The TIMESTEP Research Apprenticeship Program
Space Workforce Training for Sophomores Majoring in Physics and Astronomy at UofA

PI: Gurtina Besla, Co-I: Ewan Douglas, Program Manager: Rebecca Lipson

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 the Space and Technology sectors. The program was piloted in Fall 2022-Spring 2023 with 7 students and expanded in Fall 2023-Spring 2024 with 10 students and in Fall 2024-Spring 2025 with a cohort of 13. This program is funded by TRIF AWD and the UofA Office of Societal Impacts.

Students spend two semesters working with a faculty mentor and graduate students in a UofA Astronomy or Physics research lab, gaining hands-on experiences in instrumentation and computing. The program aims to engage students early in their Astronomy and Physics careers, reaching them within their first two years of study with the aim of increasing retention of students with limited prior research experience opportunities. This program is critical to build the space workforce, where instrumentation and computing skills are in demand, but the barrier to entry is high.

2024-2025 TIMESTEP Research Apprenticeship Program

13 Apprenticeship students were selected out of 21 student applicants. All selected students are astronomy and/or physics sophomores. Two Astronomy graduate students (Vikram Manikantan and Meredith Stone) and one Optics graduate student (Eden McEwen) 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 2025 after a UA TAP Colloquium.

(L to R): Rebecca Lipson (Program Manager), Eden McEwen (Grad Coordinator), Tristan Flores, Dulcie Quinn, Zeke DeLaughter, Magdalena Sammut, Niko Cooper, Anshul Shankar, Austin Golinkin, Rebekah Boisvert, Dantae Harris, Claire Srodawa, Quinn Komar, Camille Cioffi, Joel Shernicoff, Meredith Stone (Grad Coordinator), Vikram Manikantan (Grad Coordinator)

Demographics of Undergraduate Applicants: (30 total)
36% BIPOC
27% Female
30% PELL Recipient; 10% Eligible for Federal Work Study

Demographics of Accepted Undergraduate Apprenticeship Students: (13 total)
31% BIPOC
46% Female
23% PELL Recipient, 8% Eligible for Federal Work Study

The Apprenticeship focuses on two specific skill areas: Computation and Hardware/Software. Participating UofA 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.

7 Faculty Research Groups Participated in the 2024-2025 program, including:
- Computing Research in Astrophysics
  - Dr. Tim Eifler (Astronomy) – 2 students
  - Dr. Eduardo Rozo (Physics) – 2 students
  - Dr. Carl Fields (Astronomy) – 1 student

- Hardware & Software in Astrophysics
  - Dr. Ewan Douglas (Astronomy) – 3 students
  - Dr. Dan Marrone (Astronomy) – 2 students
  - Dr. Erika Hamden (Astronomy) – 1 student
  - Dr. Eric Pearce (Astronomy) – 2 students

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

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In focus groups with our program evaluator, Dr Sanlyn Buxner, the 2024-2025 apprenticeship students reported high satisfaction with the Apprenticeship program.

> *"I love this program, I think it helps undergrads get into research, which is super important for this field."*

Has this program motivated you to continue in your degree? (n=12)
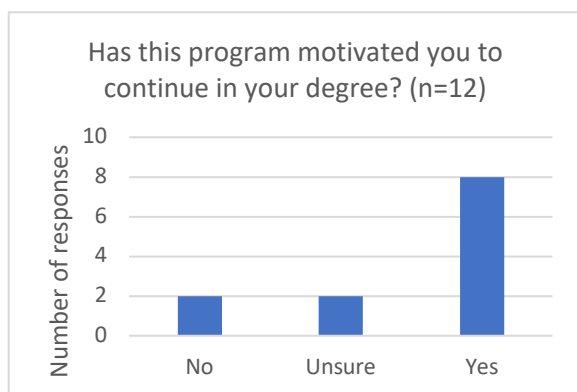
Students particularly appreciated support from Grad Student mentors who were near peer mentors and let them ask questions they were afraid to ask other mentors.

Students report that the program has motivated them to continue their degree (see left). Two who have reported "no" have since switched to a different major in the College of Science at UA.

"This research experience has reaffirmed how much I enjoy the research process and has directed me towards pursuing a postgraduate degree in Astronomy (which is my current major)."

"Research is the most motivating thing for me to continue my degree in Physics. TIMESTEP provided me with the chance to do research, and therefore motivated me to continue research."

"Actually being able to do research has allowed me to see what I may be doing after I graduate, and now that I have a better idea of what that looks like, this is motivating me to continue."

