

Using COVID-19 to Reboot Biology Education

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The novel coronavirus pandemic forced American educators to change the **way** we teach. Now, it's time for us to rethink **what** we teach. The old phrase, "never let a good crisis go to waste" applies because COVID-19 has created incredible problems but also unexpected opportunities for us to seize the moment and change the focus of biology instruction. We should all ask why so many Americans choose to ignore or reject scientific information in favor of unsourced, speculative, and generally nonsensical disinformation that appears online. Our response must be to help students develop correct explanations regarding the natural world, or they will likely accept the commonly offered pseudoscientific explanations from non-experts. As Carl Sagan noted in *The Demon-Haunted World*, "science can be a candle in the dark." The unscientific responses to the coronavirus make clear how important the use of valid evidence and the expertise of scientists and health professionals are to fight scientific illiteracy. While multiple factors beyond the control of science teachers contribute to current problems, we must do what WE can to emphasize the importance of science to the general public because failure to do so enables ignorance.

So, as biology teachers, how do we use a pandemic in a positive way? I suggest we make two major changes in what we teach: 1) use evolution as a theme in our courses, and 2) help students become scientifically prepared citizens. Evolution, and climate change, is often missing from educational standards and classroom instruction because some view it as a "controversial" topic and have concern about repercussions if taught. The pandemic crisis provides us with "cover" to elevate evolution to its rightful place in biology education because this viral spread is the result of evolution in action! Viruses mutate and evolve (this explains why we need a new flu shot every year), and pathogens evolve from benign organisms through the same natural, ongoing processes that can affect the form and function of all living things. Also, published reports show

that climate change drives the evolution of emerging diseases as well as their release from nature because of human-caused deterioration of ecosystems. Thus, the coupling of climate change, genetic variation, natural selection, and evolution means that people will face other novel diseases affecting plants and animals (including humans) throughout their lives. Basic biological research targeting one organism leads to understanding of related organisms and the possible treatment of those that cause disease. Thus, a focus on emerging diseases is an easy and relevant way to interject evolution in instruction. However, we should infuse evolution into every major concept we teach and use it to help organize content for students, as recommended by every national science education reform effort. This may help us reach students before they shut out scientific knowledge about evolution and will reinforce the universal nature of evolution and its critical role in explaining the diversity of life on earth.

The current crisis reminds us that our job as biology educators is to prepare citizens who are ready to face challenges in a world greatly influenced by science, health, and environmental issues. Again, Sagan's words are relevant: "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology." We must encourage students to ask, "How do you know that?" and "What is the evidence?" when someone makes a claim related to biological issues. Students must also question the source of the information; is it potentially biased, cherry-picked, or at odds with what is already known or with common sense? Students must come to recognize a flawed experiment and understand the difference between evidence from controlled investigations versus mere anecdotal evidence. We should help students develop a "BS detector" to identify false statements and "inoculate" them against strategies used to confuse the public. Students must also know how to interpret data presented in support of a claim, which requires incorporating more quantitative skill practice in our courses. Certainly, research on the coronavirus pandemic generates enormous amounts of data and many different experimental designs for students to investigate. We must avoid spending precious class time teaching a myriad of unconnected facts that students can find for themselves or that they will rarely use. Rather, use your time to correct misconceptions and help students

apply and synthesize information. Sure, you should teach the essential content of major concepts and principles but limit the details and vocabulary that will be quickly forgotten and hinder understanding. If we do these things, we are much more likely to help students become scientifically prepared citizens--including those who will become journalists, politicians, and lawyers--armed with scientific thinking skills, with respect for the role of valid evidence in decision-making.

The current virus crisis has created a unique opportunity for everyone to embrace teaching evolution, climate change, and related topics that should be included in a straightforward and integrated manner. We must encourage our colleagues who may be reluctant to teach such essential concepts and help them apply evidence-based teaching resources. We should develop young advocates of science and social media influencers for biology so they can talk to their families, text their followers, and become voices against ignorance. Let's hope that many of the most effective advocates for science will themselves become teachers. It is time to elevate science to its rightful and essential place in American life, discourse, and decision making. We can do that in part by teaching the **science** of biology.