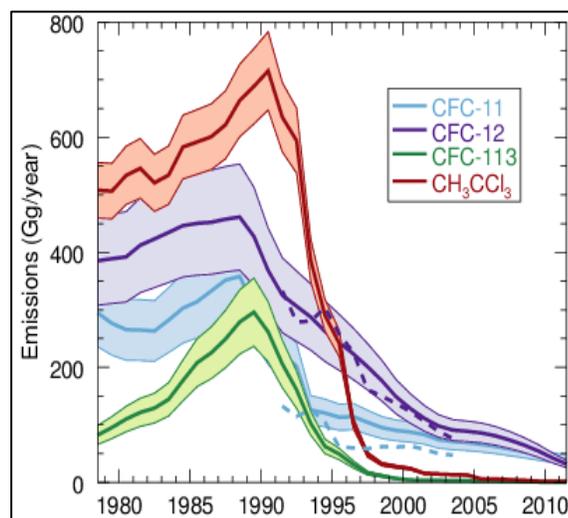
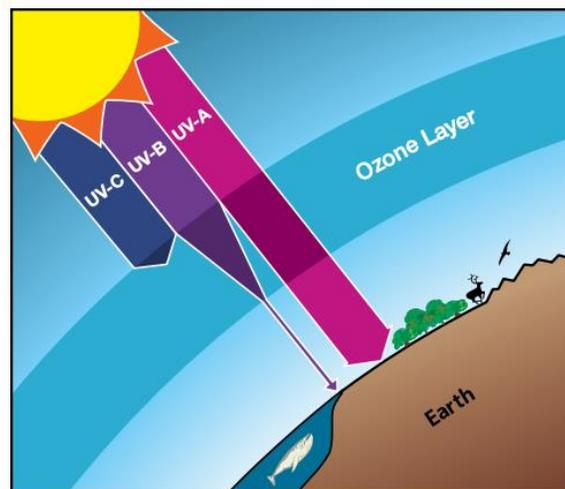


## Lab: Stratospheric Ozone MAKEUP ASSIGNMENT

**Remember: As per GHHS Policy, you have two days for each day absent to makeup assignments.**

(modified from Teach Engineering & Center for Science Education)

**Background:** Ozone is made up of three oxygen molecules and occurs naturally in the stratosphere. That ozone is an important protective shield for life on Earth, filtering out more than 99% of ultraviolet rays from the sun before they reach us. Ultraviolet rays can cause sunburns, skin cancer, immune deficiencies and cataracts. Ozone in the stratosphere forms when oxygen molecules interact with ultraviolet rays from the sun. Under normal circumstances, ozone is continuously being destroyed and regenerated by the sun's ultraviolet rays. Beginning in the 1980's, scientists discovered "holes" in the ozone layer. These "holes" are not completely empty of ozone, but areas where the ozone concentrations are lower than under normal conditions, allowing more ultraviolet radiation to reach the Earth's surface. The only practical approach to stopping the destruction of the ozone layer was to reduce the amount of human-created pollutants that contribute to its depletion. The most common ozone-destroying pollutants are in a class of chemical compounds called chlorofluorocarbons (CFCs), which were once used in air conditioner refrigerator coolants, cleaning solvents, plastic foam manufacturing and aerosol spray propellants. In 1989, CFCs were banned internationally with the Montreal Protocol. When an ozone molecule absorbs UV light from the sun, it breaks down into an oxygen ( $O_2$ ) molecule and an oxygen atom ( $O$ ). Sometimes the oxygen molecule breaks into two oxygen atoms as well. Normally, the free oxygen atom combines with other oxygen atoms or molecules to produce ozone again. When there are no outside disturbances, this process of breaking down ozone and building it back up occurs at a constant rate that keeps us protected from a lot the sun's harmful UV rays. However, harmful pollutants (such as CFCs) can also break down ozone by converting it into oxygen molecules and atoms. When this happens, ozone breaks down much faster than it can build up and "holes" appear in the ozone layer. In today's activity, you will model how pollutants destroy ozone.



### Prelab Questions:

1. What is ozone and where is the ozone layer found?
2. Why is the ozone layer important to life on Earth?
3. Describe natural and anthropogenic methods of ozone destruction.
4. Name the important piece of legislation that banned CFCs internationally.

**What We Did in Class:** Students modeled the creation and destruction of ozone in the stratosphere using marshmallows to demonstrate the effects of CFCs on the process.

Watch the video <https://youtu.be/dLXJV4A6KPE> and answer the following questions.

**Analysis Questions:**

5. If we had not banned CFCs, during what year would the ozone layer have been completely destroyed?
6. Compare UV-A, UV-B and UV-C in regards to their destructive properties.
7. Why is tropospheric ozone bad?
8. Compare and contrast solar formation and solar breakdown.
9. Why do UV-A, UV-B and UV-C act differently when hitting the ozone layer?
10. Why is the ozone hole found over the pole?
11. The Montreal Protocol, resulting in the banning of CFCs, is often considered one of the biggest environmental success stories of all time. Why do you think this is so? (not given in video)
12. What have you learned from this makeup lab?