

THE SMITHSONIAN INSTITUTION FACT SHEET

The Smithsonian Institution is a museum, education and research complex of 17 museums and galleries, and the National Zoological Park. Fifteen museums and galleries are located in Washington, D.C., two are in New York City, and the National Zoo is in Washington. Ten of the museums and galleries are situated on the National Mall between the U.S. Capitol and Washington Monument.

One of the world's leading scientific research centers, the Institution has facilities in eight states and the Republic of Panama. Research projects in the arts, history, and science are carried out by the Smithsonian all over the world.

The new National Museum of the American Indian is scheduled to open on the National Mall in 2002. The centerpiece of the museum is the priceless collection of Native American artifacts transferred to the Smithsonian from the Museum of the American Indian, Heye Foundation (New York). The New York exhibition facility - the Heye Center of the National Museum of the American Indian opened October 30, 1994 in lower Manhattan.

Another new museum, the National Postal Museum, is located near Union Station on Capitol Hill. Devoted to the history of the U.S. mail service, the museum houses the world's largest and most comprehensive collection of its kind, with more than 16 million stamps, covers, and artifacts.

HISTORY

James Smithson (1765-1829), a British scientist, drew up his will in 1826 naming his nephew, Henry James Hungerford, as beneficiary. Smithson stipulated that should the nephew die without heirs (as he did in 1835), the estate would go to the United States to found "at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge..."

On July 1, 1836, Congress accepted the legacy bequeathed to the nation by James Smithson and pledged the faith of the United States to the charitable trust. In 1838, following approval of the bequest by the British courts, the United States received Smithson's estate - bags of gold sovereigns - then the equivalent of \$515,169. Eight years later, on August 10, 1846, an Act of Congress signed by President James K. Polk, established the Smithsonian Institution in its present form and provided for the administration of the trust, independent of the government itself, by a Board of Regents and Secretary of the Smithsonian.

SMITHSONIAN MUSEUMS, GALLERIES AND ZOOS

Anacostia Museum	National Museum of the American Indian
Arthur M. Sackler Gallery	National Museum of Natural History
Arts and Industries Building	National Portrait Gallery
Cooper-Hewitt, National Design Museum	National Postal Museum
Freer Gallery of Art	National Zoological Park
Hirshhorn Museum and Sculpture Garden	Renwick Gallery
National Air and Space Museum	S. Dillon Ripley Center
National Museum of African Art	Smithsonian American Art Museum
National Museum of American History	Smithsonian Institution Building ("Castle")



ITEM #1142
AGES 8 & up

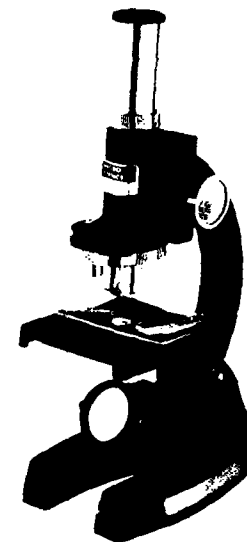
WARNING:

Only for use by children over 8 years old. Only for use under the supervision of an adult. Do not eat the stained material.

CAUTION!

Read the instructions before use, follow them and keep them for reference. Keep small children and animals away from experiments. Store the microscope set out of reach of small children. Eye protection for supervising adults is not included.

SMITHSONIAN 900x Microscope



DEAR CUSTOMER,

NSI is the manufacturer of this kit. If we made an error and left something out of this set, or if something is damaged, we are sorry and wish to correct our error. Please do not return the set to the store where you purchased it, or to the Smithsonian, as they do not have replacement parts. Instead, write us a letter giving us:

1. Date of Purchase
2. Where Purchased
3. Model Number
4. Name of Set
5. Brief Description of Problem
6. Sales Slip

We will do our best to satisfy you.

