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ART TEACHER, BE AWARE

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A BOOKLET ABOUT THE SAFE USE OF ARTS AND CRAFTS MATERIALS
FOR ELEMENTARY SCHOOL TEACHERS

Published by authority of the Minister
of National Health and Welfare

1994

Available in Canada through your local bookseller or by mail from:
Canada Communication Group—Publishing
Ottawa, Canada K1A 0S9

Cat. No. H46-3/4-1994E
ISBN 0-660-15435-8
94-EHD-183

Canadian Cataloguing in Publication Data

Main entry under title:

Art Teacher, Be Aware: A Booklet About the Safe Use of Arts and Crafts Materials for Elementary School Teachers

Issued also in French under title :
Enseignants en art, sachez...
Includes bibliographical references.
ISBN 0-660-15435-8
Cat. No. H46-3/4-1994E
94-DHM-183

1. Artists’ materials – Safety measures.
2. Art – Study and teaching (Elementary)
I. Canada. Bureau of Chemical Hazards.
II. Title: A booklet about the safe use of arts and crafts materials for elementary school teachers.

RC963.6.A7A77 1994 702.8’9 C94-980189-5

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INTRODUCTION

The visual arts are a common part of school curricula in grades one to eight; most elementary school children can expect to work with arts materials for at least an hour or two every week of the school year. As a rule, working with such materials should cause no concern for health or safety. To use some of the more “advanced” materials and techniques safely in the classroom, precautions may need to be taken. The most common health hazards from working with arts materials are perhaps the most obvious ones – cuts (from knives or scissors) or burns. What may be less obvious is that there can be risks from a few of the arts materials themselves, such as some pigments and solvents. These risks, and ways of controlling them, are the main subjects of this booklet.

This booklet is intended for art teachers working with grades one to eight; it describes what is known about the possible risks associated with some arts materials, and how such risks can be minimised. It outlines how substances in our environment can affect us; who could be at risk; which techniques and materials can be safely used in an arts course for children; and which may need special precautions. The aim is to suggest to you where there may be health concerns, and help you assess them and obtain more information about them. It is mainly concerned with promoting children’s health. However, where there are precautions to be taken, you, the teacher, should take them for your own benefit, too.

The contents of this booklet have been shaped by the results of a survey carried out by Health Canada (formerly Health and Welfare Canada) in 1991. Data from the survey are available from Health Canada – see the section on “Further Information”. The questionnaire was designed to study the use of arts materials and techniques in grades one to eight, and was filled out by art teachers. Of 3970 questionnaires mailed, 2493 (63%) were returned – an unusually high response rate for a survey of this kind – and a sample of 775 were analyzed. Among other things, the survey showed that a very wide range of topics are taught in elementary schools – from simple drawing and painting to some “advanced” topics such as sculpture using plastic resins and colour photoprocessing. From among these topics, this booklet concentrates on the materials and techniques most commonly taught and on those that require particular care.

Acknowledgements

The project officers responsible for this work were Shalini Gupta, Elaine Easson, John Harrison and Anthony Myres of Health Canada.

Statistics Canada provided advice on the contents and structure of the survey, and compiled the data. Both Devora Neumark (consultant) and Michael Holliday and Associates were instrumental in the production of this book.

Special thanks are given to the provincial Departments and Ministries of Education and school boards for their assistance, and to the schools, their principals and teachers for responding to the survey.

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Most of the materials used in arts courses are typical of the materials we encounter in daily life – from our work or our hobbies, in dust, in the food we eat and the liquids we drink. Many arts materials are, in fact, natural substances that have been prepared in forms useful to artists. There is nothing special about either the way arts materials can enter the body or the effects they can have on it – they are typical of the behaviour of "foreign" substances in general.

How harmful might such substances be? This is not as simple a question as it may seem. Any substance, even the most harmless – including table salt, water, or oxygen from the air – can make us ill if we swallow or breathe too much of it. On the other hand, even the most dangerous materials produce little or no harmful effect (or have little chance of being harmful) if we are exposed to small enough amounts of them. In short, our risk of being harmed by a substance depends both on how intrinsically toxic it is and on the amount we are exposed to.

To put this statement in perspective, it is helpful to know a little about how substances in our environment can affect us – how they can enter the body and what happens to them there.

How Substances Enter the Body

Before it can harm us, a foreign substance has to pass through the body's defences and, in most cases, get into our bloodstream. A substance we encounter has a chance to do this if we get it on our skin, breathe it in or swallow it.

The body's first defence is our various senses. Often our taste, smell or sight warn us against a substance that could make us ill. Even if we do come into contact with such a material, our skin is quite an effective barrier; it will prevent many unwanted substances from getting into our bodies unless we actually swallow them or inhale them.

And if we do inhale or swallow something that could harm us, the body has further defences. If we inhale dust particles or fine droplets of liquid, for instance, they can be trapped in the airways of the nose and throat, or in the windpipe or tubes that form the upper part of the lungs. If a dust particle is deposited on the walls of these upper airways, it is trapped in the layer of mucus that lines the walls. This prevents many substances from reaching and possibly damaging the deepest parts of the lungs. The same mucous layer may also trap a toxic or irritating gas before it can reach the most sensitive parts of the lungs. Irritating materials will probably make us cough, which can help dislodge the mucus containing them from the walls of the airways (and help remove the materials from our bodies), and warns us to get away from the source of irritation.

If we swallow something harmful, there are fewer natural defences, but it may make us throw up, thus removing the substance from our stomach before it can be absorbed into the blood and transported to the rest of the body. (**Note**: If a child accidentally eats arts materials, never induce vomiting unless told to do so by a doctor or the poison control centre).

Some materials are capable of doing harm without quite entering the body by damaging the skin, for example. If the damage is minor (such as itching, reddening or a rash) and recovery happens naturally after the substance is removed, the substance is called an irritant. If the damage is severe, visibly damaging the skin, the substance is called a corrosive; concentrated alkalis and mineral acids are examples. Any substance that can harm the skin can do much more harm to sensitive organs such as the eyes or the lining of the intestine (if swallowed) or of the lungs (if inhaled). The eyes are particularly at risk from corrosive materials because their natural defences (the eyelids and the production of tears) are often unable to stop splashes of liquid from reaching the eyeball.

