Chemical Hazards in Arts

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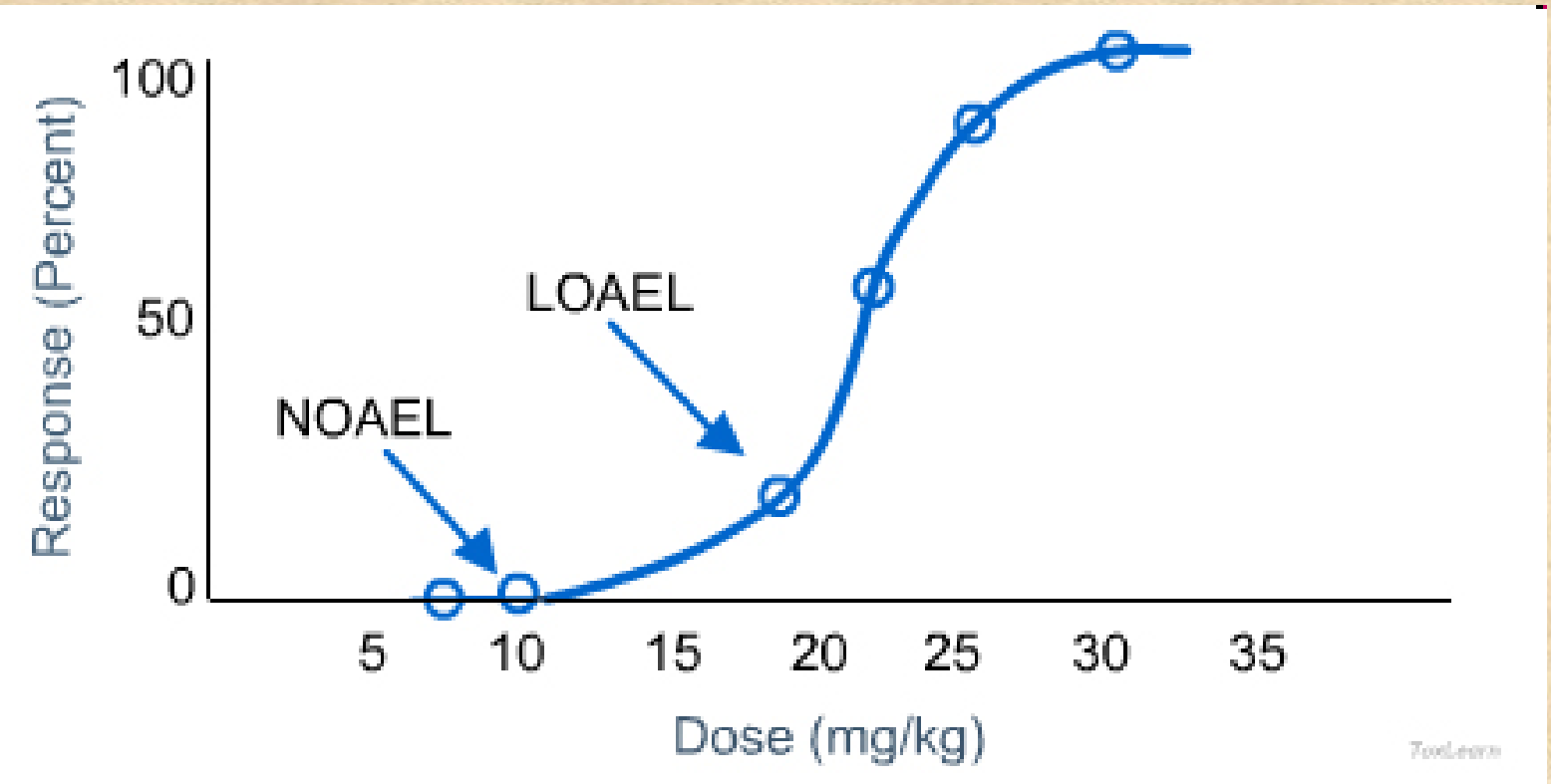
One tequila Two tequila Three tequila

Dose and response

- Small dose, big impact
- Adverse effects compared to “normal”



Effects of size on response

We're constantly chemically exposed

- Flame retardants
- Bisphenol A
- Phthalates
- Diesel exhaust
- Wood smoke
- Fragrances
- Food additives

Source: *Center for Disease Control*

King County photo by Sue Hamilton

Our bodies can handle a lot, given the chance

Avoid those exposures you can…

Routes of exposure

Inhalation is easiest route of exposure
Acids, dusts and solvents

Swallow It

Breathe It

Touch It
Inject It

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Understanding solvents

Solvents evaporate

- Dissolve and deliver/remove materials
- Evaporation rate = volatility
- VOC = volatile organic compound

