EXPERIMENT MANUAL

Chem C1000

Please observe the safety information, the advice for supervising adults on page 5, the safety rules on page 6, the information about hazardous substances and mixtures (chemicals) on pages 7-8 and their environmentally sound disposal on page 75, the safety for experiments with batteries on page 7, and the first aid information on the inside front cover.

WARNING. Not suitable for children under 10 years. For use under adult supervision. Contains some chemicals which present a hazard to health. Read the instructions before use, follow them and keep them for reference. Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes. Keep small children and animals away from experiments. Keep the experimental set out of reach of children under 10 years old. Eye protection for supervising adults is not included.

WARNING — Chemistry Set. This set contains chemicals that may be harmful if misused. Read cautions on individual containers and in manual carefully. Not to be used by children except under adult supervision.

THAMES & KOSMOS

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Thames & Kosmos, 89 Ship St., Providence, RI, 02903, USA | 1-800-587-2872 | www.thamesandkosmos.com

First Aid Information

When conducting experiments with chemicals and in case any accidents should happen during experimentation:

In case of injury, seek immediate medical help.

1. **In case of eye contact:** Wash out eye with plenty of water, holding eye open if necessary. Rinse from the nose outward. Seek immediate medical advice.

2. **If swallowed:** Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.

3. **In case of inhalation:** Remove person to fresh air. For example, move person into another room with open windows or outside.

4. **In case of skin contact and burns:** Wash affected area with plenty of water for at least 10 minutes. Cover burns with a bandage. Never apply oil, powder, or flour to the wound. Do not lance blisters. For lager burns, seek immediate medical help.

5. **In case of doubt, seek medical advice without delay.** Take the chemical and its container with you.

6. **In case of injury always seek medical advice.**

7. **In case of cuts:** Do not touch or rinse with water. Do not apply any ointments, powders or the like. Dress the wound with a germ-free, dry first-aid bandage. Foreign objects such as glass splinters should only be removed from the wound by a doctor. Seek medical advice if you feel a sharp or throbbing pain.

Warning! Contains functional sharp points or edges that pose a risk of injury.

Keep the packaging and instructions, as they contain important information.

Poison Control Centers (United States)

In case of emergency, your nearest poison control center can be reached everywhere in the United States by dialing the number:

1-800-222-1222

Local Hospital or Poison Centre (Europe)

Record the telephone number of your local hospital or poison centre here:

Write the number down now so you do not have to search for it in an emergency.

Chem C1000

Experiment Manual

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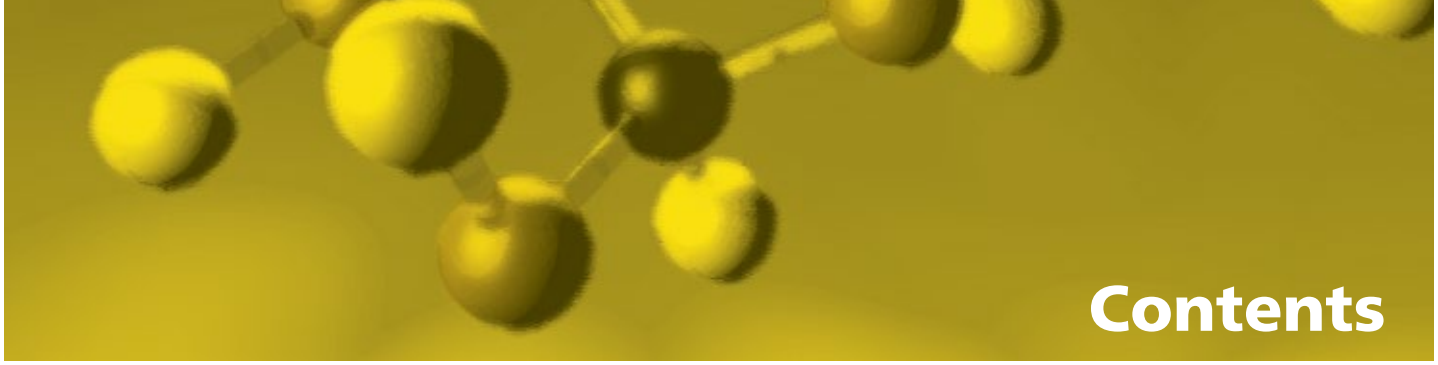

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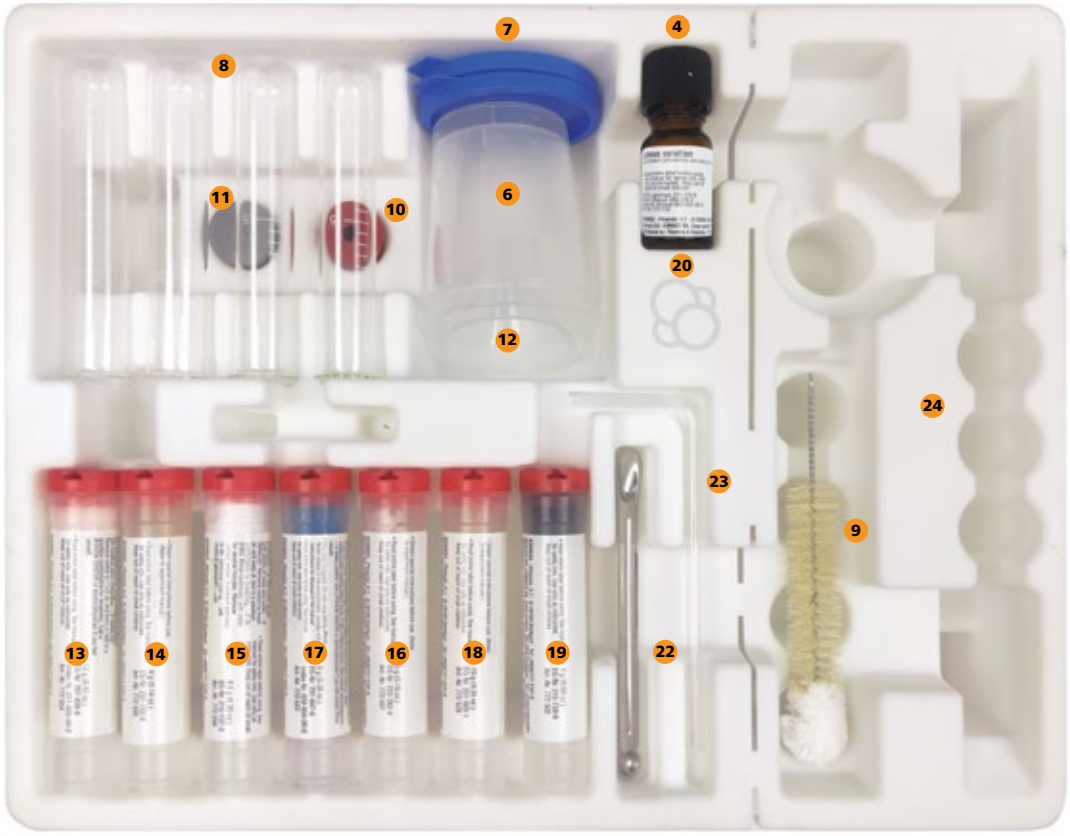

