



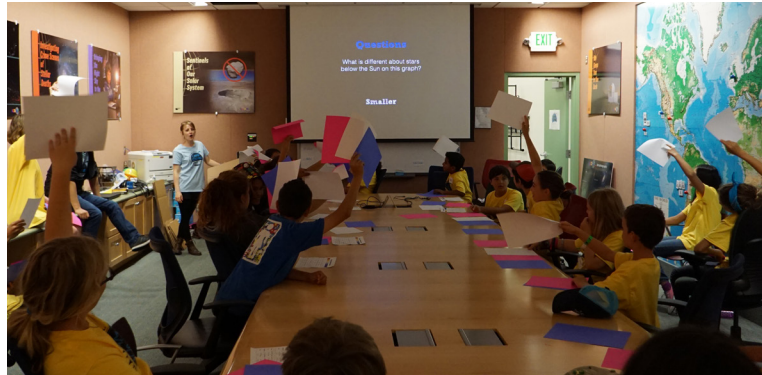
Global Sky Partners

Report on activities **Dec 2018 - Dec 2019**



LCO launched the Global Sky Partners program in 2017 with the goal of inspiring students, teachers, and the public around the world to engage in astronomy and science endeavors. Global Sky Partners are a diverse group of educators and scientists who run their own fully-supported education projects and investigations using our telescopes.

The primary aim of this program is to inspire, educate and provide authentic scientific experiences through the use of the LCO robotic telescope network. Through this opportunity, LCO aims to inspire audiences in under-represented communities and the developing world. Often these audiences would not normally be able to take part in programs involving professional scientific equipment.



The 2019 cohort of Global Sky Partners ran from 1 Dec 2018 to 1 Dec 2019. 21 projects were selected by an independent review committee, from an open call for applications. 11 of the 2018 partners were successful in reapplying and they were joined by 10 new partners.

The program used 1091 hours of 0.4-meter time during a 12 month period, consisting of 3350 requests for observations, 90 % of them were completed successfully.



The programs fall into 2 broad categories:

Mentoring, workshops and training programs (both in-person and remote)

Online programs (citizen science, self-directed study)

The reported size of the audience in 2018-2019 was as follows:

Mentoring, workshops and training programs (both in-person and remote) have a **direct audience size of ~2400** (mostly teachers and high-school students)

6 of our partners run teacher training programs, their **indirect audience size is ~13,000** (based on estimated class sizes reported)

Online programs have an audience size of **~8,300**

Total reach of Global Sky Partners program is ~24,000 individuals annually
(~11,000 annually with an additional ~13,000 students indirectly impacted)

Audience Region

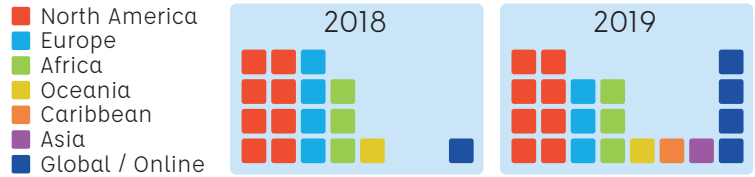


Figure 1. Geographic spread of partner audiences by region comparing 2019 and 2018 partner programs

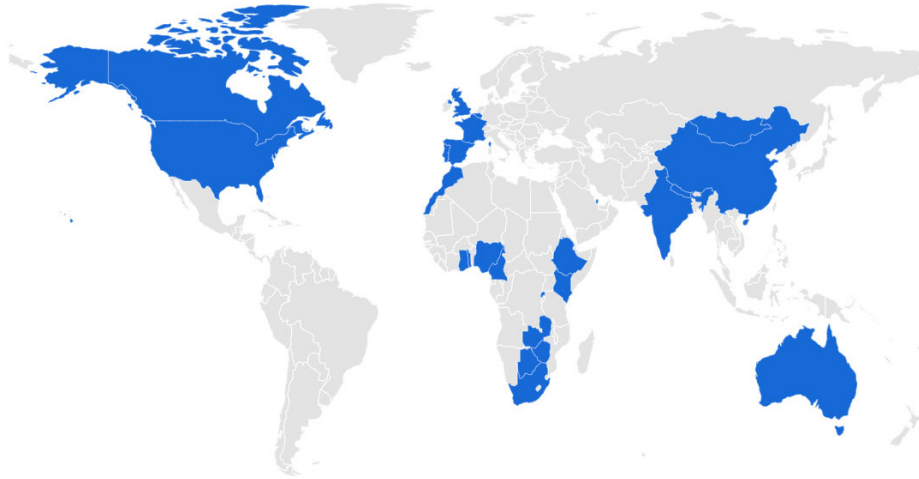


Figure 2. Geographic spread of partner audiences 2019. Global Sky Partners had a presence in 22 countries.

