IGNITION SERIES

CHEM C100 TEST LAB

Instructions

Warning! — This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Only for use by children 8 years of age and older. Use only under careful supervision of adults who have familiarized themselves with the kit's written safety precautions.

Caution! — Contains some chemicals categorized as hazardous to health. Read the instructions before use, follow them, and keep them on hand for reference.

Individual parts may have sharp points, corners, or edges. Do not injure yourself!
Never bring the chemicals into contact with any part of your body, especially mouth and eyes.
Keep small children and animals away from the experiments.
Store the kit out of the reach of small children.
Eye protection for adults not included.

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2nd English Edition © 2013 Thames & Kosmos, LLC, Providence, RI

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Distributed in North America by Thames & Kosmos, LLC. Providence, RI 02903
Phone: 800-587-2872; Email: support@thamesandkosmos.com

Printed in Germany / Imprimé en Allemagne

THAMES & KOSMOS

Contents

Goggles
Pipette
2 Measuring cups, 30 ml
2 Measuring cup lids
2 Test tubes
2 Stoppers for test tubes
2 Measuring spoon (with two heads)
pH Test strips
Die-cut cardboard sheet

Additional Items

You will need these 16 test substances:

- salt
- white flour
- rice
- granulated sugar
- baking soda
- baking powder
- white laundry detergent powder
- coffee powder
- cocoa powder
- finely ground white pepper
- washing soda (sodium carbonate, from the supermarket)
- flavored sugar such as vanilla sugar (you can make your own by adding a drop of flavor extract to a few tablespoons of sugar)
- tea leaves (from a tea bag)
- borax (from the supermarket)
- citric acid (or instant lemonade powder containing mostly citric acid)
- glucose tablets (dextrose, from the drugstore)

You will also need a tea light candle, paper towels, paper plates, and glass jars.

Instructions for Using the Safety Goggles (Item No. 052279)

Use: The safety goggles are only to be used with the experiment kit. Any other type of application is not permitted. Wear the goggles in such a way that the eye area is protected. If necessary, adjust the elastic band to the child's head circumference. The safety goggles can be used with contact lenses. Wearers of corrective eyeglasses need special safety goggles for people who wear glasses.

Duration of Use: Always wear the safety goggles when performing your experiments. Not intended for long-term use. The duration of wear should not exceed the time of the experiment.

Storage: Store safety goggles at room temperature in a dry room. After the experiment, return them to their place in the kit box, to keep them from being scratched.

Cleaning: Do not clean the safety goggles when they are dry. Rinse them with clean water and, if necessary, with a mild household liquid detergent, and dry them with a soft cloth.

Maintenance: In case of defective safety goggles or scratched lenses, exchange them for an equivalently constructed pair.

Inspection: Check the safety goggles to make sure they are in good condition, and replace them if they are damaged.

Warning: Some extremely sensitive individuals may experience an allergic reaction after skin contact with some materials under some circumstances.

Replacement: These safety goggles are available as a replacement part.

The safety goggles are tested per EC guideline 89/686/EWG (personal protective equipment) and EN 166, as well as EC guideline 88/378/EWG and EN 71-4. Test center per EC guideline 89/686/EWG and EN 166 Certification Center 0196: DIN CERTO, Westliche 56, Pforzheim, Germany. Test center per EC guideline 88/378/EWG and EN 71-4 Certification Center 0197: TÜV Rheinland Product Safety GmbH, Am Grauen Stein, Köln, Germany

Advice for Parents and Adults

This experiment kit is intended for children over 8 years of age. Select the experiments that you think are appropriate for your child. Before starting, please read through these instructions, the safety rules, and the first aid information, follow them, and keep them on hand for reference. The incorrect use of chemicals can lead to injury or other health risks. Only carry out experiments that are described in the instruction manual. The area around your work place should be kept free of all obstructions, and it should be sufficiently far from food storage areas. It should be well lit and well ventilated, and equipped with a water tap. There should be a solid table with a rugged, fire-resistant surface that you can wipe off. During all experiments, the safety glasses should be worn to protect the eyes.

