

# 3D Digital Herbarium & 3D Exhibits4Learning

The California State Polytechnic University, Humboldt Library groundbreaking project 3DHerbarium.org version one was released open source on January 25, 2024. This immersive 3D web-based interface with augmented and virtual reality views enhances botanical education for all ages, connecting botany students, faculty, citizen scientists, and the community to learn and share knowledge. The goal of version two is to extend the platform for any discipline, from archeology to zoology, and to further advance the research in creating layered animated models that enable learners to explore specimens from the whole body to internal microscopic structures.

The 3D Digital Herbarium advanced the team's understanding of 3D photogrammetry methods for modeling thin complex shapes, such as leaves and plants. Additionally, the team discovered the need for a similar tool in a variety of disciplines and is evaluating various research interests to develop the roadmap for version two, called 3D Exhibits4Learning, an open-source software platform and documentation for other institutions to develop 3D models and to create their own environments.

Cyril Oberlander, Dean, Cal Poly Humboldt Library  
AJ Bealum, Programmer & Project Manager, Cal Poly Humboldt Library



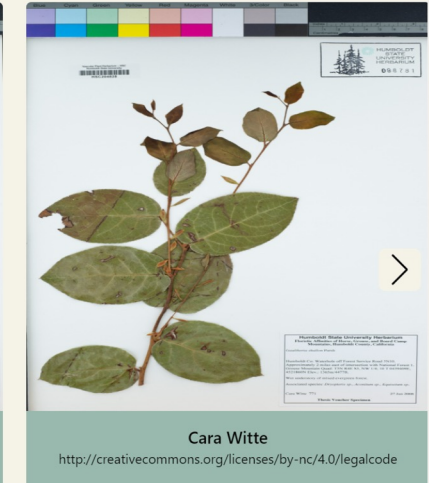
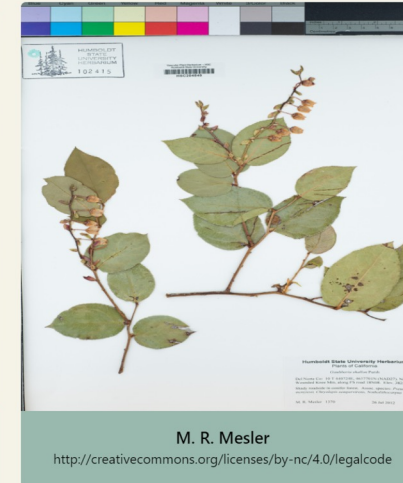
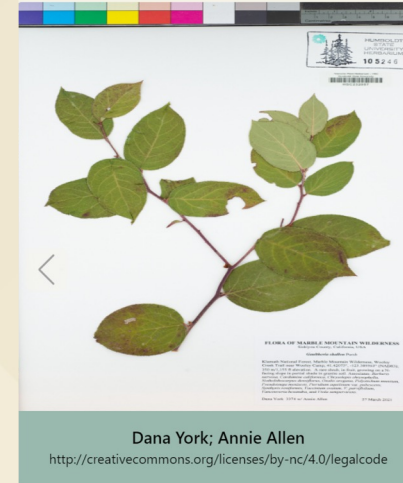
# ➤ Table of Contents

- 5 minute - Introduction
- 10 minute - Demo & Features
- 5 minute - Future of project
- 5-10 minutes Q & A

3DHerbarium.org

## Traditional Herbarium digitized in 2D

Images from the Cal Poly Humboldt Vascular Plant Herbarium



# Solution Engineering

# Video

## Curating Classroom + Co-Curricular Experiences as Innovative Project-based Learning Infrastructure

### Ideation

Dr. Bogle asks library for challenges to present to Fall Software Engineering Course



to build  
experience.

### Back to class?

Adapt Version 1: 3D Exhibits4Learning  
New Features or New Challenges?

### Summer

Cal Poly Humboldt Library  
Fall 2022 Computer Science Software Project Proposals

#### Interactive Digital Herbarium - Flora Touch Screen Kiosk Project

Make botany fun and interactive by developing an interactive digital herbarium database that is optimized for touchscreen and mobile phones, more about [virtual herbariums](#). See [HerbUX conversation](#)

Examples:

