



# ASTROEDU

Peer-reviewed Astronomy Education Activities

## **Let there be light... but not too much!**

**Build a model to learn what light  
pollution is and what its effects are.**

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### KEYWORDS

light, night, light pollution, pollution, sky observation, lighting source



### CATEGORY

Earth, Ecology



### AGE

6 - 12



### LEVEL

Middle School, Primary



### TIME

2h



## GROUP

Group



## COST

Medium Cost



## SKILLS

Asking questions, Developing and using models, Engaging in argument from evidence



## TYPE OF LEARNING

Discussion Groups, Modelling, Observation based, Project-based learning



## MATERIALS

For this activity, you will need:

- A piece of wood representing the ground.
- A piece of wood in the background representing the night sky.
- Blue paint for the sky.
- Led light lamps (e.g. Christmas tree lights) to represent the stars.
- Black sandpaper covering the ground.
- A piece of reflective paper.
- Different light designs like the ones shown in image below (Image 1)
- **Optional:** in the attachment, you can find a game of card to be printed and used as an evaluation of the activity



*Image 1: three different light designs. From left to right, the first one is unshielded and fully directed towards the sky; the second one is partially shielded; the third one is well shielded and directed downwards.*



## GOALS

Raise awareness of light pollution



## LEARNING OBJECTIVES

- Observe the damage caused by light pollution in the sky and its impact on biodiversity
- Observe the impact of the different types of lighting on the night sky in order to choose the adequate one
- Observe the impact of reflected light from a reflective floor



## BACKGROUND

### About light pollution

Light pollution is the excessive and disruptive use of artificial light that disrupts the natural patterns of wildlife, contributes to the increase of carbon dioxide CO<sub>2</sub> in the atmosphere, disrupts human sleep patterns, and obscures the stars in the night sky.

Like noise pollution, light pollution is a form of waste energy that can cause adverse effects and degrade environmental quality. Moreover, because light (transmitted as electromagnetic waves) is typically generated by electricity, primarily by the combustion of fossil fuels, it can be said that there is a connection between light pollution and air pollution (from fossil-fueled power plant emissions). Therefore, controlling light pollution will help conserve fuel (and money), reduce air pollution, and mitigate the more immediate problems caused by excessive light. Although light pollution may not appear to be as harmful to public health and welfare as pollution of water resources or the atmosphere, it is an environmental quality issue of no small significance. Better-adapted lighting solutions significantly reduce light pollution and generate savings.



Image 2 : different lighting solutions

## Light pollution and life on Earth

Light pollution is a problem affecting not only astronomers and people who simply want to enjoy the beauty of a starry night. Light pollution has adverse impacts also on birds, sea turtles, and other animals.

Many migratory birds, for example, fly by night, when light from the stars and Moon helps them navigate. These birds are disoriented by the glare of artificial light as they fly over urban and suburban areas. It has been estimated by the American Bird Conservancy that more than four million migratory birds perish each year in the United States by colliding with brightly illuminated towers and buildings. Light pollution contributes to the dramatic decline of certain migratory songbird populations over the past several decades.



### LIGHT POLLUTION DEVASTATES WILDLIFE.

Plants and animals depend on Earth's daily light and dark cycle to govern life-sustaining behaviors. Research shows that artificial light at night has adverse and even deadly effects on many species.



### LIGHT POLLUTION CAN MAKE YOU LESS SAFE.

There is no clear scientific evidence that increased outdoor lighting deters crime. Poor outdoor lighting can decrease personal safety by making victims and property more visible to criminals.



### LIGHT POLLUTION WASTES ENERGY AND MONEY.

As much as 50% of outdoor lighting is wasted, which increases greenhouse gas emissions, contributes to climate change, and renders us all more energy-dependent.



### LIGHT POLLUTION MAY HARM YOUR HEALTH.

Studies suggest that artificial light at night negatively affects human health by increasing our risks for obesity, sleep disorders, depression, diabetes, breast cancer, and more.



### LIGHT POLLUTION ROBS US OF OUR HERITAGE.

Our ancestors experienced a night sky that inspired science, religion, philosophy, art, and literature. Now, millions of children across the globe will never know the wonder of the Milky Way.



## FULL DESCRIPTION

### Step 1. Making the model

The first part of the activity involves building the model:

- 1- Cover the wood board representing the ground with black sandpaper.
- 2- Paint the wood board representing the sky in blue.
- 3- Make tiny holes on the board representing the stars (they can be in constellation forms)
- 4- Put the small led lamps (Christmas Tree Lights) into the holes to represent the stars.
- 5- Put a removable reflective paper on the ground when needed. This model takes into consideration the nature of the ground and its reflectivity (albedo) in order to show its effect on the diffusion of light where it's not needed.