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Components of a Microscope

1. Stage - The flat surface where slides are positioned for viewing.

2. Clips - Metal tabs to secure the slide to the stage.

3. Objective lenses - Lenses in the rotating turret of your microscope close to the object being magnified. These lenses are responsible for most of the microscope's magnification.

4. Eyepiece - Sometimes called the ocular, the eyepiece contains one or more lenses that are responsible for focusing the image magnified by the objective lens on the retina of the eye.

5. Focus control - A knob that moves the eyepiece and objective lenses up and down to obtain a clear view of the object being observed.

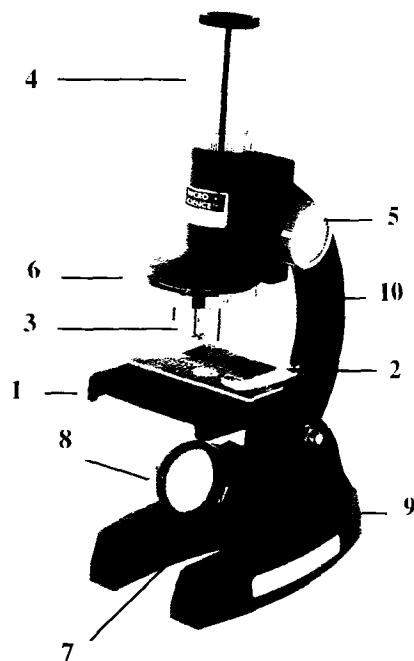
6. Revolving turret - A disk that holds the objective lenses; turning the disk changes the lens being used.

7. Light source - A small light bulb that provides illumination of the object.

8. Mirror - Reflects light directly onto the slide.

9. Base - This portion of the microscope is weighted for stability. It contains the power source.

10. Arm - This supports the eyepiece and revolving turret.



It is also useful to make temporary or permanent slides for later comparison. Make slides for each object and label accurately for later use.

Here are some suggestions to get you started:

Leaves - Tear or cut off tiny pieces of plants from outdoors, such as grass, clover, leaves from trees, and other greenery. Compare the shapes of the cells, the organization, and the objects inside each type of cell.

Hair - Lay a hair (pulled out by the root) onto the glass. Observe the thickness, the shape, and the texture. Compare human hair to dog or cat hair.

Pollen - Shake or rub a little pollen from a flower (this is often yellow or brown) onto the slide. Pollen comes in unique shapes that can identify the species of the plant.

Fibers - Compare threads from clothing to fibers from a rug. Be sure to include both synthetic and natural fibers in your comparison.

Insect parts - Observe insect legs, wings, etc.

Paper - Tear a small corner from a newspaper and a magazine and compare.

Cream of tartar - Do not add water. You should see two different kinds of crystals in this kitchen product.

Seeds (poppy, sesame) - Note the difference in size, shape, and texture of different kinds of seeds.

Celery - Have an adult cut a very thin slice from a stalk of celery and observe the bundles of fibers.

There are many books available on using microscopes. Check the science section of your library or bookstore for more ideas.

Booklet text written and compiled by Marilyn R. London, MA and David A. Jackson, PhD

BATTERY SAFETY INFORMATION

- Non-rechargeable batteries are not to be recharged.
- Rechargeable batteries are to be removed from the toy before being charged.
- Rechargeable batteries are only to be charged under adult supervision.
- Different types of batteries or new and used batteries are not to be mixed.
- Only batteries of the same or equivalent type as recommended are to be used.
- Batteries are to be inserted with the correct polarity.
- Exhausted batteries are to be removed from the toy.
- The supply terminals are not to be short-circuited.
- Keep packaging for reference since it contains important information.

Obtain a small amount of Epsom salts about the size of a large pea. Place this in a clean collection vial or small bowl. Add hot water, about 10 to 15 drops, and stir with a stirring rod or toothpick until the Epsom salts dissolves.

With your pipette, draw off (suck up into the tube of the pipette) some of the clear solution and deliver this solution (squeeze it out of the pipette) onto a clean microscope slide in the amount of a droplet about one half inch in diameter.

