

# REUSING AND RECYCLING IN THE LAB

This session was prepared by Sandra Lewis and presented by Debra Cook at ConQEST 2009.

Lots of ideas were contributed by delegates at the session, and these have been included.

Other useful websites: <http://www.uwlax.edu/ehs/labwaste.html>

Useful guides for school labs: <http://denr.sd.gov/dfta/wp/P2/Documents/Labwaste.pdf>  
[http://sustainablecampus.unimelb.edu.au/difference/lab/lab\\_awareness.html](http://sustainablecampus.unimelb.edu.au/difference/lab/lab_awareness.html)

The Three R's:

- Reduce
- Reuse
- Recycle

**Reduce** – purchase small quantities where possible, supply minimum quantities to classes and restrict access to (or hide) stock bottles, use smaller quantities where possible e.g. microscale chemistry, use more dilute solutions where possible, use cheaper/less hazardous alternatives where possible

**Reuse** – wash and reuse as many times as possible, use rechargeable batteries

**Recycle** – use “waste” from one product/process to make another

## Recycling from home

Many items from the home can be reused in the lab:

- to help store and organise to simplify the issue of laboratory equipment and reagents
- as a substitute for laboratory equipment:
  - ⇒ small yoghurt containers instead of beakers if no heating is required
  - ⇒ cut down butter container for gel electrophoresis
  - ⇒ juice bottles filled with sand and the lid glued in place can be used as a brick
  - ⇒ milk cartons can be used to mix plaster for "fossils"
  - ⇒ spice bottle for iron filing shaker or for live insect observation

Other examples: DIVIDING A TOTE BOX INTO 8 OR 4,



It takes 1L of water to produce 3 sheets of A4 paper – do you really need to print this?

To assist Teachers in managing the handing out of equipment and chemicals to prac groups, place one of each item needed by the group into a small container, then only one container gets handed to/collected by the group. If the items are large or there are a lot of items, use larger containers. Rectangular take-away containers can be used to divide the tote box into 4

### STORING TEST TUBES,



Peters ice cream containers are rectangular and are a good size for storing standard 18cm test tubes. Provide 2 with the experiment equipment – one for the clean test tubes, and the other (a different colour if possible) for the dirty ones.

### STORING SLINKIES,



Cut-off 1.25L soft-drink bottle (coke not suitable due to “waist”). The slinky is only stretched in this picture to make it clear that it is a slinky, normally it sits neatly in the container.

### STORING/DISPENSING SPOOLS OF WIRE/STRING,



Tennis ball tubes can be used to store spools of wire and string. The taller ones hold more and take up less of a “footprint” on the shelves than individual rolls – this is important when shelf space is at a premium.

## DRIP TRAYS FOR PLANTS,



Supermarket chicken pieces trays are too deep and the bases are too uneven for use as dissecting trays, but they can be used as drip trays for pot plants. If using small pots, all of the pots for a group can be held in a single tray.

Raised ridges are good for allowing drainage of over-watered plants. Over watering accounts for more deaths of lab plants than any extreme variable being examined. Positioning the pots on the ridges allows the inevitable excess water to drain away, and gives the plant a chance at survival.

## MINI GREENHOUSE,



Supermarket cake packaging – buy a mudcake, get a bonus mini greenhouse! These can be used for experiments or to raise seedlings to be used for EEs. Quite a lot of money can be saved by raising seedlings: a packet of seed costs about \$2.50 and can produce 60 to 300 seedlings (depending on the type of seed and size of the packet). A bag of seed raising mix costs about \$5.30. A punnet of 6 seedlings costs around \$2.20 each. So 60 seedlings costs about \$7.80 to produce, but \$22.00 to buy.

A 2L drink bottle or juice bottle can be fashioned into a greenhouse for plants in larger pots or in garden beds

Moss and liverworts can be kept successfully in a 'greenhouse' environment in a plastic container with a lid eg. Ferrero rocher chocolate box (if you can't find moss or liverworts easily in your gardens, your local nursery will be happy to let you collect some from the pot plants)

