# SAFETY IN THE STUDIO





ARKANSAS TECH UNIVERSITY

### DRAWING

Usually drawing is the least dangerous art activity, but there are a few problems of health and safety to watch for. Most students do not have a problem with using crayons, markers, pencils, pen and ink, charcoal, brush washes or pastels.

The exceptions to watch out for are:

1. Aerosol spray fixatives used to fix charcoal and pastel works should be used only in a place that is extremely ventilated or outside. Simply, spraying outside the classroom in the hallway would contaminate the entire building. The dust from the charcoal and pastel can also irritate some students when left in large quantities. Remember to keep your work area clean after working in order to avoid excessive media build-up.

2. Many oil crayons are imported and the non-toxic label may not be entirely accurate. Make sure to use only oil crayons that have the AP (Approved Product) or CP (Certified Product) seal of the Art and Craft Materials Institute.



Since spray fixatives should not be inhaled, make sure to follow the rules of the spray room.

### PAINTING

Be careful of certain pigments while painting since there are a number of toxic inorganic pigments that should be avoided. Seeger (1982) and McCann (1985) cite the following:

- Naples Yellow (Antimony)
- Cobalt Violet (Arsenic)
- All cadmium pigments (Cadmium)

• Chromium Oxide Green Veridian, Chrome Yellow, Zinc Yellow, Strontium Yellow (Chromium)

• Cobalt Blue, Cobalt Green, Cobalt Yellow, Cerulean Blue, Cobalt Violet (Cobalt)

- Flake White, Naples Yellow, Chrome Yellow (Lead)
- Manganese Blue, Raw Umber, Burnt Umber, Mars Brown,

Manganese Violet (Manganese)

• Vermillion, Cadmium Vermillion Red (Mercury)



These pigments are corrosive to the skin, irritative to the respiratory tract and mucous membranes. Some people can have allergic reactions. One can reduce problems associated with these pigments by good housekeeping, keeping food out of the studio and careful personal hygiene. Do not place brushes in your mouth.

The greatest hazards in painting, besides these pigments, come from working with turpentine or other toxic solvents. This hazard does not exist when using acrylics, watercolor, or tempura where the solvent is water. Oil painting, on the other hand, contains hazardous pigments, uses dangerous solvents and is usually done in an area with poor ventilation. There is not much difference in visual quality between oil paint and other paint mediums nor are there special secrets to be learned through the use of oils to justify either the trouble or expense to make them safe to work within the classroom.



**Note:** Never pour globs of paint down the sink, as they will clog the pipes when dried.

### PRINTMAKING

Careful instructions and procedures will minimize health and safety hazards in printmaking. Health problems include exposure to inks, solvents and acids, while the safety concerns relate to injuries resulting from the use of cutting tools and the crushing action of various parts of the printing presses.

#### **Beginning Printmaking**

Found objects, vegetables, glue, cardboard and linoleum are the materials most used to make prints; tempera, finger paint and water-based block printing ink are most often used to print them in most introductory courses. The safety hazard at this level involves the tools used to cut the surface of the image carrier or block. Continuous monitoring, a careful pace, and good instruction are key to keeping students safe



Closeup of printing press with a warning to keep hands away from the roller.

To minimize problems:

• Limit beginner students to working with relief prints. There are a sufficient variety of these experiences to provide many printmaking opportunities.

• Buy tools that are of good and lasting quality. Make sure tools are sharp so that cutting is sure and predictable.

• Show students how to hold the cutting tool as well as their work so that when the tools slips (because it will), no harm is done.

• Separate the cutting area from the printing area to reduce confusion and mess.

• Linoleum blocks must be cut only with linoleum cutting tools, and these tools only used when cutting linoleum.

• Complete instructions must be given for any type of press used in the studio.

• Improper practices must be corrected immediately to avoid wrong habits.

• No horseplay in the studio.

Print processes offer a great variety of learning experiences and expressive possibilities, so printmaking should be encouraged and exploited. With thorough planning, good instructions and constant monitoring, the potential hazards of all of these processes can be effectively controlled. Because printmaking is a fairly complex activity, students can, at the same time, learn important lessons about responsibility so that hazards encountered later in the more advanced activities will be better understood and significantly reduced.











Top: Mineral spirits, distilled alcohol, simple green, assorted inks, roller, and pallet knife. Bottom (left to right): Hotplate, metal shearing machine

#### Solvent and Ink Fumes

A fan or open-air system is ideal in keeping fumes away from students. Keep solvent and ink containers closed, when not being poured, to minimize vapors. Use small amounts of ink and solvent at a time. Throw away waste materials in a closed trash container. If the odor of the ink or solvent permeates the room then the amount of air going out must be increased or the amount of students working reduced.

