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A2.2. Tool Kit: Micrometeorite Toolkit

***WP 2: STAND TOOLKITS**

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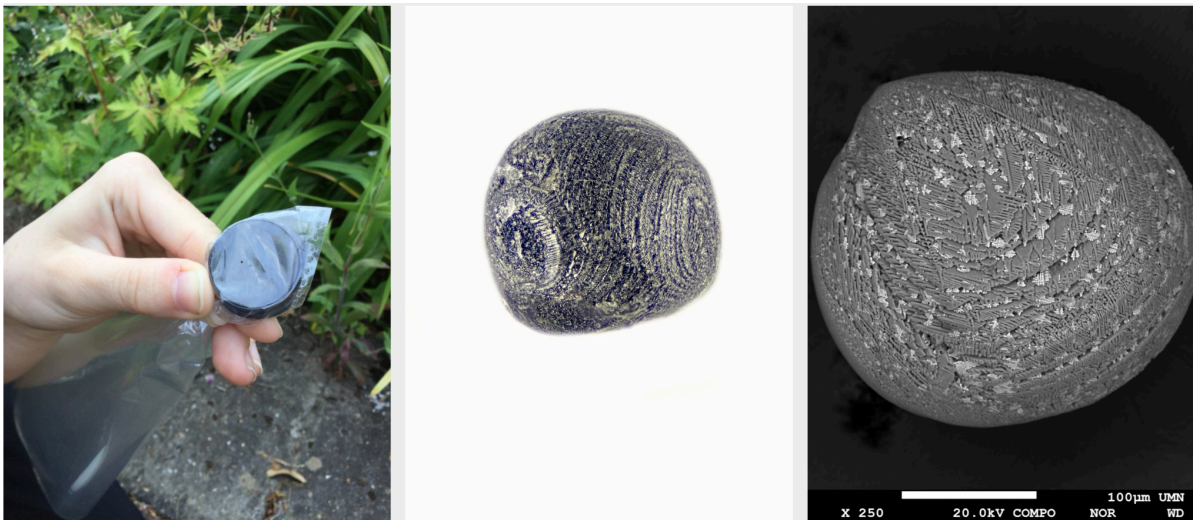
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Introduction:

In this report, we will outline the structure of Micrometeorite tool kit that can be used for the Stand project. This tool kit encompasses a variety of resources, from imaging and observation tools, along with educational materials, to aid in the study and identification of micrometeorites.

Students will engage in fieldwork, sampling areas around their habitat to search for micrometeorites and metal particles using magnets. They will learn to differentiate between extraterrestrial micrometeorites and terrestrial rocks/pebbles.



The workflow of Micrometeorite search: From sample collection to electron microscope research.



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Micrometeorite Toolkit:

Physics, Chemistry, Geography classes

Ages: 8-18.

Topic: Geology-chemistry, Geography, Hands-on and Meteorites

The Micrometeorite Toolkit is designed to guide users in identifying and distinguishing micrometeorites from other metallic particles. It provides practical tools and educational materials to facilitate a hands-on learning experience.



Curated micrometeorite collection, showcasing tiny space particles carefully stored in individual display boxes, ready for examination and study.

Purpose:

1. How to Define/find a Micrometeorite: Resources (see Teachers Manual) explaining what micrometeorites are and how to identify them.



2. Difference Between Metallic Particles: Information on distinguishing micrometeorites from other metallic particles.

Components of the Micrometeorite Kit:

3. Worksheets and Materials: A kit including worksheets, and all tools listed below (see hardware checklist).
4. Micrometeorites Resources: Optical images, SEM images, and spectra of 20 micrometeorites.
5. Processing Samples: Materials for processing micrometeorite samples.
6. Pupil Worksheet: Educational worksheets for students, guiding them through planning and carrying out their scientific investigation on searching for micrometeorites.

This toolkit aims to provide a structured and detailed approach to studying micrometeorites, fostering a deeper understanding of these fascinating cosmic particles and their significance in geological studies.




