



3

CHEMICALS OF CONCERN

Use these documents that describe partially restricted and/or chemicals of concern to demonstrate to students the limited controls that are placed on chemicals. Examples are given of where those chemicals of concern exist in common building products, how they move through the environment and how they ultimately enter the human body.

How lead affects children's health

Brain

Any exposure is linked to lowered **IQ, ADHD, hearing loss, and damaged nerves**. Acute exposures can cause convulsions, **loss of body movement, coma, stupor, hyperirritability, & death**.

Heart

Studies suggest that adults who endured lead poisoning as children had significantly higher risks of **high blood pressure** 50 years later.

Hormones

Lead disrupts levels of vitamin D, which can **impair cell growth, maturation, and tooth and bone development**.

Blood

Lead inhibits the body's ability to make hemoglobin, which can lead to anemia. This reduces oxygen flow to organs, causing **fatigue, lightheadedness, rapid heartbeat, dizziness, & shortness of breath**.

Stomach

Severe lead exposure can create intense **abdominal pain and cramping**.

Kidneys

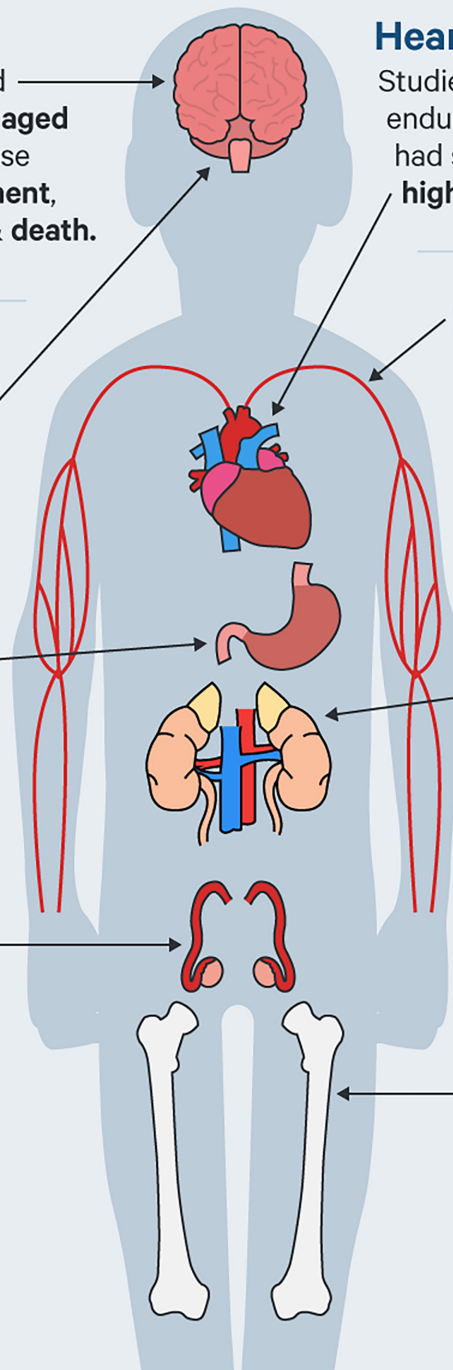
Chronic exposures can cause chronic inflammation, which can lead to **kidney failure, bloody urine, fever, nausea, vomiting, drowsiness, coma, weight gain, confusion, rash, and urinary changes**.

Reproductive System

A moderate exposure can not only **lower sperm count**, but also **damage them**. Chronic exposures can diminish the concentration, total count, and motility of sperm, though it's unclear how long these effects last after the exposure ends.

Bones

Lead may impair development and the health of bones, which can **slow growth in children**.

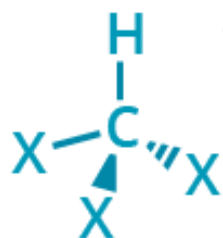


SOURCES: Centers for Disease Control; World Health Organization

TECH INSIDER

THE FLINT WATER CRISIS

The American city of Flint, Michigan, has been in the news recently due to the discovery of very high levels of lead in its water supply. But how did this lead get there? Here's a brief explainer.