Goal 2: To prepare students to succeed in the space workforce: both in research or industry through skill building in instrumentation and computing
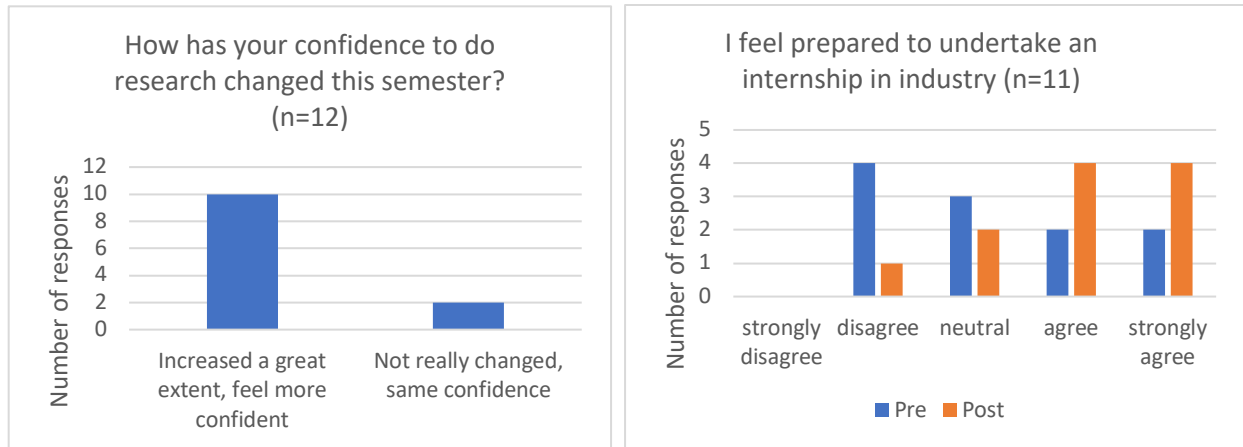
The Apprenticeship is designed to provide all students with a set of CORE Skills and a set of ADDITIONAL Skills that are dependent on the project (see table below). These skills are not embedded within the standard Physics/Astronomy curriculum. TIMESTEP runs workshops (1-2/month) to enable students to learn the CORE Skills. The ADDITIONAL Skills are taught by the Research Group PI. These cover key skills needed to enter the space workforce (instrumentation and computing)

CORE Skills (completed by all apprentices)	*ADDITIONAL Skills (project-dependent)*
Reading scientific papers	*Networking (SSH)*
Literature review & NASA Astrophysics Data System	*Creating block diagrams*
	UA High Performance Computing (HPC)
Linux Command Line	*Computer vision (image processing-eg. OpenCV and some Scikit image processing features)*
Python	
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*
	Soldering
Visualizing data (Matplotlib)	*3D printing*
FORGE playshops in core identity and resilience	*Circuit design*
SECD Professional Communication online module	*Bayesian inference*
RezBaz Computational Training program	*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.

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

Students self-reported significant increases in their feelings of being prepared for internships in industry and for research positions after the apprenticeship (see graphs).

How has your confidence to do research changed this semester? (n=12)

Number of responses

12
10
8
6
4
2
0

Increased a great extent, feel more confident | Not really changed, same confidence

I feel prepared to undertake an internship in industry (n=11)

Number of responses

5
4
3
2
1
0

strongly disagree | disagree | neutral | agree | strongly agree

■ Pre ■ Post

The program is successful in supporting students to obtain positions after the apprenticeship. 100% of students from the 2024-2025 cohort were accepted to a research program, education position or industry internship for Summer 2025.

- o 8 students were accepted to the TIMESTEP Internship program and will be working with a Tucson-based employer in the Space and Technology sectors.
- o 2 students were accepted to an NSF REU (U Florida, Virginia Tech)
- o 2 students were accepted to internships at National Labs (JPL, Los Alamos)
- o 1 student is working as a STEM Camp Instructor

2023-2024 Apprenticeship Alumni Outcomes: One year later, we surveyed the 10 students who were part of the 2023-2024 Apprenticeship cohort. 6/10 students responded to the survey.
- o 1 student has graduated and are starting graduate school in Fall 2025.
- o 100% of students have research or internships for Summer 2025, including 2 NSF REUs.
- o All students reported that the TIMESTEP program helped them to take advantage of, and succeed in, opportunities:

I have such a great base knowledge for research and I think that is one of the reasons why I have gotten into two different summer research programs. – Grace Gibbins 2023-2024 Apprentice

I think my participation in the TIMESTEP apprenticeship was key to each of the opportunities I have gotten since then. In particular, the full year of research and skills to put on a resume (Github, HPC, etc.) made me have great experience for applying to other opportunities. - Keenan Fiedler 2023-2024 Apprentice

The experience was awesome! It is one of the highlights of my undergraduate exprerience. It continues to help me succeed even just a year later! - Drishikaa Thimmaiah 2023-2024 Apprentice

Thank y'all so much for such a fulfilling experience, I would not be where I am now without this amazing program! - Grace Gibbins 2023-2024 Apprentice