Character and . . .

Crisis

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Annalee R. Ward — *Character and Crisis*

Articles

Josh Thomas — *Healing a Fractured World*

Ken Turner — *Science and Integrity: A Pandemic Lens*

Michelle A. Grace — *Character and Crisis: Toxic Workplaces and Culture Change*

Molly Hein — *Social Influencers: FOMO and Identity Crisis*

Response

Mark A. E. Williams — *Surviving a Crisis by Not Being an Idiot*

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The faculty essays presented here emerge from a semester-long process of reading and writing together in an environment of critique and review. Nevertheless, this invited journal of essays represents the authors' views and not necessarily the views of the Wendt Center for Character Education or the University of Dubuque.

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Science and Integrity: A Pandemic Lens

Ken Turner

Abstract

The COVID-19 Pandemic is a crisis that provides a lens into the integration of science and integrity. Several important questions that arose during the pandemic are utilized to follow the release of science-based answers to those questions. Examination of those questions, their answers, and their timing help to provide the answer to the question, "Was there integrity?" In the end, science practiced with integrity can illuminate a pathway through the crisis.

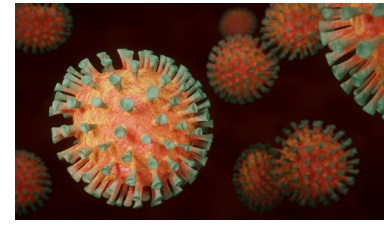
Frank has just told his wife that he is being required to get another booster of the vaccine to keep his job. He's not happy about it. He speaks his mind about the overreach of the company. "It's all a plot to plant nanobots in my blood. I have rights over my own body, and no one should be required to choose between a paycheck and civil liberties. The scientists come on TV wearing their stupid facemasks and tell everyone what they should do, when they should do it, and how much safer we will all be. These scientists change their mind every other week. First the pandemic is over, then a new variant is surging. First masks are unnecessary, then masks are required and the economy tanks. I bet the scientists had money in mask stock!"

COVID-19 vaccine

Across town, Kim has just told her husband that masks will not be required at work, and "there is no way of knowing if the people in my office or building are up to date on their vaccines. It's that governor! He just decides he knows more than the scientists and makes it illegal to have a mask mandate or a vaccine requirement. The governor

says he is sure the people in the state will make the right choice—that he thinks masks are no longer required when the vaccine and the latest booster has been available. He just wants to make points with the conservative citizens by upholding civil rights. If that's the governor's real motivation, I'd like to ask him how his civil rights argument stacks up against public health. You know how the cases of COVID-19 are headed in the wrong direction again. Has he read how few ICU beds are open in our state? I wonder what corporations have paid to get this governor elected!"

Integrity, science, crisis: these words carry different meanings to different people when applied to the COVID-19 pandemic. I write this near the end of 2021. Almost 5 million people have died worldwide ("WHO Coronavirus (COVID-19) Dashboard"). I offer a treatise at this point in the pandemic crisis with knowledge that science and integrity are assets always worthy of study.



COVID-19 virus

My perspective is that of a scientist/educator. I have taught science classes for more than 40 years, from middle school through college. For the past nine years, I have taught at University of Dubuque, mainly in the Chemistry department. I am not an epidemiologist or a human disease specialist. I am a citizen with an advanced degree in Educational Leadership who researches and strives for best practices in science education (Turner et al., "ILED"; Turner and Hoffman; Turner et al., "Engineering Design"). I am an educator and I continue to learn. I hope we can learn from our experiences with COVID-19. Science practiced with integrity on the part of scientists and scientific institutions can illuminate a pathway through the crisis of COVID. To unpack this perspective, I'll look at what constitutes a crisis, how science works, and illustrate it in the chronology of a few pieces of the COVID-19 pandemic.

The COVID Crisis

In early 2020, many adults did their jobs at home or lost their jobs (or their businesses), parents were told to become teachers, children were expected to be much more independent learners, and families often became isolated from friends and other family members. According to Beth McCaw, a professor of ministry at the University of Dubuque, a personal crisis develops when the experience of real or perceived demands (stressors) exceeds the real or perceived capacities (resources) to cope with those stressors

(McCaw; Stone; "Stress in America 2020"). A crisis confronts us singly (or across an entire world's population) and demands that an action be taken. While not everyone suffered the same consequences as the year unfolded, many people had the perception of a great increase in their stressors—with little or no increase in their resources. Individually, most people were experiencing a crisis. These many individual crises were bringing about a crisis at the institutional, statewide, and governmental levels.

