SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

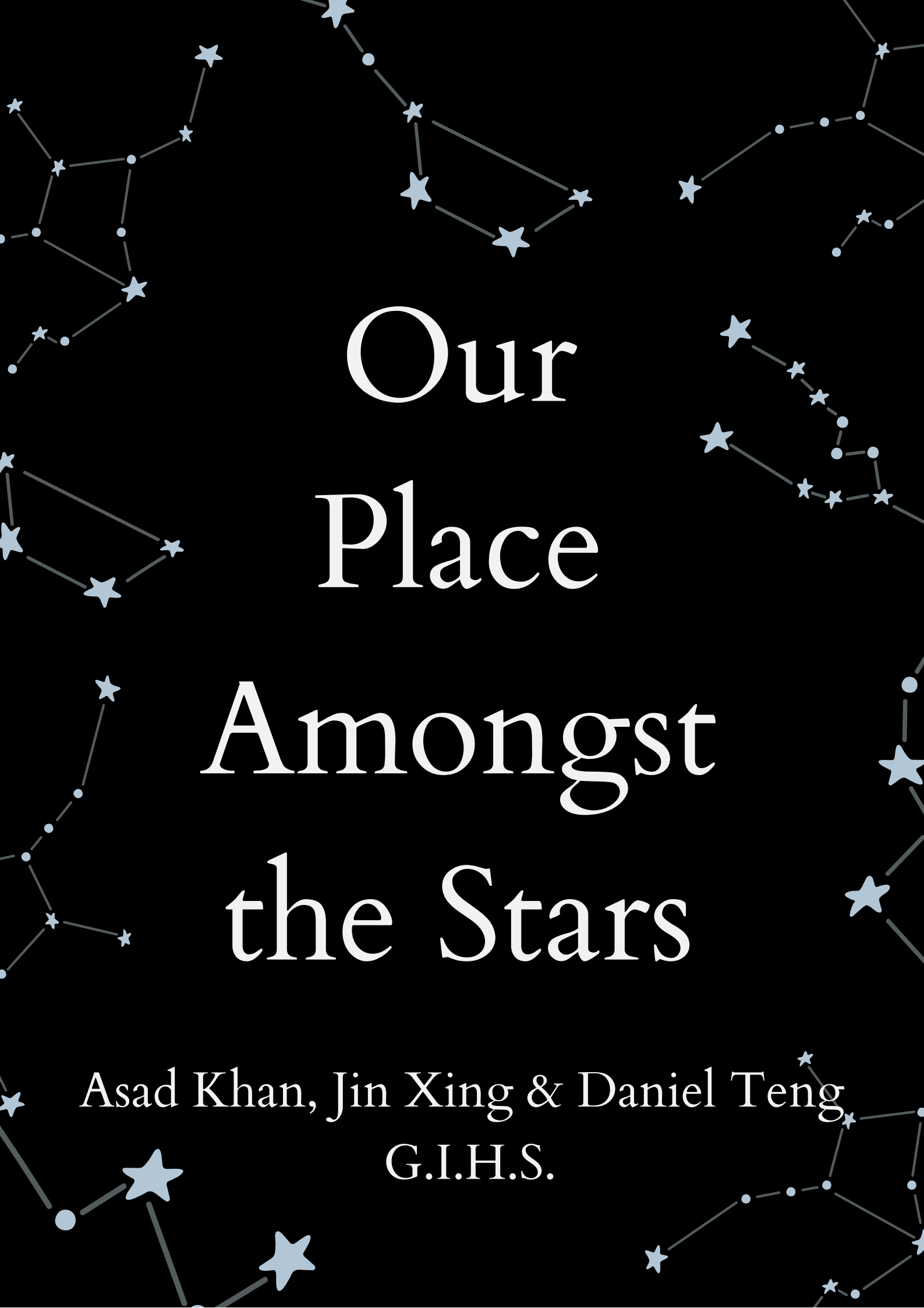
Prize Winner

Citizen Science

Secondary

Jin Xing
Daniel Teng
Asad Khan

Glenunga International High School



Our Place Amongst the Stars

Asad Khan, Jin Xing & Daniel Teng
G.I.H.S.

Light Pollution: What is it?

Light pollution is the excessive or misdirected artificial light that illuminates the night sky, caused by human activity. It can be caused by a variety of sources, including street lights, buildings, outdoor advertising, and industrial facilities. Rather than illuminating the intended area, much of the light is scattered, reflected, and refracted, resulting in skyglow, a phenomenon in which the night sky appears brighter than it should be.

Skyglow occurs when man-made light interacts with particles and molecules in the atmosphere, creating diffuse light that obscures the view of stars, planets, and other celestial bodies. This reduces our ability to observe and appreciate the beauty of the night sky, affecting professional and amateur astronomers as well as the general public. Widespread light pollution makes astronomical observation and research difficult because it makes it difficult to detect and analyze dark objects in the night sky.

Light pollution has a negative impact on ecosystems and wildlife. Nocturnal animals and insects rely on darkness for important activities such as locomotion, foraging, reproduction, and natural behaviour. The introduction of artificial lighting disrupts these patterns and behaviors, leading to disorientation and habit changes. For example, bright lights can disorient migratory birds and lead to collisions with buildings. In addition, light pollution can disrupt ecosystem balance by attracting or repelling certain species that depend on darkness.

Light pollution also affects human health and well-being. Excessive exposure to artificial light at night can disrupt your natural sleep-wake cycle, known as your circadian rhythm, leading to sleep disturbances and other health problems. The constant presence of artificial light suppresses the production of melatonin, the sleep-regulating hormone, which can affect overall sleep quality and health. In addition, the loss of dark, star-filled skies due to light pollution robs people of the aesthetic and emotional benefits that come with stargazing, weakening their connection to the natural world and the universe.

Why do we believe Citizen Science can help?

Light pollution is a serious problem in Adelaide. Adelaide, South Australia's main city, is exposed to large amounts of artificial lighting, especially in urban areas (the Central Business District). Urban growth and development has led to an increase in street lights, commercial areas, and residential areas, contributing to light pollution.

We believed that engaging citizens in data collection projects such as the Citizen Science project could be very beneficial in addressing the causes of light pollution. Some of the reasons that we believed this to be were:

- Data Collection: Citizens would be able to actively participate in collecting data on light pollution in their neighborhoods and communities. Tools such as light meters and smartphone apps could be used to measure and record light levels and document the extent of the problem. This data would help identify areas of high light pollution and help policy makers implement targeted solutions.
- Awareness and Education: Involving citizens in data collection would raise awareness of the effects of light pollution and educate the public about its effects. By participating in projects, individuals would gain a deeper understanding of the issues and would be more motivated to take action.
- Commitment to the Community: Citizen participation would foster a sense of ownership and responsibility within the community. By working together to reduce light pollution, citizens could take pride in their contribution to improving the quality of the night sky and the welfare of local wildlife.
- Cooperation with Authorities: The Citizen Science project offers citizens the opportunity to collaborate with local governments, city planners and lighting experts. By sharing the data and insights they collect, citizens could inform policy decisions and advocate for the implementation of lighting practices that minimize light pollution while meeting necessary safety requirements.
- Solution and Mitigation: Citizen-conducted data collection could reveal patterns and trends in light pollution and help identify specific sources and areas where effective mitigation measures can be implemented. Citizen participation would allow solutions to be tailored to local conditions and community needs, promoting ownership and sustainability.