TRihalOMETHANES

Disinfectant byproducts; formed by the reaction of chlorine (added to disinfect the water) with organic matter.

X = halogen (commonly Cl or Br)

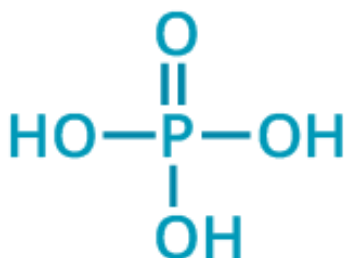
CORROSION: DETROIT VS. FLINT RIVER



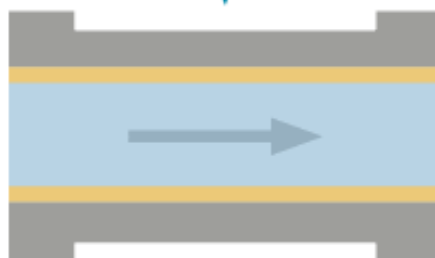
Chloride to sulfate mass ratio (CSMR); 0.45 = low corrosion; 1.60 = very high corrosion.

When high levels of trihalomethanes were detected in Flint's water, ferric chloride (FeCl_3) was added to improve removal of organic matter. However, this increased the water's already high concentration of chloride ions, and as a result made the water more corrosive.

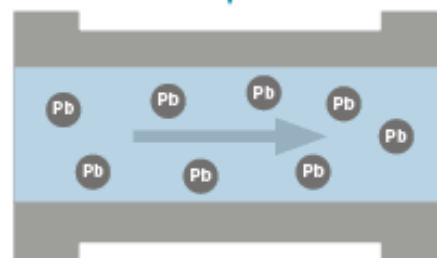
CORROSION CONTROL



WITH PHOSPHATES



WITHOUT PHOSPHATES



Orthophosphates are added to water to reduce the amount of lead leaching into it from pipes. They do this by forming a layer of low-solubility lead-phosphate complexes inside the pipe. This method of corrosion control was not used for the Flint River water supply.



© COMPOUND INTEREST 2016 - WWW.COMPOUNDCHEM.COM | @COMPOUNDCHEM
Shared under a Creative Commons Attribution-NonCommercial-NoDerivatives licence.



Miracle Mineral to Household Health Hazard: Tracing the Deadly Trajectory of Asbestos

ASBESTOS



“Miracle Mineral”

Asbestos is a naturally occurring mineral with many unique properties. The mineral is flexible yet tough, is resistant to flames and corrosion, does not conduct electricity, and when it is crushed, produces a multitude of silky filaments.

Asbestos was once called the “Miracle Mineral” and considered a natural resource that would bring Canada—one of the leading producers of asbestos—wealth and prosperity.

Fireproof & Indestructible

Asbestos fibers are woven into textiles and have proven to be an excellent fireproof insulator and structural reinforcement in construction materials. Its longevity and indestructibility made it popular, however, the consequences have been long lasting health effects.



Public Health Crusader

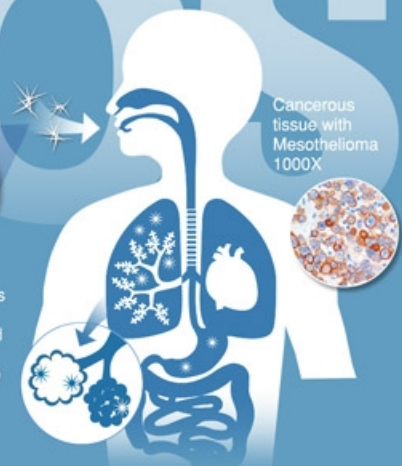
In the 1960s, Dr. Irving Selikoff identified and explained the health effects of asbestos exposure among workers. He conducted hands-on investigation of job sites and, when denied access, he went to union halls to gather medical histories and clinical results. He became a ‘Public Health Crusader’ working tirelessly to advocate for the regulation of asbestos.