Audience Demographics

From partners offering mentoring, workshops and training programs:



21 %

of the audience are from disadvantaged or under-represented communities, or developing world countries.



31 %

of the audience are mentored in publication quality research projects, resulting in **28 publications** in professional journals, and **4 talks** at professional conferences by high-school students.



34 %

of the audience take part in workshops.



23 %

of the audience take part in teacher training.

For online and citizen science partner programs surveys were sent to the audience. However the response rate was so low (less than 5%) it has not been possible to assess the demographics of the audience.

Legacy

2019 saw the return of a significant proportion of the 2018 partners. This has allowed us to build on the relationship we fostered during the first year of the Global Sky Partners program. Although new partners are essential to the program staying innovative and reaching new audiences, it is equally essential to the program to encourage and work with the successful programs.



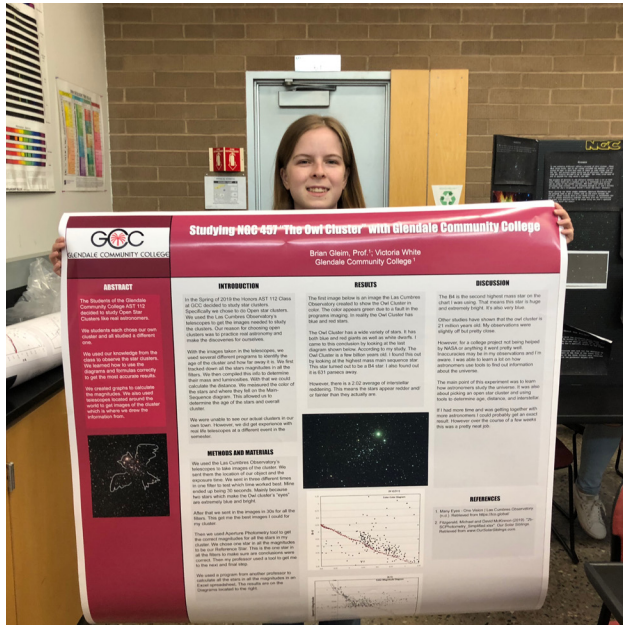


2019 Partner Programs

North America

Glendale Community Project

An astronomy club undertaking honors-level research for non-science majors.



The Glendale Community College Astronomy Club has many students eager to engage in an honors-level science experience. This partnership merged the honors students and club members into one research cohort and engaged them in the authentic practice of experimental design and execution. The students all presented posters of their research at the college's public spring exhibition.

Location Arizona

Demographic Non-science major community college students

Size 30

Bringing Astronomy Research to Under-represented groups

A mentoring project for high-school students to undertake authentic research

This program brought astronomy research opportunities to youth groups (high school age) in out-of-school and after-school settings. They were given instruction on the research process and then worked in groups to conduct a project, selecting from several types, including double star astrometry, RR Lyrae photometry, exoplanet and asteroid light curves, variable star light curves and gamma ray burst follow-up optical observations. This program was based in part on the Astronomy Research Seminar, taught for the past 10 years at Cuesta Community college. In this program student groups proposed and then carried out a study of double star systems, where they collected and analyzed data and wrote up their analysis for publication in the Journal of Double Star Observations, all within the time frame of a single semester. Students then presented their project in either an online or in-person meeting.

Location North Carolina

Demographic High-school students from disadvantaged areas

Size 20



Institute for Student Astronomical Research (InStAR)

Workshops and online mentoring for publication quality research



InStAR's mission is to develop, conduct, and promote the adoption of the Astronomy Research Seminar, which is an immersive, student team-based astronomical research experience for high school students. InStAR also serves as a central coordination site and resource for student research teams in the U.S. to obtain resources, talk with other research groups, and to be a part of a growing community of practice.