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## PLASTICS

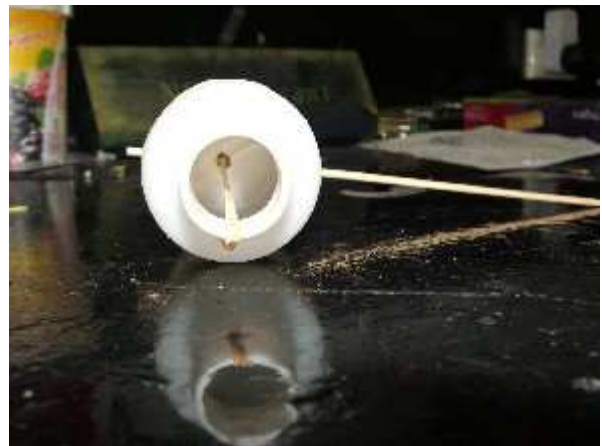


- Biscuit packaging can be used for
- storage (e.g. 20cm thermometers);
  - plant drainage trays;
  - seed raising trays (with small drainage holes);
  - moulds (e.g. making mud bricks);
  - or as lightweight, stackable examples of recyclable group 1 & 2 plastics.



Roma tomato packaging – it's a number 7

## MOTOR MOUSE COTTON REEL ALTERNATIVE,



From Gary Miller: The rubber band around the bottle is for steering it. A paper clip helps to pull the double rubber band through the bottle. You can even use soft drink bottles.

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## Recycling packaging materials

- model-making
- insulation experiments (both thermal and physical)
- Starch solution
- Glue
- Worm food

Bubble wrap and the sealed bags of air sometimes used as packaging could be used to cushion the impact of falling objects (e.g. an egg) to demonstrate the way an airbag works.



**STARCH SOLUTION** – a few starch “beans” added to hot water can be used as a starch solution if an accurate concentration is not required.

**GLUE** – a large handful of starch beans added to a cup of hot water makes a great paper glue and can be used for paper mache

Shredded paper and cardboard (especially the egg carton type) can be added to a worm farm for a bit of variety in their diet. Corrugated cardboard tends to be eaten last.

## Recycling chemicals in the lab

- Save the current batch of crystals from crystal growing experiments as seed crystals for the next batch eg. Copper sulfate, salt, Epsom, alum etc.
- Some chemicals e.g. solvents and metals can be recovered for later reuse
- Crystals grown on filter paper can be dissolved in hot water and filtered to recover the solution
- Recovered solutions that are very dilute can be heated to concentrate

### Recovery of silver from its salts

- Silver chloride is dissolved in ammonia and can be reduced to silver by copper. Procedure taken from page 3 of this site [http://faculty.concordia.ca/bird/c241/wet\\_labs/expt5.pdf](http://faculty.concordia.ca/bird/c241/wet_labs/expt5.pdf)
- Add a small piece of Copper to solutions of Silver nitrate to recover silver crystals. The resulting solution will be a weak solution of Copper nitrate. (try this under a microscope – it looks fantastic!)

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After doing as much as possible to minimize waste generation through source reduction, the next most preferable options are reuse and recycling. Chemicals can often be recovered at net costs lower than the cost of disposal. Reuse and recycling can occur at a number of points in the chemical use cycle. Some options include recovering chemicals as part of the experimental process, or participating in a chemical swap.

Recovery of chemicals can serve as a valuable learning tool for students and can be presented as the final step of a chemistry experiment, or can be an “extra-credit” opportunity for interested students. In 1989 The College of the Redwoods, in California produced a “No Waste Lab Manual” in which the by-products of one experiment become the reagents/reactants of the next experiment. The by-products of the final experiment are then available for the next set of students to begin the process again.

This manual is available at

### Waste from biology experiments



Used potting mix can be “recharged” and reused indefinitely by a stint in the worm farm. If it is salty, rinse a few times in a bucket (with waste water from the still) before adding to the worm farm.



Dissected plant material e.g. leaves, fruits and flowers; and rotten pondweed can be added to the worm farm. Do **not** add onion or garlic to a worm farm.

If you use food dye instead of eosin for the transpiration demonstrations (its cheaper and has a better range of colours), the celery/carnations can be added to compost/worm farm.

Left over EEI's: Allow the healthier plants to go to seed, then collect ready for next time.

## Set up a worm farm

Worms are useful for:

- Excellent recyclers of packaging material and plant matter
- Study a small-scale ecosystem
- Investigate worm tea as a fertiliser for an EEI
- Once you have one worm farm, you can make many more
- Dig worm castings into veggie garden and they will self-seed veggies
- you can get a worm farm specialized for dog poop, a quick Google search will turn up a few Australian distributors.

Most councils will have someone (e.g. an education officer) who visits schools and community organisations to demonstrate worm farming. Some (e.g. Ipswich city council) give away free worm farms and compost bins to schools who participate in their education program.

