



2020 Minor Challenge Set #1

STEM Field: Environmental Engineering

Level: Intermediate

Challenge Name: Exploring Dunes and Erosion

Materials required:

- Rectangular box (e.g. shoebox or printer paper box lid)
- Wind source: fan, or hair dryer with option to turn heat OFF
- Red and blue food colouring
- Sand, preferably with different grain sizes
- Small container in which to mix the sand with food colouring
- Soil (optional)

Safety:

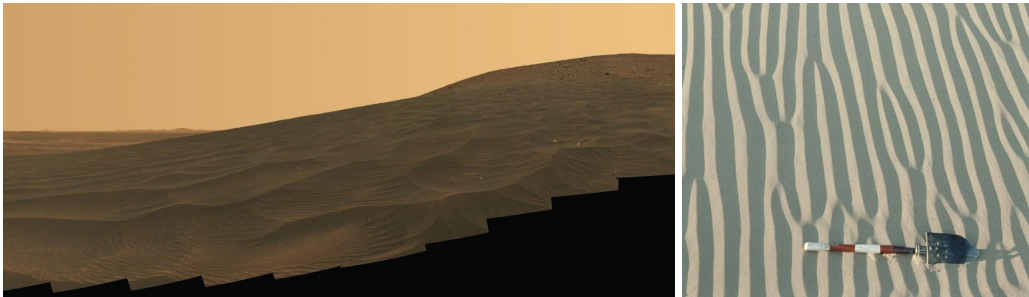
- Use personal protective equipment (PPE) such as gardening gloves when handling sand and soil.
- Take care not to inhale loose dust, and ensure to wash hands with soap after handling materials.
- Set up experiment outdoors to reduce mess.

Introduction:

Sand is a key part in several environments, such as in deserts, coastal areas, and plains. Large amounts of sand often form **dunes**. Analysing how dunes react to weather can improve our understanding of how environments change over time, and can be useful in conservation and planning efforts.

Erosion occurs when a process (e.g. water flow or wind) removes a surface material (e.g. sand, rock, soil) and moves it from one location to another¹.

When visiting the beach, have you noticed any interesting patterns formed in the sand due to the wind? In this experiment, we will model erosion using sand and a wind source.



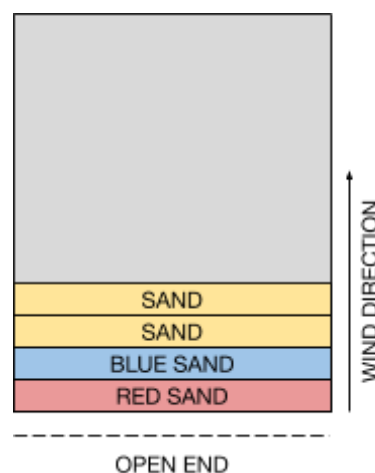
Sand dunes on Mars and in Afghanistan

Instructions:

- 1) Divide the sand into four portions. Place one portion in the small container, add a few drops of red food colouring, mix well and set aside to dry. Repeat for another portion, using blue colouring. Leave the other two portions uncoloured.
- 2) Take the rectangular box and cut or tear at two of the corners so that you can flatten out one of the four sides. This will create three “walls” and one open side.
- 3) Create a dune by pouring red sand along the flat, open side of the box. The dune should be ~8cm wide and ~2cm deep.
- 4) Create a similar sized dune with the blue sand, locating it next to the red dune. This blue dune will be located towards the inside of the box.

¹ (Encyclopedia Britannica, 2015)

- 5) Create two more dunes using the uncoloured sand, locating it next to the blue dune. These two uncoloured dunes will be located towards the inside of the box (see diagram below).
- 6) Set up your fan or hair dryer so that the wind direction is along the length of the box, heading across the dunes and towards the closed end of the box. If using a hair dryer, ensure that the heat setting is set to OFF, so that the sand is not heated up.



- 7) When the wind source is turned on, what do you think will happen to the different dunes? Write down your predictions.
- 8) Turn the wind source on, starting at a low speed before increasing it. If you are unable to change the speed on your wind source, a similar effect can be achieved by starting out at a distance away from the open end of the box before moving closer.

Continue until about half of the red sand has been eroded away. What changes do you note in the shape of the sand dunes as you changed wind speeds?

- 9) Note how the different coloured sands have been distributed: where did the red, blue and uncoloured sands end up? Can you see any differences in where smaller sand particles ended up, compared to larger particles?

Extension - Other types of erosion

Erosion of sand is just one example of a real world example of erosion. Do some research (such as through trustworthy websites) onto other kinds of erosion that occur naturally in the world. We were able to model the erosion of sand dunes using a fan or hair dryer replicating wind eroding sand. How would you try to model other kinds of erosions similarly to this challenge?

Reflection Questions:

- What were the problems associated with the challenge? Are there any improvements you could suggest?
- What are the key concepts of science and engineering that relate to this challenge?
- Here our dunes were placed in a line. What other dune shapes could we try? Investigate how different shapes affect the pattern of erosion.
- How might the results differ if wet sand was used instead of dry sand? How much water is required to notice an effect? Be careful: the water can cause the food dye to wash out!
- Does changing wind direction affect the pattern of erosion?
- How might the presence of plants affect erosion? How could this be tested in this experimental setup?
- This experiment looks primarily at dune erosion using sand. How could this experiment be changed or extended to look at soil erosion?

Submission Guidelines:

- Submit a photo of the experiment setup. Include a short summary that addresses the Reflection Questions.

- In 2020 we have changed our submission guidelines compared to 2019. To submit fill out the form here:
<https://forms.gle/ChrCXLud97E4x3AT9>

Learn More! Resources:

- Kansas River Science - Nutrient Runoff Experiment
<http://www.kansasriverscience.org/whats-water/stormwater-runoff/runoff-lesson>

Sources:

- Carolina.com. (2019). *Sand Dune Erosion in a Box Top* | Carolina.com. [online] Available at:
<https://www.carolina.com/teacher-resources/Interactive/sand-dune-erosion-activity/tr10858.tr> [Accessed 2 Mar. 2019].

Images:

- Dune on Mars:
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- Dune in Afghanistan:
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