Rule for Safe Experimentation

1. Read the experiment manual before starting the experiments, follow its instructions and keep it on hand for ready reference.
2. Thoroughly prepare your work area. Clear off the table and make sure that all the things you will need are ready.
3. Only perform the experiments described in this manual. If safety precautions are mentioned, be sure to follow them.
4. Always wear the safety glasses when performing the experiments. If something gets into your eye by mistake, such as a squirt of citric acid solution, rinse your eye thoroughly with water. Let an adult help you.
5. When you are done, cleaned all the equipment that you used and always leave your work area clean. Any leftover solid substances can be thrown into the garbage, and liquids can be rinsed down the drain with plenty of water.
6. Any investigated foods must be disposed of afterwards.
7. Do not eat or drink while performing experiments.
8. Provide necessary fire protection when experimenting with candles. Set the candle on a fireproof base. Never leave burning candles unattended, and extinguish them after the experiment.
9. If you spill anything, wipe it up immediately with a paper towel.
10. When performing experiments, wear old clothes that you don't mind getting dirty.
11. Wash your hands thoroughly after completing your experiments.

General First Aid Information

In case of contact with eyes and in case of injury: Rinse the affected area with plenty of water and in case of injury always seek medical help. In case of swallowing: Rinse mouth with water and drink fresh water. Do not induce vomiting. Seek medical help without delay. In case of inhalation of dust: Bring the individual into fresh air.

Experiments

When a scientist finds an unidentified substance, he or she uses precise examinations and chemical tests to determine the composition of the unknown substance. This process is called **chemical analysis.**

In this kit, you will use simple tools to investigate a whole range of common household substances. You will use a few different chemical investigation methods, along with your eyes and nose. Of course, you are not allowed to use your tongue, since some of the materials might be harmful to your health. Now, let's get started.

01 Experiment

Using Your Eyes and Nose

As a chemistry detective, you should try to get to know as many different substances as possible from your environment — particularly the common chemicals found around the house.

You will need: measuring spoon, 16 small name cards, paper, 16 test substances from the Additional Items section on the Contents panel

Take one sample of each substance with the measuring spoon and place the samples on a piece of paper. You will have to crush up the glucose tablet into a powder. Ideally, lay your sheet of samples on a rigid piece of cardboard or a tray to support it.

Set the matching name card next to each sample. Conduct a visual inspection. Carefully observe and sniff each sample.

Why?:

Many substances from the kitchen have very different appearances. With some white powders, you can see that they are made of very small crystals, while you see no crystals in baking soda, glucose powder, or powdered sugar. Rice comes in little grains. Flavored sugar, laundry detergent, coffee, cocoa, and ground pepper have a particularly noticeable aroma. Observe the appearance and aroma of each substance. That alone will be enough to identify pepper, tea, coffee, cocoa, and rice.

02 Experiment

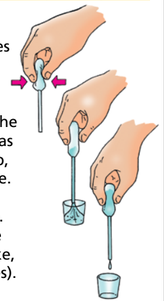
Into the Water

It's a little harder to tell the white substances apart. In such cases, a chemistry detective first investigates whether the substance dissolves in water.

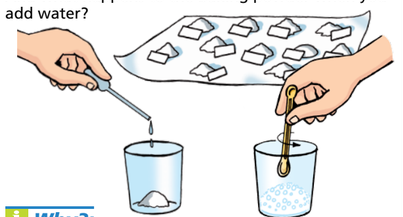
You will need: measuring cup, measuring spoon, pipette, table salt, flour, baking soda, citric acid, sugar, glucose powder, borax, baking powder, flavored sugar, washing soda, laundry detergent

How to Use the Pipette

You will use the dropper pipettes to add liquids drop by drop. Squeeze the upper part of the pipette with your thumb and index finger and dip the tip of the pipette into the liquid. As soon as you release pressure on the bulb, the liquid will rise up the pipette. Then, with a light squeeze, you can add the liquid drop by drop. After each use, rinse the pipette thoroughly (fill with water, shake, and squeeze empty several times).



