

Nature Cannot Be Fooled

‘The Challenger exploded.’ These words are frozen in time for my generation. The date was January 28, 1986, and I was a second-year anesthesia resident dropping off a patient at the Deborah Heart and Lung Institute in New Jersey. I overheard a nurse breaking the news to his colleague. Not believing my ears, I asked, “What did you just say?” He repeated, “The space shuttle just exploded.”

Each generation seems to have its own defining event that reminds us how fragile life is. For us in 1986, it was the Challenger explosion. In 2001, it was the terrorist attacks of September 11. In 2020, we face a new, terrifying enemy: the COVID-19 pandemic.

The Challenger’s loss seemed impossible. Space shuttles had flown many times without a hitch. Launches were scarcely news anymore, but this particular launch had attracted a lot of attention. First, there was a schoolteacher on board. Space travel had become so safe we could launch teachers into orbit! Second, the launch had been repeatedly delayed by cold weather.

I joined a crowd of physicians, nurses, administrators – really, anyone who could step away from patient care – around the TV. in the family waiting area. The newscasters kept repeating, “At this time we don’t have any more information.” The screen showed a seemingly flawless launch, with crisp banter between mission control and the shuttle pilot, ending with the simple “Challenger, go with throttle up.” The engines ignited; the rocket boosters lifted the shuttle to an altitude of 46,000 feet. And then, 73 seconds into



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the flight, the fuel tank exploded in a fireball and a huge plume of white smoke. The reel was replayed again and again, everyone hoping for a different ending – to see the shuttle fly safely out of harm’s way.

President Reagan asked former Secretary of State William Rogers to bring together America’s finest engineers and scientists to sift through data and understand how this unthinkable disaster unfolded. It didn’t take long. The solid rocket boosters were assembled from four sections, joined by paired O-rings. It was known that asymmetric expansion of the booster sections permitted gas to escape briefly from the joints. This “blow-by” was observed in many flights. Reassuringly, the elastic O-rings quickly sealed the joints. However, the O-rings were known to become rigid at cold temperatures. Engineers at Morton Thiokol called for

the rocket launch to be scrubbed, concerned that the seals wouldn’t hold in the freezing weather. But NASA administrators bowed to political pressure. Despite the icicles on the launch pad, NASA wanted to show that we had mastered space travel. We had reduced it to the simplicity of driving a schoolteacher to work. They were wrong. The Rogers report identified the engineering, design, management, and cultural errors that culminated in the shuttle disaster. The report was forthcoming but polite. Rogers did not want to point fingers. Richard Feynman, the iconic physicist and Nobel Laureate, wrote his own summary.¹ Feynman concluded:

“Let us make recommendations to ensure that NASA officials deal in a world of reality in understanding technological weaknesses and imperfections well enough to be actively trying to eliminate them. They must live in reality in comparing the costs and utility of the Shuttle to other methods of entering space. And they must be realistic in making contracts, in estimating costs, and the difficulty of the projects. Only realistic flight schedules should be proposed, schedules that have a reasonable chance of being met. If in this way the government would not support them, then so be it. NASA owes it to the citizens from whom it asks support to be frank, honest and informative, so that these citizens can make the wisest decisions for the use of their limited resources.”

For a successful technology, reality must take precedence over public relations, for nature cannot be fooled.”

Reality is not fungible. The universe is unfolding exactly once on our watch.

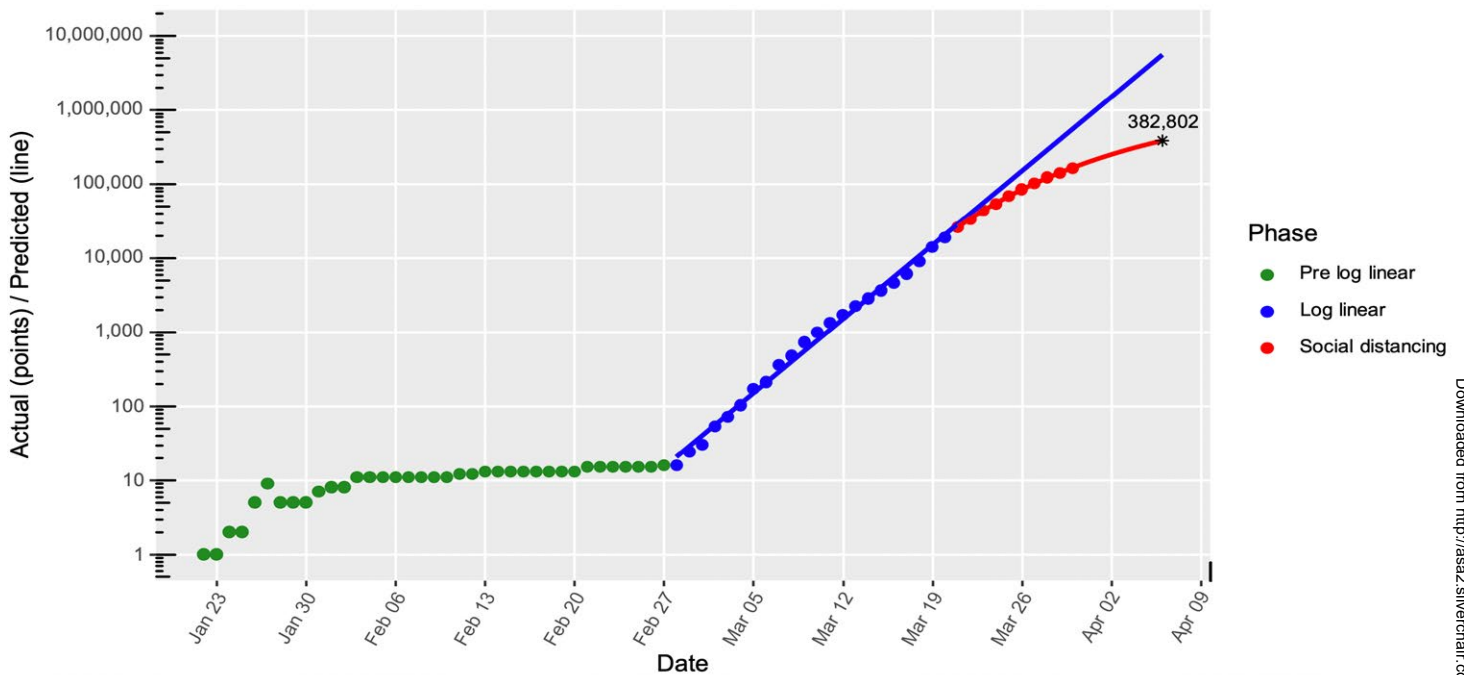
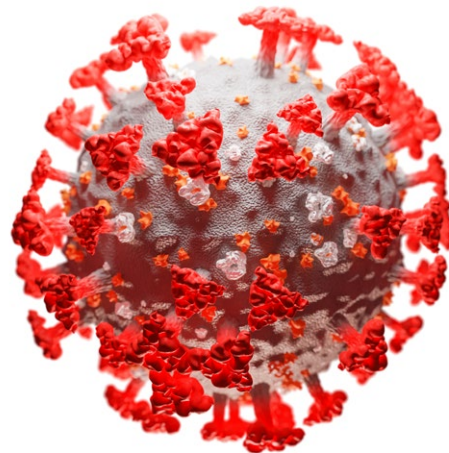


