



## Planning & Running Experiments

### Design Experiments with Waste Minimization in Mind

Waste minimization in the laboratory begins at the stage of experiment planning. Measures may range from implementing basic efforts to be more efficient with experimental procedures, to completely re-designing the way experiments are performed.

Here are some ways to set up your experiments with waste minimization in mind:

- Think about the environmental consequences of your laboratory activities
- Design your experiments to use and generate substances that possess little or no hazard to human health and the environment
- Consider the kind and quantity of waste that will be generated and adjust the experimental design to minimize it
- When possible replace chemicals with less hazardous materials
- Use solvents and other hazardous materials sparingly
- Monitor experimental reactions closely and add additional chemicals only as necessary
- Be alert for opportunities to save electricity
- Design experimental set-ups to save water
- Where feasible, include a step that destroys or inactivates any hazardous products in experimental protocols
- If your experiment is designed at a macro scale level, try to scale it down to 1/100<sup>th</sup> or 1/1000<sup>th</sup> of the original quantities. For more information refer to:
  - National Microscale Chemistry Center (NMC2) ([www.merrimack.edu/academics/science\\_engineering/chemistry-and-biochemistry/resources/national-microscale-chemistry-center](http://www.merrimack.edu/academics/science_engineering/chemistry-and-biochemistry/resources/national-microscale-chemistry-center))
  - National Small-Scale Chemistry Center ([smallscalechemistry.colostate.edu](http://smallscalechemistry.colostate.edu))
  - If you cannot convert to micro-scale, try decreasing experimental quantities by a third or one half. This can usually be achieved with conventional glassware

### Develop a Generator Specific Waste Minimization Plan

#### Identify:

- The type and quantity of waste disposed from your lab
- The processes from which waste was generated
- The available reduction and recycling options

#### Review:

- Your laboratory's annual hazardous waste report and chemical waste inventory forms
- Experimental processes, procedures and protocols

#### Consider:

- Potential waste reduction options
- Feasibility and cost benefit of suggested waste minimization measures
- Other aspects related to hazardous waste disposal: TDG training, waste manifests, BC Generator ID (BCG#)

#### Implement:

- The most environmentally friendly, safe and effective reduction options



## STEPS

### **Determine the sources of waste generated by your laboratory -**

Review all your lab protocols and processes. For each protocol, process, operation and activity generating wastes, list the following:

- Waste type (i.e. biohazard risk group 1 & 2, pathological, biomedical, sharps, solvents, chemical waste, non-hazardous solid waste, non-hazardous liquid waste, etc.)
- Main components/reagents that cause the waste to be hazardous
- Hazard class (i.e. toxic, corrosive, flammable, reactive, etc.)
- Quantity of waste generated
- Frequency of waste generated

### **Select applicable waste reduction options for specific processes**

Choose protocols and processes for reduction and look for those generating large quantities of waste or very hazardous waste; these are easy to reduce. Use the guidelines below.

#### **Consider the following criteria:**

- Resultant change in amount of hazardous waste
- Technical feasibility
- Economic evaluation
- Health and safety implications

#### **Evaluate potential waste minimization measures:**

- Process redesign
- Equipment modifications
- Process, method, technique changes
- Operating conditions changes
- Materials changes
- Operation efficiency improvements
- Training requirements
- Inventory management
- Reuse and recycle options

#### **Select an experimental process or protocol for reduction measures including:**

- Waste stream for reduction
- Proposed waste minimization method(s)
- Expected/estimated reduction

#### **Develop an implementation plan including:**

- Responsibilities
- Target dates
- Required resources