101 WAYS TO REDUCE HAZARDOUS WASTE IN THE LABORATORY

1. Write a waste management/reduction policy.
2. Include waste reduction as part of student/employee training.
3. Use manuals such as the American Chemical Society (ACS) "Less is Better" or "ACS Waste Management Manual for Lab personnel" as part of your training.
4. Create an incentive program for waste reduction.
5. Centralize purchasing of chemical through one person in the lab.
6. Inventory chemicals at least once a year.
7. Indicate in the inventory where chemicals are located.
8. Update inventory when chemicals are purchased or used up.
9. Purchase chemicals in smallest quantities needed.
10. If trying out a new procedure, try to obtain the chemicals needed from another lab or purchase a small amount initially. After you know you will be using more of this chemical, purchase in larger quantities.
11. Date chemical containers when received so that older ones will be used first.
12. Audit your lab for waste generated (quantity, type, source and frequency).
13. Keep MSDS's for chemicals used on file.
14. Keep information about disposal procedures for chemical waste in your lab file.
15. If possible, establish an area for central storage of chemicals.
16. Store chemicals in storage area except when in use.
17. Establish an area for storing chemical waste.
18. Minimize the amount of waste kept in storage.
19. Label all chemical containers as to their waste.
20. Develop procedures to prevent and/or contain chemical spills. Purchase spill clean-up kits, contain areas where spills are likely.

Segregate your wastes:

21. Keep halogenated solvents separate from non-halogenated solvents.
22. Keep recyclable waste/excess chemicals separate from non-recyclables.
23. Keep organic wastes separate from metal-containing or inorganic wastes.
24. Keep non-hazardous chemical wastes separate from hazardous waste.
25. Keep highly toxic wastes (cyanides, etc.) separated from above.
26. Avoid experiments that produce wastes that contain both radioactive and hazardous chemical waste.
27. Keep chemical waste separate from normal trash (paper, wood, etc.).
28. Use the least hazardous cleaning method for glassware. Use detergents such as Alconox, Micro, RBS35 on dirty equipment before using KOH/ethanol bath, acid bath or No Chromix.
29. Eliminate the use of chromic acid altogether.
30. Eliminate the use of uranium and thorium compounds (naturally radioactive).
31. Substitute red liquid (alcohol) thermometers (range up to 150 c) for mercury thermometers where possible.
32. Use metal oven thermometer instead of mercury thermometer in ovens.
33. Use digital thermometer where possible.
34. Evaluate laboratory procedures to see if less hazardous or non-hazardous reagents could be used.
35. Review the use of highly toxic, reactive, carcinogenic or mutagenic materials to determine if safer alternatives are feasible.
36. Avoid the use of reagents containing: barium, arsenic, cadmium, chromium, lead, mercury, selenium and silver.
37. Consider the quantity and type of waste produced when purchasing new equipment.
38. Purchase equipment that enables the use of procedures that produce less waste.
39. Review your procedures regularly (e.g. annually) to see if quantities of chemicals and/or chemical waste could be reduced.
40. Look into the possibility of including detoxification and/or waste neutralization steps in laboratory experiments.

41. When preparing a new protocol, consider the kinds and amounts of waste products and see how they can be reduced or eliminated.
42. When researching a new or alternative procedure, include consideration of the amount of waste produced as a factor.
43. Examine your waste/excess chemicals to determine if there are other uses if your lab, neighboring labs, departments or areas (garage, paint shop) who might be able to use them.
44. Review the list of chemicals to be recycled or contact the chemical recycling coordinator to see if these materials are available elsewhere within the school department.
45. Inform the chemical recycling coordinator of the types of materials you can use from the recyclables.
46. Call the chemical recycling coordinator to discuss setting up a locker or shelf for excess chemical exchange in a lab, stockroom or hallway in your department.
47. When solvent is used for cleaning purposes, use spent solvent for initial cleaning and fresh solvent for final cleaning.
48. Try using detergent and hot water for cleaning of parts instead of solvents.
49. Consider using ozone treatment for cleaning of parts.
50. Consider purchasing a vapor degreaser, vacuum bake or bead blaster for cleaning of parts.
51. Reuse acid mixtures for electropolishing.
52. When cleaning substrates or other materials by dipping, process multiple items in one day.
53. Use smallest possible container for dipping or for holding photographic chemicals.
54. Use best geometry of substrate carriers to conserve chemicals.
55. Store and reuse developer in photo labs.
56. Precipitate silver out of photographic solutions for reclamation.
57. Neutralize corrosive wastes that do not contain metals at the lab bench as part of the experiment.
58. Deactivate highly reactive chemicals in a fume hood.
59. Evaluate the possibility of redistillation of waste solvents in your lab.