[http://www.ipswich.qld.gov.au/residents/waste/worm\\_farming/](http://www.ipswich.qld.gov.au/residents/waste/worm_farming/)

If you can't get a free worm farm, use styrofoam boxes (e.g. from a fruit shop, or eskies used as packaging for frozen rats). The eskies are actually a bit better for this purpose as they "nest" i.e. one will sit inside the tapered bottom of the other without touching the bottom. If you have the room you can set one up in an old bathtub with a ply wood lid.

Instructions for DIY worm farm <http://www.abc.net.au/creaturefeatures/make/wormfarm.htm>

Regardless of whether you get a commercially produced worm farm or produce your own, you'll also need to get worms. Worms can be bought from some nurseries and hardware shops (e.g. Bunnings), or you may know someone who will give you about 1000 – a 2L ice cream container of reasonably tightly-packed worms (no more than about 4 body-thicknesses between the worms).

Good website for worm farm set up and care <http://www.ryde.nsw.gov.au/services/worm.htm>

Worm farms do not smell and are quite compact. It is conceivable that a worm farm could be kept in a classroom if an outdoor location isn't available.

Worm tea is a fantastic fertiliser and growth enhancer. Mix one milk bottle cap (15mL) in a 10L watering can and apply to plants once a fortnight.

Alternatively, start composting

<http://www.ipswich.qld.gov.au/residents/waste/composting/>

## Recycle “waste” water from still

Collect the waste water to :

- Wash up
- Water a garden
- Make up non-accurate solutions
- Use a pump to cycle the water back through the still

There is absolutely no need to use distilled water to make solutions for anything other than chlorine sensitive solutions (lead, silver) or for senior Chemistry solutions where accuracy is imperative. For everything else tap water or rain water will suffice. Harvested rain water is clean enough to be used for plant tissue culture, so it ought to be good enough for Junior Science.

## Other ideas:



PLANT LABEL: Constructed from a piece of an ice-cream container cut to exploit the curve in the plastic and a dried stem from a cobbler peg plant.

## GLAD WRAP AND ALFOIL BOXES

- Free flip open containers for long, thin items like ball and ring apparatus, tuning forks, carbon electrodes, static electricity rods etc. They will hold long stirring rods that won't fit into cutlery drawers. They have nice flat surfaces for labels and they stack well on a shelf.



CAT FOOD BOXES: Other products also produce boxes with this flip open dispenser

- Free dispensing container for handy things like corks
- Free flip open container for equipment like sponges for geology, 30m measuring tapes in dispensers, pre-prepared pracs



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#### TOP HALF OF A MILK BOTTLE:

- Free funnel with handle for solid or bulk liquid transfer
- Free scoop for potting mix, plaster or paris etc if you leave the lid on it.

CARDBOARD TUBES: From gladwrap, paper towel etc. I wish I could find something that would fit the end like a cap.

- Free pinhole camera equipment. A Pringles can is fantastic for this too
- Free protective container for delicate glassware – just use a piece of fabric or newspaper and a rubber band to seal the ends



'MOXIE' BOXES: If you're concerned about the product advertising just give it a quick spray paint.

- Free drawers for all sorts of bits and bobs!



BEROCCA TUBES: And other assorted fizzy tablet tubes

- Free bicarb and vinegar rockets! Just push out the cardboard circle in the lid and tip out the moisture adsorbent. These do a much better job than film canisters and are easier to come by these days.



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**STATIC STICK:** This container held a fancy pen.  
10 minutes of my time and a small piece of Styrofoam packaging has saved me \$20.

### PLASTIC SLEEVE BOX

- Free flip open container for class sets of laminated pages
- Free flip open container for sheets of chemical labels – label a few with sections of the alphabet or sort by DG Class

### OLD CATALOGUES

- Free pictures of scientific equipment.

Fantastic for first term of Yr 8 or for classification practice.



**1L PLASTIC MILK BOTTLE:** The possibilities are endless!

- Free pot for plants – just poke a few holes for drainage
- Free hanging pot for plants – just leave the handle on hang with a sturdy piece of chain
- Free container for prac delivery
- Free container for vial storage
- Free container for field work – just leave the handle on
- Free container for equipment storage

**2L PLASTIC MILK BOTTLE:** The possibilities are endless!

- Free container for equipment storage
- Free container for prac delivery – number them with different coloured pens for class sets
- Free container for collection and disinfecting of microscope slides
- Free container for vial storage
- Free container for equipment storage
- Free pot for plants – just poke a few holes for drainage



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**3L PLASTIC MILK BOTTLES:** The possibilities are endless!