PROCEDURE

HARDWARE CHECKLIST




	Strong magnet
	Mesh/Sieve
	Swiper
	Small bucket
	Antistatic Mat
	Small Brush
	Water
	Plastic Bags
	Plastic Folie
	Point tweezer
	Microscope Slides/petri dish
	Microscope
	Sampling tubes





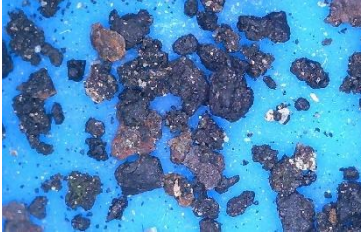
MICROMETEORITE SEARCH

Step	Action	NOTES	Duration	Check
1	<p>Go along the ground near gutters and water drains, collecting a reasonable amount of dirt on the outside of the plastic bag.</p> 	<p>The micrometeorites get washed down the waterways by rainfall, so they are likely to be most common along gutters.</p> 	15 min	
2	<p>Collect some dirt into plastic bag by sweeping with brush and dustpan</p>		10 min	





<p>3 Using a sieve or fine gauze, sieve the dirt so that only the smallest particles remain.</p>		5 min.	
<p>4 <i>Optional:</i> Take the material and wash it with water, separate the particles Organic material should float to the top and can be selected out. You may add some drops of dishwashing liquid to reduce the surface tension of the water</p> <p>Let the washed material dry</p> <p>Meanwhile educate students on differences of rocks from earth/space e.g.: Magnetism?, weight, looks on the inside see Teachers Manual section 6.2</p>		5 min. to wash 15 min to dry	
<p>5 Take the magnet and put it into plastic bag or the kitchen foil from the kit.</p>		1 min.	
<p>6 Place all collected material on a flat surface e.g. anti-static mat</p>		2 min	



7 Search for micrometeorites/metals with magnet		10 min.	
8 Hold the plastic bag above it and carefully remove the magnet. Brush the dirt off the outside of the plastic bag onto a clean mat		5min	
9 Repeat a few times (5-8)		5 min.	
10 Prepare the USB microscope and install the Viewer-Software (HiView20230724,.exe) on a computer. It is provided on the USB-Stick in the kit.		2 min.	
11 Put the USB-Microscope on the mat and select round particles. See the images in the chapter below which will help you identifying possible candidates.	 	5 min	
12 Take them with tweezers on the microscope slide		5min	



13 Put slide/petri dish under microscope investigation, using around 100x magnification, search for objects which are spherical.		2min	
14 With help of microscope, let students determine if micrometeorite was found 	Micrometeorite should be rounded with smooth surface	30 min.	
15 Collect founded spherical particles into a sample tube/small plastic bag and label them 	Labelling needs to occur Sampling Date-Time and Location	5min	
	TOTAL	122 min	



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Project Stardust
Micrometeorite highlights 2020
Photos by Jan Braly Kihle & Jon Larsen



Various micrometeorite types. Credit: Jon Larsen and Jan Braly Kihle.



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PDF versions of MM Student Worksheets

[Stardust Hunters Pupil Worksheet Blank.pdf](#)

[Stardust Hunters Pupil Worksheet Lined.pdf](#)

[Stardust Hunters Pupil Worksheet Prompts Lined.pdf](#)

[Stardust Hunters Pupil Worksheet Prompts.pdf](#)

Reference:

Larsen, J. (2017). In Search of Stardust: Amazing Micrometeorites and Their Terrestrial Imposters. United Kingdom: Voyageur Press.

