General Health Hazards in the Arts

University of Calgary, Faculty of Arts, Department of Art

Prepared by:
Workshops Technicians, Department of Art
Revised June 2017

Routes of Entry

1. How Art Materials Can Affect You

Substances can enter the body by three major routes.

a) Inhalation:

The commonest way foreign substances enter the body- vapours, fumes, dusts, gases or mists can be inhaled into the respiratory system and may damage the nose, mouth, upper respiratory tract, lungs or be absorbed into the bloodstream and travel to other organs in the body.

b) Ingestion:

Substances may be accidentally or willingly ingested through the contamination of food, drinks, and cigarettes and hands and may affect the mouth, throat and stomach or be absorbed into the bloodstream.

c) Skin Contact:

Substances may attack or destroy the natural protective barriers of the skin, damaging the skin itself, and enabling toxic chemicals to enter the bloodstream, where they are carried to various organs of the body.

2. The health effects of a substance are determined by:

- The amount of a substance to which you are exposed
- The amount of time you are exposed to a substance
- The form in which the substance is encountered (ie. Gas, fume, dust, etc.)
- The toxicity of the substance
- How your body responds to the substance

3. Acute vs. Chronic Exposure

Acute: Acute illness result from a single exposure to a toxic substance.

Chronic: Chronic illness result from prolonged and repeated exposures to a toxic substance, often in small amounts.

Biological Systems Affected

a) Skin

- The skin's protective barrier can be physically damaged by flying chips, abrasive substances and splashes of hot liquids, sparks or molten metals.
- Chemical can break down the skin's protective barrier and cause allergies and irritation. Some chemicals are absorbed through the skin and may enter the bloodstream and be transported to internal organs.
- Broken skin is susceptible to infections cause by funguses, molds and bacteria.

b) Eyes

- The eye is very delicate and highly susceptible to damage.
- The eye may be damaged from flying chips, chemical splashes or exposure to dusts or gases.
- The eye has three main natural defense mechanisms each of which has its limitations.
    - The bony structures surrounding the eye prevent physical damage from very large objects.
    - The blink reflex can protect the eye from low velocity particulates and liquid splashes.
    - Contact with clear large covering of the front of the eye, known as the cornea, initiates tearing which assists in the dilution of the foreign substance.

c) Respiratory System

Natural defense mechanisms:

- Hairs and mucous membranes in the nose trap large particles.
- Receptor cells facilitate the sense of smell.
- Chemicals at hazardous concentrations cannot always be detected, therefore the sense of smell cannot be relied upon.
- The mucous lining in the trachea and bronchial tubes traps particulates, which are then carried up to the throat.
- Coughing.
- Very small particulate gases, and vapour can reach the deep lung spaces, called the alveoli. Here particulates are trapped for weeks to months before they are cleared. Permanent damage may be initiated during this time. Gases and vapours can quickly cross the thin alveolar membrane and enter the bloodstream, where they are carried throughout the body.

Inhalation exposure to harmful levels of contaminants may result in:

- Direct injury to lung tissues
- Allergic reaction (e.g. hay fever, asthma)
- Pneumonia
- Chronic respiratory diseases which may become inactivating over time
- Lung cancer

d) Circulatory System

Contaminants which gain access to the bloodstream may:

- Directly injure the heart tissue, blood vessels, blood components themselves and blood forming tissues (e.g. bone marrow).
- Be transported to other organs and cause damage (e.g. liver, kidney).

e) Nervous System

Central Nervous System: Brain and spinal cord.

Peripheral Nervous Systems: The nerves themselves which facilitate body functions.

- Most solvents cause central nervous system depression (fatigue, dizziness, lack of coordination, nausea, mental confusion).
- Some chemicals may cause inflammation of the nerves of the extremities, results in the paralysis of muscle groups controlled by these nerves.
- After removal from exposure nervous system symptoms usually disappear. Repeated exposures over time may result in chronic nervous system disorders.

f) Reproductive System

Exposure to hazardous substances may affect reproduction in three ways.

Prior to pregnancy in both men and women by:

- Lowering fertility
- Causing genetic damage to reproductive cells
- Inhibiting conception
- During pregnancy by directly affecting the developing fetus.
- After birth infants may be exposed to mother's milk poisoned with toxic chemicals.

Types of Airborne Contaminants:

a) Gasses and Vapours

Gas

At room temperature, a state of matter that has no definite volume or shape, which can expand and contract in response to changes in temperature and pressure, and will diffuse in space.

Vapour

A gaseous form of a material which, in its normal state, is a solid or liquid. Vapours are generated through evaporation of a liquid or sublimation of a solid.

b) Dust

A wide range of particle sizes which have been generated by some mechanical action such as crushing or grinding, or by dispersion of a bulk source of particulate.

c) Mist

Generated by the condensation of a vapour or by the physical break-up of a liquid.

d) Fume

Usually formed by the vaporization of a metal, with subsequent oxidation of the vapour, and condensation of the metal oxide.

