EXPERIMENT MANUAL

IGNITION SERIES

GLOBAL WATER QUALITY

THAMES & KOSMOS

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.

Table of Contents

Kit Contents:

Item	Qty.	Item No.
Die-cut sheet	1	711 139
Sand	200 g	373 130
Round paper filters (3 large, 3 small)	6	702 842
Water filter column	1	772 874
Large measuring cup	1	708 166
Small measuring cup with lid	3	061 150

Item	Qty.	Item No.
Drinking straw	1	000 414
Cress seeds	1	532 122
Pipette	1	232 134
Balloon	1	701 060
Indicator paper strips	5	773 700
Spatula	1	000 239

Information for Parents and Adults

Dear Parents and Supervising Adults,
With this experiment kit, your children will soon be performing exciting experiments. Please assist your young researchers, because a child's curiosity and comprehension are often better developed than their manual dexterity.

Rules for Safe Experiments

1. Thoroughly read the manual and prepare all of the materials ahead of time.
2. Prepare your workplace and protect the work table with newspaper or a washable surface.
3. Perform the experiments following the instructions in the manual, recording your observations. When safety advice is provided, take note of it.
4. Keep small children and animals away from the experiment area.
5. Do not eat or drink while experimenting.
6. Wear old or casual clothes while experimenting, and wipe up any spilled substances right away.
7. Use only containers and equipment from the kit, or ones which have been recommended for use in the experiments.
8. If you are experimenting with foods, first transfer the required quantity into a container and dispose of it after use.
9. Finish by cleaning all equipment, and always leave your workplace clean. Finally, wash your hands thoroughly.
10. Dispose of used filter or indicator paper and residues from the filter column in the household trash.
11. Never drink filtered water, even if it looks clean! Dispose of it after the experiment!

CAUTION!
Not suitable for children under 3 years of age. There is a risk of suffocation due to the possibility of inhaling or swallowing small parts.

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

Notes on the Balloon
CAUTION! Children under 8 years of age can choke on uninflated or popped balloons. Adult supervision is required. Keep uninflated balloons away from children. Popped balloons should be removed without delay. Use a pump for inflating. Manufactured from natural rubber.

Assembling the Water Filter Tower

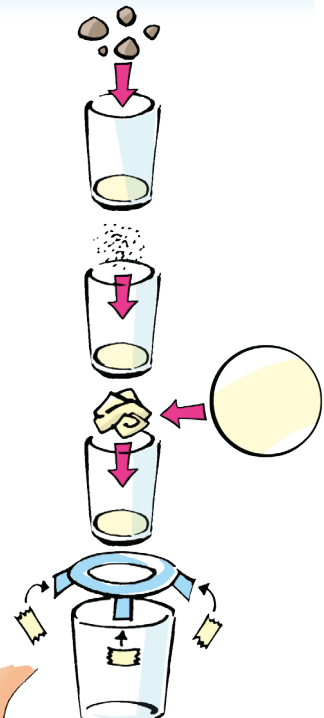
Your experiments will start with a war against dirty water.

Be sure that there is a round piece of filter paper at the bottom of each section of the filter column.

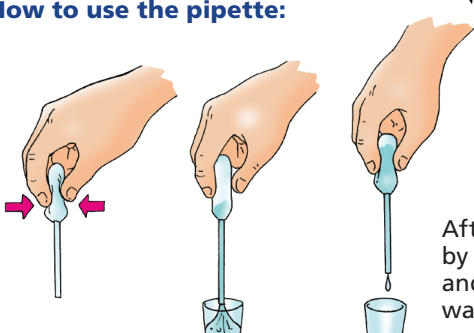
Collect some small pebbles from outside.

Fill the first section of the column with the small pebbles that you collected, the second section with sand, and the third section with a wadded-up piece of filter paper. Insert them one above the other in the order shown. Fit the cardboard holder from the die-cut sheet over the collecting cup, and insert the filter tower into its opening.

Your water filter unit is now ready for use!



