The TIMESTEP Research Apprenticeship Program

Research Training for Sophomores Majoring in Physics and Astronomy at UArizona

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The TIMESTEP Research Apprenticeship Program is an academic year program that offers participating students a paid opportunity ($15.5/hr) to build technical and professional skills that are transferable to both research positions and internships in industry. The program was piloted in Fall 2022-Spring 2023 with 7 students and expanded in Fall 2023-Spring 2024 with 10 students.

Students spend two semesters working with a faculty mentor and graduate students in a UArizona Astronomy or Physics research lab, gaining hands-on experiences in hardware and/or computing. The program aims to engage students who are marginalized in Astronomy and Physics, reaching them within their first two years of study with the aim of increasing retention of a more diverse student pool. This program is funded by TRIF funding through UArizona RII.

2023-2024 TIMESTEP Research Apprenticeship Program

10 Apprenticeship students were selected out of 21 student applicants. All selected students are astronomy and/or physics sophomores, except for one student who is a sophomore majoring in Optical Science & Engineering. Two astronomy graduate students (Vikram Manikantan and Meredith Stone) were hired to mentor students in the program. Image of the student cohort is below, taken after the students presented posters on their research projects in the end-of-program research symposium, held in April 2024.

Front row (L to R): *Vikram Manikantan (Grad Coordinator), Aakanksha Adya, Drishikaa Thimmaiah, Grace Gibbins, Suhani Surana, Meredith Stone (Grad Coordinator)*
Back row (L to R): *Philip Klaassen, Diego Torres-Barajas, Keenan Fiedler, Rohan Desia-Hunt, Pranav Chiploonkar, Namit Chandak*

Demographics of Undergraduate Applicants: (21 total)

24% Hispanic, 48% Asian, 28% White
29% Female
24% PELL Recipient; 39% Eligible for Federal Work Study

Demographics of Accepted Undergraduate Apprenticeship Students: (10 total)
10% Hispanic, 50% Asian, 40% White
40% Female
10% PELL Recipient, 30% Eligible for Federal Work Study

The Apprenticeship focuses on two specific skill areas: Computation and Hardware/Software. Participating UArizona research labs focus in areas similar to a participating TIMESTEP Internship employer or that enable the development of skills that are mapped to a participating employer.

4 Faculty Research Groups Participated in the 2023-2024 program, including:

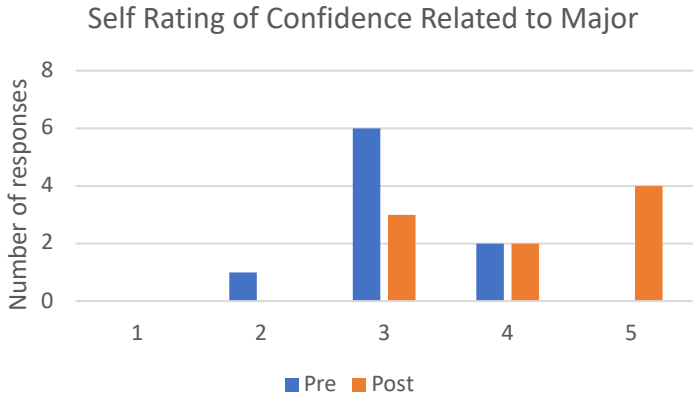
- Computing Research in Astrophysics
  - Dr. Tim Eifler (Astronomy) – 3 students
  - Dr. Eduardo Rozo (Physics) – 2 students

- Hardware & Software in Astrophysics
  - Dr. Ewan Douglas (Astronomy) – 3 students
  - Dr. Dan Marrone (Astronomy) – 2 students

Goal 1: To build a program that is valued by students and supports students to continue in their major

In focus groups with our program evaluator, Dr Sanlyn Buxner, the 2023-2024 apprenticeship students reported high satisfaction with the Apprenticeship program:

- 100% of the students reported that they would highly recommend the program to peers
- Students report increase in confidence in their ability to perform in their major after the apprenticeship (see right; pre/post survey where students rated their confidence on a 1-5 scale where 1 is "low confidence" and 5 is "high confidence").



