



Composite photo taken at New Germany State Park in MD by Geneviève de Messières



Introducing myself

About This Talk

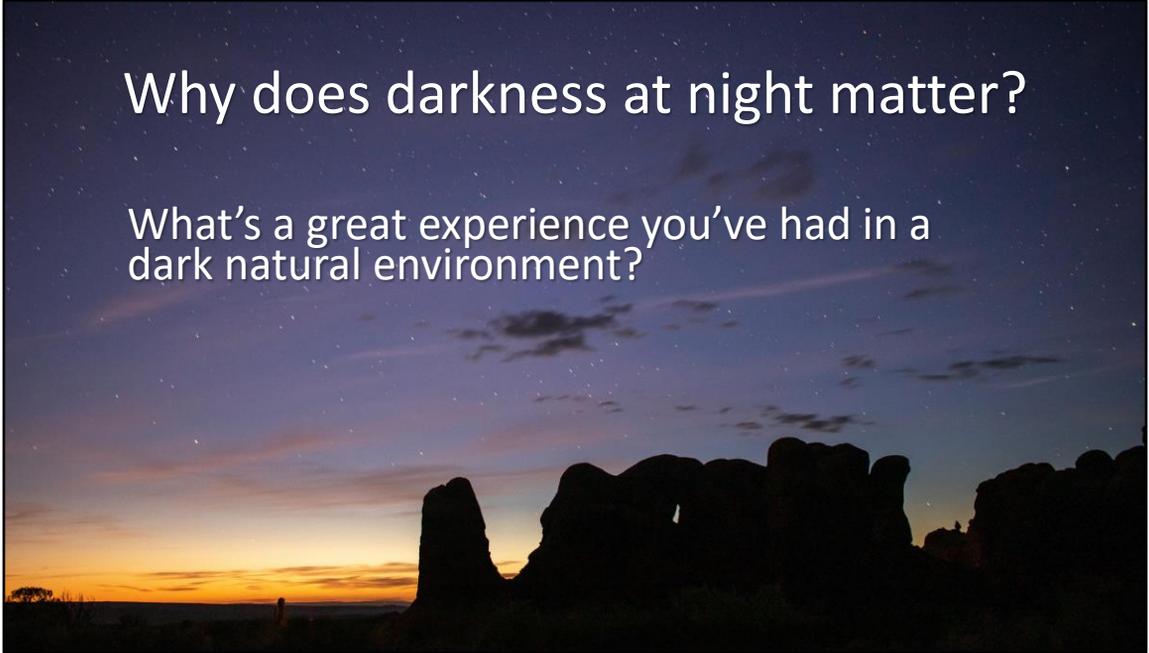
- About light pollution
- The 5 principles of good outdoor lighting
- LED streetlight discussion

© Geneviève de Messières

This composite of the Geminid meteors was taken in Bergton, VA by Geneviève de Messières

Why does darkness at night matter?

What's a great experience you've had in a dark natural environment?



Group discussion:

- Identify some of the key reasons that organisms including humans need darkness.
- Ask people to share a great experience they've had in a dark natural environment.

Photo taken at Arches National Park by Geneviève de Messières



I feel more alive under a truly dark sky. Staring up at the stars against an inky black sky, seeing the bright glow of the Milky Way, heals my heart the way that many of us feel watching the waves lap against the shore or hearing the crickets at night.

You won't see a sky like this anywhere close to DC, but we do have some protected dark skies in the Mid-Atlantic. Often to get an extremely dark sky, you might need to go out west, or to an island, or mountainous areas like Arizona or Chile.

This picture of the Orion constellation was taken by Geneviève de Messières at a dark sky site, Kitt Peak in Arizona

WHO WE ARE



INTERNATIONAL DARK-SKY ASSOCIATION

The **International Dark-Sky Association** (IDA) protects the night from light pollution and promotes responsible outdoor lighting.

International Dark-Sky Association | 2019

The International Dark-sky Association (IDA) is the leading organization working globally to protect the night. <https://darksky.org/>

IDA has chapters, delegates, and affiliates across the globe! You too can get involved!