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Even against materials that do not damage it, the skin is not a perfect barrier. Some solvents, such as turpentine, methyl alcohol (methyl hydrate) and toluene, can pass through it and into the blood and be carried to the rest of the body. (The chance of this happening is greater if the substance gets into an open sore or cut.) Then the effect may be much the same as if the substance had been swallowed.

The defences protecting other routes into the body can also be penetrated in various ways. Harmful dusts, mists, vapours or gases do not always warn us of their presence by smell or irritation. Even for those that do, the warnings may be ineffective. The sense receptors in our noses can become overworked if they are constantly responding to an odour in the air, causing us to become less alert to the smell of the substance. We may not realize we are still breathing it.

What happens when we breathe something depends on its form. We have already seen that coarse dust particles (or relatively large droplets in a mist) are likely to be trapped in the upper airways. When mucus containing the trapped substance is cleared from the airways, it is coughed up or carried to the mouth and then swallowed. If the trapped substance is toxic, the effect can be the same as swallowing it. As a result, the lungs may be protected while putting the rest of the body at risk.

On the other hand, if we breathe very fine particles or droplets and most gases or vapours, they are not likely to be trapped, and they can be carried through the narrow tubes of the lungs to the tiny air sacs (called alveoli) at their ends. There, gases and vapours can pass through the membranes of the alveoli and enter the blood. If the substances are corrosive or irritating, they could damage the air sacs and airways. Particles or liquid droplets can also lodge in the membranes of the air sacs and damage them.

Even if a harmful substance does not pass through the skin and is not inhaled, we may still get some of it inside our body: the mere fact that a substance may be toxic does not prevent someone from swallowing it – either intentionally (“to see what it tastes like”) or unintentionally, as dust on food or from unwashed hands, for example.

What Happens to Foreign Substances Inside the Body

After a substance passes through the skin, the alveoli, or the intestine, and enters the blood stream, it is carried throughout the body. If it dissolves easily in fats and oils, it will tend to concentrate in fatty tissues, such as the fat under the skin, the bone marrow, and the liver and the brain. Other materials may tend to concentrate in the bone. Although the substance may tend to concentrate in particular organs, it will still be found throughout the body, and in the blood in particular. But it may not stay in the body indefinitely.

When the body recognizes a “foreign” substance (whether a virus, bacterium, toxic chemical, transplanted heart or particle of pollen) it tries to get rid of it. The liver, the body’s “chemical factory”, provides one of the main ways of doing this. The liver tries to change poisons in the bloodstream into substances that are less harmful or more easily removed; these products are usually returned to the blood where they can be removed by the kidneys.

The kidneys are responsible for filtering impurities from our blood. These impurities include the waste products of cells and toxic substances, either broken down by the liver or unchanged. All these substances pass through the kidneys, become part of the urine and, after temporary storage in the bladder, are excreted. The net effect is that many substances in the body are removed from the blood stream and therefore from the body. Even a substance like lead, which is deposited in the bone, will be returned slowly to the blood and eliminated from the body. If no more were taken in, the amount in the body would eventually fall to a very low level; for lead, such a process can take years.

However, most substances are cleared from the body faster than lead. For some materials, such as many vapours, the removal is much faster. This happens because once the source of exposure is removed, the material passes back from the blood into the air in the lungs, and is then exhaled – the simple reverse of the process by which it was inhaled. For unwanted volatile substances, simply exhaling them is much more effective than destroying them chemically in the liver. Once we stop breathing their vapours, the amount of many solvents in the body drops within minutes or hours, and essentially vanishes within a day or two.

Whatever the mechanisms, there is a competition between the rates at which a substance enters and is removed from the body. The balance between these two rates determines how much of the substance is in the body – the faster it enters and the more slowly it is removed, the more there will be in the body at any moment. Some organs are especially sensitive to some chemicals and can be damaged even though the substance may be at higher levels elsewhere in the body. The most vulnerable organs, in fact, tend to be the ones that are most “active”. The most important of these “active” organs are the liver, kidneys and lungs because they are involved in processing and eliminating toxic substances from the body. They can be damaged if they have to process too much harmful material.

The brain, the spinal cord and the various nerves make up the nervous system. This is the body’s main control system and it is responsible for such activities as thinking, breathing, walking and talking – in fact for everything we do. Like other organs, the nervous system can be affected by a number of substances that may enter the body. Some of the effects are temporary (including those caused by most solvent vapours in moderate amounts) and are due to changes in the nervous system; most of these effects disappear fairly quickly if the source of the substance responsible is removed. Other effects can be permanent, the result of damage to the nerve cells themselves. Lead is a substance that can cause such damage; the developing nervous systems of young children are especially vulnerable.

Acute and chronic effects

The previous paragraph introduced an important distinction among illnesses that may be caused by harmful substances – the distinction between *acute* and *chronic* effects. An acute effect is a reaction that happens immediately, or within about a day, after someone is exposed to a harmful material. It is usually obvious – an example would be dizziness from inhaling the vapours of organic solvents (as in “glue-sniffing”). If it is not serious, an acute effect is generally reversed after the cause is removed. However, some acute effects can be very serious; for example, coma or death are possible if the exposure is high enough. A chronic effect results usually from prolonged or repeated exposure to relatively small amounts of a harmful substance. Chronic effects do not appear until months or years after the start of exposure (and for this reason their cause can be hard to identify) and they are not easily reversed. An example might be lung damage resulting from years of exposure to tobacco smoke.