I think this program was the single most valuable experience I have had in my professional life to date. There is nothing that I could think of to change; thank you for such a wonderful year working with TIMESTEP! - 2023-2024 Apprentice

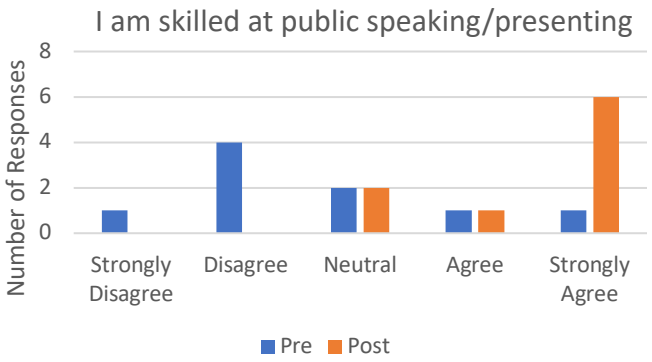
Incredible program, absolutely changed my entire undergraduate experience and I will be very grateful for the many, many doors TIMESTEP opened up for me!! - 2023-2024 Apprentice

Goal 2: To prepare students to succeed in a research or industry position through skill building

The Apprenticeship is designed to provide all students with a set of CORE Skills and a set of ADDITIONAL Skills that are dependent on the project (see table below). These skills are not embedded within the standard Physics/Astronomy curriculum. TIMESTEP runs workshops (1-2/month) to enable students to learn the CORE Skills. The ADDITIONAL Skills are taught by the Research Group PI.

CORE Skills (completed by all apprentices)	***ADDITIONAL Skills (project-dependent)***
Reading scientific papers	*Networking (SSH)*
Literature review & NASA Astrophysics Data System	*Creating block diagrams*
Linux Command Line	*UA High Performance Computing (HPC)*
Python	*Computer vision (image processing-eg. OpenCV and some Scikit image processing features)*
Version control-Git, GitHub, Git Client	*Databases, SQL*
Overleaf- LaTeX	*Drafting (r/t Solidworks, CAD)*
Debugging (e.g. Reading error messages/Stack overflow)	*Basic optics*
Visualizing data (Matplotlib)	*Soldering*
FORGE playshops in core identity and resilience	*3D printing*
SECD Professional Communication online module	*Circuit design*
RezBaz Computational Training program	*Bayesian inference*
	Machine learning (e.g. PyTorch)
	Microwave electronics and RF testing
	Digital signal processing

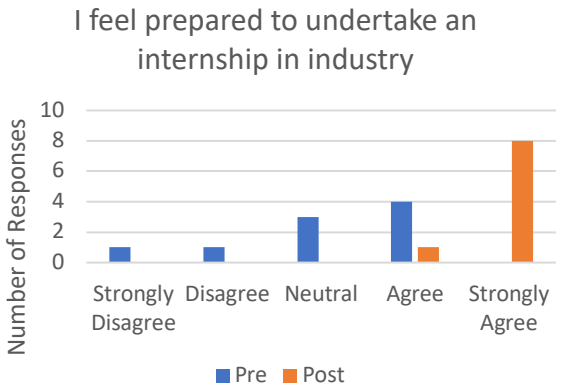
Students self-reported substantial increases in their experience in research skills, such as: reading scientific papers, public speaking and presenting about their research, familiarity with the Linux command line, Python, version control (Git and GitHub), debugging, and visualizing data.



I learned the overall expectations and setup of research. I learned the balance of working independently but reaching out when I need help. I also really learned how to advocate for myself.

- 2023-2024 Apprentice

We partnered with UArizona SECD to offer "Build the Skill" workshops for apprenticeship students that focused on Communication and Leadership Training. Students self-reported significant increases in their feelings of being prepared for internships in industry and for research positions after the apprenticeship (see graphs on the next page; data from surveys administered at the beginning and end of the apprenticeship).



Goal 3: For students to land a research or industry position post-Apprenticeship

- 9/10 students from the 2023-2024 cohort were accepted to a research program or industry internship for Summer 2024. The 10th student is working in science education.
    - 7 were accepted to the TIMESTEP Internship program and will be working with a Tucson-based employer in the tech industry in Summer 2024.
    - 1 was accepted to an REU at MSU Solar Astronomy & Space Physics
    - 1 was accepted to the Science Undergraduate Laboratory Internship (SULI) at Fermilab
    - 1 is working at a science center with youth in Minneapolis in Summer 2024

- Apprenticeship Alumni: One year later, we surveyed the 7 students who were part of the 2022-2023 Apprenticeship cohort. 6/7 students responded to the survey.
    - 3 students have graduated and are starting graduate school in Fall 2024.
    - 3 students are doing research this summer and plan to graduate in Dec 2024.
    - All students reported that the TIMESTEP program helped them to take advantage of, and succeed in, opportunities:

TIMESTEP is the main reason I am currently employed and am attending graduate school this next fall.

– Chance Lawrence 2022-2023 Apprentice (Graduated Spring 2024; starting in graduate school in Optics at UArizona in Fall 2024)

[TIMESTEP] gave me firsthand experience working in the industry that I want to work in. Showed me that it was possible if I worked hard and put myself out there.

– Jonathan Moreland 2022-2023 Apprentice

TIMESTEP helped me get another research position in the Computer Science department in January 2024, as various events and people in the program helped me fine-tune my resume and writing skills.

– Jonah Lotz 2022-2023 Apprentice