It's really people like you who make the difference. IDA is a small nonprofit, and our impact is made through our network of advocates across the world, You can join us! If you don't want to join as an advocate, you can always join IDA as a member and support us in that way.

Many of these slides were created by the International Dark-Sky Association for use in presentations like these. Those slides are distinguished by the label in the lower right.

IDA in Virginia: www.darkvirginiasky.org

DARK VIRGINIA SKY

VIRGINIA SECTION OF THE INTERNATIONAL DARK SKY ASSOCIATION

SATURDAY, MAY 1, 2021

New IDA - IES Outdoor Lighting Policy Guidance: Comprehensive Decision Making = Better Outcomes

WEDNESDAY, JANUARY 20, 2021

Rappahannock County's Night Sky Conservation Initiative Steady and Strong

WEDNESDAY, DECEMBER 18, 2019

VDOT Policy Guidelines Promise Better LED Conversion

www.darkvirginiasky.org

Laura Greenleaf represents IDA members in Virginia. Contact Laura at lauragreenleaf@verizon.net if you want advice or connections.

Thanks in part to Laura's advocacy, Virginia DNR has for the first time included dark skies among the Scenic Resources in their Outdoor Plan. Read more here: <https://www.dcr.virginia.gov/recreational-planning/vop> See chapter 10 for the Scenic Resources, and Appendix 10 for Laura's writeup of recommendations and resources that you can use to advocate for dark skies.

Virginia now has 5 dark sky parks (DSPs) – making it the dark sky capital east of the Mississippi! That does not mean that the skies there are pristinely dark. All Virginia skies are rapidly deteriorating and will get worse without our advocacy.

For advocates living close to a DSP, Laura says: "The best way they can contribute is by getting involved with the park and become part of a team working to maintain (or improve!) the quality of the park's night skies. A DSP needs strong community advocacy partnerships. [You] could help with the education and outreach with park visitors and community members and, critically, the relationship-building with local government officials."



What is light pollution? Any adverse effect of artificial light at night.

It comes in 3 main forms, Skyglow, Glare, and Light Trespass.



SKYGLOW

Skyglow is the dome of brightness on the horizon that obscures our view of the night sky. Skyglow is caused by misdirected light scattering through our atmosphere. Here we can see the skyglow of Tucson to the right of the image, and dark skies revealing the Milky Way to the left.



Have you ever been driving down a lonely road at night, only to be blinded by oncoming high beams that someone forgot to turn off? You have experienced glare! Glare is when light enters our eyes at shallow angles, causing pain and restriction of the pupil, reducing visual acuity.



Who here has been kept awake by light streaming into their bedroom window at night? Me too!! This is a prime example of light trespass, when light is falling outside of the property boundary onto another property or home. We can think of light trespass as a private property rights issue.

Many of us have experienced the annoyance of light trespass. Remember that when having conversations with your neighbors and community. Many of them have also experienced light trespass so that is a great conversation starter to get them interested in the benefits of good outdoor lighting design.



LIGHT POLLUTION CONSEQUENCES

International Dark-Sky Association | 2019

Light pollution has myriad negative consequences. From Turtles, to Humans, and everything in between, there are many reasons to protect the night.

