



Global Sky Partners

Report on activities **Aug 2021 - Aug 2022**

The background is a rich astronomical field. It features a dense population of stars, with a notable concentration of bright blue stars and smaller red stars. A prominent feature is a dark, filamentary nebula with reddish-orange highlights, resembling the 'Pillars of Creation' or a similar interstellar structure. The overall color palette is dominated by deep blues, with accents of red and orange from the nebula and stars.

Inspiring students around the world to engage in astronomy and science investigations using robotic telescopes



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Executive Summary

After the previous year's extended observing period (of 20 months) this year follows a more regular 12 month cycle, as we all begin to recover from the pandemic. We welcomed back 12 previous partners, who were joined by 18 new partners. Two previous Pilot Partners joined us as full partners, expanding their programs. We have seen a shift away from large Western programs during 2021-2022, with many of our large programs now coming from Asia. We are seeing more of our partners offering "hybrid" courses (mixture of in-person and live video participation), which replace their traditional in-person courses.

In previous years the audience numbers have been dominated by 2 citizen science partners, whose programs serve largely anonymous individuals. For the first time we are seeing other partners bring in large audiences which they have a personal connection to (either in-person or remote via video). The implication here is that these programs are able to provide a deeper level of engagement via this personal contact, and ultimately have a longer lasting impact.

From the beginning, Global Sky Partners has had the core aim to provide opportunities for non-traditional audiences and ones who would not otherwise have access to professional level scientific resources. Each year we have seen a steady increase in the number of programs being offered to the developing world and underserved communities. It is extremely gratifying that in the 2021-2022 cohort of partners, these groups are now the dominant demographic.

Our partners have continued to run their programs to the high level we have come to expect, quietly being successful and highly impactful with their audiences. Last year, some of our programs had their extraordinary successes celebrated in the media.

Mission Platinum (India) broke records by [hosting the world's largest astronomy lesson](#). **Brazil: 1000 teachers** has gained support from the Brazilian Ministry of Science, Technology, & Innovations. **Astrolab's** leader, [Dr Michele Gerbaldi, was awarded the IAU's Development Prize](#), for her work with Astrolab.

Key Partners

Thanks to ongoing support from Gordon and Betty Moore Foundation we have been able to offer 7 of our long standing partners "Key Partner" status. This means we do not require proposals from them for a period of 3 years although they still need to provide reports to us annually. The selected partners had all successfully applied to be in the program for at least 3 years and had consistently been ranked highly by the independent review committee. It has given the partners the security to make long term plans and further develop their programs.



Audience

Audience Survey

We ask every cohort of partners to share our audience impact survey with their audiences. In this cohort the survey showed that Global Sky Partners had an overwhelming positive impact. After being involved in a Global Sky Partner program, and particularly using LCO telescopes, data and resources:



98 %

said "I can contribute to science"



97 %

said "I enjoy working on science projects and would like to be involved in them in the future"



94 %

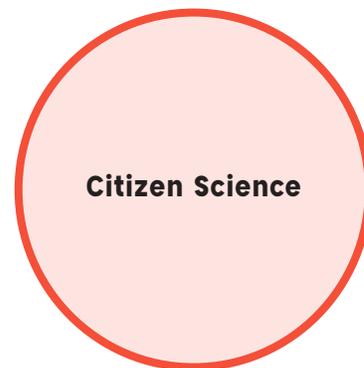
said "I am confident in my ability to do science"



Reach and Demographics

The program used **1380 hours** of 0.4-meter telescope time during the full year from August 2021 through July 2022 (2021-2022 cohort), consisting of **4708 requests** for observations. **85%** of them were completed successfully.

The programs fall into 3 broad categories:



The reported size of the audience for the 2021-2022 cohort is comparable to the previous cohort, but with a shift away from the large citizen science programs and towards programs with stronger personal connections. The category breakdown can be seen on the following page.

Total reach of Global Sky Partners program is ~100,000 individuals annually
(~22,300 annually with an additional ~80,000 students indirectly impacted)

School workshops and training programs

- **Direct audience size of ~14,800**(mostly teachers and high school students)
- 7 of our partners run teacher training programs, their **indirect audience size is ~80,000** (based on estimated class sizes reported)

Student research projects and student mentoring projects

Student research projects and student mentoring projects had a **direct audience size of ~6,700**

Citizen Science

Citizen Science programs had an audience size of **~800** (considerably lower than previous years).