Insert the slide under the objective in your Microscope and as the solution evaporates (it may take a while), the new crystals will start to form on the microscope slide. When the crystals start to form you may observe them getting bigger ("growing").

To enhance the visual picture of this crystallization process, you may add a very small amount of food coloring. However, the more dye you add the longer the crystallization process will take.

Observe and compare the shape of the Epsom salts crystals to the other crystals which you have viewed with your Microscope, such as the salt crystals and the aspirin crystals.

Experiment 5 Living Specimens viewed

If you have a pond available locally and can collect some water from it, or if you can produce your own supply of microorganisms by placing some grass and a few pinches of soil into a glass jar 1/2 filled with rain water, you can observe the many small creatures which live in the natural world

After allowing the pond water or prepared grass/soil water to remain undisturbed for a day or so, extract a pipette full of the liquid and deliver a droplet of this liquid on a slide. Observe with your Microscope what creatures or algae you have captured.

Try adding a very small droplet of different food colors to different slides for a greater visual effect and a greater viewing contrast with your Microscope.

Other Suggestions

Once you become familiar with your microscope, you will think of hundreds of objects to investigate with it. Although there are some objects for which you will not need prepared slides, most materials require some preparation. Use the hatchery and petri dish included in this kit to col-

Contents:

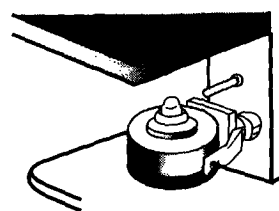
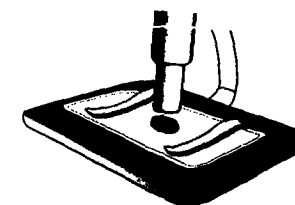
- Databank Card
- 12 Blank Plastic Slides
- 4 Plastic Collecting Vials
- 12 Blank Labels
- 12 Slide Covers
- Magnifier
- Petri Dish
- Hatchery
- Spare Bulb
- Stirring Rod
- Screw Driver
- 2 Pipettes

Instructions for Use

The microscope requires power (2 AA batteries) for the light source. Insert the batteries into the base of the microscope (see diagram). Familiarize yourself with the parts of the microscope and their functions so that you will be able to use the equipment efficiently.

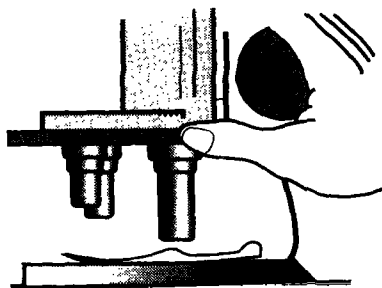


1. Place the slide onto the stage and secure it with the clip(s).



2. Make sure the light is shining directly through the slide. If flipped over, then the mirror reflects the light from the room or the sun.

3. Choose the magnification strength desired by turning the turret until you hear a click. Start with the lowest magnification, and increase the power only if you cannot see enough detail in the object.



4. Gently turn the focus control until the image is clear.

How a Microscope Works

Modern compound microscopes use two or more lenses to magnify objects. Most of the magnifying power comes from the objective lens in the rotating turret close to the specimen and light source. Using the bright light from the microscope lamp or mirror, this lens projects an image of the specimen onto the lens or lenses in the eyepiece. These lenses usually provide some magnifying power, but their purpose is to focus the magnified image onto your eye while letting you keep it a comfortable distance from the microscope.

Find and collect as many color bearing natural specimens as you can, such as flower petals, thin slices of beets, carrots, colored leaves, purple onion skin, and red cabbage leaves.

You may first wish to test these thinly sliced specimens by themselves on the microscope slide, or you may try and "extract" the color from the samples.

To "extract" the colors from natural materials you will usually have to crush the material in a solvent. You may use water, hot water, or you may need to use isopropyl alcohol (obtained from your pharmacy or from your bathroom medicine cabinet).