- Free container for equipment storage – holds a 2L bottle of oil and saves the shelf from residue
- Free container for prac delivery – number them with different coloured pens for class sets
- Free container for collection of dirty test tubes
- Free container for vial or dropper storage
- Free pot for plants – just poke a few holes for drainage

### SMALLISH TIN CANS

- Free container to hold dead matches – just half fill with sand and deliver with each prac
- Sift out the matches with a sieve and clean up the sand at the same time
- Saves the bench from messy wax taper residue
- Removes the risk of hot matches getting into the waste paper bins



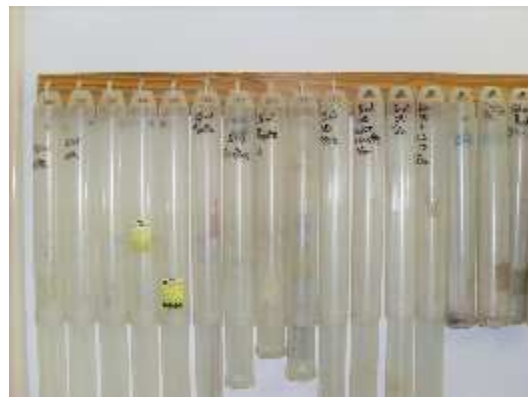
### CHUX

- Free paper towel! Just buy a packet of cheap chux, cut each in half and deliver with each prac. Saves a fortune on paper towel and encourages clean-up. Rinse and repeat.
- Free sterile cloth. Chux will withstand autoclaving. Just pop into a paper bag, seal with a double fold and masking tape. Rinse and repeat.
- Free liner for a plant container. A well rinsed old Chux will line a container like an old colander or chip basket and turn it into a

perfectly functional, and quite funky, pot for a plant. By the time it has decomposed it will be time to re-pot the plant anyway. Rinse and repeat.

### CHISEL CONTAINERS: As described by Darryl Venz on LABBIES

- Free hanging holders for long, skinny things. Great for pipettes, stirring rods etc
- For burette storage, cut the base off the end and screw the base from a second chisel container onto the assembly to make it long enough.



### JARS WITH PLASTIC LIDS

- Free specimen jars

**MOLECULAR MODEL:** Free molecular model made by students out of strips of a 2L milk bottle

### TISSUE BOXES

- Free container for rubber bands, corks, rocket tubes etc.
- Free flip open container held closed with Velcro

### PLASTIC ANIMAL TOYS FROM KIDS CHOCOLATES

Free specimens of animals you're never going to fit into a jar, like monkeys, hippos and dinosaurs. They'll fit nicely into a reused Vegemite or mustard jar, label as accurately as you can or if you can't then use names like *Dinosaurus prehistoricus* and *Ursulus ridiculus*. Great for classification practice, scientific naming practice, latin pronunciation practice and to just brighten up the lab a bit. Guaranteed to put a smile on your dial every time a kid asks "Is this real?" (which will be at least once a term! And of course the correct answer is "Of course it is!")

### STYROFOAM TRAYS

- Free small specimen dissection trays – tongues, hearts, kidneys etc
- Put out with pracs to help keep bench clean from spills
- Use with balances to help keep pan clean from spills

**STRAWBERRY PUNNETS:** Also come in different shapes and sizes for chilli, herbs etc

- Free string dispenser
- Free, clear container to hold equipment
- Free containers to make up kits for pracs – particularly good for electricity gear (1 switch, 3 bulbs, 6 leads etc)

**CARDBOARD 6-PACK CARRIERS:** If you're concerned about the product advertising just give it a quick spray paint. This also helps protect it a bit from moisture.

- Free carrier for wash bottles. Particularly handy for field work

**TWIST-TOP BOTTLES:** From sauces, honey etc

- Free bottle for glue or detergent

I would never, ever use these to replace stull cap bottles for reagents.

### DRUMSTICK ICE-CREAM COVERS

- Free boat for the Make a Magnetic Compass experiment
- Probably good for surface tension as well – let me know!

### EGG CARTONS:

- Free sectioned containers for rock specimens/collections

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### SOY SAUCE 'FISH'

Free Cartesian diver. It's best to balance the buoyancy in an open container like a beaker first.

**PLASTIC TRAYS:** From biscuits, batteries, lamingtons etc

- Free ice trays in all shapes and sizes
- Free weigh boats to use with electronic balance
- Free saucers for small pot plants

### LAUNDRY POWDER SCOOPS

Great for dispensing all sorts of things, from plaster of paris to sediments