The experiment station (for more info, see p. 10) can be divided here using a sharp knife. An adult must do this step.

Please note: The actual design of your experiment station and component storage tray may vary from what is pictured here.

Chem C1000 contains the following parts:

No.	Description	Item No.
1	Safety glasses	640-P01
2	Three dropper pipettes	640-P02
3	Clip for 9-volt battery	640-P03
4	Safety cap with dropper insert for litmus bottle	640-P04
5	Copper wire	640-P05
6	Two large graduated beakers	640-P06
7	Two lids for graduated beakers	640-P07
8	Four test tubes	640-P08
9	Test tube brush	640-P09
10	Rubber stopper with hole	640-P10
11	Rubber stopper without hole	640-P11
12	Funnel	640-P12
13	Sodium carbonate, 12g	640-P13
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15	Calcium hydroxide, 8.5g	640-P15
16	Ammonium iron(III) sulfate, 5g	640-P16
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18	Citric acid, 10g	640-P18
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20	Small bottle for litmus solution	640-P20
21	Lid opener	640-P21
22	Double-headed measuring spoon	640-P22
23	Angled tube	640-P23
24	Experiment station (part of the cardboard insert)	640-P24
25	Filter paper sheets (not pictured)	640-P25

Keep the packaging and instructions, as they contain important information.

Please check whether all of the parts and chemicals listed in the parts list are contained in the kit.

How can individual parts be reordered?
Contact Thames & Kosmos customer service to inquire about an order.

Additional materials required
On page 13, we have made a list of the additional materials required for a number of experiments.

Safety Information

Information for Parents and Adults

What you need to know about chemistry experiment kits

With Chem C1000, children can take their first steps into a field of study that may not yet be part of their regular curriculum in school, but, as experience shows, fascinates children who are curious, have fun discovering new things, and want to know what causes the phenomena they encounter in their everyday environment. Chem C1000 provides an engaging introduction to chemistry, bridging the realms of play and learning. The experiments can be done without previous knowledge of chemistry or lab experience because the experimental procedures are described in detail in this manual.

The experiment kit makes it possible to perform 125 simple, exciting, and instructive experiments ranging from creative experimentation with color on paper to tracking down a notorious climate-changing molecule in a number of different places.

It is normal to have questions about the safety of a chemistry experiment kit. You know that improper use of chemicals can lead to injuries or other health risks. This kit complies with all applicable U.S. consumer product safety regulations, including those for chemistry sets. Moreover, this kit complies with the more rigourous European safety standard EN 71-4, in which the safety requirements for chemistry experimental kits are established, to reduce risks to a minimum. This standard forms the reliable basis of all Thames & Kosmos chemistry experiment kits. The standard contains requirements for the manufacturer — for example, the requirement that no particularly hazardous substances can be used. They also require the manufacturer to carefully inform the parents or adult supervisors of the possible hazards and to require them to accompany their children in their new hobby with a helping hand. Therefore, please read all of the safety information prescribed by EN 71-4 listed in the box on the right as well as the advice below. Emphasize to your child the importance of following all of this information, and the importance of carrying out only the experiments that are described in this manual.

The **safety rules** (pages 6-7), the **information about hazardous substances and mixtures** (pages 7-8), and the safety information accompanying each experiment inform you of the risks and help you evaluate the suitability of each experiment for your child. In case anything should happen, please find the **first aid information** and the **poison control center contact information** on the inside front cover. To avoid injuries please inform your child how to handle the angled glass tube on page 12 (place it into the rubber stopper and remove it from the stopper).

Instructions for **setting up the work area** are described on page 10. Proper **waste disposal** techniques are on page 75. A list of **additional materials** required can be found on page 13.

We advise you to carry out the experiments in the prescribed order, since the knowledge of working techniques described in the earlier experiments is a prerequisite for the later ones.

We wish your young chemist, as well as you, a lot of fun and success with the experiments!

Tips and information for you and the child performing experiments.

Advice for Supervising Adults

A. Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.

B. The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.

C. This experimental set is for use only by children over 10 years.

D. Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.

E. The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids (e.g. citric acid), alkalis (bases, e.g. sodium carbonate) and flammable liquids (denatured alcohol).

F. The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided (also see page 10).

Safety Rules

All of the experiments that are described in this manual can be performed without danger if you carefully follow the tips and rules summarized below.