Place the solvent (usually the alcohol) in a collecting vial or a shallow dish, and add the chopped up plant material to be extracted. Crush and stir with a stirring rod or toothpick until the color is seen in the solvent or alcohol.

Using the pipette, draw some of the colored solution into the tip (tube) and deliver it (squeeze it out) on to a clean microscope slide in the amount of a droplet about one half inch in diameter.

Place the slide onto the stage of your Microscope, and carefully add a drop of the vinegar while watching for a color change. Alternatively then add one drop of baking soda solution to the slide and look for a color change again.

All of your drops of vinegar or baking soda solution will need to be done very carefully so that you do not spill liquid off of your microscope slide. Be ready to dry the Microscope slide and stage with tissue or paper towels in case of a spill. Be careful and be neat.

Experiment 4 Growing other crystals

Just as you were able to grow aspirin crystals in previous experiments, there are other crystals which you can grow on a slide to view with your Microscope.

One of these is Epsom salts crystals. Epsom salts contains the chemical magnesium sulfate which has interesting crystal shapes and which will crystallize easily from solution. You can obtain Epsom salts at your local pharmacy or grocery. Epsom salts is a chemical which, when dissolved in water, produces a soothing solution for sore feet (foot bath).

If an aspirin tablet is placed in alcohol, the starch settles out and the acetyl salicylic acid dissolves. If the alcohol is drawn off by use of a pipette and placed on a slide, the alcohol evaporates and the aspirin crystals will form rapidly.

You can perform this experiment by obtaining some isopropyl alcohol (rubbing alcohol) from your pharmacy or medicine cabinet, and pouring about a teaspoon of it into a small dish or one of your collecting vials, and then adding an aspirin tablet to the alcohol. You may crush the aspirin tablet with a stirring rod or a toothpick, stirring it around to help the aspirin dissolve in the alcohol.

When the non-dissolving starch has settled to the bottom of the solution, you need to draw up some of the clear alcohol of this mixture into your pipette and then deliver it (squeeze it out) from the pipette onto a clean microscope slide. You need only a droplet about a half-inch in diameter.

As the alcohol evaporates, the aspirin (acetyl salicylic acid) crystals will form on the microscope slide, and you can observe their formation.

To visually enhance the process of this crystal formation, you may wish to add a very small amount of any food coloring to the droplet on the slide. Do not add too much dye, since it will slow down the evaporation of the alcohol and cause the crystals to form much more slowly.

Experiment 3 Chemical reactions observed

Although your Microscope is not powerful enough to magnify atoms and molecules (you would need an Electron Microscope for this!), you can see the results of chemical reactions with your Microscope.

For this experiment you will need some isopropyl alcohol, some kitchen vinegar (white vinegar is best) and a solution of baking soda (make by dissolving baking soda in water).

It is often possible to change the colors of many natural occurring plants and flowers chemically with an acid (the vinegar) or a base, also called alkali (the baking soda solution).

You can observe this color change with your Microscope as it happens.

History

The purpose of a microscope is to magnify extremely small objects, which cannot be seen by the naked eye. Before the microscope, early scientists had already used magnifiers made of glass, and even glass globes filled with water, to enlarge the image of small objects. During the 1500s, a single lens version of the scientific tool called the microscope was invented, and some time around the beginning of the 1600s, two lens (compound) microscopes similar to the microscopes used today began appearing. These microscopes not only magnified more strongly than the single lens kind, but provided clearer images and larger fields of view as well.

In 1655 Robert Hooke published *Micrographia*, a series of microscopic observations on a wide variety of objects ranging from chalk to insects and molds. When Hooke examined thin slices of cork with his microscope, he saw that the cork was made of network of chambers like a honeycomb, and he called the chambers "cells." We now know that in the living cork oak tree, these chambers contain the cork tree's cells, and call these fundamental living units "cells" in honor of Hooke.