In general, if we are exposed to small amounts of a possibly harmful substance once a week, but the amount we take in is naturally removed from the body within a day or so, there is no opportunity for the substance to build up in the body, and therefore little chance of it causing chronic effects. However, for a substance to produce chronic effects (without causing acute damage), it does not need to be present in the body all of the time. Irritants, like acid fluxes, can cause chronic bronchitis from repeated exposures even though the substance may be quickly removed from the body after each exposure. Adverse *effects* can build up even if the substance causing them does not.

In general, there is very little risk of chronic effects to students if they use something one or two hours per term, and very little more if they work with materials for an hour or two per week. (Exceptions here might be arts materials that contain poisonous substances such as lead or cadmium, which persist in the body for months or years; but materials containing such substances should be avoided wherever possible.) However, as part of the learning process, students should be taught about the hazards of a technique and proper precautions to take in school and for later, when they are out of school and on their own. In addition, children may have multiple exposures to chemicals so that although no one exposure is significant, the combined exposures may be significant.

Allergies and sensitisation

A few people can be very sensitive to some substances, and show acute reactions if they are exposed to them. The reactions may be itching and reddening of the skin (an allergic reaction that occurs when some people come in contact with wool, for example); flu-like symptoms if a dust that can trigger a reaction is inhaled; or severe breathing difficulties such as asthma.

In some cases, this sensitivity to small amounts of material usually develops as the result of prolonged exposure to the substance in question. For example, sensitisation to formaldehyde can cause a person to react to the trace amounts that are used as preservatives in some paints.

If such problems arise, the best remedy is likely prevention – if a student shows an allergic reaction to arts materials used in your class, that student should be offered a different activity.

Children, Adults and Arts Courses

Children can be more at risk from poisons and other harmful materials than most adults. There are several reasons for this, including the fact that children’s body defences are not fully developed; their rapidly growing tissues are easily damaged by poisons or lack of oxygen or nutrients; and they absorb relatively more materials through their intestines than do adults. With young children, the brain and nervous system are still developing, making these organs vulnerable to the adverse effects of many toxic materials. Also, the fact that a child weighs less than an adult means that a given amount of a harmful substance will produce higher concentrations inside the child’s body if swallowed or inhaled. All of these factors combine to make children susceptible to small amounts of toxic materials that would not harm an adult. In general, the younger the child, the greater the risk.

For young children the biggest risks are accidents or misuse, such as tasting arts materials. Most of the arts materials likely to be used in schools are safe if they are used properly. An arbitrary but useful division can be made at age twelve. Children younger than this – primary or junior school children – should generally not use materials that might be hazardous either by skin

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contact or by being swallowed or inhaled. As children grow older, not only are they generally less susceptible to toxic materials, but they are also more likely to understand and carry out precautions for the safe handling of arts materials. Older children can use most art materials used by adults – the main exceptions would be those containing toxic materials such as lead, cadmium, and chromates, or highly corrosive materials such as concentrated acids or alkalis.

It should be noted that ill or disabled children may need special consideration. Examples of situations requiring attention could include comprehension problems with learning disabled children, or interactions of solvents with medications. Problems are more likely to arise in the senior grades where more hazardous materials may sometimes be used. Teachers may wish to refer to “Teaching Art Safety to the Disabled”, referenced at the back of this manual.

Most of the rest of this booklet describes ways of minimising risk to students. However, you, the teacher, should be sure to take precautions of your own since you may be teaching the same topics (and therefore working with the same materials) several times a week. In preparing for classes you may have to work with materials in a less safe form – for example, concentrated acids, powdered pigments or bulk solvents. You may need to wear protective equipment (such as impermeable gloves or goggles) in such cases, or use extra ventilation. Because of your more frequent contact with these materials (and with perhaps higher concentrations), your chances of experiencing an adverse effect from exposure to them are greater than those of your students.

USING ARTS MATERIALS SAFELY

Young children (grades one to six) should use only non-toxic materials. Older children (grades seven and eight) can use more hazardous materials, but only if suitable precautions are taken. While it is important to know about any hazards that a procedure or a material may present, and how to minimize the hazard, it is also important to know which materials can be used safely, without the need for special precautions. Most arts materials used in schools can be used with no more than basic, common-sense care. This section describes them and also some of the main exceptions – when and why some arts materials may need to be handled with extra care.

The great variety of materials and procedures used in arts courses makes it very difficult to discuss them individually; instead we have broken them down into categories, describing how hazards may arise, and what precautions are advisable. In the majority of cases, materials can be used quite safely, and this booklet generally focusses only on examples where some care is needed.

Some Materials Used in Arts Courses

Before we look at some individual arts techniques, it is useful to consider some materials that are likely to be used in many of these techniques. Solvents, pigments and adhesives are broad classes of materials that have wide applications in activities reported in the survey and can be discussed in general terms. In addition, corrosive materials may be used in a number of activities. They can be discussed collectively, and precautions for handling them appear at the end of this section.

Solvents

Solvents are simply liquids that can dissolve other substances. They are used in many arts techniques, either as part of the art material itself (in paints, inks or adhesives) or for cleaning up. One of the most common, most useful – and harmless – solvents is water. You should make water the solvent of choice wherever possible.

The term “solvent” commonly refers to “organic chemicals” used in paint strippers, oil-based paints, inks, etc. Due to their toxicity, such organic solvents should not be used for grades one to six. If teachers or older students work with such solvents, precautions need to be taken against them both as liquids and as vapours.

As liquids, organic solvents can irritate the skin by dissolving out some of its natural oils. Effects like these are not likely to be a big concern in schools, because there should be no need for extensive skin contact to occur. If contact is likely, appropriate impermeable gloves should be worn, or a barrier cream used. Polyvinyl chloride (PVC) gloves are adequate for working with most solvents that are likely to be used in schools. However, PVC gloves are not suitable for toluene, ketones, or chlorinated solvents and give only fair protection for mineral spirits. Solvents such as methanol (methyl alcohol or methyl hydrate) and turpentine can be acutely poisonous if they are swallowed. They should be used only by older children, and then only under supervision.

