



CEE 772: Instrumental Methods in Environmental Analysis

Lecture #1

Introduction: Course Administration
and Analytical Review

(Skoog, Chapt. 1A-1D)

(Harris, Chapt. 0)
(pp.xvi-12)

(pp.1-11)

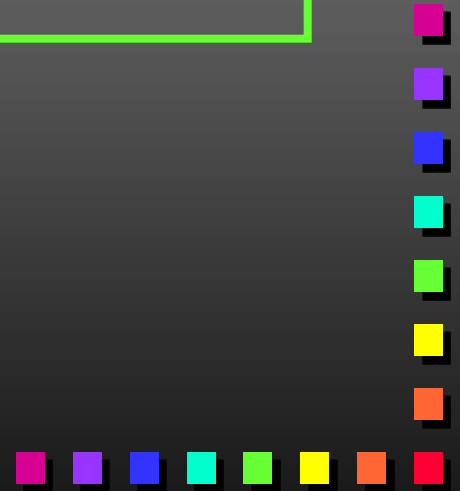
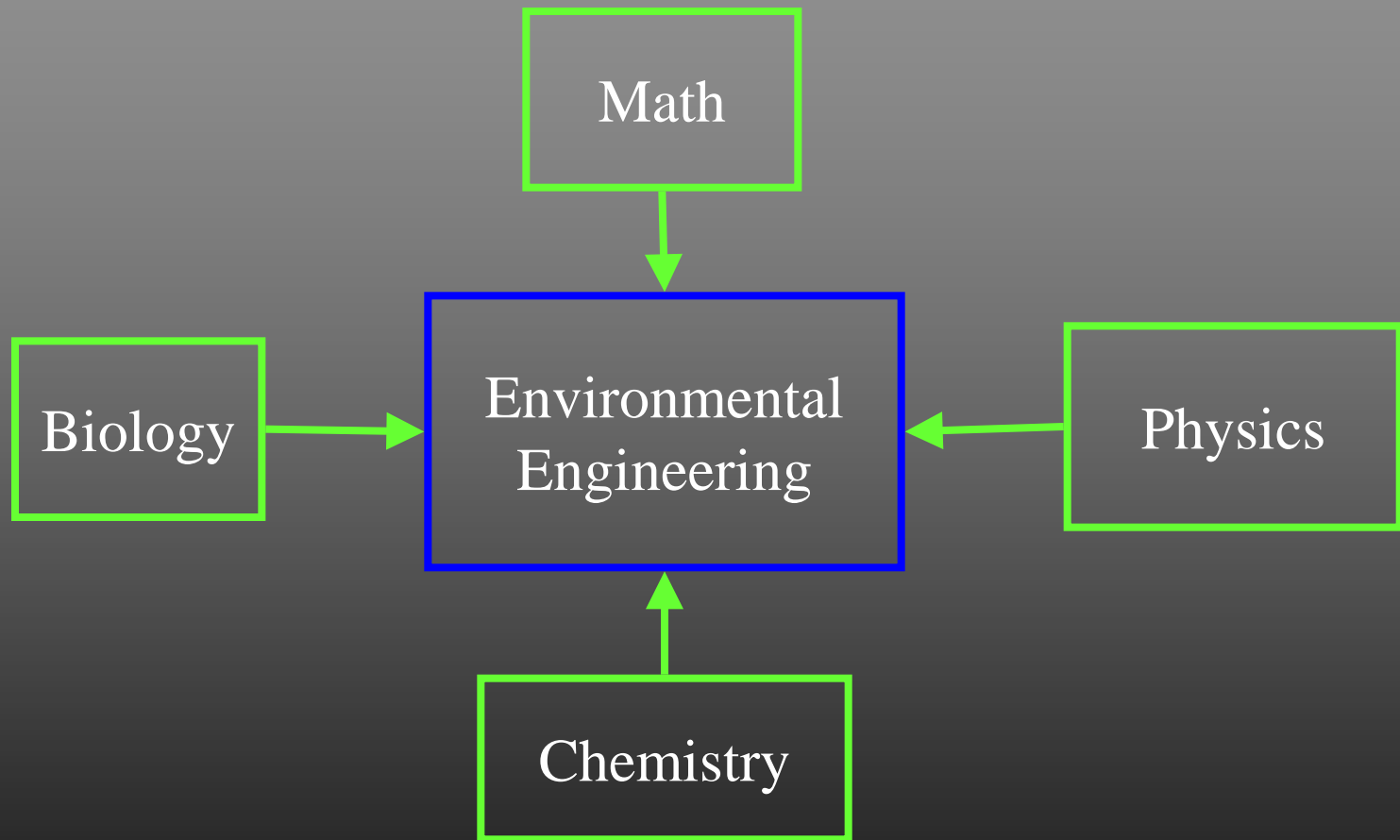