Safety rules for chemical experiments

1. **Read these instructions before use, follow them and keep them for reference.** Pay special attention to the quantity specifications and the sequence of the individual tasks. Only perform experiments that are described in this instruction manual.
2. **Keep young children, animals and those not wearing eye protection away from the experimental area.**
3. **Always wear eye protection.** If you wear corrective eyeglasses, you will need protective goggles for those who wear eyeglasses. When working, wear appropriate protective clothing (old smock and smooth fingered gloves).
4. **Store this experimental set out of reach of children under 10 years of age** (for example, in a lockable cabinet). This includes the additional materials.
5. **Clean all equipment after use.**
6. **Make sure that all containers are fully closed and properly stored after use.**
7. **Ensure that all empty containers are disposed of properly.**
8. **Wash hands after carrying out experiments.** Chemicals that accidentally get onto your skin must be rinsed off immediately under running water.
9. **Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.**
10. **Do not eat or drink in the experimental area.** Do not use any eating, drinking or other kitchen utensils for your experiments unless it is specifically recommended. Any containers or equipment you use in your work should not be used in the kitchen afterwards. Dispose of used drinking straws in the garbage immediately after the experiment. Do not save and reuse them.
11. **Do not allow chemicals to come into contact with the eyes or mouth.**
12. **Do not replace foodstuffs in original container. Dispose of immediately** (in the household trash or the sink). If you are investigating food products (e.g., sugar, flour, table salt), fill the required amount into one of the graduated beakers (do not use the double-headed measuring spoon for this). Make note on the beaker of what it contains and the date it was filled.
13. The tealight candle required for some experiments has to be placed on a fire-resistant surface (such as an old plate). Extinguish the flame at the end of the experiment at the latest as well as when you leave the experiment area even if just for a moment.
14. During the experiments with open flame, be sure that there are no flammable objects or liquids nearby. Have a bucket or box with sand ready for extinguishing any fires. If the fire can't be extinguished right away, notify the fire department immediately.
15. Any filled container or experimental apparatus that is to remain standing for a longer period of time (e.g., for the precipitation of substances) has to be labeled and stored out of reach of young children and animals.
16. Get any additionally required materials ready before starting an experiment.
17. Handle breakable materials (e.g., the glass test tubes or angled tube) carefully.

Also note the information on the chemical vial labels, the information about "Hazardous substances and mixtures" on p. 7 – 8 as well as the safety and waste disposal instructions for the individual experiments (for example, regarding how to properly handle the angled tube). If additional products are required, also take note of the warnings on their packaging (e.g., for denatured alcohol).

Safety for experiments with batteries

WARNING! Only for use by children aged 10 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep the packaging and instructions as they contain important information.

- For some experiments, you will need a 9-V type 6LR61 square battery, which could not be included in the kit due to its limited shelf life. Press the battery clip equipped with red and black wires onto the battery.
- Have an adult check your experimental setup before performing the experiment.
- Non-rechargeable batteries are not to be charged. They could explode.
- Rechargeable batteries are only to be charged under adult supervision.
- Rechargeable batteries are to be removed from the toy before being charged.
- Exhausted batteries are to be removed from the toy.
- Dispose of used batteries in accordance with environmental provisions, not in the household trash.
- The supply terminals of the battery clip are not to be short-circuited: Neither the battery wire contacts nor the wires connected to them should touch each other. Make sure there is no unintended short circuit due to conductive metal objects, such as coins or a keychain. A short circuit can cause the wires to overheat and the battery to explode.
- Don't throw batteries into the fire and don't store them near heat sources.
- Avoid deforming the batteries.
- Never perform experiments using household current. You know that you should never insert any objects into the wall socket holes. The high voltage can be extremely dangerous or fatal!
- Don't use any voltage source other than the specified battery, including a power supply unit.
- After you are done experimenting, remove the battery clip from the battery.

Hazardous substances and mixtures (chemicals)

How they are labeled and how to properly handle them

In the following, we provide you with a list of the chemicals contained in this chemistry set as well as the chemicals you will be obtaining in addition that are classified as hazardous substances or hazardous mixtures. For each substance, the list shows hazard statements (in blue) and precautionary statements for avoiding the hazards. In the margin, you will find the corresponding **pictograms** and a **signal word** for the scope of the danger: WARNING means limited risk, and DANGER means elevated or significant risk.

The figure to the right shows the pictograms that appear in the following list of substances. The text under each one cites dangers associated with substances that are designated with the pictogram. A substance designated with a pictogram may be associated with one or more of the hazards listed under that pictogram. For example, copper sulfate (exclamation point) is harmful and irritant. You can find out exactly what hazards are associated with a certain substance by referring to the following list.

The pictograms are a component of Regulation (EC) No 1272/2008, also called the GHS Regulation. GHS stands for Globally Harmonized System, a system whose aim is to achieve a classification and designation of hazardous substances and mixtures that is uniform throughout the world.

Some of the chemicals listed below only cause limited risks. Therefore they are not labelled with a pictogram or signal word. Nevertheless the given precautionary statements should be observed.

Substance/mixture causes
- corrosion (destruction) of metals
- burns on skin
- severe eye damage

Substance/mixture is
- acutely harmful if swallowed, in contact with skin, or inhaled
- an irritant to skin, eyes, and respiratory tract
- sensitizing to skin
- narcotic

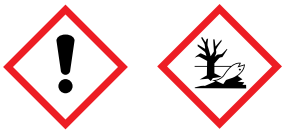
Substance/mixture is
- acutely very toxic
- very toxic or toxic with long lasting effects to aquatic life

Ammonium iron(III) sulfate
Not a hazardous substance
Obtain special instructions before use. May cause slight eye irritation. – Prolonged or repeated contact may dry skin and cause irritation.

