The Laboratory Efficiency Assessment Framework @ Exeter

CHOOSE GREENER CHEMISTRY

What is ‘green’ chemistry? It is the design of chemical products and processes that reduce or eliminate the generation of hazardous substances. There are several steps you can take to make your experiments safer for staff, more sustainable, and create less hazardous waste. Steps to take:

1 Plan your experiments

- Plan carefully to use the minimum amount of chemicals and reduce waste as much as possible
- Check your inventory before purchasing new items and determine if an order is necessary – can you borrow overstock will be wasted) a chemical when only a small amount is needed?
- Consolidate orders with other groups
- Only buy what you need (avoid ordering in bulk if overstock will be wasted)
- Consider disposal when planning your experiment

2 Consider substitutes

Research less harmful alternatives to achieve the same results! Plan experiments with safer reagents and catalysts for less hazardous chemical syntheses. Can toxic products and waste created be reduced/minimised?

Greener solvent guide:

beyondbenign green chemistry education

Greener Solvent Guide

For more resources for Green Chemistry in chemistry education: http://bit.ly/gc-resources

Key: Hazardous | Problematic | Preferred

* Indicates Highly Hazardous

Undesirable Solvents	Alternative
Pentane, Hexane(s)	Heptane
DMF, DMAc, NMP, DMSO	Acetonitrile, Cyrene[c], Cyclopentyl methyl ether (CPME)[a], dimethyl carbonate[c]
Tetrahydrofuran, Methyl tert-butyl ether (MTBE)	2-Methyltetrahydrofuran (2-MeTHF), CPME
Di-isopropyl ether or diethyl ether*	2-MeTHF or tert-butyl methyl ether, CPME
Dioxane or dimethoxyethane	2-MeTHF or tert-butyl methyl ether, CPME
Chloroform*, dichloroethane* or CCl_4*	Dichloromethane
Pyridine (as a base)	Triethylamine (Et_3N)
Dichloromethane (in extractions)	Ethyl acetate (EtOAc), MTBE, toluene, 2-MeTHF
Dichloromethane (in chromatography)	EtOAc/heptane[b], 3:1 EtOAc/EtOH[b]
Benzene*	Toluene
Acetone	Ethyl lactate[a]

For a review of organic reactions in water: http://bit.ly/org-rx-water
For a review of solvent-free organic reactions: http://bit.ly/solvent-free-org-rx

References:
Prat, D., *et al.*, *Green Chemistry*, **2016**, *18*, 288–296; Dunn, P. J., *et al.*, *Green Chemistry*, **2008**, *10*, 31–36.
a. MilliporeSigma Greener Solvent Alternatives [https://www.sigmaaldrich.com/technical-documents/articles/analytical/solvents-and-reagents/greener-solvent-alternatives.html].
b. Taygerly, J.P., *et al.*, *Green Chemistry*, **2012**, *14*, 3020–3025.
c. Byrne, F.P., *et al.*, *Sustain Chem Process*, **2016** *4*; 7 1–24.

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3 Managing inventory and sharing resources

- Keep track of your inventory to avoid buying duplicates
- Share overstock with other labs so none is wasted

4 Disposal

- Correct disposal at the end of an experiment is essential
- Consult your lab manager if you have questions

Scan to learn more about lab sustainability at the University of Exeter

Any questions? Contact LEAF@exeter.ac.uk

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