ECOLOGICAL IMPACTS

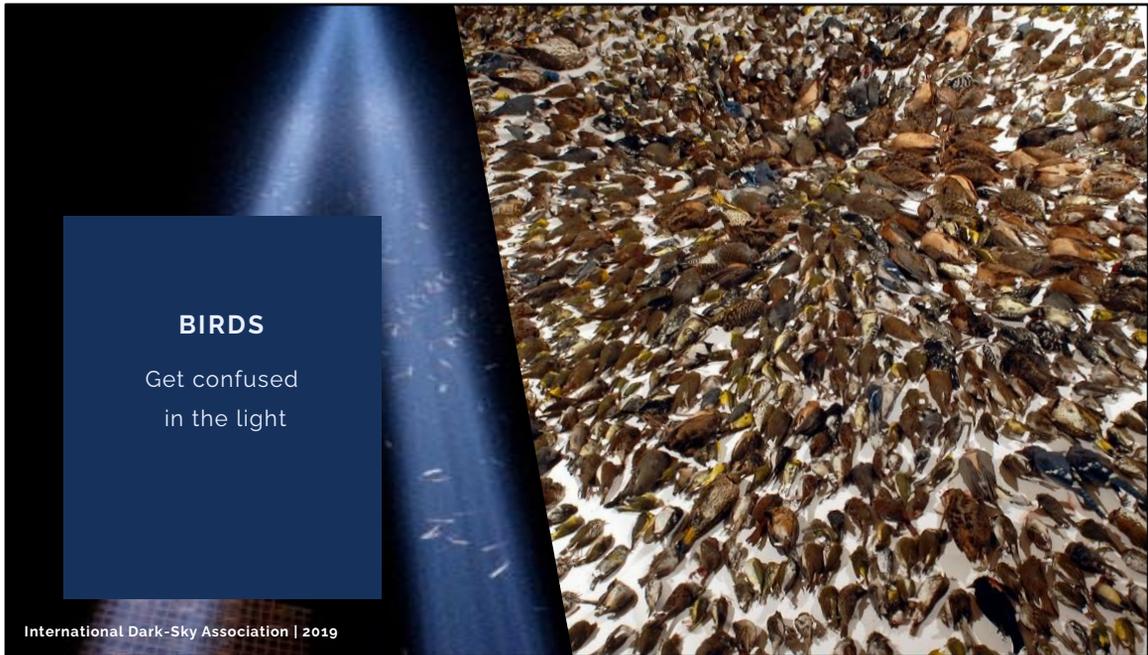
Organisms need food, water, shelter, a place to raise their young ... and a natural night.

TURTLES
cannot find their
way to the sea

KELLIE PENDOLEY

International Dark-Sky Association | 2019

Hatchling turtles are affected by light pollution. Before the advent of artificial illumination, hatchlings always oriented themselves toward the ocean by the brightest part of their field of vision. Historically, this has been the ocean, reflecting the brightness of the moon and stars. Now, hatchlings get confused and disoriented as they clamber toward city lights.

