



Some aspects of safety in school science
and technology for key stages 1 and 2

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Be safe!

Second edition

ASSOCIATION FOR SCIENCE EDUCATION

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and technology for key stages 1 and 2**

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**The Association for
Science Education**

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INTRODUCTION

In primary schools science is very much, and should be, an open-ended activity. As such it is not always possible to predict all the problems which might occur. Safety standards at school should be higher than those often found at home. Primary schools are extremely safe places with few reported accidents and almost none resulting from science-related activities. In this document, therefore, we do not wish to be alarmist, but rather to raise awareness about possible causes for concern so that teachers can easily and safely take account of them. Whilst we have not described general safety aspects associated with the classroom or work area, we have taken account of some practical activities which would not always be considered a part of science.

Minor accidents, which result in scratches and cuts, are an acceptable part of growing up. This document is an attempt to prevent avoidable injury.

It is likely that all members of staff in a primary school will teach science, usually as part of a topic or theme. This means that all teachers will, at some time, be supervising the sort of practical work which is essential to scientific activities. There are few risks associated with science in primary schools, but those which do exist can be used as valuable learning experiences in their own right. Children should be taught to recognise the danger warning sign and other internationally used warning symbols. The teacher with curriculum responsibility for science should draw the attention of all members of staff to any hazards. It is wise not to assume automatically that procedures described in books and magazines are safe. Any local rules must of course be obeyed.

In the (unlikely) event of an accident or other emergency, each school should have a plan of action with which all members of staff are familiar. The plan should allow for the summoning of assistance if necessary, enable any injury to be attended to without delay, and permit pupils to be evacuated and/or appropriately supervised. It may also be necessary to contact parents or guardians, and to follow local rules for reporting accidents.

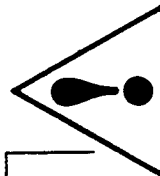
Further advice on safety can be obtained from the ASE's journals: *Primary Science Review* and *Education in Science*.

WHY A SECOND EDITION?

This edition has been thoroughly revised in the light of the National Curriculum in England and Wales. Although targeted at teachers of children in key stages 1 and 2, it will be of use to a wider audience. There are changes to the advice where there is a changed perception of what it is safe for children of this age to do, or where the original comments need clarification.

WHO IS THIS BOOK FOR?

- Teachers in nursery schools
- Teachers in primary schools
- Teachers in middle schools
- Teachers in special schools
- Those helping teachers in the classroom
- Staff in field centres
- Governors
- LEAs formulating General Risk Assessments under the COSHH Regulations
- Teachers in training
- Teacher trainers
- INSET providers
- Publishers and equipment suppliers.



DANGER

This second edition of *Be Safe* was prepared in consultation with the Health and Safety Executive's Education Service National Interest Group.



SAFETY IN THE NATIONAL CURRICULUM

Extracts from the programmes of study for science in key stages 1 and 2.

... encourage an appreciation of the need for safe and careful action.....(KS1)

... they should be introduced to ideas about how they keep healthy through exercise and personal safety..... (KS1).

... experiences could include, for example, road safety activities.....(KS1).

... explore ways in which good health can be promoted in relation to their own daily routine..... They should be introduced to the fact that while all medicines are drugs, not all drugs are medicines; and they should begin to be aware of the catastrophic effect on health resulting from an abuse of drugs (KS2).

They should learn about the dangers associated with the use of mains electricity(KS2).

A Safer World

A critical awareness of the role of science in society is one of the contributions which science studies make to education (see *Non-statutory Guidance for Science*). In their study of the local environment children should begin to appreciate how their actions can influence it, for good or ill. Arising from their awareness of safety in their own environment, children should develop a concern for global issues which affect the safety and well-being of all living things.

Within the National Curriculum, science is an entitlement for all children. Through the exploration of science they will develop their intellectual and practical skills. Issues relating to health and safety occur throughout the programmes of study and attainment targets.

Children grow up in a dangerous world. It is part of their education to learn how to approach hazards in a safe way. With this in mind, it is often a valuable experience to discuss with the children the safety needs of an activity and to guide them into developing their own safety rules.

Safety in Explorations

Attainment target 1 promotes investigation and exploration in science. In their planning of practical activities, teachers need to anticipate likely safety issues. They should also explain the reasons for safety measures and discuss any implications with the children. Children should always be encouraged to consider safety when they plan and carry out their investigations. The National Curriculum encourages collaborative learning, which should lead children into considering the needs and safety of others.



Examples of statements of attainment

Pupils should:

- carry out an investigation with due regard to safety (Sc1/4g).
- know that personal hygiene, food, exercise, rest and safety, and the proper and safe use of medicines are important (Sc3/2b).
- know about the factors which contribute to good health ... and avoidance of harmful substances such as tobacco, alcohol and other drugs (Sc3/4b).
- understand that the greater the speed of an object, the greater the force and/or time that is needed to stop it, and understand the significance of this for road safety (Sc10/4b).
- understand the danger associated with the use of electricity, and know appropriate safety measures (Sc11/2b).
- know the danger of looking directly at the Sun (Sc16/1b).

Living Safely

The National Curriculum encourages, indeed requires, teachers to promote amongst children a sense of personal responsibility for their health and safety. Children will encounter health and safety issues through such topics as road safety, fire fighting, hygiene, first aid and nutrition.



1. MAKING THINGS

Pupils should be taught to use equipment safely (Technology in the National Curriculum KS2).

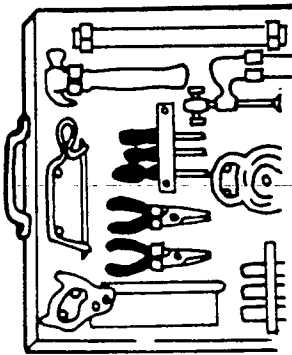
Many activities in science and technology lead children to make and to test structures of one sort or another. Teachers should train them in the correct use of tools such as scissors, craft knives and woodworking tools. Apart from being inherently a safe practice, it will stand the children in good stead in their

activities outside school. Whenever tools are used, classroom management is of great importance. Tools or materials given by parents or industry may be unsuitable for schools and their acceptance and use should be considered carefully.

SAFETY CODE

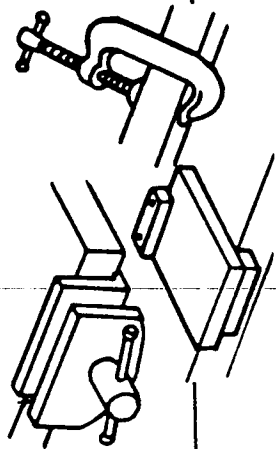
for using tools and glues

Make sure children know how to use all the tools which are available to them, and how to keep the work area tidy by returning tools to a specially-designed box or board. Provide adequate work space.



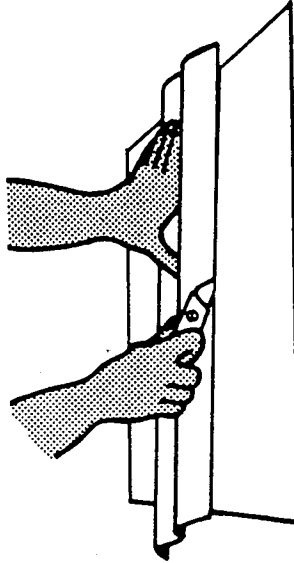
Cutting tools present fewer hazards when kept sharp, but children should be warned to take care when using them.

When sawing, make sure that saw blades are firmly fixed to the handle. Secure the material firmly to the bench using a vice, bench hook or G cramp.



Avoid using wood chisels.

Craft knives should be used under supervision and only by responsible pupils, with a metal safety rule whenever possible.



Have available only small hammers and periodically check that their heads are firmly secured to the shafts.

Avoid the use of tin snips by children. Any cut metal edges should be smoothed or covered.

Do not let children use high-powered tools such as drills, jigsaws, etc. which work directly from mains voltage (240 or 110 volts).

Recent research shows that expanded polystyrene can be cut safely with craft knives, scissors and hot-wire cutters (with good ventilation to get rid of the smell).

Fine dusts from wood, polystyrene and other plastics are recognised as hazardous. However, manual sanding is unlikely to produce a dangerous level of dust.

Soldering irons, if needed at all, should operate at low voltage e.g. 12 volts.

Hot-glue guns should be used only under adult supervision.

'Super glues' should not be used by children. Wallpaper pastes containing fungicide are also unsuitable.

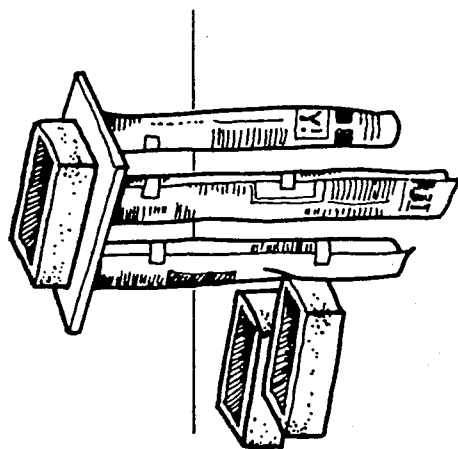
Glues which give off a heavy vapour should only be used in a well-ventilated area.

