EXPERIMENT MANUAL

Version 2.0

CHEM C1000

THAMES & KOSMOS

WARNING: Only for use by children over 10 years old. Not suitable for children under 10 years. To be used solely under the strict supervision of adults who have studied the precautions given in the experimental set. Contains some chemicals which are classified as safety hazards. 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 mouth and eyes. Keep young children and pets away from experiments. Store the chemistry set out of reach of young children. Eye protection for supervising adults is not included.

CHEMISTRY SET

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

CHEM C1000 contains the following parts:

No.	Description	Item no.
1	Protective goggles	052297
2	Two dropper pipettes	232134
3	Clip for 9-volt battery	042106
4	Safety cap with dropper insert for litmus bottle	704092
5	Copper wire	703059
6	Two large graduated beakers	087077
7	Two lids for graduated beakers	087087
8	Four test tubes	062118
9	Test tube brush	000036
10	Rubber stopper with hole	071028
11	Rubber stopper without hole	071078
12	Funnel	086228
13	Sodium carbonate	033412
14	Potassium hexacyanoferrate(II)	033422
15	Calcium hydroxide	033432
16	Ammonium iron(III) sulfate	033442
17	Copper(II) sulfate	033242
18	Citric acid	032132
19	Litmus powder	771500
20	Small bottle for litmus solution	771501
21	Lid opener	070177
22	Double-headed measuring spoon	035017
23	Angled tube	065378
24	Experiment station (part of the polystyrene insert)	709812
25	Filter paper sheets (not pictured)	080156

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.

CAUTION! Some parts of this kit have pointed or sharp corners or edges due to their function. There is a risk of injury! We reserve the right to make technical changes.

Save the packaging and instructions, since they contain important information.

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

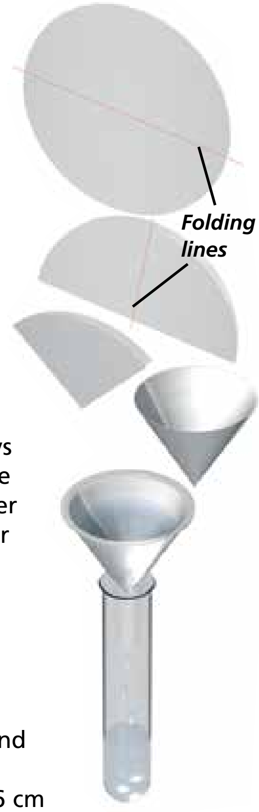
How can individual parts be reordered?
Contact Thames & Kosmos at 800-587-2872 or visit our website at www.thamesandkosmos.com to inquire about an order.

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

3 Magic blue and secret inks

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

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 lasts 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. 9 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 6 cm 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.

The solution prepared from litmus powder is filtered.

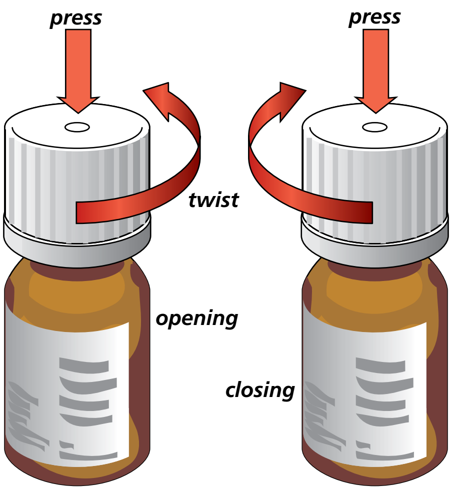
What's happening here?

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 3 cm 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.



How the safety closure of the vial for the litmus solution works.

Mysteriously appearing blue ring

And finally, a not-so-simple but very impressive experiment.

> **!** For **ammonium iron(III) sulfate** and potassium hexacyanoferrate(II), note the warnings in "Hazardous substances and mixtures" on pp. 7 – 8.