By involving citizens in data collection projects, Adelaide could leverage the collective efforts of residents to effectively combat light pollution. Through collaboration, awareness and data-driven decision-making, we can reduce the negative effects of light pollution, restore the beauty of our night skies, and create more sustainable and greener cities.

Why are we doing this?

From a young age, the three of us have always had a passion for stars and the night sky. One of our earliest childhood memories for all of us is dreaming of being an astronaut, as every child does. Two of us grew up in intensely populated cities, one in Lahore, Pakistan, and the other in Shanghai, China. Here we have individual responses from each team member as to what drove their passion in this project:

Asad, Year 10:
For me, growing up in Lahore, a city with a population of 11 million, stars were a foreign concept. So many people cramped into a city so small in comparison led to extreme light pollution. But I remember that on nights where we would have load shedding, where the power would be cut off because the supply couldn't match the demand, you would be able to see everything in the night sky, because the entire city sat in darkness. That was when my father got me my first telescope, and I have been obsessed with stars since then. Now that I am older, I feel a strange sort of jealousy thinking about people that lived only a few centuries ago, the fact that they were able to look up into the night sky and see all the wonders of space. Since coming to Australia, I've only seen that kind of scene once or twice, when we travelled far away from the city, and I wish that I could see it more often, because it gives you a strange sense of hope that in a universe so large, drowned in the eternal darkness of space, we are not alone.

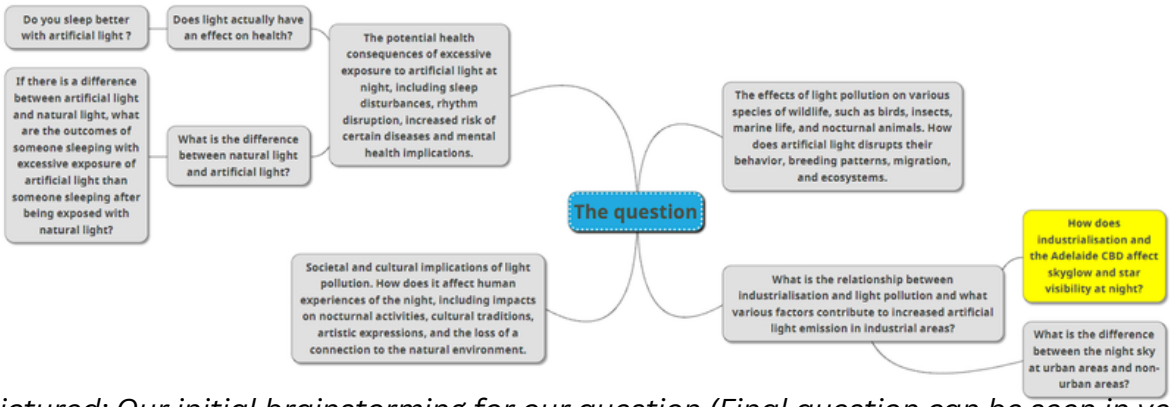
Jin, Year 10:
I spent my younger years in Beijing, where my family and I lived in an apartment complex in the heart of the city. I never cared much for stars back then because I didn't really see many up there. It was only when I came to Australia that I realised how beautiful the night sky truly was. But after I visited the Flinders Range, I was finally capable of seeing how much I had been missing out on. From that point on, light pollution became something that I was really passionate about. It is safe to say that that experience changed me, and that I want to experience it over and over.

Daniel, Year 9:
My passion for stars comes from a childhood memory that I have associated with them. I remember vividly that my family would go on hiking trips, and being able to see the stars with them at night was my favourite part, I just hadn't realised it yet. It would be great to be able to see the stars at night like I was able to on those hiking trips with my family, which is why I am passionate about it.

The Question: How does industrialisation and the Adelaide CBD affect skyglow and star visibility at night?

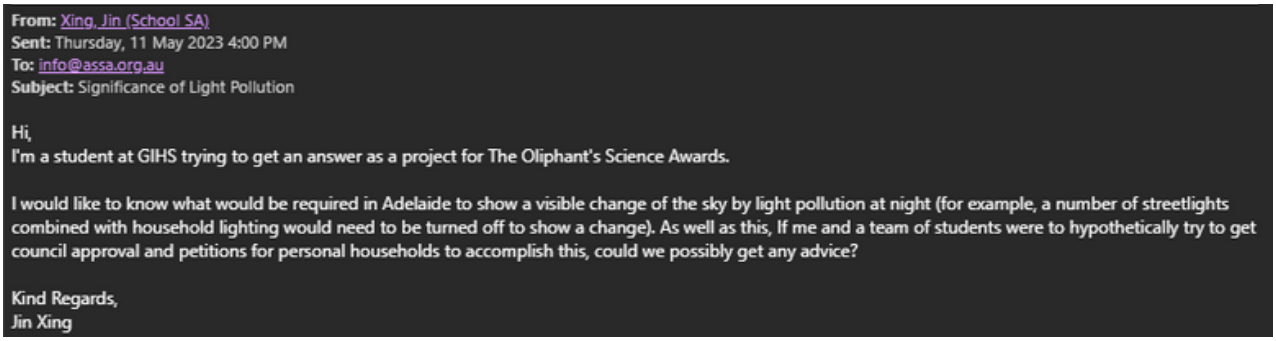
The Question and The Process

Now that we had something that we were all passionate about, we started to brainstorm about the possible ways we could get the people involved to make some real change, or at least make the foundation for change to be made. We had multiple ideas go around, until eventually we decided that we would do a mass data-collection project. We promptly signed up for the Science Awards and began our research. The question that we had landed on was, "How does industrialisation and the Adelaide CBD affect skyglow and star visibility at night?"



Pictured: Our initial brainstorming for our question (Final question can be seen in yellow).

To gather more information, we reached out to the Astronomical Society of South Australia (ASSA), asking about the amount of artificial light that would be needed (we knew that light being extremely fast, the change would be almost instantaneous) to be turned off to have an impact on light pollution. We were extremely grateful to the ASSA for responding so fast and taking an interest in our project, as they forwarded our question to the River Murray International Dark Sky Reserve committee.