DANGER

Calcium hydroxide
Causes skin irritation. – Causes serious eye damage. – May cause respiratory irritation.
Do not breathe dust. – Wear eye protection. – IF ON SKIN: Wash with plenty of soap and water. – IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. – Get medical advice/attention.
These warnings also apply to its aqueous solution, called lime water (prepared in Experiments 9 and 10).

Citric acid
Not a hazardous substance
Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts.



DANGER

Copper(II) sulfate
Harmful if swallowed. – Toxic in contact with skin. – Causes skin irritation. – Causes serious eye irritation.
Wash face, hands and any exposed skin thoroughly after handling. – Do not eat, drink or smoke when using this product. – Wear protective gloves/protective clothing/eye protection/face protection. – Specific treatment (See first aid instructions). – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. – IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or doctor/physician if you feel unwell. Remove/Take off immediately all contaminated clothing. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention. – IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell. Rinse mouth.
Very toxic to aquatic life with long lasting effects.
Avoid release to the environment. Comply with the instructions for disposal on p. 75.

Litmus powder
Not a hazardous substance

Potassium hexacyanoferrate(II)
Not a hazardous substance
Obtain special instructions before use. May be harmful if swallowed. – Harmful to aquatic life with long lasting effects. – May cause slight eye irritation.

WARNING

Sodium carbonate
Harmful if inhaled. – Causes serious eye irritation.
Avoid breathing dust/fume/gas/mist/vapors/spray. – Use only outdoors or in a well-ventilated area. – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. – IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.

Hydrogen peroxide (3% aqueous solution) (Not included)
Do not get in eyes or on skin.

Warning! The following applies to **all** chemicals: **Store locked up. Keep out of reach of children.**
This applies to all children except for the experimenting child who is being instructed and supervised by an adult.

Also follow this precautionary statement:
IF SWALLOWED: Get immediate medical advice/attention and have product container or label of chemical substance at hand.

For the sake of environmental protection:
Dispose of contents/ containers (of no-longer-needed chemicals) to a hazardous waste disposal location.

For information on the protective equipment required, see “Work area and equipment” on p. 10.

1 What is chemistry?

You are probably familiar with tailors, people who work with fabrics. They find, examine, dye, cut, sew, and stitch various fabrics together into all sorts of different styles of clothing. Well, chemists are people who work with the "fabrics" of our world. They explore the properties and transformations of materials. Of course, you know that we're not talking about actual fabrics or clothing materials here, but the stuff out of which everything that exists is composed.

All of these materials are what chemistry, the science of materials and transforming them, is all about. With this kit, you too can perform transformations of materials and chemical reactions like a professional in the laboratory. This kit includes exciting experiments: sudden changes in color, hissing and bubbling gases, and magical physics tricks with water and air. You will learn all about the seven chemical substances contained in the cylindrical vials in the kit. Don't be intimidated by their complicated sounding names, like potassium hexacyanoferrate(II) — by the time you are finished with this kit, you will know them all very well!

The scope of your explorations will by no means be limited to these seven chemicals. No, your experiments integrate materials from your surroundings and your environment as well. Accordingly, the informational boxes "Side Notes" and "Technology and Environment" are provided in addition to the instructions for the experiments in order to broaden your perspective.

One more note on the experiments: Oftentimes, several experiments are collected into an "experiment section" with an explanation at the end of the section. It is often best to do these experiments together in one session.

Chem C1000 is nothing more and nothing less than a key that opens the gate to the world of materials. Of course, to conquer this world, considerable effort as well as a number of special tools are required. For more than a few kids, the explorations undertaken with an experiment kit have led them to study chemistry later on and work in one of the many fields of chemistry.

But even if you end up doing something completely different — participating in some way in the quest for solutions to our environmental problems, for example — it can be useful to have had a peek at the world of materials. It will then be easier for you to form your own scientific opinions and back them up too.

"Oh dear, these aren't the right fabrics for sewing!"

2 Work area and equipment

"Let's conduct some research!"

You should have an appropriate work area for your experiments. Although you can't really wreak too much havoc with this chemistry set, the living room table or a new desktop could get some stains on them. A sturdy old table or workbench are the most suitable. The work surface should be washable and heat-resistant. The kitchen or any place where foods are kept is not a suitable place for chemical experiments. Your work area needs to be brightly lit and freely accessible; it should also be possible to ventilate it well in case it gets stinky. Unneeded objects and flammable materials, especially fabrics, have no business being in the work area. When performing experiments, do not wear a scarf, neckerchiefs, or loose sleeves and if you have long hair, tie it back.