Dust	Mist	Fume	Fibre
1-100 um	0.01-10 um	1.0 um	5.0 um
0.1 um 1.0 um		10 um	1 um = 1 cm

Ventilation of the Studio:

Effective ventilation is the best method for controlling contaminants generated and released into the studio atmosphere.

Two basic types of ventilation:

a) General Ventilation

The concentration of the contaminant generated is diluted by mixing the contaminated air with uncontaminated air. General ventilation is most effective for the control of vapours produced by liquids that are not highly toxic.

b) Local Exhaust Ventilation

The generated contaminant is captured at the source, before it has a chance to escape into the general air in the room. Local exhaust ventilation is required if the contaminant is highly toxic or large amounts of the toxic material is produced (e.g. silk screen washing, nitric acid etching, kiln firing, welding, dry clay mixing, etc.). A local exhaust system should be designed such that the air currents movie in a direction which carry the contaminants away from the workers breathing area.

Personal Protective Equipment:

If exposure to toxic materials cannot be prevented then the appropriate personal protective equipment shall be worn. Contact the Safety Office for assistance in selecting the correct personal protective equipment.

a) Respiratory Protection

Respiratory protect the wearer against inhalation of airborne contaminants. There are two general categories of respirators.

1. Air supplying respirators provide a supply of uncontaminated air, different from the workplace air.

2. Air purifying respirator remove the contaminants from the workplace air you breathe. They do not supply air and therefore must never be used in oxygen deficient atmospheres. Face pieces come in three configurations:

    - Quarter mask: Covers the mouth and nose
    - Half mask: Covers the mouth, chin and nose
    - Full face piece: Covers the face from the chin to hairline and from ear to ear
    - Disposable particulate “dust masks” are also available

Remember it is important to:

- Wear a respirator appropriate for the specific contaminant(s) of concern.
- Ensure that it fits properly, ensuring a mask to face seal. Facial hair prevents a tight seal.
- Wear a respirator which is in a clean and sanitized condition.
- Store the respirator, when not in use, in a clean place, without disrupting the face piece shape.

Types of Cartridges/ Filters for Air Purifying Respirators:

- Organic vapours cartridges
- Acid gases cartridges (chlorine, hydrogen chloride and sulphur dioxide)
- Ammonia cartridges
- Dust, mist and fume pre-filters

Face and Eye Protection:

The eye and the face require protection from three types of hazards.

a) Chemical splashes and dust:

- Hooded goggles should be worn for protection against dust and noncorrosive chemicals (weak acids, alkalis and solvents)
- An approved face shield should be worn for protection against chemical splashes, from corrosive acids and alkalis

b) Flying particles produced in chipping, grinding and machining:

- Safety spectacles, with or without side shields, containing safety lens and completely surrounded by frames
- Flexible fitting goggles
- Chipping goggles

c) Radiation:

In wielding, brazing or furnace operations, in addition to glare, ultraviolet and/ or infrared radiation may be emitted. Goggles or an approved welding helmet should be worn. Goggles with an appropriate shade for the given type and intensity.

Contact lens and standard glass lens are NOT substitutes for proper eye protection.

Hand Protection:

a) The skin of the hands and fingers are the areas most exposed to hazards such as chemicals, heat, abrasions, and electricity (radiation).
b) No one type of glove offers protection against all chemicals and physical hazards.
c) When choosing a glove a number of factors must be considered:

- The specific type of hazard
- Degree of dexterity required
- The grip provided
- Length
- Whether lined or unlined
- Whether disposable or non-disposable

d) Protective hand creams are available which when applied to the skin offer limited protection against skin contact with some chemicals.

Hearing Protection:

a. Signs that you may be exposed to noise levels which may eventually cause permanent hearing loss include:
   - Ringing in the ears (tinnitus) after leaving a noisy area
   - Difficulty in communicating at three feet
   - Difficulty in hearing several hours after exposure

b. Contact the Safety Office to determine if hearing protection required.
c. The two basic types of hearing protection are:
   - Ear plugs
   - Ear muffs

Solvents, Aerosol Sprays, Acids and Alkalis

Organic Solvents

Organic solvents are frequently used in most art media. Artists are continually being exposed to solvents. Although all solvents are potentially harmful and should be used with precaution they can be used safely.

Some solvents are highly toxic and cannot be used safely with string controls:

- Benzene (Benzol)
- Carbon tetrachloride
- Methyl, n-butyl ketone

- N-hexane
- Trichloroethylene

Generally, all organic solvents:

- Affect the central nervous system and act as depressants and anaesthetics.
- May cause dermatitis, following direct contact with the skin, by weakening its natural fatty tissue. With the exception of chlorinated hydrocarbons, organic solvents are highly flammable.