#### **Contamination by Skin Contact**

While using gloves can be awkward at first, they eliminate the problem of ink or solvents coming into direct contact with the skin. Most household plastic gloves will protect from ink contamination. Gloves used with solvents must be more carefully selected and should not be expected to provide long-term protection since the solvent will eat away at it. Carefully dispose of dirty gloves, waste rags and paper.

#### Disposal

Dispose of used rags and waste paper in a self-closing waste can and empty it daily. Waste solvents should not simply be washed down the sink drain, since that usually leads directly to city water treatment plants and can create serious pollution problems.

#### **Advanced Printmaking**

To make permanent block prints, oil-based inks and the solvents they require are necessary. The hazards of these can be reduced by good housekeeping and careful instruction, but can happen. Alternatives to these inks are water-soluble silkscreen inks that are permanent. It is not possible to substitute water-based ink for intaglio processes.

• Oil-based inks will stain cloths permanently so an apron should be worn to protect clothing. Inks will stain skin temporarily. Use a soap that contains pumice before washing hands to get ink off easier.

• Always use the vent fan when printing with ink to minimize inhaled vapors.

• Use the vent fan when using acid baths during intaglio processes.

• Turn off the hotplate if you're the last person to use it. Leaving it on and unattended can cause a fire. Also, do not touch the hotplate when it is on because it will cause burns.

• Alcohol cleans sharpie off surfaces.



Acid station with vent hood.



Eye wash and shower station.

### FIBERS AND DYES -

Only two aspects of fiber work really require attention to eliminate health hazards involved in fiber work.

#### Bacteria, Dust, Fibers

If yarns are purchased commercially, concern about bacterial contamination is virtually unnecessary. However, when wool or other fibers are used in spinning, be sure the raw fiver has been thoroughly sanitized to prevent bacterial growth. This situation is rare, but has happened can be serious. Do not work with any raw wool, or other fibers, that has been brought into this country "informally."

#### Dyeing

There are a great variety of dyes available, which are used, in different processes and for different fabrics. Not a lot is known about potential problems that are associated with these dyes. Previously, food dyes were though to be harmless, but recent studies have shown that they may be carcinogenic. Benzidine congener (family) dyes, used in many common products, have also been found to be carcinogenic and have been discontinued in some applications. Mordants, such as chrome, ammonia, and oxalic acid, can cause various toxic reactions, including respiratory and eye irritation, skin corrosion and allergies. Re-packaging of dyes by distributors cause problems because label warnings are sometimes not transferred to the new container.

The most hazardous dyes seem to be fiber-reactive (cold water) dyes, which cause symptoms such as asthma, "hay fever," swollen eyes and sudden severe allergy, after long exposure. An approved dust mask and gloves is recommended to reduce exposure to all dyes. When mixing dye powder, use an entire package at one time so that leftover packages will not spill and release dust. McCann also suggests that when possible, the entire dye powder package be submerged in water while it is being opened to prevent any inhalation.

To make a box to mix dye in:

- Shellac the inside of a cardboard box to seal it.
- Put a glass or plexiglass sheet on the top to see through.
- Cut holes in the sides.
- Wear gloves to mix dye inside the box.
- No mask is needed or messy cleanup.

Common dying processes are tie dying and batik. Common household dyes are used in these processes, and they should be handled with great care. Wear gloves and thoroughly wash any parts of the body where dyes may have been spilled. Only let carefully trained students mix dye from powder. Heated wax is used in batik dying processes. Heated wax is highly flammable and can cause painful burns. To heat the wax, use a double boiler set–up, where the wax is set in a container that stands in water to which the heat is applied. Never heat wax directly on a hot plate, which might accidentally be turned to an unsafe high temperature. In any dyeing process requiring the heating of the dye bath, exercise extreme caution to prevent scalding.

#### **Textile Printing**

Block printing and silkscreen printing allow a variety of craft activities. The most popular of which is printing on t-shirts. Oil-based block printing or silkscreen ink has the advantage of permanence, but the disadvantage of making the fabric stiff. To leave the material soft, special textile ink is preferred. The same toxicity problems still arise with these inks and solvents as in other print processes. Caution must be used to reduce skin contact and inhalation of the fumes. Gloves, barrier creams and good ventilation are must have precautions. Using acrylic paints or inks is recommended as a substitute and manufacturers of acrylic products may have suggestions for using their products in textile printing. Don't assume ink or paint must be petroleum based to be permanent.