Although the direct size of the Global Sky Partner audience is smaller than the previous period, with the shift in demographics towards teacher and school workshops, the indirect size has increased significantly.



Audience Region

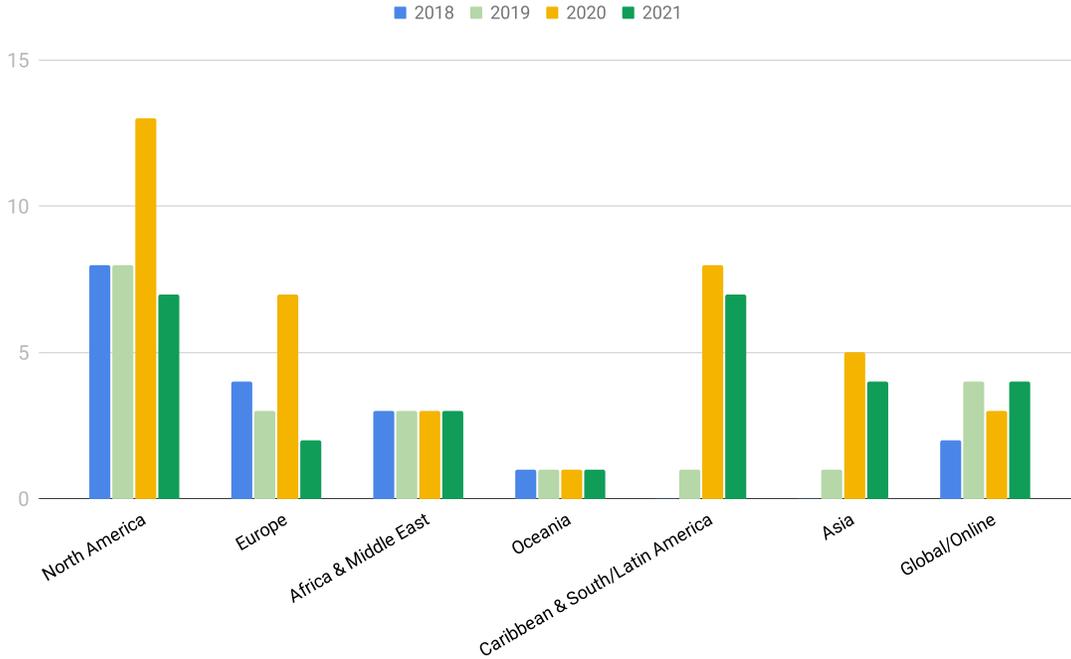


Figure 1. Geographic spread of partners offering programs, comparing the 2018, 2019, 2020, and 2021 cohorts.

Number of impacts



Figure 2. Geographic spread of partner audiences for 2021-2022 cohort. Global Sky Partners had a presence in 45 countries. The color scale indicates the number of impacts partners had in each country.



Audience Demographics

From partners offering mentoring, workshops and training programs, with a total audience size of ~21,500 individuals:



58 %

of the audience are from disadvantaged or underrepresented communities or developing world countries with a **further 37%** being from mixed representation



31 %

of the audience were mentored in publication quality research projects



64 %

of the audience took part in workshops and teacher training



71 %

of the audience were high school students



19 %

of the audience were teachers.

With the introduction of the **Mission Platinum** and **Brazil: 1000 teachers** partners, numbers of schools and students involved from the developing world, has seen a sharp increase.