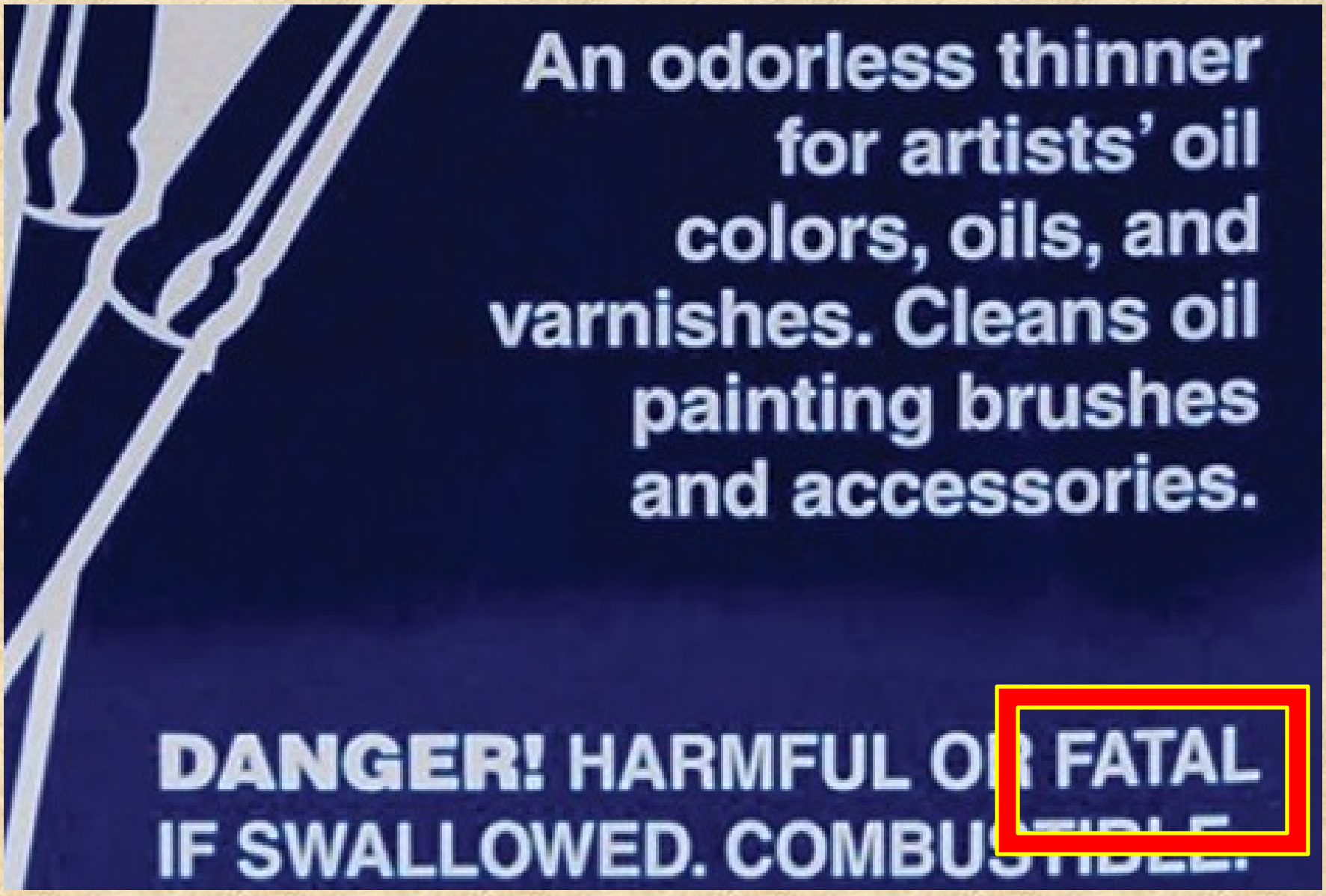
Solvents can be flammable or toxic

Lacquer thinner’s the most hazardous

Turpentine is more toxic, more volatile and more flammable than mineral spirits

Gamsol is pure with no toxic aromatic solvents When evaporated there’s no residue

Safer isn't the same as safe



Pure Citrus Solvent

Allergen
Skin Sensitizer
Combustible

Corrosive compounds in the arts

- Photochemistry
- Intaglio printmaking
- Glass etching
- Patination of metals
- Pickling of metals

Hazardous liquids require splash goggles

Jackson Safety V-80 Monogoggle

Eye washes required near corrosives

- 0.4 gallons a minute for 15 minutes
- Hands-free
- Tepid water

Available from
Grainger and others
for under $100

King County photo by Dave

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www.acclaimimages.com/_gallery/_print_pages/0420-1007-3011-

Photographic stop baths

- Acetic acid vapors
- Sodium sulfite contamination from developer

Acids in intaglio printmaking

- Ferric chloride
  - Burns skin and eyes on contact
- Hydrochloric acid
  - Vapors burn skin, eyes, lungs
- Nitric acid - Bad news

Nitric acid for zinc plates
Corrosive, oxidizer, toxic

Nitric Acid Toxicity

- Highly toxic orally
- Fuming nitric acid – red color
- Inhalation of vapors
  - Intense irritation
  - Feel better for awhile
  - Then depressed lung function, coma, death