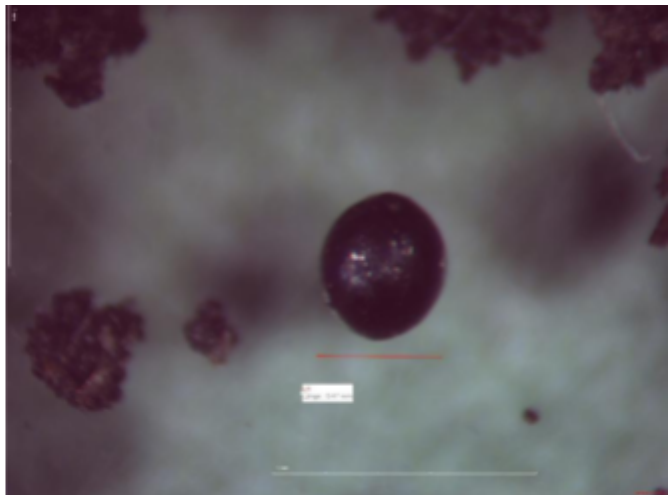
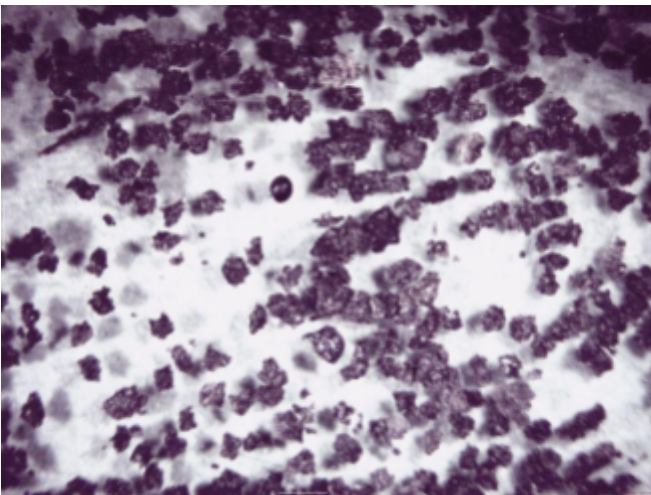


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ANNEXES

Optical Observation of Micrometeorites

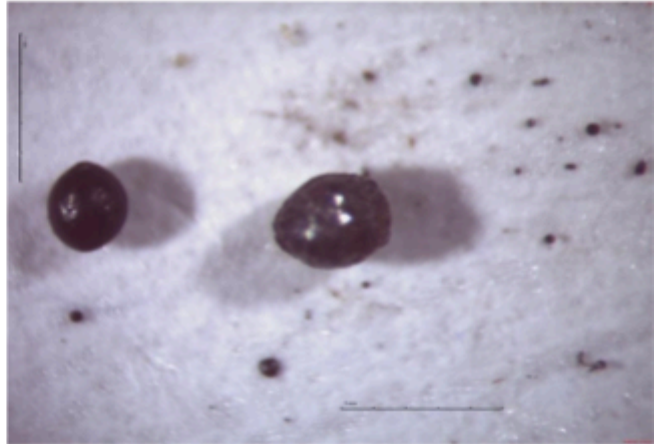
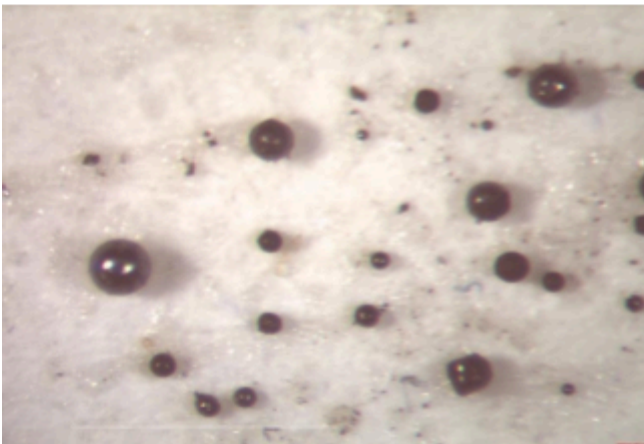
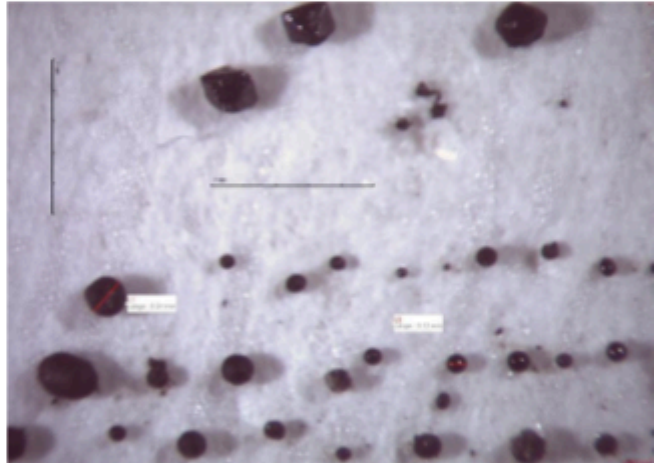
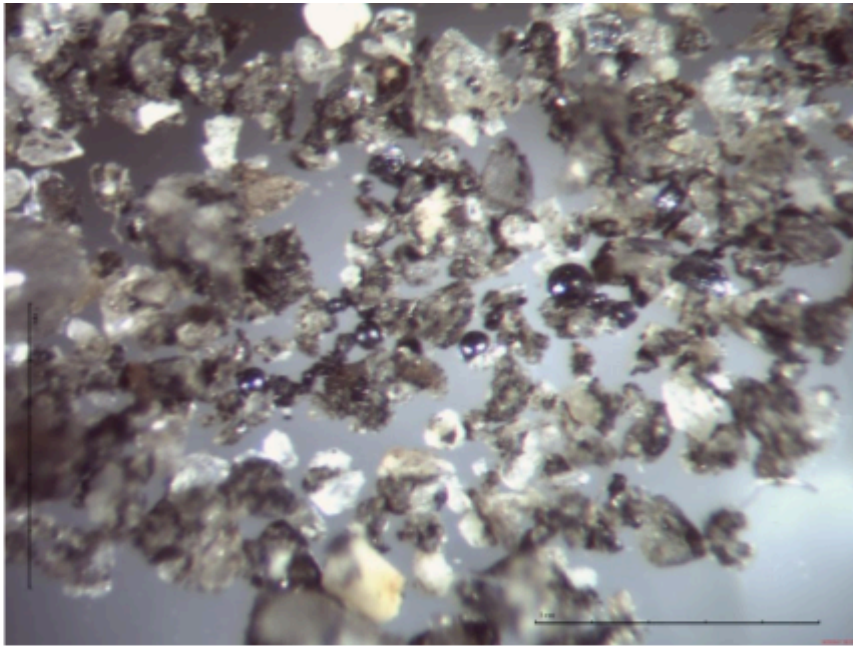
Following, you can see some Microscope Images and selected Micrometeorites.



