

Activity	Investigate the relationship between night sky viewing and lighting in cities and towns in Missouri.
Standards	<p>NSSS/MLS: 5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.</p> <p>3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p>
Learning Outcomes	<ul style="list-style-type: none">• Students will be able to describe night sky viewing patterns in Missouri for reported data.• Students will be able to discuss the relationship of limiting magnitude reported to night sky brightness of different locations.

Map URL: <http://arcg.is/1K8WGf>

Engage

What do you see in the night sky?

- This map shows night sky viewing data reported to Globe at Night from Missouri citizen scientists in 2015.
- Before opening the map, ask students questions to engage them in thinking about what they see in the night sky.
 - ? When you look up in the sky at night, what do you see?
 - ? How do the things you observe differ in brightness?

Explore

How do the viewing experiences shown on the map differ?

- Click the URL or type it in your browser to open the map.
- Zoom in or out of the map so that you can see all of Missouri on your screen. This is citizen science data. That means that it is voluntarily reported by interested citizens who took the time to view and report.
- Open the legend under GaN2015-Missouri.
 - ? What do the different colors of dots represent on the map (You might need to click on the dots to figure this out)
 - ? Do you notice any patterns? (What do you notice about the locations of dots in Missouri? What do you notice about the colors?)

Explain

What information about the viewing experiences can we get from the data?

- Click on the orange dot nearest to Kansas City. Notice that (1 of 42) is written at the top of the box.
 - ? What does this mean? What is the range of dates for the data represented by this dot?
- Close the information box and zoom in until you can see many dots in the area. Zoom in until they are separated from each other. Now click on each of them.
 - ? What do you notice now?
- Click On this link: <https://www.globeatnight.org/infographic/2015> and scroll down to the graph. You can change the view to Missouri only in the dropdown menu on the right.

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- ? How many observations at Limiting Magnitude of 1 were made in Missouri in 2015? How many were made at Limiting Magnitude of 5?
- Open the table associated with the data. Look at the different information reported by the by citizen scientists. Most of the reports do not have the constellation observed for the data.
- ? Is there a way to infer what constellation was the focus of the observation made for each date? What other information would we need to be able to do that?



Elaborate

How does location affect how much we see in the night sky?

- Click on Artificial Night Sky Brightness to add this to the map. The brighter areas are where there is more light emitted to the sky from lighting on the ground. Click on the three dots under this content and change the transparency to 75%.
- ? What do you notice about the location of the brightest areas?
- ? Is there a relationship between these and the limiting magnitude of the constellation under study in the reports of citizen scientists? (Zoom into areas to better see the surroundings at each location.)



Evaluate

How can we as human being mitigate the amount of light emitted into the night sky?

- Think about nighttime lighting in your community.
- ? How much light escapes into the night sky? Can we measure that?
- ? Is there a way to create a solution that allows less light to escape?

Sort in Tables

- Tables are only available for certain map layers.
- In the Details pane, point to the desired layer name and click the Show Table button.
- Click the Name column header and choose Sort Ascending or Sort Descending.

Turn a Map Layer On or Off

- Press the Details button to turn on the pane.
- Show the table of contents for the map by pressing the button, Show Map Contents.
- Show layers by checking the box next to layer names.
- If a map layer name is light gray, zoom in or out of the map until the layer name is black. The layer can now be turned on.

more ►

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Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to U.S. public, private, and home schools as a part of the White House ConnectED Initiative. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://connected.esri.com>.

THEN TRY THIS...

- Look at the following for additional information and activities:
- Light Pollution Activities with Students
<https://www.arcgis.com/apps/MapJournal/index.html?appid=78c53f05c93f40dfb1df61c492681c81>
- Lights On, Lights Off <https://storymaps.esri.com/stories/2017/Lights-On-Lights-Out/index.html>
- A Sky Without Stars <https://geogeeks.maps.arcgis.com/apps/Cascade/index.html?appid=2109312e08cb4e59afec3afcf154eda7>



REFERENCES

This GIS map has used data from GLOBE at Night and information from a presentation by the National Optical Astronomy Observatory for the International Year of Light.

- GLOBE at Night <https://www.globeatnight.org/>
- Presentation National Optical Astronomy Observatory http://globeatnight-network.org/presentations/For_SzeLeung3.pdf

WWW.ESRI.COM/GEOINQUIRIES

Version Q4 2016. Send feedback: <http://mga.missouri.edu>

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