UC SANTA CRUZ | Baskin Engineering

Electrical and Computer Engineering

Wet-Dry Cycling System for Origins-of-Life and RNA Production Research

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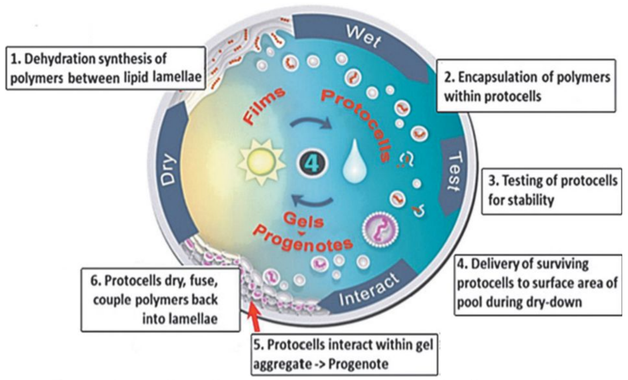
For more info and videos!

SCAN ME

Abstract

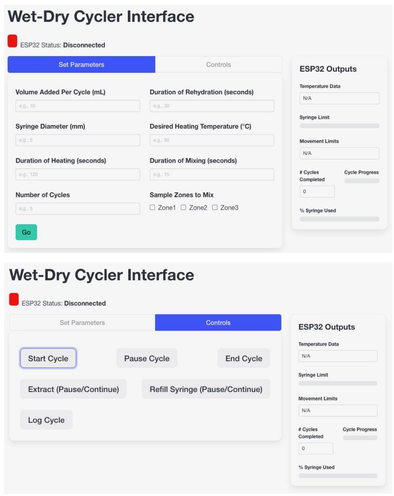


By automating the dehydration, rehydration, and agitation of ribonucleotides we simulate some environmental conditions of prebiotic Earth facilitating their optimizations for efficient abiotic RNA synthesis. A novel method to synthesize specific RNAs may also widen pharmaceutical uses of currently prohibitively expensive RNAs.

How It Works

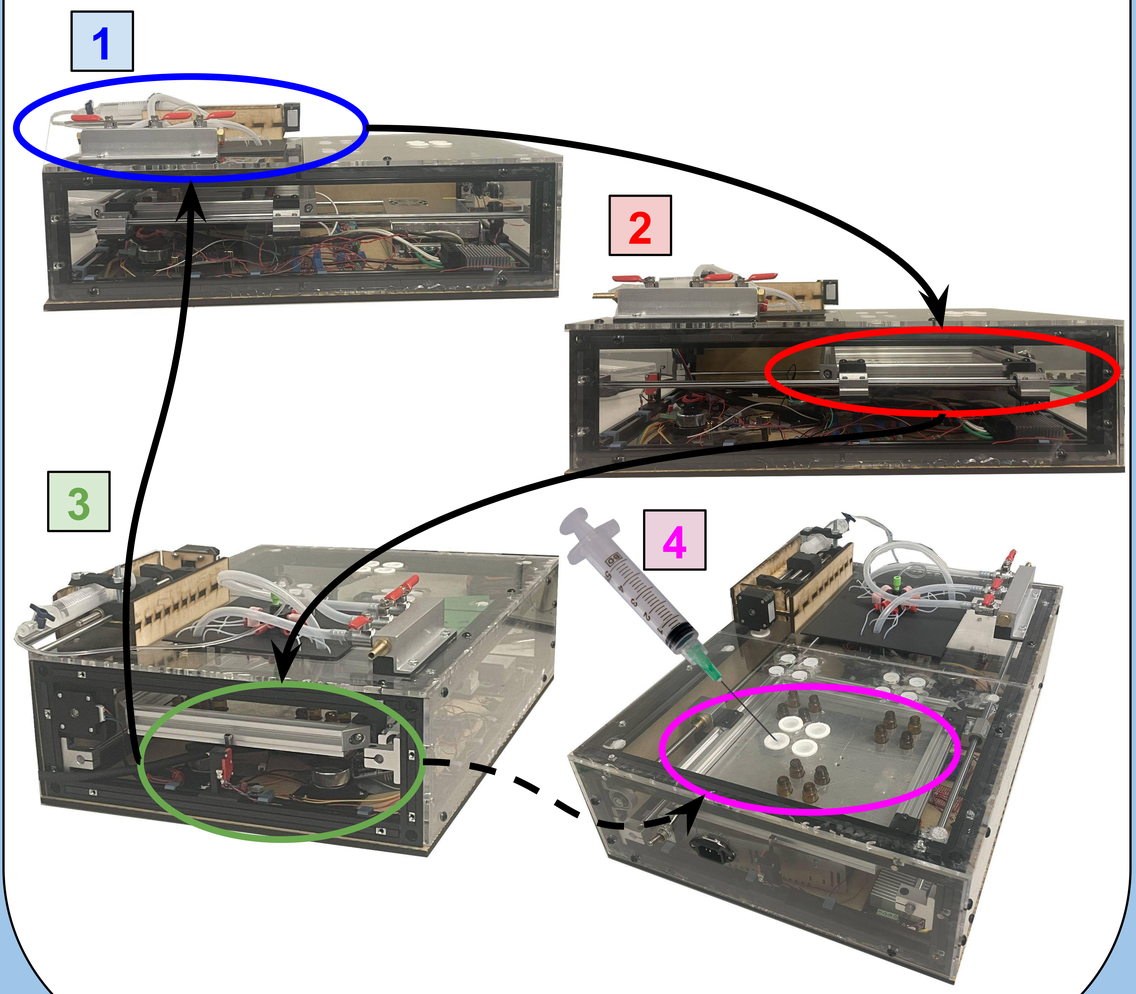
The GUI enables researchers to automate their experiment by changing parameters such as water volume, cycle time, number of cycles, and target temperature. The website displays real-time temperature control, system status, and progress for up to 12 vials.

