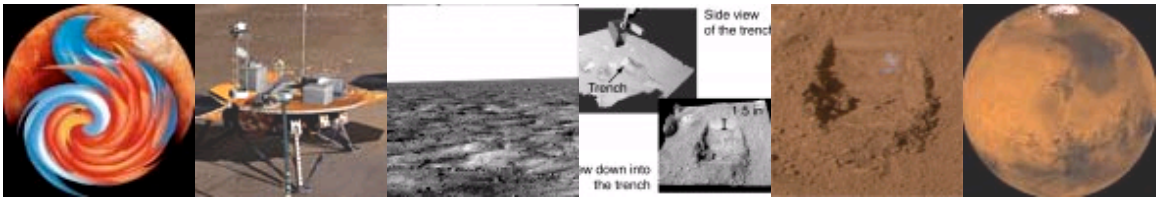


Cooking Up a Cap: Martian North Polar Layered Bean Dip

Overview
Using bean dip layers, students explore the subsurface of the Martian North Pole.

Objective
- To construct an edible model of the Martian arctic terrain.
- To compare part of the model to the layers at the Phoenix Mars Lander site.

Time Line
1 class period

Preparation
1. Collect the necessary ingredients as described in the materials list.
2. Prepare the model using the following procedure. When you make the dip, it will be from the bottom working up. Although the lowest layer is spread first, it is the base.

Lowest layer: dirt and ice - meat

Phoenix landed farther north on Mars than any previous mission, at a site expected to have ice-rich permafrost beneath the surface, but within reach of the lander's robotic arm. Phoenix is equipped to study the history of the water now frozen into the site's permafrost and to check for carbon-containing chemicals that are essential ingredients for life.

2nd layer: dirt – bean dip

This would be commercially available bean dip. This layer acts as an insulator keeping the ice below intact.

3rd layer: patches of frost – sour cream

Peaking through the cheese/spices layer will be patches of sour cream. There will be fewer frost patches in the beginning of the mission and more in the later part of the mission.

Top layer: soil and dust – cheese

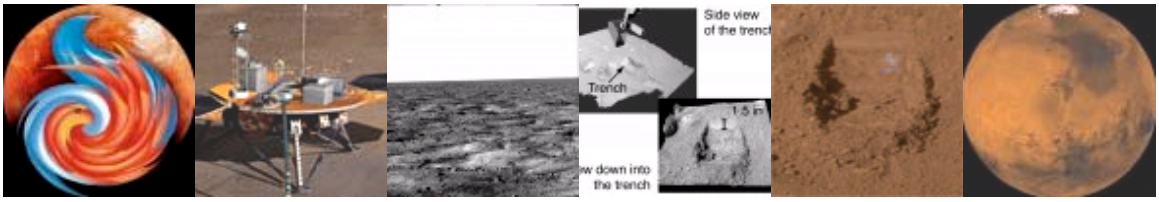
Grated cheddar cheese and a dusting of a chili powder/herb/pepper seasoning (this mixture should be made to taste)

Sprinkled throughout layers: salsa – pebbles

Chunks of diced vegetables are spread through to represent pebbles and stones at the Phoenix landing site. Red tomatoes, black olives, and green onions work well.

Phoenix scoop: Tostitos Scoop Tortilla Chips

Everyone should use his/her own "arm" with a chip being held by the fingers to represent the Phoenix arm. The scooping action should be like a backhoe (arm extended scooping back towards the person). the Robotic Arm, about 2.35 meters (7.7 feet) long, will dig into the ground and deliver samples to two instruments for analysis. The arm can reach far enough to dig about half a meter (20 inches) deep. Once the arm reaches the icy-soil layer, the powered rasp will be used to acquire samples. The arm was built by NASA's Jet Propulsion Laboratory, Pasadena, Calif., based on designs from previous missions.