Keeping the work area clean and using common sense are fundamental in eliminating hazards. Most of the time the problems mentioned here will not arise since it is normal to work with commercial yarn. Other protective measures include: exercising reasonable care, wearing dust masks, and gloves, and meticulous instruction. More advanced process bring increased hazards of dust and dye.



# STAINED GLASS

Working with leaded glass is the most likely glass fabricating process to be done in an art room setting. Working with epoxy resins or concrete to fill the channels between very thick, faceted glass, or laminating glass panels into layers are processes more likely undertaken by artists specializing in this medium and should be done in schools only with very advanced instruction. Leaded glass is well within the skill levels of beginners. Attention needs to be given to those aspects of the process, which can cause injury or long-term health problems.

#### **Glass Cutting**

It looks easy when done by an expert, but cutting glass often doesn't turn out quite like it should. At best, clean cuts leave very sharp edges that need to be smoothed with emery paper. Obviously, the glass must be handled with great care to avoid cuts. When the planned cut is less smooth than intended, and the trimming must be done with grozing pliers, extreme care should be taken in handling the glass. Not only are the edges of the glass likely to be jagged, but the small pieces and slivers of glass must be watched very carefully and contained as much as possible. Work should be done over a cleared, smooth surface so the fragments can be easily brushed into a waste container. Goggles must be worn to protect the eyes from any shards of glass that fly in unexpected directions. As each piece is cut, set it well out of the way so that it must be handled as little as possible before the assembling of the project.

#### Handling Lead Came

One must thoroughly wash their hands and fingernails after handling lead came. Small particles from cutting or sanding the came can be passed to the mouth and ingested. Ingesting enough will result in lead poisoning.



Glass cutter.

#### Soldering

The solder used in leaded glasswork is a 60–40 or 50–50 mixture of lead and tin and should not have an "acid–core." In the soldering process, it is the solder, which melts, not the lead came, and the lead fumes given off from that solder should not be breathed. Good general ventilation in the work area plus a fan that will blow the fumes away from the participants should be sufficient. A better method is to rig a vacuum cleaner with its intake near the work and the exhaust hose arranged to carry the fumes outside. If possible, work in front of an open window with an exhaust fan to extract fumes. Do not solder under a canopy hood, since the fumes will be drawn up and directly past a student leaning over his or her work.

In general, wear gloves that will protect hands from being cut by sharp glass edges, yet still allow free manipulation of the glass. Limit cutting to simple shapes until good cutting skills have been achieved. Exercise care in the process of applying the putty, so that sharp edges of the came, particularly at joints, do not cause cuts.



Soldering Iron.

## CERAMICS

Ceramics has become an increasingly popular art form in recent years. There are probably few schools where some ceramics activities don't occur and many where the program is extremely sophisticated and extensive. It is not only one of the most pervasive art activities in our society, it is one of the most complex. It involves a number of often-ignored hazards. From the raw material to the finished object, clay goes through several different states and a series of manipulations, each of which has inherent health or safety hazards. It is in three of these stages the most serious hazards occur: mixing, glazing and firing.

#### **Clay Mixing**

Normally, the digging and refining processes occur before teachers and students come into contact with clay, so the first problem usually encountered is with clay dust that escapes from the bags in which it is packaged. During commercial preparation, clay is ground very finely so that leakage from these bags is not uncommon. The bags are sometimes ripped in delivery, but more often they are torn open after arrival and partially used. As a result, the environment in which clay is stored is almost always a dusty place. This clay dust is then scuffed into the air and tracked throughout the school, leaving a film of powder over nearly everything in direct contact with it.

Silica may compose up to 60 percent of the clay. Usually it is chemically bonded with other elements, but if not, it is known as free silica and can be the cause of chronic silicosis. Silicosis is ultimately a disabling disease of the lungs. No one should be unnecessarily exposed to free silica; its effect is long-term and usually does not result in problems for 10–15 years. It is, however, the ceramics teacher and serious student, working with clay for a period of years, who are in the greatest jeopardy. For their protection, as well as for short-term students, correct clay handling and mixing procedures must be maintained. The teacher's own risk should be sufficient motivation to insure an effective program of dust containment.

In addition to the health hazards, the safest possible procedures for mixing clay must be devised. Pug mills and clay mixers should be used only after detailed instructions have been given and tested and always with close teacher supervision. Incidentally, be sure that barrels used to collect clay for reuse are frequently checked for foreign materials or small tools, which may have been inadvertently dropped in. These could later create serious problems in the mixing equipment.