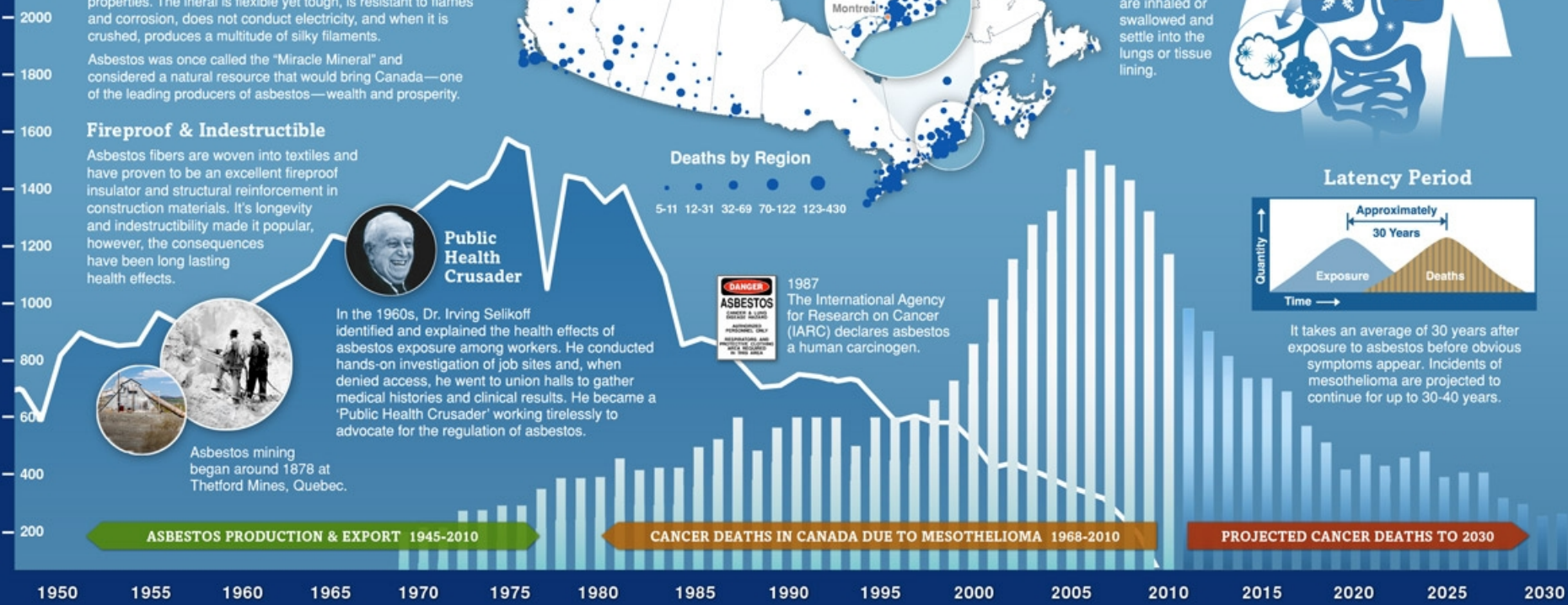
Asbestos mining began around 1878 at Thetford Mines, Quebec.



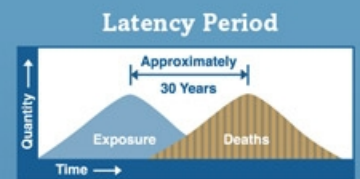
Microscopic asbestos fibres are inhaled or swallowed and settle into the lungs or tissue lining.



Canadian Production and Export of Asbestos in Tonnes (x1000)



DANGER ASBESTOS
 CANCER CAUSING
 RESPIRATORY AND
 REPRODUCTIVE SYSTEMS
 1987 The International Agency for Research on Cancer (IARC) declares asbestos a human carcinogen.