60. Evaluate other wastes for reclamation in labs.
61. Scale down experiments producing hazardous waste wherever possible.
62. Convert to microscale experiments wherever possible.
63. Use demonstrations or video presentations as a substitute for some experiments that generate chemical waste.
64. Use pre-weighed or pre-measured reagent packets for introductory labs where waste generation is high.
65. Include waste management as part of the pre and post laboratory written procedure.
66. Maintain a neat and tidy lab.
67. Polymerize epoxy waste to a safe sold.
68. Consider using solid phase extractions for organics.
69. Rotavape hexane for reuse.
70. Destroy ethidium bromide using $NaNO_2$ and hypophosphorus acid.
71. Run mini SDS-PAGE 2d gels instead of full size slabs.
72. Treat sulfur and phosphorus wastes with bleach before disposal.
73. Treat organolithium waste with water or ethanol.
74. Seek alternatives to phenol extractions (e.g. small scale plasmid prep using no phenol may be found in Biotechnica, Vol. 9, No. 6, pp. 676-678).
75. Use procedures to recover metallic mercury.
76. Review procedures to recover mercury from mercury containing solutions.
77. Recover silver from silver chloride residue waste.

Use the following substitutions where possible:

Original Material	Substitute	Comments
78. Acetamide	Stearic acid	in phase change & freezing point depression
79. Benzene	Alcohol	
80. Benzoyl peroxide	Lauryl peroxide	when used as a polymer catalyst
81. Chloroform	1,1,1-trichloroethane	
82. Carbon tetrachloride	Cyclohexane	in test for halide ions
83. Carbon tetrachloride	1,1,1-trichloroethane 1,1,2-trichloro-trifluoroethane	

Use the following substitutions where possible:

Original Material	Substitute	Comments
84. Formaldehyde machines	Peracetic acid	for cleaning kidney dialysis
85. Formaldehyde	"Formalternate" (Flinn Scientific)	for storage of biological specimen
86. Formaldehyde	Ethanol	for storage of biological specimen
87. Formalin	See formaldehyde	
88. Halogenated solvents	Non-halogenated solvents	in parts washers or other processes
89. Sodium dichromate	Sodium hypochlorite	
90. Sulfide ion	Hydroxide ion	in analysis of heavy metals
91. Toluene	simple alcohols and ketones	
92. Wood's metal	Onion's Fusible alloy	
93. Xylenes	simple alcohols and ketones	
94. Xylene or toluene	Non-hazardous proprietary liquid scintillation cocktails	in radioactive tracer studies
95. Fluorinert	Non-volatile, reusable pressurizing fluid	CS_2

96. Purchase compressed gas cylinders, including lecture bottles, only from manufactures who will accept the empty cylinders back.
97. Limit the amount of chemical donations accepted.
98. Return excess chemistry to the distributor.
99. Replace and dispose of items containing polychlorinated biphenyls (PCB's).

100. Identify equipment containing Universal Waste (e.g. mercury, PCB's, lead). Label these items to indicate what components may need special handling or disposal. Sample items include: fluorescent lamps, computer and electronic components, mercury switches, ballasts, and batteries.

101. Send us other suggestions for waste reduction.

This list was originally prepared by the Division of Environmental Health and Safety at the University of Illinios at Urbana-Champaign for use by the laboratories at that university. The information provided in this list should be used only as a guide. Consideration for the general condition of your facility and the knowledge and experience of your staff will determine which of these suggestions may be appropriate for your school system.