Course Administration

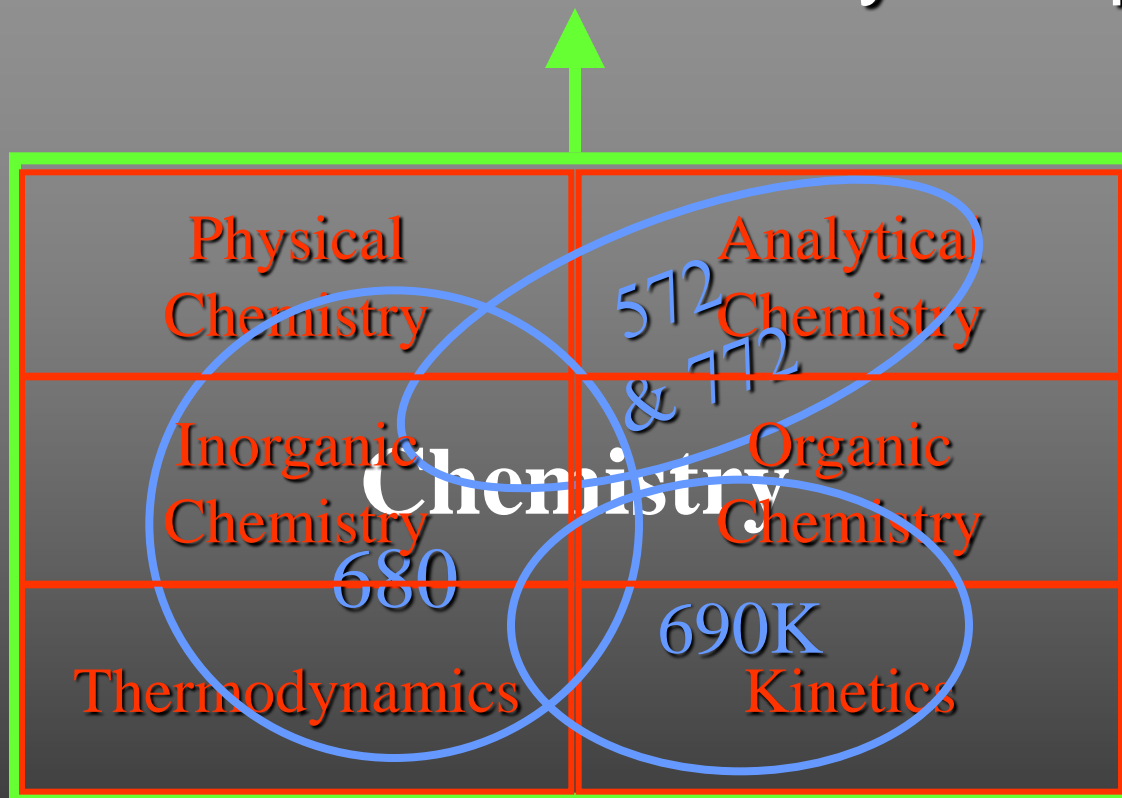
- Schedule
 - TuTh: lecture, M: lab in Elab II, room 301/308
- Course Syllabus
- Book: Skoog et al., 2006
 - supplemented by Harris, 2006
 - course notes (Reckhow, 2012)
- Detailed Course Outline
- Instrument Project
 - Design and execute lab exercise
 - Supporting lecture
 - Written report
- Web site



