Title: Leaf Wettability and Contact Angle

Experimental Objectives: Estimate the wettability or contact angle of water on leaf surfaces in microgravity.

Educational Objectives:

1. Understanding Surface Tension and Contact Angle (NGSS MS-PS1-1)
    - Objective: Students will understand the concepts of surface tension and contact angle by observing how water droplets interact with different leaf surfaces.
    - Explanation: By measuring the shape and spread of water droplets on various leaf surfaces, students will learn about surface tension and how it affects the wettability of different materials. This will help them understand the physical properties of liquids and surfaces.
2. Application of Measurement and Mathematical Analysis (NGSS MS-ETS1-4)
    - Objective: Students will develop skills in measurement and mathematical analysis by calculating the contact angle of water droplets on leaf surfaces.
    - Explanation: Students will use measurements of droplet dimensions to apply trigonometric principles and calculate the contact angle. This will enhance their ability to gather, analyze, and interpret data using mathematical tools.
3. Exploring Plant Biology and Environmental Interactions (NGSS MS-LS1-5)
    - Objective: Students will explore the interaction between plant biology and environmental factors by studying how different leaf surfaces affect water droplet behavior.
    - Explanation: By observing the wettability of various leaf types, students will gain insights into how plant structures interact with water, which is crucial for understanding processes like transpiration, water absorption, and plant adaptation to different environments.

Materials and Equipment Required (Include quantity and volume):

1. Fresh leaf trimmings (various types, if possible)
2. Syringes or droppers (to dispense water droplets)
3. High-resolution camera or video recording equipment
4. Transparent ruler or a measuring scale (for droplet size estimation)
5. Light source (to improve visibility of the droplets)
6. Ziploc bag or equivalent for leaf trimmings and material containment

Experimental Procedures:

1. Preparation: Collect fresh leaf trimmings of different types.
2. Set up a high-resolution camera with a clear view of the leaf surfaces.
3. Droplet Dispensation: Use a syringe or dropper to place a small water droplet on the surface of each leaf trimming.

4. Ensure the droplet is gently placed to avoid additional forces that might alter its natural shape.
5. Recording Observations:
    a. Record the interaction between the water droplet and the leaf surface using the camera.
    b. Use a light source to improve visibility and contrast of the droplet's edge.
    c. Repeat the experiment on different leaf surfaces, verbally noting the leaf type in each experiment.
6. Collect the leaf trimmings and dispose. Empty and stow the experiment equipment.

Students will use these data to measure the contact angle and estimate the droplet geometry. At the middle school level, the contact geometry can be qualitative and associated with different leaf types. At more advanced levels, the contact angles can be quantitatively estimated.

Expected Outcomes:

- Learning Outcome 1: Understanding Surface Tension and Wettability:
    - Students will learn about surface tension and its effect on the shape of water droplets on different surfaces.
    - Explanation: By observing how water interacts with leaf surfaces in microgravity, students will understand the concept of wettability and how it is quantified by the contact angle.
- Learning Outcome 2: Application of Trigonometry in Real-World Contexts (Advanced Levels):
    - Students will apply basic trigonometric principles to measure and calculate the contact angle.
    - Explanation: Using measurements of the droplet's dimensions, students will calculate the contact angle, integrating math and science skills.
- Learning Outcome 3: Experimental Design and Data Analysis:
    - Students will develop skills in experimental design, precise measurement, and data analysis.
    - Explanation: Conducting the experiment and analyzing the results will help students learn how to design experiments, make careful observations, and interpret data.

Total Estimated Astronaut Time (minutes): 30 Minutes

- 10 minutes to gather materials and read procedures
- 15 minutes to perform the experiment
- 5 minutes to clean up and stow materials