Beware of the risk of solvent misuse.



These activities should involve variables to be controlled in the development of a 'fair test' (KS 2).

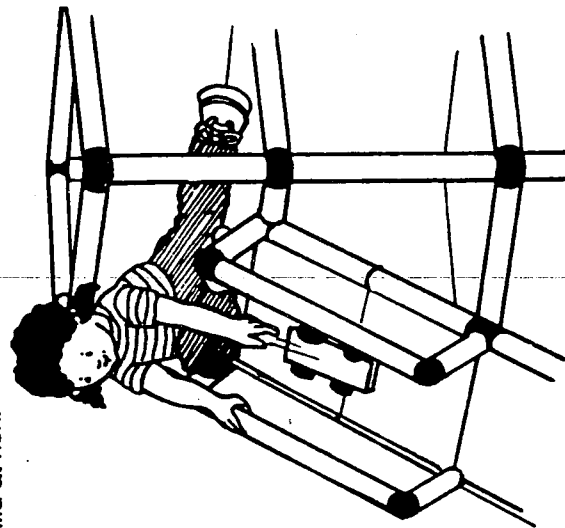
2. TESTING THINGS



Open-ended work often involves testing something the children have made, to see if it fulfils the need. Several topics require materials to be tested to breaking point. A swinging object, such as a pendulum, can be a serious hazard if it is heavy. An adequate, safe space must be allowed for its movement.

Warn children about the dangers to face, and eyes in particular, from rubber bands or other materials snapping when over-stretched. Nylon fishing line, guitar strings, etc. may also break, flick back and cause a deep cut.

Where the children have designed and made a large construction to support, carry or contain a child (e.g. buggy, bird-watching hide, climbing frame) it is important that the tests do not put a child at risk.



SAFETY CODE for testing things

Keep eyes away from stretched materials.
Consider using eye protection.

When releasing objects from a height, be sure that the children do not put themselves at risk.

When using pulleys or other hanging devices, ensure that they are attached to a secure fixing.

Place a box containing waste material under a hanging load. The load should itself be as low as possible, as should swinging weights (e.g. a pendulum).

A large construction designed to support, carry or contain a child should be checked for strength and stability before use.

When testing using heavy objects, a cardboard box could be placed underneath to keep feet away. If the box contains soft or waste material e.g. bean bags, etc. it will cushion the fall.

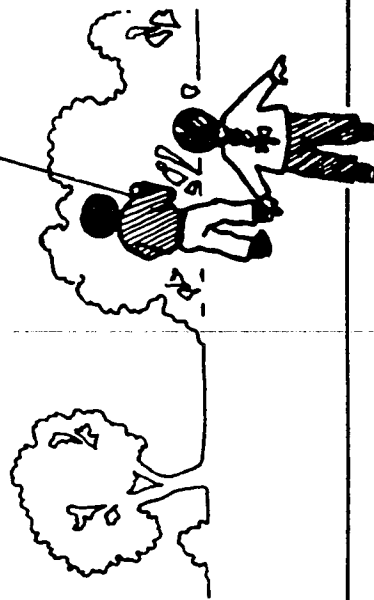
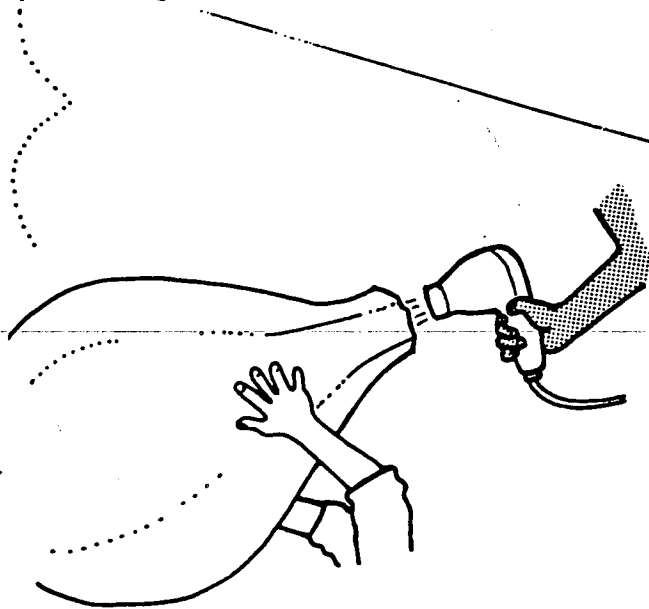
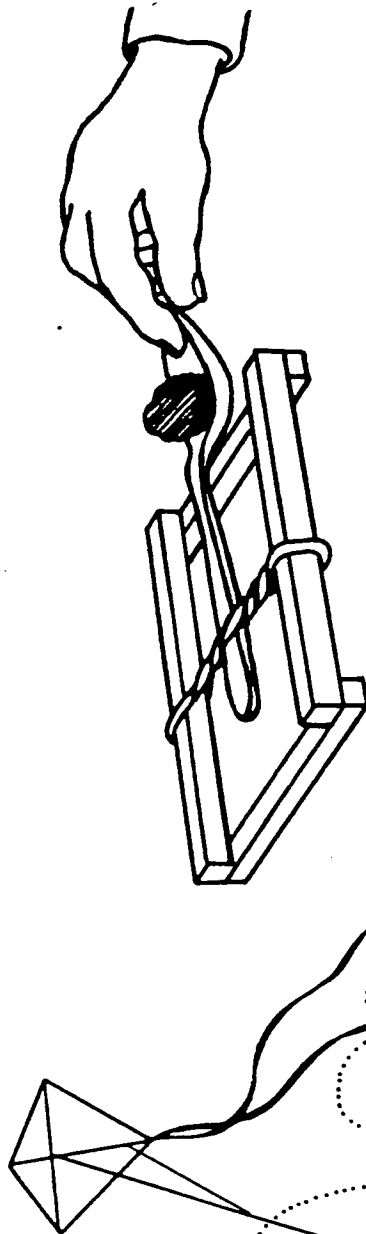
A high fixing is often needed for work on pulley systems. Ensure that it is secure enough for the intended load.



3. FLYING THINGS

They should explore the forces which involve movement, friction and falling under gravitational force (KS 2).

Some flying things can be used indoors e.g. paper aeroplanes and small hot-air balloons, whilst others require a large open space outdoors. Most activities with flying things require close supervision.



SAFETY CODE for flying things

Hot-air balloons are best filled using a hair drier. They can be flown indoors. Never use hot-air balloons with burning fuel.

Kites, aeroplanes and gliders should never be flown near over-head power lines or electricity substations; buildings and roads may also present hazards.

Water rockets may be bought or home made.

Make sure they are directed well away from spectators when launched, and do not cause panic when they come down.

Chemically-powered rocket motors and kits for making model rockets may be safely used following

the manufacturer's instructions. These motors must never be modified, nor should any attempt be made to make such a motor.

Launching parachutes by careless throwing can be dangerous. Be aware of the added danger of children leaning out of upstairs windows and over stairwells.

Spinning discs (e.g. 'Frisbees') and boomerangs should always be directed away from spectators.

Test catapults, ballistas and mangonels with care; use projectiles that are safe, and direct them away from spectators.

4. FOOD AND HYGIENE



SAFETY CODE

for food hygiene

The preparation of food offers many opportunities for scientific and technological activities. An appreciation of the importance of cleanliness and personal hygiene is essential in this topic.

Before starting work with food, children should tie back any long hair, wash their hands with soap and water and cover any cuts and scratches on the hands with waterproof dressings.

They should be encouraged to wear clean 'cookery' aprons. Re-washing of hands after breaks and visits to the toilet is very important.

A special cookery table is ideal, but if a classroom table has to be used then it should be covered with a clean plastic sheet. In either case, work surfaces should be cleaned by the teacher before use, with a disinfecting solution (e.g. Milton).

Equipment, including cutlery, needs to be stored in secure, clean conditions and used only for food preparation and washing-up.

Particular foods can present certain problems e.g. red kidney beans should be cooked thoroughly to destroy the poisons in the outer coat; contact must be avoided with juice of chili peppers and the skin. Spices used for 'sniff tests' should be covered with muslin. Eggs and raw meat need to be cooked thoroughly to avoid the risk of infection

Teach children the need for personal hygiene through food preparation and tasting investigations.

Ensure cooking surfaces and utensils are clean.

