STEM Project 1E – Dust Behaviour

Dust: Earth & Beyond

The Challenge

To address dust issues encountered on the Moon, Mars and Earth

Write your name on the Earth

Ways to Meet the Challenge

This project has many different parts to it and you will be looking at one area in particular.

Design and conduct an investigation into how dust behaves on different surfaces

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Find Out More and Get Thinking

Here are some points you might like to consider in your project to design and conduct an investigation into dust behaviour:

1. Think about the kind of materials that vehicles, scientific equipment and astronaut suits might be made of. These are the surfaces that you need to examine.

2. **Work safely with dust!** You might like to collect some dust by sieving some soil to collect the fine particles – make sure you wear a dust mask and safety glasses when doing this and check with an adult before starting. Any dust can potentially harm your lungs so wear protective equipment and wash your hands before eating.

3. Make sure you have a controlled test by having enough dust to run several tests. There are many other controlled variables you need to keep in mind for this investigation. Some you should think about are the size of the surface you are testing, the angle the surface is on and if the surface is wet or dry.

4. Where will you carry out your investigation? If you are working outside, try to choose a spot protected from the wind.

5. Perhaps consider fabrics as well as hard surfaces. Clothing or shelter would be exposed to dust and could be investigated.

6. You may not be able to measure a dependent variable for your investigation (gather QUANTITATIVE data) but instead you might consider gathering QUALITATIVE data. Qualitative data could be taking before and after photographs of surfaces or writing detailed observations.

STEM Project 1E – Dust Behaviour

Here are some suggestions for investigations you might try to get you started thinking:

- Time how long a set amount of dust takes to slide down different surfaces.
- Examine if dust is affected by static electricity if you charge up a surface.
- How does dust behave if the surface is moving side to side or vibrating?
- Try coating the surface with oil or polish the surface and see how that affects dust behaviour.
- Does the size of dust particles affect its behaviour on the surface?
- If the surface is painted, does this affect dust behaviour?
- Will the temperature of the surface affect dust behaviour?

Apollo 16 astronaut Charlie Duke
Image credit: NASA
https://www.nasa.gov/sites/default/files/styles/image_card_4x3_ratio/public/images/174291main_image_feature_802_ys_full.jpg

STEM Project 1E - Dust Behaviour

In the space below, brainstorm all the ideas you have about how you could design and conduct an investigation of dust behaviour on surfaces.

When you were brainstorming, were there some things that you found you need to know more about? Write those down here. You may like to use the PALMS 5 STEM Research Guide - Digital to find out more about these things.

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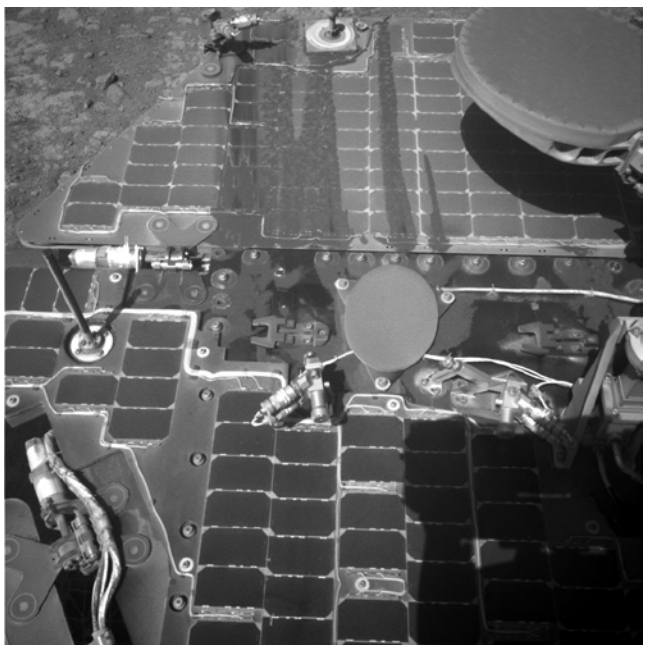
Scientists all over the world organise the way they think about and carry out their work in the same way – we call this the *scientific method*. They also write quite formally in the 'third-person' style (not using phrases such as 'you', 'we' or 'I)'.

To try and solve your part of the STEM problem and meet the challenge, you will carry out an investigation, by designing and carrying out an experiment.

When you are going to design an experiment, there are certain things that you always need to consider and include. The STEM Project Experiment Worksheet on the next pages will help you to design your experiment and organise the data you collect. It is important that you include as much detail as possible so your experiment could be repeated by anyone who reads it.



Mars Rover Image credit: NASA /JPL-Caltech
https://www.nasa.gov/sites/default/files/thumbnails/image/pia20329-1041.jpg

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STEM Project 1E - Dust Behaviour

Below are explanations of the terms used in the STEM Project Experiment Worksheet.

Problem/Aim – What problem are you investigating? What is the purpose of the experiment? You only need to write a sentence or two for this section. You would write something like "To investigate how quickly dust slides down different surfaces." You may even like to write it as a question e.g. "Will dust slide faster on painted or unpainted surfaces?"

Variable – A variable is any part of an experiment that can be measured, changed or controlled. It may have factors such as an ingredient, a way of doing something or be part of the surroundings, like temperature.

Independent variable – This is the variable that you are going to change to see what effect it has. A fair test only changes one thing so there is only ever one independent variable.

