Comments about the Climate Modeling activity and the related discussion.

1) The NetLogo Simulation
The NetLogo model/simulation that people used is a very, very, very, very, very oversimplified example for a climate model. Did I mention that it is a very simple model? There is more information about the model if you click on "Model Info". The NetLogo code is unique and open source, and for those adventurous enough, you can view the code if you click "NetLogo Code."

Here are some responses to questions that people had about the model.

Ticks
Ticks are just an arbitrary measure of time and have no units (e.g., hours, days). They are just a way to be able to plot the results and control the speed.

Temperature
There are not units for temperature. It is just a measure of the number of particles absorbed by the surface and "trapped" within the land "reservoir." The particles are shown as bouncing around and sometimes "escape" when they hit the upper surface. The rate of escape is a based on an arbitrary probability in the code….not necessarily based on real science.

Sun Brightness
The sun's brightness parameter is also just an arbitrary measure of the incoming solar radiation (yellow lines). I guess you can assume the value of 1 is the present-day brightness and lower numbers indicate lower incoming radiation and higher numbers indicate higher incoming radiation. For the model, it either increases or decreases the number of rays coming into the simulation. I can't tell from the code if a brightness of 0.5 reduces the incoming number of rays by 50%, or if a brightness of 3.0 triples the number of incoming rays.
Key Take away => higher brightness causes temperature to increase.

Albedo
Albedo is the reflectivity of Earth's surface and represents the probability of an individual sun's ray entering the land reservoir. A lower albedo (lower reflectivity) will increase the probability of a ray being absorbed, and conversely, a higher albedo (higher reflectivity) will decrease the probability of a ray being absorbed.
Key Take away => higher albedo causes temperature to decrease.

Clouds
The clouds portion of the code is kinda funky and probably the least constrained or founded in reality. In the code, an incoming ray hitting a cloud will reflect back to outer space and never reach Earth. Obviously, sun's rays still hit Earth even on cloudy days. Similarly, rays bouncing off the land surface will bounce of the bottom of the cloud and return to Earth. The infra-red rays (purple lines) escaping land do not reflect off the bottom of the clouds. There probably is a way to parameterize the probability of reflecting or passing through clouds, but this is not in the code.
Key Take away => more clouds cause temperature to decrease……in this model.

CO2
The number associated with the "CO2 amount" does not have any units (i.e., not ppm – parts per million). Present-day values presently exceed 400 ppm with a global average of 407 ppm in 2018. The relative impact of CO2 amount is arbitrary in the code and may even be somewhat exaggerated (IMHO). Incoming rays are not reflected if they "collide" with a CO2 particle, but the outgoing infra-red rays colliding with the CO2 particles will be reflected back to Earth.

Key Take away => more CO_2 causes temperature increase.
Relationship Between Variables
Some people incorrectly assumed there was a relationship between the various parameters.
"How exactly albedo can be affected by CO_2 levels." (student response)
There is not a relationship (i.e. cause and effect) between any of the parameters you tweaked in this code. The albedo does not affect CO_2…. IN THIS MODEL.

In the real world, some of these parameters do have direct impacts on the other parameters. For instance, an increase in CO_2 concentration will increase the temperature, which will cause glaciers to melt, which will decrease albedo. These interactions are known as feedbacks or feedback loops. There are two types of feedback loops….positive and negative.

Positive feedbacks are ones in which changes reinforce or continue to increase trends. For example, warmer temperatures cause glaciers to melt, which reduces albedo, which causes more sun's rays to be absorbed, which causes warmer temperatures, which causes glaciers to melt…and so on and so forth.

Negative feedbacks are ones that correct or cancel out any perturbation. Predator-prey relationships are a good example where an increase in bunnies means more food for coyotes, which means better chance of survival for coyotes and more coyotes, which means more coyotes to eat bunnies, which means bunny population goes down, which causes coyote population to go down, which allows more bunnies to live…..you get the idea. A climate example is called the Daisy Earth model, where warmer temperatures means more daisies can grow, daisies are white so that increases the albedo, which reflect more sun's rays, which reduces temperature, which causes daisies to die, which reduces the albedo, which causes the temperature to increase, which means more daisies can grow…..

These feedback mechanisms and interactions are big part of what climate scientist are trying to understand.

2) Climate Model Discussion
What is your opinion/perspective about the accuracy of climate models?
Overall, folks seemed to grab the essential aspects about the accuracy climate models. Student responses about the accuracy of the climate models spanned from very accurate to "no-so-sure", but the vast majority responded with "somewhat accurate." Two related comments that struck home with me were:
"A lot of criticism seems to be harbored on what is spot on rather than successfully predicting a trend" (Steph Spada)
"[Climate models] mathematically follow trends, rather than events" (Kaya Horlbogen)
Almost everyone indicated they appreciate and understand the limitations of the climate models.

What are some similarities and differences in climate and pandemic models
Student responses to this question also did a nice job grasping key similarities and differences between these models.
Some similarities identified include
- models are predictive scenarios…not meant to be spot on.
- heavily dependent on input data and mathematical relationships
- both of them can have broad ranges based on the actions of humans

The primary differences identified include
- the differences in the time scale of the models (short- vs long-term)
- the availability and accuracy of the input data

Shout out to Kermalyn Prospere
I just wanted to bring attention to a comment that Kermalyn made about the source of the information.

"Every person comes with their preconceived notions about what data should be included and why. The point in the second article which was questionable *was the fact that the author thought that only his point of view was correct over all the other scientist who worked in the UN. I do not believe that they always get things correct* ***and judging from the fact that this article was published from a website funded by the Koch brothers I am hesitant to believe that it is unbiased or completely accurate in and of itself. "***

We did not get a chance in the course to talk about the source of information, but please be aware the source of information may have a preconceived bias.

The first reading is from a blog from Columbia University.
- not a peer-reviewed article, but reference peer-reviewed information
- most universities are considered to have a liberal bias

The second reading is from the Cato Institute
The Cato Institute is an American libertarian think tank headquartered in Washington, D.C. It was founded as the Charles Koch Foundation in 1974 by Ed Crane, Murray Rothbard, and Charles Koch, chairman of the board and chief executive officer of the conglomerate Koch Industries. (Wikipedia).

The final reading is from The Atlantic magazine.
- considered a left-leaning news media

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