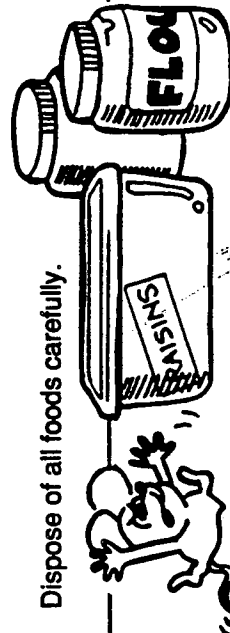
Use cookery aprons, utensils and washing-up equipment for cookery only. Do not use cooking ovens for other purposes.

Store food correctly.

Site cookers, including microwave ovens, carefully and maintain according to manufacturer's instructions.

Be aware that some people are sensitive to some foods and food additives.

Dispose of all foods carefully.



Only small quantities of food should be stored in school, in labelled, rodent-proof containers (e.g. ice-cream or margarine tubs). Perishable foods should be stored in a clean refrigerator at the correct temperature (5°C). If a freezer is used, it should be set to -18°C. A fridge-freezer thermometer is useful as a check and as a teaching aid.

Ideally, a sink should be reserved for washing-up cookery utensils but, if this is not possible, then a special washing-up bowl should be kept.

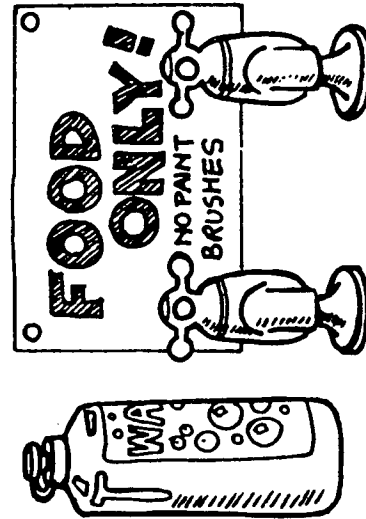
When using a microwave cooker, always refer to the manufacturer's instructions.

When locating a cooker, consider the fire risk to nearby flammable materials e.g. curtains or displays, and the hazards associated with the movements of children.

Investigations involving tasting should follow the same hygiene rules as for cooking.

The use of food tests is generally inappropriate in primary schools. However, the dcip test for Vitamin C is safe. Iodine solution may be used to test for starch.

Activities involving hot oil and boiling sugar are usually inappropriate at this age.

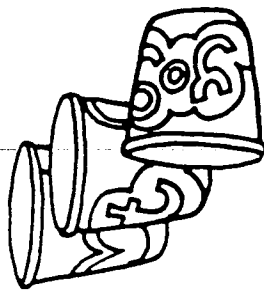




5. GLASSWARE

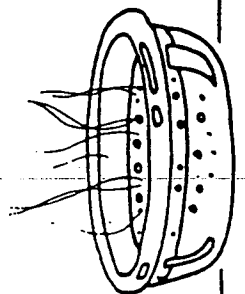
Activities should encourage a working understanding of safety and care... (KS 2).

Yogurt pots and other similar plastic containers are cheaper and, in many instances, more suitable than expensive and fragile glassware. However, children do need to learn how to handle glass safely. This is best done within the classroom.



When going outside to collect materials, use plastic containers and never glass bottles or jars.

Some glassware, such as ovenware or 'Pyrex', can withstand sudden changes in temperature without shattering. However, this is not a feature of normal glass which will shatter if, for example, hot water is poured into it. Do not use ordinary glass containers for heating substances or for transporting hot liquids. Use ovenware or laboratory glass, ceramic or metal containers instead.



SAFETY CODE for dealing with broken glass

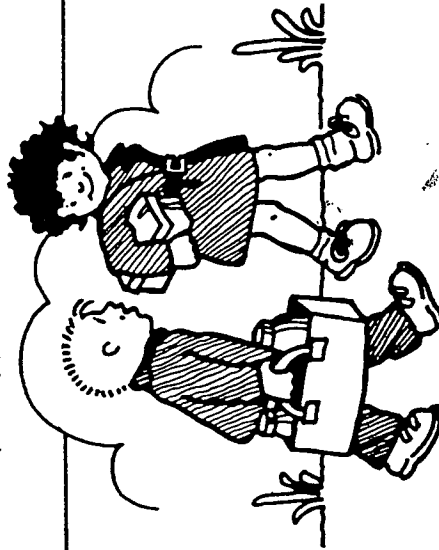


Wash any wounds carefully and cover immediately with a sterile dressing.

Be careful to ensure that you wash yourself thoroughly to avoid unnecessarily prolonged contact with blood which can be infective. It is advisable to use protective gloves. Further advice will be found in *First Aid Manual* (see bibliography).

Train children how to deal with broken glass. It is a teacher's responsibility to decide whether children are sufficiently mature to be allowed to clear up broken glass under supervision.

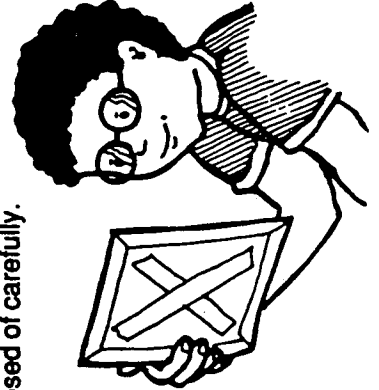
Wrap broken glass thoroughly in newspaper and dispose of it carefully. Never put unwrapped broken glass in a bin which might be cleared by an unsuspecting person.



Plastic mirrors are safer than glass ones. If glass mirrors or pieces of plane glass are used it is advisable to bind their edges and cover their backs with strong adhesive tape.



All chipped or broken glassware should be disposed of carefully.

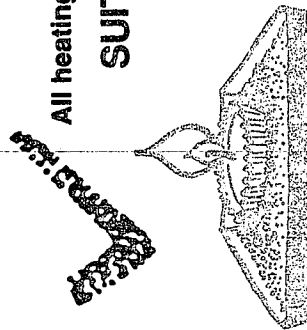


6. HEATING AND BURNING



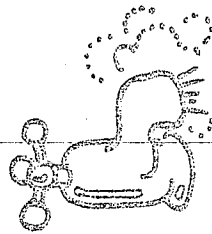
All heating activities require close adult supervision.

SUITABLE SOURCES OF HEAT



Candles and night-lights

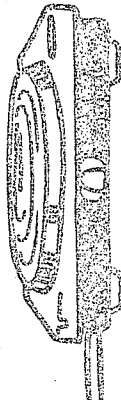
These provide a simple, local flame or heat source. During use they should stand in a layer of sand inside a metal tray (e.g. a baking tray).



Hot water from a tap, kettle or immersion heater

This is probably the best heat source for use in primary schools. The water does not always need to be near boiling.

Microwave ovens, stoves such as the 'Baby Belling' and mains electric boiling rings
These are useful for exploring the science in cookery, candle making, dyeing fabrics and other investigations. Ovens used for foods should not be used for other purposes.



Hair driers

These are useful for filling hot-air balloons and for drying materials. They must not be used where water might enter the drier.



Kilns

These should only be operated by a competent adult and not a child.



SOME SOURCES OF HEAT NOT RECOMMENDED

Spirit burners and oil lamps

These should not be used. Methylated spirit is the largest cause of fires in science lessons in secondary schools. Solid fuel is a suitable alternative to methylated spirit burners in model steam engines. Consider warning children of the dangers of using spirit burners in home chemistry sets and steam engines.

Picnic stoves

Types intended for outdoor use should not be used indoors.

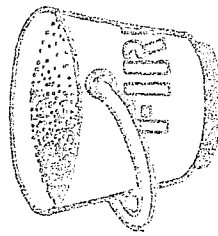
Portable bottled-gas burners

These should not be used in school because they have been identified as a cause of accidents.

Hot-air paint strippers

These are very dangerous and are too powerful for use in school.

FIRE SAFETY



A bucket containing dry sand is recommended as an additional item to the usual fire fighting equipment. It should be available whenever there is a risk of fire. Dry sand can be poured easily on minor fires and will usually restrict or extinguish them. Make sure you and the children know what the school expects to be done in the event of a fire.

Further guidance will be found in the DES booklet *Safety in Practical Studies* (see bibliography).

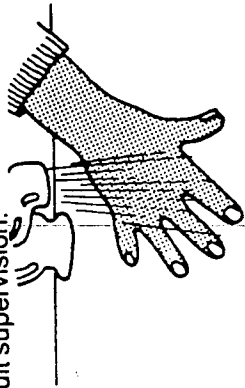


6. HEATING AND BURNING

Children should investigate changes that occur when familiar substances are heated and cooled (KS 2).

SAFETY CODE for heating things

Ensure that all heating activities take place under close adult supervision.