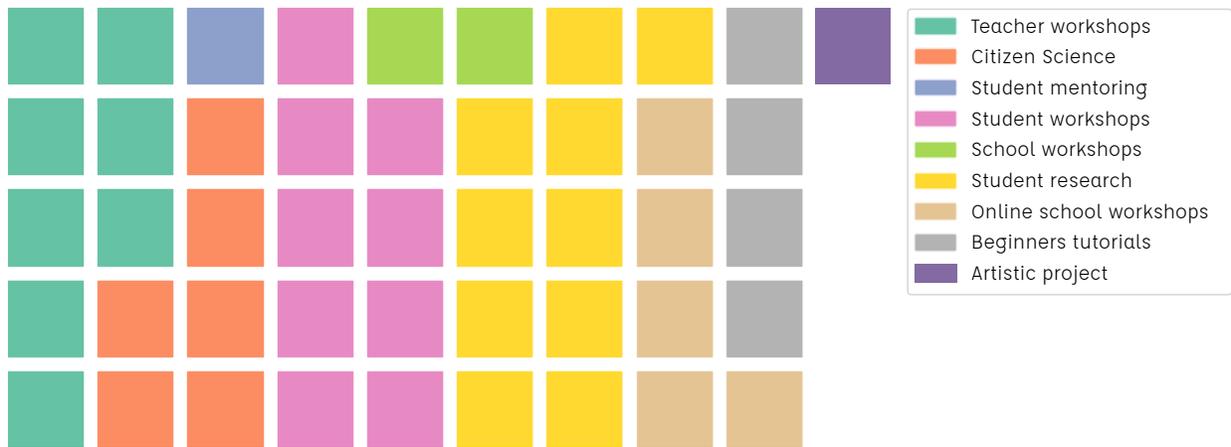


Figure 3. Activity breakdown by partner. The size of each box indicates the number of partners involved in the labeled activity. Some partners are involved in multiple activities.

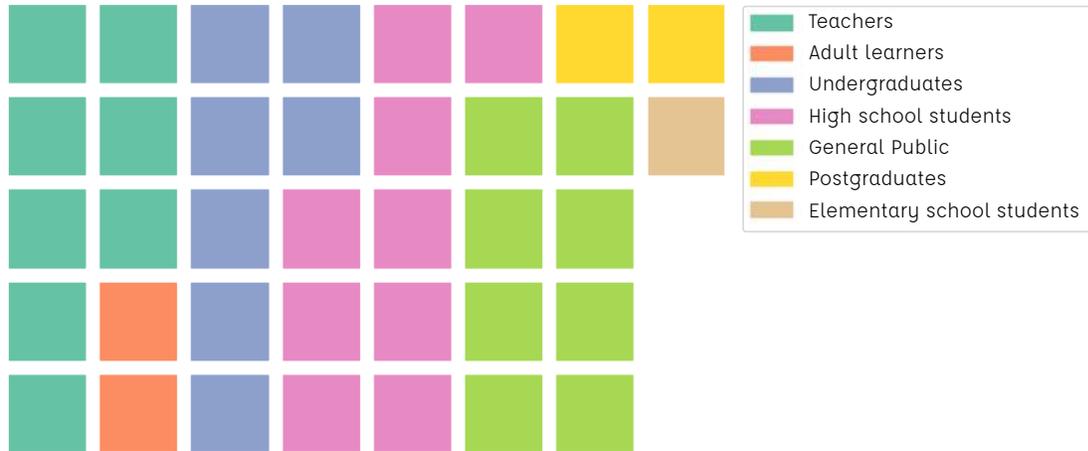


Figure 4. Audience breakdown by partner. The size of each box indicates the number of partners targeting the labeled audience. Some partners target multiple audiences. Undergraduate students are from underserved communities and the developing world. Postgraduate students are from African universities.



Figure 5. Audience demographic breakdown by partner. The size of each box indicates the number of partners targeting the labeled demographic. Some partners target multiple demographics.



Achievements

The following publications are by high school students in peer-reviewed journals, as a result of investigations through Global Sky Partners in 2021-2022:



17 papers published in **Journal of Double Star Observations**,

2 papers published in **Journal of the American Association of Variable Star Observers**

1 paper published in **Astronomy: Theory, Observations and Methods Journal**



13 talks were presented by students at professional conferences

**2021 - 2022
Partner Programs**





Astronomy Research Seminars for High School and Undergraduate Instructors and Students

teacher workshops

Astronomy Research Seminars provide high school and undergraduate students, and educators with training and mentoring on the whole process of performing science, taking data (using LCO), analyzing that data and ultimately publishing the findings in a peer-reviewed journal.