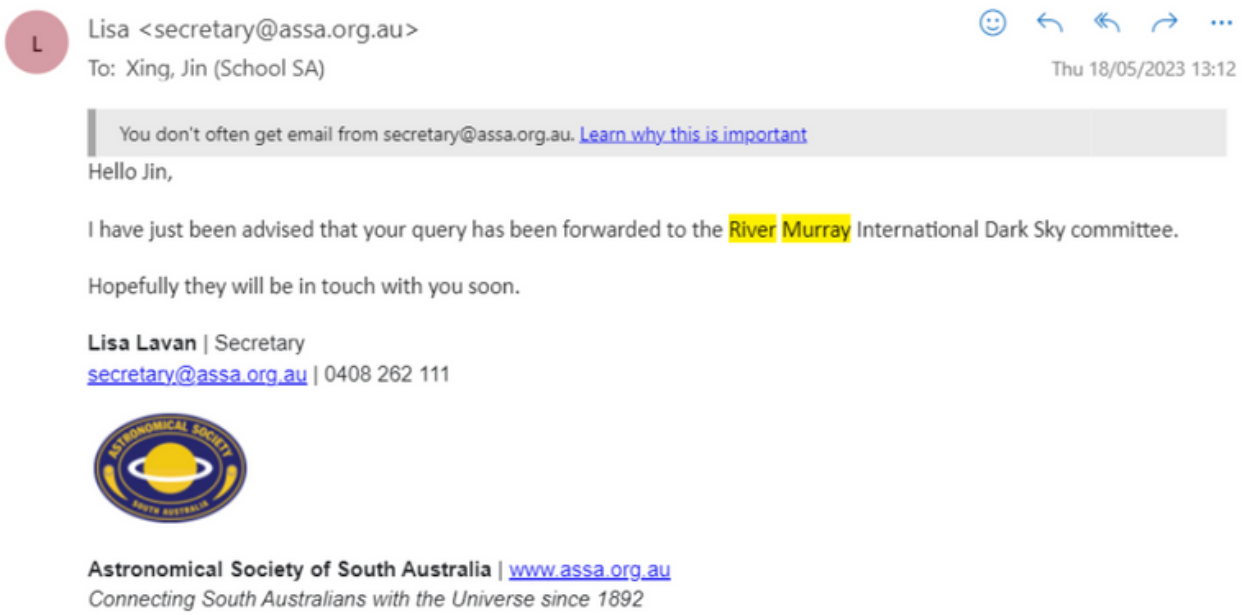
From: Xing, Jin (School SA)
Sent: Thursday, 11 May 2023 4:00 PM
To: info@assa.org.au
Subject: Significance of Light Pollution

Hi,
I'm a student at GIHS trying to get an answer as a project for The Oliphant's Science Awards.

I would like to know what would be required in Adelaide to show a visible change of the sky by light pollution at night (for example, a number of streetlights combined with household lighting would need to be turned off to show a change). As well as this, If me and a team of students were to hypothetically try to get council approval and petitions for personal households to accomplish this, could we possibly get any advice?

Kind Regards,
Jin Xing

Pictured: Our email to the ASSA regarding our question.



Lisa <secretary@assa.org.au>
To: Xing, Jin (School SA)
Thu 18/05/2023 13:12

You don't often get email from secretary@assa.org.au. Learn why this is important

Hello Jin,

I have just been advised that your query has been forwarded to the River Murray International Dark Sky committee.

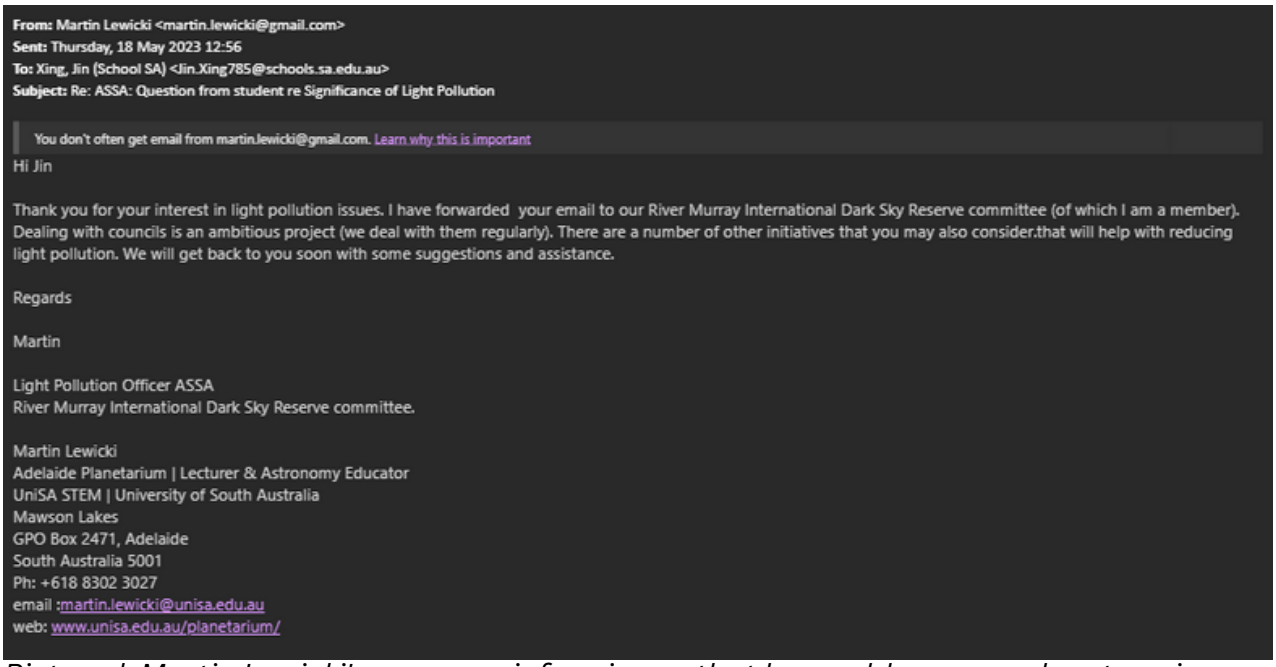
Hopefully they will be in touch with you soon.

Lisa Lavan | Secretary
secretary@assa.org.au | 0408 262 111

Astronomical Society of South Australia | www.assa.org.au
Connecting South Australians with the Universe since 1892

Pictured: The ASSA's response, where they put us in touch with the RMIDS committee

Later on, we got a response from Martin Lewicki, an Astronomy Educator at Adelaide Planetarium and member of the RMIDS committee. He informed us of how the committee regularly collaborated with local governments and councils and told us that they would soon reach back to us with more information on the projects that we could undertake.



From: Martin Lewicki <martin.lewicki@gmail.com>
Sent: Thursday, 18 May 2023 12:56
To: Xing, Jin (School SA) <Jin.Xing785@schools.sa.edu.au>
Subject: Re: ASSA: Question from student re Significance of Light Pollution

You don't often get email from martin.lewicki@gmail.com. Learn why this is important

Hi Jin

Thank you for your interest in light pollution issues. I have forwarded your email to our River Murray International Dark Sky Reserve committee (of which I am a member). Dealing with councils is an ambitious project (we deal with them regularly). There are a number of other initiatives that you may also consider.that will help with reducing light pollution. We will get back to you soon with some suggestions and assistance.