EXPERIMENT 33 Place a square or round filter paper (approx. 7 – 8 cm sides or diameter) onto a sufficiently large screw-top lid turned over. Place 1 drop of ammonium iron(III) sulfate solution (1 spoon tip in 2 cm of water) into the middle of the filter paper. Now allow the spot to grow to 5 – 6 cm diameter by adding saline solution drop by drop. Wait until the saline solution is fully absorbed. Then, in the middle of the spot, place 1 drop of sodium carbonate solution (1 small spoonful in 2 cm of water) and then 1 drop of the potassium hexacyanoferrate(II) solution prepared according to the tip on p. 19. Wait again until the solutions have soaked in. Now add saline solution again drop by drop to the starting point. After the second or third drop, a deep-blue, jagged ring suddenly appears — something like in the illustration.

A reaction on filter paper: Berlin blue ring

What's happening here?

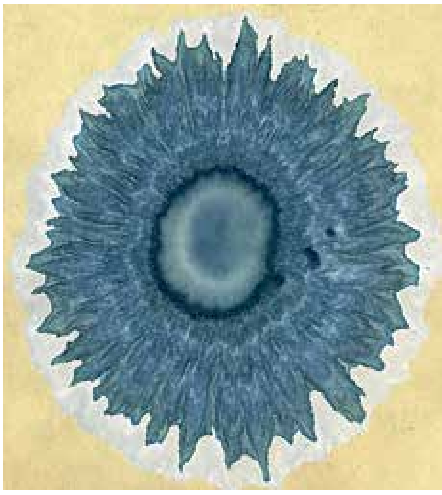
You already know how Berlin blue is formed; and you also know that Berlin blue is broken down by sodium carbonate solution (Experiment 16). While the majority of the ammonium iron(III) sulfate is transported by the saline solution to the "outskirts" of the paper, the rest remaining in the center would produce a distinct blue coloration. That is prevented by the sodium carbonate. Through the addition of saline solution again, the potassium hexacyanoferrate(II) also travels to the outskirts — even farther than the sodium carbonate, in fact. In the area where there is no longer a noteworthy amount of sodium carbonate, there is nothing left to stop the formation of the Berlin blue.

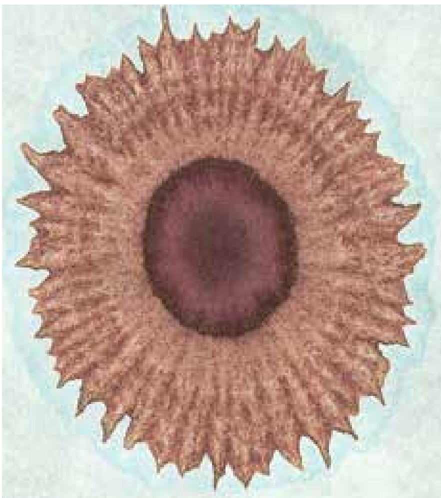
> **?** **Question 10.** This experiment requires a little flair and patience. Sometimes parts of the blue ring fade again, especially if more water or saline solution is dripped on. Why do you think that is?

Side Notes

Pattern images for painters and fabric designers

In the experiments in this chapter, the interplay of colors and shapes has been emphasized, while the physical and chemical processes took a back seat for now. In so doing, you are tracing the footsteps of a man who took a similar approach. The chemist F. F. Runge (1794 – 1867) experimented with dyes and color reactions on filter paper and so became the father of paper chromatography — a technique that only became an integral part of chemical practices much later, during World War II (1939 – 1945). Runge published a book about his "self-grown pictures." He wanted to give drawers, painters, and fabric designers inspiration for their work.

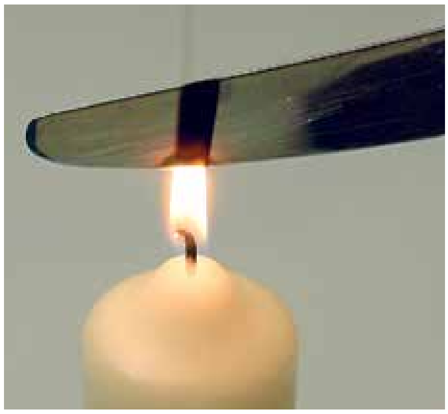




Produced according to the original formula of Friedlieb Ferdinand Runge, the inventor of this painting technique.