The following suggestions should be observed to limit clay-mixing hazards as much as possible:

• Determine if the quantity of clay to be used warrants mixing it from powder. While it is somewhat more expensive, ready mixed clay is preferable because it eliminates the need for dust handling or mixing equipment. An explanation and demonstration of how clay is made will be sufficient until students are working at a more advanced level.

• Store and mix clay in an area separated from the studio so as to reduce the area of dust contamination.

• Keep all powdered clay bags in storage covered tightly with polyethylene sheeting in order to contain the dust.

• Stack clay bags off the floor on pallets or shelves so that cleaning the floor is easier and more complete.

• Wet mop the floor of the mixing area frequently; never sweep or dry mop, since this stirs up dust particles and provides inadequate cleaning. Vacuuming is effective only if there is a HEPA (high energy particulate air) filter in the vacuum cleaner, which will prevent recycling of the dust through the air.

• Wear a dust mask specifically designed to filter out silica and other particles whenever working in the clay mixing room or when sanding a dry, but unfired (greenware) object. Be sure the mask is the correct type (one having NIOSH approval #TC-21C-132, for example).

• Have a local exhaust system operating whenever the clay mixer is in use; this will draw off most though not all of the problem particles.



#### Glazing

The second stage of clay work involves the process of glazing. This is a complex area, since the great variety of materials used in mixing glazes makes it difficult to generalize about the hazards. Glazes are often purchased ready-mixed, but in some programs the teacher will have the students learn glaze formulations, using bulk glaze chemicals to mix their own colors. In either form, simple rules should govern their handling:

• Allow no food in the area where glazes are being used; it is very easy to contaminate that food and thereby ingest chemicals.

• Always use a stirring stick; never use hands to mix the glaze.

• Wash hands thoroughly after working with the glaze.

• Work on an easily cleanable surface when applying the glaze; formica or plastic are suitable. Clean with a wet sponge or rag when finished.

• Glazes should be sprayed only in a booth with an exhaust fan that effectively carries away excess airborne particles.

When mixing the glazes from powder, there is the additional need to exercise extreme care containing the dust. This means there should be effective local ventilation or that toxic dust masks or respirators must be worn during the mixing process. Protective clothing such as a smock or shop coat should also be worn during this process. To contain dust, wear these garments only in the mixing area; wash them frequently. Figure 11 lists several glaze substances that should not be used in a school setting; all are suspected carcinogens or highly toxic.

Perhaps the most recognized of glaze hazards is lead. But it is sometimes used in classrooms. The usual justification for this is that the objects being glazed will not be used as food containers, and thus there will be no chance of contamination. Two factors need to be considered, however. First, if any other objects are fired along with lead-glazed pieces, they are likely to be contaminated by lead fumes (as is the air around the kiln during firing). Thus the lead can be passed along in sufficient quantities to represent a hazard to ultimate users of the objects.

Second, lead frits, often thought to be non-soluble and therefore safe for use, may not always be so. "Lead frits vary in solubility (the capacity to dissolve in liquids to form a solution) depending on factors like: method of production, size of particles. Due to the variation in solubility some inhaled and ingested particles may dissolve in body fluids. Therefore, we believe that lead frits are not reliably non-toxic and should be handled with the same precautions used for other lead compounds. Copper used in, or on, ware fired in a kiln with lead containing objects can affect the solubility of the lead on other ware. Although there may be some justification for professional potters to use these materials in their private studios, there can be no such justification for their use in a school setting.

### GLAZE MATERIALS THAT SHOULD BE AVOIDED

The following materials are suspected carcinogens or are highly toxic and, regardless of how carefully they may be handled, should not be used in junior or senior high school settings. While it might be possible to control them in the studio of a professional potter or even the studio of a very limited number of advanced students, there is no justification for subjecting secondary level students to the inherent hazards.

Lead and its compounds: (-acetate, -silicate, -bisilicate, -monoxide, -oxide)

Arsenic and its compounds: (-oxide, white oxide, -trioxide)

Cadmium and its compounds: (-oxide, -sulfide, -chloride)

Nickel and its compounds: (may produce highly toxic nickel carbonyl in firing)

Beryllium and its compounds (-oxide, beryl, beryllia)

Zinc chromate

Selenium and its compounds (-oxide, -dioxide)

Any uranium compounds



#### Firing

The final step in the ceramics process, which involves hazards to teachers and students, is kiln firing. It involves intense heat around the kiln, and the vitrifying clay or glazes five off a variety of fumes, some of which may be highly toxic. All kiln firing, for example, produces carbon monoxide when various impurities in the clay decompose during firing. Depending on the clay and glaze content, gases such as sulfur dioxide, fluorine, chlorine and nitrogen oxides are produced. The heating of any metal above its melting point also produces fumes. Because of the number of chemicals involved, and the variety of possible mixtures, identifying a few general guidelines to reduce hazards is not really possible. Ceramics teachers, therefore, have a special obligation to keep up with the technical literature relating to safety. They should continually question manufacturers about health and safety hazards related to their products.