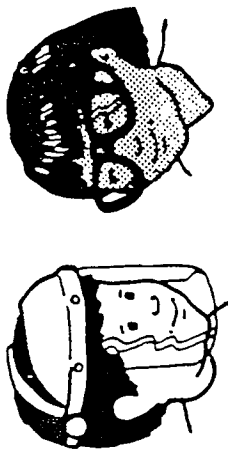
Warn children about the dangers of fire and of scalds from hot liquids, steam and apparatus that has been heated. Warn them that boiling rings and hotplates can burn even though they may not appear to be hot.



Teach children that if they get burnt either from a flame, or a hot liquid, then they should immediately flood the burnt area with cold water. If they do this within seconds and keep pouring on cold water for at least ten minutes then they may prevent a burn injury from forming.

Teach children not to sit when heating things because they may not be able to move quickly enough if there is an accident.

Protect the eyes when necessary, for example when heating chemicals or testing materials. Safety goggles, safety spectacles or face shields must fit. Face shields may be more effective than goggles or spectacles on small heads.



Tie back long hair and avoid loose garments.

Stand all candles or night-lights in sand in a metal tray during use, to promote stability and also to catch any burning fragments which may be produced when materials are burnt in a flame.

Take care when disposing of matches.

When testing materials by heating, use only a small sample and have adequate ventilation, as most plastics, modern fibres and fabrics give off harmful fumes when burning.

Never heat glass objects except those made for the purpose.

Never leave naked flames unattended.

If it is necessary to carry very hot water around the work area, only do so in a kettle.

Turn saucepan handles away from the front of stoves to avoid accidental spillage.

Place boiling rings and stoves where they cannot be knocked, but at a suitable working height for children.

Switch off stoves and boiling rings immediately after use.

... and for measuring temperature

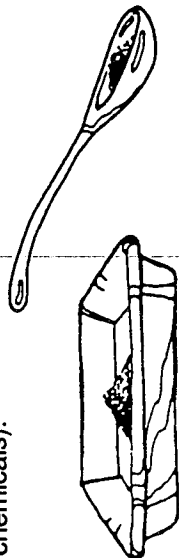
Use spirit-filled thermometers, liquid crystal strips or dial type (e.g. 'Thermotik') or digital thermometers which are robust and easy to read. Avoid using mercury-in-glass thermometers as they release a little poisonous mercury vapour if broken. A sensor coupled with a computer may also be used to detect and measure temperature. Overheating thermometers e.g. by putting them in a flame will damage them.



6. HEATING AND BURNING

TECHNIQUES FOR HEATING OVER OPEN FLAMES

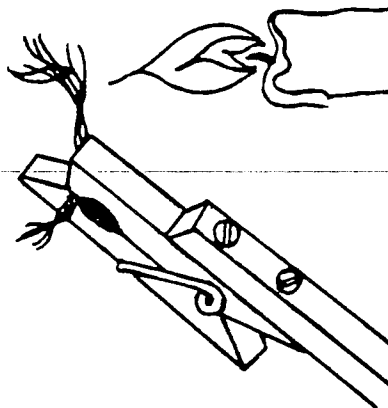
Substances can be heated in metal spoons, small containers made of aluminium foil or in metal lids or bottle tops with any lining removed before use (see section 7, Safety Code for using chemicals).



Use a wooden clothes peg, fixed to the end of a handle (made of square-section timber), to hold materials in a candle flame.

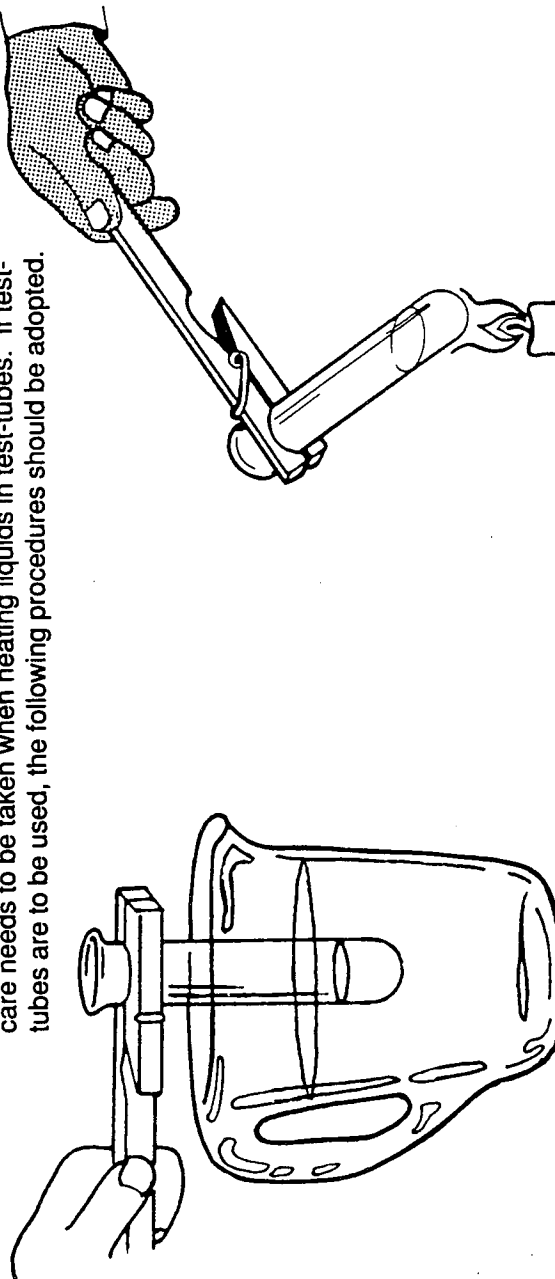
Only small samples should be heated. As well as increasing the risk of accidents it is often difficult to observe small changes when large samples are used.

Always ensure that there is adequate ventilation.



HEATING LIQUIDS IN TEST-TUBES

Most investigations do not require specialist glassware. Particular care needs to be taken when heating liquids in test-tubes. If test-tubes are to be used, the following procedures should be adopted.



Point the mouth of the tube away from the user and from anyone else. There is a major risk of the contents spitting out.

Shake the tube gently while it is in the flame.

This will ensure the liquid is at an even temperature throughout. If this is not done the water (usually) at the bottom of the tube nearest the flame will boil and, as it turns to steam, it may suddenly force out the rest of the contents.

Remove the tube from the flame whenever vibrations are felt, and then return it as they die down.

Never heat a corked test-tube.

Protect the eyes with safety goggles, safety spectacles or face shield.

Hold the test-tube in a proper test-tube holder of suitable size; do not use a paper holder.

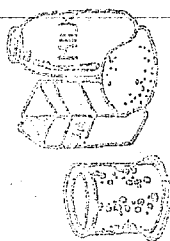
Do not fill the tube more than 1/5th full.

Whenever possible, heat the liquid by placing the test-tube in a container of hot water rather than over an open flame.

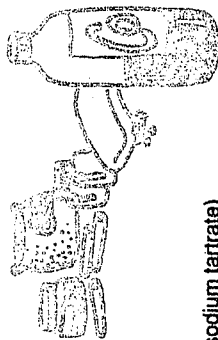


7. CHEMICALS

Children should explore chemical change in a number of everyday materials (KS2).



Chemical changes are taking place all around us, even in the kitchen. They are both useful and fascinating. Children can learn much about the composition of materials and about classification by using 'chemicals'. This can be done safely but always warn pupils NEVER to put chemicals into their mouths.



The following chemicals can be used safely by children (but remember that any substance, even salt, can be harmful if taken in sufficient quantity).

aluminium foil
baking powder (sodium bicarbonate and tartaric acid)
bath salts
bicarbonate of soda (sodium hydrogencarbonate)
blackboard chalk (calcium sulphate or carbonate)
borax (sodium borate)
carbonated (fizzy) drinks
chalk (calcium carbonate)
charcoal
citric acid crystals
clay (moist)
cobalt chloride paper
copper foil or powder
cream of tartar (tartaric acid and potassium hydrogen tartrate)
detergents (hand-washing types)
Epsom salts (magnesium sulphate)
food colouring
glycerine (glycerol)
health salts (e.g. 'Alka-Seltzer', 'Andrews Liver Salts')
lead shot or foil
lemon juice (contains citric acid)
litmus paper or solution
marble chips (calcium carbonate)
milk
oils, vegetable and mineral
plaster of Paris/Polyfilla'
salt (sodium chloride)
sand
soap
steel wool
sugar

SUITABLE CHEMICALS

Just because a substance can be bought easily in a shop, it is not necessarily safe for use in the classroom.

tea (contains tannic acid)
Universal indicator paper or solution
'Vaseline'
vinegar (contains ethanoic acid, also called acetic acid)
vitamin C (ascorbic acid)
washing powder (hand-washing types)
washing soda (sodium carbonate)
water glass (sodium silicate)
zinc foil

Indicators to show acidity or alkalinity can be prepared by crushing (or, if necessary, boiling) red cabbage, beetroot, rose petals, blackberries and many other plant materials in water and then filtering or sieving. The coloured solution is then ready for use.

