**Air Pollution**

**Objective:** In this lab you will learn;

* What the most common indoor and outdoor air pollutants are.
* How these contaminants are sampled.
* What you can do to reduce the common air pollutants.

**Introduction:**

In 1970, President Richard Nixon and the United States Congress established the United States Environmental Protection Agency (EPA) in response to growing public outcry against environmental degradation. Beginning with the passing of the Clean Water Act in the 1970’s, the EPA has worked for the past 40 years to enact policies, regulations, and laws to protect human health and safeguard the natural environment.

Any place in which the earth is modified by human action falls under the domain of environmental law and policy. Environmental values of individuals can be motivated by a variety of factors including, but not limited to: economics, moral or ethical concern, religion, justice, and ecology.

In the United States, **ambient air pollution** is regulated at the federal level under the **Clean Air Act** (CAA). The EPA estimates that over 230,000 early deaths will have been prevented by 2020 due to the Clean Air Act.

**Indoor Air Pollutants:**

Indoor air pollutants are those contaminants typically found inside a building, usually a home or business. Since we typically spend most of our time indoors low levels of pollutants can collect in our bodies over time causing adverse health effects. Some of the common indoor air pollutants are;

**Radon** is a radioactive gas that comes from the breakdown of naturally occurring uranium in soil and rock. It is invisible, odorless and tasteless, and can only be detected by specialized tests. Radon enters homes through openings that are in contact with the ground, such as cracks in the foundation, small openings around pipes, and sump pits.

**Environmental Tobacco** is listed as an indoor air contaminant. It is harmful to the user as well as those exposed to second hand smoke. The health effects include respiratory problems, asthma, emphysema and cancer. This is one contaminant that is easy to eliminate.

**Biological contaminants** include bacteria, molds, mildew, viruses, animal dander and cat saliva, house dust, mites, cockroaches, and pollen

**Carbon Monoxide (CO)** is an odorless, colorless, tasteless gas that can be fatal at high levels of exposure. In prolonged low exposure cases, it can cause symptoms similar to the flu. Sources of carbon monoxide include car exhaust, unvented or leaking chimneys or furnaces, and tobacco smoke.

**Volatile organic compounds (VOCs)** are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands.

**Pesticides** are chemicals or substances used to kill or eliminate pests. The chemicals used are often toxic and cumulative in humans and other animals.

**Asbestos** is a mineral fiber that has been used commonly in a variety of building construction materials for insulation and as a fire-retardant.  Both the EPA and Consumer Products Safety Commission (CPSC) have banned several asbestos products.  Manufacturers have also voluntarily limited uses of asbestos. Today, asbestos is most commonly found in older homes, in pipe and furnace insulation materials, asbestos shingles, millboard, textured paints and other coating materials, and floor tiles

**Ammonia** is a common cleaning product and is often used in other applications. Ammonia is also a “common by- product of animal waste due to the often inefficient conversion of feed nitrogen into animal product (Gay and Knowlton, 2009).” When animal excretion begins to decompose, ammonia is released into the air. Ammonia enters the atmosphere as a particulate and can cause respiratory and cardiovascular problems (Gay and Knowlton, 2009). Ammonia also contributes to haze and algae blooms.

**Outdoor Air Pollutants:**

Outdoor Air Pollutants are found outside of buildings and come from many sources such as car and appliance exhaust, burning of fossil fuels and other industrial applications and it can also be naturally occurring such as some particulate matter (dust). Pollution can travel long distances by wind and affect large areas. Some examples of common outdoor air pollutants include:

**Ozone (O3)** is created by the reaction of daylight ultraviolet rays usually in the summer and is harmful in the lower atmosphere. The negative effects include respiratory problems and are very harmful to organic matter such as latex, plastics and animal lung tissue

**Particulate Matter** Particulate matter (PM) is the term used to refer to solid and liquid matter dispersed in air. PM may include acids, organic chemicals, metals, soil or dust particles, and allergenic particles such as mold spores or pollen (EPA, 2003). Particle size is an important factor in determining whether particulate matter will result in adverse health effects for those exposed.