Glass etching compounds

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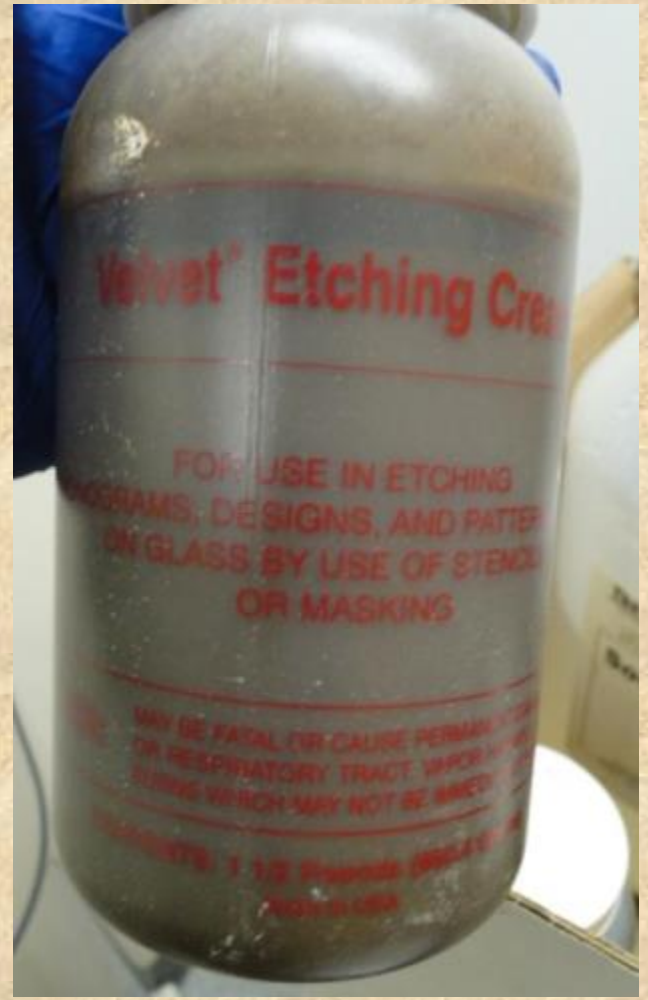


Photo: ©Dave Waddell – Used with permission

Hydrofluoric acid (HF)
Absorbs quickly through skin

- Anesthetic
- Bone disintegration
- Extreme pain
- Gangrene, amputation
- 250 mls = death
- Used as toilet stain remover

Mix Armour Etch with water

You get hydrofluoric acid

Patinas

Many recipes to choose from

Liver of sulfur

- Releases poisonous sulfide gas when acidified
- Requires good local ventilation
- Keep off skin

King County photos by Dave Waddell

Applying acid patina

- Hydrochloric acid
- Phosphoric acid
- Selenious acid
- Nitric acid

Black patina - selenious acid

- Corrosive
- Very poisonous
- Absorbs directly through skin
- Easily inhaled vapors can cause pulmonary edema/coma

Toxic metals

- Many pigments contain ground metals
- Some of these are quite toxic
- Inhalation is usually the route of concern

Antimony

- Inhalation can harm lungs, heart, enzymes
- Ingestion can cause kidney damage, respiratory failure
- Skin contact can cause ulcers

- Naples yellow 41
- Antimony white 11

Arsenic

- Corrosive to skin
- Damages nervous system, kidneys, mucous membranes
- Skin, bone marrow, lung cancer

- English, Paris, Veronese, Schweinfurt greens
- Cobalt violet
- Emerald green
- Green 21, 22
- Scheele's green
- Yellow 39

Photo © http://janeaustensworld.files.wordpress.com/2010/03/450px-paris_green.jpg

Cadmium

- Poison by inhalation, ingestion
- Internal organ damage
- Lung and prostrate cancer

- Cadmium red
- Cadmium orange
- Cadmium yellow
- Red 108, 113
- Orange 20, 23
- Yellow 37

Chromium

- Lung damage
- Skin and respiratory irritant
- Carcinogen

- Barium chromate
- Lead chromate
- Strontium chromate
- Zinc chromate
- Chromic oxide
- Chromic sulfate

Image © www.naturalpigments.com/chrome-yellow-medium.html

Cobalt

- Inhalation linked to asthma, fibrosis
- Ingestion linked to heart damage
- Animal carcinogen

- Dryer in inks
- Cobalt blue
- Cobalt violet
- Aureolin
- Cobalt yellow
- Cerulean blue

Lead

- Toxic by inhalation, ingestion
- Nervous system damage
- Reproductive toxin
- Children are more at risk

- Flake white
- Lead white
- Naples yellow
- Chrome yellow
- White #2, 4
- Red #103, 104, 105
- Orange 21, 45
- Yellow 34, 46
- Green 15

Manganese

- Irritant to eyes, lungs
- Chronic inhalation causes nervous system disorder that resembles Parkinson's disease

- Dryer in inks
- Raw/burnt umber
- Manganese blue, violet
- Red 48
- Blue 33
- Violet 16
- Black 14, 26