How to use the pipette:



After use, rinse the pipette by filling it with clean water and squeezing out the water two or three times.

EXPERIMENT 1
Make clean water from a dirty concoction

How can filthy water be made clean again?

You will need: water-filter column, small measuring cup, spatula, *as well as: teaspoon, dirt, water (not included)*

❶ Prepare some dirty water. In the small cup, mix water and one teaspoon of dirt. Stir vigorously.

❷ Pour the dirty water into the top cup of the filter column.

❸ The water that comes out the other end is a lot cleaner than the brown broth that you poured in.

Take a look at the three filter layers!
What do you see? Write down your observations.

MY OBSERVATIONS:

Explanation:

The water is cleaned as it passes through the filters. Just like a large wastewater treatment plant, your equipment has several cleaning stages. The little rocks filter out large impurities, while the sand and paper filter hold back finer materials.

More Tests!

Repeat Experiment 1 with different kinds of filters. Which filters work the best, and which don't work well?

	FILTER QUALITY	
	good	bad
Paper Towel		
Potting Soil		
Sawdust		
Paper		
.		
.		
.		

Tip: Instead of the round filter paper, you can use an ordinary coffee filter.

EXPERIMENT 2
Not everything can be filtered

What happens when you filter watercolor paint or ink?

You will need: water-filter system, small measuring cup, *as well as: ink, watercolor paint mixed in water (not included)*

1. In a small cup, mix water with a few drops of ink or some watercolor paint.
2. Pour the colored mixture into the filter column.
3. Study the water in the collecting cup. What do you see?

MY OBSERVATIONS:

Explanation:

The colored water flows quickly through the filter system. But its cleaning power is very poor: The water in the collecting cup is still the same color as before.

Dirty water consists of more than just impurities that you can see with your naked eye. It can also contain microscopic particles.

Particularly dangerous particles are bacteria, which can cause diseases, and toxins. These kinds of impurities cannot be filtered out by your water filter. Other cleaning processes are needed to turn dirty water into clean drinking water.

More Tests!

Repeat Experiment 2 with different filters. Try seeing what other filters might work for colored liquids!

You will need: water-filter system, filter paper, *as well as: freezer bag, rolling pin or hammer, activated charcoal tablets*

Tip: Activated Charcoal

You may have some charcoal tablets from the drug store or activated charcoal granules from an aquarium store.

Ask your parents to help you with this experiment.

Dear Parents,

Even though activated charcoal is not dangerous, it is advisable for you to provide assistance to the child who will be performing this experiment. Only give your child the required amount, and keep the rest of the package locked away so it doesn't get into the hands or mouths of young children or pets.

Please take note of the information provided by the manufacturer.

❶ Put two activated charcoal tablets in a freezer bag, close the bag well, and bang carefully on the tablets until they have been broken into large pieces.

Be careful not to turn them into powder!

❷ Make a little cone out of the round filter paper, and place the cone in the third column section. Pour the activated charcoal pieces into the cone.

3 Fill the other filter column sections with sand and small rocks as before.

4 Pour a small cup of colored liquid through the filter.

Explanation:

Activated charcoal provides a very effective cleaning. The charcoal binds to the dyes and removes them from the water. Activated charcoal is very porous and crumbly, so it has a very large surface area for the dyes to stick to.

Tip: If you have more than one filter system, you can assemble their various filter sections into one gigantic tower with all kinds of different filters.

DID YOU KNOW?

How Water Purification Works

Modern water purification plants work with mechanical, biological, and chemical processes applied in sequence. In other words, they are designed to have three stages. The dirty water is first sieved with a so-called screen, which holds back large impurities such as branches, dead animals, leaves, rocks, or empty bottles. Then the dirty water flows into a settling basin. There, heavy particles such as sand and broken glass can sink to the bottom. Next, the water is directed into an aeration basin. This is where bacteria get into the act. They produce an organic slime that can be used as fertilizer. In addition, the dirty water is chemically treated in order to bind pollutants to other materials that can then be filtered out.