Many solvents are quite volatile, meaning that large amounts can evaporate into the air in short periods of time, posing a fire risk. If you work with solvents, you are likely to inhale some of their vapours. If their vapours are inhaled in large amounts, most solvents can have some harmful effects – chronic or acute. The acute effects appear as symptoms such as dizziness, headache or nausea – they are effects on the nervous system. Very high exposures could produce more serious symptoms, including coma. But, once again, these should not occur if solvents are used properly and in small quantities. Heavy exposures might occur if a large volume of solvent was spilled and allowed to evaporate in a confined space. Amounts of solvents used in classrooms should be kept to a minimum to reduce the amount of vapour that can be inhaled and to reduce the chance of spills. Processes such as silk screen printing that use large amounts of solvent-based inks should be undertaken only with older students and under conditions of good ventilation.

The acute effects of solvent inhalation are almost always temporary and will begin to disappear when the source of solvent vapour is removed. They might, in fact, be considered warning symptoms. The difficulty is that such symptoms can have a number of causes, including infections and other factors that have nothing to do with exposure to solvents. But if you find that such symptoms do appear to be associated with the use of solvents (or other arts materials), you may need to reconsider how you are handling your materials. Perhaps you need better ventilation, or you should restrict the amounts of material used.

Some solvents are capable of producing chronic effects (notably liver, kidney or nervous system damage) in people who are exposed to them over a period of years. While it is not a good idea to breathe solvent vapours unnecessarily, in most cases it is unlikely that normal exposure to small amounts for a few hours per week would add much to the risk of chronic effects.

Pigments

Pigments are substances used to give colour to inks and paints; some of the same substances are also used in coloured glazes for ceramics or glassware. Pigments used in inks and paints can be either organic or inorganic. Some are traditional materials used for centuries, while others are relatively new substances developed in the last hundred years or less. In all of these categories there are materials that present few, if any, hazards, and some that should be used with care. In particular, artists' paints contain a much wider range of pigments than children's paints and are more likely to include pigments, including some based on lead, cadmium or chromates, that could be harmful.

Most pigments are unlikely to cause harm if they simply get onto the skin. A greater concern arises if pigments are swallowed or if their dusts are inhaled. While large amounts of pigments containing lead or chromates could lead to acute poisoning if they were swallowed, a more likely concern would be chronic health effects from exposure to lower levels over a long time. Check the pigments you are using – find out what they contain and what their hazards might be. In many cases the label on the packaging may tell you what pigments a paint contains; when in doubt, contact the supplier or manufacturer.

Small amounts of pigments based on lead, chromate, cadmium or arsenic accidentally swallowed over a long period could lead to chronic effects. Therefore, such pigments are best avoided in schools. This means that the habit of pointing a paint brush with one's lips is to be strongly discouraged; similarly, washing hands at the end of a class is an important habit to develop. A less obvious precaution is to avoid dust from pigments, since dust is likely to be inhaled. Wherever possible, use ready-mixed paints rather than mixing them up from powdered pigments, and avoid grinding up pigments. Primary or junior school children should not have access to powdered pigments or use artists' paints.

Adhesives

There are safe adhesives available for most school arts uses. Water-based glues, or flour paste can be used with no real problem. However, some adhesives for special purposes may need to be used with care.

Primary or junior school children should not have access to large amounts of adhesive, in case they try to swallow it. Even water-based glues may contain preservatives which could make a small child ill if large amounts of the adhesive were swallowed. Nor should they work with glues that involve chemical reactions (such as epoxy glues); their components can be irritating or poisonous if they get on the skin or are swallowed, and their vapours can irritate the lungs. To prevent exposure to solvent vapours, glues based on organic solvents should not be used by younger children. Instant glues are hazardous because they can glue the skin together so strongly that surgery is required. They should be used only by older children (grades seven and eight) and under supervision.

Older children can work with most adhesives with supervision, but if potentially irritating materials such as epoxy adhesives are used, the children should wear rubberized gloves.

Corrosives

Several arts activities use acids or alkalis. In the diluted form in which they are normally used, these materials are not hazardous if used properly by older children. But if the diluted solutions have to be made up from concentrated acids or alkalis – a job for the teacher, not the students – precautions are essential because concentrated acids or alkalis are highly corrosive to the skin and eyes. Wear rubberized gloves (with no holes in them), a protective apron and goggles when you handle the concentrated chemicals. An eyewash fountain and emergency shower (for students and teachers) should be available. Always add the *chemical to the water*, slowly. The order is very important. Mixing water with a concentrated acid, for example, can produce a lot of heat. If, by mistake, you add the water to the acid, the result can be a burst of steam that sprays acid over you. If you splash any corrosive in your eyes, rinse your eyes with cool water for at least 15 minutes (preferably from an eyewash fountain) and get medical attention. Do not wear contact lenses when you work with corrosives – they can trap splashed liquids against the eyeball.

Particular Techniques

This section discusses some of the more common arts activities. They are presented roughly in order of how often they are taught, as indicated by the national survey. The most popular activities, painting and drawing, (reported by about a third of teachers surveyed) carry very few risks. Other popular activities such as sculpture or modelling and fibre arts can use a variety of materials, ranging from the essentially harmless to some that need special care. In a few percent of the questionnaire responses, relatively “advanced” techniques such as photoprocessing were reported. Generally, these should not be taught in elementary schools due to the corrosive or poisonous nature of some of the substances used.

Drawing

By and large, the materials often used in drawing classes in the early grades pose no health risks to students or teachers. These are traditional materials such as crayon, charcoal, chalk, and ordinary black pencil. Charcoal and the graphite in pencil “lead” are forms of carbon that are unreactive and are unlikely to cause harm even if swallowed. Pastels intended for adult use should not be used for students in grades one to six.

Sometimes less traditional media such as correcting fluid or felt markers are used in the early grades. Some of these release small quantities of organic vapours; the amounts involved are not likely to cause harm, but it is prudent not to use these materials in primary classes. If several children are using markers, say, around one large table, the vapour level can get high enough to cause headaches. Some drawing inks containing carbon black may contain possibly harmful substances; again, it may be wise not to use these inks in primary classes.