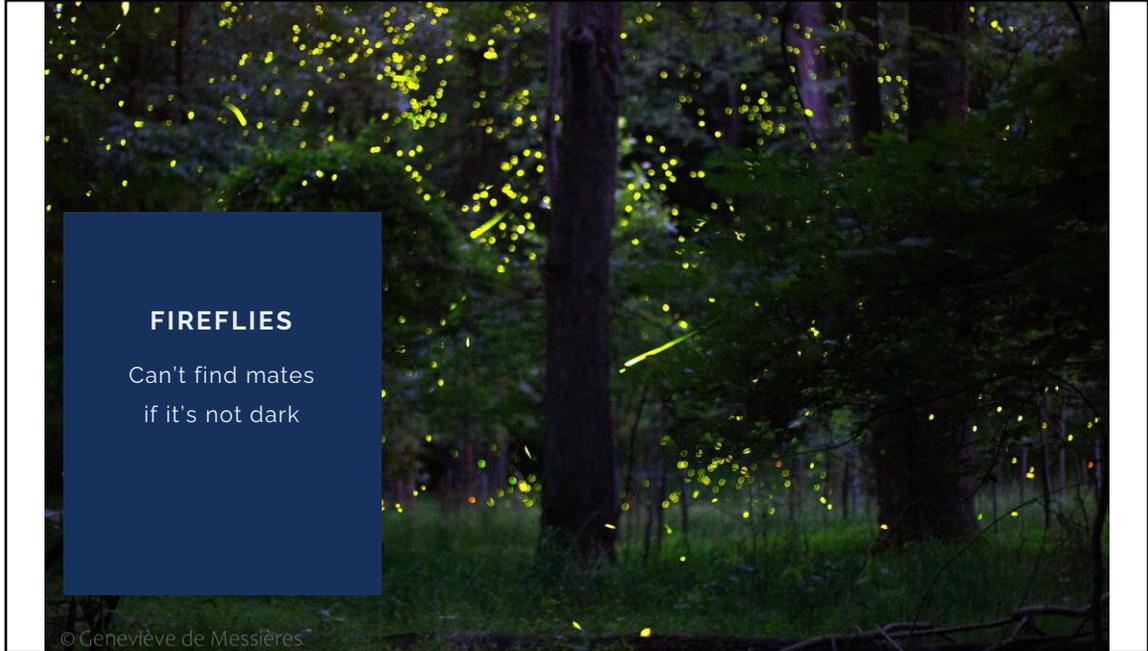


BIRDS

Get confused
in the light

International Dark-Sky Association | 2019

Birds are like moths in that they are attracted to the light. Birds also migrate using celestial navigation. When birds are confronted by large, brightly lit skylines of urban areas they become disoriented. Not only are they attracted to the light pollution of the city, but the skyglow obscures their view of the night sky which they use to find their direction. Birds will fly toward the light, and if they don't immediately collide with the building they are reluctant to leave the lit area and return to the dark. They may fly around in circles until they drop to the ground with exhaustion. It will still be in danger of mortality; a bird dropped into the depth of canyons of city lights is in an unfamiliar habitat, susceptible to starvation, dehydration, and predation. **There is data that estimates up to one hundred million to a billion birds die from collisions with buildings in North America each year.**



A review article about fireflies and how they are hindered by artificial light, as well as how nocturnal insects are disoriented by artificial light:
<https://onlinelibrary.wiley.com/doi/10.1002/ece3.4557>

This composite image of fireflies was taken in a Prince George's County park in Maryland by Geneviève de Messières



TREES

bud earlier and
lose their leaves
later under artificial
light

International Dark-Sky Association | 2019

Trees are even affected by light pollution! Those exposed to artificial light at night bud earlier, lose their leaves later, and have shorter lifespans. You can see how the distribution of light on these trees has affected their natural cycles.

ENERGY WASTE



3-7 BILLION DOLLARS
spent every year on unneeded lighting

21 MILLION TONS OF CO₂
burned by unnecessary lighting

International Dark-Sky Association | 2019

Light pollution is also a waste of money and energy. About 35% of lighting worldwide is wasted light, shooting straight up into the sky. When we do the math, we spend around 3-7 billion dollars a year on wasted light, while adding 21 million tons of Carbon Dioxide to the atmosphere each year.

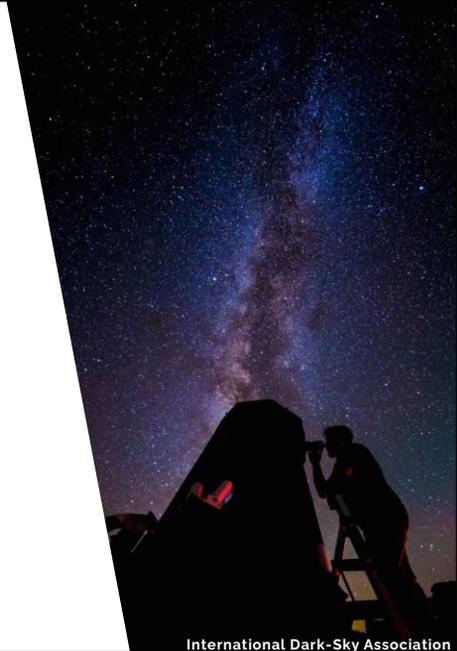
HUMAN HEALTH

MELATONIN

hormone that regulates sleep wake cycle
(circadian rhythm)

AMERICAN MEDICAL ASSOCIATION

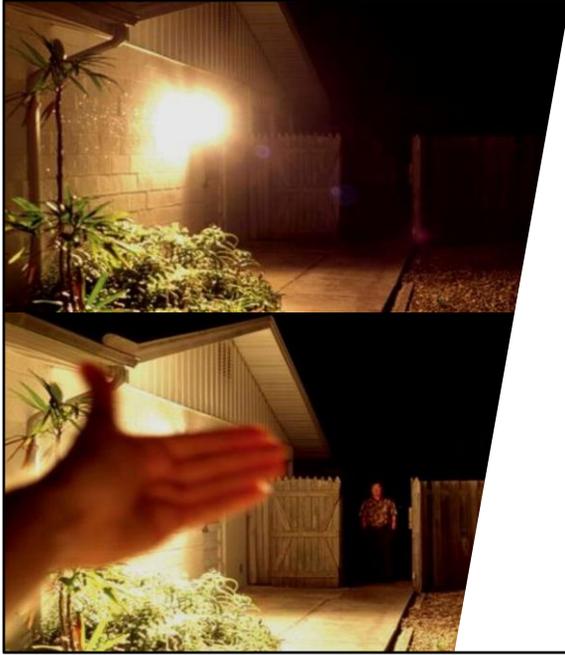
Human and Environmental Effects of Light
Emitting Diode Community Lighting 2016
report