Regards

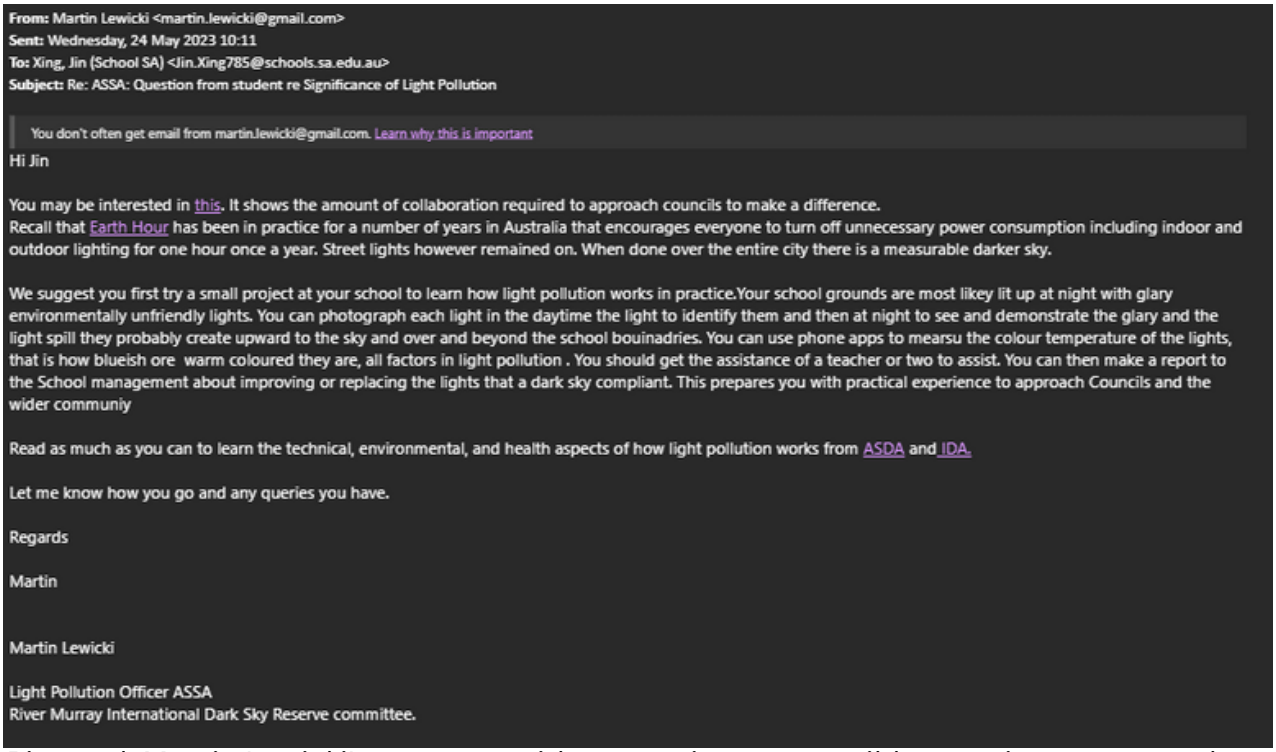
Martin

Light Pollution Officer ASSA
River Murray International Dark Sky Reserve committee.

Martin Lewicki
Adelaide Planetarium | Lecturer & Astronomy Educator
UniSA STEM | University of South Australia
Mawson Lakes
GPO Box 2471, Adelaide
South Australia 5001
Ph: +618 8302 3027
email :martin.lewicki@unisa.edu.au
web: www.unisa.edu.au/planetarium/

Pictured: Martin Lewicki's response informing us that he would soon reach out again.

We were now making real progress, and had started to get some idea of how to pitch the idea to people to get them involved. While we waited on Martin's response, we had started drafting plans for getting the word out to people and creating a way for data to be collected simultaneously. Soon after, Mr. Lewicki got back to us, and he offered some really valuable ideas that helped set us on our way and decide how we were going to conduct the project.



From: Martin Lewicki <martin.lewicki@gmail.com>
Sent: Wednesday, 24 May 2023 10:11
To: Xing, Jin (School SA) <Jin.Xing785@schools.sa.edu.au>
Subject: Re: ASSA: Question from student re Significance of Light Pollution

You don't often get email from martin.lewicki@gmail.com. Learn why this is important

Hi Jin

You may be interested in this. It shows the amount of collaboration required to approach councils to make a difference.
Recall that Earth Hour has been in practice for a number of years in Australia that encourages everyone to turn off unnecessary power consumption including indoor and outdoor lighting for one hour once a year. Street lights however remained on. When done over the entire city there is a measurable darker sky.

We suggest you first try a small project at your school to learn how light pollution works in practice.Your school grounds are most likey lit up at night with glary environmentally unfriendly lights. You can photograph each light in the daytime the light to identify them and then at night to see and demonstrate the glary and the light spill they probably create upward to the sky and over and beyond the school bouinadries. You can use phone apps to mearsu the colour temperature of the lights, that is how blueish ore warm coloured they are, all factors in light pollution . You should get the assistance of a teacher or two to assist. You can then make a report to the School management about improving or replacing the lights that a dark sky compliant. This prepares you with practical experience to approach Councils and the wider communiy

Read as much as you can to learn the technical, environmental, and health aspects of how light pollution works from ASDA and IDA.

Let me know how you go and any queries you have.

Regards

Martin

Martin Lewicki

Light Pollution Officer ASSA
River Murray International Dark Sky Reserve committee.

Pictured: Martin Lewicki's response with suggestions on possible experiments to conduct.

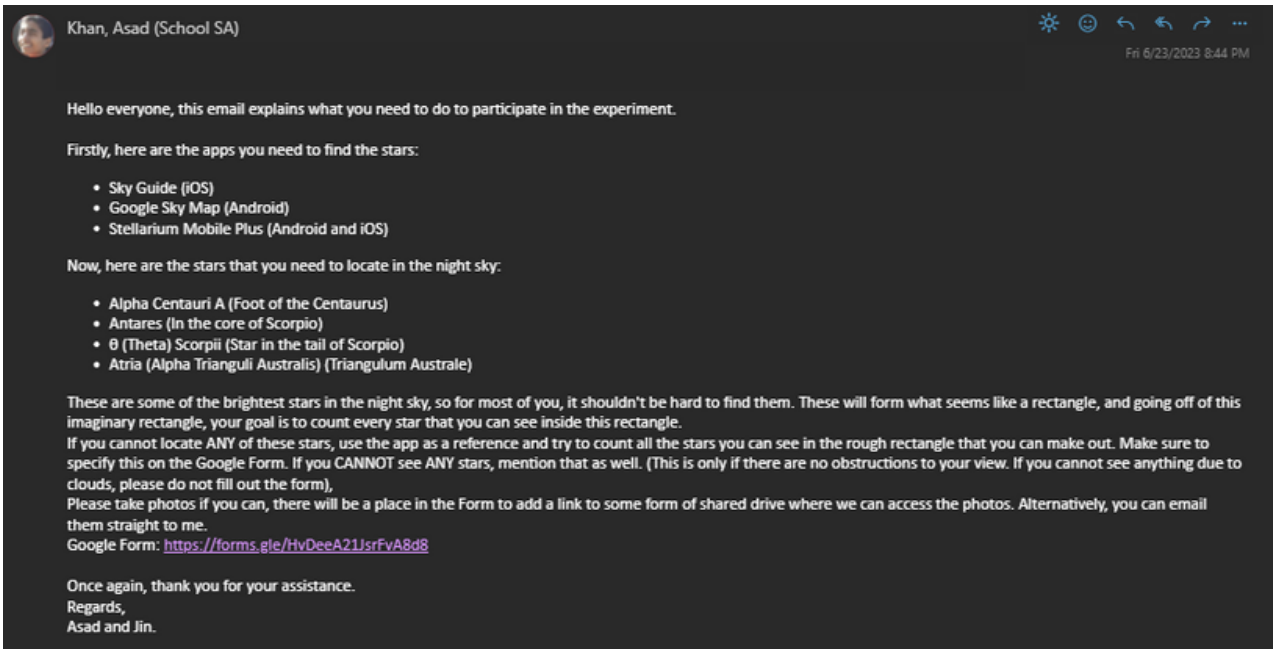
With Mr. Lewicki's suggestions, we came up with an idea that did not only gather valuable data regarding light pollution, but also involved the wider community. The idea was to have people stargazing at the same time and observing how many stars they see. Through this, we could observe the effects of light pollution in different areas, which provided insight into the different levels skyglow in the city.

