CANDAC
Canadian Network for the Detection of Atmospheric Change

Name: _____

The Montreal Protocol

Introduction: The Montreal Protocol on Substances that Deplete the Ozone Layer was the first international environmental agreement that aimed to reduce the use of ozone-depleting chemicals (ODCs). It was signed in 1987 at the Headquarters of the International Civil Aviation Organization in Montreal, Quebec. According to Kofi Annan, Former Secretary General of the United Nations, the Montreal Protocol is the single most successful international agreement to date. It specifies that the production and consumption of products containing ODCs be completely phased out in both developed and developing countries by the year 2040; most ODCs will be phased out by 2015. CFCs, carbon tetrachloride, halons and hydrobromofluorocarbons are already completely phased out.

It was originally thought that these chemicals were harmless; however, in time their detrimental effects were realized. Chlorofluorocarbons (CFCs) are man-made ODCs that contain chlorine, fluorine and carbon atoms. Many CFCs were used as coolants, propellants in aerosols, and solvents in degreasers. Trichlorofluoromethane (Freon-11) was mostly used as a refrigerant because it has a low boiling point and can be used in low pressure operating systems. Carbon tetrachloride (Freon-10) was widely used in fire extinguishers and as a precursor to refrigerants. Halon 1011 chemicals replaced the fire extinguisher chemical carbon tetrachloride once people understood its toxic effects. Halon 1001 chemicals were used to sterilize the soil for crops and as a general fumigant to kill pests. All of these chemicals are useful but cause destruction of the ozone layer.

References: United Nations Environment Programme (1987). *Montreal Protocol on Substances that Deplete the Ozone Layer*. UNEP. Last amended December, 1999. Retrieved from http://www.unep.ch/ozone/mont_t.htm.
Environment Canada (2008). *Ozone-Depleting Substances.* Last updated May, 2010. Retrieved from http://ec.gc.ca/ozone/default.asp?lang=En&n=D57A0006-1.

→ **Instructions:** The production and consumption of the chemicals listed below are regulated by the Montreal Protocol. On a separate sheet of paper, write out the chemical formula and draw the chemical structure for each of the chemicals.

1) Carbon tetrachloride (Freon-10)
2) 1,1,1-Trichloroethane (Methyl chloroform)
3) Bromomethane (Halon 1001)
4) Bromochloromethane (Halon 1011)
5) Trichlorofluoromethane (Freon-11)

→ **Instructions:** Write a short paragraph (maximum ten sentences) explaining why you think developed and developing countries have different control measures and phase out dates for ozone-depleting chemicals.