#### Some important questions are:

• What is the exact nature of the chemical changes caused by firing glaze substances? What fumes are likely to be released and how can protection from the most hazardous be provided? Are there chemicals that must not be mixed because of a synergistic effect in the firing?

• What is the best location for the specific kiln(s) in use? If they are inside the building, what is the volume of air (cfm) necessary to insure fumes are carried off through a canopy hood? How far should a kiln be located from a flammable wall surface?

• What is the maintenance schedule to be followed for each specific kiln type and kiln part? Who is qualified to carry out maintenance? Do the kilns require inspection by a fire marshal? What type of periodic inspections should be done and by whom?

• What safety controls are available for each kiln to prevent over firing or missed shutoff times?

It is reasonable to expect the manufacturer or the distributor of materials and equipment to give answers to these questions; if they expect to continue to supply products to schools, they must accept the responsibility of working with teachers to develop the most hazard-free conditions.

Clay is a wonderfully creative medium in which to work and there is no reason for conditions to exist, which make it an unsafe medium if the general precautions outlined here are followed. The full-time or specialist ceramics teacher, who is probably also a serious potter, will need to constantly search for information from sources such as NIOSH, OSHA, and the Center for Occupational Hazards. NIOSH and OSHA are agencies of the Department of Labor and can be contacted for information through the regional offices of that department. COH is a private non-profit organization and is located at 5 Beekman Street, New York, NY, 10038.

### **DIGITAL ARTS**

#### **GRAPHIC DESIGN & DIGITIAL PHOTOGRAPHY**

With the popularization of graphic and commerical art has brought new health concerns to artists. Continuous use of a computer might result in developing overuse injuries, or work-related musculoskeletal disorders, cumulative trauma disorders (CTDs), reptitive strain/stress injuries (RSIs), repetitive motion injuries, etc. The injuries can affect the upper extremities such as, fingers, hands, wrists, elbows, shoulders, and neck. This can cause problems such as shoulder tendinitis, epicondylitis (tennis elbow, golfer's elbow), and carpal tunnel syndrome. The first two are inflammation of the tendons of the shoulder and elbow, and the latter is due to inflammation of the carpal tunnel nerve at the wrist.

Reptitive movements and long periods of stationary postitions can lead to overuse injuries. Giving yourself frequent rest breaks and not working at a computer for more than 4 hours a day will minimize chances of developing an overuse injury. Examples of pressure injuries are resting your wrists on the edge of a table or your bottom on a chair for prolonged periods of time.

#### Precautions to minimize injuries

Adjust the keyboard, monitor, mouse, work table and chair to achieve a comfortable and neutral position. You should be looking straight forward, your elbows at your sides, your upper arms vertical with your elbows with your upper arms horizontal, and wrists straight. Do not slouch or force yourself to sit up straighter than feels normal. Sit with your knees bent at a 90 angle with your feet flat on the floor.

Frequent rest breaks will help the body recover from localized fatigue. The recommended monitor viewing distance is 18-24 inches while not leaning forward in your chair.

Adjust the monitor so that your eyes are level with the top of the monitor. Lighting can create glares off VDT screens. Avoid headaches by giving yourself frequent rest breaks for your eyes.

A good computer chair will have these characteristics:

- 1. An adjustable seat height of 16-20 inches.
- 2. A seat pan long enough to support the legs without pressing in at the knee, and wide enough to allow movement.
- 3. The back rest should support the upper and lower parts of the back with a convex curvature from top to bottom and concave from side to side.
- 4. If armrests are included, they should be padded and should not elevate your shoulders.
- 5. The chair should have a steady base with 5 legs.

#### TRADITIONAL GRAPHIC DESIGN

Several techniques are included in traditional graphic design such as, drawing, painting, retouching, and paste-up of mechanicals. A wide varity of materials is used—including paints, dyes, inks, bleaches, spray fixatives and adhesives rubber cement, and solvents—which can be applied by pen, brush, swab, marker, aerosol spray can, or air brush.

