



Colorado Science and Engineering Fair

2025 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Time-Sensitive Medicine Dissolution in a Microgravity Environment Emulated by Acoustic Levitation

Finalist's Name: Helen Wan

School and City: Pine Creek High School

Sponsor's Name: Sanjukta Lahiri

Category: Physics & Astronomy

Division: Senior (grades 9 - 12)

Abstract (250 words or less):

As humanity ventures beyond Earth, the challenges of space travel extend far beyond rocket science and astrophysics. Astronauts face extreme physiological stresses—cosmic radiation, muscle atrophy, bone loss, and cardiovascular strain. In deep-space missions, where medical resources are limited, ensuring reliable drug performance is critical. However, microgravity can alter how medications dissolve, absorb, and act within the body, potentially compromising their effectiveness.

This study investigates medication dissolution in microgravity using an acoustic levitator, which suspends small samples without physical contact. A custom-built 40 kHz levitator was developed, capable of levitating objects up to 4.0 mm in diameter and 15 mg in mass, including powders, crystals, and liquid-medication mixtures. To assess dissolution rates, medicine and water were placed on the node for set intervals. Direct weighing was unreliable due to retained moisture, so controlled microwave heating evaporated the water, and the final mass was determined using differential weighing.

Ground trials validated the methodology, producing dissolution rates consistent with literature. However, microgravity significantly altered dissolution rates. A mathematical model based on the Noyes-Whitney equation quantified these changes for the first time. Ibuprofen dissolved nearly twice as slowly, while Aspirin's rate decreased by 29%, suggesting altered diffusion dynamics.

This research lays the foundation for space-optimized pharmaceuticals, ensuring effective drug delivery in space. Beyond space travel, potential applications include pharmaceutical formulation advancements, improved drug delivery systems, and precision medicine technologies utilizing acoustic levitation for testing in low-gravity environments.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature:

Date:

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. **A signed copy of this form must be included in your notebook.**