

**Evaluation of the California Institute of Technology (Caltech)  
Global Relay of Observatories Watching Transients Happen (GROWTH)  
Partnership for International Research and Education (PIRE)  
Spring 2020 Course: Astro 350, Astronomical Techniques**

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## Response Statistics

- 6 out of 9 participants completed the survey for a 67% response rate.
- Not all open-ended questions were required and therefore sample size may vary throughout the report.

# Respondents' perceptions of course logistics

	Strongly disagree		Disagree		Neither disagree/ agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture information was presented in a logical, step-by-step order.	0	%	0	%	0	%	2	33%	4	67%	6
The course raised challenging questions.	0	%	0	%	0	%	0	%	6	100%	6
The course stimulated interest and deeper thinking about the subject.	0	%	0	%	1	17%	1	17%	4	67%	6
Having special events, such as field trips, enhanced my learning experience.	0	%	0	%	2	33%	0	%	4	67%	6
The use of real world data was valuable to my learning.	0	%	0	%	0	%	1	17%	5	83%	6
The tutorials were helpful for understanding the lecture content.	0	%	0	%	1	17%	0	%	5	83%	6
Instructor handled student questions well.	0	%	0	%	0	%	1	17%	5	83%	6
Instructor could identify and address student concerns about the material.	0	%	0	%	0	%	1	17%	5	83%	6
Instructor was available to provide assistance during office hours.	0	%	0	%	0	%	0	%	6	100%	6
Instructor demonstrated enthusiasm for the subject matter.	0	%	0	%	0	%	0	%	6	100%	6
Instructor had a strong command of the subject matter.	0	%	0	%	0	%	0	%	6	100%	6

Note: Darker shades of blue indicate higher counts of respondents who selected that rating. This note applies to all similar tables in the report.

# Helpfulness of tutorials for respondents' understanding of lecture content

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## Response

A lot of the tutorials were not enough to answer the homework questions, it wasn't until after lecture that I could do the homework.

All tutorials are available for quick access along with videos to accompany them.

The tutorials were great preps before a class. Like you can come to class knowing what professor would be lecturing on that specific day. I would suggest, however, for some lengthy tutorials, if they can be divided into particular session with names of different categories, that would be easier to follow when we do a project and want to go back and review.

Provided a way for the student to improve their skills outside of class but in a way that was time-efficient and accessible.

The tutorials were great and very helpful.

The tutorials helped me understand the concepts by breaking down the greater concept into its fundamentals, then bringing everything into a bigger picture

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# Respondents' suggestions for improving tutorials

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## Response

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If anything, perhaps more tutorials or more examples within the tutorials could assist students with understanding the versatility of tools at our disposal, but I understand this sort of thing could easily make tutorials feel too long and too cluttered with overlapping subjects.

I'm not sure.

I cannot think of anything.

I think professor Quimby is doing a great job. I mean, this is the only class in the semester that I (and many more students in the class) know what's we are actually learning/ still confused about. So cheers, and thank you!

Sometimes two tutorials were assigned as homework before lecture. While I appreciate the semi-flipped classroom style, I found it hard to watch two separate 20-40 minute tutorials with my schedule before class. One tutorial at a time and no tutorials/quizzes on days when projects are due would be helpful for me.

More python tutorials, more than relate to the use of python on the class.

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# Respondents' perceptions of course outcomes