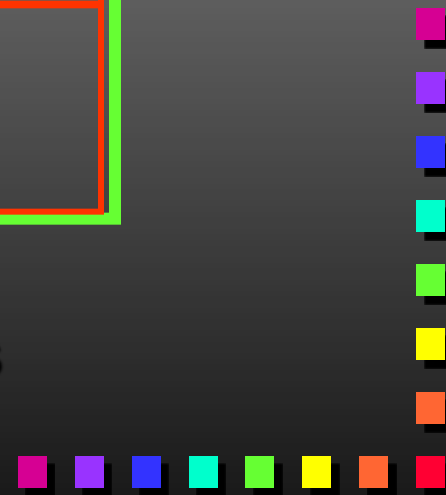
Relation with Environmental Engineering



Relation with other Chemistry Disciplines



- First of two courses on chemical analysis



Questions for Environmental Analytical Chemists

- How do we assess water quality?
 - What to measure, when and why
- How do we do it?
 - Gravimetry, titrimetry, spectrophotometry, chromatography
- What can chemical analysis tell us?
 - What can't it be used for?
- What is the significance of WQ parameters?
 - Metals, nutrients, solids, organics?
- How should samples be collected and preserved?
 - How do we spot blunders?
- How sure can we be of the measurements?



Why learn WQ analysis?

- You may have to make these measurement yourself
 - As a consultant
 - As a utility or industrial employee
 - As a graduate student
- You may need to interpret and critique water quality data collected by others
- You may need to select the types of water quality analyses required for a particular job



Review

- Laboratory Basics
 - CEE 577
 - Early Chapters in Harris
- Units
 - Mass based
 - Molarity
 - Molality
 - Normality
 - Mole fraction
 - Atmospheres

- Chemical Stoichiometry
 - mass balance
 - balancing equations
- Thermodynamics
 - law of mass action
 - types of equilibria