As the new disease was transmitted across the world (almost 250 million cases as of October 31, 2021, according to the World Health Organization, or WHO) ("WHO Coronavirus (COVID-19) Dashboard"), many hospitals became so overburdened that they were curtailing elective procedures and turning hallways and parking lots into areas to treat COVID-19. Certainly, most healthcare facilities were experiencing a gap between the needs of the patients and the resources the facility had for their treatment. Those facilities were experiencing a crisis. Cities and states were similarly impacted by the rising tide of needs of their citizens and the lack of resources to address those needs. Individually, institutionally, and governmentally, we were experiencing a crisis.

People looked for answers from science, but as astrophysicist Carl Sagan wrote, "We live in a society absolutely dependent on science and technology and yet have cleverly arranged things so that almost no one understands science and technology. That's a clear prescription for disaster" (Sagan and Kalosh). If we are to understand any perspective from science on the crisis, it is important to know how science works.

How Science Works

Scientists uncover information about the world around us through observation. In those observations they may measure with analytical tools, attempting to peer at a black hole light years away or determine the pull of a single Fluorine atom on an electron of Carbon. Sophisticated instruments have been developed so that scientists can measure these things, but in the end, it is still an observation. These observations are recorded, then analyzed, then evaluated and eventually published.

Scientific observation

Did I say published? In practice, getting published is not guaranteed. First, scientists must submit their findings to a publication where the manuscript will undergo peer-review. The peer-review process is the cornerstone of quality science publications, according to Dana Barr, editor of the *Journal of Exposure Science and Environmental Epidemiology*. Typically, three anonymous reviewers with expertise related to the topic of the paper will read and suggest revisions to the paper if needed. Or they could determine that the paper does not demonstrate the rigorous testing and validity required for publication, in which case they recommend that the manuscript be declined for publication. If published, additional interested scientists around the world can attempt to replicate the original findings and push the boundaries of the research a little farther, using their unique gifts of intuition and creativity. The new findings, if worthy, will also be published through the peer-review process.

The peer-review process is an important gateway for truth-telling.

The peer-review process is an important gateway for truth-telling. It represents a way for the scientific community to agree or disagree without attempting to shout the other side down (Thomas). The integrity of a scientist, as well as whatever institution they represent, is on the line in the peer-review process. Anyone can make a claim on TV (within the limits established by the FCC and the FDA). But a scientist must prove their claims with data and before their peers. Thus, the peer-review process is a key standard to preserve the integrity of whatever is published.

Scientists in industry, government, and academia construct experiments to try to learn a little more about the world around us by taking small and time-consuming steps. A single experiment proves almost nothing. It is the repetition of many, many experiments, summarized by overarching trends, that eventually "prove" a particular item. But even then, the door is always open to some new experiment that demonstrates the contrary. Dalton's Atomic Theory was built on the shoulders of many researchers and their conclusions.[1] Part of that theory held that atoms were indivisible. For almost 100 years, scientists thought that atoms were the smallest particle of matter. But in 1897, J. J. Thompson published the results of his work with evacuated tubes and electrical discharges and showed there were particles smaller than the atom and a part of every atom—electrons! Dalton's Atomic Theory was amended to incorporate this new information, and scientists improved our understanding of matter based on these experiments.

Science is like cutting a trail through a tangle of unknowns. Imagine this kind of time-consuming, incremental process being used to find the answers to a novel virus beginning to spread across the world. In early 2020 we wanted scientific answers to the virus in the immediate moment of the unfolding pandemic crisis, but science does not work that way.

Scientific integrity means telling the truth with transparency when reporting scientific phenomena or research (Barr). Philosopher Cheshire Calhoun indicates that attributes of integrity include having proper regard for one's role in a community process and having proper respect for the judgment of others. In this case, a scientist must have proper regard for truth-telling while reporting their work and respect for the judgment of other scientists.

The integrity of any individual scientist can affect the public perception of all scientists; it can affect the public perception of science itself. And the integrity of any scientific institution has an even more important effect on society's perception. For these reasons, Ralph Cicerone, then the president of the National Academy of Sciences, stated that ". . . the perceived misbehavior of even a few scientists can diminish the credibility of science as a whole." Scientists and the scientific community need to protect scientific integrity with zeal.

