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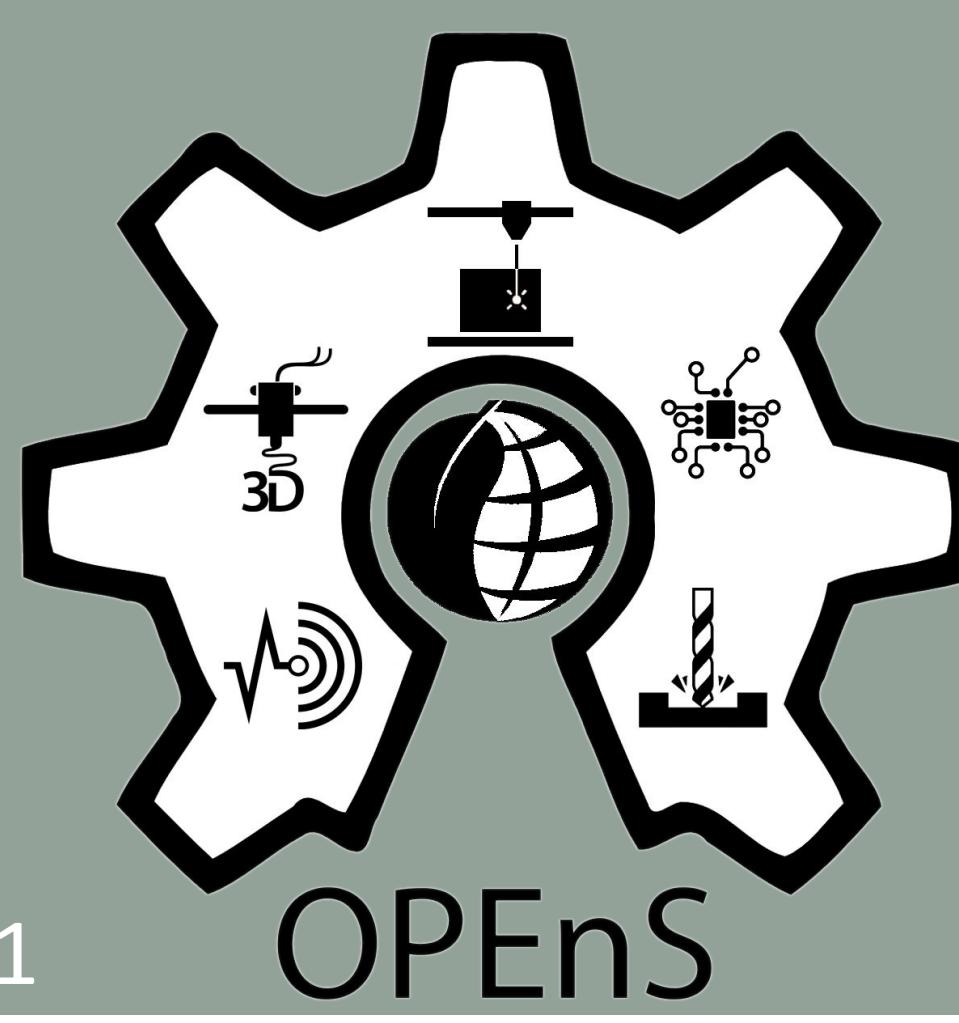
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# Openly Published Environmental Sensing (OPEnS) | Advancing Open Environmental Instrumentation

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## ABSTRACT:

- Questions that we ask, things that we observe - are shaped by our instrumentation. What we make, makes us.
- Scientific instrumentation ought to be driven by the questions we want to ask, not by what we know how to measure.
- Sharable digital files can readily become physical objects (through 3D printing); low-cost sensor technologies are becoming relatively more accurate and less expensive; wireless communication is ubiquitous and capable; and there is a growing community of researchers who seek to apply these capacities to advance scientific observations.
- Barriers persist which have largely obviated the adoption of these transformative technologies including: learning curves, assembly and management of interdisciplinary teams, and access to the required equipment.
- The OPEnS Lab (founded 2016) is a USDA and NSF initiative where engineering students help researchers expand instrumentation.

## PURPOSE



**Interdisciplinary:** we educate and mentor 36 undergraduate researchers across Electrical, Computer Science, Mechanical, Industrial, and Ecological Engineering.