Humans are not untouched by this phenomenon. Humanity evolved on this planet with reliable cycles of light and dark. The addition of light into what has always been darkness disrupts our natural circadian rhythm, the internal cycle syncing our biological clock with the day night cycle. Our circadian rhythm is mediated by the hormone melatonin. Secretion is suppressed when we are exposed to light at night, specifically blue/white light that mimics what we experience under a daytime sun. This disrupts our health, exemplified by the fact that exposure to artificial light at night has been linked with an increased risk for all types of cancer.

Blue light is particularly harmful. Glare from blue lighting is especially intrusive for older drivers, causing safety hazards.

The AMA issued recommendations to shield streetlights and use light that is 3000k or lower. You can read their 2016 report here: <https://www.ama-assn.org/sites/ama-assn.org/files/corp/media-browser/public/about-ama/councils/Council%20Reports/council-on-science-public-health/a16-csaph2.pdf>



MYTH: MORE LIGHTING IS SAFER

REALITY: WELL DESIGNED LIGHTING IS SAFER

International Dark-Sky Association | 2019

Find out more about lighting, crime, and safety here: <https://www.darksky.org/light-pollution/lighting-crime-and-safety/>



All types of light pollution are increasing rapidly! These images show the progression of artificial light at night as seen from space. It's not hard to imagine a world without any remaining natural darkness, at all, if we continue at our current rate.

HOW DARK ARE YOUR SKIES?

GLOBE AT NIGHT

SKY QUALITY METER



PC: HERITAGE STARFEST

Want to know the quality of your night sky at home? You can get involved with community science!

Globe at night is a free web-application that asks you to count the visible stars in a common constellation to measure how dark your sky is.

You can use a sky quality meter to provide a more specific sky-quality reading to Globe at Night – some apps provide sky meter readings.

Your data will be entered in a global database of measurements that help us to better understand how light pollution is proliferating across the world.



**ARE YOU ONE OF THE
LUCKY ONES?**

**ONLY 2 OUT OF 10 PEOPLE ON EARTH CAN
SEE THE MILKY WAY**

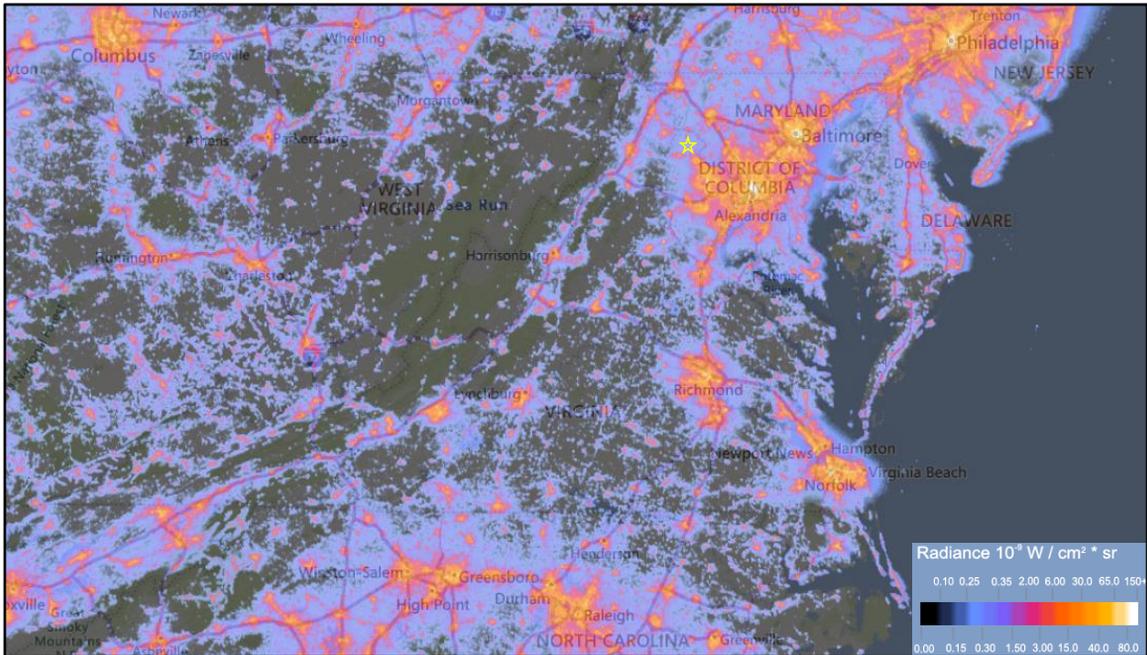
99% OF THE USA AND EUROPE
live under light polluted skies