What's happening here?

Experiments 58 – 60 confirm it: carbon dioxide is "heavier" than air. Take another look at the table with the weights per liter on p. 42. Carbon dioxide therefore sinks to the bottom of containers, displacing the lighter air and thus displacing the air component oxygen, which is responsible for maintaining fires. If the oxygen is used up (Experiment 40) or displaced by carbon dioxide (Experiment 60), the candle goes out. This latter fact explains why carbon dioxide is suitable as an extinguishing agent. In Experiment 60, you spread out a little "carpet of CO_2" on the surface of the tealight candle which robbed the flame of the oxygen it needed to keep burning.



When the candle flame is cooled off by the knife blade, carbon dioxide is precipitated in the form of soot.

Burning — from a chemist's perspective

When a candle burns, it becomes smaller. Where does the burnt candle mass go, anyway? It doesn't disintegrate into nothing. It breaks down into combustion products, which you will study more closely now.

! For Experiments 61 – 64, use a **tealight candle on a fireproof base**, for example on a plate.

EXPERIMENT 61

Additional material: *Knife*
Place the tealight candle on an old plate, light it, and hold the bare knife blade a few millimeters over the wick in the flame. Black soot forms.

EXPERIMENT 62

Hold a screw-top jar over the tealight candle flame as shown in the illustration. Put the lid on the jar while it's still upside down and stand it right side up. Open the jar, add enough lime water so that the bottom is covered, close the jar again, and shake it. The clearly visible cloudiness indicates carbon dioxide.

Combustion gases of the tealight candle are trapped.

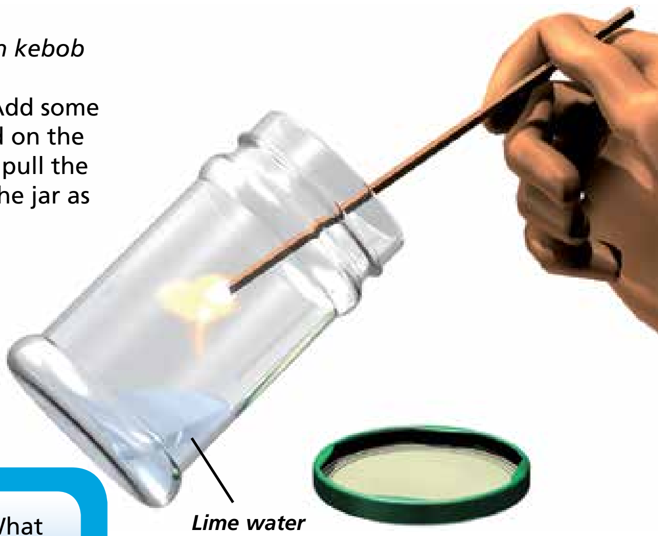
? **Question 18.** How did the "heavy" carbon dioxide get into the screw-top jar?

EXPERIMENT 63

Additional material: *Small sticks of wood or shish kebob skewers*
For this experiment, you will need an assistant. Add some lime water again to the rinsed-out screw-top jar. Light a small stick of wood on the tealight candle and hold the burning stick for 5 – 6 seconds in the jar. Then pull the stick out, carefully give it to your assistant so they can put it out and close the jar as quickly as possible. Shake! Now observe the familiar cloudiness.

EXPERIMENT 64

Additional material: *Stick lighter*
Repeat Experiment 62 by holding the flame of the lighter under the jar instead of the candle. Check the combustion gases for carbon dioxide using lime water.



Carbon dioxide is produced when wood burns, too.

? **Question 19.** Let's assume that you've run out of lime water. What could you use to check for carbon dioxide in Experiments 62 – 64?