Barr states, "Scientific Integrity means fully disclosing all potential areas of bias, curtailing blatant scientific misconduct, and . . . to ensure quality science is published in our journals" (17). Her argument is that without full disclosure and transparency, we cannot ensure scientific integrity within the article.

Scientific integrity means telling the truth with transparency when reporting scientific phenomena or research.

According to the Committee on Science, Engineering, Public Policy of the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine, research data, methods, and other information integral to publicly reported results should be publicly available (Cicerone). This has become a standard for all peer-reviewed journals. Without the public availability of results, the integrity of the article can be questioned. Indeed, public health physician Natasha Bagdasarian and colleagues made the case in 2020 that rapid publication of COVID-19 studies and opinions through preprints runs the risk of allowing improperly vetted articles to influence public health policy decisions.[2] It is

important to ensure that the scientific community maintain the public's trust in it.

If a scientific institution does not maintain its transparency and trust with the public and with its own employees, its integrity is compromised and a toxic culture may threaten the institution from within. Lack of trust, respect, and transparency will result in this toxic culture (Grace).

When a scientist or group of scientists are people of moral character who publish the results of their research with integrity, that science can help us find a pathway from pre-pandemic to post-pandemic. Science with integrity can help us to move from a time when the disease was affecting nearly every aspect of our lives to a "new normal".

The Role of Science with Integrity in the COVID Crisis

As the pandemic crisis unfolded across the world, people (and governments) looked to scientists for answers and a path to the "new normal". However, science builds knowledge a piece at a time, slowly. There are rarely absolutes, and the answers require study and more study and comprehensive analysis to make sense of data. To understand how science works in the time of the pandemic, let's consider a few of the important questions we were asking about the disease, and the timeline of information released. I have used some information released by the World Health Organization (WHO); it is made up of more than 8,000 public health experts, doctors, epidemiologists, scientists, and managers. WHO had personnel doing research, summarizing research, and reporting research as the pandemic unfolded across the globe.

1. Is there human-to-human transmission?

On January 14, 2020, a WHO press briefing stated that, based on experience with respiratory pathogens, the potential for human-to-human transmission existed. "It is certainly *possible* that there is limited human-to-human transmission" (italics added). But on the same day WHO also tweeted that "*preliminary evidence* by Chinese authorities had found 'no clear evidence of human-to-human transmission'" (italics added). Then, by January 30, WHO advised the Director-General that "four countries had evidence (8 cases) of human-to-human transmission" ("Listings").

As pertains to human-to-human transmission, barely more than 14 days after becoming aware of a cluster of "pneumonia of unknown cause" in

Wuhan, WHO scientists stated that human-to-human transmission *was possible*, but quoted Chinese sources who found no clear *preliminary evidence* of that occurring (italics added). However, by January 30, 2020, WHO stated that there had already been eight cases in four countries that demonstrated person-to-person transmission. We (the public) want to have our questions answered immediately with no uncertainties. But early in the pre-pandemic, some of those answers were not yet known—or at least not before the end of January ("Listings").

Transparency is an important part of truth-telling.

Was There Integrity? It may be confusing as to why a group of scientists can state at one time that person-to-person transmission is unlikely, and later insist that eight cases were known to have occurred. But that is what happens as more information is obtained. WHO did present the information, with appropriate caveats (see italicized words in statements above), and the source for their statements. As more information was obtained, WHO made changes to their messaging. That transparency is an important part of truth-telling.

2. Can the disease be spread by asymptomatic people?

On February 4, 2020, during the meeting of the WHO executive board, in responding to a question, the WHO Secretariat said, "It is possible that there may be individuals who are asymptomatic that shed virus, but *we need more detailed studies around this* to determine how often that is happening and if this is leading to secondary transmission" ("Listings") (italics added). It seems the question persisted, because on June 10, CNBC reported that Dr. Maria Van Kerkhove, head of WHO's emerging disease and zoonosis unit said "From the data we have, it still *seems* to be rare that an asymptomatic person actually transmits onward to secondary individuals" ("Listings") (italics added). The use of "seems" attests to the lack of a definitive study on the subject. But a scientific study published through JAMA Network Open a few months later on January 7, 2021, found that the proportion of transmission from individuals who did not have COVID-19 symptoms was estimated at greater than half of all transmission (Johansson).