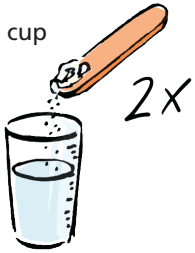
EXPERIMENT 3 Dissolving in water

In the last experiment, you were able to see how solid plant particles can be filtered out of water. The example with the colored water showed you that it can be a lot harder to remove something from the water if it has become completely dissolved.

What will actually happen if you add salt to water?

You will need: large and small measuring cups or a glass, spatula, *as well as: table salt (not included)*

❶ Fill the large measuring cup halfway with warm water. Add two full spatulas of salt. Watch what happens to the salt.



Next, stir with the spatula. What do you see now?

❷ Transfer some of the liquid to the small measuring cup and set it in a warm spot, such as the window ledge, for a few days. What happens?

Explanation:

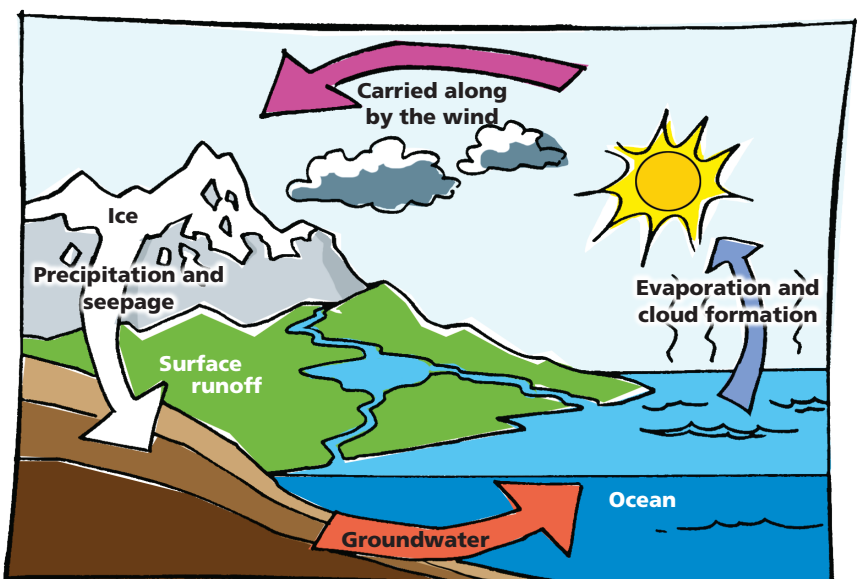
At first, you can easily see the grains of salt in the water. When you stir, they seem to disappear, as the salt dissolves in the water. But it's still there! After a few days, the water evaporates and you can once again see the salt as little crystals on the bottom of the cup.

More Tests!

	dissolves well	only dissolves after stirring	doesn't dissolve
Flour			
Oil			

Water Cycle

Earth's water is always in motion. Large quantities run in warm or cold streams through the oceans — not just on the surface, but at the bottom of the ocean as well. In addition, the sun's heat evaporates huge quantities of ocean water, especially in warmer regions. The rising water vapor cools off as it reaches higher layers of air, where it forms clouds consisting of fine water droplets or ice crystals. The wind then moves these clouds around. Sooner or later, it starts to rain — sometimes over the ocean, sometimes over dry land. On land, the water forms rivulets, rivers, and seas, it wets the ground, it forms groundwater, and it eventually flows back into the ocean, thus completing the water cycle.



EXPERIMENT 4 Why rain isn't salty

If rain is created from evaporated seawater, then why isn't it salty?

You will need: small measuring cup washed clean,
as well as: plastic bowl, plastic wrap, tape, stone, paper towels, table salt, red fruit juice (not included)

1. Fill the plastic bowl with some water and a few teaspoons of salt. Add a little red fruit juice. Wad up a few paper towels and line the bottom of the bowl with them. They will become completely saturated with liquid.