The audience comes from 6 high-schools in 4 different states and the instructors come from colleges and universities in 8 different states in the US. A third of the student audience come from high schools with an enrollment from minority groups which is higher than the state average.

Location Across USA

Demographic High-school teachers and students

Size 50



STEM through astronomical research

Introductory course in astronomy leading to publication quality research projects

The Boyce Research Initiatives and Education Foundation (BRIEF) provides research opportunities to students to enhance their educational experience and introduce them to the scientific and technical communities. BRIEF is providing, as its primary education mission, hands-on astronomy research experiences, using LCO for students of all ages that result in their publishing peer-reviewed papers.

BRIEF has developed 3 complimentary curricula using LCO, leading students through the essentials of requesting observations, making observations, analysing data, and writing publications for peer-review. Students investigated double stars and contributed exoplanet observations to the NASA TESS mission.



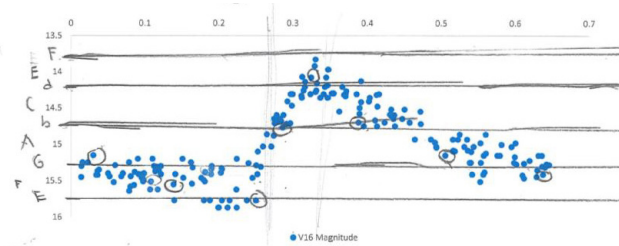
Location San Diego area

Demographic High-school students and teachers

Size 200+

Appalachian Star Song Project

Workshops to analyse LCO astronomical data and use sonification tools to turn their astronomical data into music



Appalachian Starsong Project is a joint project of Western Carolina University and the Fontana Regional Library system to create a STEAM (science, technology, engineering, art, math) project. Students made supernovae and variable star observations, then created light-curves from their data. The students visualised this light curve data through a process called "sonification". Their time-series observations were represented as a musical melody, which the students then harmonized using an AI composition tool. A local musician (Jude Lowerly) was also invited to record the student compositions, based on the time series data, on the Appalachian lap dulcimer.



Location North Carolina

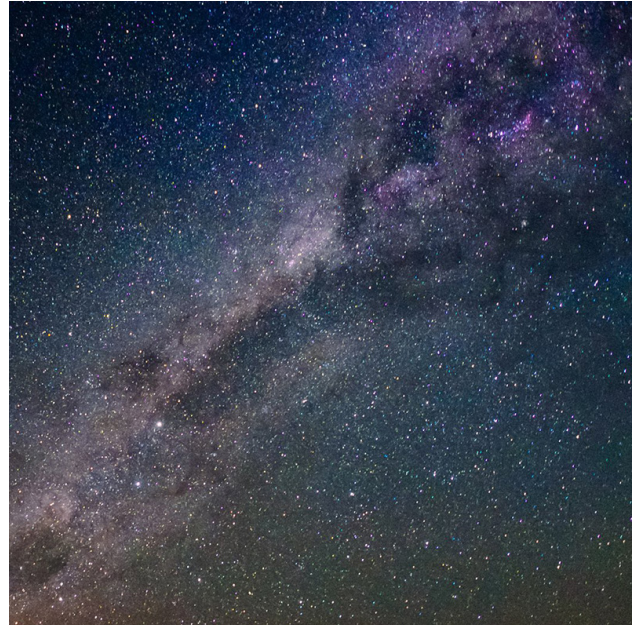
Demographic High-school students from disadvantaged counties and native-american heritage

Size 30

Canadian National Museum of Aerospace

An after-school club for 30 students analysing variable stars

The Canada Aviation and Space Museum in partnership with the Conseil des écoles publiques de l'Est de l'Ontario, provided high school students with the opportunity to create and carry out their own investigations of the night sky. Guided by a professional astronomer, student participants were taught how to research the background of a topic, choose a target and create an observing plan, and then analyze the data from the telescope.