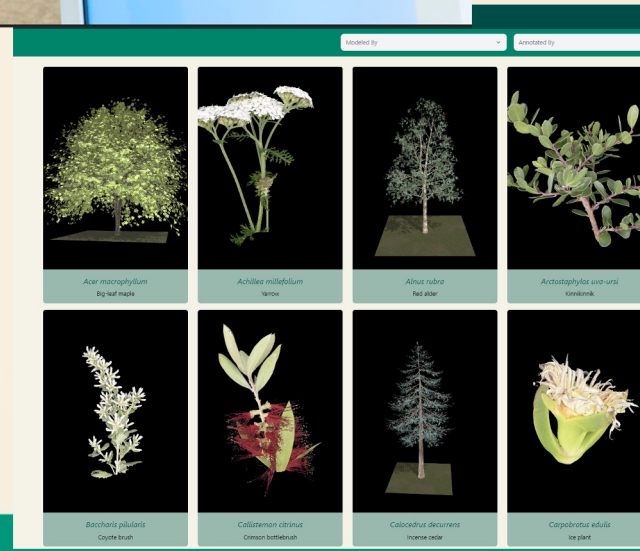
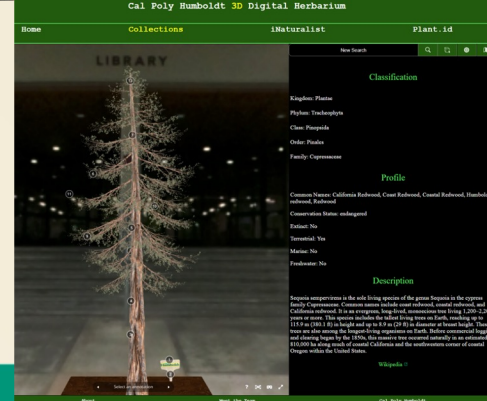
- [California Herbaria](#)
- [Infinite Herbarium \(Art/Science/Machine Learning\)](#)
- [New York Botanical Garden](#)
- [Flora of Wisconsin](#)
- [HerbUX Project \(Brown University\)](#)
- [Australasian Virtual Herbarium](#)
- [Harvard University Herbaria](#)
- [Texas Oklahoma Regional Consortium of Herbaria](#)
- [Charles Sturt University - Virtual Herbarium \(Grasses Guide\)](#)
- [Open Science Network Herbarium Databases](#)
- [Appalachian State University Herbarium Resources](#)
- [UConn Biodiversity Research Collections](#)
- [Plant Finder Touchscreen Kiosk](#)
- [Augmented Reality concept video "Power to the Plants"](#)
- [3D Scan of Botanical Gardens and 3D botanical models](#)
- [PlantShare](#)
- [Cal Poly Humboldt Library Guide on Redwoods: https://libguides.humboldt.edu/c.php?g=3038286&e=2025821](#)

APIs:

- [Plant.id API is machine learning plant identification service](#)
- [iNaturalist](#) and [iNaturalist API](#) and [Python version](#). [iNaturalist open data](#), for more, see [iNaturalist on GitHub](#)
- [Simulated Plant Growth Modeling: https://en.wikipedia.org/wiki/Simulated\\_growth\\_of\\_plants](#)


Microscopic or Segmentation Views

- [Microscopic view of Redwood](#)



## How to make a 3D immersive Botany experience?

Collections iNaturalist Plant.id Annotations



**1** Taxonomy and Description

**7**

**3**

**5**

**6**

Classification

Profile

3D Model

Species: *Gaultheria shallon*  
Kingdom: Plantae  
Phylum: Tracheophyta  
Order: Ericales  
Family: Ericaceae  
Genus: *Gaultheria*

Common Names: Shallon, salal, shallal  
Extinct: No  
Habitat: Terrestrial  
Freshwater: No  
Marine: No

Build method: Photogrammetry  
Created with: Blender, Photocatch, Sketchfab


Ima  
Model  
Annotator:

Specimen Search Collections iNaturalist Plant.id Accessibility

Welcome to the 3D Digital Herbarium

Check out our 3D Models on the Collections page, see user uploads on iNaturalist or identify an unknown specimen with Plant.id. You can also see interior components of a pine tree below with our newest, experimental feature!

*Pinus* (Pine)  
Pinus is a genus of gymnosperms in the family Pinaceae. There are many living representatives of this genus in California and throughout the world.