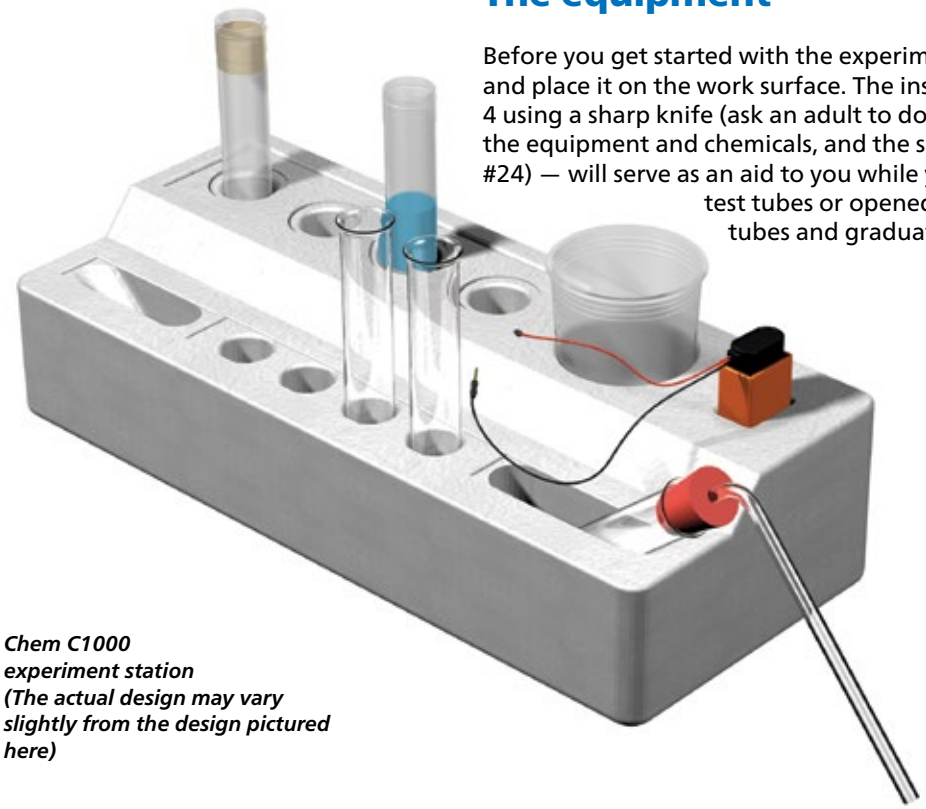
You will need water to perform your experiments and to clean the equipment. A nearby water faucet and drain would of course be ideal. Otherwise, ready a dispensing bottle with water (you can use a carefully cleaned dish-washing liquid bottle for this, for example). Discard reaction products containing copper residues as indicated in Chapter 11. You can pour all other reaction products into the drain with plenty of water. Or you can toss the waste into a small plastic jug half-filled with water labeled "chemical waste" that you empty and clean right after the experiments. To immediately wipe up spilled liquids, use a rag. After using it, rinse it out thoroughly.

The most important part of your protective equipment is the **safety glasses** (part #1). Make sure the glasses fit snugly and are comfortable to wear by adjusting the lengths of the side pieces. An old smock serves as **protective clothing**, and fingered gloves with a smooth surface are suitable as **protective gloves**. Keep the frequently used additionally required materials in your work area as well (See p. 13 for a list).

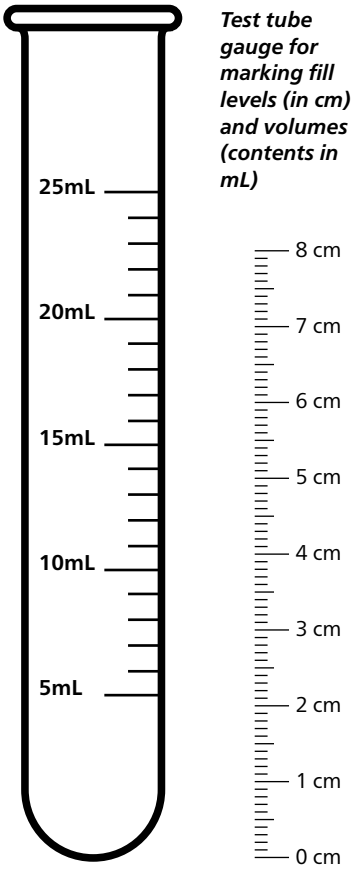
If other people have access to your work area, you will need to put all of the equipment and chemicals away somewhere that they cannot be reached by young children, preferably locked away in a cabinet.

The equipment

Before you get started with the experiments, pull the cardboard insert out of the box and place it on the work surface. The insert can be divided at the place shown on p. 4 using a sharp knife (ask an adult to do that for you). The larger part is used to store the equipment and chemicals, and the smaller part — the **experiment station** (part #24) — will serve as an aid to you while you're working. It is used as a stand for filled test tubes or opened chemical containers or as a holder for test tubes and graduated beakers for various reactions.



Chem C1000 experiment station (The actual design may vary slightly from the design pictured here)



Test tube gauge for marking fill levels (in cm) and volumes (contents in mL)

The most important device when performing chemical experiments is the **test tube** (part #8). It is used to hold liquid or solid substances, particularly to make solutions of solid substances. In some test tube experiments, we indicate the quantity of solid according to the approximate height of the column of solid in the test tube, for example: "effervescent powder up to a height of 3 cm".

To clean the test tubes, use the **test tube brush** (part #9). But don't press too hard or you might break the thin glass. Cleaning is best done under running water. Place the cleaned tubes to drip dry in a clean container (e.g., a screw-top jar, see "Additional materials") with the opening facing downward.

Place filled test tubes into the small holes in the experiment station. The slanted shafts are for holding the test tubes that are set up with a **stopper with hole** (part #10) and **angled tube** (part #23) for certain experiments (more on this in the next section).

You will use the **stopper without hole** (part #11) to seal test tubes in which you dissolve substances in water with a shaking action. When shaking a test tube, always press on the stopper as shown in the illustration.

When shaking a test tube, always press on the stopper with your thumb!

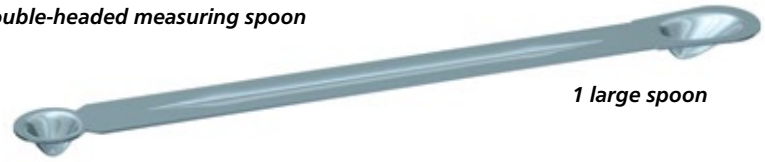
For some experiments, you will need somewhat larger containers: the two **graduated beakers** (part #6) with **lids** (part #7). When performing experiments, a graduated beaker fits securely in the large recess in the experiment station, for example in Experiments 38 and 88. The small compartment to the side is for accommodating the square 9-volt battery. Using the beakers, you can measure 10, 25, 50, 75 and 100 milliliters. One milliliter (abbreviated as mL) is one-thousandth of a liter and corresponds to the cubic centimeter used for solids (abbreviated as cm^3, cube having equal edges of 1 cm). To open a filled and sealed graduated beaker, place it on the table, hold it firmly, take a hold of the tab and pull the lid upward.