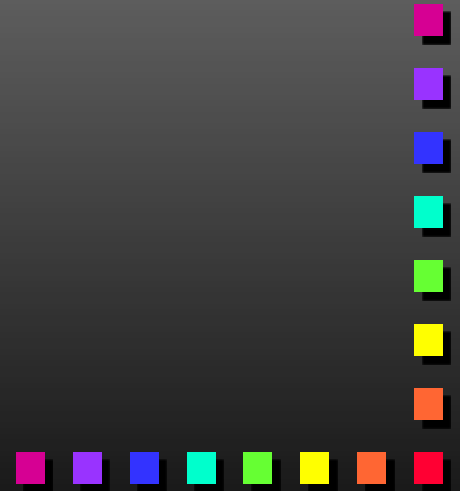
1 1.008 H 2.20 1s ¹ Hydrogen	<p style="text-align: center;">Element Symbol</p> <p style="text-align: center;">Atomic Number, Z — 1 — 1.008 — Atomic Molar mass (g/mol)</p> <div style="text-align: center;"> <table border="1"> <tr> <td>1</td> <td>1.008</td> </tr> <tr> <td>H</td> <td>1s¹</td> </tr> <tr> <td>Hydrogen</td> <td></td> </tr> </table> <p>Electronegativity (Allred-Rochow if Pauling not avail.) — 2.20 — Valence Configuration</p> <p style="text-align: center;">Element Name</p> </div>																1	1.008	H	1s ¹	Hydrogen		2 4.003 He n.a. 1s ² Helium
1	1.008																						
H	1s ¹																						
Hydrogen																							
3 6.941 Li 0.98 2s ¹ Lithium	4 9.012 Be 1.57 2s ² Beryllium	5 10.811 B 2.04 2s ² 2p ¹ Boron	6 12.011 C 2.55 2s ² 2p ² Carbon	7 14.007 N 3.04 2s ² 2p ³ Nitrogen	8 15.999 O 3.44 2s ² 2p ⁴ Oxygen	9 18.998 F 3.98 2s ² 2p ⁵ Fluorine	10 21.180 Ne n.a. 2s ² 2p ⁶ Neon	11 22.990 Na 0.93 3s ¹ Sodium	12 24.305 Mg 1.31 3s ² Magnesium	13 26.982 Al 1.61 3s ² 3p ¹ Aluminum	14 28.086 Si 1.90 3s ² 3p ² Silicon	15 30.974 P 2.19 3s ² 3p ³ Phosphorus	16 32.066 S 2.58 3s ² 3p ⁴ Sulfur	17 35.453 Cl 3.16 3s ² 3p ⁵ Chlorine	18 39.948 Ar n.a. 3s ² 3p ⁶ Argon								
19 39.098 K 0.82 4s ¹ Potassium	20 40.078 Ca 1.00 4s ² Calcium	21 44.956 Sc 1.36 4s ² 3d ¹ Scandium	22 47.88 Ti 1.54 4s ² 3d ² Titanium	23 50.942 V 1.63 4s ² 3d ³ Vanadium	24 51.996 Cr 1.66 4s ¹ 3d ⁵ Chromium	25 54.938 Mn 1.55 4s ² 3d ⁵ Manganese	26 55.847 Fe 1.83 4s ² 3d ⁶ Iron	27 58.933 Co 1.88 4s ² 3d ⁷ Cobalt	28 58.69 Ni 1.91 4s ² 3d ⁸ Nickel	29 63.546 Cu 1.90 4s ¹ 3d ¹⁰ Copper	30 65.39 Zn 1.65 4s ² 3d ¹⁰ Zinc	31 69.723 Ga 1.81 4s ² 4p ¹ Gallium	32 72.61 Ge 2.01 4s ² 4p ² Germanium	33 74.922 As 2.18 4s ² 4p ³ Arsenic	34 78.96 Se 2.55 4s ² 4p ⁴ Selenium	35 79.904 Br 2.96 4s ² 4p ⁵ Bromine	36 83.80 Kr n.a. 4s ² 4p ⁶ Krypton						
37 85.468 Rb 0.82 5s ¹ Rubidium	38 87.62 Sr 0.95 5s ² Strontium	39 88.906 Y 1.22 5s ² 4d ¹ Yttrium	40 91.224 Zr 1.33 5s ² 4d ² Zirconium	41 92.906 Nb 1.6 5s ¹ 4d ⁴ Niobium	42 95.94 Mo 2.16 5s ¹ 4d ⁵ Molybdenum	43 (98) Tc 1.9 5s ² 4d ⁵ Technetium	44 101.07 Ru 2.2 5s ¹ 4d ⁷ Ruthenium	45 102.91 Rh 2.28 5s ¹ 4d ⁸ Rhodium	46 106.42 Pd 2.20 4d ¹⁰ Palladium	47 107.87 Ag 1.93 5s ¹ 4d ¹⁰ Silver	48 112.41 Cd 1.69 5s ² 4d ¹⁰ Cadmium	49 114.82 In 1.78 5s ² 5p ¹ Indium	50 118.71 Sn 1.96 5s ² 5p ² Tin	51 121.75 Sb 2.05 5s ² 5p ³ Antimony	52 127.60 Te 2.1 5s ² 5p ⁴ Tellurium	53 126.91 I 2.66 5s ² 5p ⁵ Iodine	54 131.29 Xe 2.6 5s ² 5p ⁶ Xenon						
55 132.91 Cs 0.79 6s ¹ Cesium	56 137.33 Ba 0.89 6s ² Barium	57 174.97 Lu 1.27 6s ² 5d ¹ Lutetium	58 178.49 Hf 1.3 6s ² 5d ² Hafnium	59 180.95 Ta 1.5 6s ² 5d ³ Tantalum	60 183.85 W 2.36 6s ² 5d ⁴ Tungsten	61 186.21 Re 1.9 6s ² 5d ⁵ Rhenium	62 190.2 Os 2.2 6s ² 5d ⁶ Osmium	63 192.22 Ir 2.20 6s ² 5d ⁷ Iridium	64 195.08 Pt 2.28 6s ¹ 5d ⁹ Platinum	65 196.97 Au 2.54 6s ¹ 5d ¹⁰ Gold	66 200.59 Hg 2.00 6s ² 5d ¹⁰ Mercury	67 204.38 Tl 1.62 6s ² 6p ¹ Thallium	68 207.2 Pb 2.33 6s ² 6p ² Lead	69 208.98 Bi 2.02 6s ² 6p ³ Bismuth	70 (209) Po 2.0 6s ² 6p ⁴ Polonium	71 (210) At 2.2 6s ² 6p ⁵ Astatine	72 (222) Rn n.a. 6s ² 6p ⁶ Radon						
87 (223) Fr 0.7 7s ¹ Francium	88 226.03 Ra 0.89 7s ² Radium	89 (260) Lr 1.3 7s ² 6d ¹ Lawrencium	90 (261) Unq n.a. 7s ² 6d ² Unnilquadium	91 (262) Unp n.a. 7s ² 6d ³ Unnilpentium	92 (263) Unh n.a. 7s ² 6d ⁴ Unnilhexium	93 (264) Uns n.a. 7s ² 6d ⁵ Unnilseptium	94 (265) Uno n.a. 7s ² 6d ⁶ Unniloctium	95 (266) Une n.a. 7s ² 6d ⁷ Unnilennium															