The method was to:

- Highlight an area in the night sky that would be easily discoverable for almost anybody
- Have participants locate the stars using different applications
- Have people count the amount of stars that they could see in the highlighted space
- Coordinate this at the same time over several nights (time was a controlled variable as we didn't want the recordings to be affected by different factors at different times)
- Have people submit the information alongside their location, which would help us analyse trends

We made a presentation regarding the topic that we presented in class and after we had people's interest and had given them an idea of what our intentions were, we sent out an email to our class and reached out to other people as well to have the maximum amount of people involved in the project.

Conducting the Experiment



Khan, Asad (School SA)

Fri 6/23/2023 8:44 PM

Hello everyone, this email explains what you need to do to participate in the experiment.

Firstly, here are the apps you need to find the stars:

- Sky Guide (iOS)
- Google Sky Map (Android)
- Stellarium Mobile Plus (Android and iOS)

Now, here are the stars that you need to locate in the night sky:

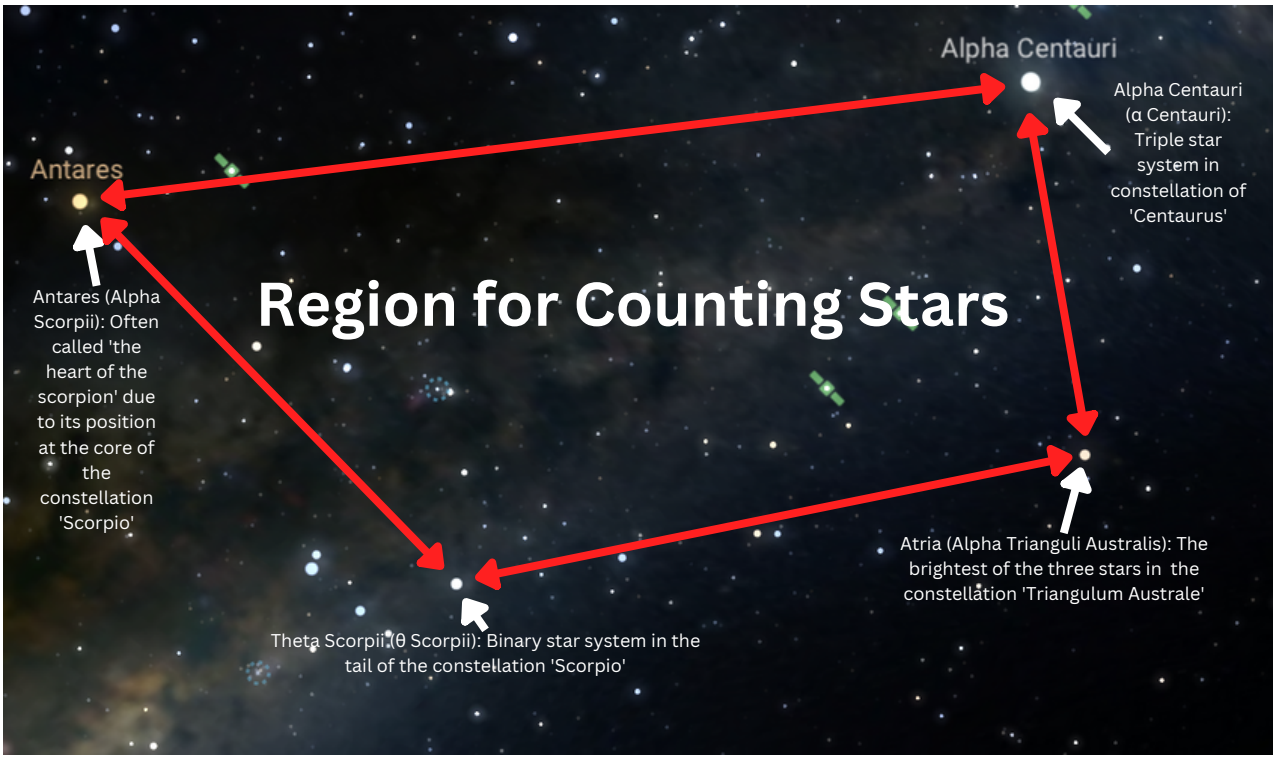
- Alpha Centauri A (Foot of the Centaurus)
- Antares (In the core of Scorpio)
- θ (Theta) Scorpii (Star in the tail of Scorpio)
- Atria (Alpha Trianguli Australis) (Triangulum Australe)

These are some of the brightest stars in the night sky, so for most of you, it shouldn't be hard to find them. These will form what seems like a rectangle, and going off of this imaginary rectangle, your goal is to count every star that you can see inside this rectangle.
If you cannot locate ANY of these stars, use the app as a reference and try to count all the stars you can see in the rough rectangle that you can make out. Make sure to specify this on the Google Form. If you CANNOT see ANY stars, mention that as well. (This is only if there are no obstructions to your view. If you cannot see anything due to clouds, please do not fill out the form),
Please take photos if you can, there will be a place in the Form to add a link to some form of shared drive where we can access the photos. Alternatively, you can email them straight to me.
Google Form: https://forms.gle/HvDeeA21JsrFvA8d8

Once again, thank you for your assistance.
Regards,
Asad and Jin.

Pictured: The email we sent out to the group regarding the experiment.

We started by highlighting the area that we wanted people to count stars in. We did this by looking at some of the brightest stars in the night sky and forming a rectangle of sorts out of it.



Pictured: Diagram showing the region we chose for participants to count stars in.

Note: It is not mentioned in the email but the experiments were conducted around 9 PM in Australian Central Standard Time (GMT 9:30) to take into account people's sleep schedules and still have nighttime activity which affects skyglow.

We instructed participants to use one of three apps that would help them locate the stars (these apps used augmented reality to make finding stars easier). The three apps were:

- Sky Guide (iOS)
- Google Sky Map (Android)
- Stellarium Mobile Plus (Android and iOS)

The stars required to be located and triangulated/ordered in the night sky:

- Alpha Centauri A (Foot of the Centaurus)
- Antares (In the core of Scorpio)
- θ (Theta) Scorpii (Star in the tail of Scorpio)
- Atria (Alpha Trianguli Australis) (Triangulum Australe)

These are generally some of the brightest stars in the night sky, so for most of the participants, it shouldn't be hard to identify these. These will form what seems like a rectangle, and going off of this imaginary rectangle, the aim is to count every star that can be seen inside this rectangle.
If none of these stars cannot be located, the app will be used as a reference. Participants will then attempt to make out any stars in this rectangle. (dismissing any if they aren't sure whether it's a star). This would be specified in the recording of data. If participants were able to see stars but not identify the four, they were asked to take a photo. Ifx no stars were visible, it would be recorded as well (This is only if there are no obstructions to the view. If you couldn't see anything due to clouds and / or surrounding objects, the participants were asked not to fill out the form).