The **chemical vials** (parts #13 – 19) have two chambers: a large one for larger quantities and a small one for chemicals of which only a little is needed. The amounts added are as needed and are in line with the safety standards applicable to experiment kits. The uniform size of the vials is a result of the size of the labels, which contain information prescribed by law. The illustration shows how to open the **safety closures** using the **lid opener** (part #21). When opening a vial, sometimes a small amount of the chemical that is stuck to the lid will fall on your hand or on the work surface. This can be prevented by forcefully tapping the vial on the working surface several times before opening it. You can place opened chemical vials into the large recesses in the experiment station, since they easily tip over, which would make a mess and waste material. Once you have removed the amount you need, close the vial immediately. See p. 14 for an explanation of how to open and close the safety closure with **dropper insert** (part #20) of the bottle for the **litmus solution** (part #20).

If you have trouble opening or closing the safety closures, ask an adult for help.

This is how to open the chemical vials using the lid opener.

The double-headed measuring spoon



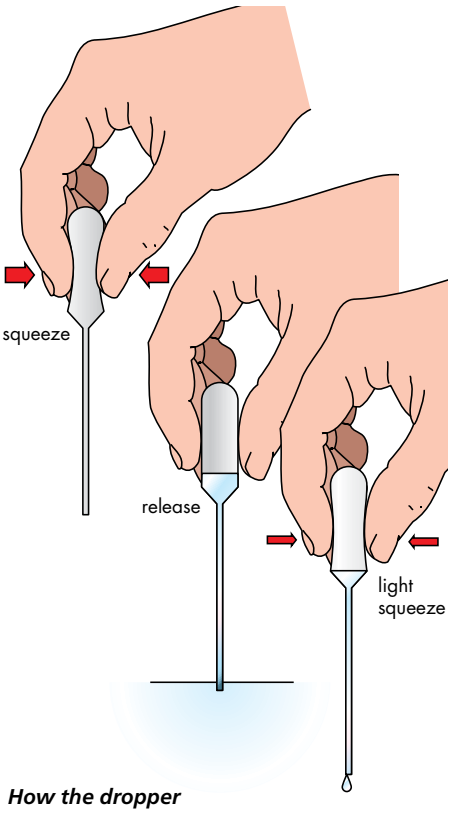
1 large spoon

1 small spoon

To remove the chemicals from the supply bottles, use the **double-headed measuring spoon** (part #22). When the instructions refer to "1 spoonful" or "1 large spoonful," that means one level scoop from the larger end, and "1 small spoonful" means a level scoop from the small end. "1 spoon tip" means about half of the smaller end. You must wash and dry the double-headed measuring spoon after each use, since otherwise you will introduce trace amounts of the chemicals into other vials.

When you want to add liquids drop by drop, use the **dropper pipette** (part #13). The illustration to the left shows how to use it. Squeeze the top bulb of the pipette between your thumb and forefinger and dip the end into the liquid. As soon as you release pressure on the bulb, the liquid rises into the pipe. Then, you can release individual drops one by one by applying gentle pressure on the bulb. After use, clean the pipette by filling it repeatedly with water, shaking, and emptying.

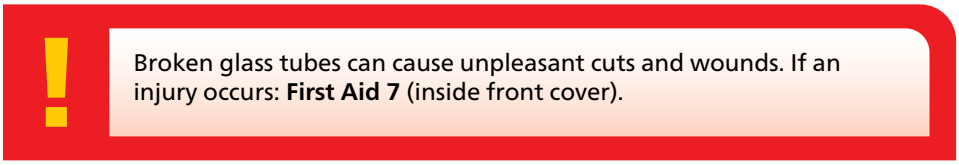
You won't need the **funnel** (part #12) just for filling liquids (e.g., the litmus solution), but above all for filtering. You will learn how that works right off the bat in the first experiment. You will need the filter paper sheets included in your kit. If you run out of filter paper sheets, you can also use round ***white coffee filters*** for this, or you can trim yourself some round filters from ***white filter bags***.



How the dropper pipettes work.

Working with the angled glass tube

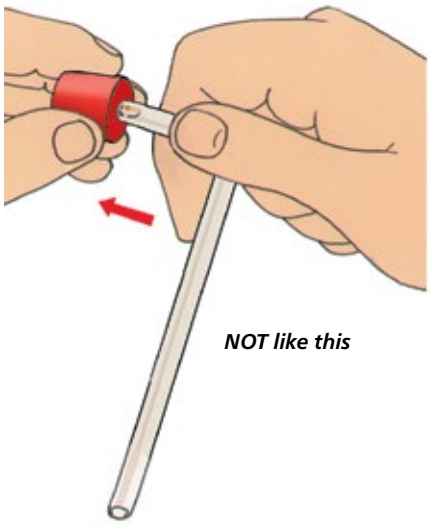
Placing the angled tube into the rubber stopper with hole and removing the tube from the stopper is not as easy as it looks. Ask an adult to help you with it.



First hold the hole in the stopper and the angled tube under running water. Then twist the tube into the hole, preferably back and forth, and do not force it by any means. Hold the angled tube as shown in the illustration. You can give it extra protection by using a thick cloth to hold onto the glass tube.

It is often more difficult to take the angled tube out of the stopper than it is to put it in. To do this, gently pull the glass tube to both sides to form a small gap between the stopper and glass tube so that water can penetrate into it. Do the same thing on the opposite side of the stopper. Hold the glass tube right above the stopper and pull it out of the hole while constantly twisting it back and forth. **It is essential that you follow these instructions!**

The angled tube is not pushed into the stopper (a and b) but twisted in (c). Also, hold the long legs of the angled tube close to the stopper.