57 138.91 La 1.10 6s ² 5d ¹ Lanthanum	58 140.11 Ce 1.12 5d ¹ 4f ¹ Cerium	59 140.91 Pr 1.13 6s ² 4f ³ Praseodymium	60 144.24 Nd 1.14 6s ² 4f ⁴ Neodymium	61 (145) Pm 1.07 6s ² 4f ⁵ Promethium	62 150.36 Sm 1.17 6s ² 4f ⁶ Samarium	63 151.96 Eu 1.01 6s ² 4f ⁷ Europium	64 157.25 Gd 1.20 5d ¹ 4f ⁷ Gadolinium	65 158.93 Tb 1.10 6s ² 4f ⁹ Terbium	66 162.50 Dy 1.22 6s ² 4f ¹⁰ Dysprosium	67 164.93 Ho 1.23 6s ² 4f ¹¹ Holmium	68 167.26 Er 1.24 6s ² 4f ¹² Erbium	69 168.93 Tm 1.25 6s ² 4f ¹³ Thulium	70 173.04 Yb 1.06 6s ² 4f ¹⁴ Ytterbium
89 227.03 Ac 1.10 7s ² 6d ¹ Actinium	90 232.04 Th 1.3 7s ² 6d ² Thorium	91 231.04 Pa 1.5 6d ¹ 5f ² Protactinium	92 238.03 U 1.38 6d ¹ 5f ³ Uranium	93 237.05 Np 1.36 6d ¹ 5f ⁴ Neptunium	94 (244) Pu 1.28 7s ² 5f ⁶ Plutonium	95 (243) Am 1.3 7s ² 5f ⁷ Americium	96 (247) Cm 1.3 6d ¹ 5f ⁷ Curium	97 (247) Bk 1.3 7s ² 5f ⁹ Berkelium	98 (251) Cf 1.3 7s ² 5f ¹⁰ Californium	99 (252) Es 1.3 7s ² 5f ¹¹ Einsteinium	100 (257) Fm 1.3 7s ² 5f ¹² Fermium	101 (258) Md 1.3 7s ² 5f ¹³ Mendelevium	102 (259) No 1.3 7s ² 5f ¹⁴ Nobelium

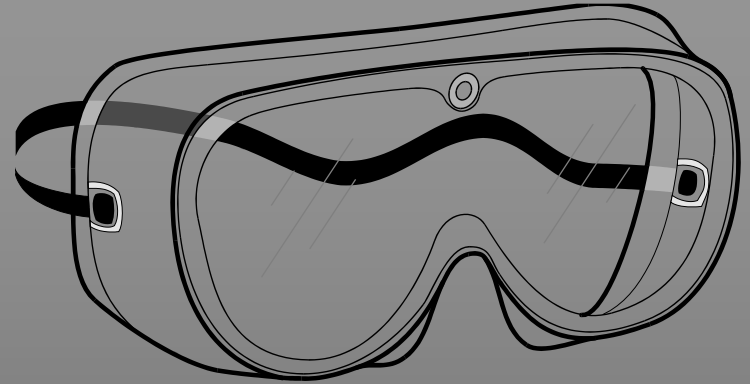


Chemical Equilibria

- Law of mass action
 - equilibrium quotients
- Examples
 - ion product of water
 - acid dissociation
 - precipitation
 - redox
 - adsorption
 - volatilization



Personal Safety



- Lab coats
 - Recommended for protection from acids & bases
- Goggles
 - Especially important if you don't wear shatter-proof glasses
- Gloves
 - Latex: good flexibility, but leaky
 - Butyl rubber: much better
- General
 - Avoid loose fitting clothing