The impact is larger than the number of educators engaged, as more than half of these were educators who continue to do research projects with their students at the high school and undergraduate levels. Seventeen papers have been published in the Journal of Double Star Observers as a direct result of this program's participation as a Global Sky Partner, between August 2021-July 2022.

 Location

USA

 Size

40

 Demographic

High school and undergraduate students, and educators

North America

Cosmic Adventures

student research

A program delivered by Orange County Astronomers for their junior members to study exoplanets and eclipsing binaries.

45 weekly meetings were held during the year with professional astronomers in attendance to guide and help the students. At each session, students presented their work and asked their questions. The main focus of their research was studying exoplanets. The students aim to publish their findings.

 Location

USA

 Size

10

 Demographic

Astronomical society members



Stanford Online High School

student research

There are two different astronomy courses at Stanford Online High School. Astrophysics is a course for STEM students and astrobiology, a course for non-STEM students and for STEM students who have not taken the prerequisite courses for astrophysics. The second semester of astrophysics is an Astronomy Research Seminar. Astrobiology does not include research projects, but students do use LCO to take color images.

The courses in 2021-2022 were highly successful and spawned a few auxiliary projects. Approximately 75% of the students reside in the United States. The rest are scattered over the globe. 10 students presented their work at 2 professional conferences.



Location

USA



Size

35



Demographic

High school teachers and students





Kids' Research Exoplanet Watch (KREW) 2021

student workshops

This partner program involved student workshops in middle schools in the rural Southern Appalachian region and a summer Camp in the same area. The students began with simple deep-sky imaging tasks, then moved on to observing the exoplanet Wasp 36b. They used a tool designed by another partner, MicroObservatory, to perform the data analysis. During their summer camp the leader ran a similar workshop, observing the exoplanet TrES-3b.

 Location

USA

 Size

16

 Demographic

Middle school students

GCC Exoplanet and Variable Star Search

student research

Community college student projects for this program were largely to study exoplanet transits and intrinsic variable stars. The LCO images supported students' research and written communication projects, which are both required components of their Honors curriculum. The classes observed and analyzed the time-series images to determine properties of the objects, then they wrote up their findings into journal-article format papers.

 Location

USA

 Size

16

 Demographic

Non-science major
community college students
and high school students



STEM Through Astronomy Research - San Diego (STAR – SD)

student research

STAR-SD conducted seminars and student research projects during the reporting period. This partnership enabled their students to conduct their own observations and learn how science is done through publication of their results or through posting their reduced data from their LCO observations to scientific (e.g. NASA) databases. After initial experiences students are encouraged to go further by doing increasingly independent research with general guidance. Many also become mentors to the new students and some intern on STAR-SD projects.

During this period STAR-SD brought on two partners to fill specific needs in their program, Blue Dot (LA county) and the Bush School (Washington). Blue Dot focuses on introducing 7 to 12 grade students to science through

observing and astrophotography with emphasis on the under-served and inner city communities. The Bush School programs include python training and the use of spectroscopy in astronomy.

The STAR-SD students published 2 papers in peer-reviewed journals, 3 groups presented their work at a professional astronomy education conference, and 10 students took part in international observing campaigns with professional astronomers.

 Location	 Size	 Demographic
USA	455	Middle and high school students

MicroObservatory Exoplanet Partnership



teacher workshops

student workshops

MicroObservatory operates 2 projects which have been in development during 2022: DIY Planet Search and Youth AstroNet. The Exoplanet Partnership pathway is intended to offer high-school and life-long learners who use their DIY Planet Search website the opportunity to "graduate" from MicroObservatory data to LCO 0.4m telescope data, thereby deepening their analysis skills while learning about the effect of data quality on the scatter of an exoplanet transit light curve. This past year, they enlisted LCO Global Partners to help test their DIY Planet Search Group Account Functionality - a feature that scaffolds the experience of multi-object aperture photometry so that a whole class can efficiently make measurements and generate a light curve collaboratively in their

customized [JS9](#) environment. The Partners made a number of valuable recommendations for their interface, which is now publicly available.

Their learning pathway for middle school age students is called YouthAstroNet project - a 5 year research project on the scale-up of innovative technology experiences in astronomy and science imaging. Over the past year, they completed a comprehensive update of their Moodle learning platform for YouthAstroNet learners, and began to experiment with the kiosk portal to the LCO telescopes to plan how to integrate LCO observations in the YouthAstroNet learning portal.