Was There Integrity? Again, it may be confusing that scientists would say that asymptomatic transmission *seems* to be rare, only to conclude in later months that asymptomatic or pre-symptomatic transmission may be responsible for more than half the cases. But again, the spokesperson had responded based on the current information, with the added caveat that it

"seems" to be rare. As more information about transmission became known, the scientists changed their messaging. It was prudent, important, and showed integrity to change the message based on the most recent studies.

3. Should asymptomatic people wear masks?

A publication released by WHO in January 2020 stated that, for individuals without respiratory symptoms, a medical mask is not required *as no evidence is available* on its usefulness to protect non-sick persons ("Listings") (italics added). However, masks might be worn in some countries according to local cultural habits. But by December 2020 WHO guidance was that "Masks should be used as part of a comprehensive strategy of measures to suppress transmission and save lives. Make wearing a mask a normal part of being around other people" ("Coronavirus Disease").

The first directive notes that no evidence was available at the time. However, studies of the effectiveness of wearing masks became more common in the months that followed. By April, 2020, a preprint summary of studies claimed that "Public mask wearing is most effective at stopping spread of the virus when compliance is high. The decreased transmissibility could substantially reduce the death toll and the economic impact while the cost of the intervention is low" (Howard). This summary had not yet undergone peer-review, but it hinted that evidence was accumulating, referencing peer-reviewed studies already being published.

Mask-wearing

A study published in April 2020 (Leung) found that cloth masks were especially effective for source control of the virus. Turns out we were thinking about the wrong person gaining the protection. Most masks do NOT provide much protection for the wearer, except for those wonderful masks and shields that health care workers use—those masks supply them with quite a bit of protection. The rest of us were left with the options of cloth, disposable, double layer, or neck gaiter; our mask protects others nearby from our potentially virus-laden respiratory droplets. A few months later, in July 2020, a summary of publications concluded, "The findings of this systematic review and meta-analysis support the use of face masks in a community setting" (Coclite).

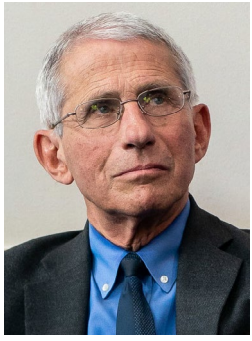
Later, a model published in August 2020 concluded that, "even with a limited protective effect, face masks can reduce total infections and deaths

. . .” (Worby and Chang). A later study concluded, “Therefore, wearing masks in public is essential as its effectiveness has already been established by the current studies” (Wang et al.). Your mask protects me, my mask protects you. So, you see, wearing a mask is a community protection kind of thing. You might have the virus and not know it (asymptomatic or pre-symptomatic), but your mask gives the rest of us some protection from you. Your mask doesn't protect you, it protects us.

Was There Integrity? Scientists first reported that masks were not required for asymptomatic people because no studies were available to guide them (“Listings”). But studies were soon provided that linked mask-wearing and disease transmission rates, and scientists changed their evaluation. Did it show a lack of integrity to change a directive? I think it would show a lack of integrity if the directive had not changed. The first WHO directive was based on what was known at the time—even suggesting the need for studies. The new WHO directive, advising mask wearing in any public place, was based on many subsequent peer-reviewed studies.