The following chemicals may be used with care, but they are poisonous, flammable, corrosive or irritant. Close adult supervision is essential.

FOR GROWING CRYSTALS
chrome alum (chromium potassium sulphate)
cobalt nitrate
copper sulphate
ferrous sulphate (iron(II) sulphate)
manganese sulphate
potash alum (aluminium potassium sulphate)

Rochelle salt (potassium sodium tartrate)
sodium thiosulphate
zinc sulphate

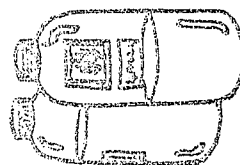
AS SOLVENTS
methylated spirit*
nail varnish remover*
paraffin*
surgical spirit*
white spirit*

FOR PHOTOGRAPHY

fixer (mainly concentrated hypo [sodium thiosulphate])
developer (this is corrosive - avoid contact with skin)
stop bath (mainly acetic [ethanoic] acid which is corrosive when undiluted)

OTHER CHEMICALS

liquid household plant 'foods' such as 'Baby Bio'
cement and concrete
cold water dyes
dopip
iodine solution
iodine tincture*
metal polish ('Duraglit')
paints* and varnishes*
slaked lime (calcium hydroxide)
'Spray Fix'



** These substances are highly flammable. Under no circumstances should they be put near a naked flame.*



7. CHEMICALS

SAFETY CODE

DANGEROUS CHEMICALS

These household chemicals are dangerous and in the classroom should be used only by the teacher, if at all. Consider warning the children about the dangers in their homes.

bleach
caustic soda (sodium hydroxide)
de-rusting solutions
dishwasher detergents
disinfectants
dry cleaning fluids
some fertilisers
fireworks, sparklers and party poppers
some plant growth substances e.g. rooting powders
hydrogen peroxide
lavatory cleansers
'Milton' (hypochlorite solution)
oven cleaners
paint strippers
pesticides, fungicides and insecticides
scale removers
weedkillers
biological and automatic machine washing powders

for using chemicals...

Use spoons kept for this purpose, and not fingers, for transferring solid chemicals. Use droppers for liquids.

Only tip out small quantities so that it is never necessary to return excess chemical to its container.

Prevent contact with the eyes. This can happen when chemicals 'spit' out of a tube during heating or when fingers are contaminated with chemicals. Wear safety spectacles, safety goggles or a face shield if there is any likelihood of this happening.

Avoid skin contact and consider using protective gloves if the skin is known to be sensitive.

Wipe up any spillage at once.

Always wash hands after using chemicals.

...and storing them

Always store chemicals in containers securely labelled with the name of the chemical, and with a hazard warning symbol if appropriate.

Be aware of the risk of confusion and avoid using food or drinks' containers for the storage of chemicals.

Keep only small quantities of chemicals.

Keep a record of all chemicals stored.

Store all chemicals in a locked cupboard or room away from heat sources, and separate from those intended as foodstuffs.

If more than a half litre of any flammable liquid is held, it must be locked in a flame-resistant store.

	CORROSIVE		EXPLOSIVE		FLAMMABLE		IRRITANT or harmful		OXIDISING AGENT		RADIOACTIVE		TOXIC
--	-----------	--	-----------	--	-----------	--	---------------------	--	-----------------	--	-------------	--	-------

Teach children to recognise the international warning symbols which they may come across on containers of hazardous chemicals (but note that not all containers of hazardous chemicals will be labelled). See page 21 for the biohazard symbol.

DISPOSAL OF DANGEROUS AND UNWANTED CHEMICALS

If you have chemicals you wish to dispose of, consult your science adviser or advisory teacher or contact the CLEAPSS School Science Service or SSERC (if your education authority is a member) for advice.



8. ELECTRICITY

Pupils should know that many household appliances use electricity, but that misuse could be dangerous (Sc11/1a).

MAINS ELECTRICITY

Equipment such as power-units, electric kettles, boiling rings, computers and the heating and lighting equipment for aquaria should be safe to use if bought from a major school supplier or other reputable source.

In general, children will not need to handle mains equipment at school. However, there may be instances where the use of mains equipment is appropriate e.g. low voltage power supplies. In these cases children should be shown how to use them safely.

Employers must now have all electrical equipment checked annually. Some education authorities arrange this automatically. Earth-leakage circuit-breakers should be considered if children are using equipment powered by mains electricity.

SOURCES OF ELECTRICITY

Dry batteries

These are the safest type of battery for use in schools. It is not possible to receive an electric shock through the skin from a 1.5 volt battery, unless a great many of them are joined together. This type of battery CANNOT be recharged and no attempt should be made to do so. Never put them in an oven in an effort to rejuvenate them. Tiny batteries, as used in watches, etc. are not suitable.

Rechargeable batteries

These can be used over and over again. If allowed to discharge quickly, for instance through a short circuit, wires and batteries can get very hot. This can damage a plastic battery box as well as giving children an unpleasant surprise. A member of staff should always supervise their

recharging, using only a charger designed for this type of battery. High capacity rechargeable batteries are best avoided.

When using batteries it is best not to mix different types.

Car batteries and similar accumulators are not appropriate.

Low voltage power supplies (up to about 12 volts)

These may be particularly convenient if a lot of time is spent investigating electricity, when replacing dry batteries may become expensive. Different equipment requires different power supplies: follow the manufacturer's instructions.

SAFETY CODE

for using electricity

Teach children never to misuse mains electricity and warn them of electrical dangers in the home.

Do not use mains equipment which has a damaged plug or frayed lead. Such equipment is very dangerous and is the commonest source of accident with electrical equipment.

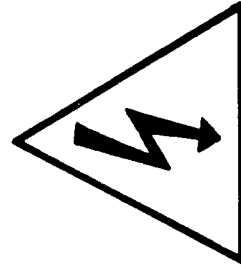
Teach children always to switch off the mains at the socket before attempting to unplug or plug in mains electrical equipment. They should do this only under close adult supervision.

Use only approved plugs with appropriate fusing.

Store batteries in such a way that their terminals cannot touch and short circuit.

Do not allow children to cut open batteries since their contents can be corrosive and poisonous.

Discard old batteries as they often leak.



RISK OF ELECTRIC SHOCK



9. OURSELVES

SAFETY CODE

Children are interested in, and should know something about, themselves. They will gain an understanding of biological variation through a study of individual differences. Although, in general, this is thought of as a 'safe' topic, there are some aspects where there are possible hazards.



Make sure that each child is physically fit for the activity that she/he is about to undertake. No child who is excused the school's PE activities on medical grounds should be the subject for investigations which examine the effects of exercise on breathing and pulse rate, nor in measurement of lung capacity. Take care that children with medical problems (e.g. epilepsy, asthma) or on regular medication are not put at risk.

Avoid situations which can lead to emotional stress. Investigations can change into competitions or some children may think they have been identified as 'abnormal'.

Illegitimacy, adoption, etc. may cause some children to be sensitive about the subject of heredity, and therefore this must always be approached with care.

for investigating ourselves...

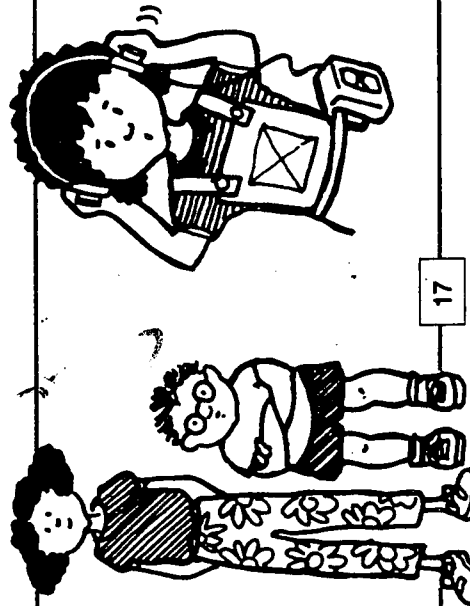
Be sensitive to the differences between children. Avoid putting individuals into situations of physical or emotional stress.

When foods are used for investigations into the sense of taste, ensure that all surfaces and utensils are clean. Do not allow the foods to become contaminated, and teach children to wash their hands before handling food.

Disinfect mouthpieces, clinical thermometers and any other shared objects put into the mouth, using a solution such as Milton. Whenever possible avoid sharing and use disposable items e.g. straws.

Do not take samples of human blood or cheek cells because of the risk of infection.

Local regulations concerning the keeping and giving of medicines must be strictly followed.



...and other animals

Always obtain eyes, hearts, kidneys, etc. fresh from a butcher, since the animals from which they have been taken will have been checked by Health Inspectors. Use the material as soon as possible to minimise any risk of infection. Even so, care should be taken because of this possibility.