 Location

USA and Global

 Demographic

High school students and teachers

Central and South America

Astro Kopernicus

student workshops

Two students from 8th grade and one from 9th grade participated with two teachers in the research. Due to personal problems one of the students left the project in the final phase. The research was accepted for publication in the Journal of Double Star Observations and achieved 1st place in the regional seminar of school science. In January 2022 they participated in the National School Science Seminar for Chile.

 Location	 Size	 Demographic
Chile	3	High school students



Astwonomi Lakay

public outreach

Astwonomi Lakay was primarily designed for students at university to capture astronomy images using LCO. In reality the organizers changed their program to be oriented to the general public. Images captured with LCO have been distributed to social media for educational purposes.

Location	Size	Demographic
Haiti	20	General public

Atlas-Catalog of Open Clusters

citizen science

This project aims to observe, study and describe open clusters using LCO resources. The ultimate aim of this project is to create an open source catalog of open clusters. During the 2021B semester they engaged their community of amateur astronomers and teachers in intensive training on their analysis tools. Throughout the year they made observations and analyzed their data.

Location	Size	Demographic
Colombia	273	Amateur astronomers and high school teachers

BRAZIL: 1,000 Teachers...30,000 Students

teacher workshops student workshops

"BRAZIL: 1,000 Teachers...30,000 Students" is a 3-year joint project with the International Astronomical Search Collaboration and the Brazilian Ministry of Science, Technology, & Innovations (MCTI). Teachers from all 26 states in Brazil have been invited by the MCTI to enroll. These include impoverished rural areas of the country with internet access but limited or no resources for use in the science classroom.

Each teacher has on average 30 students and receives one hour of time on the 0.4-m LCO telescope network. They take deep sky images then make use of these with their students in the classroom.

The program started in February 2022 and already has 183 teachers involved. This project has built on the successes of two previous Global Sky Partner projects.

 Location	 Size	 Demographic
Brazil	183	Teachers

Hiparcia

student research student workshops

The aim of this project was to engage students in observing and tracking Near Earth Asteroids using LCO. Their focus was on training the students to use data analysis tools and on developing a machine learning algorithm to help with the detection of asteroids in the data they captured from LCO.

The team gave extensive public talks (including talks by their students) to amateur societies and the general public, highlighting LCO data.

 Location	 Size	 Demographic
Paraguay	515	High school students

Exopastronomy

student research student workshops

Exopastronomy seeks the development and strengthening of new educational strategies in the classroom. They conducted 11 astronomy workshops for university and high school teachers. The subjects of the workshops were variable stars and eclipsing binary systems.

Location	Size	Demographic
Colombia	2300	University and high school teachers

Study of Transient Phenomena in Solar Stars

student research student workshops

This project trains their audience to analyze astronomical data and organizes observing campaigns to study different Sun-like stars, which have transient phenomena. These can be variable stars or exoplanets around the stars, but they have branched out into asteroid analysis.

The group ran 7 workshops in 2021-2022 which trained their audiences on how to analyze images and then to analyze new data. In some cases they wished to refine the published brightness of stars, in other cases they wanted to monitor a target for variability.

Location	Size	Demographic
Colombia	130	High school students

Europe

ORBYTS

student research research projects

[ORBYTS \(Original Research by Young Twinkle Students\)](#) is an educational program in which secondary school pupils (16-17 y/o) work on scientific research linked to the [Twinkle Space Mission](#) with mentoring from PhD students and other early career scientists.

The goal of every partnership is that students will contribute towards publishable research. They get hands-on experience of working closely with scientists and doing scientific research. The program also addresses diversity challenges by dispelling harmful stereotypes and challenging any preconceptions about who can become a scientist.

Working with school groups they obtained several exoplanet light curves.

 Location	 Size	 Demographic
UK	24	High school students

PETeR (Educational Project with Robotic Telescopes)

teacher workshops student workshops research projects

[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 knowledge. This is achieved by dedicating observation time with robotic telescopes to educational activities and e-science projects aimed at students and amateur astronomy associations.