Mercury

- Toxic by inhalation, skin contact, ingestion
- Nervous system damage

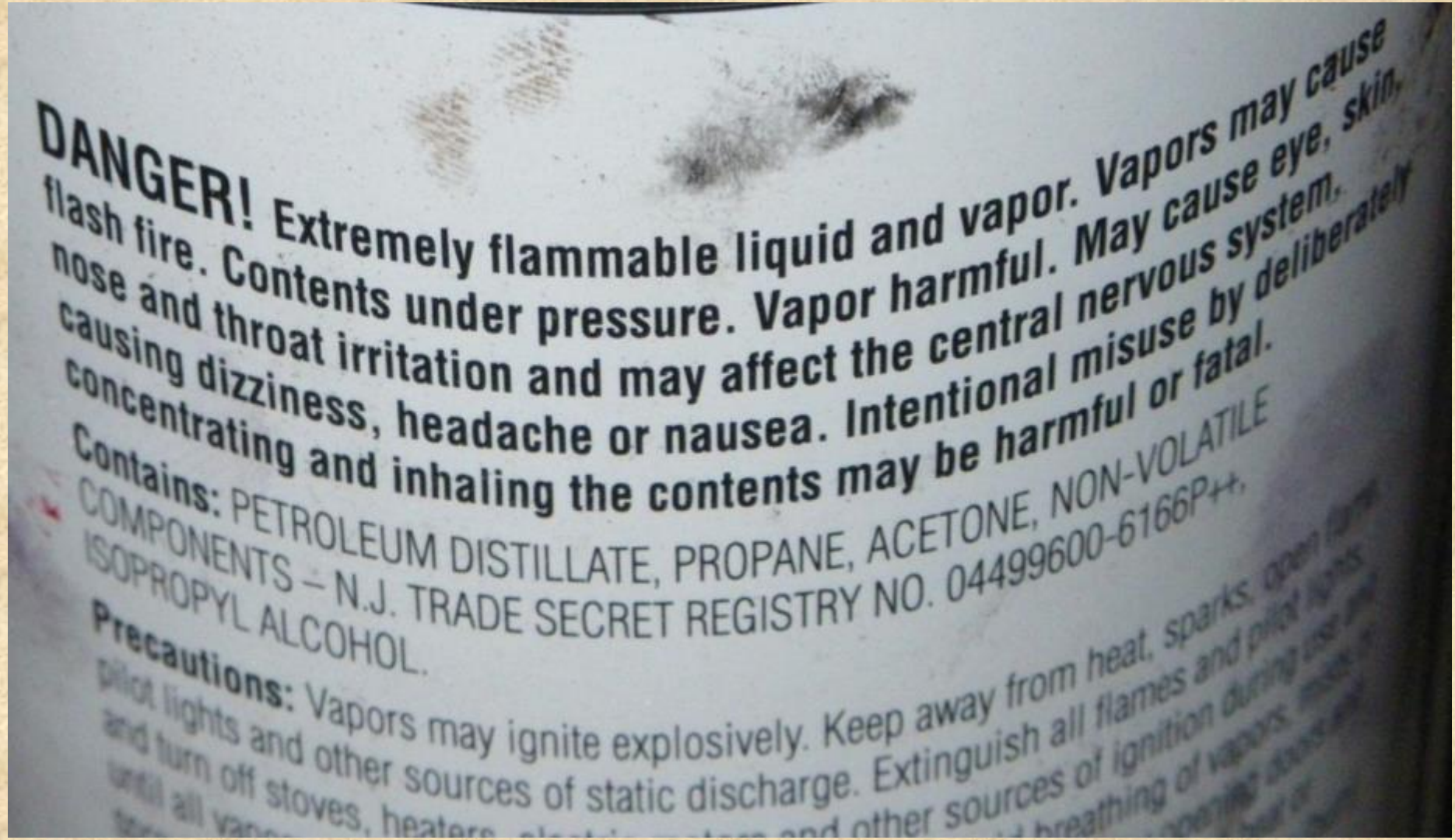
- Vermillion
- Cinnabar
- Mercadium colors
- Red #106

Nickel

- Skin allergies/eczema
- Pulmonary edema
- Carcinogen by inhalation

- Nickel yellow
- Nickel titanate
- Titanium yellow
- Rutile yellow
- Yellow 53, 57, 150
- Green 10

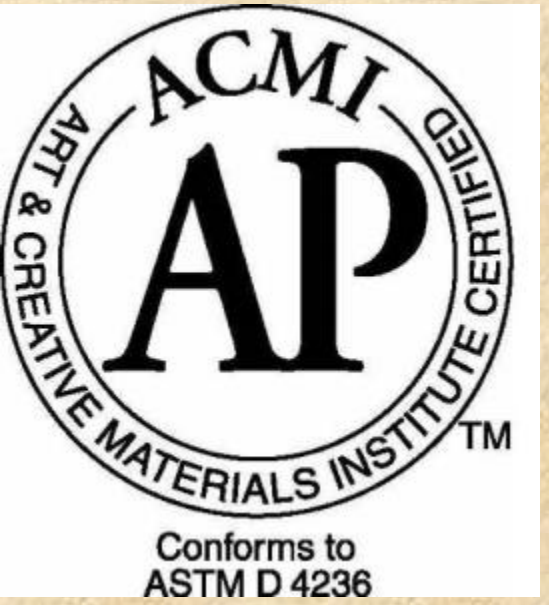
Labels are helpful!