After studying eyes, hearts, kidneys, etc. carefully wipe all surfaces with a disinfectant solution. Dispose of the material by incineration or in sealed bags via the system that the school kitchen uses.

When doing work on sound and hearing, teach children that listening frequently to loud sounds can damage their hearing.

Be aware that some children may dislike handling parts of animals, and others may object on cultural or ethical grounds.

Parts of animals should always be handled with sensitivity to their origin.



10. ANIMALS

Over a period of time children should take responsibility for the care of living things, maintaining their welfare by knowing their needs and understanding the care required (KS 1).

Living things make an important contribution to the education of children. Through keeping animals (and plants), young children learn about their needs, the characteristics of living things and begin to recognise their variety. In order to foster concern and respect for living things, it is essential that all animals (and plants) are well maintained. There must always be proper planning for the correct care and maintenance of them, including the difficulties of holiday times.



EXAMPLES OF SUITABLE ANIMALS

Mammals:

Mongolian gerbils
Syrian hamsters (nocturnal)
laboratory rats
Guinea pigs
rabbits

Note that all small mammals are less suitable for use in infant classrooms, since the children may have difficulty in handling them with care.

Reptiles:

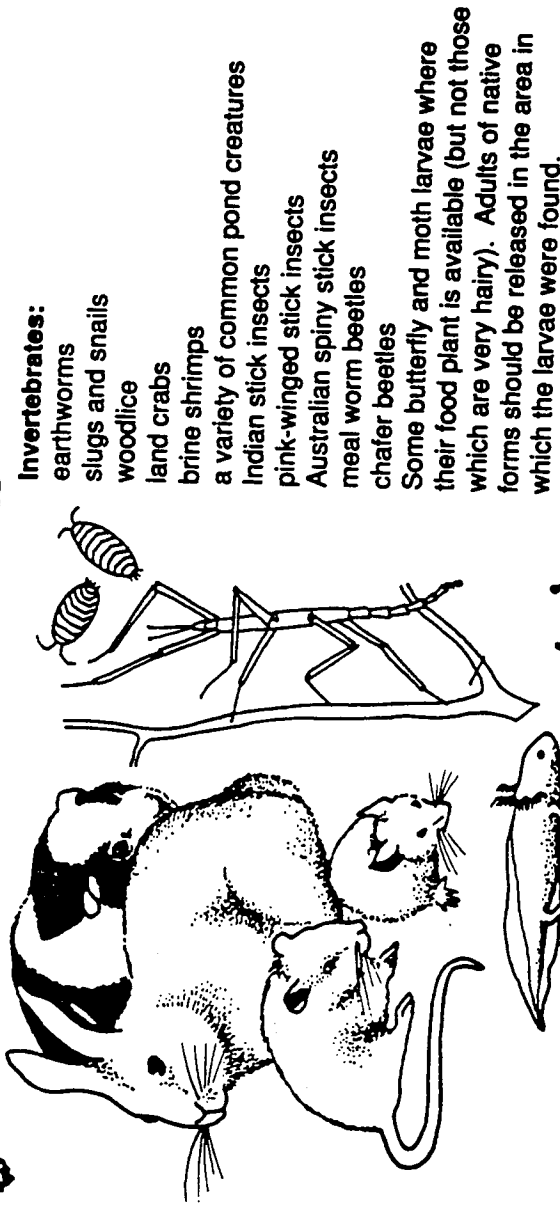
garter snakes

Amphibians:

clawed toads
Axolotls
bull-frog tadpoles
tiger salamanders

Fish:

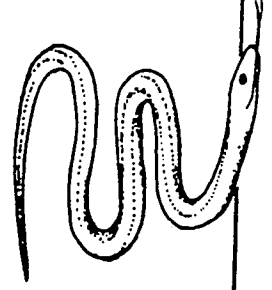
cold-water fish
tropical fish



Invertebrates:

earthworms
slugs and snails
woodlice
land crabs
brine shrimps
a variety of common pond creatures
Indian stick insects
pink-winged stick insects
Australian spiny stick insects
meal worm beetles
chafer beetles
Some butterfly and moth larvae where their food plant is available (but not those which are very hairy). Adults of native forms should be released in the area in which the larvae were found.

Frog spawn is best left in its natural environment. Therefore, take only small amounts for study.



All animals taken from their natural environment for study should be returned as soon as possible.



10. ANIMALS



ANIMALS WHICH SHOULD NOT BE KEPT

Animals which can transmit diseases to humans:

mammals and birds caught in the wild, recently-imported birds, terrapins and tortoises, recently-imported Giant African land snails.

Animals which are becoming scarce:

adult British amphibia and reptiles, (when bred in schools these should be returned to the wild).

Animals which are venomous:

some snakes, many tropical spiders, striped stick insects.

Animals which are difficult to keep in captivity:

grass snakes (which feed on frogs), exotic mammals, lizards.

Animals which can produce allergic reactions:

locusts (except if kept for a short time), garden tiger moth caterpillars (larvae), brown-tailed moth caterpillars (larvae), birds. (Particular care should be taken where a child has known allergies)

Animals that can infest:

cockroaches.

There are legal restrictions on the taking of some animals (and plants) from the wild. Children often bring injured birds or dead animals into school and these should be removed from the premises as quickly as possible. Dead animals are likely to be infected. Wrap in a plastic bag and then in newspaper and put in a rubbish bin. For injured animals, consult animal welfare organisations e.g. PDSA, RSPCA. Some animals, such as cats and dogs, should not be kept in schools but may be welcomed as occasional supervised visitors.

SAFETY CODE for keeping animals

Before keeping any animal consult a reliable reference book, such as those produced by the RSPCA.

Obtain animals, particularly small mammals, only from reputable suppliers.

Teach children always to wash their hands before and after handling animals (a good opportunity for health education).

Keep the housing clean and disinfect cages at regular intervals.

Prevent contact between maintained animals or their foodstuffs and wild animals to avoid transmission of disease.

Encourage children not to bring whole, or parts of, untreated dead vertebrate animals into the school.

Do not allow animals to wander freely on floors or tables unless these are cleaned immediately afterwards.

Consider the safety and well-being of the animals and teach children to handle them with due care.

Ensure that animals are always fed correctly and make suitable arrangements for holiday periods.



Wash carefully all animal bites and scratches. Seek medical advice if in doubt about the risks of infection.



11. MICRO-ORGANISMS

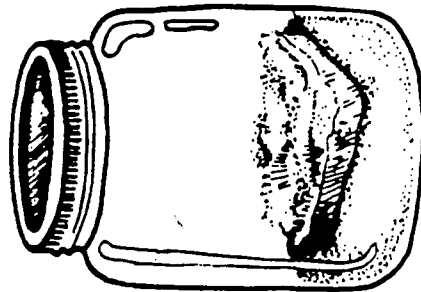
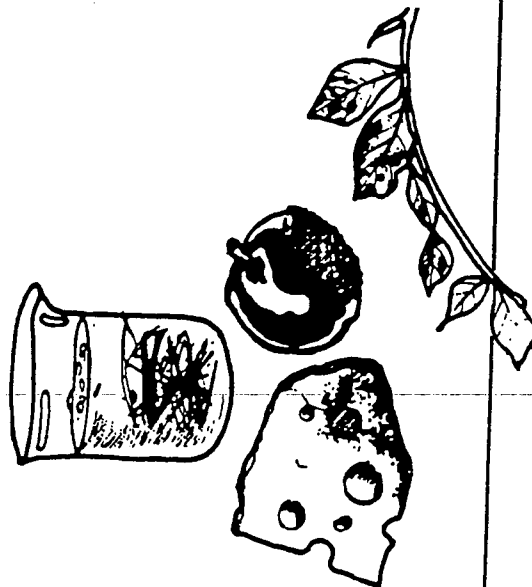
Children should investigate the extent to which a selection of everyday waste products, for example, garden refuse, paper, plastic materials and cans 'decay naturally' (KS 1).

It is important always to apply safe and hygienic techniques when dealing with micro-organisms of any type, since this will help to foster the idea of good practice. In general, the micro-organisms which are likely to be studied in primary schools are limited to various moulds and yeast.

RISKS WHEN USING MICRO-ORGANISMS

During the primary years the stress will be on observation and the carrying out of simple investigations only. It is neither necessary, nor advisable, to grow cultures on special growth media.

It is possible to culture a wide variety of potentially harmful micro-organisms and the appropriate conditions for the safe handling of these are not likely to be found in primary schools. Furthermore, special training and techniques are required for such work. This type of work with micro-organisms should *not* be carried out in the primary school.



