly teaching media and scientific literacy in our classes, we allow our students to fall prey to the loudest, most convincing voices in the room—who may not be the most scientifically informed. ■

Online Connections

Table 3: <https://bit.ly/3vQUG5J>

Rubric 1: <https://bit.ly/3fLMbDm>

Rubric 2: <https://bit.ly/3f08j08>

Rubric 3: <https://bit.ly/3pq5CUA>

COVID-19 Connections

260 sick at camp: CDC says children susceptible to COVID-19. https://www.ksn.com/news/health/coronavirus/260-sick-at-camp-cdc-says-children-susceptible-to-covid-19/?fbclid=IwAR2CN6vjmxex0l1R_Z8Bq6FVauXMzjDMKm7YGnNgfptZzox2DwZuZ-KhE

COVID-19 study: School ventilation systems could play role in stopping coronavirus spread (ABC7 Chicago). <https://abc7chicago.com/ventilation-covid-spread-covid-19-study/6342910/>

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Climate Change Connections

2020: A critical year for our future and for the climate. <https://www.worldwildlife.org/stories/2020-a-critical-year-for-our-future-and-for-the-climate>

Climate Change: Vital Signs of the Planet. <https://climate.nasa.gov/causes/>

Climate change: Fake news or global threat? This is the science. https://www.telegraph.co.uk/environment/2019/10/15/climate-change-fake-news-global-threat-science/?WT.mc_id=tmg_share_tw

Climate Feedback—A Scientific Reference to Reliable Information on Climate Change. <https://climatefeedback.org/>

Global Weirding with Katharine Hayhoe. <https://www.youtube.com/channel/UCi6RkdaEggRVKi3AzidF4ow>

NASA Climate Kids. <https://climatekids.nasa.gov/>

Hurricane Florence isn't the result of climate change, global warming. <https://www.usatoday.com/story/opinion/2018/09/14/hurricane-florence-climate-change-global-warming-weather-greenhouse-flood-column/1289272002/>

Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/>

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The Sea Is Rising, but Not Because of Climate Change. <https://www.wsj.com/articles/the-sea-is-rising-but-not-because-of-climate-change-1526423254>

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