Other drawing materials should present no real risk, but it is common sense to prevent students from tasting crayons or getting ink on their hands unnecessarily.

Painting

Painting materials commonly used in the earliest grades – poster paints or other water-based paints and food dyes – pose no hazards in normal use. However, many paints contain traces of preservatives that could be harmful if large amounts of paint were swallowed. It is common sense to make sure this does not happen, and that students develop good work habits and wash their hands after class.

A few painting materials that are sometimes used in elementary schools may need more care. Most water-based acrylic paints can be used safely for elementary school classes (although formaldehyde, which is used as a preservative in acrylic paints, may trigger allergic responses in people who are already sensitised to it). Oil paints use vehicles or thinners, such as turpentine, that can be irritating or hazardous if swallowed or if they contact the skin or if their vapours are inhaled. For this reason, artists' oil paints should be used only by older children, and with adequate ventilation. If you use such paints, check their pigments for possible hazards, as outlined in the section on Pigments above. Seek out non-toxic clean-up materials and oils, mediums and varnishes available for use with oil paints.

Techniques that produce paint mists – air brush, or the use of aerosols (whether pumped or pressurized) – are not suitable for classroom courses unless there is good local ventilation, or they can be done outdoors. Again, water-based paints are preferred.

Sculpture, modelling and carving

Sculpture, modelling and carving can involve a range of materials such as clay, plaster, wood and plastics. Of these, clay and plaster sculpture or modelling were most mentioned in the survey responses, making up over three-quarters of reported activities in this category.

Most of the materials used in sculpture present little hazard by skin contact or if they are swallowed, but some may give rise to concern if working with them produces dust. For children, soapstone as a carving material should be avoided – alabaster or cast plaster is preferable. Clay or plaster dust, for example, can be irritating to the lungs. Chronic inhalation of clay dust can cause silicosis. Students should not mix up clay or plaster from powder; the wet forms of these materials pose no significant inhalation risks. Wood and stone dust can also be irritating and, in some cases, after long exposure, even damaging to the lungs. Western red cedar and boxwood are examples of woods that produce irritating dust. Marble or limestone can produce hazardous dust if it contains free silica. Keep dust under control, with local ventilation if grinding or sanding is done; vacuum or wet mop (rather than sweeping) to remove dust every day. If you work with stone or wood regularly, controlling dust may be more important for your health than that of your students, who are likely to work with these materials for only a few hours. (**Note:** Thermal burns can occur if body parts are cast in plaster).

Sometimes sculpture using plastics is part of elementary school arts courses. Whether this activity involves plastic fabrication or the use of plastic resins for moulding or casting, it generally requires precautions. While styrofoam is soft enough to be carved safely, other techniques of plastic fabrication and other materials can produce hazards. Hot-wire cutting, sawing or sanding of plastics can produce fumes or dust that may be poisonous or very irritating to the lungs; these techniques are not recommended for elementary schools.

If you use commercial thermosetting plastics to make small moulded items, follow the instructions on the packaging. Using epoxy, acrylic or polyester resin for casting or moulding requires more elaborate precautions. These plastic resins, or the substances that are used to make the plastic set or harden, can be irritating or poisonous if they get on the skin or if their vapours are inhaled; they should never be swallowed. Do not use such materials with grades one to six school children; with older children, use the smallest amounts possible; have the children wear rubber gloves or barrier creams when handling resins; and provide good local ventilation.

Silkscreening and other printmaking techniques

Printmaking covers a number of techniques, including silkscreening (the printmaking technique most often reported in the survey), lithography and photosilkscreening. Common to all the techniques are the inks, and often organic solvents, but some processes use other substances for etching or for photosilkscreening.

A printmaking ink consists of pigments, which give the ink its colour, vehicles (the liquid – such as water or mineral spirits – in which the pigment is suspended) and modifiers, added to an ink to change its stickiness, its thickness, or the rate at which it dries. There is a wide variety of substances available in all three categories. Water-based inks as a rule require fewer precautions than inks based on organic solvents. Choose ready-made inks that do not contain pigments or modifiers based on lead, chromates or cadmium. When you work with inks, take care that they are not swallowed or allowed to get into open cuts or sores. Use impermeable gloves if appropriate.

With these cautions in mind, printmaking can be taught in elementary schools. However, younger children should work with only water-based inks, and stencils made using water-soluble glues (or “resists” made from liquid wax or rubber latex), or paper cutouts. Linocuts are also suitable for these children because the tools are less likely to slip and cause cuts than tools used in other engraving techniques. Use special inks approved for children to print the linocuts.

Solvent-based inks may be suitable for older children, if the amount of solvent used is controlled. For example, the teacher, not the students, should do any cleaning of silk screens with organic solvents such as mineral spirits. If you do use inks based on organic solvents, good ventilation is important when silkscreen prints are printed and dried, because during these steps considerable volumes of the solvent will evaporate in short periods of time. To help control these vapours, large numbers of prints being dried together can be placed in a specially ventilated room or directly in front of a window exhaust fan.

Among the more specialised printmaking techniques sometimes used in grades seven and eight, some forms of lithography use acids to etch the plates. In the diluted form in which they are used, the acids usually present no significant risk – as long as they are not splashed into the eyes – but if you have to make them up from concentrated acids and water, take proper precautions. (See the section on Corrosives above.) If you etch zinc metal plates with dilute nitric acid, use good ventilation to remove the fumes that are formed. Ferric chloride on copper plates is a better alternative for etching.

Preparing photostencils for photosilkscreening can involve chemicals such as potassium or ammonium dichromate that are poisonous or hazardous by skin contact. Presensitized emulsions are recommended because they eliminate the need to work with dichromates. Rubber gloves and eye protection should be worn.

Ceramics

As noted under Sculpture Modelling and Carving, powdered clay is hazardous by inhalation, and children should work only with wet clay. With this proviso, the main precautions needed for ceramic work concern glazes and the firing of pottery.

