**ASK A SCIENTIST (2021)**

**Question and Answer Session with Scientist Brenden Fischer-Femal**

**and Bryan Middle School Students**

(note: grey are repeat/similar questions)

**12:30 Class**

* What got you into the field of chemistry and also learning about climate change?
  + I got into chemistry and specifically geochemistry in college because of some amazing professors teaching me about how the Earth is shaped by chemical reactions. Learning about climate change has been of interest to me in the last 5 years because I think it’s incredibly important to learn more about what our future holds.
* How long do you think it would take humanity to fix this issue of global warming? If we fix this issue of global warming let’s say in like 20- 30 years are we going to see a reduction of natural disasters?
  + I think it will depend on our actions. If we can confront the issue head-on and put significant resources into it, we could see improvement in ~ 50 years. More than likely, it will be over 100 years before we will see a reduction in natural disasters and lower our CO2 levels to under natural (280 ppm).
* If we reduce global warming that would make are environment much different do you think that there would be different species or organisms that can evolve like in Charles Darwin’s theory of evolution?
  + Yes, species are already adapting and evolving to a warmer world. However, evolution is slower in most species than the warming we are creating. Therefore, it will take 1000s to 1,000,000s of years before they could evolve to a significantly warmer world like we are creating in the next 100 years.
* Just how expensive is carbon storage?
  + There are many different techniques, ranging in cost from ~ $30 to $1000 per ton of CO2 sequestered.
* How long do we have to fix the environment before it is too late?
  + I would say in some ways it is already too late in terms of creating significant change. However, it will get much worse in 50 years, so I would say about 50 years.
* Can you see the effects of climate change in rocks? If so, how?
* How can you put carbon in minerals?
  + Carbon can be put in minerals in different ways. However, one way that we can see in real life is evaporating water that has carbon in it, such as hard water on the windows of your car or house.
* What made you want to study this? How long have you been studying this for?
  + I’ve been wanting to study climate change since I learned about how the previous generation is ignoring the long-term consequences of CO2 emissions. I have been studying this for about 7 years.
* How long did it take you to have a PDH candidate at The University of Utah.
  + I will have taken about 6 years to finish my PhD.
* What where the first steps you noted that made you want to study climate change and what have you done so far to help this problem of climate change.
  + Unfortunately, I don’t think I have done too much yet to help the problem. Teaching people about the consequences and systematics of how climate change works does help in some ways because people will be more cognizant of how much CO2 they are emitting themselves. My studies of past climate change can also in some ways help predict how much CO2 emissions will affect the world as well.
* What is another way for us to address climate change?
* Why did you choose to study this?
* How long have you studied this for?
* What does looking at rocks help todays’ climate change?
* What are you going to get after your degree?
* What is a Carbon Reservoir?
  + A carbon reservoir is just like a water reservoir, it’s a place on Earth that is storing carbon.
* What is a runaway green house?
  + A runaway greenhouse is when the Earth warms a bit, which then melts permafrost or triggers other carbon reservoirs to realease, which then causes further warming, which then triggers more melting/release of carbon, and Earth gets warmer and warmer.
* How would storing the Carbon work? Why did that one patch open up?
* In 15 years will climate change be a problem?
* How do geologists study carbon released in the past?
* How do geologists find the reservoirs?
* If didn’t have any factories that affect are air pollution or climate change would we get better air to breathe or do we need the factories?

**1:30 Class**

* What made you want to study science I collage?  Could you say climate change is important for you?
* How can we use these tools to help the world?
* What would happen if all the carbon was released?
  + The Earth would get very hot!
* How do you store carbon?
* What is the estimated time it would take to put this technique into effect?
* How do they release carbon into the air?
  + We release carbon into the air anytime we drive our cars, heat our houses, burn wood, etc… The burning of fossil fuels, organic carbon buried for millions of years is the main way we release carbon to the air.
* Do you know how much carbon does come out of ice?
  + Carbon does not technically come out of water ice. However, if permafrost (frozen soils) melt, it can release organic carbon trapped in the ice. Also, methane ice (frozen methane) can release methane (CH4) if it’s melted.
* Why are people struggling to address the issue of climate change?
  + Because we value short-term gains over long-term stability. If we can make quick money selling and using fossil fuels and delay spending in green technology, people will do it. However, that isn’t going to work out very well in the long run.
* What got you into climate change?
* Do you think the more technology is made, the more that climate change affects people?
* If there was enough money to fix the runaway greenhouse effect, how long do you think it would take?
  + I think that more green technology is better, and the more wasteful technology is worse. I think we can fix the runaway greenhouse in about 50 years if we put a lot of resources into fixing it.
* How can they collect carbon in the rocks like that?
* If the carbon is released, then how is it captured and analyzed?
* You mention having to involve a lot of aspects of science such as physics and chemistry to help with your research. Does it ever become too much work and if so what do you do to make sure that work gets done?
* Do you see carbon storage as a viable solution to the greenhouse runaway effect that you mentioned? What are some potential problems?
* How is geology helping people determine what will happen in the future?
* Throughout you (Brenden's) research, what has he found most interesting?
* How many disruptions are there?
* How hard is it to finish the solution?
* Which specific carbon isotopes do you look into?
  + Carbon-12 and Carbon-13.
* What exactly is carbon burial?
  + Carbon buried into the Earth, where it is effectively stored for 1000s to 1,000,000s of years.
* What does calcium-carbonate look like? How does excess carbon dioxide open up more reservoirs?
  + Calcium carbonate looks like a white powder in small quantities, or white-to-grey hard rock in larger quantities. Excess carbon dioxide releases more carbon reservoirs by melting permafrost (frozen soils), releasing the carbon stored in the organic matter trapped in the ice. It also can release methane ice in the ocean, where CH4 (methane) is trapped in near-ocean bottom sediments.
* What numbers of the carbon isotope do you study?
* How is calcium carbonate formed on our soil? Is there an easy non-polluting way to produce it?
  + Great question! It’s formed when rain goes into the soil and evaporates, just like hard water on your windows. There isn’t an easy way to produce a lot of it yet, but we are working on it.
* Why is everyone struggling to address the issue of climate change?
* How can we warm the earth to create mass of consequences for life honor?