**Carbon Monoxide** see above

**Nitrogen Dioxide** **(NOx)** is an irritant causing nose, throat and eye irritation as well as impaired lung function and respiratory illness in children (EPA, 2010). It comes from similar sources as carbon dioxide.

**Sulfur Dioxide** enters the atmosphere through the burning of coal and oil. It is a major contributor to acid rain as well as smog. Exposure to high levels of sulfur dioxide can lead to respiratory illness, cardiovascular disease, and breathing problems (Clean Air Trust, 1999).

**Hydrogen Sulfide** is a colorless gas with a rotten egg odor at low concentrations and no odor at high concentrations. Symptoms of hydrogen sulfide exposure include eye irritation, coughing, loss of smell, drowsiness, respiratory tract irritation and death at high doses. It occurs naturally with oil and natural gas (State of Michigan, 2010) and also in decomposing animal manure (Jacobson, 2008).

**Ammonia** see above

**Lead** can adhere to particulate matter but may also come from burning of leaded gasoline

**Materials:**

 Air Sampling Impinger

 Air sampling test kit

In air pollution studies, most of the sampling is done with some type of vacuum equipment. The vacuum is required to draw an air sample through a chamber holding a special absorbing solution. The absorbing solution is chemically selective for a particular gas, and is held in a special glass bubbling tube called an impinger. Since gaseous pollutants differ chemically, the absorbing solutions are also different. In order to make a quantitative test, a means to measure the amount of air that is drawn through the absorbing solution has to be known. This is done by the use of an impinger which is attached to the vacuum portion of the air sampling train, one can accurately monitor the amount of air which is pulled through the absorbing solution by counting the number of times the impinger has been drawn.

**Procedure:**

1. Each lab group will conduct air sampling tests at two locations of their choosing- one indoor site and one outdoor site.
2. Conduct an initial survey at each location, recording potential sources of air pollution and whether pollution control devices are being used and operating correctly.
3. Using a Kestrel device, record wind speed, temperature, heat stress, wind chill, relative humidity, and dew point. Using your group’s collective knowledge, record the weather conditions for the past 72 hours on your data sheet.
4. Use the hand operated syringe pump to sample air and test it using the procedures outlined in the individual test kits.

*To use the Hand Operated Syringe Pump:*

1. Depress plunger to “0” position.
2. Remove stopper assembly from impinging tube and pour the designated amount of absorbing solution into the glass tube (refer to individual test kit instructions to determine what amount of absorbing solution is added to impinging apparatus)
3. Replace stopper assembly. Connect flexible tubing to short tube (outlet) of impinge assembly and to intake connections of syringe.
4. Begin to sample the test atmosphere by completing one complete cycle (pulling out- depressing plunger). Twenty complete strokes on the syringe per minute is equivalent to sampling the air at one liter per minute (Lpm). Continue sampling until required volume of air has been sampled (refer to individual test kit instructions).
5. At the end of the sampling period, disconnect impinging apparatus and remove from holder. Test the absorbing solutions as outlined in the procedures in the individual test kit instructions.

**References:**

Clean Air Trust. *Sulfur Dioxide.* 1999. http://www.cleanairtrust.org/sulfurdioxide.html

Environmental Protection Agency. An Introduction to Indoor Air Quality. 2010.

 http://www.epa.gov/iaq/no2.html

Gay, Susan W. and Knowlton, Katharine F. *Ammonia Emissions and Animal Agriculture,*

 *Virginia Cooperative Extension.* 2009. http://pubs.ext.vt.edu/442/442-110/442-110.html

Jacobsen, Larry, Sullivan, Jim, and Mukhtar, Saqib. *Hydrogen Sulfide: How Serious an Outdoor*

 *Air Quality Concern?*. Livestock and Poultry Environmental Learning Center. 19 Sept.

 2008. http://www.extension.org/mediawiki/files/d/d6/08sepflyer.pdf

State of Michigan. *Hydrogen Sulfide H2S- Q & A*, Department of Natural Resources and

 Environment. 2010. http://www.michigan.gov/deq/0,1607,7-135-3311\_4111\_4231-9162-

 -,00.html