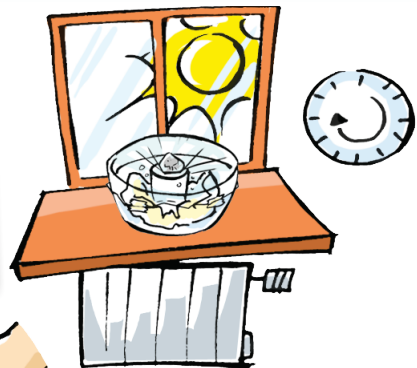
2. Set the clean, empty measuring cup right in the middle of the bowl, positioned between the wet wads of paper towel so it can't fall over.

3. Stretch plastic wrap over the bowl and secure it to the outside with tape.

Place a large stone or other weight right in the center of the plastic wrap above the cup, so the plastic wrap is pressed down a little right above the cup.

4 Set the bowl in the sun or on a warm heater for a few days.

Tip: If you tap carefully on the stone, the drops collected on the plastic wrap will fall into the cup.



5 Remove the plastic wrap and carefully taste a drop of the water that has collected in the measuring cup.

Does it taste salty? And is it still colored?

Explanation:

The sun's heat makes water evaporate from the bowl, leaving the salt behind. The water vapor turns back into liquid water on the plastic wrap, and then trickles into the cup. This is similar to the way that large quantities of drinking water are being obtained from the ocean in many regions today, sometimes with the use of solar energy.

EXPERIMENT 5 — SOS for the cress

Why does so much effort have to be put into cleaning wastewater?

You will need: cress seeds, 3 small measuring cups, filter paper, pipette, *as well as: table salt, vinegar or lemon juice*

❶ Place a small piece of ripped-off filter paper in each measuring cup, sprinkle a few cress seeds and sand on top, and moisten everything well. To help the seeds sprout faster, set the lid on loosely. Place them in a sunny location and be sure that the seeds always stay moist.

Tip: Water the plants with the pipette, then you can find the correct quantity of water!

❷ After the plants have grown for a few days, sprinkle a pinch of salt into one of the measuring cups. To the next cup, add a few drops of vinegar or lemon juice. And simply stop watering the plants in the third measuring cup. What happens?

Explanation:

The cress plants that were treated with salt or vinegar shrivel or die. Dirty wastewater is just as harmful for animals and plants.

And without water, plants will very quickly dry up. Exceptions to this rule are plants that are of a type that can thrive in dry environments.

Vinegar and lemon juice are both what chemists call acids.

EXPERIMENT 6 Living things and water

The next experiment will show you how important water is for all living things, such as plants and animals.

All plants and animals are made largely of water, and therefore they need water in order to survive. The next experiment will show you just how much water is contained in fruits and vegetables!

You will need: *fruit or vegetable (such as an apple, a cucumber, or a potato), plate, knife, kitchen scale (not included)*

❶ Cut the fruit or vegetable into slices on the plate. Have an adult help you! Weigh the slices on a kitchen scale and note the weight!

❷ Set the plate with the fruit or vegetable slices in the sun or on a warm heater for a few hours. Check their weight!

❸ Let the slices dry for several days, until their appearance stops changing. Weigh them again.

Explanation:

In the heat, the slices shrink and lose weight as the water contained in them evaporates. A potato, for example, contains up to 80% water (over ¾ of the potato is water), and with the cucumber it's over 95% (except for a small portion, it consists completely of water). All living things need water to survive!

	Starting weight	Weight after 5 hours	Weight after 3 days
Pickle			
Apple			
Potato			

EXPERIMENT 7 Measuring pH

As you learned in the previous experiments, water is essential to the life of all animals and plants, and when it is polluted, it can do us a lot of harm. You can take a measurement, called a pH measurement, to determine if water is overly acidic or basic, and therefore harmful to plants and people.

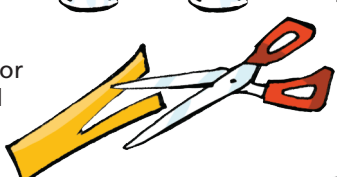
The pH value is an indication of how acidic or basic (alkaline) a substance is. A base or alkali is the opposite of an acid.