	Strongly disagree		Disagree		Neither disagree/agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	
Increased my understanding of the research process in astronomy/astrophysics.	0	%	0	%	1	17%	1	17%	4	67%	6
Increased my interest in becoming an astronomer.	0	%	2	33%	0	%	1	17%	3	50%	6
Increased my overall knowledge of astronomy/astrophysics.	0	%	0	%	1	17%	1	17%	4	67%	6
Increased my understanding of UNIX.	0	%	0	%	2	33%	0	%	4	67%	6
Increased my ability to program with Python.	0	%	0	%	1	17%	1	17%	4	67%	6
Increased my knowledge of basic statistics (probability distributions and error analysis).	0	%	0	%	1	17%	2	33%	3	50%	6
Increased my understanding of photometry.	0	%	0	%	1	17%	2	33%	3	50%	6
Increased my understanding of image processing.	0	%	0	%	1	17%	1	17%	4	67%	6
Increased my ability to process data using student-developed code.	0	%	0	%	2	33%	0	%	4	67%	6
Increased my ability to fit models to data.	0	%	0	%	1	17%	2	33%	3	50%	6
Increased my ability to produce written and oral reports on my work.	0	%	0	%	0	%	2	33%	4	67%	6
Increased my excitement and passion for astronomy/astrophysics.	0	%	1	17%	1	17%	0	%	4	67%	6
Increased my interest in astronomy/astrophysics research.	0	%	2	33%	0	%	0	%	4	67%	6

# Course impact on respondents' understanding of the research process

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## Response

Being able to go to the Mt Laguna Observatory and take data for ourselves helped me gain more excitement to start working on researching projects.

I learned data processing is a very important first step, as astronomical data does not come easily. You have extinction, atmospheric blurring, and voltages on the CCD to worry about, among other things. Then, you have to deal with all the uncertainties and errors and quantify them so that they can be compared to other data fairly. A lot of astronomy is detangling trends and periods and brightnesses from messy data.

It makes me appreciate the value of collaboration. Flying solo on every research project is just a road to unnecessary stress.

I understand it more but not necessarily like doing research more lol.

I know some of the techniques that astronomers use!

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Note: Respondents were only shown this question if they indicated Agree or Strongly agree to the statement "Increased my understanding of the research process in astronomy/astrophysics."

# Course impact on respondents' interest in becoming an astronomer

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## Response

Being an astronomer is tough. Probably not for me!

The trip to MLO and the projects cemented that this path was right for me.

This course showed real life applications that Astronomer's use which I thoroughly enjoyed. It helped clear any doubts I had about working in the career.

Yes, I was already interested and this course was amazing. Especially the field trip to mount laguna.

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Note: Respondents were shown this question if they indicated Agree or Strongly agree to the statement "Increased my interest in becoming an astronomer."



# Course impact on respondents' interest in conducting research in astronomy or astrophysics

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## Response

While computer coding has its frustrations and quirks, the end result of a piece of research ends up full of so much fascinating information that it's worth the struggle.

No, thank you. I mean I learned a lot and all but I'd rather my career path be less stressful. But good for who want to stay committed to the field.

I feel better prepared to approach professors about conducting research now that I know some basic astronomical tools

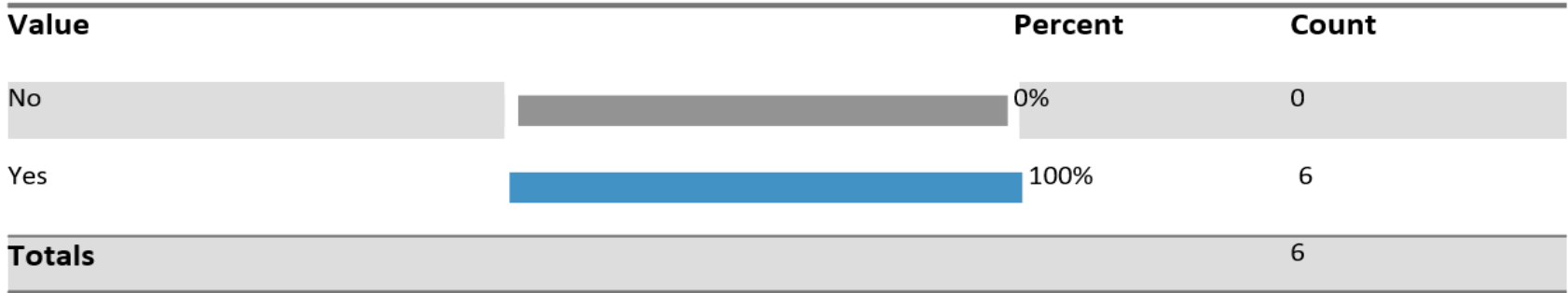
This course was the most enjoyable and informative in my opinion. It makes me excited to continue working on similar applications in a research environment.