Materials Needed

1 pound cooked ground beef
(or 18 oz CHI-CHI'S® Restaurante Taco Tub ground beef or 1 can (15-ounce) refried beans)
2 jars of bean dip
2 cartons (16-ounce) sour cream
2 jars Salsa
¾ cup chopped green onion
1 cup diced tomatoes
1 can (2.25-ounce) sliced ripe black olives, drained
1 cup shredded cheddar cheese
1 cup shredded Monterey Jack cheese
1 package (.78-ounce) taco seasoning mix
3 bags Tostitos Scoop Tortilla Chips
A mixing bowl
A mixing spoon
Individual plates, one for each participant
Napkins

Management

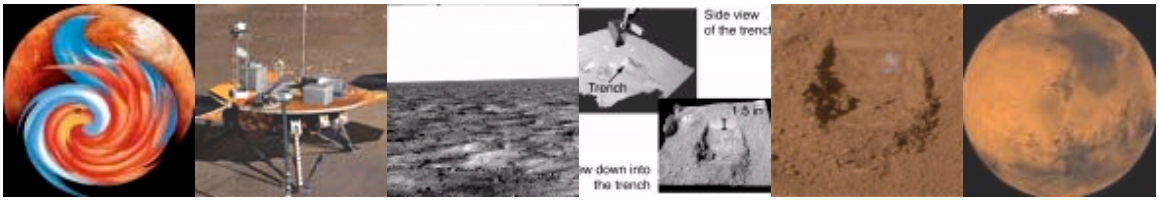
Due to the less-serious nature of the activity, you may prefer to save this activity for last.

Procedure

1. Distribute the NASAFacts on Mars Phoenix Lander (*http://www.nasa.gov/pdf/213817main_mars-phoenix2.pdf*) You may want to divide the class into groups at this time for easier distribution of the additional Mars scoops later in the class period.
2. Spread meat on a 10-inch microwave-safe serving platter and cover. Microwave on HIGH (100% power) 2 to 2 1/2 minutes or until hot, rotating dish once; uncover.
3. Layer bean dip and salsa.
4. Combine sour cream and seasoning mix and chopped vegetables; spread over beans.
5. Layer remaining ingredients over sour cream mixture.
6. Ask Reflection Questions in reinforce structure of the Martian arctic subsurface.
7. Distribute chips and allow participants to practice scooping.

Reflection Questions

1. What do the meat/beans represent? The sour cream? The salsa? The cheese? The chip?
2. How is ice on the Martian surface different from ice under the surface?
3. How was the model like the Phoenix landing site? How was it different?
4. How would this model change after the scoop digs in and overturns material?



Answer Key

1. The meat: dirt and ice

The sour cream: Ice and permafrost, a permanently frozen layer at some depth below the surface in frigid regions of a planet.
The salsa: peeples
The cheese: dust
The chip: the Phoenix Lander scoop

2. Findings from Mars Odyssey indicate the top half meter (20 inches) of Mars' surface layer is mostly ice throughout large regions of the planet pole-ward of 65 degrees north latitude. Is this the frozen residue of an ancient ocean? Did it diffuse into the ground from water vapor in the atmosphere? Did a retreating ice sheet leave it behind? Information such as the amount of layering, the textures of the ice and soil, and the chemical composition at different depths could distinguish among those and other possibilities.

3. One week after landing on far-northern Mars, Phoenix lifted its first scoop of Martian soil. A glint of bright material appears in the scooped up soil and in the hole from which it came. That bright material might be ice or salt.

4. Underlying material will be exposed to weathering from solar radiation, top layers will be insulated. The Mars Viking 1 lander dug a 6-inch-deep, 12- inch-wide, 29-inch-long trench as the first sequence in an attempt to reach a foot beneath the surface of the red planet. The trench was dug by repeatedly backhoeing in a left-right-center pattern. The backhoe teeth produced the small parallel ridges at the far end of the trench. What appears as small rocks along the ridges and in the soil at the near end of the trench are really small dirt clods. The clods and the steepness of the trench walls indicate the material is cohesive and behaves something like ordinary flour.

Notes

The Martian North Polar Bean Dip recipe for "Cooking Up a Cap" was inspired by the "Cookin' Up a Comet" activity from NASA Stardust mission educator's guide (http://stardust.jpl.nasa.gov/classroom/activities/2-stardst-ch02.pdf).

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