Place a small measuring spoonful of table salt in the measuring cup, add two pipettes of warm water, and stir with the measuring spoon. Wait a few minutes to see if the salt dissolves. Thoroughly rinse the measuring cup and repeat the experiment with each of the other substances. What can you determine? What does the laundry detergent do? And what happens to the baking powder when you add water?



Why?:

All of the materials here except flour dissolve in water. In the process, baking powder forms gas bubbles and laundry detergent forms foam. You can use this as a simple test to tell flour, baking powder, and laundry powder apart from the other white substances.

03 Experiment

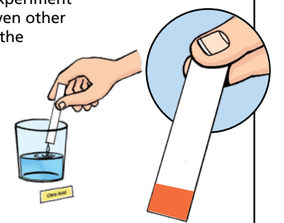
Sour or Not?

As you know, vinegar tastes sour — chemists call it an **acid**. Citric acid is also a kind of acid. On the other hand, there are other substances that are, in a manner of speaking, the counterparts or opposites of acids. They are called **bases**. Chemists are able to determine the level of acidity of a solution (its so-called pH value) without having to use their tongues. That's what the strips of paper are for. They are called pH indicator strips, and they will change color to reveal the acidity of a solution.

You will need: 2 measuring cups, pipette, measuring spoon, pH indicator strips, citric acid, table salt, granulated sugar, flavored sugar, washing soda, baking soda, borax, glucose

In one measuring cup, dissolve a spoonful of citric acid in water. Fill the other cup with only water. Cut each pH indicator strip into four pieces. Briefly dip a piece into each liquid. Compare the colors to the pH color scale on the other side of this instruction sheet. Repeat the experiment with each of the seven other substances listed in the materials above.

When working with acids and bases, it is very important to wear safety goggles.



Tip:

Keep the pH indicator strips in their sealed bag until you are ready to use one, because even the moisture in the air can alter the indicator strip's color slightly. The indicator strip can also stain your fingers, so wash them thoroughly after experimentation. Put the used strips on a piece of scrap paper so they don't stain your work surface.

Why?:

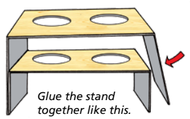
You can use the test strips to determine the degree of acidity of a solution, and thereby differentiate citric acid, borax, and washing soda from the other white powders.

04 Experiment

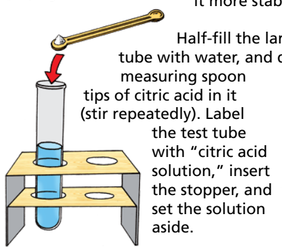
Gas Factory

Many substances will react chemically with others, which means that they undergo changes. This can also be used as an identifying feature. Chemists are familiar with many such **reagents**. Citric acid, for example, can be used as a reagent.

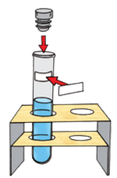
You will need: measuring spoon, die-cut sheet, large test tube, measuring cup, pipette, pH strips, citric acid, baking soda, washing soda, baking powder, borax, table salt, granulated sugar



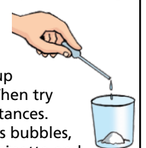
Assemble the test tube stand using the parts from the die-cut cardboard sheet. Taping the stand to your work surface makes it more stable.



Half-fill the large test tube with water, and dissolve ten measuring spoon tips of citric acid in it (stir repeatedly). Label the test tube with "citric acid solution," insert the stopper, and set the solution aside.