4. Should Hydroxychloroquine Be Taken to Prevent or Cure COVID-19?

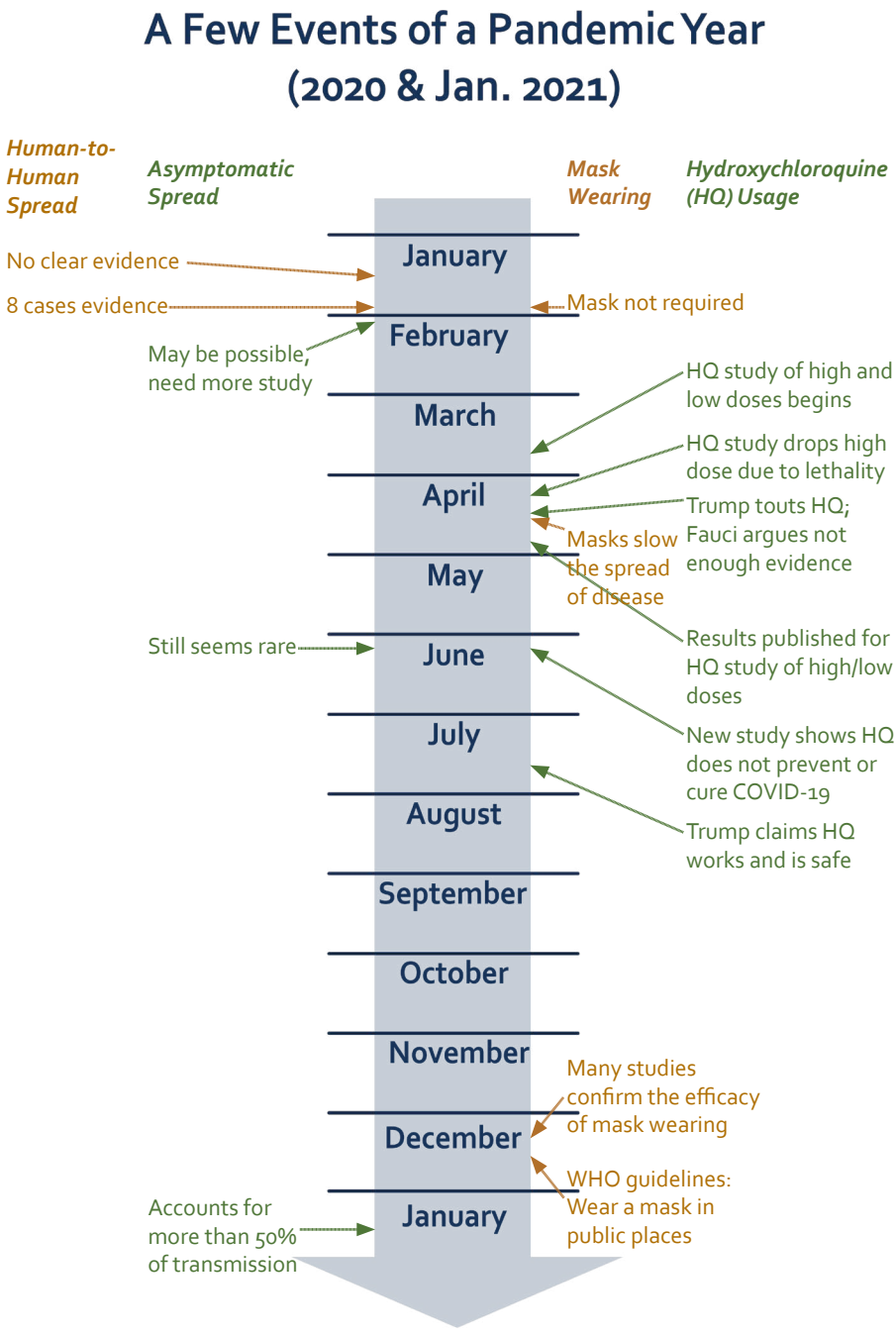
On April 11, 2020, then President Trump told reporters at a White House briefing (Yu) that he might take hydroxychloroquine (Weeks later he confirmed that he was taking it (Karni and Thomas).). He also said that people should take it. And in regard to its efficacy, he said, “Maybe it's true, maybe it's not. Why don't you investigate that?” At the same briefing, Dr. Anthony Fauci said, “We don't have any definitive information to be able to make any comment” (Yu). I prefer the scientist's statement of no definitive information over the politician's call to embrace the new treatment while we investigate it.



Dr. Anthony Fauci

A study begun on March 23, 2020, on two different doses of chloroquine (a close chemical relative of hydroxychloroquine) on patients hospitalized with severe COVID-19 symptoms was re-structured when 16 of the 41 patients (39%) taking the higher dose had died by the 13th day of the trial (Borba). The study was published on April 24, 2020.

A study published in the New England Journal of Medicine on June 3, 2020 concluded that hydroxychloroquine neither prevented the illness nor worked as a post-exposure prophylaxis (Boulware). Nonetheless, Trump continued



The events discussed in this article via timeline

to promote its use in a video he posted on Twitter and in a statement on July 28 he said, "I happen to believe in it. I would take it. As you know, I took it for a 14-day period. And, as you know, I'm here" (Lovelace).

Was There Integrity? There was a lot of interest in hydroxychloroquine in 2020. People across the globe were looking for a silver bullet that might prevent or cure this easily transmittable virus. Some studies (in labware) indicated that high doses of hydroxychloroquine might have antiviral activity. But when administered to humans at that high dosage rate, lethality also increased and studies had to be modified or terminated (Borba). Eventually, based on several studies, hydroxychloroquine as a treatment option was abandoned (Boulware). The scientists studying and reporting their studies on hydroxychloroquine maintained integrity. They published their methods, their data, and their evaluation. Because they maintained their integrity, our medical communities, and society as a whole, understand this aspect of the virus a little better.