Annotated by: Heather Davis  
Model by: AJ Bealum

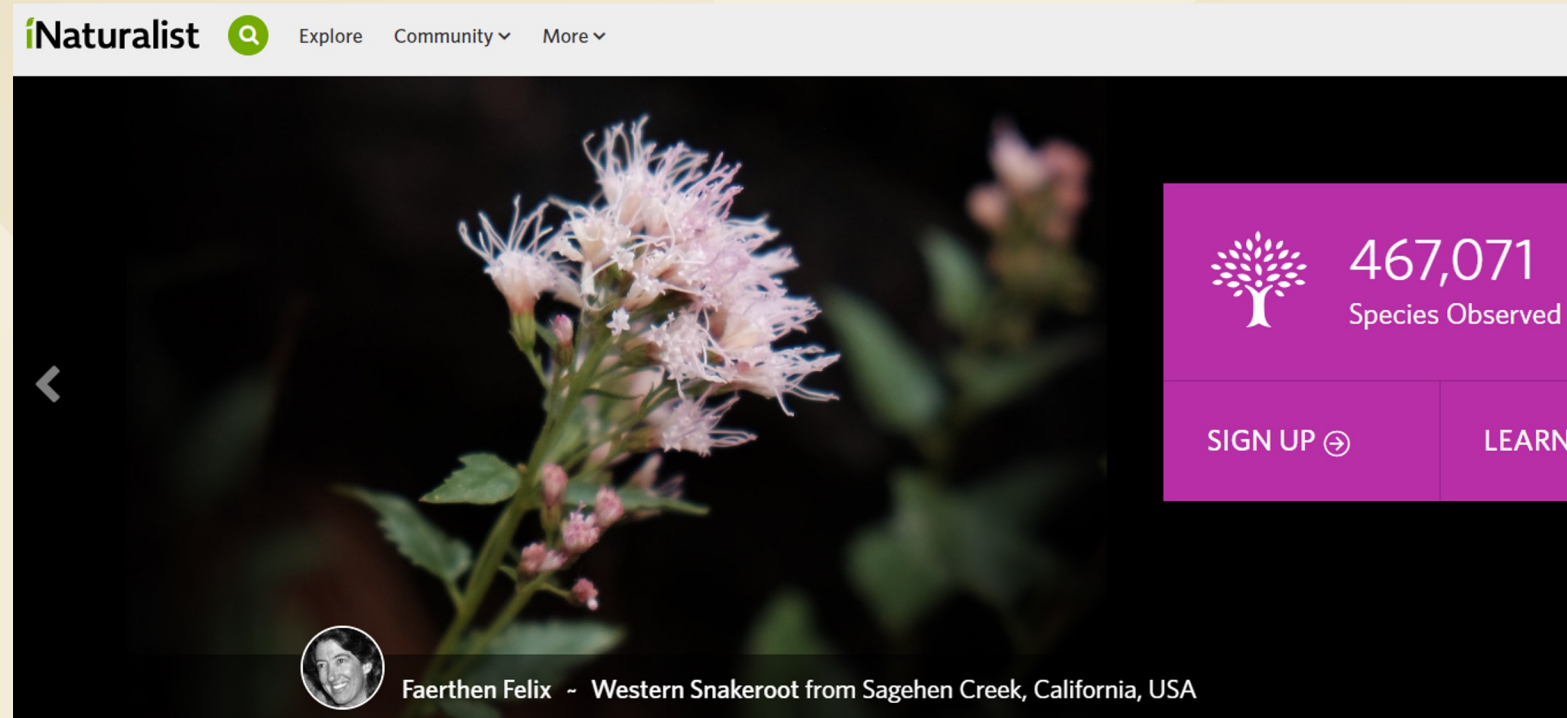
Cal Poly Humboldt

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## Live Demo



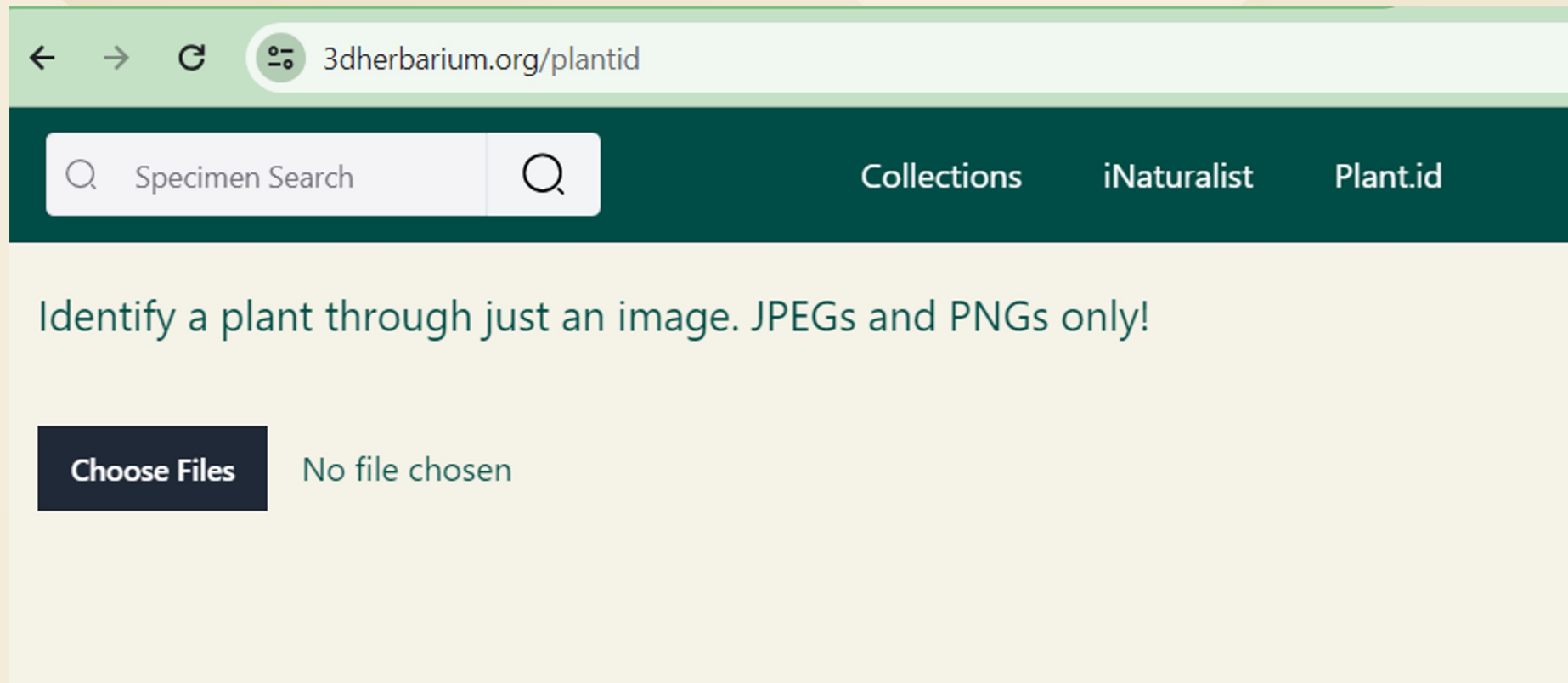
**iNaturalist: 175M observations by over 7.3M members: community scientists, biologists, naturalists... & used by Cal Poly Humboldt Botany Students for Plant Identification**



