# TICTACS:

**T**OOL FOR
**I**NVESTIGATING
**C**LOSED
**T**ERRARIUMS
**A**SSISTED BY
**C**ITIZEN
**S**CIENCE

The Spring Institute for
Forests on the Moon

PATRICK GROVE & CO

# PROBLEM

Studying Closed Ecological Systems Is Hard

No standard model (i.e. Arabidopsis)

Must be observed over ecological scales - time, volume, diversity.

Difficult to measure without interfering (destructive sampling, etc.)

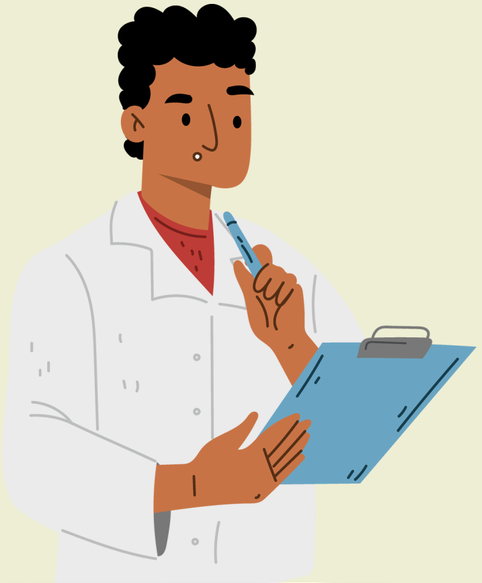
Difficult/Impossible to replicate precisely.

Reproduction of scale-dependent emergent properties (weather, biogeochemical cycles, etc.)

# SOLUTION

## (FUN) CROWD-SOURCED DATA COLLECTION

# ADVANTAGES OF CITIZEN SCIENCE FOR TICTACS



## SELF-FUNDING

Participants pay for a TICTACS terrarium, which reimburses production cost and ongoing program management.

## FUNDAMENTAL RESEARCH

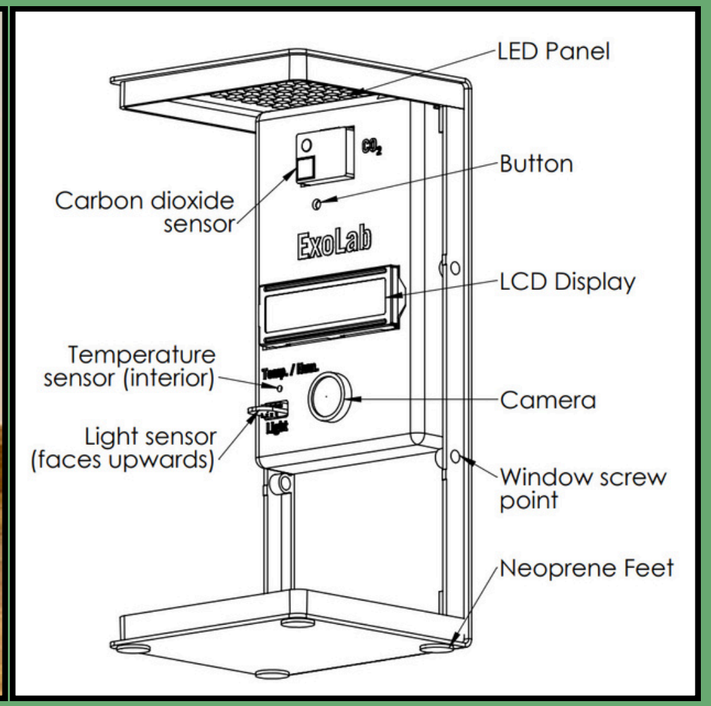
Versatile, low-cost platform for investigating closed ecological ecosystems.

## EDUCATE & INSPIRE

TICTACS demonstrates basic ecological principles and makes them explicit via real-time data.

Guided observations encourage engagement.

# SIMILAR BUT DIFFERENT


MAGNITUDE.IO EXOLAB


TICTACS V1

# TIC TACS

- Hermetically Sealed
- Fixed Volume
- Wide Mouth
- Widely available

Replace lid with hollow 3D print to hold electronics.