Add a spoon tip of baking soda to a measuring cup, and use the pipette to add a few drops of the citric acid solution to it. It will fizz up vigorously with little gas bubbles. Then try the same thing with the other substances. Which ones fizz up and produce gas bubbles, and which don't? Finally, rinse the pipette and other tools thoroughly with water.



Why?:

When combined with citric acid, baking soda and washing soda create the gas carbon dioxide — the same gas found in sparkling water. That helps you differentiate them from other white substances. Baking powder also exhibits this same foaming behavior, but water alone is enough to trigger it, since baking powder is a mixture of baking soda and a solid acidic substance. Borax does not react with the citric acid solution.

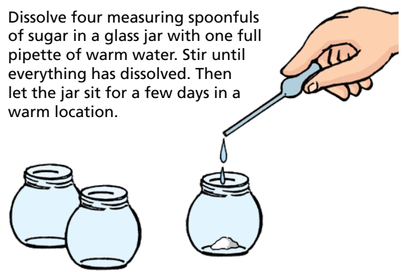
05 Experiment

Pretty Crystals

When a substance dissolves in water, it seems to disappear. In reality, it has just gone into hiding, and it will reappear when the water evaporates. Sometimes when that happens, the substance forms beautiful crystalline shapes, which you can also use to identify the substance.

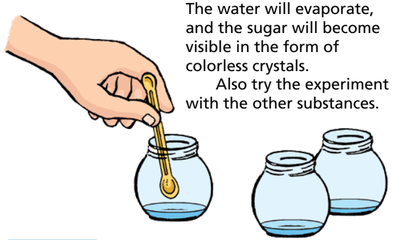
You will need: pipette, measuring spoon, 3 old glass jars, sugar, glucose, table salt

Dissolve four measuring spoonfuls of sugar in a glass jar with one full pipette of warm water. Stir until everything has dissolved. Then let the jar sit for a few days in a warm location.



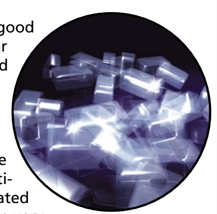
The water will evaporate, and the sugar will become visible in the form of colorless crystals.

Also try the experiment with the other substances.



Why?:

Not all substances form good crystals: granulated sugar and, of course, powdered sugar form fine spikes, and table salt forms tiny cubes. Glucose, on the other hand, just forms a whitish glop. You can use this as a way to differentiate glucose from granulated sugar (sucrose), which are very similar in their other properties.



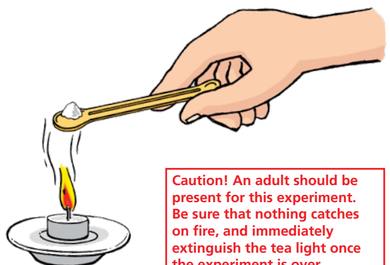
06 Experiment

Heating Things Up

The way a material behaves when heated can also be an important identifying feature.

You will need: measuring spoon, tea light, plate, table salt, glucose, sugar, paper towel

Heat some glucose by putting it in the depression of your measuring spoon and holding it over a tea light flame. How does it change? What do you smell? **Caution — don't burn yourself!** Stop heating as soon as the glucose turns brown. Otherwise it will carbonize and be hard to remove. Finally, rinse the measuring spoon under running water and dry it with a paper towel. Next, see how granulated sugar and table salt behave when heated.



Caution! An adult should be present for this experiment. Be sure that nothing catches on fire, and immediately extinguish the tea light once the experiment is over.

Why?:

When heated, sugar decomposes and forms a brownish caramel, recognizable by its color and its characteristic smell (just like caramel candy). Table salt, on the other hand, withstands the heat of the flame without changing at all. It would need a much higher degree of heat for a chemical reaction. You can use this to distinguish sugar from salt.

By now you have gotten to know a few methods of chemical analysis and the characteristics of some common substances. Now you will demonstrate your knowledge by analyzing a substance without knowing beforehand what it is.