The first materials that call for caution are rubber cement and rubber cement thinners. They used to contain n-Hexane, a chemical that causes dermatitis, narcosis, and peripheral neuropathy. Now it has been replaced with heptane which is less dangerous, but still flammable. Good ventilation is needed for fumes from rubber cement and its thinners.

Spray painting should be done in a spray booth or outside to prevent inhalation and accidental spills. For water-based paints, a NIOSH-approved respirator or N95 dusts and mists filter. For solvent-containing paints, you need a respirator with an organic vapor cartridge and N95 spray prefilter.

Dyes used in markers, colored inks, spray markers, and liquid water colors do not have many known hazards from a lack of long-term studies. The solvents used to clean them up do require good ventilation. The use of bleach to remove dyes from the skin is not recommened to avoid dermititus. Using gloves will allow you to avoid skin contact with dyes in the first place.



Since spray adhesives should not be inhaled, make sure to follow the rules of the spray room.

Spray fixatives are used on top of drawings to prevent smudging. Spray adhesives are used to stick paper together. A common solvent is petroleum distillates. They are not usually considered highly toxic unless they contain hexane, but in spray-mist form they may cause chemical pneumonia is substantial quantities are breathed in. Be sure to use both spray fixatives and adhesives in a well-ventilated spray room to prevent breathing in fumes. Aerosol spray cans are also explosive and usually flammable. If possible, aerosol spray should be replaced by non-aerosol sprays. Mouth atomizers for spraying are not recommended because of the risk of liquid backing up into the mouth. Make sure to use aerosol products in a spray room especially when spraying large amounts.

Although the retouching of drawings, packages, photographs have been replaced by computer techniques, freon and methyl chloroform are commonly used for film cleaning. Freon can cause irregular heart rhythms in large quantities. Methyl chloroform is less toxic, but it can cause narcosis.

lodine and potassium iodide in water are commonly used as a black-andwhite bleach. lodide is strong skin irritant and is poisonous if ingested. Ethyl alcohol is used as a stopping agents, and is only slightly toxic. Thiourea is used as a clearing agent, but is suspected of causing cancer in humans since it causes cancer in animals. Color bleaching uses a variety of chemicals such as, potassium permanganate and sodium bisulfate. Of the two the sodium bisulfate is the clearing agent. In powder or in concentrated solutions, potassium permanganate is highly corrosive, but mildly irritating in dilute solution. When diluting the acids, always add the acid to the water, never the reverse. Wear rubber gloves and goggles for protection. Sodium bisulfate decomposes in acid solutions to product sulfur dioxide, which is higly irritating to the eyes and respiratory system.

Transparency retouching uses potassium permanganate, sulfuric acid, and sodium chloride to bleach yellow dyes. Adding more potassium permanganate solution than specified in the directions will cause the danger of producing highly toxic chlorine gas. Sodium chloride releases chlorine gas in acid solutions. Sodium chloride in powder form is irritating to the skin, eyes, nose and respiratory system, and causes allergic reactions. Local exhaust ventilation is required for all of the above bleaches.

Stannous chloride and disodium EDTA bleach magenta dye and are both highly toxic. Stannous chloride solutions are skin irritants and the dust is a respiratory irritant. Ingesting disodium EDTA causes kidney damage and tetany (irregular muscular spasms of the extremities) due to calcium depletion. Sodium hydrosulfite (sodium dithionite) used in a cyan bleach is flammable and can decompose to produce sulfur dioxide. Sodium cyanide causes skin rashes and is extremely poisonous by ingestion and possibly by inhalation. It is recommended to not use cyanide bleaches. Gum arabic solution is often sprayed onto photographs as a fixative. Inhalation of this can cause "printer's asthma," so called because about 50 percent of the printers who used to spray it became sensitized to gum arabic.

Care should be used when applying rubber cement for adhesive purposes. It is extremely flammable and its harmful vapors may cause allergic reactions. Do not injest or place it in contact with heat, sparks, or open flame. Use ventilation to minimize inhalation of the flames. It can damage your work surface so protect your area with an impermeable material.

The xacto knife is used by all graphic designers to cut out prototypes and projects. Keep a firm grip when using the knife and take your time to make clean cut. They may seem less harmful since the majority of the blade is encased in the plastic handle, but take care since it is still a sharp blade. Once the end of the blade is dull, used the plastic bit at the end of the knife to safely snap off the dull blade. Wrap the old blade in a piece of tape and discard it into the trash. Replacement blades can be purchased.