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Note: Respondents were shown this question if they indicated Agree or Strongly agree to the statement "Increased my interest in astronomy/astrophysics research."

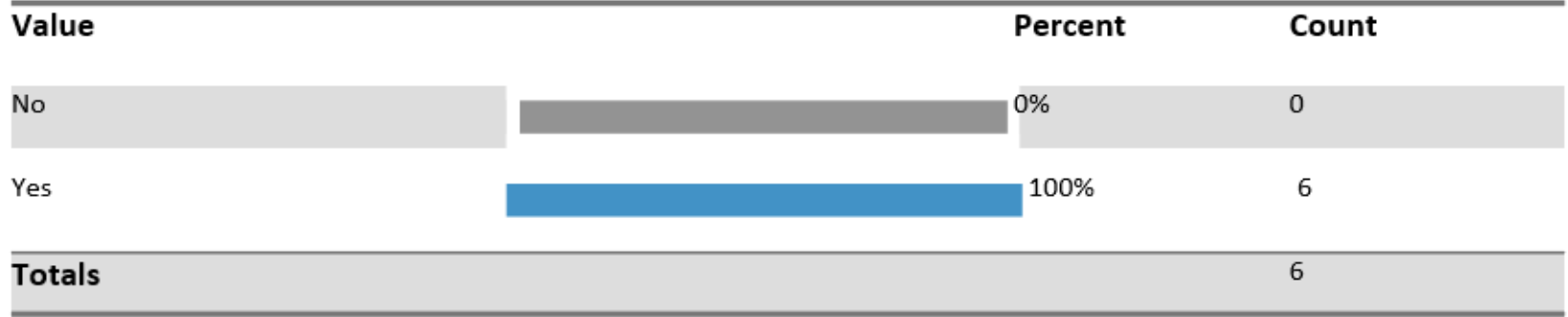
# Respondents' majors and plans to stay in the major

Question: Do you have a STEM (Science, Technology, Engineering, and Math) major?



Note: If respondents answered Yes to this question, they were shown the question "What is your major?" Five respondents were astronomy majors and one was a computer science major. Respondents were also asked "What is your current area of study (degree and field)?" Two respondents were working towards a B.S. in Astronomy, one towards a B.A. in Astronomy, one towards a B.S. in Computer Science, and two indicated Astronomy but did not specify the type of degree.

Question: Do you plan to stay in this major?



# Course impact on decision to remain in STEM major

Question: Has your participation in this course impacted your decision to remain in your major or change your major?

Value	Percent	Count
No	33%	2
Yes	67%	4
<b>Totals</b>		<b>6</b>

Note: If respondents answered Yes to this question, they were shown the question "In what ways?" If respondents answered No to this question, they were shown the question "Please explain".

**No, did not impact decision to stay in major:**

- I saw this course as more of an applied astronomy course. As such, I believe it should be the last course of the program, in which we place all of what we've learned so far into practice.
- I would finish my Bachelor's as soon as possible.

**Yes, impacted decision to stay in major:**

- I enjoyed it a lot. I look forward to being able to apply the methods learned in my future studies in Astronomy.
- I looked up summer python-astronomy courses so I can further my knowledge and maybe work for nasa or others.
- I'm not sure this is for me, but I'm not sure what else I have.
- As stated before, this course completely wiped away most of my doubts in my choice of major

# Respondents' interest in pursuing graduate education

Question: Are you interested in pursuing graduate school?

Value	Percent	Count
No	0%	0
Undecided	17%	1
Yes	83%	5
<b>Totals</b>		<b>6</b>

Note: Respondents were shown the question "What degree and field?" if they answered Yes to "Are you interested in pursuing graduate school?"