International Dark-Sky Association | 2019

So, have you had the experience of being under a truly natural dark night sky?

Who here has seen the Milky Way?

Unfortunately, today only 2 in 10 people in the world live under skies that reach that level of natural darkness.



Light pollution in Virginia and nearby states. Orange and white are bright city lights, while black are dark areas. Loudon County is marked with a yellow star.

From last year's VIIRS data. (presented in colorblind-friendly colors)
<https://www.lightpollutionmap.info/#zoom=6.18&lat=37.7014&lon=-78.3369&layers=B0TFFFFFFFFFFFFFFFFF>

Laura recommends the Atlas of Artificial Night Sky
 Brightness: <https://cires.colorado.edu/Artificial-light>

WE CAN MAKE A DIFFERENCE



So, we know light pollution is a problem, and that it is increasing, but light pollution is the only pollution we can solve “at the speed of light!” Light pollution is completely reversible, and the solutions are truly win-win – for ecosystems, for humans, for energy costs, and for climate health.

Each individual action makes a difference, and we can work to create changes on a larger scale that benefit everyone.

It can feel discouraging when, for example, you are trying to get information on the specifics of a proposed LED streetlight plan, and you are being shut down by officials who don’t want to share. Without your advocacy and action, there may be no progress. However, you’re not alone, there are many others with similar goals, and many resources that can help you.

You can also consider helping write a lighting ordinance for your area or improve whatever ordinance is in place. Many Virginia localities do already have zoning ordinances that address lighting. But they are often older, do not take LED lighting into account, are often too vague, have too many exceptions, and inadequate resources for enforcement.

Laura pointed out that Pittsburgh just passed the first dark skies ordinance of its kind in the country: <https://pittsburghpa.gov/press-releases/press-releases/5207>

An IDA advocate was instrumental in advancing it and making it happen: <https://www.darksky.org/monthly-star-diane-turnshek/>



FIVE PRINCIPLES

For Responsible Outdoor Lighting

International Dark-Sky Association | 2019

The International Dark-Sky Association has just released the 5 principles for responsible outdoor lighting. These are the same concepts that IDA has advocated for years, but phrased more clearly.

LIGHT TO PROTECT THE NIGHT Five Principles for Responsible Outdoor Lighting		  
USEFUL		ALL LIGHT SHOULD HAVE A CLEAR PURPOSE Before installing or replacing a light, determine if light is needed. Consider how the use of light will impact the area, including wildlife and the environment. Consider using reflective paints or self-luminous markers for signs, curbs, and steps to reduce the need for permanently installed outdoor lighting.
TARGETED		LIGHT SHOULD BE DIRECTED ONLY TO WHERE NEEDED Use shielding and careful aiming to target the direction of the light beam so that it points downward and does not spill beyond where it is needed.
LOW LIGHT LEVELS		LIGHT SHOULD BE NO BRIGHTER THAN NECESSARY Use the lowest light level required. Be mindful of surface conditions as some surfaces may reflect more light into the night sky than intended.
CONTROLLED		LIGHT SHOULD BE USED ONLY WHEN IT IS USEFUL Use controls such as timers or motion detectors to ensure that light is available when it is needed, dimmed when possible, and turned off when not needed.
COLOR		USE WARMER COLOR LIGHTS WHERE POSSIBLE Limit the amount of shorter wavelength (blue-violet) light to the least amount needed.