#### GAME, GRAPHIC, AND INTERACTIVE MEDIA DESIGN

As with graphic design, reptitive movements and long periods of stationary postitions can lead to overuse injuries. Giving yourself frequent rest breaks and not working at a computer for more than 4 hours a day will minimize chances of developing an overuse injury. Examples of pressure injuries are resting your wrists on the edge of a table or your bottom on a chair for prolonged periods of time. Be sure to follow the correct posture as mentioned before.

It is important to remain cautious around the 3D printer since it is a process that is still in its infancy. The 3D printer is a loud and slow device so wear proper ear protection. Long periods spent around high volumes can damage your hearing. The materials that are fed into the printer will release vapors that may be hazardous during heating. There are two kinds of materials which are ABS and PLA. ABS stands for Acrylonitrile Butadiene Styrene and are combustible materials. ABS is combined in thin strands. PLA is a biodegradable thermoplastic aliphatic polyester derived from corn starch tapioca. Be aware of the moving parts and that the printer uses high voltage to work.

### Sculpture -

All three-dimensional activities are likely to be classified as sculpture. This can mean anything from a simple cut and folded paper form to a cast object involving modeling, mold making, metal heating and pouring, grinding, polishing and adding patina. Except that the objects created in each case occupy three dimensions, and are viewed as such, they have little in common.

The sculpture processes normally seen in the elementary school do not go much beyond various paper or cardboard constructions fastened with glue and staples, papier-mâché, simple wood constructions, clay and perhaps wire worked in combination with scrap materials. There are of course some hazards involved with each of these, such as the use certain adhesives, cutting tools, and the problems of any clay activities. These hazards have already been discussed in earlier chapters. The sculpture activities of concern here are those of advanced students. These involve more advanced methods and materials.

Realistically, there are many sculptures processes well within the capabilities of beginning students, which are almost never done because of the cost, and complexity of materials and equipment. Where these processes exist, the teachers must demonstrate extreme concern for the health and safety of the students. These teachers must be familiar with the highly technical information specifically directed to sculpture with those media.

Similarly, using plastics to make sculpture has dropped significantly in popularity and frequency in recent years, probably in part because the health hazards of the various epoxies and resins have become better known. Many of the exciting visual possibilities these materials once seemed to have, no longer are so attractive to artists, students or teachers. Although plastics in many forms continue to have widespread commercial application, only a few professional artists use them.

#### **Wood Carving and Construction**

These involve hand or power cutting tools, which have been discussed in earlier sections of this book. In addition, however, it is important to emphasize the necessity of wearing eye protection and being sure work is done in a location where non-involved students will not be injured by flying chips or errant pieces of wood. Sanding and polishing wood are not particularly hazardous activities unless power equipment is used improperly. Belt or orbital sanders are relatively easy to control and should cause little difficulty, although large floor models sometimes move at a speed which can pull a piece of wood away from an inattentive student. All tools should be equipped with proper guards. Power sawing and sanding produce significant quantities of wood dust, much of which is suspended in the air for some period of time. Fixed sanding equipment or saws should be fitted with vacuum dust collecting systems, and students should wear appropriate dust masks if there is extensive wood working going on. Typically there will not be enough dust in an art classroom for this to be a serious problem, but an aware teacher will take the proper precautions, should dusty conditions prevail.

Finishing materials used with wood primarily involve solvents, which have already been discussed, and since the adhesive most often used in attaching pieces is non-toxic white plastic glue, few problems exist in this area.

#### Metal Forming-Welding

In some schools, metal sculpture has grown in popularity and welding is not an uncommon practice. Although most metal work occurs in an industrial arts shop rather than the art room, some aspects of metal forming and joining may be found there. The major hazards in working with metal involve cutting, either with hand-held metal snips or large guillotinetype cutting presses. Under no circumstances, should the latter be used without extensive training and careful supervision. In fact, where work of this scale is undertaken, an especially thorough skill-testing program should exist.



Welding is a similar case. The most common types of welding include oxygenacetylene, arc welding and brazing. Of these, arc welding is probably the least likely to be found in any secondary school art program. Teachers whose students arc-weld should consult, as a minimum, publications such as Welding Safety or the Accident Prevention Manual for Industrial Operations. Welding in any of its forms, however, is a very specialized task and requires a fully trained and experienced teacher to prevent accidents. Welding should not be considered a process students can pursue "creatively" without a complete and thorough grounding in correct procedures.

The following rules should be considered minimum guidelines for safe welding activities:

- Read and follow all warning labels.
- Always check to be sure equipment is in good working order.
- Acetylene and oxygen tanks must always be chained to a wall or to a substantial portable cart to insure they do not fall over and damage gauges or fittings.
- Use correct protective equipment (masks, clothing and gloves).