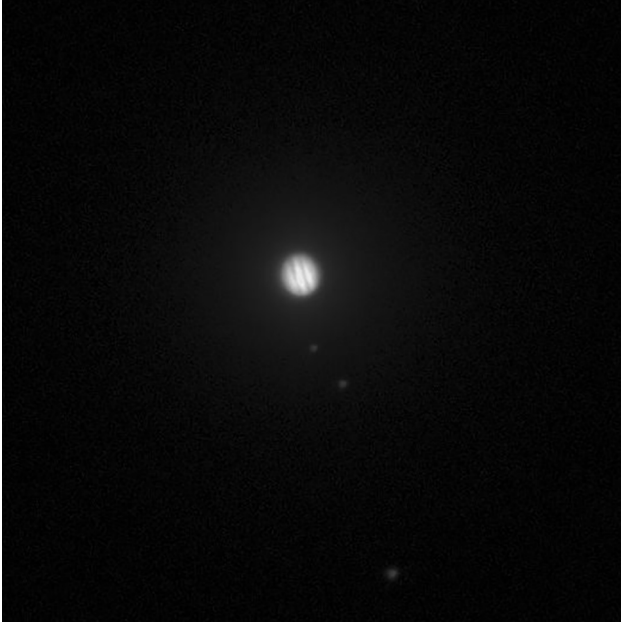
Location Ottawa, Canada

Demographic Grade 9 students

Size 30

Modeling Astronomy

Teacher training workshops



Teacher training workshops were provided for teachers in the US using the Modeling Instruction pedagogy, an inquiry-based learning approach modelled after the professional scientific process. The astronomy education component of the curriculum featured LCO data of Jupiter's moons, which had been taken for this project. This dataset and the educational materials now form part of the core aspect of this teacher training pack.

Location Across USA

Demographic High-school physics teachers

Size 30

Europe

PETeR

Teacher and school workshops, and research project mentoring

Proyecto Educativo con Telescopios Robóticos (PETeR) - An Educational Project with Robotic Telescopes. PETeR is an enquiry-based online lab which aims to familiarize the Spanish educational community with the scientific method and practice, while contributing to the diffusion of Astronomy and Astrophysics. This is achieved by dedicating observation time with robotic telescopes to educational activities and e-science projects aimed at students and amateur astronomy associations.

Location Spain (mainland and Canary Islands)

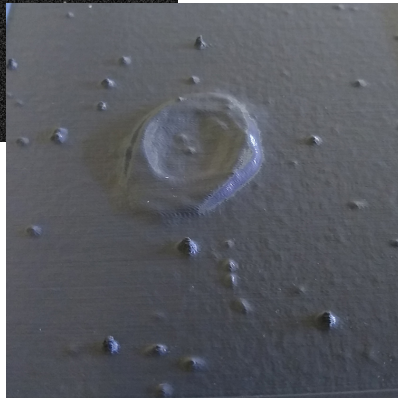
Demographic Elementary and High-school students

Size 150 schools



Tactile Observatory

Creating 3D printed images from LCO observations in school workshops



The Tactile Observatory is an extension of the Tactile Universe (TU) project. Blind and visually impaired students made observations with LCO to learn about galaxy research. Using the TU's tactile image processing pipeline, students were able to 3D print their observations as tactile images. The audience is blind and vision impaired students from KS2 (upper primary) and KS3 (lower secondary) in the UK. High quality datasets were collected in this project which will be used by the Tactile Universe project in the future.

Location UK

Demographic Elementary school students and teachers at blind and visually impaired schools

Size 20

Africa

West African International Summer School for Young Astronomers

Summer school which trains the next generation of scientists in West Africa

The West African International Summer School for Young Astronomers (WAISYA) is an innovative short course in astronomy for West African university students and school teachers who teach STEM. The school is designed and taught by a team of professional astronomers from West Africa and the rest of the world using educational research principles. Their mission is to build a critical mass of Astronomers and develop a community of scientific leaders in related fields in the West African Region and Africa as a whole. Students attending the school chose variable star targets, requested observations with LCO and analysed their data within days.



Location Nigeria

Demographic Postgraduate students from 8 west African countries

Size 30

AstroLab

Summer school which trains the next generation of scientists in southern Africa



Astrolab is a tutorial, based on telescopic observations, to learn how to do science and discover that science can be challenging, interesting and manageable. This tutorial has been developed primarily for undergraduate science students in order to emphasize the nature of science with the interdisciplinary nature of astronomy, and its natural links with technology and instrumentation. Astrolab is a learning-by-doing laboratory to acquire research competences and to understand the complexity of practical work. Astrolab works with students from universities in sub-Saharan African countries.

