

LIGHT POLLUTION, AN INTRODUCTION TO ASTRONOMY/ENVIRONMENTAL EDUCATION

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Abstract

The problem of Light Pollution exists most everywhere, and is still growing rapidly. The preservation of the astronomical environment is strongly connected and requires effective education. We present some of the activities that can be integrated in the schools.

Brief Introduction

The excess light in the sky has an adverse impact on the environment and seriously threatens to remove forever this wonder of nature. This is the Light Pollution problem.

What causes Light Pollution

Sky glow is the result of light that is projected upwards and then scattered back by particles in the atmosphere to the surface of the Earth. There is interferes with the optical waveband of the electromagnetic spectrum.

It has been estimated by some researchers that up to 30% of all Light Pollution may be the result of poorly designed or maladjusted roadway lighting.

Consequences of Light Pollution

Light Pollution is a growing threat to the nighttime environment. Components of light pollution include:

Unnecessary energy waste, Night-time car accidents, Glare, blinding us and harming visibility, Destroying mankind's view of the Universe, Presenting a potent threat to professional astronomy as observations of very faint objects are required, Animals and plants are disturbed.

All these present wasted light that does nothing to increase nighttime safety, utility or security.

BUT NOTHING IS MORE EFFECTIVE THAN EDUCATION!

ACTIVITIES

I. SAVE THE STARS!

Activities for Elementary, Gymnasium Students

Objectives: students observe and familiarize themselves with the night sky.

Light Pollution may seem an abstract topic to teach to elementary school students, but with some relatively simple props the subject can be easily grasped by even the youngest minds. The ideas which follow can be easily used in the classroom.

A Box Full of Stars!

Have students bring in a box with a lid (a shoe box is ideal). Show them pictures of a couple of constellations. Have your students copy the stars from a constellation onto the lid of the box. Poke holes in the stars the students have drawn. They can get creative with the lids: draw their favorite constellation or make up their own, color the drawing, and/or write a story about it. Then put small flashlights inside the boxes (a Mini-Maglite with the top removed is ideal). Close the blinds and turn out the lights. Leave the lights out for a few moments. When the lights are turned on again discuss how easily the stars are drowned out by bright light.

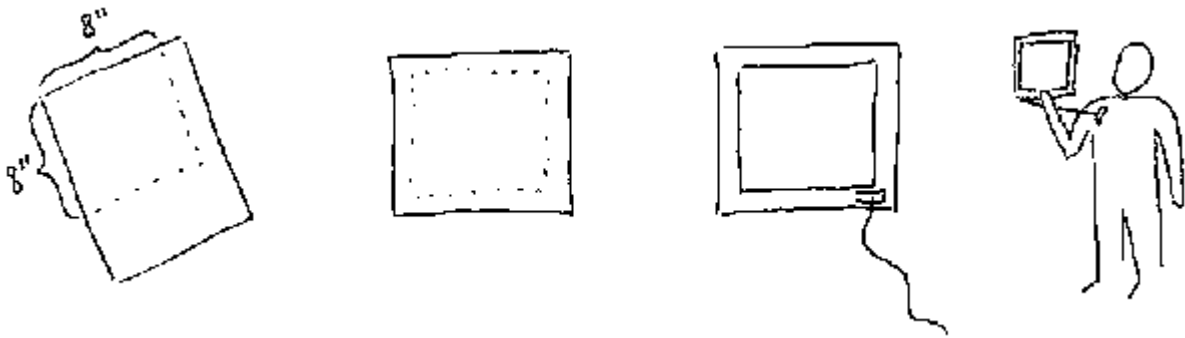
Then continue as follows:

Have you ever walked outside on a clear dark night or been to a planetarium and seen the night sky full of stars? If you have, I bet you've wondered: "How many stars are there?!" To find out just how many stars are visible from your own backyard, just follow the directions below!

Trying to count the stars in the sky is like trying to count all the bits of sand at the beach! It would take too long to count them one by one.