Figure 1: Model of the log linear and asymptotic portions of COVID 19 case numbers as of March 30, 2020. Data are from https://usafactsstatic.blob.core.windows.net/public/data/covid-19/covid_confirmed_usafacts.csv. Code and model details are available at <https://github.com/stevenishafer/COVID19>.

It is following the laws of nature, laws over which we have no control. If we choose to watch carefully as the universe unfolds before us, we may understand the process. If we understand the process, we can predict outcomes. We can even go further and predict how our interventions can alter outcomes. A famous cartoon shows a speed limit sign, $e=mc^2$, and a policeman pointing to it, saying “It’s the law.” He’s right. We have not, cannot, and will never change the laws of nature.

We can choose to ignore science. NASA was told, clearly and unambiguously, that the space shuttle might explode in the cold weather. They pushed the launch button. We have been repeatedly warned that pandemics will happen.^{2,5} Those warnings were ignored.^{6,7} We are only beginning to understand the profound and grim consequences.



Physicians in Wuhan, China, told us that this new coronavirus was dangerous – highly contagious, often lethal. We chose to downplay their urgent advice through January and February. We are finally heeding the advice of scientists, specifically epidemiologists and public health experts. In my own simplistic

models of COVID-19, there is evidence that our social distancing efforts started to flatten the exponential trajectory (Figure 1).

We will get through this. However, this may be a once-in-a-lifetime demonstration that science works, and that ignoring science is far more dangerous than we appreciated. If so, perhaps we will have renewed respect for the other warnings of science. Rigorously studying nature and calculating our trajectory, scientists are warning us about the massive declines in insects, bee colony collapse, the loss of marine diversity, rising levels of greenhouse gases, acidification of the oceans, the Anthropocene extinction, a collapse of food production, and ominously rising seas. The list is so long, the projected consequences

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so overwhelming and apocalyptic, and the time course so far in the future that it is tempting to just ignore all of it. We did that with the risk of pandemics. We are seeing the consequences of our folly in real time.

The pandemic is here. It cannot be ignored. Only science can guide us out of this pandemic. Please listen to scientists. Please follow the guidance of scientists to get us through this pandemic. Please help public health scientists tamp down the exponential spread. Please let pharmacologists develop specific therapies to prophylax against infection and attenuate the clinical severity. Please let critical care doctors, emergency department physicians, and infectious disease specialists apply their best science to patient care. Please let virologists and immunologists develop vaccines. Once vaccines are developed, please get vaccinated. Every one of us has a responsibility to interrupt the chain of COVID-19 infection.

This issue of the *ASA Monitor* may also provide guidance. Drs. Johnson and Rafique provide an overview of COVID response from the unique perspective of the Nebraska

Biocontainment Unit (NBU). Dr. Johnson is one of the world's authorities on the treatment of patients with Ebola, a nasty virus that kills so quickly that it has minimal opportunity to cause a pandemic. Dr. Jain takes us through the critical elements of personal protective equipment, with specific reference to the procedures developed by Dr. Johnson and colleagues at the NBU. Drs. Sundararaman, Talbot and Dean address physician wellness during the COVID-19 pandemic. In their essay "Ethics at the Head of the Bed: Anesthesiologists Confront COVID-19." Drs. Burgart, Gentry, Deutch, and Lozada offer a thoughtful perspective on challenges we uniquely face as anesthesiologists. Finally, Dr. Sibert bluntly asks, "What should we have done?"

I thank the invited authors listed above, who were asked to write these feature articles in exactly two weeks. Several of them are also on the front lines of treating patients. It took Herculean effort for them to produce unique and timely articles relevant to the current COVID epidemic while concurrently caring for the onslaught of patients at work and family at home. I also applaud the efforts of health care workers worldwide who are using the tools of science to care for patients during this pandemic.

Science works. Science will guide us through this pandemic. If there is a lesson here, it is that we cannot afford to ignore science. We may fool ourselves into a false sense of security, but *nature cannot be fooled*.

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