King County photo by Dave Waddell

1988 Labeling of Hazardous Art Materials Act

- Requires manufacturers to list potentially harmful substances in paint products
- “Trade secrets” lets some withhold potentially important information from the customer
- For instance, if there’s under one percent formaldehyde, it may not be listed on the label



Potentially safer products

- **AP** or **CP** Sticker (approved)
  - Evaluated by a toxicologist
  - Not considered toxic
  - Fewer acute or chronic risks
- Look for word “Non-Toxic”

Photos: Dave Waddell

Caution label

- Evaluated for health risks
- Info on safe & proper use
- Common constituents:
  - Toxic metals like lead & cadmium

Photos: Dave Waddell

Avoid products with this warning

WARNING

This Product May Contain A Chemical Known To The State Of California To Cause Cancer, Or Birth Defects Or Other Reproductive Harm.

Label your secondary containers
Name and main hazard

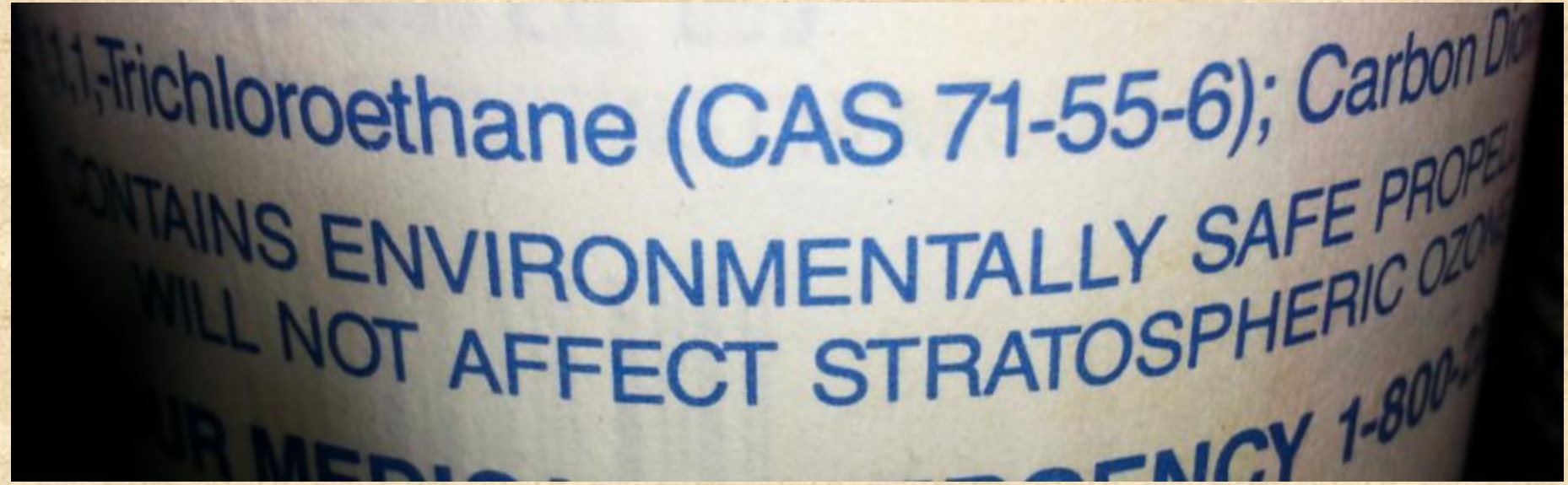
Limitations on labels

- Risks evaluated for 25 year old, 180 lb man
- Not all hazards are chemical-based
- Sensitivities and susceptibilities vary
- Your knowledge is only as good as the label

Beware of greenwashing!

