

GROWTH focuses on creating a pipeline of STEM-trained students, educators, and workers through undergraduate and graduate courses, which engage students in data-driven discovery, expose them to research in astronomy and astrophysics, and develop their interest in research. Four courses were offered in Spring 2017; results for three are presented here.

### Key findings and recommendations:

- Most respondents were interested in conducting astronomy/astrophysics research. To help facilitate this, project leads should consider the following: 1) sharing research opportunities in the syllabus and during class; 2) recruiting students to participate in the GROWTH internship; 3) keeping in contact with students after the course ends, such as adding them to the GROWTH newsletter mailing list or emailing them with news, updates, and opportunities.
- Some undergraduate respondents did not feel the course material was presented in a logical step-by-step order. Perhaps this is because of familiarity with content, as graduate student respondents did not have any concern about the order in which material was presented. To address undergraduate students' concerns, instructors should consider sharing at the beginning of the course, and throughout the semester, why material is presented in a certain order.

Course names, student level, number of students (survey response rate), and key demographics are displayed below.

Course	Student level	# of students in course (survey response rate)	Key demographic characteristics
AS6005- Advanced Astronomical Observations	Graduate	7 (71%)	5 Males; 5 MAs in Astronomy/Astrophysics
YSC2217- Observational Astronomy	Undergraduate	6 (67%)	3 Males; 1 STEM major
A51- Advanced Introductory Astronomy	Undergraduate	19 (37%)	3 Females; 1 URM; 4 STEM majors

## AS6005– Advanced Astronomical Observations (National Central University, Taiwan)



AS6005 is a continuation to National Central University's Observational Astronomy course offered in the fall semester. The course teaches students the basic skills needed for optical astronomy such as telescope operation, data reduction, and time series analysis. Five respondents completed the survey.



### Course impact

Respondents agreed the course impacted their knowledge of the field, knowledge of skills necessary for astronomical observation, and interest in astronomy and astrophysics. Given this is a graduate course, respondents are likely highly motivated to engage and learn.



### Course effectiveness

Respondents felt the course:

- Had an instructor that was knowledgeable about the material and facilitated the course well
- Stimulated their interest and thinking
- Raised challenging questions
- Provided valuable opportunities to collect/use real world data



### Future plans

All respondents are interested in astronomy and astrophysics research. Four shared the course **positively affected their interest** in pursuing further education/career in STEM and three plan to pursue a PhD.



Intend to pursue a PhD



Undecided about PhD

*"I learned how to use large and professional telescopes and process data to know the properties of stars, galaxies, and other objects. That is what I couldn't do before this course. After this course, I feel more like that I am becoming an astronomer rather than an amateur."* - Graduate student

## YSC2217– Observational Astronomy (Yale-NUS College, Singapore)



YSC2217 is an undergraduate course offered by Yale-NUS College in Singapore and was taught by a project member from a US partner institution. The course focused on observing astronomical phenomena and conducting research with the observations. Five respondents completed the survey, though one did not answer all questions.



### Course impact

The course impacted respondents' knowledge of the field and techniques. Four had **increased excitement and passion** for astronomy/astrophysics.

The course increased my understanding of the research process in astronomy/astrophysics.



### Future plans

Two students are interested in participating in future research projects.



Interested in participating in astronomy/astrophysics research projects



Not interested in participating in astronomy/astrophysics research projects



### Course effectiveness

Nearly all respondents found the instructor and the course effective and felt the course **offered a valuable learning experience**. **Two did not feel the information was presented in a logical step-by-step order**, suggesting students may need clarification or explanation of how the course is structured.

*"I would be interested in conducting astronomy research as a hobby/class project/short-term summer programme, but may not as part of a major or career. I enjoy doing it at a leisurely pace just for personal interest."* - Undergraduate student

## A51- Advanced Introductory Astronomy (Pomona College, USA)



A51 is an advanced introductory course offered by Pomona College in California. This course explores the modern and historical scientific techniques that have been implemented to develop the current view of the Universe and its evolution. Seven respondents completed the survey.



### Course impact

Findings suggest that the **course had a positive impact on students' knowledge of the field**. Notably, all respondents strongly agreed that their **overall astronomy/astrophysics knowledge increased**, suggesting that the course provided a good introduction to the topic area. Six respondents agreed that the course **increased their excitement and passion** for astronomy/astrophysics.

The course increased my understanding of the research process in astronomy/astrophysics.



### Future plans

Four respondents, who are not currently involved with astronomy/astrophysics research, are interested in participating in future research projects.



Interested in participating in astronomy/astrophysics research projects



Already participating in astronomy/astrophysics research projects



Not interested in participating in astronomy/astrophysics research projects



### Course effectiveness

Generally, respondents felt the instructor was knowledgeable about the material and facilitated the course well. All **strongly agreed the instructor had a strong command of the subject matter** and handled students' questions well. **Three students did not feel the information was presented in a logical step-by-step order**, suggesting clarification or explanation of course structure may be needed.

*"This course definitely reinforced my previous interest in pursuing some research experience in astronomy; I felt that this course did a great job preparing me for research by introducing many astrophysical concepts to me at the qualitative level."* -Undergraduate student