Allocation of MMs from sampling by Gerhard Grau



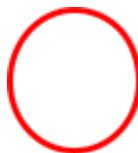
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Allocation of MMs from sampling by Gerhard Grau





Stardust Hunters Pupil Worksheet Blank

Name _____ Date _____ Year _____



SEARCHING FOR MICROMETEORITES

WHAT I AM
INVESTIGATING

EQUIPMENT

I PREDICT...

REASONS FOR MY
PREDICTION



Stardust Hunters Pupil Worksheet Lined

Name _____ Date _____ Year _____



SEARCHING FOR MICROMETEORITES

WHAT I AM INVESTIGATING

EQUIPMENT

I PREDICT...

REASONS FOR MY PREDICTION



Stardust Hunters Pupil Prompts

Name _____ Date _____ Year _____



SEARCHING FOR MICROMETEORITES

WHAT I AM INVESTIGATING

What is the question you are trying to answer?

What do you want to find out?

EQUIPMENT

What do you need for your investigation?

I PREDICT...

What do you think you will find?

REASONS FOR MY PREDICTION

Why do you think you'll find this..?



MY PLAN

This is what I
will do...

MY RESULTS

This is what I
found...

REFLECTION

What went
well?

What would I
change if I did
it again?



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Stardust Hunters Pupil Prompts Lined

Name _____ Date _____ Year _____



SEARCHING FOR MICROMETEORITES

<p>WHAT I AM INVESTIGATING</p> <p>What is the question you are trying to answer?</p> <p>What do you want to find out?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<p>EQUIPMENT</p> <p>What do you need for your investigation?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p>I PREDICT...</p> <p>What do you think you will find?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
<p>REASONS FOR MY PREDICTION</p> <p>Why do you think you'll find this..?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	