From the IDA: The interplay of all five principles must be considered in the design, installation and use of outdoor lighting, and that treating the principles in isolation from one another is insufficient to address the growing global problem of light pollution: “Unless all five factors are considered in lighting decisions, the trends of the past decades will continue, and quite possibly accelerate.” <https://www.darksky.org/values-centered-lighting-resolution/>

Source of graphic: <https://www.darksky.org/our-work/lighting/lighting-principles/>

USEFUL



ALL LIGHT SHOULD HAVE A CLEAR PURPOSE

Before installing or replacing a light, determine if light is needed. Consider how the use of light will impact the area, including wildlife and the environment. Consider using reflective paints or self-luminous markers for signs, curbs, and steps to reduce the need for permanently installed outdoor lighting.

Make sure that a light really is needed in the first place! That is called warranting. If a light is there just to look pretty, maybe take it out and try seeing how pretty a natural night sky can be.

Source: <https://www.darksky.org/our-work/lighting/lighting-principles/>



Aiming lights down at the task at hand dramatically reduces glare, increasing visibility and better illuminating the intended area. Shielding lights also means the need for use of less light, as you aren't wasting it out into your neighbor's window or up into the sky, therefore you can use less light and save yourself some money on your energy bill!

Shielding graphics are from the International Dark-Sky Association

Source: <https://www.darksky.org/our-work/lighting/lighting-principles/>

LOW LIGHT LEVELS



LIGHT SHOULD BE NO BRIGHTER THAN NECESSARY

Use the lowest light level required. Be mindful of surface conditions as some surfaces may reflect more light into the night sky than intended.

Even if we shield every light, there will still be some light reflected up from the ground. To minimize this, only use the amount of light needed for the task at hand. This is an especially important principle for us to communicate, because many people seem to think that more light makes a safer environment (data do not generally support this idea) and many cities are terribly over-lit.

Source: <https://www.darksky.org/our-work/lighting/lighting-principles/>

CONTROLLED



LIGHT SHOULD BE USED ONLY WHEN IT IS USEFUL

Use controls such as timers or motion detectors to ensure that light is available when it is needed, dimmed when possible, and turned off when not needed.

If a neighbor's light is on all night, you might suggest a motion detector to them. Not only will it save energy and preserve the night, but it also has a better chance of scaring off an intruder, and alerting the resident and neighbors of activity.

This is the greatest benefit LED lighting has to offer us. It's comparatively easy to do things like dim LED streetlights during low-traffic times like the middle of the night.

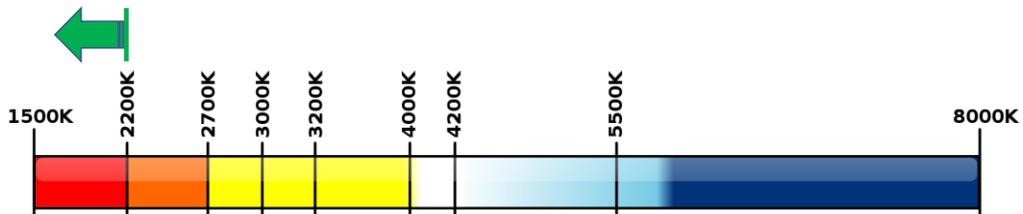
Source: <https://www.darksky.org/our-work/lighting/lighting-principles/>

COLOR



USE WARMER COLOR LIGHTS WHERE POSSIBLE

Limit the amount of shorter wavelength (blue-violet) light to the least amount needed.



The color of light is important. Light color is measured in Kelvin, and dark sky best practices recommend only going as high as 2200 Kelvin to minimize the amount of blue in the light. This is healthier for human and environmental health.

Learn more about the new recommendation that most outdoor lighting should have a correlated color temperature of no more than 2200 K:

<https://www.darksky.org/values-centered-lighting-resolution/>

Note that the IDA will still, at least for now, consider lights with CCTs of 3000 K or less eligible for the Fixture Seal of Approval program. But 2200 K is recommended.

Source: <https://www.darksky.org/our-work/lighting/lighting-principles/>

Spectrum image source: <https://www.darksky.org/our-work/lighting/lighting-for-citizens/led-guide/>

WHERE TO FIND THIS LIGHTING?