Glazes used in ceramics (and enamelling) contain some of the same pigments that are used in oil paints and inks, and require the same precautions in choosing materials. A more serious concern about ceramic glazes is that some of them may contain lead. Use only glazes labelled “lead-free” or “leadless”. Dry glazes also contain free silica which can damage the lungs if inhaled for extended periods. Students should not work with powdered glazes, or with any glazes unless they are approved for children. Take careful housekeeping precautions to control dusts, such as cleaning up all spills and wet mopping rather than sweeping.

When pottery is fired, the clay or glaze can release gases or vapours (such as carbon monoxide or metal fumes) which can be poisonous or damaging to the lungs. Therefore, glaze and fire pottery only if you have a kiln with exhaust ventilation. To avoid the risk of burns or excessive heat exposure, make sure your kiln is in a room not used by children. Anyone looking into the hot kiln should wear infra-red goggles.

Fibre arts and dyes

In general the fibres used in such activities as weaving and dyeing present no significant health concerns – with the important exception that some children (and adults) may have allergic reactions to them. On the other hand, some care is needed in choosing and working with dyes. About ten percent of the elementary school courses reported doing some form of dyeing – including tie dyeing, batik and fabric dyeing – and used food dyes, natural plant and vegetable dyes, household dyes and fibre-reactive dyes.

Some household dyes may be irritating or hazardous if their dusts are inhaled, or if they are swallowed or get on the skin. Cold-water fibre-reactive dyes (dyes that react chemically with the fibre) are very fine powders that may cause severe allergies, including asthma, if the dye powder is inhaled. For mixing powdered dyes, a glove box can be used*. A glove box is a sealed glass-topped box with openings in the sides for your gloved hands. Otherwise, wear an NIOSH** approved toxic dust respirator. Risks can also be minimised if you work with liquid dyes (or control dusts by opening powdered-dye packages under water) and wear rubber gloves when you work with the dye solution. Children should not work with powdered dyes. Household or cold-water fibre-reactive dyes should be restricted to older children.

Food dyes, and vegetable dyes such as spinach and onionskin present no significant hazards. By and large, most natural dyes present fewer hazards than the artificial dyes. However, natural dyes often require mordants to help them bind to the fibre and some of these substances can be harmful if they are swallowed, inhaled, or get onto the skin – particularly potassium dichromate (“chrome”) and to some extent copper sulphate and stannous chloride (“tin”). If you work with these mordants, avoid inhaling their dusts, and wear rubberized gloves (good practice whenever you work with dyes). Alum, ferrous sulphate and

* see M. McCann, *Artist Beware*, 1992.
** National Institute of Occupational Safety and Health (US).

cream of tartar are mordants that can be used with no significant hazards, though you should make sure they are not eaten. As a general rule, with primary or junior school children, it is best to premordant the fabric yourself so that children are not in contact with mordants.

Among individual techniques, batik involves the use of heated wax. If the wax is overheated it can produce fumes that are irritating and flammable. Do not use open flames or hot plates with exposed elements. An electric frying pan is good since it gives fine temperature control. The lowest workable temperature setting should be used. A double-boiler is also useful for melting wax safely. Never leave melting wax unattended.

Photoprocessing

Photographic processing and printing were reported in only a few percent of the questionnaires returned in the survey. Photographic chemicals, especially those used in colour processing and printing, can be poisonous or very irritating; they should be used only with caution, and restricted to older children. Find out about the chemicals you are going to use, choose the least hazardous you can work with, and follow any safety instructions on the packages. Where possible, buy premixed solutions. If you mix up photographic chemicals from concentrates or powders, a glove box should be used. This is a job for the teacher – students should not work with powdered or concentrated photographic chemicals.

Rubberized gloves or tongs should be used for work in developing baths. In addition to possible hazards from skin contact, there is some risk through inhalation during photoprocessing and printing: stop baths generally contain acetic acid, and formaldehyde may be used in some prehardeners or stabilisers. These and other photographic chemicals produce vapours which can be irritating. For example, fixers give off sulfur dioxide. Make sure there is good ventilation in the dark room*.

Stained glass

In working with stained glass, the main hazards come at two stages: when pieces of glass are being cut to size, and then when the pieces are joined. In the first stage, the edges of freshly cut pieces of glass can be sharp enough to cut fingers. If students cut glass themselves, they should wear protective leather gloves; and if they use grozing pliers, face shields are needed.

In the second stage, when the pieces of glass are being assembled, the possible hazards come from the glazing materials themselves – lead cames, soldered copper foil and sometimes epoxy adhesives.

Using lead cames to join pieces of glass raises the possibility of getting lead on the fingers (with the risk of lead then getting into the mouth); there is also chance of lead dusts being formed if oxide films have to be cleaned from the cames before they can be soldered. Soldering the joints in the cames also carries the risk of producing hazardous fumes. Therefore, local ventilation and good housekeeping are very important. If you work with lead, vacuum up or damp mop all dusts and make sure hands are washed carefully at the end of class.

Using copper foil instead of lead cames as glazing material eliminates the need to handle lead metal, but generally involves more soldering, as a joint running the whole length of a piece of glass must be soldered. Choose lead-free solders. Make sure there is adequate local ventilation during soldering. Use a window exhaust fan and work on a table right in front of it or use local exhaust ventilation. Avoid lead-based solders and zinc chloride fluxes (which can produce hazardous fumes). Oleic fluxes are safer to work with and are recommended.

* Darkrooms require at least twenty air changes per hour.

If you use only epoxy adhesives, you avoid exposure to lead or soldering fumes, but some care is still needed in handling the adhesive, which can be irritating to the skin, eyes or lungs. Students should use rubberized gloves and work with good ventilation.

