# Space Dust

## Topic

Investigating micrometeorites

## Introduction

The media carry stories about meteorites coming toward the Earth, but the Earth is actually being constantly bombarded with dust and dirt – otherwise known as micrometeorites – from space. These are very small particles with a diameter of 100 microns ( m) or less. When passing through the Earth's atmosphere, friction causes the surface of micrometeorites to heat up, creating their typically rounded, glassy surface. Objects left outside will accumulate a number of micrometeorites; larger numbers will be found at certain times, such as after snow and rain storms, which cause them to fall from the upper layers of the atmosphere. If the surface of an object at a crime scene has collected a number of micrometeorites and you know roughly how many you would expect to find after a certain length of time, you should be able to estimate how long the object has been outside, or to judge that there has been rain or snow. Rain gutters are a good place to look for micrometeorites because roofs provide a large collecting area for dust falling to Earth. In the first part of this experiment, you will isolate and study micrometeorites from a rain gutter. In the second part of the experiment, you will leave a container outside and examine the number of micrometeorites collected at certain times.

## Time required

Part A: 1 hour
Part B: 10 minutes on day 1, 20 minutes on each of several subsequent days

## Materials

3 – 4 teaspoonfuls of debris from rain gutters that can be accessed safely*
small plastic container (about 0.5 liter)
disposable plastic teaspoon
small glass or plastic dish (e.g., 8 cm Petri dish)
strong, disc magnet**
2 plastic freezer bags (about 23 × 17 cm)
2 sheets of 8½ × 11 unlined white paper
illuminated magnifier (see diagram 1 on page 5.07–1), magnifying glass with at least 30× magnification, or microscope
large shallow plastic container (about 1.5 liter)
water

*A teacher or another responsible adult should collect the debris from the gutter and place it in the small plastic container.
**See, for example, http://www.wondermagnets.com/cgi-bin/edatcat/WMSstore.pl?user_action=detail&catalogno=0063

## Safety note

**Wash your hands after handling the debris from the rain gutter.**

## Procedure

*Part A: Observing micrometeorites*

1. Put the debris in the small plastic container and allow it to dry.
2. Tip the contents of the container onto a sheet of paper. Spread them out and crush any large pieces with the spoon to give a collection of particles like those in diagram 1 below.
3. Put the magnet in one of the plastic bags and pass it closely over the debris on the sheet of paper.
4. Hold the magnet with the debris it has collected over a clean sheet of paper. Remove the magnet from the bag and allow the black specks to fall onto the sheet of paper. Alternatively, you can turn the bag inside out to keep the specks safe until later.
5. Inspect the black specks with a strong magnifier or a microscope.
6. Draw some of the specks you see in data table A below.

1

*Dried, crushed debris*

**DATA TABLE A**

*Part B: Estimating how often micrometeorites fall*

1. Pour water into the large plastic container to a depth of about 1 cm.
2. Place the container outside in an open area and leave undisturbed.
3. Return to the container after 24 hours.
4. Place the magnet in the other plastic bag and pass the magnet over the surface of the water.
5. Carefully remove the magnet from inside the bag while turning the bag inside out to trap any specks of debris inside the bag.
6. Take the bag inside. Allow any specks from the bag to fall on to the paper and inspect them with a strong magnifier or a microscope.
7. If you have found any micrometeorites, note the number in data table B below. Check the box in data table B if it rained since you last returned to the container.
8. Return to the container every few days and repeat steps 4 to 7.

**DATA TABLE B**

| | First observation | Second observation | Third observation |
|---|---|---|---|
| Days since container placed in position | | | |
| Rain since last observation? | Yes/No | Yes/No | Yes/No |
| Micrometeorites found this observation | | | |
| Total number of micrometeorites found since container placed in position | | | |

## Analysis

*Part A: Observing micrometeorites*

1. Why do you use the magnet to isolate the micrometeorites?
2. What did the specks look like when you looked at them through a strong magnifying glass or microscope? Did you see rounded or angular shapes?
3. What do you think explains their appearance?

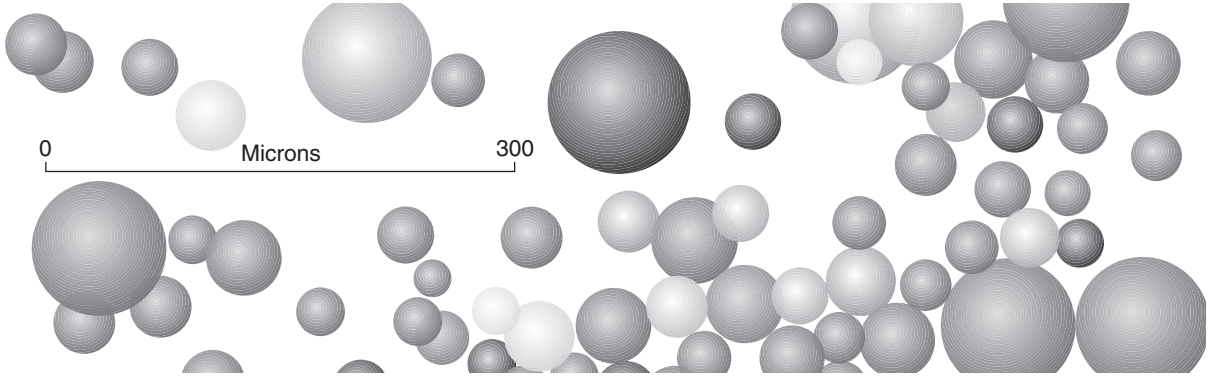
*Part B: Estimating how often micrometeorites fall*