They organized 5 teacher training sessions and a summer school for teachers. They have also developed new investigation projects for teachers on the topics of supernovae in galaxies, hunting for variable stars, and age dating open clusters.

 Location	 Size	 Demographic
Spain and Canary Islands	7300	Elementary and high school students, and teachers

Astrolab (Starlight in the university lab)



student workshops

research projects

Astrolab is a tutorial developed by Jean-Pierre DeGreve and Michele Gerbaldi. Nicole van der Blik joined the team in 2020.

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. While working on Astrolab, science students plan and perform real-time observations with an LCO 40cm telescope, and transform those observations into a scientific result. It is a learning-by-doing tutorial to acquire research competences and to understand the complexity of practical work.

Due to the Covid-19 pandemic no travel and no physical meetings were possible in 2021 but they are planned in 2022. Late 2021 was very active with

several refresher courses and one-to-one training, taking place via video-conference, for lecturers. Due to continuing COVID 19-restrictions two tutorials in late 2021, in Zimbabwe and South Africa, were canceled.

An astronomy course was offered for the first time in Peru, at the PUCP (Pontifica Universidad Catolica del Peru) to the undergrads. Astrolab is at the core of this course and observations with LCO an integral part of the course as well. After a refresher course via video, Astrolab was taught at the University of Pretoria, (South Africa) during the 2021B semester in the context of an astrophysics course.

📍 Location

Sub-Saharan
Africa

📊 Size

44

👥 Demographic

Undergraduate and
postgraduate students and
faculty

Pan-African School for Emerging Astronomers (PASEA)

student workshops

PASEA is an innovative short course in astronomy for African university students in STEM that incorporates educational research ideas and is designed and taught by a global collaboration of astronomers. PASEA curriculum centers around inquiry-based activities mimicking scientific research practices. The approach is based on education research and aims to simultaneously teach scientific practices and content. Due to the ongoing pandemic, during 2021-2022 their course was entirely remote, but attracted over 250 students from 16 African countries, of which 60 were accepted onto the course.

The remote course was expanded to 3 months, instead of the 5-day in-person course. The leaders found this had a huge benefit on the students' learning. Using networking tools like Slack, the students were able to build a strong social group. The flexible nature of using LCO was ideally suited to PASEA.

Location

African countries

Size

60

Demographic

Undergraduate students



Space Technology Agency

student workshops

Three undergraduate students of Miserere University undertook a project in image processing of astronomical data under the guidance of Space Technology Agency Uganda.

 Location	 Size	 Demographic
Uganda	3	Undergraduate students

Middle East, Asia and Oceania

Mission Platinum

teacher workshops student workshops

The aim of Mission Platinum was to host the world's largest astronomy lesson. They achieved this with over 7000 students from across the Uttar Pradesh district of India.

The LCO education team provided training to teachers (via Zoom) on using our observing website. The leaders then ran school workshops taking images using LCO. Over 4000 images were taken by 1000 students in 25 schools. These students were joined by 7000 more students for the record breaking astronomy lesson, hosted by LCO and the UK High Commission in India.

 Location	 Size	 Demographic
India	8000	Teachers and students

Astrometry Research Group of Sri Lanka

research projects student workshops

Astronomy research in Sri Lanka is an astronomy club for physics undergraduates studying in Sri Lanka. To contribute toward this development, the 'Astrometry Research Group of Sri Lanka' started as a pilot project to test and carry out astrometry research in Sri Lanka, where there is currently no university level research or degrees. The pilot project gathered a group of undergraduate and graduate students from the University of Ruhuna in Sri Lanka.

This program has been so successful that it is being expanded to a formal university course in 2 universities in Sri Lanka in 2022-2023 cohort.

 Location	 Size	 Demographic
Sri Lanka	10	Undergraduate students



Photos from Mission Platinum



Our Solar Siblings

student workshops

teacher workshops

[Our Solar Siblings](#) provides an established teacher training program to enrich the science curriculum with astronomy content. It provides an evidence based, curriculum based, project for high school level astronomy. OSS provides teaching and learning support for the participants. The science focus covers the entire life cycle of stars. LCO is used to provide inspirational color images to the teachers and their students.