It takes an average of 30 years after exposure to asbestos before obvious symptoms appear. Incidents of mesothelioma are projected to continue for up to 30-40 years.

Credits: Asbestos pipe photo: R.W. Huntley; Irving Selikoff photo: ©Earl Dotter, www.earldotter.com; Asbestos fibres image courtesy U.S. Geological Survey; Mesothelioma image: Macmillan Publishers Ltd., Modern Pathology, Trupiano et al., 2004; Map of Canada created with data from the 2006 Census Divisions, Statistics Canada and the Canadian Mortality Database, Statistics Canada; Timeline created with data from the Vital Statistics Database and the Canadian Mortality Database, Statistics Canada and Statistics Canada and Natural Resources Canada, Mineral Production in Canada, 1948-2002.





Formaldehyde Found in Building Materials

Formaldehyde¹ is a colorless, flammable gas with a pungent, suffocating odor. It is released into the atmosphere from forest fires, automobile exhaust, and tobacco smoke; it is a significant component of smog. Very small amounts of formaldehyde are naturally produced in humans and other organisms and can naturally occur in some building materials (e.g. wood). Formaldehyde is produced industrially for use as a preservative, disinfectant, and for the manufacturing of a number of glues, resins, and other materials for building products. For industrial scale production, formaldehyde is manufactured from the oxidation of methanol (wood alcohol CAS No. 67-56-1), which is in turn derived from fossil fuels. The heavy metal silver is one of the primary catalysts used in the process. Other catalysts include a mixture of metals, including iron oxide.

Formaldehyde is a key component of several polymers used in building materials including urea formaldehyde, phenol formaldehyde (PF—or more commonly known as phenolic resin), and melamine resin. It is also a building block in the manufacture of methylene diphenyl diisocyanate (MDI).

- Urea Formaldehyde (UF—CAS #9011-05-6): An amino resin widely used as a binder in composite wood products (particleboard, plywood, and paneling), as well as in carpet;
- Phenol Formaldehyde (PF—CAS #9003-35-4): Used as a binder in fiberglass batt insulation and in composite wood products designed

for exterior use (due to its higher water resistance than urea formaldehyde). Also used increasingly as an alternative to urea formaldehyde in interior composite wood products. PF is also used as a binding agent for paper-based products such as paper composite countertops.

- Melamine resin (CAS #108-78-1): An amino resin used to make laminate countertops, glues, and fabrics. Melamine formaldehyde has recently been introduced as an alternative to UF and PF for composite wood products.
- Methylene diphenyl diisocyanate (MDI—CAS #101-68-8): used directly in composite wood and other products as a binder or glue and as a building block material (feedstock) in the production of polyurethane (PU) for both hard plastics and foams.

Health impacts

Cancer

Formaldehyde is targeted for elimination because it has been classified as a known carcinogen by the State of California (Proposition 65)² and the World Health Organization (International Agency for Research on Cancer).³ The National Institute of Health's National Toxicology Program (NTP) states that formaldehyde is reasonably anticipated to be a human carcinogen.⁴

Non-cancer

Formaldehyde causes eye, nose, and respiratory irritation and can be an asthma trigger in sensitive individuals.

Formaldehyde can cause contact dermatitis, associated with an allergic reaction to the chemical.⁵ In addition to its own toxic properties, formaldehyde can react with other chemicals in the atmosphere to create carbon monoxide.⁶ It is designated a Hazardous Air Pollutant by the US EPA as one of the major toxic constituents of smog.⁷ In 1992, formaldehyde was formally listed by the California Air Resources Board (CARB) as a toxic air contaminant in California, with no safe level of exposure.⁸

Methanol, from which formaldehyde is made, causes eye, skin and respiratory irritation and long-term chronic exposure can damage to the central nervous system and vision.⁹ Some of the products made with formaldehyde are chemicals of concern as well. Phenol formaldehyde, for example, is listed as a suspected immunotoxicant under the National Institute of Health's Database on Hazardous Chemicals and Occupational Diseases.¹⁰