They should be stored in closed containers, located in flammable storage cabinets. Flammable and combustible liquids are usually defined in terms of The National Fire Protection Association (NFPA) classification. The flammability of a liquid is primarily determined by its flash point. The flash point is the minimum temperature of a liquid at which sufficient vapour is given off to form an ignitable mixture with the air near the surface of the liquid, in the presence of an ignition source. Many common solvents are highly flammable at room temperature.

Solvents (Organic):

Routes of Entry: Skin contact and inhalation.

Direct skin contact – skin irritation, dryness, defatting of skin (removal of natural oils).

Inhalation of Vapors:

-May affect central and peripheral nervous systems (headache, irritability, sleep disturbances, poor work performance.)
-Blood, liver, kidney and digestive system may be adversely affected by long term low exposures, or short term high exposures.
-Fire and explosive hazards
-Irritation of the mucous membranes and upper respiratory tract.

Chemical Family	Examples	General Health Effects
Aromatic Hydrocarbons	Benzene Toluene Xylene Styrene	-Central nervous system depression -Possible bone marrow disorders -Dermatitis as a result of repeated skin contact -Septemic poisoning with possible chronic liver and kidney damage
Aliphatic Hydrocarbons	Petroleum Kerosene N-hexane Mineral spirits VM+P napthar	-Asphyxiation -Central nervous systems depression -Dermatitis as a result of repeated skin contact

	Gasoline	-Irritation of nervous system -Irritation of mucous membranes of upper respiratory traces -Peripheral nervous system damage (n-hexane) -Systemic poisoning with possible chronic liver and kidney damage
Chlorinated Hydrocarbons	Carbon tetra-chloride Methylene chloride Trichloroethylene	-Central nervous system depression -Dermatitis as a result of repeated skin contact -Systemic poisoning with possible kidney and liver damage -Some are suspect carcinogens -Decompose in presence of excess heat or ultraviolet light to form highly toxic phosgene gas
Ketones	Acetone Isophorone Methyl ethyl ketone	-Central nervous system depression -Dermatitis as a result of repeated skin contact -Eye irritation -Narcosis -Peripheral nervous system damage (methyl, n-butyl, ketone)
Alcohols	Methyl Alcohol Ethyl Alcohol	-General solvent effects -Ingestion of methyl alcohol may result in optic nerve damage -Irritation of mucous membrane

Safe Work Practices for the Use of Solvents

1. Never smoke, eat or drink when solvents are in use.
2. Substitute, where possible, a highly toxic solvent with one of lower toxicity.
3. Do not use solvents for cleaning hands.
4. Store solvents in closed containers, in approved flammable storage cabinets.
5. Waste solvents must be collected in approved safety cans, and not poured down the drain. Arrangements can be made with the Safety Office for weekly pick-ups.
6. Use local ventilation provided. If ventilation is inadequate then a NIOSH approved respirator with organic vapour cartridges should be worn. Consult the Safety Office.

7. When handling solvents wear appropriate chemical gloves and splash goggles.
8. Use solvents in well ventilated areas.
9. Avoid any ignition source: e.g. water heaters, furnaces, pilot light.
10. Use solvents out of the doors whenever possible.
11. Have a fire extinguisher handy at all times.

Aerosol Sprays:

Air brushes and spray guns generate aerosol mists. Aerosol sprays are in the form of fine mists, which may contain toxic substances. The fine mists produced can enter the deep lung spaces. They can travel long distances before settling.

Aerosol sprays should only be generated in the presence of adequate local exhaust ventilation.

Acids and Alkalis:

Strong Acids: Acetic, carbolic, chromic hydrochloric, nitric, sulfuric, hydrofluoric, perchloric.

Strong Bases: Potassium, hydroxide, sodium hydroxide, sodium carbonate, calcium oxide (quick lime), ammonia, calcium hydroxide, potassium carbonate.

Safe Work Practices for the Use of Acids and Alkalis:

1. When mixing, add acids to water, not the other way around.
2. When handling acids and bases wear appropriate chemical gloves and splash goggles.
3. Diluted acids and bases may be poured slowly down the drain, with excess water. Let the water run for several minutes afterwards.
4. Concentrated acids and bases should be collected in approved safety cans, and disposed through the Safety Office.
5. Keep acid baths covered when not in use.
6. Immediately wash hands or flush eyes if direct contact is made.

Basic Rules to Minimize Exposure:

1. Do not eat, drink or smoke in work area.
2. Wear personal protective equipment whenever needed:
   a. Gloves
   b. Respirators
   c. Eye protection
   d. Hearing protection
   e. Barrier creams
3. Take time to learn about the chemical components of the art materials you use and take every precaution you can using these materials.
4. Store materials properly in the appropriate containers. All materials should be clearly labelled.
5. Flammable materials should be stored in proper flammable storage cabinet.
6. Flammable materials should be stored in a proper flammable storage cabinet.