Political messaging on the topic of hydroxychloroquine was a bit messier, as persons in authority continued to promote its use—even after it had been shown to be ineffective. Politicians ought to be concerned that our ability to have trust and confidence in their actions is tied to our perceptions of the politician's integrity (Rose and Heywood; Duba). It is also important to realize that leadership in any capacity ought to recognize a responsibility to trust and integrity (Hein).

Conclusions

Is there a role for science to play in the times of an unfolding crisis? *Yes!* Some would respond to my answer with the question, *but can science be trusted when science can move so agonizingly slow?* I say, *Yes!* Science can seem to move slowly, but that slower pace based on study after study is what ensures truth, accuracy. It is what maintains the integrity of both scientists and the institutions that the scientists represent. The integrity, the truthfulness of science, is born out of incremental approaches from many researchers and the process of peer-review. On that time-tested methodology we can place our trust.

Should we believe in science? It may be splitting grammatical hairs here, but I choose to use the term *believe in* for those things that I cannot prove. I believe in God. I believe that Jesus came to earth as a man, died on a cross, and rose again. You may choose to believe in many gods or no gods.

But I keep science clear of the term *belief*. Science is a record of human observations of the world around them and their attempts to make sense of those observations. That does not require me to believe in science.

Science is a useful and important resource in times of crisis. Science has helped and continues to help us understand the nature of the COVID-19 virus our world is fighting. It has resolved issues of transmittance and unsubstantiated cures, and led to development of several highly effective vaccines.

We may trust science to provide a roadmap through a crisis. It may come slowly, but it does come. The painstakingly slow processes that are inherently part of science are what sustain the integrity of science. Because of those processes, we can trust science to help illuminate the path through the COVID-19 crisis. As new treatments are developed, the slow, rigorous testing by scientists will point us toward the measures that help and away from those that hinder.

Can scientists tell us when COVID-19 will end? It may be that COVID-19 is here to stay, much like flu, measles, or whooping cough (Sepkowitz). It is also likely that other forms of bacteria or viral diseases may sweep across the world in new future pandemics. When that happens, it will be science with integrity that society looks to for answers. And we can hope, as foreseen by Justin Rosenstein, that COVID-19 was a dress rehearsal to prepare our global community for a better response (39). As a science teacher, I am leaning into the learning.

The painstakingly slow processes that are inherently part of science are what sustain the integrity of science.

Ken Turner, Professor of Science Education, teaches Chemistry, Math, Research Writing, and Engineering Design (not all at once) at University of Dubuque. He has taught students from 6th to 18th grades, and strives to bring an engaging lesson each day. Ken has been published several times and is also part of the leadership of ILED, Iowa Leadership in Engineering Design; bringing engineering design workshops to educators of all levels across Iowa.

When not teaching, Ken is happy to settle back and enjoy island time with his wife, his children, his grandchildren, his friends, his dog, and anyone who would like to join a toast to a sunset.

Photo credit p. 28: "Vaccine" by Spencer Davis, www.pixabay.com
Image credit p. 29: "Coronavirus" by Daniel Roberts, www.pixabay.com
Photo credit p. 30: "Chemist" by Michal Jarmoluk, www.pixabay.com
Photo credit p. 35: "Mask" by Juraj Varga, www.pixabay.com
Photo p. 36: "Anthony Fauci" Public domain, via Wikimedia Commons

Notes

[1] Dalton's Atomic Theory, published in 1801, was a seminal work, providing an explanation for the observations and conclusions of Boyle's Law, Charles Law, and the Law of Definite Proportion.

[2] Preprints, those manuscripts released before peer review has taken place, offer a quicker, additional route in the peer-review process. A preprint offers a glimpse of what the researcher(s) have found right now—answering the public demand for answers now. But a preprint is only as trustworthy as its authors and citations. It is a glimpse of what may be considered truth soon; but its timeliness has not yet been tested by a rigorous peer-review. I did leave the Howard preprint in the works cited because it gave a review of several preliminary studies. By the end of 2020 those findings had been confirmed by several peer-reviewed papers, including papers by Coclite et al.; Fisman et al.; Wang et al.; Worby and Chang.

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