Copper enamelling

Copper enamelling should only be done in senior grades (grade seven and above). This type of metal work often uses acids as pickling agents for cleaning the metal surfaces, and some of these can be hazardous if they get on the skin or in the eyes. Ferric chloride and sodium bisulphate are often used in pickling solutions. Sodium bisulphate can be very irritating to the skin as either a powdered solid or a concentrated solution, but dilute pickling solutions based on either it or ferric chloride are less hazardous than the common alternatives – dilute nitric or sulphuric acid. Concentrated acids should not be used. If either of these two acids is used and has to be made up by diluting the concentrated acid, care is needed – see section on Corrosives. Make up the pickling solutions for your students, and if you do pickle or etch with nitric acid, make sure you have proper ventilation to remove fumes.

Enamels themselves can contain toxic pigments, and should be investigated before being used in class. Use only lead-free enamels. To control pigment dusts, apply enamels as liquids rather than powders wherever possible.

Infra-red goggles are needed for looking into the kiln. The kiln needs proper ventilation since flourides and other toxic fumes can be released.

SOME GENERAL GUIDELINES

From the point of view of health and safety, there is little need to restrict arts education, or to require inconvenient and expensive protective equipment (other than suitable gloves and perhaps goggles or face shields); there are plenty of safe materials available for most projects, and simple precautions that can be taken with more “advanced” materials. As we have seen, the risk of long-term effects from exposure to materials in a properly run arts class is slight; and the risk of acute effects can be minimised by a suitable choice of materials and precautions. Many precautions are a matter of developing safe work habits – for both you and your students. Basic precautions learned in using school materials can promote good work habits for anyone who goes on to use more hazardous materials.

Controlling the Risk

In summary, here are some general common-sense rules, that can help you work safely in a classroom.

First of all, find out about any hazards that might be presented by materials in your courses, and how you can minimize them. This booklet can serve as an introduction to areas that may require precautions. However, if you decide that some of your materials or techniques require additional precautions, you should look for more information. Some useful references are listed at the end of this section. To find out about individual products, you can get information from the manufacturer or supplier.

Techniques that produce toxic or very irritating dusts, mists or fumes may require special ventilation or protective equipment – a fume hood or exhaust fan, a face shield or even a respirator. You can find out if such equipment is necessary by reading one of the reference works mentioned in the final section of this booklet. In general, if such equipment *is* called for, the technique should not be taught to elementary school students. Some materials may require protective gloves to be used; if they are required, find out what kind is appropriate and, when you use them, make sure they have no holes in them. Gloves that absorb harmful liquids and trap them against the skin can be worse than no gloves at all.

If you do find that what you are teaching calls for protective equipment, first try to find another material or another technique. The need for such items as ear plugs, dust masks or eye shields indicates that the materials or processes are potentially hazardous for this age group. But if you decide to continue with your project, use as little material as possible, work with adequate ventilation, and use the appropriate protective equipment.

In general, keep food and drink away from art materials. If you put an arts material into a new container, make sure the container is properly labelled. Do not use old food containers whose contents could be mistaken for something edible. For the same reason, do not store arts materials in refrigerators that also contain food or drink. This advice is partly a matter of precaution, and partly a matter of habit. Even when the arts materials are harmless, it is a good habit for both teachers and students to keep them separate from things that might be swallowed – a habit that might pay off when more hazardous materials are used.

If you use substances such as concentrated acids or alkalis, flammable liquids, and oxidizing agents such as concentrated nitric acid, you should make sure they are stored properly. Do not use the same cabinet or cupboard to store substances that can react with each other – if bottles are broken and the substances mix, there could be a dangerous reaction (including a fire). For example, do not store concentrated acids next to concentrated alkalis, or an oxidiser next to a flammable liquid such as lacquer thinner.

Further Information

Whenever you use a new material, find out about it – how it should be used; what its hazards might be; how they can be minimized, how it should be disposed of. One source of such information is in the Material Safety Data Sheet (MSDS) provided by the manufacturer or supplier. The MSDS will identify the product, give its chemical name and describe its physical properties, together with a summary of its possible hazards and any precautions that should be taken. Because MSDSs are intended for industry use, they are often quite densely formatted, and some of the data are quite technical. It may not be easy to find what you need to know until you are familiar with the format and the terminology. Guides to reading an MSDS have been published by the Canadian Centre for Occupational Health and Safety, 250 Main Street East, Hamilton, Ontario, L8N 1H6.

In Canada, potentially hazardous consumer products, which include some arts and crafts materials, will be labelled with health and usage warnings according to mandatory labelling requirements set down under the Hazardous Products Act. For information on this Canadian labelling program contact the Product Safety Bureau, Health Canada, 50 Victoria Street, Hull, Quebec, K1A 0C9.

Some art and craft materials may have the ASTM D-4236 label on their packages. ASTM D-4236 is a chronic hazard labelling standard that was developed, under the auspices of the American Society for Testing & Materials (ASTM), by a group of artists, health professionals, art materials manufacturers, and others concerned with the safety of art materials. Products may also bear one of the Seals of The Art & Craft Materials Institute, Inc. (ACMI) – CP (Certified Product), AP (Approved Product), and HL Health Label (Non-Toxic). These seals indicate that the products conform to ASTM D-4236 and have been deemed by the Institute not to contain materials in sufficient quantities to be toxic or injurious, or to cause acute or chronic health problems. Products certified by ACMI that have a hazard associated with their misuse bear the HL Health Label and an appropriate health warning and safe use instructions. For further information on the ASTM standard or ACMI labelling program, contact the Art & Craft Materials Institute at 100 Boylston Street, Suite 1050, Boston, Massachusetts 02116, U.S.A.

A list of these and other reference materials is provided below. It includes both general references and information on specific activities. You can refer to them to find out if you need extra precautions, and if so, how to take them.

Survey Results

In 1991, a national survey was undertaken to study the use of art materials and art processes in art classes in grades one through eight (in Quebec primary grades and grades one and two secondary). The objective of this survey was to provide information about the safe use of arts and crafts materials by children and teachers and to provide information about the hazards of excessive exposure to toxic products, so that all art programs may be enjoyed without undue concern. Results of the survey are available from the Environmental Health Directorate, Health Canada, Environmental Health Centre (Building 8), Ottawa, Ontario, K1A 0L2.