Dependent variable – This is the variable that you are testing so it is the one you are going to measure.

Controlled variables – These are all the other variables that you keep the same to make sure a fair test is carried out. There will always be more than one of these, including making sure that you are using the same equipment and methods for repeat experiments. You do only need to list the things that will have a direct effect on the experiment.

Hypothesis – What do you think is going to happen? Another way to think of a hypothesis is that it is an informed guess, using the knowledge you gained by researching your problem. This is a sentence that predicts how the independent variable will affect the dependent variable. You could use a sentence such as 'If a surface is painted, dust will slide down faster than if

it is unpainted'. In this example, whether the surface is painted or not is the independent variable (you are changing this) and how fast the dust slides is the dependent variable (you are measuring this and it will depend on the independent variable).

Materials and Equipment – This is a detailed list of all the things you will need to complete the experiment. You should include the size of equipment (e.g. 3x3cm squares of paper napkin) and the quantity.

Method – Write a step by step description of how you will do the experiment. Remember, it needs to be written in third person point of view so avoid using 'I' or 'we'. Make sure you are very detailed so someone else can do exactly the same experiment by following your method. You may even like to include some diagrams or photos of how your experiment is set up.

Safety – Make a list of any things you'll need to do to make sure you work safely and don't create a hazard for anyone else or the environment.

Results – In this section you will record any observations or measurements you make. It is usually best to put your data in a table, making sure you have titles on all your columns and that the units you are measuring in are included. Whatever your independent variable is should be in the left column. Make sure you make space in your table for any repeat trials you do. You may also like to take photographs or videos to record your results. Check with your teacher how they would like to see your results.

Conclusions – What do your results tell you about your original aim or hypothesis? You should write a sentence or two stating whether your results support your hypothesis or not and explain any patterns you notice in your results.

STEM Project 1E – Dust Behaviour

STEM Project Experiment Worksheet

Title:
Problem/Aim: (What problem are you investigating? What is the purpose of the experiment?)
Variables: Independent Variable (What are you changing?): Dependent Variable (What are you measuring?): Controlled Variables (What are you keeping the same to make it a fair test?):
Hypothesis: (What do you think is going to happen? An informed guess)
Materials and Equipment: (List all things you will need for the experiment)

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Method: (A step by step description of how you will do the experiment. Avoid using 'I' or 'we'. Labelled diagrams might help)

Safety: (What will you do to minimise hazards to people and the environment?)

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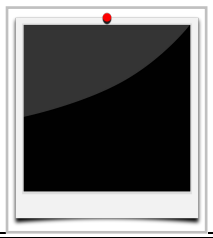
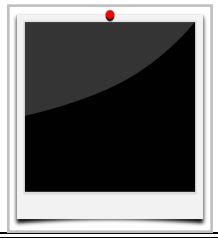
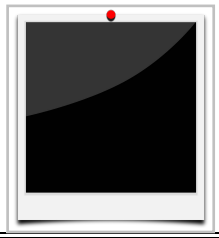
STEM Project 1E – Dust Behaviour

Submit your experiment design to your teacher for checking before continuing!

Once they have approved your experiment, you can get started.

Results: (Record your observations and measurements. A table may be best for this. Remember that the independent variable should be in the left column and you must include the units of measurement. Attach photographs, if required, by clicking on the icon below or typing the file names in this box with a brief explanation of what the photo is showing)

Photos:

Conclusions: (What do the results tell you about your original aim or hypothesis?)

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Could It Be Better?

Once you have carried out your experiment/s, you need to review your ideas and work. In this section, you can identify any problems or difficulties you encountered and suggest ways you could improve your project if you were to start again.

These questions will help with your review process. Write or draw your ideas for improvement in the table below.

- Do you currently have access to enough of the materials you used to carry out a larger experiment? Is there enough of it available in Australia? On Earth?
- Will current technology be useful, or do you need something more?
- Estimate how much it would cost to put your plan in place.
- Estimate how long it would take to put your plan in place.
- Can you do all of this yourself or do you need to bring in some experts? Who might these experts be?
- Did your experiments or tests give you enough information to start to solve the problem tomorrow? What further experiments or tests might you need to do?

Problem encountered	Possible solution

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Problem encountered	Possible solution
Any other ways to improve your solution if you have unlimited resources, time and access to the best people!	

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Report Back To Base

To finish off your STEM Project, you or your group need to let everyone know what you found out and what solution you came up with for your problem.

There are many ways you could do this, and your teacher may ask you to do it a particular way or have you come up with your own ideas. When writing or making your presentation, make sure you think carefully about who your audience is and how much detail you need to include. More visual presentations (colourful or with lots of pictures) are always more interesting.

Whatever kind of presentation you end up doing, you should cover the following things:

- What you found out or discovered that you didn't know before.
- What you designed, built, programmed or tested.
- The STEM skills you used (problem solving, creativity, critical analysis, teamwork, independent thinking, communication, digital literacy).
- The data you generated in your investigation and what shows (this may be in the form of tables or graphs and may not be relevant to every section of the project).
- How you could better investigate the challenge if you had no limit on resources or time.
- The most challenging aspect of the project.

Don't forget!

- Save this file as a PDF and submit it to your teacher. Don't forget to include your name!
- Check that any photos have uploaded or send them to your teacher separately (tell them the file name)
- Submit your Report Back To Base presentation to your teacher

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