### Step 2. Observations

Once the model is ready, students are encourage to observe the model under different lighting configurations:

- 1- Observing the model with no lighting added (see Image 1- Absence of Light pollution)
- 2- Observing the model when bad lighting is added (see Image 2 - Light pollution)
- 3- Observing the model when better lighting is added (see Image 3 - Minimize light pollution effects)
- 4- Observing the model with the reflective floor (see Image 4 - effect of reflective floors even with good lighting)

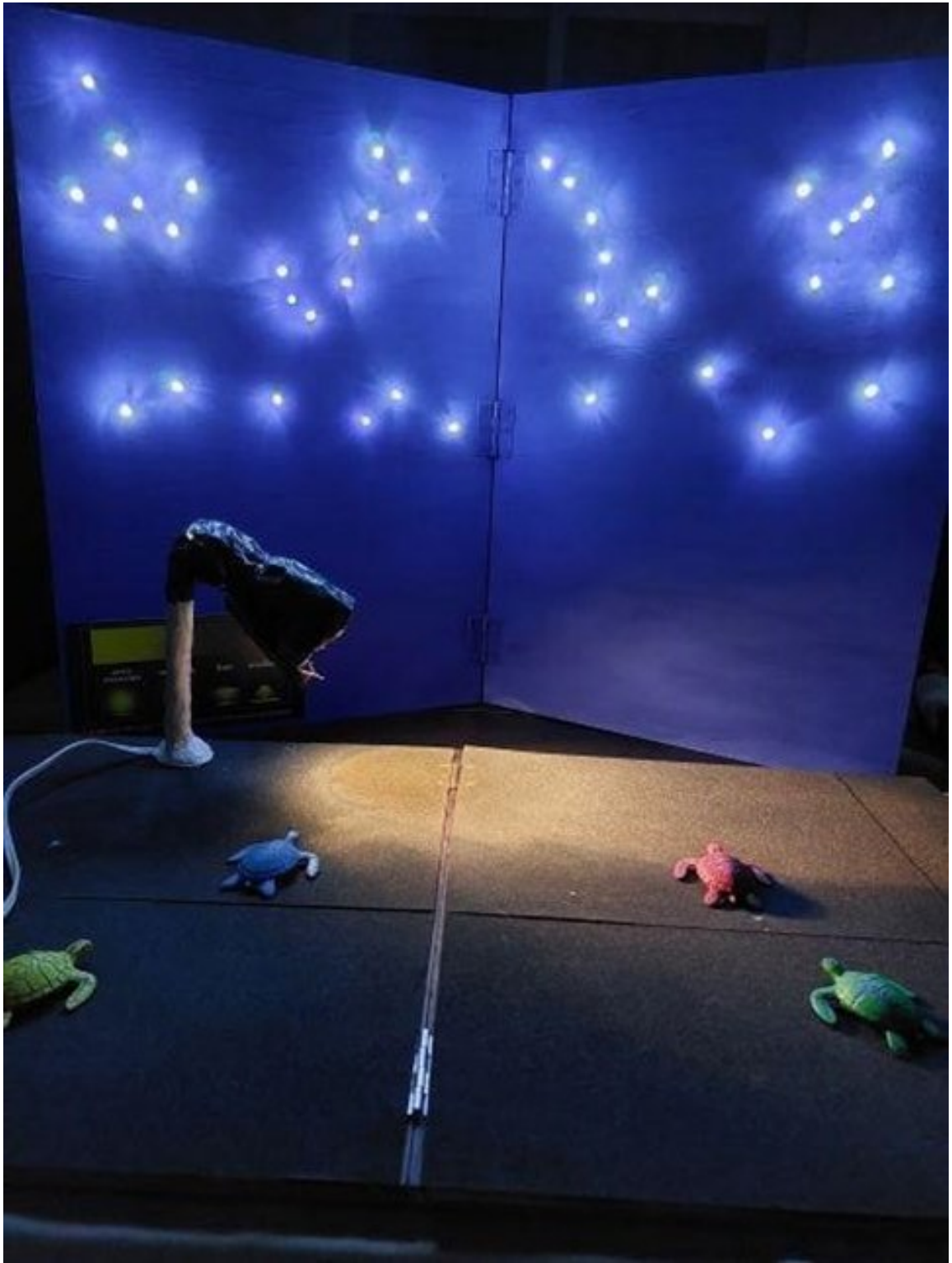


*Image 4 : absence of Light pollution*

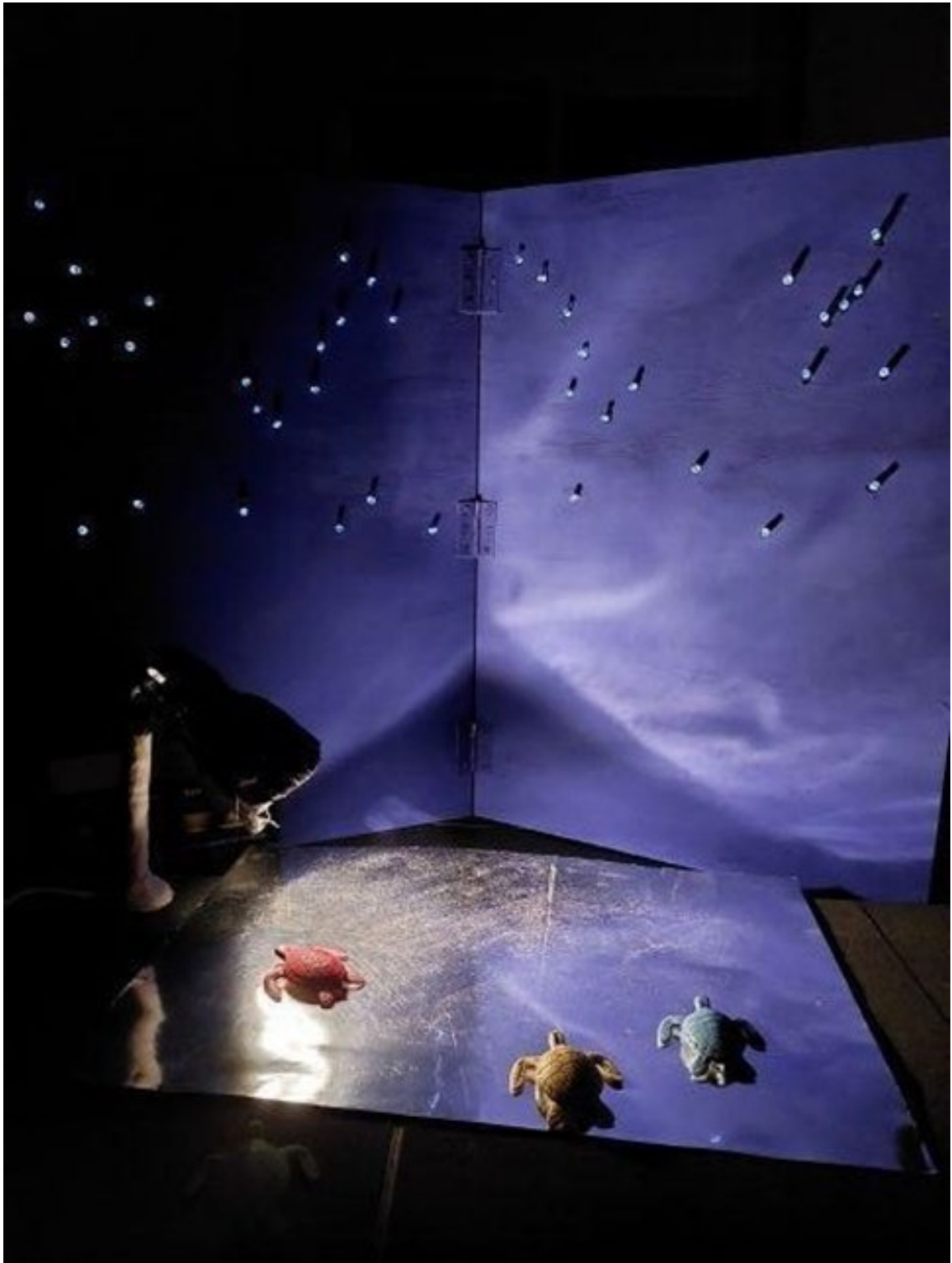


*Image 5 : light pollution*





*Image 6 : minimization of light pollution effects*



*Image 7 : effect of reflective floors even with good lighting*

### **Step 3. Discuss the results**

Observing different lighting setups, the students can learn how to use outdoor lighting responsibly by only using it where it's needed and in the amount required (images 4,5,6). This model also takes into consideration the nature of the ground and its reflectivity (albedo) in order to show its effect on the diffusion of light where it's not needed (image 7).

In the following discussion, it is very important to raise awareness about the negative impact light pollution can have on the night sky and on biodiversity.

You can also discuss with the students different kinds of "good and bad" light shown in Image 8.