You will need: indicator paper, pipette, 3 small measuring cups, *as well as: water, scissors, vinegar or lemon juice, paper towel*

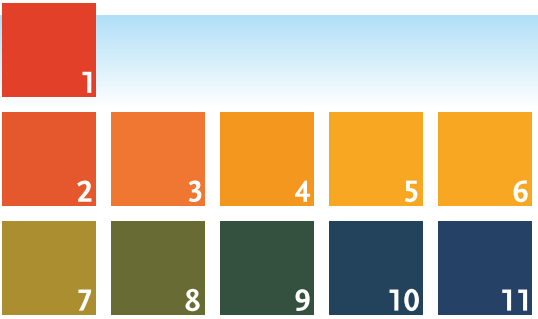
❶ In one cup, mix a few drops of vinegar and one pipette of water.

Mix lemon juice and water in the second cup, and to the third cup, just add water.

❷ Cut the indicator paper in half, and then lengthwise down the center.



❸ Briefly dip the slices of paper into the liquid and set them down on the paper towel. Compare the color against the pH color scale. You will also find a table with the color scale on the die-cut sheet.



pH Color Scale

You can read the pH value of the solution by the color of the indicator paper. It extends from red (acidic) through yellowish green (neutral) to blue (basic).

Explanation:

You can use the pH indicator paper to determine the degree of acidity of a liquid. Acidic liquids are red, neutral ones (meaning that they are neither acidic nor basic) are yellowish green, and basic liquids, which are the opposites of acids, are blue.

Tip: Put unused indicator paper back in the bag, because it can become discolored by water particles in the air.

More Tests!

Determine the pH value of other liquids!

Lemon Juice	about 2
Cola	2 – 3
Vinegar	2 – 3
Milk	6 – 7
Sour Milk	4
Rainwater	5 – 6
Aquarium Water	
Tap Water	
Water from a Pond	
Saltwater	

EXPERIMENT 8 Sparkling water sparkles

It's the gas known as carbon dioxide that gives sparkling water its sparkle.

You will be producing this gas from vinegar and baking soda — a household ingredient that is used for baking. The experiment will also show you that the gas dissolves in water.

You will need: balloon, drinking straw, *as well as: 2 empty, thin-sided plastic water bottles with caps, vinegar, baking soda (in the supermarket baking section), teaspoon*

❶ Fill the first plastic bottle about a quarter of the way with vinegar, and the second bottle about a third of the way with cold water.

Vinegar Water

❷ Using a spoon, carefully put about 2 to 3 teaspoons of baking soda into the balloon. The measurement does not need to be exact.

❸ Pull the balloon opening tight over the neck of the first bottle, but be sure to let the body of the balloon hang down to the side so that no baking soda falls into the bottle yet.

Vinegar

4 Lift up on the balloon so that all the baking soda falls into the bottle. It will react with the vinegar and produce a lot of carbon dioxide gas, which will inflate the balloon. Shake the bottle a little to help the reaction along.

5 Carefully remove the balloon, being sure not to let the gas escape. With the help of the straw, force the gas into the second bottle so that it collects on top of the water. Remove the balloon and quickly twist the cap onto the bottle. Shake the bottle vigorously for a few seconds. What happens?

6 You can pour the liquid down the drain. Rinse the sink with water afterwards.

Explanation:

There is a lot of carbon dioxide chemically bonded in the baking soda powder. An acid, in this case vinegar, releases it.

When the carbon dioxide is transferred into the bottle with the water, it pushes out the air from inside the bottle. After you shake it, a portion of the carbon dioxide has disappeared. It has dissolved in the water to form carbonic acid. That means that there is some gas missing in the bottle, which collapses in on itself.

Unfortunately, this gas, which we humans produce in large quantities every day, also dissolves in the world's oceans, where it turns into carbonic acid and harms ocean creatures such as coral and shellfish.

More Tests!

Now test the pH value of the water!

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