Occupational exposures

Formaldehyde and methanol exposure are both problems in the workplace. The Occupational Safety and Health Administration (OSHA) has established a formaldehyde standard for protective clothing and equipment that applies to all occupational exposures to formaldehyde.¹¹ The Center for Disease Control's (CDC) National Institute for Occupational Safety and Health (NIOSH) regulates occupational exposures to formaldehyde¹² and methanol.¹³

Indoor air quality and other user exposures

Formaldehyde is one of a group of volatile organic compounds (VOCs) that

help form smog and ground level ozone in the outdoor environment. Inside of buildings, it is a growing threat to human health due to its use in a wide range of building and consumer products that release it into the indoor air environment.

Formaldehyde can be released to the user from products treated directly with formaldehyde, such as fabrics, and from products that use formaldehyde-based binders. Urea formaldehyde continues to outgas formaldehyde for years after manufacture and has been a target of green building programs and regulatory action. Products containing phenol formaldehyde also outgas formaldehyde during use, however at a far lower rate than urea formaldehyde-based products. Some paints, adhesives and other wet applied products create formaldehyde as they cure.

Methanol feedstock and heavy metal catalysts of formaldehyde manufacture are not known to remain present in the final product and hence are considered purely occupational exposure issues.

LEED™ credits buildings that source products without urea formaldehyde, however, two of the other products described here that are frequently used as alternatives to UF (PF and melamine) still expose users to formaldehyde and the third (MDI) exposes workers to formaldehyde.

Resources

More information on formaldehyde, its health impacts, and recent regulatory actions to reduce emissions can be found in the PharosWiki entry on Formaldehyde at www.pharosproject.net/wiki/index.php?title=Formaldehyde

ENDNOTES

- 1 Formaldehyde (CAS No. 50-00-0) is also known as methanal, methylene oxide, oxymethylene, methylaldehyde, or oxomethane and has the chemical abbreviation HCHO.
- 2 California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, "Safe Drinking Water and Toxic Enforcement Act of 1986—Chemicals Known to the State to Cause Cancer or Reproductive Toxicity" March 2008. http://www.oehha.org/prop65/prop65_list/files/032108list.pdf.
- 3 International Agency for Research on Cancer (IARC), Monographs on Evaluation of Carcinogenic Risks for Humans—Formaldehyde. <http://monographs.iarc.fr/ENG/Meetings/88-formaldehyde.pdf>.
- 4 National Institute of Health, 11th Report on Cancer, National Toxicology Program 1998. <http://ntp-server.niehs.nih.gov/index.cfm?objectid=32BA9724-F1F6-975E-7FCE50709CB4C932>.
- 5 Isaksson M, Zimerson E, Bruze M., Occupational Dermatitis in Composite Production. *J Occup Environ Med.* April 1999, 41(4):261-6.
- 6 Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for Formaldehyde, July 1999. <http://www.atsdr.cdc.gov/toxprofiles/tp111.html>.
- 7 US EPA, 1996 National-Scale Air Toxics Assessment. <http://www.epa.gov/ttn/atw/nata>.
- 8 California Air Resources Board. Technical Support Document: Final report on the identification of Formaldehyde as a Toxic Air Contaminant. Sacramento, CA: CARB. July 1992. <http://www.arb.ca.gov/toxics/id/summary/formald.pdf>.
- 9 World Health Organization "Health and Safety Guide No. 105 Methanol" International Programme on Chemical Safety, 1997. <http://www.inchem.org/documents/hsg/hsg/v105hsg.htm>.
- 10 National Institute of Health, "Relational Database of Hazardous Chemicals and Occupational Diseases" <http://hazmap.nlm.nih.gov/hazmapadv.html>.
- 11 29 Code of Federal Regulations § 1910.1048.
- 12 National Institute for Occupational Safety and Health, "International Chemical Safety Card: Formaldehyde". <http://www.cdc.gov/niosh/ipcsneng/neng0275.html>.
- 13 National Institute for Occupational Safety and Health, "International Chemical Safety Card: Methanol." <http://www.cdc.gov>