• Work inside only if there is an effective ventilation system and then stand so as to avoid breathing any of the fumes rising from the work. If working outside, be sure fumes blow away from other persons and building openings.

• Be very careful of fire. Keep all flammable materials well away from the work area and be sure to have an appropriate fire extinguisher within easy reach.

Welding and brazing produce various air contaminants from the rods and the metals being joined as well as from coatings or painted surfaces, which produce fumes when heated. Most of these fumes are difficult to identify, and they should all be assumed to be harmful and so require proper ventilation.

Generally, there are an almost unlimited number of materials and processes that can be used to make sculpture. The simplest of these usually involve no unexpected hazards. However, the more complex processes, such as metal forming and casting or work in plastics, are not ones which should be undertaken in most school art programs. The teacher must not only be skilled in the processes to teach them effectively, but fully aware of the health and safety hazards they create. These problems will not be easy or inexpensive to solve, and a careful evaluation of the educational and aesthetic goals of the art program should be made to determine the importance of such activities in the program.

### JEWELRY MAKING -

Complex manipulation of materials and tools demands careful attention to potential hazards in jewelry making. Most teachers recognize that the cutting, filing, casting, soldering or polishing inherent in this craft have the potential for causing a variety of injuries. Consequently safety is a normal part of instructional procedures in jewelry making. Wearing goggles during grinding and polishing is probably the most obvious protection. If teachers follow normal practices they will absolutely require eye protection for even brief periods.

In addition to eye protection, sufficient ventilation is necessary to remove fumes and fine dust particles from many steps in the process. For example, in mixing the dry powder to make an investment mold for lost wax casting, ventilation is needed to protect the students from inhaling the dust, which may contain up to 30 percent silica, a long-term cause of silicosis. Dust is also a problem when breaking up investment molds. Proper ventilation also insures that fumes from molten metals are not inhaled. If brass or bronze is being cast, there will be trace amounts of beryllium and arsenic in these copper alloys, and their effects can be very serious. Furnaces used for burnout of the wax in this process also must be located near effective ventilation.

Local ventilation will also protect students from soldering fumes created by the materials used for flux: cadmium, fluorides, and perhaps lead. Intense exposure to these can be dangerous, but if the fumes are drawn away by an effective air movement system, the dangers are relatively slight.

For many years, jewelry studios used asbestos blocks or boards as heat resistant surfaces on which to solder. Few teachers cannot know the dangers of asbestos fibers, which can often be broken loose from these objects. Since no amount of exposure to asbestos fibers is considered acceptable, immediately and correctly dispose of any such blocks or boards. Be sure to check with the school administration about how this can most safely be done; schools do not take student exposure to asbestos lightly.

Perhaps the best way to introduce jewelry making to students is to have them design and work with very simple materials such as string, yarn, leather thongs and found objects, which can be manipulated, into body adornment. As they develop a sense of how materials can work together, wire and plastic can be explored. When they are ready to try their ideas entirely in metals, they will then have a good sense about jewelry design and will find the safety requirements easier to manage. If students understand design concepts, they will have far less trouble in understanding and accepting health and safety precautions.

### CONTROL JEWELRY HAZARDS BY:

• Be sure all machine guards are in place and in use on any grinding or polishing tools in the room.

• Clearly instruct students on how to cut and saw metal or wire. Proper metal snips or coping saws should be used; vises or clamps should hold metal in place during the cutting, and safety glasses or goggles should be used. Be sure to file rough metal edges to reduce cuts or scratches.

• Heat metal only where local ventilation is available. In soldering or melting metals for casting, fumes should be drawn away from the student; it may be necessary to have individual elephant trunk hoods at workstations to insure full protection.

• Wear eye protection and work only in an area with good general ventilation when polishing; be sure long hair and sleeves are securely tied back to prevent tangling in the polishing wheel.

• Handle acids used in the pickling process (nitric, sulphuric, sodium bisulfate) with great care. Wear gloves, always add acid to water in mixing the solution, and keep acid baths covered when not in use. When the acids should be disposed of, be sure to follow methods prescribed for the school—do not simply pour the diluted solution down the drain. If there is no disposal policy, request that school officials find out how it should be done so city water treatment facilities are not damaged. Pickling acids need local exhaust ventilation.

• Keep work areas clean and dust-free.

• Periodically check torches and all hoses to be sure they are in good condition and do not leak.

- Use only cadmium-free silver solders and fluoride-free fluxes.
- Use lead-free enamels.
- Develop rules to be followed in the use of protective equipment.