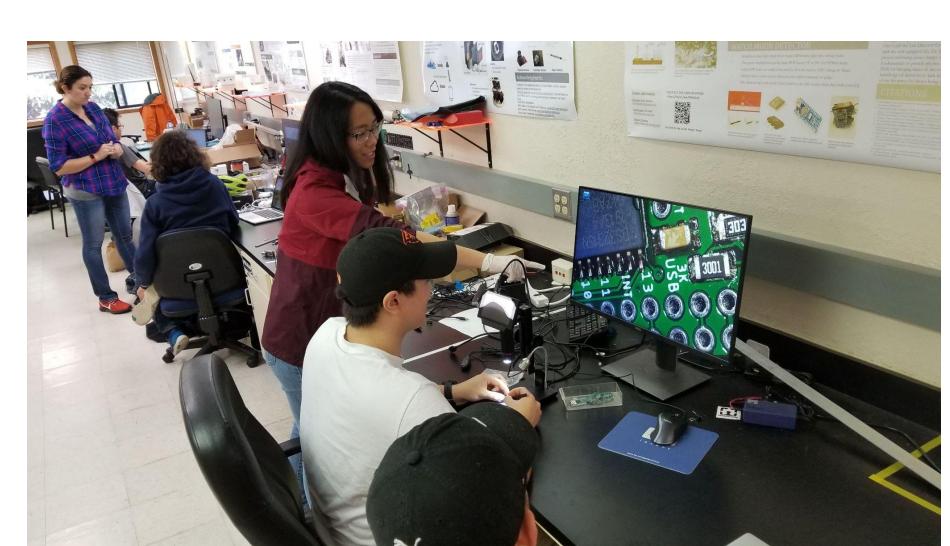
### Over 200 students served.

**Collaborative:** design solutions to sensing barriers with professor PIs, regional (DOT, Sanitation) & national (USDA, NOAA, EPA) agencies, and native coastal communities incorporating Traditional Ecological Knowledge.

**Transformational:** 20 projects span measurement challenges across the geosphere presented by the USA, Africa, and Europe. We select for high-impact and feasibility.

**OPEN:** Everything we produce is published in open-access journals and on GitHub.

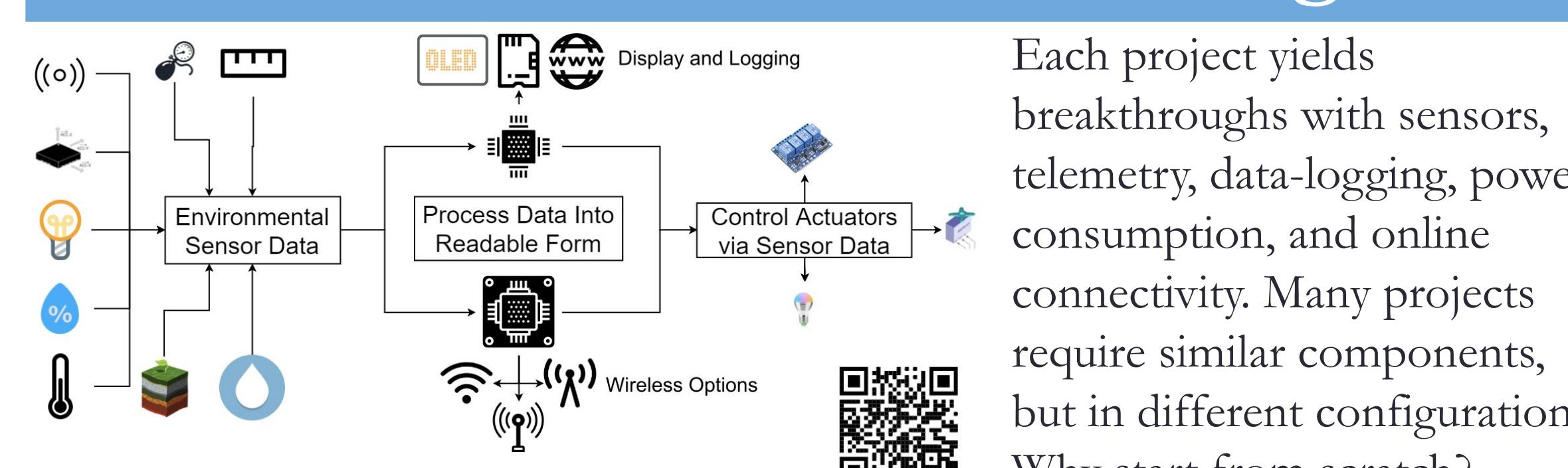
**Educational:** We provide a unique real-world training environment by combining environmental sensing needs with engineering and produce resilient, experienced designers bound for grad school and industry.



OPEnS students evaluating a newly reflowed PCB for quality and defects with an electronic microscope

Undergraduate engineering student installing OPEnS Dendrometer on a grapevine.

