**Use Case Tests for Simulated Lunar Plant Habitat AI Agent**

## Hypothetical Pod Set-Up

* Environmental controls:
  + Fans
  + Water flow
  + Nutrient dispenser (see EDEN nutrient compound info)
* Biological tools:
  + Automated metagenomics from sample to taxonomy report
  + Automated RNAseq from sample to DGE report
* What plants:
  + Tomato (plant from EDEN experiment)
  + Legume (plant that was used in ExoLab-11)

## Test Case 1

* CO2 sensors detects levels at 1800ppm
  + AI pod should set off alarm and report anomaly
  + A list of potential biological impacts should be generated
  + Environmental response:
    - Fans should be triggered to increase flow rate
    - Notification should be provided that CO2 levels are reducing
    - Fans should shut off once CO2 levels are back to nominal
  + Biological response:
    - Images should be evaluated to assess impact to plant health
    - Report should be generated (e.g. no impact observed, fruit production has slowed)
    - Notification should be made for the images to be re-evaluated each week to ensure growth rate (or the color, or the germination) is restored

## Test Case 2

* Humidity sensors detect 30% RH
  + AI pod should set off alarm and report anomaly
  + A list of potential biological impacts should be generated
  + Environmental response:
    - Water dispenser should be triggered to increase water flow
    - Notification should be provided that %RH levels are increasing
    - Water flow rate should reduce once %RH is back to nominal
  + Biological response:
    - Images should be evaluated to assess impact to plant health
    - Report should be generated (e.g. no impact observed, fruit production has slowed)
    - Notification should be made for the images to be re-evaluated each week to ensure growth rate is restored
* Humidity sensors detect 85% RH (for Fragaria (strawberry) plant
  + AI pod should set off alarm and report anomaly
  + A list of potential biological impacts should be generated
  + Environmental response:
    - Water dispenser should be triggered to reduce water flow
    - Notification should be provided that %RH levels are decreasing
    - Water flow rate should increase once %RH is back to nominal
  + Biological response:
    - Metagenomics (Amplicon, 16S and ITS) analysis should be triggered:
      * automated sample to sequencing protocol executed
      * followed by automatic data processing
      * output report of % taxonomy should be generated
        + Below are the taxonomy reports that were generated by the automated sequencing hardware
        + 16S report:  
          ​​[Fragaria\_GAmplicon\_16S-taxonomy-and-counts.tsv](https://drive.google.com/file/d/16G0dYDzBH7qUCLLPud7TsrNLKD7CIDcm/view?usp=drive_link)
        + ITS report:   
          [Fragaria\_GAmplicon\_ITS-taxonomy-and-counts.tsv](https://drive.google.com/file/d/1dI-Crrwxe9VPRPlCkqK2De5GaErCGBVT/view?usp=drive_link)
    - Taxonomy report should be evaluated for known pathogens
    - If a known pathogen is detected, a treatment should be automatically dispensed and reported in the log
    - Subsequent metagenomics (amplicon) analysis should be scheduled for 2 weeks post treatment to ensure pathogen is no longer detected

## Test Case 3

* Image monitoring system detects reduced green signal and increased yellow signal
  + Images for this test case are available here: [Test\_Case\_3\_Images](https://drive.google.com/drive/folders/1wiNeV_WBgk7PcnTmsDc4Vrsm6s6B6qzn?usp=drive_link)
  + AI pod should set off alarm and report anomaly
  + A list of potential environmental causes should be generated
  + Environmental response:
    - Each potential environmental parameter should be evaluated for any anomalies
    - If any anomalies are detected they should be corrected
    - Note: Anomaly will be related to Nitrogen levels, which should be evaluated and increased or decreased accordingly (from EDEN nutrient compound info)
  + Biological response:
    - Images should be re-evaluated weekly to assess if environmental correction improves plant color
    - If plant color is not improved, automated RNAsequencing analysis should be triggered to identify potential molecular causes to better respond
* ~~Gene expression data shows increased expression of pathways indicative of reduced photosynthesis (DGE)~~
  + ~~AI pod should set off alarm and report anomaly~~
  + ~~A list of potential environmental causes should be generated~~
  + ~~Environmental response:~~
    - ~~Each potential environmental parameter should be evaluated for any anomalies~~
    - ~~If any anomalies are detected they should be corrected~~
    - ~~CO2 levels should be evaluated and increased or decreased accordingly~~
  + ~~Biological response:~~
    - ~~Subsequent RNAseq analysis should be scheduled for 2 weeks post environmental parameter adjustment to ensure pathways are back to nominal~~