Classroom Activity

10 Big Question: Why does climate change?

Climate models

Due to the complex nature of the many factors involved in climate change, accurately predicting what will happen in the future is very difficult. In this activity you will use a very simple climate model to calculate the amount of CO_2 in the atmosphere and average global temperature.

Before you begin, read the following explanation of climate models:
http://www.windows2universe.org/earth/climate/cli_models2.html
http://www.windows2universe.org/earth/climate/cli_models4.html

Next, visit the interactive model here:
http://www.windows2universe.org/earth/climate/cli_model.html

Follow the instructions given to alter the amount of CO_2 emissions and the time scale before stepping the time forward to create your graph. When you wish to start over, you may need to refresh the page. Answer the following questions using the model and the information found on the websites above.

Questions

1. If the CO_2 emissions remained at the 6 GtC level from 2000 onwards, what would be the approximate average global temperature in the year 2100?
2. If the CO_2 emissions remained at the 6 GtC level until 2040 and then increased to 8 GtC, what would be the approximate average global temperature in the year 2100?
3. If the CO_2 emissions remained at the 6 GtC level until 2040 and then decreased to 4 GtC, what would be the approximate average global temperature in the year 2100?
4. Why does the CO_2 concentration (and therefore temperature) continue to rise even if the emissions from human activity (such as burning fossil fuels) are kept constant or reduced?
5. How high can you get the temperature?
6. How low can you get the temperature?
7. Why is the relationship between CO_2 emissions and global average temperature relatively easy to model?
8. What things does this model ignore? (Hint: some things are listed on the website!)
9. What are some of the risks with using predictive models?
10. How do we test predictive models?

Answers

1. 17.25 degrees Celsius
2. 17.75 degrees Celsius
3. 17 degrees Celsius
4. Because even though the amount of CO_2 being added to the atmosphere is the same or reduced, it's still adding to what is already there. The only condition that would not add to the amount of CO2 would be zero emissions.
5. 21.5 degrees Celsius with 30 GtC CO_2 emissions
6. 15.1 degrees Celsius with zero emissions
7. Temperature rises about 3 degrees Celsius for each doubling of CO_2 concentration.
8. This model does not take into account things like wind or rain patterns that might accompany and in turn influence warming, where in the atmosphere the CO_2 is, the influence of other greenhouse gases, and many other factors.
9. There are processes and feedback between different parts of the Earth that may not be considered by the model, either because they are unknown or not well understood.
10. Scientists use sets of known data from the past to test the predictive powers of new models. If the model predicts what has already happened, they are confident it will be reasonably accurate using new data.