Ensuring of these boundaries, we created a Google Form, where participants were able to submit their results alongside images taken. These questions consisted of:

- Where were these results recorded?
- What night is this taken on? (We had the experiment conducted on several nights at the same time)
- Were you able to find all four stars? (Alpha Centauri, Theta Scorpii, Antares, Atria)
- If you could not locate any stars, using the app as reference, how many stars could you see in the general area?
- If you were able to locate the stars, how many stars did you count?
- Are there any factors that you know off that affect your visibility in the night sky? (e.g. living close to or in the city, living in Adelaide Oval, etc.)
- Add any images that you took on the night.

After the period of recording results, we collated it and had our data.

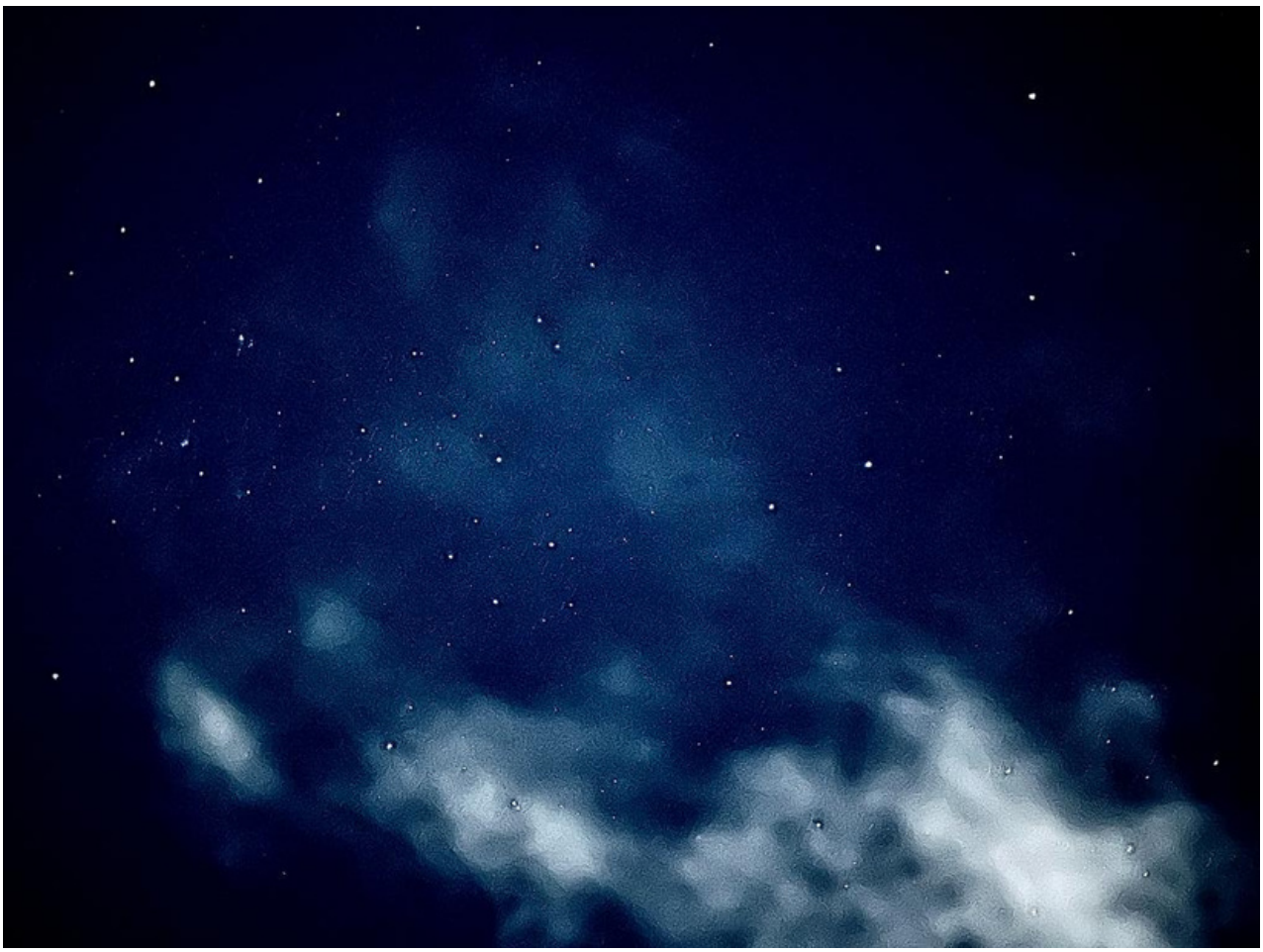
Results

Thankfully, we had several responses from participants which showed us the obvious interest in the topic. After collecting all the data, we were able to map it and observe the trends that we saw. (Note: This is spread out due to numerous participants not living in the school zone)

Pictured: Map showing (average) amounts of stars recorded over the course of the experiment. Refer to table below for ranges.

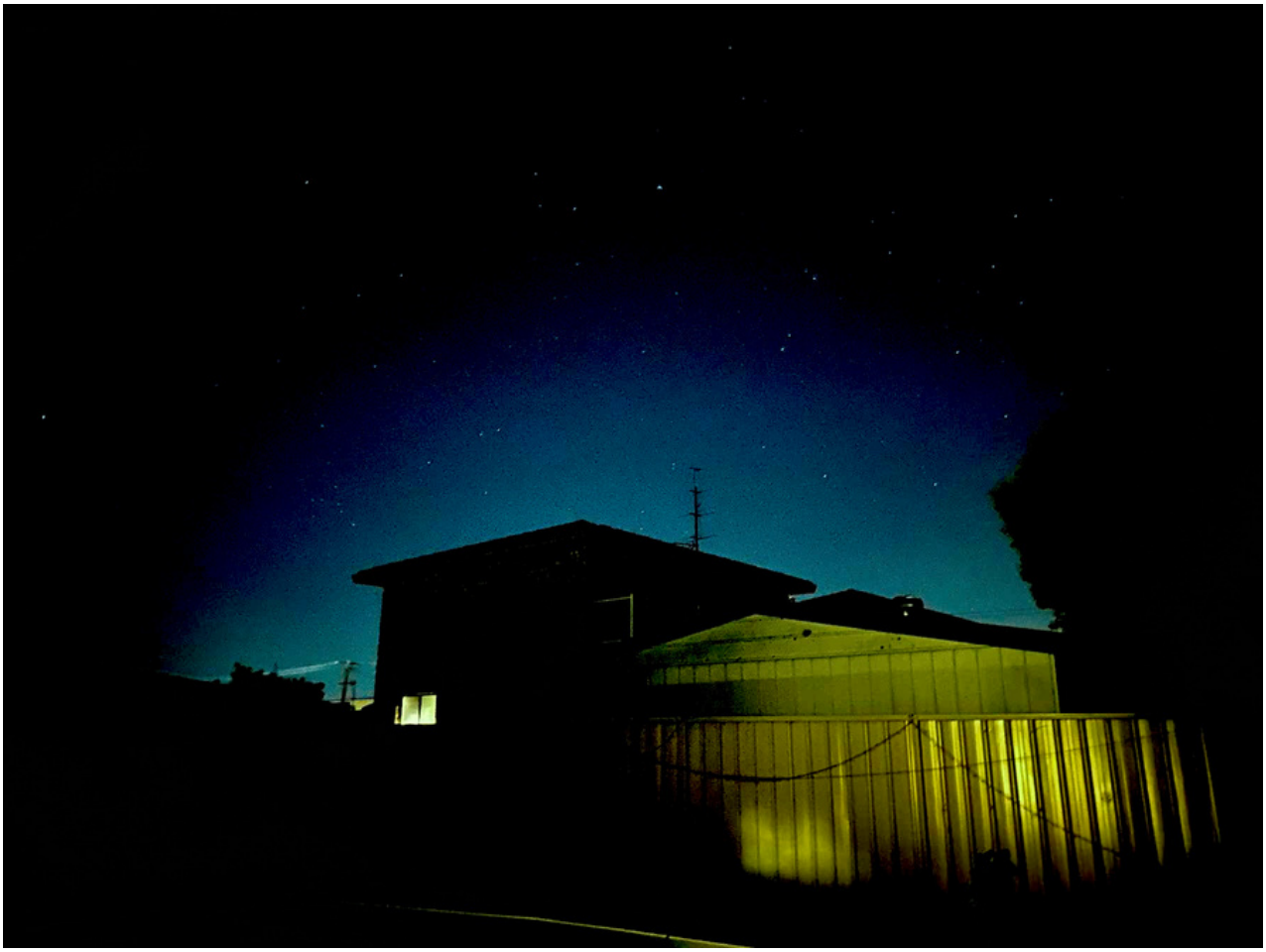
Class Number	Range of Stars in Class (A low range can be expected due to high light pollution)
1	0 to 20
2	21 to 40
3	41 to 60
4	61 to 80
5	81 to 100
6	100+