1. Why do you think you put water in the container?
2. Did more micrometeorites appear in the container after precipitation (rain or snow)?

## Want to know more?

*Part A: Observing micrometeorites*

1. Meteorites can consist of metal or stone, or a mixture of both. The metal in meteorites is a mixture of nickel and iron; both of these can be magnetized, making it possible to separate them from a mixture of other materials.
2. The specks should look rounded and glassy (see the diagram below), and may have pits on the surface. Specks with an angular shape are of terrestial origin.
3. The micrometeorites become very hot as they pass through the atmosphere before reaching Earth. The outside has melted and may have been struck by other debris, causing the pitting.




*Appearance of species when magnified.*

*Part B: Estimating how often micrometeorites fall*

1. The water should help to trap any micrometeorites falling into the box.
2. The number of micrometeorites falling into the box should be greater after precipitation, because rain or snow removes particles held in the atmosphere at higher altitudes. If you are studying an object that has been lying outside and you know roughly how many micrometeorites you expect to find on it, you can assume that precipitation has fallen on the object if it yields many more than this number. This information can be useful in solving a crime.

# Special Safety Note To Experimenters

Each experiment includes any special safety precautions that are relevant to that particular project. These do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely essential that you read, copy, and remain mindful of the General Safety Precautions that follow this note. Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Be prepared for unexpected dangers by following basic safety guidelines the entire time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note: The book assumes that you will read the safety precautions that follow, as well as those in the box within each experiment you are preparing to perform, and that you will remember them. Except in rare instances, the general precautions listed below will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say **BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE** does not mean that you should be careless when boiling water or cutting a section of a stem for microscope work. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, wait to perform it until you find out from a qualified adult that it is safe.

**GENERAL SAFETY PRECAUTIONS**

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the individual experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

**PREPARING:**

—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

**PROTECTING YOURSELF:**

—Follow the directions step-by-step; only do one experiment at a time
—Locate exits, fire blanket and extinguisher, gas and electricity shut-offs, eyewash, and first-aid kit
—Make sure there is adequate ventilation
—Act sensibly at all times
—Wear an apron and safety glasses
—Do not wear open shoes, loose clothing, or loose hair
—Keep floor and workspace neat, clean, and dry
—Clean up spills immediately, being careful to follow the recommended procedure for dealing with the spilt substance
—Never eat, drink, or smoke in the laboratory or workspace
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

**USING EQUIPMENT WITH CARE:**

—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs


Published by Facts On File, Inc. 

—Don't use your mouth to pipette liquids; use a suction bulb
—Check glassware is clean and dry before use
—Check glassware for scratches, cracks, and sharp edges
—Report broken glassware immediately so that it can be cleaned up by a responsible person
—Do not use reflected sunlight to illuminate your microscope
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

**USING CHEMICALS AND BIOLOGICAL MATERIALS:**
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear safety glasses, lab apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly
—Use sterile procedures when handling even common and harmless microorganisms
—Avoid contact with human blood
—Treat all living organisms with appropriate respect

**HEATING SUBSTANCES:**
—Wear safety glasses, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Use test tubes, beakers, and other glassware made of Pyrex™ or borosilicate glass
—Use alcohol-filled thermometers (do not used mercury-filled thermometers)
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—If your laboratory does not have heat-proof workbenches, put your Bunsen burner on a heat-proof mat before lighting it
—Take care when lighting your Bunsen burner; use a Bunsen burner lighter in preference to wooden matches
—Turn off hot plates, Bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Keep sheets of paper and other flammable objects away from your Bunsen burner
—Have a fire extinguisher on hand

**FIELDWORK:**
—Be aware of environmental dangers (e.g., do not carry out fieldwork near dangerous roads, cliffs, or water)
—Remember that strong sunlight can be dangerous – pack sunscreen and a good supply of drinking water if you will be outside all day
—Never carry out fieldwork in areas where you cannot find your way to safety easily and quickly and never wander off on your own in search of new areas to study

**FINISHING UP:**
—Clean your work area and glassware (follow any instructions given by a supervising adult)
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residues and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws
—Dispose of all microbiological cultures by treatment with an appropriate disinfectant

**BE SAFETY CONSCIOUS AT ALL TIMES**