## Demo

- See user uploads from the social network for naturalists and biologists, iNaturalist.
- Content can be filtered through options on the map, these include:
  - Filter by location (including options for radius size)
  - Filter by observation grade (verifiable, research or any)
  - Filter by observation date
- Being a social media site, iNaturalist also provides data about the most active users regarding a given specimen.
- These results are also filtered through the map options allowing the user to find local, active users interested in the same biodiversity as themselves.
- Students in Botany taking Plant Taxonomy/Identification classes use iNaturalist for assignments


- Exactly as it sounds, Identify a plant from a photo.
- Results appear in the order of what the image of your plant is most likely to be (with likelihood percentage).
- Clicking on a given result will reroute you to collections page for that particular specimen.





# Future

- 3DHerbarium.org an experimental feature to view inside the specimen using opacity slider... a potential feature of the herbarium
- The 3D Herbarium is just the beginning of a general 3D learning tool, the 3DExhibits4Learning
- Mushroom 3D model
- Vertebrate articulated skeleton 3D model




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Phloem (100x magnified)  
In Pinus wood, we also have phloem cells that make up a portion of the vascular tissue that is located outside of the xylem.

Xylem (40x magnified)  
In Pinus wood, there are specialized cells known as xylem which are responsible for transporting water and minerals throughout the plant body.

Annotated by: Heather Davis  
Model by: AJ Bealum

# ➤ Future... roadmap to 3D Exhibits4Learning

We welcome feedback & suggestions

IMLS Planning grant submitted, awaiting to hear if granted.

Cal Poly Humboldt Library Planning Grant Proposal  
LG-255157-OLS NLG to IMLS National Leadership Grant Program  
3D Digital Herbarium & 3D Exhibits4Learning  
Narrative

## Introduction

After a year of photogrammetry research and software development, the Cal Poly Humboldt Library launched the world's first 3D Digital Herbarium ([library.humboldt.edu/3d-digital-herbarium](http://library.humboldt.edu/3d-digital-herbarium)) encompassing over forty 3D models, with the release of the Version 1 [open source](#) software on January 24, 2024. Our 3D Digital Herbarium showcases 3D specimens, relevant 2D digitized herbarium specimen sheets, botanical and location information, and student annotations. Our initiative was to create an immersive 3D web-based interface that inspires and improves botanical education to all ages by making herbarium information more accessible, and connecting botany students, faculty, citizen scientists, and community to learn about native plants in California. The project provides an engagement framework for students to develop their skills with 3D modeling and communicating science worldwide, while also expanding learners' access to specialized collections within an immersive learning experience.



14 month planning process to build:

Flexible open-source immersive prototype platform for galleries, libraries, archives, and museums to showcase their collections:

**3D Exhibits for learning any discipline!**

- Customizable configuration and APIs
- Editorial submission workflows for teams, courses, and shared projects.
- Explore Omeka integration.
- Interactivity features for learner engagement; flashcards, games, quiz...
- Partner feedback and evaluation of mockups and prototypes
- Photogrammetry and workflow training documentation.
- Preservation options



# > Thank you, questions?

**What is your vision for the future of learning in digital environments?**

What are the learners' behaviors and expectations for learning?

What research activities align how we approach these questions?

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