07 Experiment

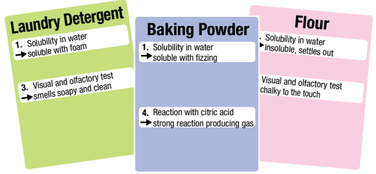
Test with the Help of the Cards

Using what you learned in the previous experiments, you are now ready to try an actual chemical analysis. Let's start by analyzing a chemical in a trial situation in which we know the chemical we are analyzing: sugar.

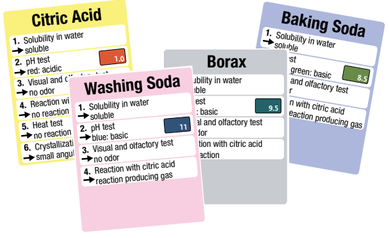
First write the word "sample" on a piece of paper, tape it to a clean test tube, and fill it a quarter of the way with granular sugar. It is on this sample that you will try out the tests, one after the other in sequence. The cards from the die-cut sheet will help you to identify an unknown white substance.

You will need: 11 chemical ID cards, test tube, measuring spoon, 2 measuring cups, pipette, pH indicator strips, citric acid solution, sugar, tea light, plate

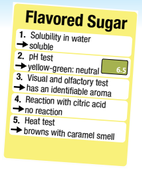
Test 1
First check whether a spoon tip of the sample will dissolve in water. Since it dissolves with ease and does not produce a foaming or fizzing reaction, then it cannot be laundry powder, flour, or baking powder. Eliminate these cards. Save the solution.



Test 2
Test the solution's pH. Since it is neural, eliminate the citric acid, washing soda, baking soda, and borax cards.



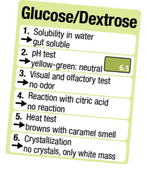
Test 3
Smell the sample. If it does not smell like anything, you can also rule out the flavored sugar.



Test 4
Add one spoon tip of the sample to a measuring cup and use the pipette to drip some citric acid solution onto it. Since it doesn't foam up, this serves as a safety check. It really can't be baking soda, baking powder, or washing soda.

Test 5
Now only salt, glucose, and granulated sugar are left. Heat a spoon tip of the sample over the tea light flame. It turns brown and smells of caramel. So it's sugar, and you can put away the salt card.

Test 6
Let the solution from Test 1 evaporate. This will take a few days. Small, clear crystals form. So it can't be glucose, which does not form crystals. Only the granulated sugar card is left — and that's what our sample is!



Some tests produce no useful reaction, so this information has been left off the chemical ID cards.

Why?:

Using this series of tests, you ruled out possibilities until you determined the identity of the sample chemical. With these tests (you may not have to carry out all of them) and the chemical ID cards, you can identify every substance from the list.

08 Experiment

Time to Get Serious

Now try an actual chemical analysis in which you don't know the chemical from the beginning. For example, you could ask your mother or father to pick one substance from your list, put it into your test tube "sample" container, and give it to you — without letting you know what it is, of course.

You will need: chemical ID cards, test tube with unknown sample, measuring spoon, measuring cup, pipette, pH indicator strips, citric acid solution, tea light, plate

Here's how:

First examine the unknown substance with your eyes and nose, as in Experiment 1. If it's a white substance, carry out the various tests with the help of the cards as in the last experiment, until only one card is left. Then you've done it, and you can call yourself a chemistry detective.

pH Color Chart

From the color of the pH indicator paper, you can find the pH of a solution. It ranges from red (a solution with a pH of 1 is an acid) to yellow-green (a solution with a pH of 7 is neutral) to blue (a solution with a pH of 11 is a base).

Tip:

The indicator paper can be neutralized after use and reused. Dip the red strips into a basic solution (for example, the baking soda solution) and dip the green and blue strips into an acidic solution (for example, the citric acid solution). The paper will turn yellow again and can again be used.