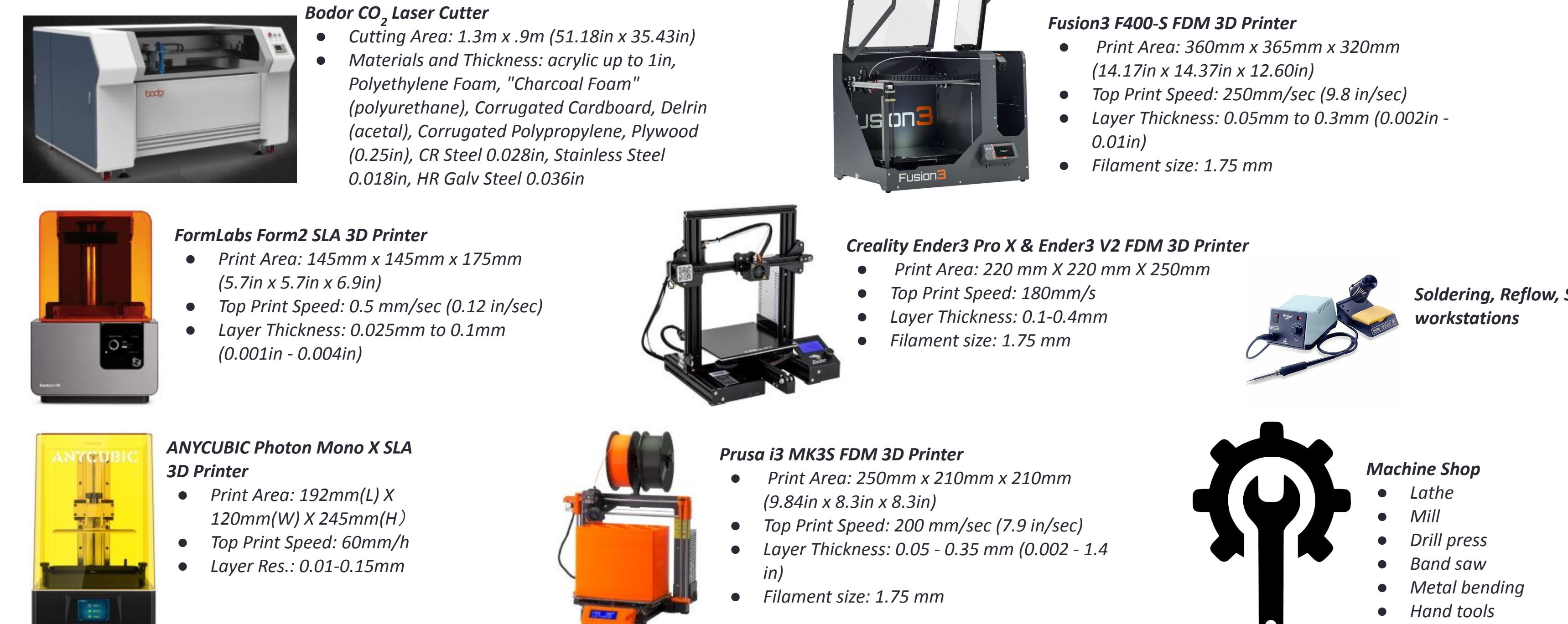
## Can we solve in-situ sensing?



**Loom:** Designed by OPEnS, each new component, once proven, is modularized into a reconfigurable architecture. Subsequent projects can enable and recombine modules to create new devices faster.

## WE PROVIDE

With just a few strategic machines, a little space, and a collaborative group of diverse people, we can accomplish a great deal.



## SELECTED DESIGNS

[scan QRs to view project online]



## LESSONS LEARNED

- Undergraduate students can be especially successful working on well-defined problems, founded in the client's specifications / requirements.
- Keeping the project-to-mentor ratio low facilitates accountable environment, skills training, and collaborative problem solving. Lab PI (Dr. Selker), Director (Dr. Udell) each manage a subset of projects based on specialty and project needs, determined each term.
- Many design-and-deploy iterations are required to reach robust solutions. Each repetition reveals new discoveries and opportunities for improvements.
- Projects are multi-generational, high student turnover. Requires strict documentation practices for new students to onboard effectively.
- New projects typically require over a year to go from concept to the field. Base funding provided by the NSF and USDA has been essential.
- Despite social distancing spurring innovations in collaboration, there are many critical aspects to in-person collaboration for which there are no good remote alternatives.
- Base funds help provide the essential resources to support the lab director (Dr. Udell), other administrative staff, and student designers.
- We seek student commitments on average of 2 years or more to make training feasible with project turnover.

## RESULTS



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11. + 6 more articles in drafting or under review!

Undergraduate authors

## GET INVOLVED

OPEnS invites you to join and contribute to this dynamic virtual engineering community.

- Sponsor a Project as a Partner
- AGU / EGU Joint Sessions
- OPEnS Virtual Expo
- DIY Sensor Workshops, Virtual or In-Person
- Help Test and Evaluate
- OPEnS Extern Program sends our staff to your lab for a summer
- We accept Interns any time of the year!



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