Evidence



Pictured: Image taken in Ingle Farm (edited to assist with visibility)

This image acts as a good reference point for dark sky visibility. Ingle Farm is approximately 16.4 km from Adelaide's Central Business District. A night sky photo taken approximately 16 kilometres from the Adelaide CBD may have less light pollution than a photo taken in the CBD due to a number of factors. In the CBD, there are many artificial light sources such as streetlights, buildings and commercial buildings, causing higher levels of light pollution. These light sources emit light that is scattered and reflected by the atmosphere, creating glare in the sky and obscuring celestial objects. In addition, the proximity of buildings in central business districts increases the risk of light leaks, where artificial light enters unintended locations. Away from the CBD, the density of artificial lighting decreases, resulting in a less lustrous sky, clearer skies, and better star visibility. There is also less light pollution at greater distances, making the night skies more suitable for astrophotography and stargazing.



Pictured: Image taken in Glenunga (saturated to assist with visibility)

This image acts as a good reference point for suburban light pollution. Night sky photos taken in suburbs farther from the Adelaide CBD are likely to have less light pollution than photos taken in the CBD, but due to the level of urbanization and differences in artificial lighting, some night sky photos taken at Engle Farm may have less light pollution than photos taken in the CBD. less light pollution than the original photo. region.

The CBD's concentration of buildings, streetlights and commercial facilities creates high levels of artificial lighting and contributes significantly to light pollution. A bright, abundant light source nearby increases sky brightness and light scattering, reducing the visibility of stars and celestial objects.

In general, moving to the suburbs away from the central business district results in less light pollution. Suburbs still have some degree of artificial lighting, but the density of buildings and urban infrastructure tends to be lower compared to the CBD. This reduces light sources and skylights, improves star visibility in the night sky, and reduces light pollution.

However, the level of light pollution varies between suburbs far from the CBD and specific locations like Ingle Farm. As a suburban area, Ingle Farm is likely to have fewer artificial light sources compared to the CBD, but may have more light sources than more remote suburbs due to factors such as population density and lighting practices. If your Ingle farm is densely populated or if there is a significant light source nearby. B. Light pollution can be relatively high on highways and commercial areas compared to remote suburban areas.

Limitations

Sensor limitations:
The sensors used in cell phone cameras are generally smaller and less sensitive than dedicated astrophotography cameras. It may not be able to accurately capture subtle differences in faint stars and light pollution.

Noise and image processing:
Cell phone cameras often use noise reduction and image processing algorithms that can affect the accuracy of captured images. These algorithms can smooth out details, change colours, and introduce artifacts, making it difficult to measure light pollution accurately.

Dynamic range:
Mobile phone cameras have a limited dynamic range compared to specialized cameras. If you're shooting a scene with both bright light pollution and dark areas, it's difficult for the camera to accurately capture the full brightness range, and you may lose detail in bright or dark areas.

Lens limitations:
Cell phone camera lenses are typically designed for everyday photography and may not be optimized for night sky photography. These can cause aberrations, distortions and loss of sharpness, which can affect the accuracy of the captured image.

Inconsistent settings:
Most cell phone cameras automatically set exposure, white balance, and other parameters. These settings are different for each phone model and may cause discrepancies in captured images. This makes it difficult to compare results from different devices and to obtain accurate and consistent measurements.

Light pollution source:
Light pollution is not evenly distributed across the sky. It may vary depending on the direction, intensity and type of light sources present in the environment. A single photo of him, taken with a cell phone camera, does not comprehensively capture all the light pollution in a given location.

Calibration and reference standards:
Accurate measurement of light pollution requires calibration and a reference standard to compare captured images. Cell phone cameras typically do not have built-in calibration capabilities, making it difficult to obtain accurate measurements without additional equipment or techniques

Improvements

Collecting more data from multiple sources and locations will enable a more informed analysis of the relationship between industrialization and light pollution. Increasing the sample size and geographic coverage allows for a wider representation of different industrial areas, lighting practices, and environmental contexts. This large dataset enhances the statistical significance of our results and improves the generalizability of our conclusions.

As data sets grow, more advanced statistical analysis can be used to uncover correlations, trends, and patterns with greater accuracy and confidence. Enhanced statistical power allows us to see subtle relationships, identify potential confounders, and establish stronger causal links between industrial activity and light pollution. This enhances the scientific rigor of the research and increases the overall validity of the research.

By conducting tests and case studies in different locations, we can study the impact of industrialization on light pollution in different environments and industrial sectors. Selecting locations with different degrees of industrial development, urbanization, and lighting regulation allows us to compare and contrast the impact of different industrial practices on light pollution. This comparative analysis provides valuable insight into the contextual nuances and specific challenges associated with different industrial environments.

Future Potential

Light pollution is a major environmental problem with multiple impacts on human health, ecosystems, and astronomical observations. Addressing and controlling light pollution requires concerted efforts by individuals, communities and governments.

The future direction of light pollution control is to focus on raising awareness and education. Raising public awareness of the effects of light pollution is critical to gaining support and participation in efforts to reduce light pollution. Educating communities, policy makers and lighting professionals about the importance of implementing responsible lighting practices can lead to big changes. By encouraging the use of energy-efficient lighting fixtures, directing light only where it is needed, and employing shading techniques, individuals and communities can reduce light pollution while meeting their lighting needs.