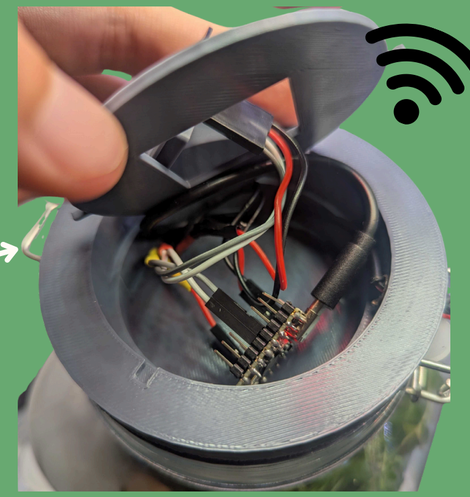
# TIC TACS

Environmental Sensors automatically upload data to cloud database.

- CO2
- Humidity
- Temperature
- Pressure
- Lux

Hermetic Seal

Standardized Terrarium Recipe



Inside of lid.

OLED Sensor Readout

# EXPERIMENTAL DESIGN

## STANDARDIZED:

**Terrarium Environment:**

- Volume
- Leakage Rate
- Incoming Light Spectrum

**Terrarium Recipe:**

- Plant species & mass
- Initial water quantity
- Substrate composition
- Reproducing population of detritivore invertebrates

**Sensor Data:**

- Pressure
- Temperature
- Humidity
- CO2
- Lux

## DEPENDENT VARIABLES:

**Home Environment:**

- Ambient Temperature
- Initial Atmosphere
- Daily Light Integral

## OUTPUTS

**Emergent Data:**

- Leakage rate
- Net photosynthetic activity
- Inferences about atmosphere composition and heterotroph metabolism

# PROPOSED STANDARD TERRARIUM MODEL

## TROPICAL UNDERSTORY BIOME

- Fast nutrient cycling, small nutrient reservoirs
- Similar environment to jar - low light, humid, still air

## SPECIES REQUIREMENTS

- Very small - mature form fits within 10 cm^2
- Tolerates high soil moisture and humidity
- Asexual reproduction**


| Phototrophic Producers | Heterotrophic Detritivores | Saprotrophic Decomposers |
|---|---|---|
| Generic Mosses + Allies (Bryophyta, Lycopodiaceae spp.) | Springtails (Collembola spp.) | Microbial Nutrient Cyclers (C, H, O, N, P, S) (Inoculate system with several soils) |
| Creeping Fig (Ficus pumila) | Isopods (Aramadillidium, Porcellio spp.) | Yeast (Saccharomyces cerevisiae) |
| Dwarf Baby Tears (Hemianthus callitrichoides) | Milipedes (Ivory Milipede, Chicobolus spinigerus) | Volunteer Fungi: Mold/Mildew/etc |
| Nerve Plant (Fittonia spp.) | Fruit flies (Drosophilia melanogaster) | |

| Requirements | Amount | Acquisition |
|---|---|---|
| Volume | 1L | Container |
| Substrate (& Microbes) | 200g | Collect rich soil samples from 3 nearby locations |
| Plant Biomass | 100g<br>Minimum 3 species | Purchase, collect from environment. |
| Invertebrates | 2 reproducing populations<br>Minimum 2 species | Purchase, collect from environment |

# AUTOMATIC DATA COLLECTION


https://thingspeak.mathworks.com/channels/2987094

# SUPPLEMENTARY MANUAL OBSERVATIIONS

- Presence/Absence of Species or Functional Groups
- Evidence of reproduction (flowering, juveniles, etc.)
- Foliage health (color, turgor, etc.)
- Animal/Plant Behaviors

# THANKS FOR YOUR ATTENTION

SCAN ME

## SIGN UP FOR WAITLIST

If this looks like it would be fun to participate in, scan the QR code to put your name on a list to be contacted when it's available.

## VOLUNTEER TO DEVELOP

The Spring Institute for Forests on the Moon is a non-profit, volunteer-run space research organization that is developing closed ecological life support technology and promoting the space democratization.

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