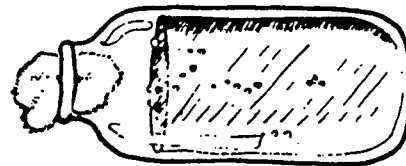
Many microbes release large quantities of spores into the air. Some people are allergic to these and therefore microbes should be grown in securely covered containers which are never opened. However, since yeasts produce large amounts of carbon dioxide gas as they grow, it is important that their containers are *not* completely sealed. A plug of cotton wool will allow the release of gas, but will prevent any spores from escaping or entering.



EXAMPLES OF SUITABLE MATERIAL

baker's yeast
hay or grass infusion in rain water
mildews and rusts on weeds and garden plants
milk
mouldy cheese, bread or fruit
pond material
soil
yogurt

A mould garden, using bread on a bed of moist sand in a large screw-topped jar, may be used to show the variety of colonies which can develop. Disposal of such material needs special care - see the section on Safe Disposal.



Further guidance will be found in the DES booklet:
Microbiology. An HMI guide for schools and non-advanced further education (see bibliography).



11. MICRO-ORGANISMS

SAFETY CODE for using micro-organisms

Never grow (culture) micro-organisms except on the natural substances where they normally grow.

Wipe up all spills. With micro-organisms other than yeast, use a disinfectant solution and wear disposable gloves, as described in the section on Safe Disposal.

Teach children to wash their hands thoroughly with soap and water after handling any source of micro-organisms.

Securely cover all containers in which micro-organisms are grown. Do not uncover them for observation (but note the precautions with yeasts).

Never allow fermentation by yeasts in closed containers as the pressure of the gas generated could cause an explosion.

Date all cultures which are to be left for extended periods of study.

Do not leave cultures forgotten for long periods before disposal.

Dispose of anything which begins to smell.

Never use material from dustbins or polluted water for investigations on micro-organisms.

Teach children to take care not to contaminate cuts or abrasions with microbes.

Teach children NEVER to put anything into their mouths when carrying out microbe investigations.

SAFE DISPOSAL

Teachers should dispose of all cultures as follows:

Wear disposable gloves.

Destroy the micro-organisms by adding bleach, hypochlorite solution (1% solution) or a proprietary disinfectant such as Milton. Be careful when opening and adding the solution to the culture, or vice versa, not to release spores into the air.

Soak the culture overnight.

Seal the culture (e.g. in a polythene bag) and place it in a dustbin.

Glass containers can be washed after soaking and re-used or sent to the bottle bank.

Lock away the solutions used to destroy micro-organisms until they are required, as these can also constitute a hazard.

Yeast should be treated as under Food and Hygiene, see section 4.



BIOHAZARD



12. PLANTS

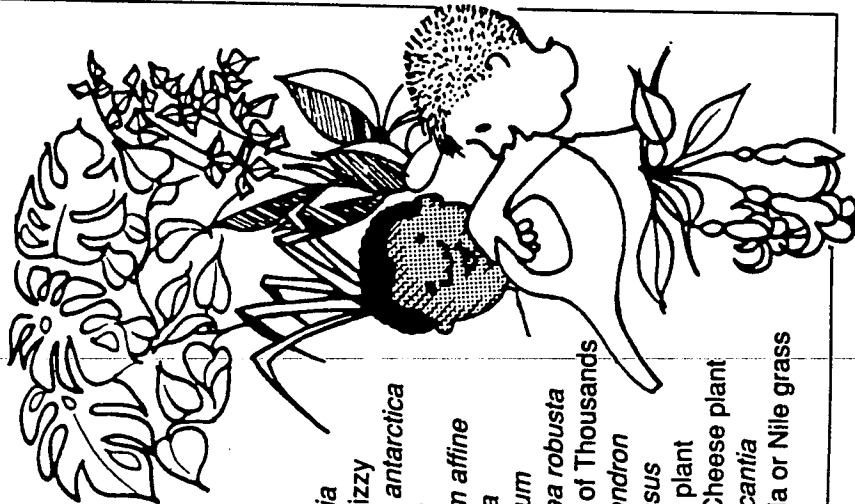
Children should have opportunities both to observe at first hand and to use books, stories, pictures, charts and videos to find out about a variety of animal and plant life (KS 1).

Plants offer an easy opportunity for children to experience the wonder of watching a living organism grow and develop. By growing plants in the classroom, pupils can be encouraged to care for and appreciate the needs of other living organisms and to develop caring attitudes towards them.



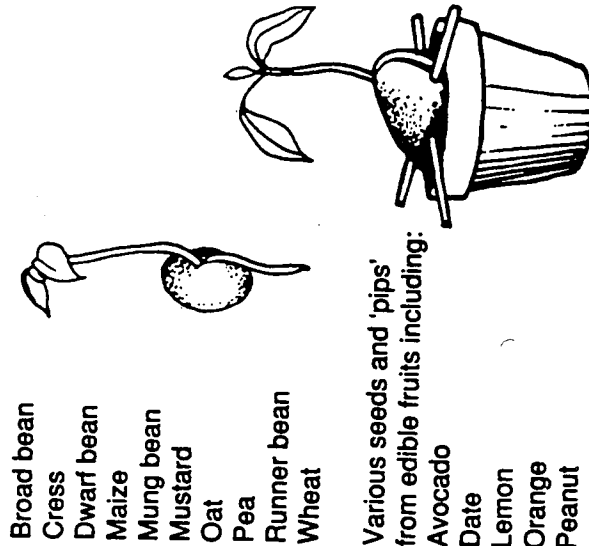
EXAMPLES OF SUITABLE PLANTS

PLANTS FOR GENERAL USE



Begonia
Busy Lizzy
Cissus antarctica
Coleus
Exacum affine
Fuchsia
Geranium
Grevillea robusta
Mother of Thousands
Philodendron
Rhoicissus
Rubber plant
Swiss Cheese plant
Tradescantia
Umbrella or Nile grass

PLANTS TO ILLUSTRATE GROWTH FROM SEEDS



Broad bean
Cress
Dwarf bean
Maize
Mung bean
Mustard
Oat
Pea
Runner bean
Wheat

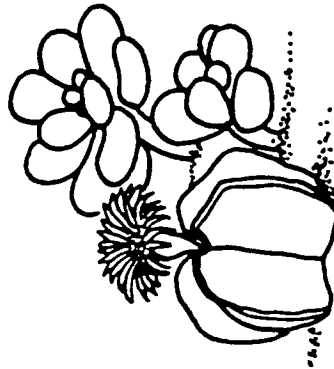
Various seeds and 'pips'
from edible fruits including:

Avocado
Date
Lemon
Orange
Peanut

Seeds from commercial growers are often
treated with poisonous pesticides, but many
seeds which are safe to use are available from
health-food shops.

PLANTS WITH PARTICULARLY INTERESTING GROWTH FORMS

Bromeliads
Cacti (be particularly careful with
those forms having sharp spines)
Succulents



These lists are only illustrative and do not
preclude the maintenance of other species.



12. PLANTS

POISONOUS PLANTS

In their exploration of their environments, children will take an active interest in nature including the plant community. Most plants are safe for children to handle and to investigate. However, some are poisonous or have parts that are poisonous (e.g. rhubarb leaves). It is safer to regard all plants, and parts thereof, as poisonous unless you have certain knowledge to the contrary. The particular vulnerability of children with asthma and allergies must also be borne in mind. For example, plants of the primrose family are irritant and may cause dermatitis in sensitive individuals.



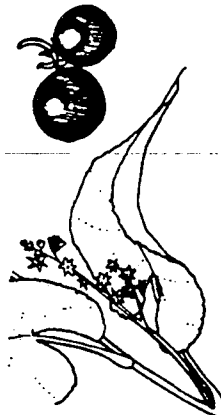
Giant Hogweed
Caster oil seeds
Holly
Laburnum

All parts of these plants should be considered poisonous:

Mountain Ash seeds
Potato (except tubers, when not green)
Privet

Red kidney beans (except when well cooked)
Spindle-tree

Rhubarb (except leaf stalks)
Tomato (except fruits)
Yew



Black Bryony



Black Nightshade



Cuckoo Pint



Deadly Nightshade



Hemlock



Henbane



Ragwort



White Bryony



Woody Nightshade

SAFETY CODE

for using plants

Teach children to avoid touching their eyes whilst handling plants.

Teach children never to taste any part of a plant unless absolutely certain that it is safe to do so.

Warn children especially about attractive looking fruits and seeds which might be poisonous.

Never use seeds dressed with pesticides.

Always wash hands after handling plants.

Identification may require reference to suitable texts e.g. *Poisonous Plants and Fungi. An Illustrated Guide (see bibliography).*



13. SCIENCE 'OUT OF DOORS'

Children should study aspects of their local environment which have been affected by human activity... for example, farming, industry, sewage disposal, mining or quarrying (KS 2).