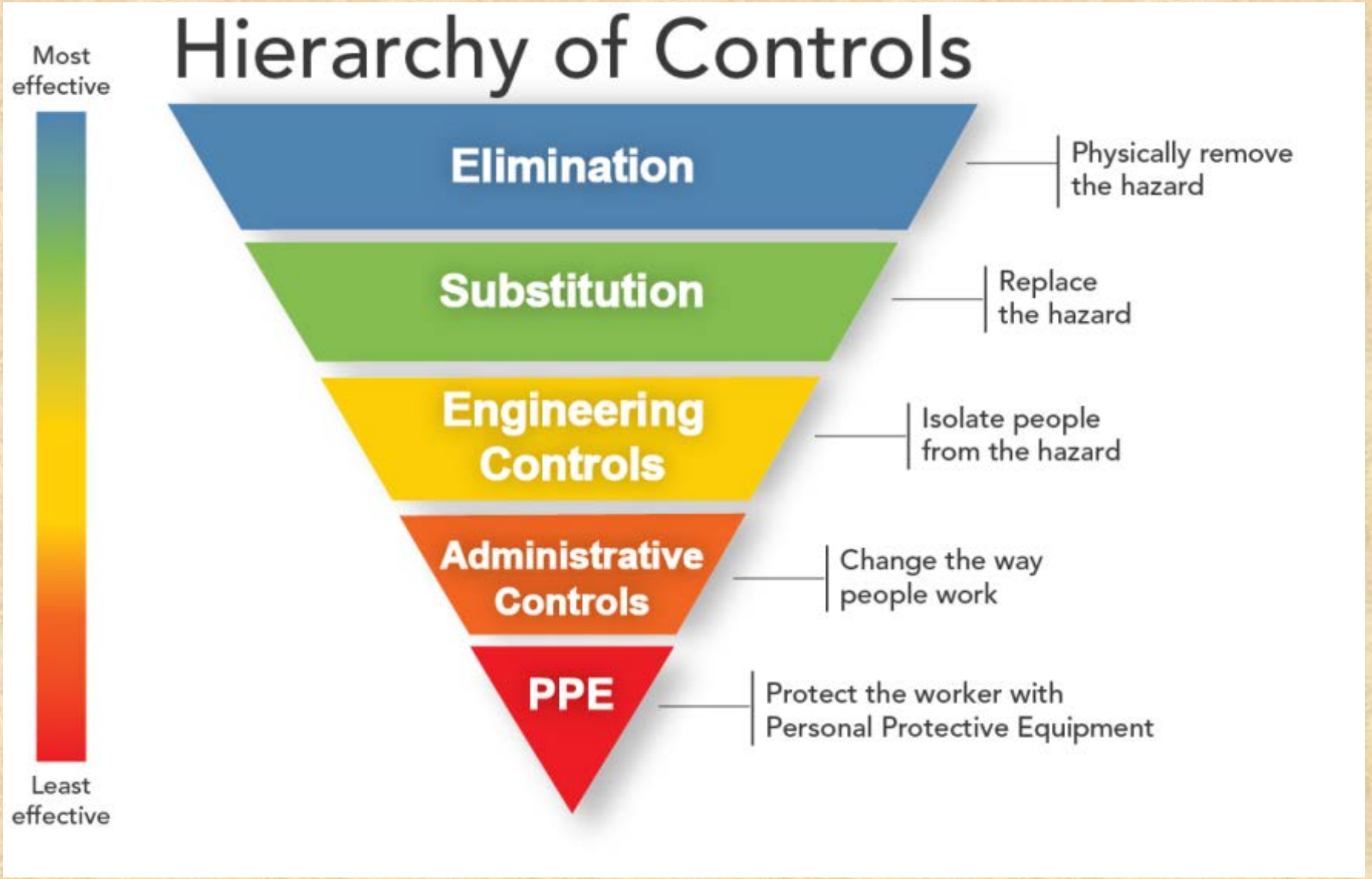
Note the happy face

Back of aerosol can



"1,1,1-Trichloroethane is an Class 1 Ozone Depleting Substance under Section 602 of the Clean Air Act."

Protecting artist's health and safety



MORE EFFECTIVE

Not using toxic stuff

Using less HAZARDOUS stuff

Sucking toxic vapors/dusts away

Barriers between toxic stuff and you

LESS EFFECTIVE

How much is getting on your piece? How much is entering your lungs?

Spray adhesive solvents
All are flammable, toxicity varies

Higher toxicity ↑

- Toluene
- Hexane
- Cyclohexane
- Acetone
- Heptane
- Petroleum naphtha
- Methylpentane

Lower toxicity ↓

Which should we choose?

Let’s look at those cans

Avoid hexane + acetone combo!

- Powerful neurotoxin if inhaled or on skin
- Destroys nerve cells in extremities (hands/feet)
- Poor recovery from damaged nerves

Spray Adhesive Precautions

- Check the ingredients
- Avoid hexane & toluene
- Avoid breathing vapors
  - Outside upwind
  - Use a spray booth
- Use protective gloves
- Never with young kids

Hexane in rubber cement

Heptane – safer substitute

Toxic heavy metals

Encaustic pigments

- Avoid inhalation or contaminated clothing
- Avoid heavy-metal based pigments

No issues with solid wax

Water, oil & wax bind pigments

Let’s look at ceramics

Clay dusts contain free silica

- Silicosis from inhaling silica over time

Work with wet clay to limit dust

The clay on those pants won’t stay wet

Not the ways to clean up clay dust

Vacuuming? Use HEPA filters

Wet mop instead

Control dust contamination

Use moist microfiber mops & cloths for final pass

Kiln emissions

Comparative toxicity

Volatility increases availability

Metal	Permissible exposure limit (mg/M^3)	Melting/boiling pt. °F
Arsenic	0.005	**1502** / **1135**
Cadmium	0.005	**610** / **1409**
Silver	0.01	**1763** / 4013
Lead	0.05	**621** / 3164
Cobalt	0.1	2723 / 5198
Selenium	0.2	**423** / **1265**
Barium	0.5	**1337** / **2084**
Chromium	1.0	3375 / 4842
Copper	1.0	1981 / 4653
Nickel	1.0	2647 / 4950
Manganese	5.0	**2273** / 3564

- Low fire clay bisque: 1321–1458°F
  - Cadmium, lead and barium melt
  - Arsenic and selenium boil
- Low fire: 1750–2110°F
  - Lead and silver melt
  - Arsenic, cadmium, barium and selenium boil
- Mid and high range: 2124–2381°F
  - Lead, manganese and silver melt
  - Arsenic, cadmium, barium and selenium boil