Location Botswana

Demographic Postgraduate students from 10 southern African countries

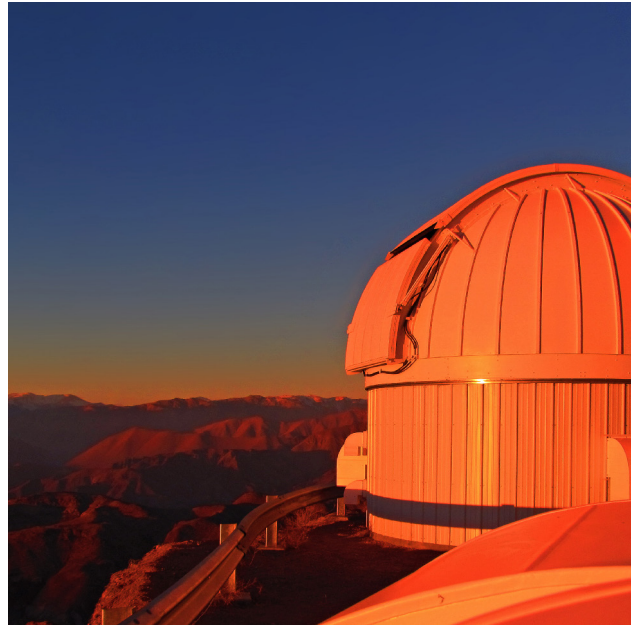
Size 70

Asia

Youth Astronomy Teachers' Link

Groups of students compete to do a research project with a university mentor

The Youth Astronomy Teachers' Link (YATL) is one of China's leading astronomy education NGOs. The YATL Astronomy Research Project for High School started in 2016. Each year more than 15 schools compete for research opportunities which make use of LCO for publication-quality science.



Location China

Demographic High school students

Size 15

Australia

Our Solar Siblings (teacher training)

Teacher training in basic astronomy



Our Solar Siblings provides an established teacher training program to enrich the science curriculum with astronomy content. LCO is used to provide inspirational color images to the teachers and their students.

Location Australia

Demographic High school teachers

Size 120



Global programs

(where instructors and students communicate remotely)

Our Solar Siblings (student mentoring)

Middle and high school students engaged in publication quality research

This aspect of Our Solar Siblings provides educational and scientific mentoring to students to under-take research investigations using LCO.



Location Canada, USA and Australia

Demographic Middle and high school students

Size 10

Stanford online high school

High school students doing publication quality research



Stanford Online High School (SOHS) is an accredited, independent school for intellectually passionate students in grades 7 - 12. The SOHS Astronomy Research Club involves students across the world in astronomy research education and projects. These students have published 9 posters at professional conferences and 3 peer-reviewed papers on their research with LCO.

Demographic High school students

Size 16

100 hours for 100 schools

Teacher mentoring in basic astronomy

100 hours for 100 schools (100/100) is a collaboration between several organizations involved in providing high quality and well supported astronomy education programs. 100 schools were selected from the 1,300 schools that already actively participate in International Astronomical Search Collaboration in 6 countries. The teachers were invited to choose and develop a project with their students, from a selection of suggested projects, ranging from basic to advanced. Training is offered through Galileo Teacher Training Programme and Global Hands on Universe.



Location 6 countries in the developing world

Demographic Elementary and high school teachers

Size 100 schools

Online programs

(where the audience communicate with each other via online platform)

Our Solar Siblings (self-taught course)

A self-guided course ending in a research investigation



Our Solar Siblings provides a self-guided basic astronomy course in a virtual learning environment. At the end of the course the participants engage in a research investigation using LCO.