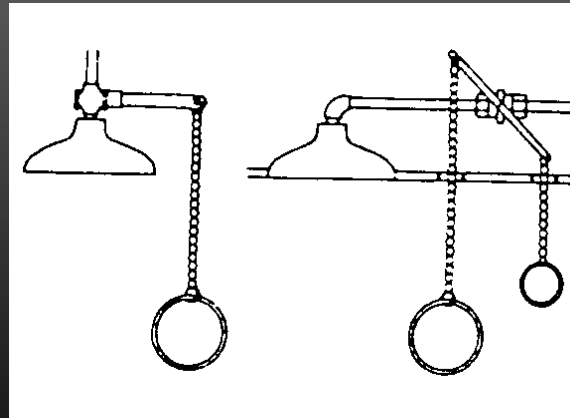
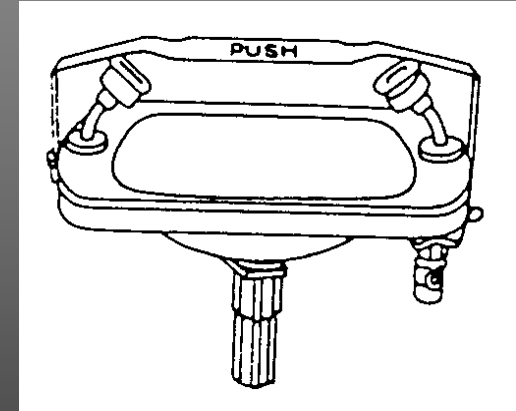
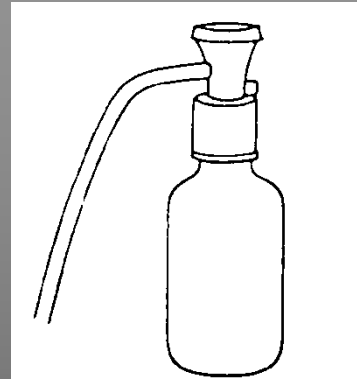
Lab Safety

■ Washes

■ Eye wash

- Squeeze bottle
- Plumbed fixture

■ Drench Shower



Eye wash

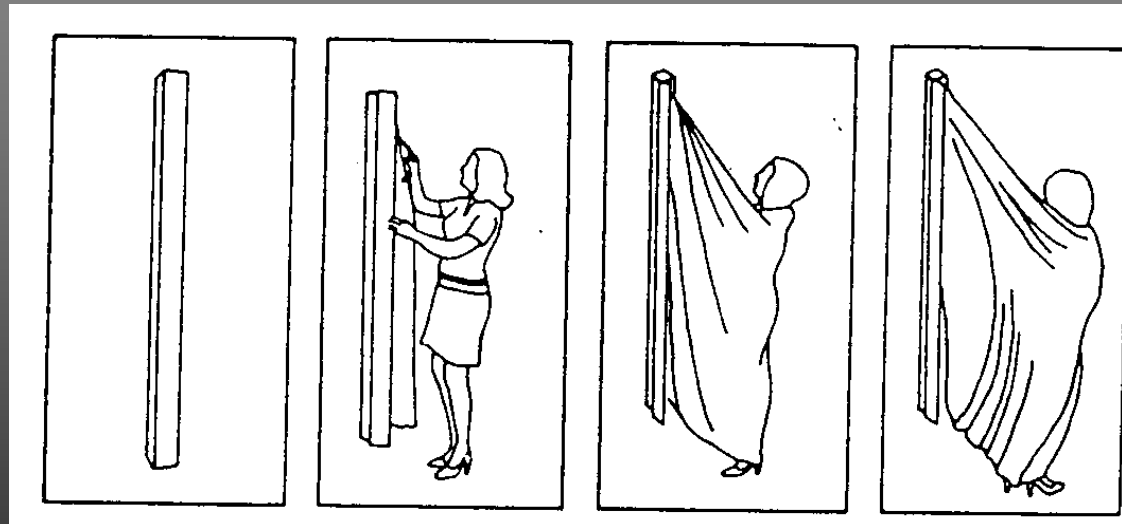
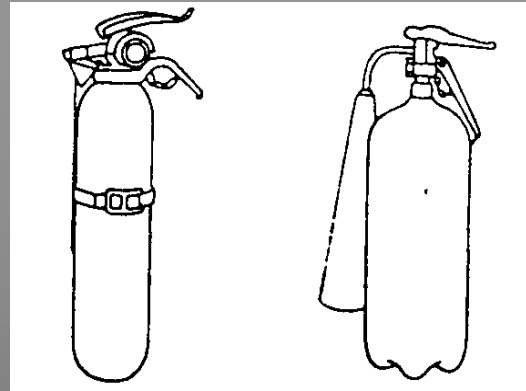
- In Attleboro WTP