Graduate degrees pursuing:

- Ph.D., astronomy
- PhD in Astronomy
- Education
- Astronomy or Machine learning MS or PhD
- Undecided

# Course impact on interest in pursuing graduate school

Question: Has participating in this course affected your interest in pursuing graduate school?

Value	Percent	Count
No	50%	3
Yes	50%	3
<b>Totals</b>		<b>6</b>

Note: If respondents answered Yes to this question, they were shown the question "In what ways?". If they answered No to this question, they were shown the question "Please explain".

### No, did not affect interest to pursue graduate school:

- No comment
- Not sure how it has effected my wish to go to grad school quite yet.
- I already knew pursuing graduate school was somewhere along my path, the interest has always been a certainty

### Yes, affected interest to pursue graduate school:

- I want to learn more.
- I've been introduced to the computer science side of astronomy which I've found I really enjoy. I hope to specialize in Astroinformatics in graduate school.
- Astronomy is looking more interesting.

# Respondents' suggestions to improve the course

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**Response**

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Mentioned earlier, but: I like the semi-flipped classroom style but would appreciate only 1 tutorial assigned per class as homework and no quizzes or assignments on days when projects are due.

Just about the tutorials. I mentioned it in the first session of the survey.

Create/enforce a CS python course requirement before taking this class.

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# Respondents' demographics

With which gender do you most closely identify?

Value	Percent	Count
Female	33%	2
Male	50%	3
Other, please specify:	0%	0
Prefer not to answer	17%	1
<b>Totals</b>		<b>6</b>

# Respondents' demographics (Cont.)

With which ethnic and racial background(s) do you most identify? (Select all that apply)

Value	Percent	Count
American Indian/Alaskan Native	0%	0
Asian	17%	1
Black /African American	0%	0
Hispanic or Latino	50%	3
Multiracial	0%	0
Native Hawaiian/Pacific Islander	0%	0
Other, please specify:	0%	0
Prefer not to answer	0%	0
White/Caucasian	33%	2
<b>Totals</b>		<b>6</b>



# Respondents' demographics (Cont.)

Are you a first-generation college student (a first-generation college student is an individual whose parents never enrolled in post secondary education)?

Value	Percent	Count
No	50%	3
Prefer not to answer	0%	0
Yes	50%	3
<b>Totals</b>		<b>6</b>

# Key findings

- The majority of respondents agreed or strongly agreed that the course increased their:
  - **Knowledge** in astronomy/astrophysics and basic statistics
  - **Understanding** of the research process in astronomy/astrophysics, UNIX, photometry, and image processing
  - **Ability** to use Python, fit models to data, process data using student-develop code, and produce written and oral reports
  - **Interest** in becoming an astronomer and astronomy/astrophysics research
  - **Excitement and passion** for astronomy/astrophysics
- Respondents appreciated the field trip to Mt Laguna Observatory and the opportunity to collect data for themselves.
- All respondents agreed that the course raised challenging questions and that the instructor was available to assist during office hours, demonstrated enthusiasm for the subject matter, and had a strong command of subject.
- Almost all of the respondents commented that the tutorials were helpful for understanding the lecture content, especially when outside of class.
- All respondents indicated planning to stay in their STEM major with four reporting that participation in the course impacted this decision. One respondent stated that the course “completely wiped away most of my doubts in my choice of major.”
- Five of the six respondents reported that they intend to pursue graduate school and one respondent was undecided. Half of respondents indicated that the course impacted this interest because they want to learn more and found the content to be interesting and enjoyable. Those who indicated that the course did not impact their graduate school interest shared that they either already knew that they wanted to pursue graduate school or that they were not sure what the impact of the course is yet.

# Recommendations

- In addition to the assigned tutorials, provide a list of optional tutorials that students can view at their own pace if needed without feeling overwhelmed. A few students commented that they would appreciate more tutorials with examples.
  - To increase the effectiveness of tutorials, organize them by category so that students can more easily reference them when needed.