Protecting yourself from inhalation toxins

Select an N95 dust mask or respirator

Best methods

Half-mask cartridge respirator Local exhaust ducts

Best methods

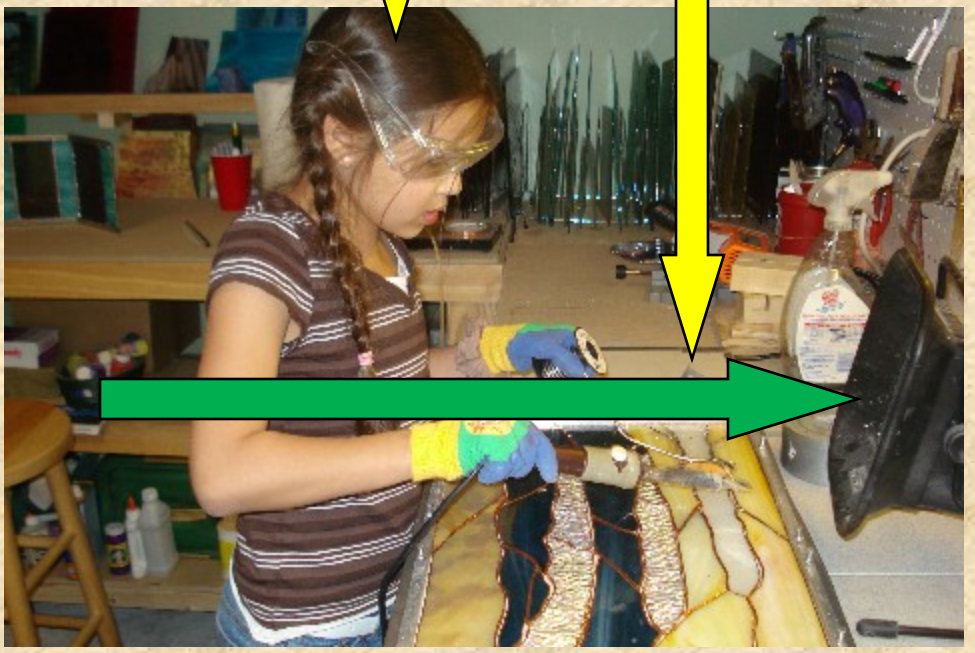
Half-mask cartridge respirator Local exhaust ducts

Local ventilation for toxic dusts/vapors

you

art work

Clean air comes in



toxics sucked away

What about indoor air cleaners?

- Particles?
  - High efficiency (HEPA) filter
- Chemical vapors or fumes?
  - HEPA then charcoal filter
- Change filters when needed
- Balance cost/performance

Avoid ozone generators!

Ozone Generators

State of Alaska Epidemiology

Bulletin

Copies of any bulletin may be ordered by calling the Section of Epidemiology at (907) 269-8000 or by writing to us at PO Box 240249, Anchorage, Alaska 99524-0249

Bulletin No. 36
September 8, 1997
Ozone Generators - Warning - Not For Occupied Spaces

Not all indoor air cleaning devices are alike, and certain types could cause health problems. Machines that purposefully produce ozone as an indoor air cleansing agent are currently on the market for residential use - these products should be avoided.

