

Six Classes

**We can reduce harmful chemicals
for a healthier world.**

Periodic table of elements

hydrogen 1 H 1.0079																	Halogens ↓					helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180					
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948					
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80					
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29					
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]				
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnium 110 Uun [271]	ununium 111 Uuu [272]	unubium 112 Uub [277]	ununquadium 114 Uuq [289]									

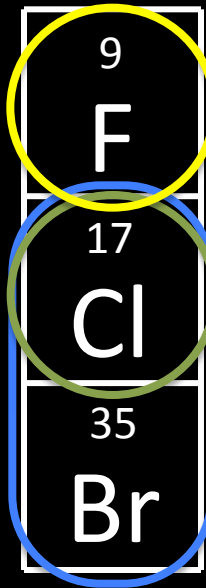
* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
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** Actinide series

actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]
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Six classes



- 1. Fluorinated chemicals**
stain and water repellants
- 2. Chlorinated antimicrobials**
triclosan and triclocarban
- 3. Flame retardants**
brominated, chlorinated, phosphate
- 4. Endocrine disrupting plasticizers**
BPA, phthalates, etc.
- 5. Some solvents**
benzene, methylene chloride, xylene, etc.
- 6. Some heavy metals**
lead, mercury, chromium, cadmium, arsenic, etc.



Toxics Use Reduction Institute

Solvents

Six Chemical Classes Webinar Series

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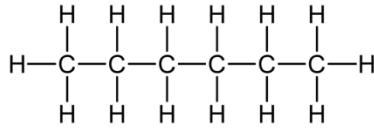
Solvents – basic functions

- Dissolve or disperse materials
- Carrier solvents
- Cleaning and stripping
- Mixing medium

Hydrocarbon Solvents

- Aliphatic organic solvents

- Petroleum distillates, mineral spirits, hexane

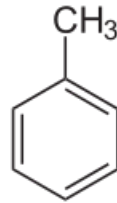


- Paints, coatings, thinners



- Aromatic organic solvents

- Toluene, xylene, benzene



- adhesives, printing inks



Chlorinated Solvents

- Methylene chloride (dichloromethane)

- perchloroethylene (perc)

- Paint strippers



Credit: Making it mine blogspot

- Dry cleaning



Oxygenated Solvents

- *Examples:*

- ethyl acetate
- acetone
- glycol ethers
- alcohols

- Nail polish and polish remover



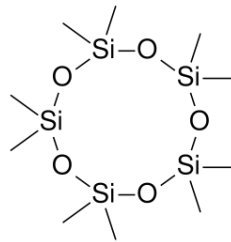
- Janitorial cleaners, personal care products



Volatile Methyl Siloxanes: cyclosiloxanes

- Examples:

- D5 cyclic siloxane



- Dry cleaning



- D4 and D5 cyclic siloxanes (cyclomethicone, cyclosiloxanes)

- Cosmetics, hair conditioners, personal care products

CYCLOPENTASILOXANE



Purpose Antiperspirant
Use Reduces underarm perspiration
Warnings For external use only. Ask a doctor before use if you have sensitive skin. Do not use on broken skin. Stop use if rash or irritation occurs. Keep out of reach of children. If swallowed, get medical help or contact a Poison Control Center right away. Do not use if the security seal is broken or missing.
Directions Apply as needed to underarms
Non-medicinal Ingredients WATER/EAU • CYCLOPENTASILOXANE • PPG-15 STEARYL ETHER • CETEARYL ALCOHOL • DICAPRYLYL CARBONATE • DIMETHICONE • CETEARETH-33 • PARFUM/FRAGRANCE • CETYL ALCOHOL



Water

Nature's original solvent



Human Health Concerns

Broad, diverse category with various concerns

- **Neurotoxicity** – most organic solvents
- **Carcinogenicity** – Chlorinated/brominated
- **Liver and kidney toxicity** – many organic solvents
- **Reproductive toxicity**
 - e.g., ethylene glycol ethers, N methyl pyrrolidone (NMP)
- **Contact dermatitis, defatting of skin** – many organic solvents

Other Concerns

Broad, diverse category with various concerns

- Environmental Concerns
 - Volatile Organic Compounds (VOCs) contribute to ground level ozone pollution
 - Potential groundwater contamination from spills
 - Persistence – siloxanes, chlorinated solvents
- Safety Concerns
 - Flammability – many organic solvents

Examples of Exposure

- Methylene Chloride paint strippers
 - Very volatile, high inhalation exposure
 - High vapor density – vapor “sinks”
 - Worker deaths from bathtub refinishing



Credit: Making it mine blogspot

- Cyclosiloxanes
 - Volatile, inhalation exposure
 - Used widely in personal care products and found throughout the environment
 - Health and environmental concerns



Siloxanes - Current activity and concerns

There's no such place as "away"

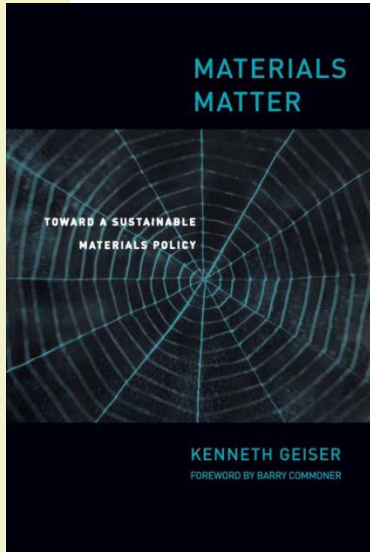
- **Cyclic Siloxanes – D4, D5, D6**
 - EPA negotiating exposure monitoring agreement with industry. Risk assessment is planned.
 - Biomonitoring in California
- **D5: Canadian Siloxane D5 Board of Review**
 - concluded that although persistent, unlikely to cause environmental effects
- **D4: Canada requires pollution prevention planning**
 - EU Determination of Persistent, Bioaccumulative and Toxic

Solutions? Safer Alternatives

- Paints and coatings: water-based products
- Paint strippers: dibasic esters
- Garment dry cleaning: wet cleaning
- Ethylene based glycol ethers: propylene based glycol ethers

Take Away Points for Solvents

- Diverse set of substances
 - Many known health, environmental, and safety concerns
 - Neurotoxicity, flammability, liver and kidney toxicity, respiratory, eye and skin irritants
 - Some emerging concerns or questions
 - E.g., cyclosiloxanes
 - Safer alternatives available
 - Move forward using Green Chemistry
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Book recommendation:
Materials Matter
By Dr. Kenneth Geiser

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“The products we purchase and use are assembled from a wide range of naturally occurring and manufactured materials. But too often we create hazards for the ecosystem and human health as we mine, process, distribute, use and dispose of these materials... This book argues that the safest and least costly point at which to avoid environmental damage is when materials are first designed and selected for use...”