Our Solar Siblings were affected by successive COVID-19 lockdowns in Australia. Non-essential teacher professional development was canceled. The effect was they did not attract new teachers, however their existing teachers continued to be involved.

 Location

Australia

 Size

500

 Demographic

Teachers, high school and middle school students

Shristi Astronomy

student workshops

Shristi Astronomy organizes in-person and remote learning workshops, specifically in astronomy research skills, including astronomical observation and data analysis. During 2021-2022 they ran 3 training sessions, one of which had over 400 attendees. The attendees are mostly undergraduate students from India.

Data was taken using LCO for use as training sets during the workshops. A smaller number of students were then able to continue using LCO for deeper investigations.

 Location

India

 Size

800

 Demographic

Undergraduate students and teachers

Exoplanet Watch

student research citizen science

Exoplanet Watch is a citizen science project about observing exoplanet transits and creating light curves from either observed or archived exoplanet observations. This partnership enables people who have an interest in astronomy but who don't have their own telescope to actively participate in astronomy research and improve their understanding of planets beyond our own solar system.

In December 2021, Exoplanet Watch held a global observing campaign for transiting exoplanet HD80606b, in preparation for an upcoming observing opportunity using the James Webb Space Telescope. Because this exoplanet has a long transit time of around 12 hours, multiple telescopes worldwide were needed to be able to capture the whole transit. The orbital period of 111 days means its transit can only be seen a few times a year. JPL astrophysicist Kyle Pearson wrote a [scientific paper about HD80606b](#), and included all student observers as authors.

 Location

Online and international network

 Size

640

 Demographic

Amateur astronomers and students



Where's the Flux?

citizen science

This project provides its audience with training on the analysis of real photometric data through the social media platform Reddit. The observation program consists of weekly, multi-band photometric monitoring of a mysterious variable star, KIC 8462852, with the LCO 40-cm network. The program's goal is to measure the extent and chromaticity of its long term variability. Additionally, this program allows for their community to respond and follow the start of any "dip" identified by more frequent measurements from AAVSO observers.



Location

Online network 40



Size



Demographic

General public, online network

Hunting Outbursting Young Stars (HOYS)

citizen science

A citizen science project which monitors a small number of star forming nebulae for outbursts from young stars. Their project networks amateur astronomers contributing data from personal telescopes. This partnership allows teachers to be involved in this citizen science project by using LCO. They have created extensive video tutorials on data analysis and how to upload the data to their database.

Their teachers are located in Canada, Croatia, France, Germany, Greece, India, Portugal, Romania, Spain, Turkey, UK and USA. The group has also published 2 peer-review publications during this period.



Location

Online and international network



Size

373



Demographic

Teachers

Gee Whiz Astronomy Modeling (GWAM)

student workshops teacher workshops

Modeling instruction is a teaching model where the teacher demonstrates a skill while describing each with a rationale. This partner uses modeling to teach core skills in astronomy data analysis to high school students and teachers. All sessions are remote via Zoom and offered in English and Spanish. They have students attending from Afghanistan, Chile, India, Iran, Iraq, New Zealand, South Africa, Spain, UK and USA. The students start by taking an image just for aesthetics and then take more images for data analysis, particularly exoplanets and variable stars.

Additionally American Modeling Teachers Association (AMTA), in cooperation with University of the Pacific, offered a distance learning 3-credit graduate course for astronomy teachers entitled Astronomy Modeling with Exoplanets, which incorporates using LCO.

 Location	 Size	 Demographic
Online and international network	70	High school students and teachers

Quotes from Global Sky Partner audiences



To get to do a little bit of what professional astronomers do is something exciting, to study a little bit of what astrophysicists see and study every day has been a small dream fulfilled.

I would like to add that it has been a very fun and entertaining ride. It is an experience from which you can learn a lot, placed and directed such to be a positive experience.

The experience was phenomenal thanks to the wonderful (and patient) instructors. I would love to be involved again in the future!

The resources at Las Cumbres Observatory are excellent. The project managers are great people and very professional. For our work team, having your help and contributions is very valuable and an honor.

Working with robotic telescopes has been my dream since I was in school. Thank you so much.

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MOORE
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