



## Unit 6 Summative Assessment

Choose one of the proposals discussed in Module 6 and write a one- to two-paragraph statement of support or dissent for that proposal. Support your choice with clear, explicit reference to your understanding of the carbon cycle.

Include:

- a. Opinion of support or opposition of proposal
- b. Reference to societal impacts from pursuing proposal
- c. Reference to economic impacts from pursuing proposal
- d. A scientific description of how the proposed intervention would change the movement (flux) of carbon among Earth's reservoirs
- e. Articulation of a benefit and a drawback from pursuing proposal

The proposals are:

1. **Stop Burning Fossil Fuels Immediately** (presented by WhaleHuggers, an environmentally-focused nonprofit). The burning of fossil fuels for energy, transportation, and manufacturing purposes is out of control and identified by the scientific community as a primary driver of climate change. Emissions from these fossil fuels significantly increase the concentration of atmosphere-warming greenhouse gases. It is the moral responsibility of governments across the globe, but especially developed and first-world countries, to immediately curtail these greenhouse gas emissions by rigorously pursuing alternative energy resources and taxing carbon emissions to pay for the transition to alternative energy.
  
2. **Continue Burning Fossil Fuels but Begin Spraying Sulfate Aerosols Globally into the Atmosphere** (presented by PetroPAC, a lobbying group that supports the oil industry). Fossil fuels are the backbone of the global economy. Without fossil fuels, factories would not be able to produce goods, there would not be sufficient energy to meet global demand, and the transportation of goods would be severely limited. However, burning of these fossil fuels may have an impact on the global climate, including increased atmospheric and ocean temperatures, rising sea level, and the delicate balance of ecosystems. Research has shown, however, that not all materials introduced in the atmosphere have insulating and warming effects; the presence of sulfur aerosols from massive volcanic eruptions actually decreases the amount of absorbed solar radiation by reflecting this radiation back into space, thereby having a cooling effect on the atmosphere. Aerosols, in this context, are tiny droplets of sulfuric acid suspended in clouds. In order to combat global climate change, significant funds must be reserved for geoengineering the global-scale, human introduction of sulfur aerosols into the upper levels of the atmosphere, offsetting the warming effects of warming greenhouse gases.



3. **Encourage Phytoplankton Growth through Ocean Iron-fertilization** ("presented" by Sebastian Siderophile, a geochemical oceanographer at L'Institut d'Océanographie in Marseille, France.). The United Nations Intergovernmental Panel on Climate Change (IPCC), the community of the world's top scientists, identifies carbon dioxide (CO<sub>2</sub>) as a primary driver of global climate change. While atmospheric CO<sub>2</sub> concentrations are on the rise, resourceful solutions to decrease these potent gases become ever important. Photosynthetic organisms absorb CO<sub>2</sub> from the atmosphere while in the process of creating life-sustaining sugar compounds. Therefore, increasing the amount of photosynthetic organisms globally will result in a net decrease in atmospheric CO<sub>2</sub> and dramatically slow the effects of climate change. We propose taking advantage of the photosynthesizing powers of phytoplankton, which are small critters but abundant throughout the world's oceans, to immediately reduce atmospheric CO<sub>2</sub> concentrations. It is understood that phytoplankton populations bloom and flourish when iron is introduced into ocean waters (through chemical weathering of minerals or human intervention). Because these organisms are photosynthetic, an increase in phytoplankton results directly in a greater absorption of CO<sub>2</sub> gas from the atmosphere. Iron fertilization of the oceans is an elegant, effective, and simple process that global communities should aggressively and immediately pursue to slow the effects of climate change.
  
4. **Carbon Sequestration by Capture and Geological Injection** ("presented" by Carbon Injection, Limited, an Australian start-up company). The global carbon cycle describes the dynamic exchange of carbon from multiple reservoirs on Earth. With the increased scrutiny of increasing carbon dioxide on global temperatures, processes that remove carbon dioxide from the atmosphere are important to identify. While there are natural processes that remove atmospheric CO<sub>2</sub>, they are too slow to be useful. If we as a global community are serious about mitigating the effects in climate change, we must pursue more robust and man-made solutions to atmospheric CO<sub>2</sub> withdrawal. Carbon Injection, Limited, hires the most talented minds in the world to geoengineer creative solutions for drawing CO<sub>2</sub> out of the atmosphere and safely pumping this CO<sub>2</sub> into deep injection wells, far from the atmosphere. At Carbon Injection, we develop plans that convert and upgrade conventional power plants to factories that also absorb CO<sub>2</sub>. The CO<sub>2</sub> is stored under high pressure in liquid form. It is then injected into wells that go down tens of thousands of feet into the most stable and geologically sound subterranean reservoirs. Our plans are adaptable to almost anywhere in the world, meticulously protect shallower drinking water aquifers, and are a true 21<sup>st</sup>-century solution to the greatest global challenge of our lifetime.
  
5. **Package and Send CO<sub>2</sub> into Space** ("presented" by Space Disposal, Inc., and RocketMan Enterprises). We all know it; radical climate change is going on because of all the CO<sub>2</sub>



and other greenhouse gases introduced into the atmosphere from human activity. We hear all types of solutions, like buying hybrid or electric cars, installing solar panels on your roof, and so on. The fact is, all of these options require big changes to our lifestyle, and change is hard. But, our engineers here at Space Disposal, Inc., have developed technology that will reverse the effects of modern climate change and allow you to live life the way you have always wanted to, without sacrificing your dream car or buying expensive solar panels. In conjunction with our sister company, RocketMan Enterprises, we at Space Disposal, Inc., have developed technologies that capture CO<sub>2</sub> from the atmosphere, package the CO<sub>2</sub> onto rockets, and send that stuff into space! You release, we capture, and RocketMan takes it away. With potential launch sites situated conveniently throughout all seven continents and within 100 miles of all major cities worldwide, our breakthrough approach will effectively decrease the amount of atmospheric carbon to concentrations experience just before the Industrial Revolution. All you have to do is nothing! Keep living life the way you have always wanted and save the planet at the same time. It is a win-win for all of humanity!

6. **Subsidize Alternative Energy Sources from Carbon Tax** (“presented” by Senator Wendy Reyes, Arizona). The only substantive action to combat climate change is to reduce greenhouse gas emissions released by fossil fuels used in the energy sector. Within the next 10 years we must transition our electrical power generation from fossil fuels to alternative forms of energy. Currently, our alternative energy options (solar, wind, hydrothermal, etc.) are prohibitively expensive, so in order to give these necessary alternatives a fair chance in the energy market, we need to instate a substantial tax on all uses of fossil fuels. The funds generated from this “carbon tax” will then be paid out as subsidies to companies capable of setting up alternate energy sources. Once a majority of power generation is supplied by alternative energy sources, we will immediately see the increase of atmospheric CO<sub>2</sub> concentrations slow and perhaps start to decrease, thereby helping the atmosphere trap less and less heat. This carbon tax is a fair and substantive action in order to curb the human input of atmospheric CO<sub>2</sub> and to curtail the effects of climate change.