SCHOOL AND LOCAL ENVIRONMENTAL AREAS

Particular care must be taken to ensure that children are effectively supervised whenever they are working out of doors. Environmental areas, which may or may not contain a pond, offer opportunities for children to study aspects of their environment at first hand and to maintain it. Careful management can create a number of different types of environment (marsh, rocks, etc.) within a small area and with convenient access. Not only can children investigate these, but they can also follow seasonal changes which would be impossible on a one-off visit to a distant site.

Any 'off-site' visit, no matter how short, will need adequate supervision and may be subject to local rules.

There are few hazards associated with environmental areas, except perhaps with ponds. The article 'Safety and the School Pond' (*Primary Science Review*, Summer 1988) discusses safe design.

Tetanus is an ever-present risk whenever the skin is cut, and immunisation against this might be considered for teachers and children. Consult your community physician about this. Hands should be protected by disposable gloves or plastic bags if litter is collected for surveys, as there are risks both of infections and of cuts.

In addition to the points mentioned below, the SAFETY CODES for animals, plants and micro-organisms also apply.

SAFETY CODE

for environmental areas

Teach children to wash their hands carefully whenever they have handled or examined animals, plants, soil, etc.

Check for the presence of any hazard e.g. broken glass, poisonous plants, etc.

Do not allow unrestricted access to ponds, or to areas which contain plants which could injure e.g. brambles, nettles, etc.

Cover abrasions and cuts with waterproof dressings.

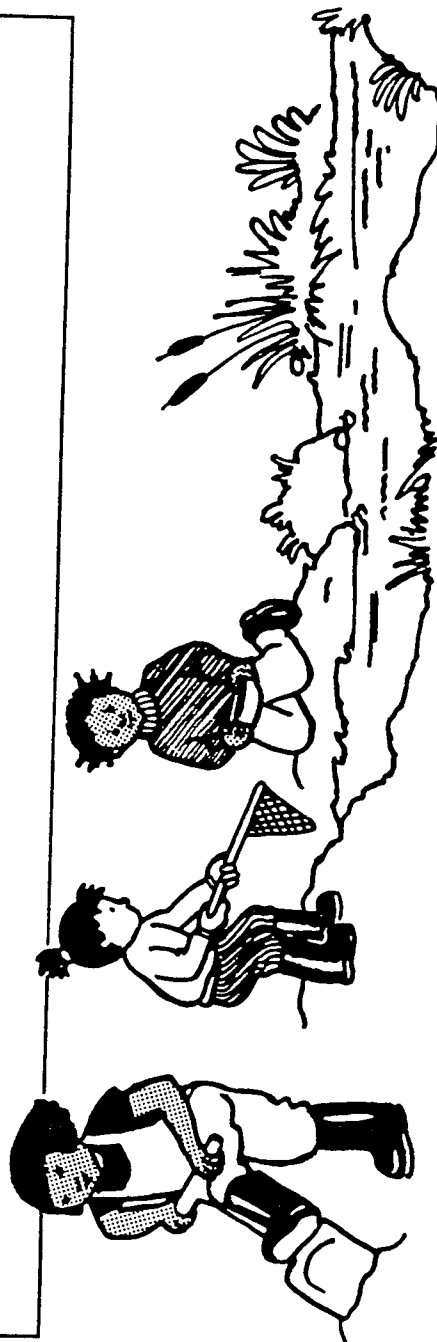
Do not let young children work unaccompanied near a pond.

Teach older children how to work unaccompanied around a pond without endangering themselves or others. Do not, however, allow this unless you can be reasonably certain of their sensible behaviour.

Use a pooter or small paint brush to collect insects and minibeasts.

Keep birds' nests and unwashed feathers in sealed plastic bags or containers.

Teach children how to use garden tools safely.



Children should collect, and find differences and similarities in, natural materials found in their locality, including rocks and soil (KS 1).



13. SCIENCE 'OUT OF DOORS'

SAFETY CODE

for fieldwork

Be aware of the dangers of slipping on wet grass and rocks.

Avoid open water which may be deep and dangerous.

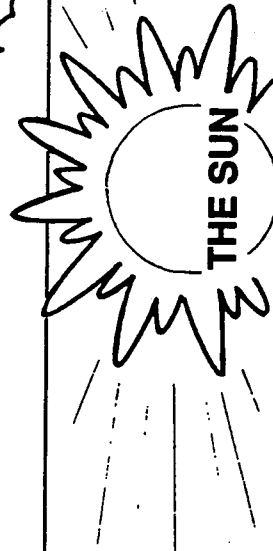
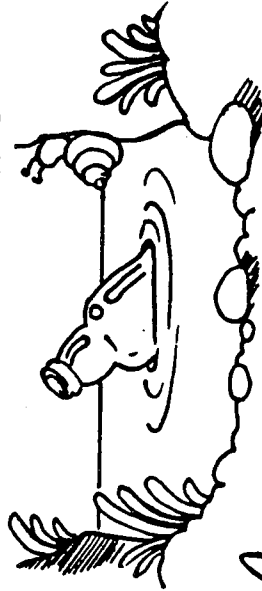
Avoid pond dipping where access is steep or difficult.

Be aware of the possible presence of Weil's disease in water polluted by rats. Children are rarely at risk, but nevertheless make sure that cuts and abrasions are not exposed, by covering them with waterproof dressings.

Be aware that crops may have been sprayed with fertilisers and pesticides.

Warn children about the dangers of discarded chemical drums.

Do not allow children to do rock chipping.



Never look at the Sun directly or through a lens or coloured glass. Even during an eclipse the light from the Sun can permanently damage the eye. Be especially careful with binoculars or telescopes.

A lens or magnifier can focus the Sun's rays on to a small area. This can cause burning and care must be taken to make sure this does not happen by accident. Broken glass sometimes causes fires this way.

When focusing a microscope that does not have a built-in light source, take care that the mirror is not directed towards the Sun. This is dangerous because the Sun's rays could be reflected through the microscope into the user's eye.

FIELDWORK AND INDUSTRIAL VISITS

Visits to distant sites pose particular problems not always encountered when using local environmental areas. A prior visit by the teacher is recommended.

Visits should always be organised in accordance with local rules regarding parental permission, supervision, transport, safety, first aid and insurance.

For certain industrial visits, there may be a minimum age requirement and particular levels of supervision necessary.

Children should be encouraged to wear sensible clothing and footwear. Protective clothing and special footwear may be required on visits to industrial sites, including quarries.

Every consideration should be given to avoid damaging the environment and disturbing the balance of the animals and plant populations. The removal of fossils, minerals or rocks should only be done after due consideration; permission to do so may also be needed.

Rock chipping, if it is to be done at all, should be carried out only by a teacher using a geology hammer and eye protection.

Follow the Country Code (see bibliography).



14. BIBLIOGRAPHY

A. Books referred to in *Be Safe!*

- Science in the National Curriculum*
DES/ Welsh Office (HMSO, 1989) ISBN 0 11 270667 3.
- Technology in the National Curriculum*
DES/ Welsh Office (HMSO, 1990) ISBN 0 11 270709 2.
- First Aid Manual*
Authorised manual of St. John Ambulance, St. Andrew's Ambulance Association and The British Red Cross (Dorling Kindersley, 1987) ISBN 0 86318 2305.
- Safety in Practical Studies*
DES (HMSO, 1981) ISBN 0 11 270305 4.
- Microbiology. An HMI guide for schools and non-advanced further education*
DES (HMSO, 1985) ISBN 0 11 270578 2.
- Poisonous Plants and Fungi. An Illustrated Guide*
Marion R. Cooper and Anthony W. Johnson, MAFF (HMSO, 1988) ISBN 0 11 242718 9.
- Out in the Country*
Containing the Country Code
(CCP 186, 1990) - free from Countryside Commission Publications, 19-23 Albert Road, Manchester M19 2EQ.

B. Other useful books and articles for primary teachers

- CLEAPSS (members only, free of charge).
CLEAPSS *Science Equipment News* - twice yearly newsletter for teachers in first, junior and middle schools.
- L5p *Safe use of household and other chemicals*
- L42 *Plants for primary science*
- L86p *Electrical safety*
- L111 *Tools and techniques*
- L112 *Batteries etc - which to buy?*
- L124 *Aquaria - electrical safety*
- L145p *Beakers etc - glass or plastic?*
- L157p *Thermometers for primary schools*
- L164a *Heating in primary science*
- GLU *Glues and adhesives*

RSPCA Books

- Animals in Schools* (4th edition, 1986).
Small Mammals in Schools (2nd edition, 1989).
Visiting Animal Schemes. A guide to good practice for schools, local education authorities and VAS officers (1988).

Battery Safety Guidelines

Free from The British Battery Manufacturers' Association,
7 Buckingham Gate, London SW1E 6JS.

Emergency Aid in Schools

(St. John Ambulance, 2nd edition, 1988). ISBN 0 900700 408.
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