



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: Paper for the Planet 2: Kickstarting Microbial Succession Following California Wildfires

Finalist's Name: Naomi Kruse

School and City: Schullandheim, Colorado Springs

Sponsor's Name: Tami Kruse

Category: Environmental Engineering

Division: Senior (grades 9 - 12)

Abstract (250 words or less):

With unnatural wildfires disrupting ecosystems worldwide, they are leaving behind toxic ash, depleted microbial communities, and barren landscapes. In urban environments, the microbial elements necessary for natural secondary succession are often absent, preventing recovery. This work looks at the development and use of a cellulose-based, seed and/or fungi-infused, biodegradable paper to kickstart microbial and plant succession in post-fire urban and hard-burn settings.

Paper for Planet integrates three key remediation strategies found in nature: (1) Neutralizing toxic ash—*Pleurotus ostreatus* to break down pollutants and stabilize soil pH (2) Restoring microbial communities—introducing arbuscular and ectomycorrhizal fungi to reestablish soil microbiomes, and (3) Enhancing plant establishment and carbon sequestration—most native wildflowers and all trees grow more successfully in mycorrhizal environments, and support long-term carbon storage.

The methodology involves the development of cellulose-based paper that contains precursors that mimic nature following fire, where fires neither burn too frequent nor too hot. Testing its effectiveness under post-fire conditions that include variations in ash exposure (ash-contaminated soil and groundwater) and microbial inoculation (*Pleurotus ostreatus*, arbuscular mycorrhizal fungi, and ectomycorrhizal fungi). I analyzed changes in pH, seed germination success, and mycelium growth over 21 days.

Measurements involved two programs I developed to quantify mycelium and seed germination. Mycelia Measure utilizes Otsu's method and grayscale thresholding to analyze heart-shaped samples. Codeledon Count utilizes leaf color pixel detection to count leaves.

Paper for the Planet successfully grows *Pleurotus* mycelium at a rate that correlates to its ability to neutralize ash soil H⁺ concentration. It is also a successful medium used to introduce arbuscular fungi and ectomycorrhizal fungi, along with their symbionts, to charred soils, demonstrating its potential to kickstart post-wildfire recovery.

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.**