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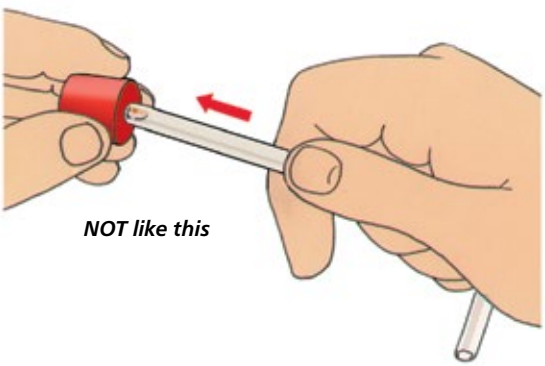

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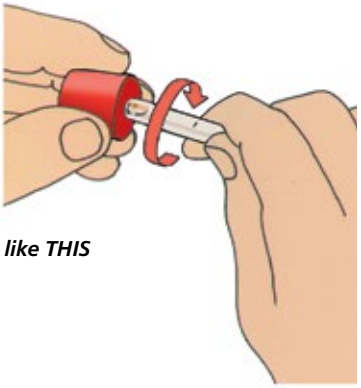

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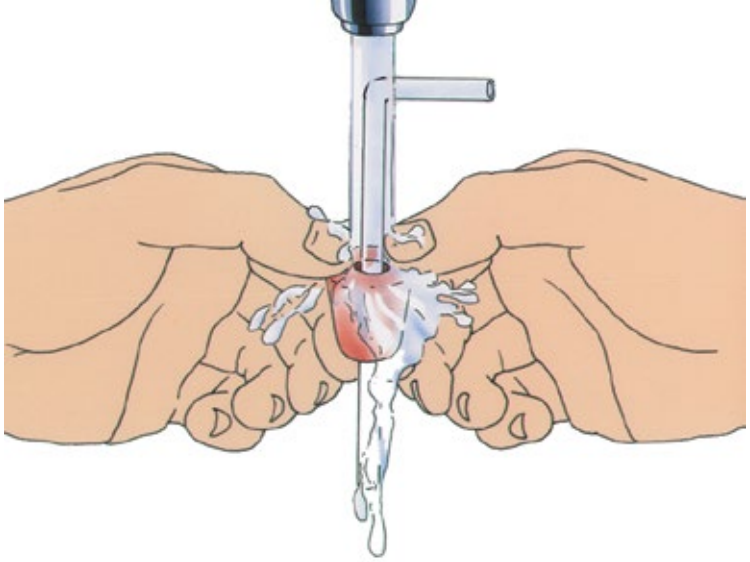


A trick to make it easier to loosen the angled tube in the rubber stopper.

Materials that would otherwise end up in the trash.

Additional materials

Containers that don't cost anything and otherwise end up in the trash:
- Two or three transparent, clean jelly or jam jars with lids (called glass jars with lids in the manual)
- Plastic bowl or container like the ones ice cream or ground beef come in (called basins in the manual)
- Small, clean glass bottles

Items that can be found in the household or easily obtained in the supermarket:
- Aluminum foil, paper towels, tealight candle, coffee filter (round filter or filter bags), cotton pads or balls, matches
- Demineralized (distilled) water, sodium bicarbonate (like Arm & Hammer® baking soda)
- White vinegar (wine vinegar)

From the drug store or pharmacy:
- Hydrogen peroxide (100 mL of 3% aqueous solution)
  This substance is needed starting in Chapter 8 and should be given to the experimenter only as required.

Materials that are only needed in isolated cases (e.g., nails or paperclips), will be listed for the respective experiment.

Cleaning the containers

In chemistry, cleanliness is an essential prerequisite for the success of the experiments, since contaminants can trigger undesired secondary reactions. So make it a habit right from the beginning to carefully clean the used containers when an experiment is completed.

In most cases, cold water and a test tube brush are enough. If that doesn't do the trick, try warm water and a little dish-washing detergent. That will help especially with greasy or oily grime. Then rinse thoroughly!

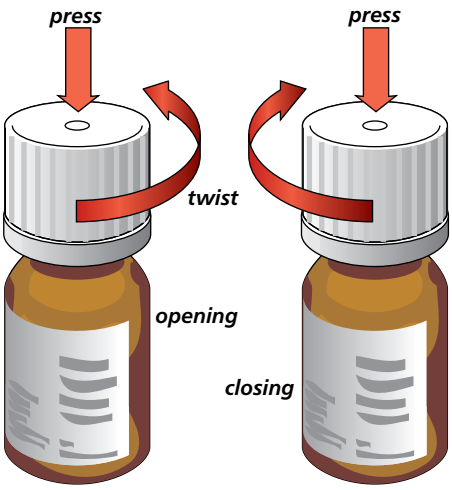
Two tips:
Lime residues — white films after experiments with lime water — disappear after treatment with household vinegar.

Berlin blue (or Prussian blue) softens alkaline detergents. In both cases, rinse well afterward, of course.

3 Magic blue and secret inks

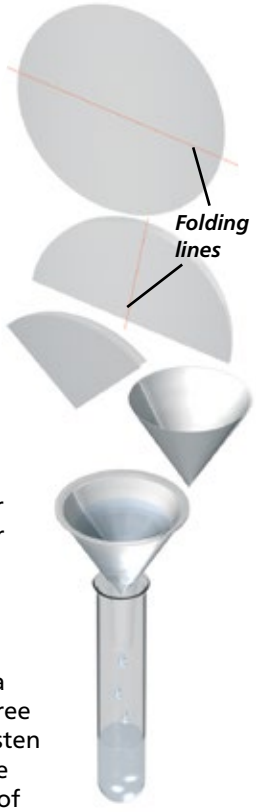
Round filters and filter bags from which you can trim round filters.