FIGURE 1. Commonly Flame Retarded Products in Buildings



GUIDELINES TO SELECTING MATERIALS WITHOUT HARMFUL FLAME RETARDANTS

Item	Are products without potentially harmful flame retardants available?
1a Polyisocyanurate Foam Boards Insulation	Rare or Unavailable*
1b Spray Polyurethane Foam (SPF) Insulation	Rare or Unavailable*
1c Polystyrene Foam Boards (XPS and EPS) Insulation	Rare or Unavailable*
2 Upholstered Furniture	Uncommon
3 Curtains, and Textile Wall and Ceiling Covers	Common
4 Padding Under Broadloom Carpet	Uncommon
5 Steel Protected with Intumescent Paint	Common
6a Televisions and Other Electronics with Plastic Cases	Uncommon
6b Computers with Plastic Cases	Uncommon

* Alternatives to plastic foam insulation that do not include potentially harmful flame retardants are described in the following text.

RETAILERS CHANGING THEIR CHEMICAL PROTOCOLS

Home Depot's Chemical Strategy				
Substance	Health Effects ^(a)	Carpet	Interior / Exterior Latex Paint	Fiberglass Insulation
Triclosan	Persistent, Bioaccumulative Toxicant	Banned	Banned	(f)
Isocyanates	Asthmagen	(g)	Banned	(f)
Formaldehyde ^(b)	Carcinogen, Asthmagen	Banned	Banned	Banned
Lead/Heavy Metals	Persistent, Bioaccumulative Toxicant, Carcinogen, Developmental and Reproductive Toxicant	Banned (Added heavy metals)	Banned	Banned (Added heavy metals)
Alkylphenol ethoxylates (including nonylphenol ethoxylates) ^(c)	Persistent, Bioaccumulative Toxicant, Developmental and Reproductive Toxicant	Banned (Nonylphenol ethoxylates)	Banned (Dec. 2019)	(g)
PFOA and PFOS	Persistent, Bioaccumulative Toxicant, Developmental and Reproductive Toxicant	Banned	(f)	(f)
Organotins	Persistent, Bioaccumulative Toxicant, Reproductive Toxicant	Banned	(f)	(f)
Ortho-Phthalates ^{(c)(d)}	Carcinogen, Developmental and Reproductive Toxicant, Endocrine Disruptor	Banned	(f)	(f)
Vinyl Chloride	Carcinogen, Mutagen	Banned	(f)	(f)
Coal Fly Ash ^(e)	Persistent, Bioaccumulative Toxicant, Carcinogen, Developmental and Reproductive Toxicant	Banned	(f)	(f)
Halogenated flame retardants (including brominated flame retardants) ^(c)	Persistent, Bioaccumulative Toxicant, Carcinogen, Developmental and Reproductive Toxicant	(h)	(f)	Banned
Antimony Trioxide	Carcinogen, Developmental and Reproductive Toxicant	(h)	(f)	Banned

Table by Healthy Building Network, based on Home Depot Chemical Strategy released October 25, 2017

- Health effects taken from Pharos Chemical and Material Library, October 25, 2017.
- Home Depot also restricts formaldehyde emissions from laminate flooring to 0.0073 ppm or less, well below the State of California's CARB 2 standard of 0.05 ppm.
- Different specific chemicals may have different associated hazards, but one or more chemicals in this class are known to have the hazards listed.
- Home Depot also eliminated phthalates from vinyl resilient flooring in 2015.
- Contains heavy metal impurities with the listed hazards.
- Not commonly present in this type of product.
- Occasionally present in this type of product as residuals of production.
- May be present as intentional substance in this type of product, but not banned by the Chemical Strategy.