Periodicals

Center for Safety in the Arts, *Arts Hazards News*, Michael McCann, Editor (New York, NY).

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Vulovich, M. *Kiln Safety*. The Edward Orton Jr. Ceramic Foundation, Westerville, OH (1989). (Reprinted for a series of articles which appeared in *Ceramic Scope Magazine* as "Technically speaking: kiln safety".)

APPENDIX A

HAZARDS OF ART TECHNIQUES

Technique	Material/process	Hazard
Airbursh	Pigments	Lead, cadmium, manganese, cobalt, mercury, etc.
	Solvents	Mineral spirits, turpentine
Batik	Wax	Fire, wax fumes
	Dyeing	Dyes
Ceramics	Clay dust	Silica
	Glazes	Silica, lead, cadmium, and other toxic metals
	Slip casting	Talc. asbestiform materials
	Kiln firing	Sulfur dioxide, carbon monoxide, fluorides, infra-red radiation, etc.
Commercial art	Rubber cement	*n*-Hexane, fire
	Permanent markers	Xylene, propyl alcohol
	Spray adhesives	*n*-Hexane, 1,1,1-trichloroethane, fire
	Airbrushing	See Airbrush
	Typography	See Photography
	Photostats, proofs	Alkali, propyl alcohol
Computer art	Ergonomics	Carpet tunnel syndrome, poorly designed work stations
	Video display	Glare, ELF radiation
Drawing	Spray fixatives	*n*-Hexane, other solvents
Electroplating	Gold, silver	Cyanide salts, hydrogen cyanide,
	Other metals	Acids
Enamelling	Enamels	Lead, cadmium, arsenic, cobalt, etc.
	Kiln firing	Infra-red radiation
Forging	Hammering	Noise
	Hot forge	Carbon monoxide
Glassblowing	Batch process	Lead, silica, arsenic, etc.
	Furnaces	Heat, infra-red radiation
	Colouring	Metal fumes
	Etching	Hydrofluoric acid, fluoride salts
	Sandblasting	Silica
Holography	Lasers	Non-ionizing radiation, electrical
	Developing	Bromine, pyrogallol. See also Photography

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HAZARDS OF ART TECHNIQUES

Technique	Material/process	Hazard
Intaglio	Acid etching	Hydrochloric and nitric acids, nitrogen dioxide, chlorine gas
	Solvents	Alcohol, mineral spirits, kerosene
	Aquatint	Rosin dust, dust explosion
	Photoetching	Glycol ethers, xylene
Jewelry	Silver soldering	Cadmium fumes, fluoride fluxes
	Pickling baths	Acids, sulfur oxides
Lithography	Solvents	Mineral spirits, isophorone, cyclohexanone, kerosene, methylene chloride, etc.
	Acids	Nitric, phosphoric, hydrofluoric, hydrochloric, etc.
	Talc	Asbestiform materials
	Photolithography	Dichromates
Lost wax casting	Investment	Cristobalite
	Wax burnout	Wax fumes, carbon monoxide
	Crucible furnace	Carbon monoxide, metal fumes
	Metal pouring	Metal fumes, infra-red radiation, molten metal
	Sandblasting	Silica
Painting	Pigments	Lead, cadmium, mercury, cobalt, manganese compounds, etc.
	Oil, alkyd	Mineral spirits, turpentine
	Acrylic	Trace amounts ammonia, formaldehyde
Pastels	Pigment dusts	Lead, cadmium, & mercury compounds
Photography	Developing bath	Hydroquinone, monomethyl-p-aminophenol sulfate, alkalis
	Stop bath	Acetic acid
	Fixing bath	Sulfur dioxide
	Intensifier	Dichromates, hydrochloric acid
	Toning	Selenium compounds, hydrogen sulfide uranium nitrate, sulfur dioxide, gold salts
	Colour processes	Formaldehyde, solvents, colour developers
	Platinum printing	Platinum salts, lead, acids, oxalates

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HAZARDS OF ART TECHNIQUES

Technique	Material/process	Hazard
Relief printing	Solvents	Mineral spirits
Screen printing	Pigments	Lead, cadmium, manganese compounds, etc
	Solvents	Mineral spirits, toluene, xylene
	Photoemulsions	Ammonium dichromate
Sculpture, clay		See Ceramics
Sculpture, laser	Lasers	Non-ionizing radiation, electrical
Sculpture, neon	Neon tubes	Mercury, electrical
Sculpture, plastics	Epoxy resin	Amines, diglycidyl ethers
	Polyester resin	Styrene, methyl methacrylate, methyl ethyl ketone peroxide
	Polyurethane resins	Isocyanates, organotin compounds, amines, mineral spirits
	Acrylic resins	Methyl methacrylate, benzoyl peroxide
	Plastic fabrication	Decomposition products (carbon monoxide, hydrogen chloride, hydrogen cyanide, etc.)
Sculpture, stone	Marble	Nuisance dust
	Soapstone	Silica, talc, asbestiform minerals
	Granite, sandstone	Silica
	Pneumatic tools	Vibration, noise
Stained glass	Lead came	Lead
	Soldering	Lead, zinc chloride fumes
Weaving	Loom	Ergonomic problems
	Dyeing	Dyes, acids, dichromates
Welding	Oxyacetylene	Carbon monoxide
	Arc	Ozone, nitrogen dioxide, ultraviolet & infra-red radiation, electrical
	Metal fumes	Copper, zinc, lead, nickel, etc.

APPENDIX A

HAZARDS OF ART TECHNIQUES

Technique	Material/process	Hazard
Woodworking	Machining	Wood dust, noise, fire
	Glues	Formaldehyde, epoxy
	Paint strippers	Methylene chloride, toluene, methyl alcohol etc.
	Paints and finishes	Mineral spirits, toluene, turpentine, ethyl alcohol, etc.
	Preservatives	Chromated copper arsenate Pentachlorophenol, creosote