The solution prepared from litmus powder is filtered.



How the safety closure of the vial for the litmus solution works. (The actual vial lid may be black.)

For now, the magic blue is still hidden in the chemical vial labeled "Litmus powder." When you open the vial, you will discover a dark, fine-grained substance inside. To perform experiments with it, you will need to prepare a litmus solution, which takes one day. You know: sugar and salt dissolve in water so easily that it seems as if it disappears. It's not quite so easy with the litmus powder. First you need to become acquainted with one of the most important laboratory techniques: **filtering**.



Super-sieves in action

You will need the filter paper sheets from your kit for these experiments. If you run out of filter paper sheets, you can always use white coffee filters for filtering: either the round ones or the larger filter bags out of which you can cut round filters (diameter approx. 10 cm). In the experiments, we will call these filters "filter paper."

EXPERIMENT 01

Additional material: *Sand*

Fold a round filter paper as shown in the illustration. You will end up with a cone consisting of one layer of filter paper on one side and of three layers on the other. Place the filter cone into the funnel and moisten it with a little water. This will help it stick better to the wall of the funnel. In a sealed test tube, shake some sand with about 17 mL of water (remember, keep your thumb on the stopper!) and pour the mixture into the filter cone. The sand remains in the filter and a nearly clear liquid, the filtrate, drips into the test tube below.

What's happening here?

Sand is made of small quartz crystals. The particles are difficult to dissolve or not soluble at all in water and too large to pass through the tiny pores of the filter paper. In contrast, the particles of water and the soluble substances are so small that they overcome the "filter blockade" with no trouble. By using super-fine sieves, you can separate the soluble from the insoluble components of a mixture.

EXPERIMENT 02

Preparing the litmus solution. Place 8 mL of water in a test tube and add 3 small spoonfuls of litmus powder to it (level scoop). Close the tube with the stopper, shake vigorously and allow the closed tube to stand for one day somewhere that is out of the reach of young children.

Now set up the funnel and filter for filtering like in the previous experiment. Place the funnel on the vial provided for the litmus solution and pour the deep-blue mixture into the filter. You can dispose of the insoluble leftovers in the trash. If denatured alcohol (careful, fire hazard!) is available, an adult should add a half pipette of it to the vial.

Litmus is a plant product with a limited shelf life. The denatured alcohol acts as a preservative.

DANGER

Denatured alcohol: Highly flammable liquid and vapor. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. – Keep container tightly closed.

Now place the safety closure with dropper insert onto the vial and close it (by turning the closure clockwise). The illustration on the previous page shows how to close and open the safety closure by turning and pressing it at the same time.

When refilling (recommended due to the limited shelf life), the dripper insert must first be removed. Have an adult help you with this if necessary. Okay, now the litmus solution is ready to use.

Question 1. The safety closures are designed to prevent small children from opening the vials. What features make this a safety closure, and why?*

Blue here, red there

EXPERIMENT 03

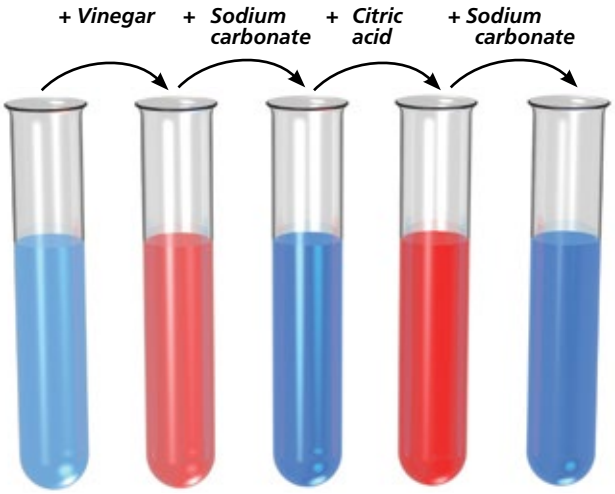
Additional material: *White vinegar (wine vinegar)*
To a test tube with 8 mL of water, add 3 drops of litmus solution. The solution is light blue. Pour a little vinegar into a test tube and drip it into the litmus solution using a pipette. The first drops already cause the color to turn bright red. You will need this solution for the next experiment.

Regarding Experiments 4 – 8:

For **sodium carbonate** and **citric acid**, note the "Hazardous substances and mixtures" information on pp. 7 – 8.

EXPERIMENT 04

Add a spoon tip of sodium carbonate to the red solution from the previous experiment. Rock the tube gently back and forth: The solution turns blue again, this time a bit darker than the aqueous (watery) solution in Experiment 3. Don't throw this solution away, either!



Blue here, red there

Side Notes

The optical brightener of the Netherlands

Litmus is a mixture of plant materials that is obtained above all from lichens such as Roccella montagnei shown below. The Dutch once used the dye for "bluing" their laundry. The blue covers the yellow tint in textiles and thus produces the "whitest of whites." Today, the "optical brighteners" contained in detergents — products of chemical ingenuity — do the trick.

The name comes from the Netherlands, too: lakmoes, a Dutch word whose origin linguists are not completely in agreement about. There is pretty much a consensus about the second syllable, moes, meaning puree, pulp, mush. Whereas some think that lak means paint (hence "colored pulp"), others say that hidden in lak is the Old Dutch word lêken, meaning to drip. Both interpretations are consistent with the preparation process. The lichens were ground with water between millstones into a colored pulp that was allowed to ferment and drain. The dried deep-blue mass was then ground into powder.

The lichen Roccella montagnei, from which litmus powder is obtained (photo: Prof. Dr. V. Wirth, Karlsruhe).

Pressed litmus (© and photo: chemie-master.de)

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