Anton van Leeuwenhoek was a cloth merchant and amateur scientist who lived in the 17th and 18th centuries in the Netherlands and he also described objects he saw through a microscope. He noticed tiny objects moving around under his lens and, realizing that they were alive, gave them the name "animalcules." Today we recognize that Leeuwenhoek was actually observing the one-celled living things we know as bacteria and protozoans, as well as microscopic many-celled organisms such as rotifers.

Although the quality of microscopes continued to improve, it wasn't until the middle of the 19th century that the next real advances in the microscopic examination of living things occurred. Robert Koch, Louis Pasteur, and others found ways to dye bacteria and other cells in order to see them more clearly. These techniques allowed scientists to distinguish between harmless and disease-causing bacteria, and for the first time to begin seeing how cells themselves were put together.

Although the use of stains was a powerful tool for investigating the structure of cells, in many cases the staining process killed or distorted the cells under examination. In the first half of the 20th century, the introduction of more sophisticated lens and lighting systems permitted scientists to observe the structures of intact living cells. Today computer assisted laser scanning and laser confocal microscopes allow even more detailed investigation of living cells than can be achieved with ordinary light microscopes.

Today, the highest magnification images are obtained with microscopes that use electrons - not light - to resolve objects. These techniques range from scanning and transmission electron microscopy - which are commonly used by biologists to examine small organisms and parts of cells - to scanning tunneling electron microscopy, which can visualize single molecules and atoms.

To prepare a temporary slide, follow these steps:

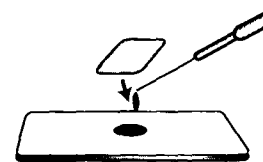
- A. Make sure the glass slide and cover glass are clean.
- B. Prepare your sample by brushing it clean. If the material is thick, you will not be able to see it in the microscope, because the light source has to illuminate the material from below. Have a supervising adult, cut a thin slice of the material to make a slide.
- C. Pick up the sample with the tweezers and lay it in the center of the glass slide.
- D. Add a drop of water to the sample.
- E. Using the tweezers, gently place the cover glass over the sample and press it down to remove air bubbles.
- F. Remove any excess water by blotting the slide with a tissue or other absorbent material.

Permanent slides require the use of a fixative such as a clear adhesive instead of the water.

Experiments

Experiment 1 Observing crystal shapes

You can observe the shapes of crystals from various chemicals with your Microscope.



Common table salt (sodium chloride) is a good specimen to start with.

Using a blank slide, moisten it with just enough water to be able to hold in place a few salt crystals so that they do not fall off of the slide. Focus the Microscope on the crystals on the slide and observe the shape of the crystals. You should see them as perfect "cubes," just like small building blocks! This particular shape is the actual structure into which sodium chloride crystallizes. Other types of chemicals, which form crystals, will possess their own particular geometric crystalline shapes. The study of these crystal shapes is called *Crystallography*.

To enhance the observation of these different crystals, you may use just a very small amount of blue food coloring, being careful to dry off the excess dye with a tissue or paper towel, so that the crystal shapes are now highlighted in blue.

Try and find other crystals to look at with your Microscope. Try the same above procedure with cream of tartar or sodium carbonate (baking soda) crystals from your kitchen.

Look at as many crystals as you can find, such as sugar; Epsom salts; bath salts; baking "powder;" driveway de-icing crystals (usually calcium chloride); and kosher salt (pickling salt).

Experiment 2 Observing fast growing crystals

If a solid dissolves in a solvent, like alcohol, which evaporates quickly, crystals of the solid will form in a very short time.

In common aspirin tablets, the active ingredient is acetyl salicylic acid (aspirin). Most of an aspirin tablet contains a non-active ingredient, usually starch. The aspirin tablet is really a mixture of these solids, pressed together to make a tablet.

Starch is NOT soluble in alcohol, but aspirin (acetyl salicylic acid) is soluble in alcohol.