Local exhaust can be inexpensive

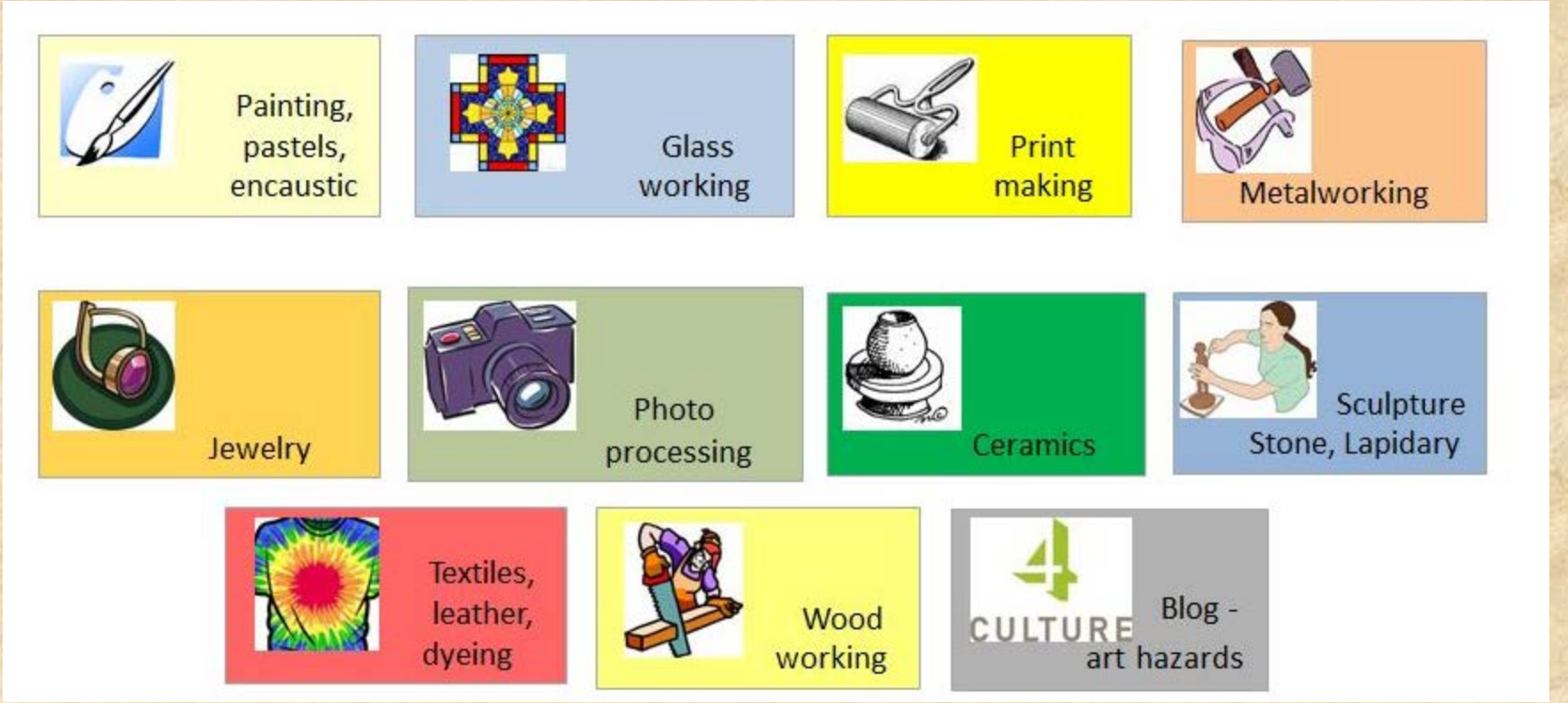
Homemade local exhaust option

Inexpensive but must still work properly.
Target flow rate is 100 linear feet/minute

Avoid crimps in ventilation ducts

Photo © Jaime Rojo. http://www.brooklynstreetart.com/theblog/2011/11/03/street-artist-xam-architecture-for-the-city-bird/

Some discipline-specific guidelines



OK, let's talk photochemistry

Common photography issues

- Exposure to toxic developers
- Lack of chemical eyewash near corrosives
- Improper disposal of waste fixer

Amidol

- Highly toxic by inhalation - asthmagen
- Severe irritation and allergies to skin
- Absorbed through skin to blood stream

Catechin (catechol)

- Poison by inhalation
  - Convulsions, damages liver & kidneys
- Severe skin irritation and allergies
- Absorbed through skin
- Ingestion of one gram can be fatal

Hydroquinone

- Irritation and allergies from skin contact
- Toxic by ingestion
- Eye injuries

p-Phenylenediamine

- Highly toxic by all routes of exposure
- Severe skin allergies
- Inhalation can cause severe asthma
- Ingestion linked to nervous system damage

Reducing risks from developers

- Use premixed chemicals to avoid dusts
- Adequate ventilation (10-20 air changes/hour)
- Protect your skin

Ceramics

Toxic metal exposure risks

Glaze mixing

Firing

Sanding

Sweeping

Leaching

Glazes

- Buy premixed to avoid dust
- This one says “Food Safe*”

Photo: Dave Waddell

Wait a minute

- What's that symbol?

Read the labels carefully

Photo: Dave Waddell

Jewelry

Soldering and brazing hazards

Smoke is dust

Ultrafine particles

Deeply inhaled

Readily enter bloodstream

Hazardous metals of concern

- Lead
  - Neurotoxin
- Cadmium
  - Carcinogen by inhalation
- Nickel
  - Carcinogen by inhalation, skin sensitizer

Toxins linked to soldering/brazing

- Some metal fumes released
  - Lead, cadmium, silver, nickel
  - Not a problem if good ventilation is provided
- Fluoride-based flux
  - Toxic
  - Bone and teeth defects

Use a fluoride-free, borax flux

Safer pickle options?

- Citric acid
- Acetic acid (vinegar) and salt

Make your pickle last!

- Avoid contamination!
- Just add a bit of water to replace evaporation

Acid puts copper in solution

It's not OK to pour it down the drain
Most artists neutralize before disposal

Neutralizing doesn't remove copper
which is extremely toxic to fish

Painting & Drawing
Aqua Oils

Mix of vegetable oil, detergent, metallic soap drier and pigment

Oil drier
Combustible, toxic, sensitizer

Prevent rag fires

Linseed oil

- Low toxicity
- Causes spontaneous rag fires

Safer oil-paint brush cleaners

Photo: Dave Waddell

Safer substitutes - Printmaking

- Plates that don’t require a nitric acid etch
- Gamsol-like odorless thinners
- Disposable screens for screen printing
- Water-based film-adhering fluids

Safer substitutes - Glassworking

- Cullet instead of powdered glass
- Wet grinding and cutting
- Bead blasting instead of acid etching

What is hazardous?

- Corrosive
- Toxic
- Flammable
- Reactive

What is waste?

- Don’t want it
- Can’t use it
- Unknown
- Orphaned
- Spilled

King County photo by Dave Waddell

What's **not** hazardous waste?

- Something that's still useful
- Empty containers

- Things that are hazardous but not chemicals

Handle wastes properly

- Securely store them
- Separate these incompatibles
  - Acids in separate cabinet
  - Flammables in separate cabinet
  - Bleach away from ammonia

Reduce your waste generation – And your disposal costs!

- Buy only what you need
- Use it all up
- Select non-hazardous products
- See if others can use viable art products you no longer need