Lab Safety

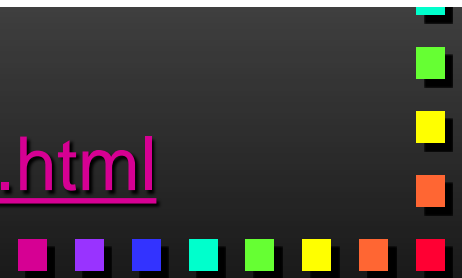
- Fire

- Extinguisher
- Fire blanket



- General: EH&S safety manual

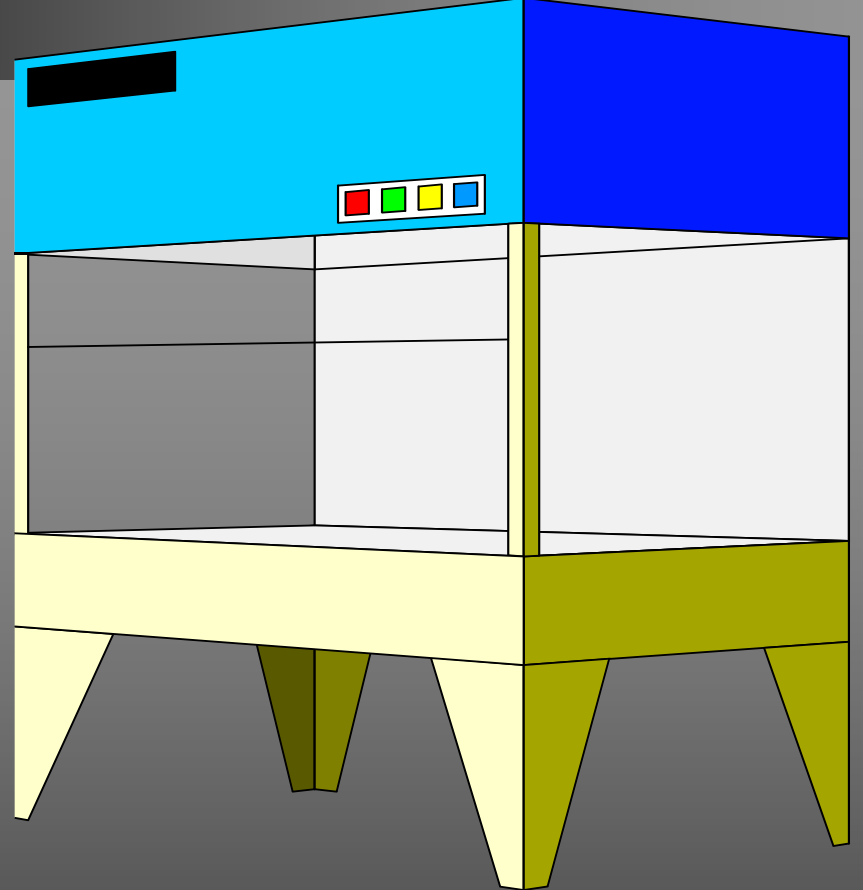
- <http://www.umass.edu/safety/lhs.html>



Vapors

- Fume hood
 - Face velocities
 - Sash position
 - EH&S standards

- <http://www.umass.edu/safety/fume-hood.html>



Disposal

- General waste
 - Non recyclables
- Recyclable materials
 - Paper, plastic
- Non hazardous Chemical waste
 - Organic waste (container with EH&S hazardous waste label)
 - Aqueous waste (flushed down a drain after pH neutralization)
- Hazardous wastes
 - Definitions
 - Typical Examples



■ To next lecture