Web Server

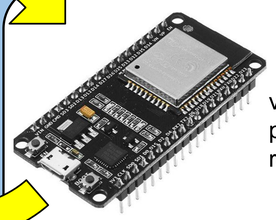


Our Solution

Our solution uses cost-efficient materials and accessible lab equipment to build a system that simulates some conditions of prebiotic earth.The device automates cycles of rehydration, magnetic agitation, and dehydration to mimic natural wet-dry environments found in hydrothermal regions. Sample ports allow extraction of intermediate stage reactions without disrupting the current cycle. This design offers precise control over parameters, consistent results, and affordability to support origin of life RNA research.

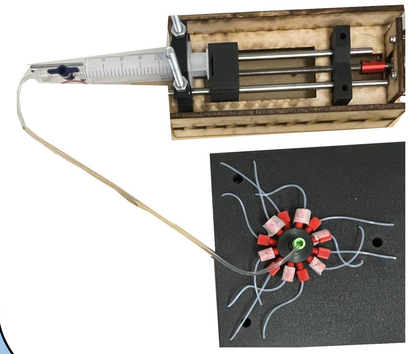


ESP 32



The ESP32 microcontroller acts as the system's central hub by connecting via web socket that communicates with the user's PC. It allows users to adjust parameters like water volume, temperature, and cycle timing, while managing real-time data from sensors.

1 REHYDRATION



A lead screw syringe pump precisely controls syringe movement to dispense water through a 13-port manifold. The manifold distributes the flow evenly to 12 sample ports.

2 DEHYDRATION

A silicone heating pad on the bottom of the aluminum plate uses bang-bang control to maintain the desired temperature within ±0.5°C during dehydration. The flow of CO_2 and N_2 gases over the samples aid dehydration.

3 MAGNETIC AGITATION

Samples are stirred using magnetic agitation. Small magnetic pills at the bottom of each sample are spun using rotating magnets attached to a DC motor.

4 EXTRACTION

For the extraction method, silicone X-cut circles are used, allowing a needle to be inserted and extract the sample. The extracted sample is then sent for analysis using gel electrophoresis, HPLC, nanopore sequencing and mass spectrometry.