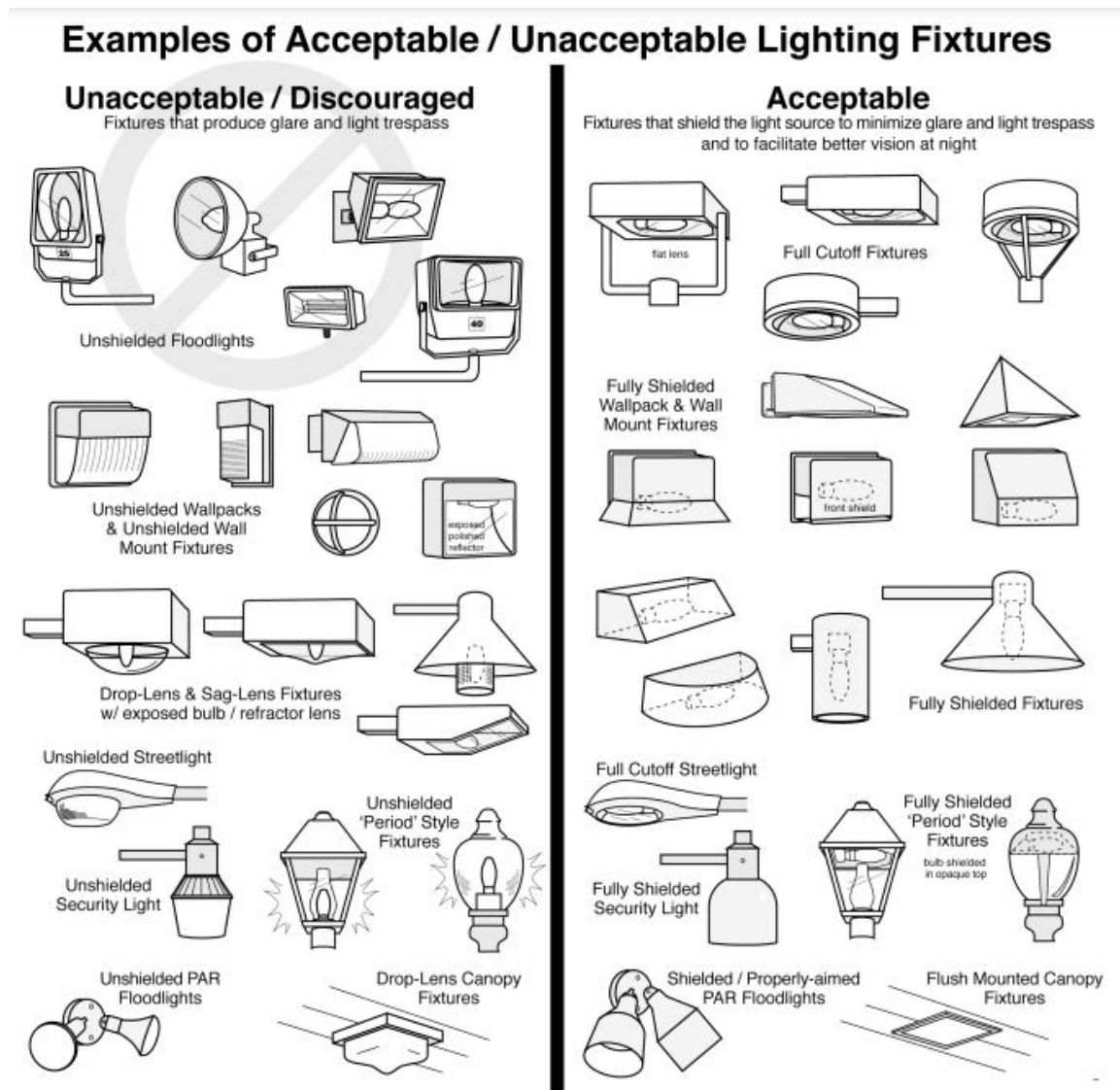


Image 8 : examples of acceptable and unacceptable lighting

#### Step 4. Minimize light pollution in your school (optional)

If the activity is taking place in a school we can suggest that, afterwards, the students who worked on the activity take a tour of the school and give their opinion on whether the external lighting installed meets the requirements to minimize light pollution and if not to submit their suggestions to the management.



EVALUATION

In order to evaluate how well students can now make the difference between good and bad lighting setups, the teacher can print the game of cards in the attachment and provide the images of different light options to the students, asking them to classify the light configurations as acceptable or unacceptable, in order to limit light pollution.

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## CURRICULUM

This activity was developed to be used in a science class at primary or lower secondary school. It can also be used as a practical exercise in technology, physics or astronomy classes with older students and even as an exhibit or a team building exercise to raise awareness towards light pollution.

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## ADDITIONAL INFORMATION

For more information about the STEAM-Med co-design project : [Read this Link](#)

This activity is available in other languages: Link (to be provided soon).

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## FURTHER READING

Resources about light pollution in English (from the International Dark-Sky Association)

- What is light pollution? <https://www.darksky.org/light-pollution/>
  - Light pollution - take action: <https://www.darksky.org/get-involved/>
  - Outdoor Lighting Basics:  
<https://www.darksky.org/our-work/lighting/lighting-for-citizens/lighting-basicsng-basics/>  
<https://www.britannica.com/science/light-pollution>
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