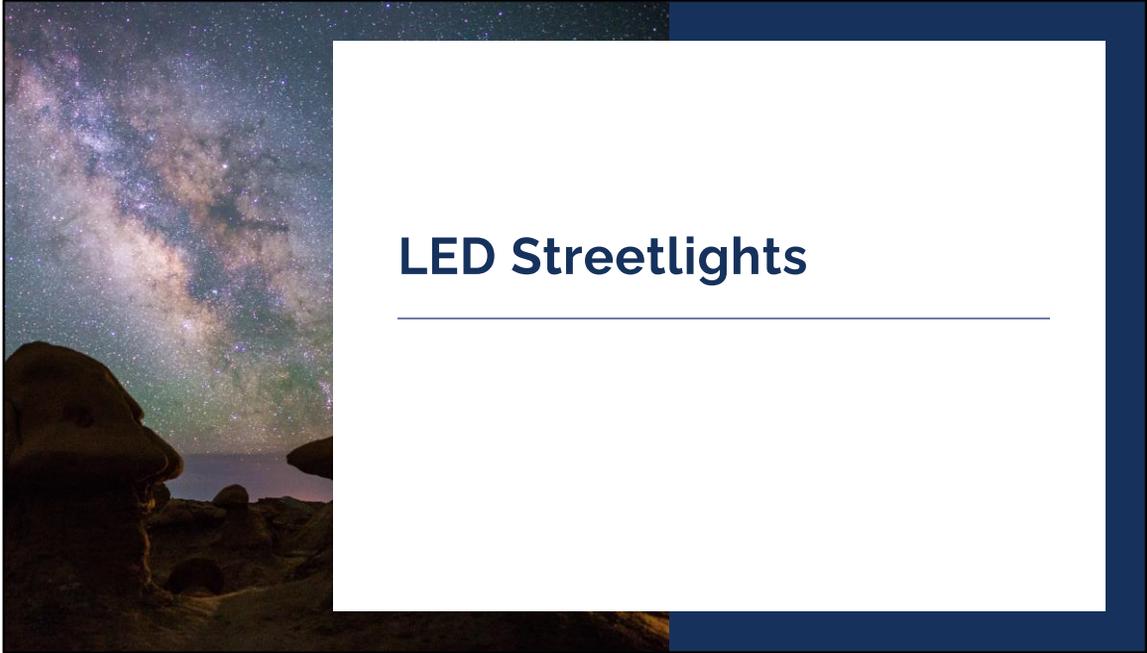
IDA FIXTURE SEAL OF
APPROVAL PROGRAM



International Dark-Sky Association | 2019

If you are looking for dark sky friendly lighting, check out IDA's fixture seal of approval program! There is an online searchable database where you can find dark sky friendly lighting of all types.

Also, look for the seal when you are buying lighting at your local hardware store!



Slide was adapted from an International Dark-Sky Association slide.

All five principles must be considered when designing outdoor streetlighting, athletic field lighting, utility lighting and more.

LED streetlights are not necessarily better than other kinds. There are possible energy efficiency savings, but oftentimes LED streetlights are set far too bright because they're so efficient – canceling out part of the energy savings and ruining night skies. In general, the trend toward LED streetlights is being carried out clumsily, with many new streetlights far too bright, too blue, and improperly shielded. However, it can be done right, and the opportunity to transform the nation's streetlighting on this kind of scale only comes once in a generation, so it's crucial that we advocate for proper design the first time.

The great benefit of LED is that it is easily controlled – with motion sensors, timers, remote programs, and more – to allow features like dimming streetlights during low traffic times. That may require a little extra capital investment in the form of hardware to allow the lights to be dimmed. The investment is certainly worth it.

What conversations about LED streetlights are happening in your county, area, and town?



If you are doing advocacy, consider running activities and public outreach about the value of the natural night sky. I can help, as can Laura Greenleaf.

This image of the Orion Nebula was taken by Geneviève de Messières from a dark-sky location, Kitt Peak in Arizona.

Questions? Reach out to Geneviève at demessieresgenevieve@gmail.com.