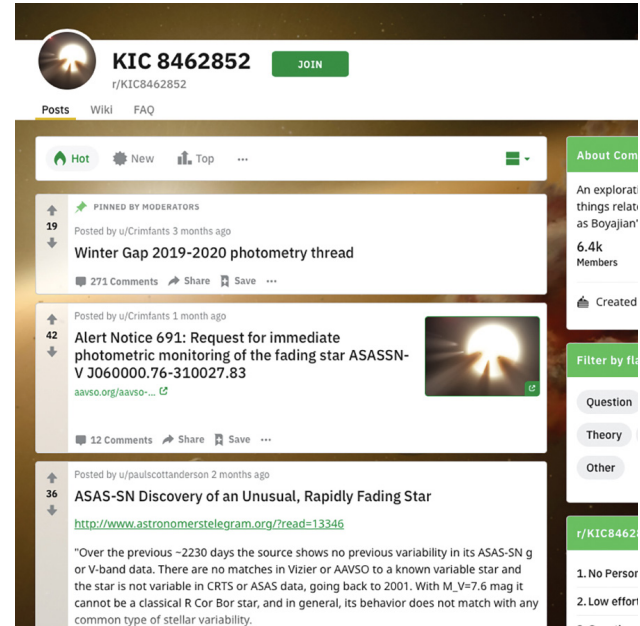
Demographic High school teachers

Size 500

Where's the Flux

Community observations of an unusual astrophysical source (Tabby's Star)

Community observations of secular dimming in the enigmatic dipper, KIC8462852. All of the imaging and analysis of KIC8462852 is handled by members of the sub-Reddit social discussion site for this object. This provides an excellent way to disseminate the latest news, alerts and discoveries about this fascinating object, as well as mentoring people in data analysis. All of the communication and education is in the public domain and can be viewed by anyone.



The screenshot shows the subreddit page for KIC 8462852. At the top, there is a header with the subreddit name 'KIC 8462852', a 'JOIN' button, and navigation links for 'Posts', 'Wiki', and 'FAQ'. Below the header, there are three posts:

- Post 1:** Pinned by moderators, titled 'Winter Gap 2019-2020 photometry thread'. It was posted by u/Crimfants 3 months ago and has 271 comments.
- Post 2:** Titled 'Alert Notice 691: Request for immediate photometric monitoring of the fading star ASASSN-V J060000.76-310027.83'. It was posted by u/Crimfants 1 month ago and has 12 comments. It includes a thumbnail image of a star with a bright flare.
- Post 3:** Titled 'ASAS-SN Discovery of an Unusual, Rapidly Fading Star'. It was posted by u/paulscottanderson 2 months ago and includes a link to an astronomer telegram post.

On the right side of the page, there is a sidebar with 'About Com' (Community), 'Filter by fl', 'Question', 'Theory', 'Other', and 'r/KIC8462' (subreddit name) with '1. No Persor' and '2. Low effort' options.

Demographic Public (via Reddit)

Size ~7000

MicroObservatory exoplanet partnership

A custom built lab environment for investigating exoplanet data from LCO

The screenshot shows the 'LABORATORY FOR THE STUDY OF EXOPLANETS' interface. At the top, there are navigation links for HOME, MODELING LAB, TELESCOPE, IMAGE LAB, and DATA LAB. Below this is a blue banner with the text 'Plan your investigation and predict what you may find.' The main area is divided into a control panel on the left and a central visualization area. The control panel has three sections: 'ADJUST PLANET' with 'CHANGE PLANET SIZE' (Reduce and Enlarge buttons), 'CHANGE PLANET SPEED' (Slower and Faster buttons), and 'TILT ORBIT' (Tilt down and Tilt up buttons). The central area shows a large yellow star with a small black planet in its orbit. At the bottom, there is a 'Zoom' slider and a 'Viewing distance: 30,000,000 miles' indicator. Below the main interface is a 'PAGE' navigation bar with numbers 1 through 6 and the text 'MY SAVED MODEL'. At the very bottom, there is a section titled 'WHY DO I NEED A MODEL?' with two columns of text: 'In Modeling Lab, you'll develop a scientific model that will help you predict and interpret the signal of an' and 'Zoom the model out until the star is just a dot and the planet is no longer visible. (Use the Zoom slider.)'

MicroObservatory operates a network of small aperture telescopes and a suite of extensive educational labs. Through a pilot partnership with LCO, MicroObservatory enhances their audience's learning experience. MicroObservatory have developed tools to allow time-series analysis entirely in a web browser, complete with extensive training tools. The inclusion of LCO data allows their audience to take their study of exoplanets further.

Demographic Public (but mostly teachers)

Size ~6000

Contact

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