



Dirty Ice Snow Cones



This is a fun activity regarding water ice on Mars to use for a science booth, summer camp, or family science night.

BACKGROUND

Scientists continue to gather more data about the atmosphere and surface of Mars. The Mars Gamma Ray Spectrometer (GRS) aboard the Mars Odyssey Spacecraft has measured down to tens of centimeters below the Martian surface. This provides a new perspective on the elemental composition of the near-surface of the planet. Prior to GRS, the existence of buried frozen water ice was theorized based upon physical and thermodynamic arguments. Because visible light detects only the very top surface of Mars, visual maps of high latitude regions show a small permanent water ice cap at the North Pole and a larger permanent carbon dioxide ice cap at the South Pole of Mars. The areas surrounding these caps appear as brown dusty or soil-like material. However, GRS can measure down below this surface soil layer. We now have gamma ray data indicating large amounts of hydrogen in the form of water ice are buried at high latitude regions. Indeed, current estimates are that between 30-70 wt% H₂O is located poleward of 60° latitude at both poles.

A question resulting from this data is whether this water rich surface is more like dirt with water ice filling the pore spaces (icy dirt) or more like ice in which dirt is sprinkled (dirty ice). A second question is why the ice rich areas appear brown in visual images. What is the Martian surface like in these polar regions? Is it icy dirt, dirty ice, or something else?

Materials

- Shaved ice/snow cone maker
- Cookie crust, graham cracker
- Red syrup
- Disposable cups/spoons or Dixie cups
- GRS Water Map

Activity

Build “dirty snow cones” to engage visitors in a discussion of water ice on Mars. You can start with a cup of ice which is 100% water and proceed to have a discussion about how to interpret the GRS water map (percentage of water to dirt). The red syrup is to color the ice and make it more palatable to eat. Add different amounts of cookies to the mixture to talk about the presence of dirty ice on Mars.

Directions:

- 1) Provide context by explaining to students that data from the Mars Odyssey spacecraft indicate that large amounts of water ice are buried within the top couple of feet of the Martian surface. The activity provides an opportunity to discuss whether this ice is like icy dirt or dirty ice.



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- 2) Show participants the GRS Water Map and point out that color scale bar represents the weight percent of water ice that has been detected at the surface of Mars. If you were to dig up 10 pounds of material at a location with 40 wt% water ice, 4 pounds of the sample would be water ice and 6 pounds of the sample would be dirt, rock, and other material.
- 3) Shave a serving of ice into a container. Ask participants to estimate the weight percent of water ice inside the container. Discuss idea that the container holds 100 wt% water ice because it is pure ice.
- 4) Ask participants how you could reduce the weight percent of water ice in the container. If participant suggests that you could remove some of the ice, question whether this would decrease the weight percent or amount of water ice. Participants often offer that you could add some other substance to the cup so that it is not pure ice.
- 5) Add “dirt” by stirring crushed graham crackers into the container. Explain that you are decreasing the water weight percent by adding in another substance. If you could weigh the amount of ice you had originally and the amount of “dirt” you are adding, you could determine the water weight percent of the container.
- 6) If available, show participants pre-made frozen water-soil samples of dirt saturated with water. Discuss that icy dirt typically has water weight percents between 1-30 wt % water ice. Emphasize that water weight percents of 50-70% water ice are more similar to the dirty ice found in the snow cone.
- 7) Add red syrup to the mixture to make the snow cone look more “Martian” and to taste better, but emphasize that the rocks of Mars are red due to oxidized or rusted iron in the rocks, not due to sugary syrup.
- 8) If time and interest allow, ask participants why the high latitude regions of Mars look dark and dirty even though they have a great deal of water ice. Try to incorporate their suggestions into an explanation that the dirty ice on Mars is buried by a thin layer of soil and dust that hides it from detection using visible and other low energies of light. Sprinkle more graham crackers over the snow cone to demonstrate this. Explain that gamma rays coming from hydrogen in the buried ice are able to penetrate through this dust layer have been detected by the Mars Odyssey spacecraft.