STARBASE Challenge: Ice Zones

Water is essential for life. As a result, scientists looking for life beyond our planet often search for signs of water, including its solid form, ice. For this challenge, you are going to explore how scientists decide where to look for ice on other planets and planetary bodies. You will use a clay ball, ice cubes, and a heat or desk lamp to model planets and moons that may contain ice.

Part 1: Background Information on Planets and Ice

Use the *Planetary Thermometer* and information from the video links below to answer the following questions:

How Can This Super Hot Planet Have Ice? (https://tinyurl.com/sbcthotplanet)
How is Equator Hot but Poles are Cold? (https://tinyurl.com/sbctequator) – Watch until 1:08

1. Water will freeze at 0 °C (32 °F). Based on this information, which planets are cold enough to have ice?

2. Earth's *average* temperature is above freezing. How is it possible for our planet to have ice?

3. Based on what you've learned about Mercury, is it possible that other planetary objects like the Moon, to have places that are *permanently* cold?

4. What areas on Earth are the warmest? The coldest?

5. Why do you think these areas are the warmest and coldest?

6. Do you think other planets and moons have warmer and cooler areas? Why or why not?

This challenge was inspired by Ice Zones from the Lunar Planetary Institute.

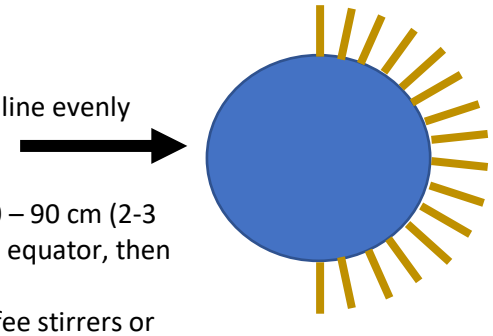
Part 2: Build a Test Planet

Materials:

- 1 lamp (preferably adjustable like a desk lamp) with a 100 Watt or greater light (LED or CFL won't work)
- 1 (15 cm or larger) clay ball or Styrofoam ball (to simulate the Moon)
- 1 paper plate
- 16 coffee stirrers or large toothpicks
- 2 ice cubes of similar size
- Small insulated cup or container to keep the ice frozen
- Clock or timer
- Pencil

1. Put one coffee stirrer or toothpick into the top and one into the bottom of your Moon so that they are sticking out. **These will represent the north and south poles of your Moon.**
2. Hold each coffee stirrer or toothpick so one points up and the other straight down. Spin your Moon 13-15 cm (or 5-6 inches) in front of the lamp to create day and night on the Moon's surface.
    - Which part of the Moon gets the most sunlight: the top, the middle, or the bottom?

3. Add the rest of the toothpicks or coffee stirrers to the Moon in a line evenly stretching from the north to south pole as show in the picture.



4. Darken the room and shine the *Sun* (lamp) at your moon from 60 – 90 cm (2-3 ft) away with the center of the light directly aimed at the Moon's equator, then slowly turn your Moon.
    - What do you observe about the shadows cast by the coffee stirrers or toothpicks?

    - Are there any parts of the Moon that are shielded from the Sun and don't get any light?

    - How could you create places on your Moon that are permanently in shadow on the Moon's surface? (Think about how the surface of your Moon is different from Earth's Moon?)

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5. Create craters in your Moon by poking 10-15 1-cm deep holes in it with a pencil, including one in the north near the pole.
    - When you shine the *Sun* on your moon and turn it, what do you observe about the light in the craters you made?

    - Are your observations of the craters near the poles the same or different from those on closer to the equator? Why do you think so?

    - How would you expect the amount of light to influence the temperature of craters that stay dark?

6. Comets can carry ice to other planetary bodies like the Moon. You will use ice cubes to represent comets that have crashed into the Moon. Put one cube inside a crater near a pole and the other near the equator. Make sure to push the ice cubes into the ball so that they are beneath the surface with the tops of the cubes exposed. This will help them stay in place.
    - Which ice cube do you expect to melt faster? Why?

7. Hold your moon by the poles about 13-15 cm (5-6 inches) away from your *Sun* for three minutes.
    - Where is the sunlight most intense?

    - What affect do you think this is having on the ice cube in that area?

8. Remove the ice cubes and examine them closely.
    - Do you observations of the ice cubes after this test match your predictions? Why or why not?

9. Imagine you are a scientist investigating a planet that may be too close to its sun to have ice.
    - Where on this planet would you look to try to find some? Why?

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