Use a regular piece of paper (though heavier paper such as construction paper works best), a pencil, a pair of scissors, a ruler, a piece of string, two pieces of scotch tape, and a clear night sky. First, we need a way to divide up the sky into little pieces so we can pick our samples. Use the scissors, ruler, pencil, and piece of paper to make a square 8 inches wide and 8 inches tall. Then measure 1 inch from the edge all the way around and cut out the middle. Cut a piece of string 16 inches long. Tape one end to one of the corners of the frame. Next, go outside on a nice clear night when lots of stars are visible. Remember that you also need a dark sky; don't go out too early after sunset or when the full Moon is in the sky. Tape the other end of the string to your shoulder and hold the frame up in front of you so that the string is tight. Look through the frame at the stars. This divides the sky up into 40 pieces. Hold the frame steady and count how many stars you see inside it. Do this 5 times in different parts of the sky,

and take these five numbers, called *samples*. Each time, write the number of stars in the boxes on the back of this page. When you are done, go back inside and add up the samples. Then divide the sum by 5 (the number of samples). This will be your *average* number of stars you saw in the frame. The frame divides the sky into 40 pieces, so multiply the average by 40. This will give you the number of stars you can see from your very own backyard!



On a perfectly clear, very dark, night you can see as many as 1,500 stars. How many did you see? You probably saw much less than 1,500. One of the reasons why you did not see that many stars is *light pollution*. We have many lights on our houses, schools, and other buildings. We also have many street lights, parking lot lights, billboards, and signs all around us. Most of these lights are not made very well and spray light up into the sky! These lights often cause *glare* which gets in people's eyes and causes them discomfort and often they cannot see very well because of it. Light going directly up into the night sky and glare wastes more than a *billion* dollars every year because some of the electricity used to run the lights is being thrown away. Finally, light pollution ruins the night sky. All those beautiful stars are drowned out by wasted light.

What can we do? We can make sure that light doesn't go up into the sky and that it shines down on the ground where it belongs!

2. Observe the design of outdoor lighting

Activities for Gymnasium and High school Students

Objective

- In this activity, students observe the design of outdoor lighting and discuss how this affects the efficiency and effectiveness of the job which the lighting is intended to do and the degree of light pollution which occurs.

- More advanced students may also observe and describe the spectrum of the outdoor lighting and how that is related to the effectiveness of the lighting and to the degree of light pollution.

General Information

- It is safer and more interesting and effective if students work in small groups.
- The activity can be completed in one or two evenings, plus a class period for discussion.
- It effectively integrates science and technology.

Background Information

- Most of us are vaguely aware of lighting in our environment, but how often have we looked closely at lighting fixtures (even those in our own back yard)?
- We may have noticed deficiencies in lighting but not investigated their cause.
- Research has shown that many students have deep-seated misconceptions about light and lighting.
- What happens when yellow light shines on a blue car in a dark parking lot?
- Can you see a mirror or a bicycle reflector in a completely darkened room?
- Does light from a given source travel further at night than during the daytime?
- This activity is useful for dealing with such questions.

What the students will do

- make a study of outdoor light fixtures as scientific, technological, and societal devices.
- answer the question: How efficiently and effectively do the lights they observe do their job?

Doing the activity

- Go outdoors in front of your house during the evening, and look at your block or the area visible from your home. Make a diagram of your block (or area).
- Observe all the lights -- the lights at your house, at your neighbors' houses, on the street, and any others visible to you. Note every one of the them by recording each light's approximate location on your diagram, record what kind of light it is (porch light, security light, street light, decorative yard light, flood light illuminating a tree, etc), and try to identify the type of lamp. Mercury vapor lamps are a coldish white. High-pressure sodium lamps are pinkish or amber, Low pressure sodium lamps are bright yellow. Incandescent lamps are a yellowish white.
- (Optional) Use a spectroscope or diffraction grating to analyze the spectrum and identify the type of lamps you observe.
- Note the following about the lights you observe.
 - ⇒ what kind of fixture the lamp is in (if easily apparent)
 - ⇒ observe how street lights are mounted (on their own pole or on a utility pole...are they "cobra head" or "full cut off" ?)
 - ⇒ estimate the amount of glare (on a scale of 1 to 5, for instance, where 1 vs "no glare at all" and 5 is "very glary")
 - ⇒ estimate qualitatively how well the lights do their job by considering their contributions to glare, energy waste, and light pollution.

Evaluation

The evaluation should be based on the reports kept by the students, including their ability to record and fully describe the light sources in their neighborhoods.

Closure

The students will become aware of the different types of lighting in their neighborhoods and how well each type of light does its job.

References

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