Another potential focus area is the implementation of government-level lighting regulations and policies. Governments can play an important role in reducing light pollution by creating and enforcing regulations that encourage responsible lighting practices. These regulations may include guidelines for the installation of outdoor lighting, limits on excessive or unnecessary lighting, and efficiency requirements for lighting fixtures. By incorporating light pollution considerations into urban planning and development processes, cities and communities can create aesthetically pleasing and environmentally friendly environments. Additionally, technological advances help control light pollution. The development and deployment of more efficient lighting technologies such as LED lights can help reduce energy consumption and minimize light leakage. In addition, intelligent lighting systems with sensors and adaptive controls enable dynamic lighting adjustments based on real-time requirements to further reduce light pollution.

Collaboration between scientists, astronomers and citizen scientists can also help us understand and monitor light pollution. Initiatives such as the Globe at Night program encourage individuals to contribute observations of the brightness of the night sky, thereby helping build a comprehensive picture of light pollution around the world. These citizen science efforts provide valuable data for researchers and policy makers to help develop effective strategies to combat light pollution.

In summary, tackling light pollution requires a multi-pronged approach that includes awareness-raising and education, regulatory action, technological advances and collaboration. By raising awareness, enforcing responsible lighting practices, enacting regulations, leveraging innovation and engaging citizen scientists, we can reduce light pollution and leave the beauty of the night sky for future generations. can work on it.

Further Research on Light Pollution

Light pollution is a serious problem in Adelaide, caused by several factors, including inadequate street lighting coverage. This causes light scattering and directs a significant portion of the light upwards, contributing to the night sky's brightness.

One factor that exacerbates light pollution is the colour temperature of the lighting used. Many modern artificial light sources, such as LED lights, have high colour temperatures and tend to be on the bluish side of the spectrum. These lights emit a cooler, bluish light compared to traditional warm lights. Bluish light is easily scattered in the atmosphere, contributing to the brightness of the sky and reducing the visibility of stars and celestial bodies. On the other hand, warm lights have a lower colour temperature and emit a more yellowish or amber light that has less impact on the night sky.

Another aspect that contributes to Adelaide's light pollution is the reflection of light off the ground and other surfaces. Light emitted by streetlights and other sources can bounce off reflective surfaces such as roads, buildings, and sidewalks and return to the atmosphere. This reflected light increases the overall brightness of the night sky and contributes to the brightness of the sky. To combat Adelaide's light pollution, it is important to take measures to reduce the light spread and upward light. This can be achieved by using well-designed and shielded street lights that direct light downwards and prevent unwanted light from being emitted into the sky. In addition, using warm lights with a low colour temperature can minimize the scattering of light in the atmosphere and reduce skyglow. Efforts should also be made to reduce the amount of light reflected from floors and other surfaces. This can be achieved by using materials and surfaces that absorb or scatter light rather than reflect it.

By minimizing light reflection, less light is sent back into the atmosphere, further reducing the effects of light pollution. Overall, tackling light pollution in Adelaide requires a comprehensive approach, including proper lighting fixture design, use of warm light colours, and strategies to minimize light leakage and reflections. By taking these measures, we can reduce the negative effects of light pollution, preserve the natural darkness of the night sky, and improve the visibility and perception of celestial objects.

How can this data be utilised?

The goal of this Citizen Science Project was to collect light visibility data in different areas of Adelaide to better understand the extent of light pollution and skyglow. By involving citizens in data collection, we aimed to raise awareness of this issue and gather valuable information that can be used to develop targeted solutions to reduce light pollution. As the timeframe was not long enough to reach out to local government and urge for change, we instead formulated a plan of how this data could be utilised.

Adoption and Engagement:

- Engage with the community through outreach campaigns, social media and local organizations to encourage participation in events regarding light pollution.
- Provide materials and workshops to educate volunteers about light pollution, its effects, and the importance of data collection.
- Build partnerships with local schools, colleges and astronomy clubs and involve students and hobbyists.

Data collection:

- Distribute light pollution measurement kits to volunteers, including light meters and data recording tools.
- Instruct attendees on proper measurement techniques and protocols for data collection.
- Encourage volunteers to collect data from different locations in Adelaide, including urban, suburban and rural areas.
- Gather information about factors such as ambient lighting, colour temperature, and sky visibility.

Policy Recommendations and Solutions:

- Work with local governments, environmental groups and lighting experts to develop policy recommendations to reduce light pollution.
- Advocate for adoption of lighting codes and policies that promote responsible lighting practices, such as proper shielding and directional lighting. Promote the use of warm, low colour temperature light to minimize the scattering and negative effects of artificial lighting.
- Raise awareness about the benefits of dark sky preservation and the importance of night sky preservation in human health, wildlife, and astronomical research.

Community Involvement and Education:

- Organize community workshops, seminars and events to disseminate project results and engage citizens in discussions on light pollution.
- Work with local schools to incorporate light pollution education into the curriculum and encourage environmental stewardship among students.
- Develop public awareness campaigns and initiatives to encourage individuals and businesses to adopt responsible lighting practices such as: Use of motion sensors, timers, and low intensity lighting where appropriate.

By conducting this citizen science project and using data collected in different light conditions in different parts of Adelaide, we can develop a better understanding of light pollution and its impact on skyglow. The information collected will serve as a valuable resource for developing targeted solutions, raising awareness and driving policy changes that promote sustainable lighting practices. Together we can reduce light pollution, keep the night sky naturally dark and improve the overall quality of life in Adelaide.

Conclusion

Industrialisation and its interaction with the Adelaide Central Business District (CBD) undoubtedly affect the way skylights and stars are seen at night. The concentration of industrial activity and urban development in the CBD will increase artificial lighting, which can affect the night sky's brightness.

The industrial areas in and around the Adelaide CBD serve as hubs for manufacturing, warehousing and other industrial infrastructure, requiring the use of outdoor lighting for safety and operational reasons. The existence of these facilities contributes to the spread of artificial lighting in the area. Effective lighting of these spaces often requires powerful fixtures that emit large amounts of light upward. As a result, the cumulative glow emanating from these industrial sources mixes with his CBD urban lighting, resulting in a phenomenon known as skyglow.
Skyglow represents the ubiquitous brightness of the night sky caused by the scattering and reflection of artificial light. It permeates the atmosphere, creating a bright haze that reduces the natural darkness that once existed.

Our results showed that industrialisation and the CBD do in fact have an effect on skyglow as locations farther away from the area had a lesser amount of light pollution and were hence able to have more stars visible.

To combat the effects of industrialization on light pollution and skylights, it is important to implement effective lighting practices and techniques. This includes the use of shielded and well-regulated lights that minimize upward light emission and light scattering. Energy efficient warm temperature lighting solutions can also reduce flare and glare caused by high colour temperature light. (Refer to Page 18)

Additionally, raising industry awareness and introducing lighting regulations that encourage responsible lighting practices will go a long way in reducing light pollution. By working on balanced and efficient lighting solutions, Adelaide will preserve natural darkness, improve star visibility and create a more sustainable and aesthetically pleasing urban environment for residents and visitors alike can be produced.

The response to our project showed us that there is a clear interest amongst people in the issue of light pollution, and harnessing this interest will be at the benefit of everyone as we increase community participation in a real-world problem.