

Demonstrating Light Pollution and Shielding

This demonstration will illustrate the effects of lighting on our view of the night sky and how shielding can reduce light pollution while at the same time making the lighting more effective. All of the materials are provided in the Dark Skies Education Kit. This demonstration is adapted from an activity on the Paper Plate Education website: <http://analyzer.depaul.edu/paperplate/lights.htm>.

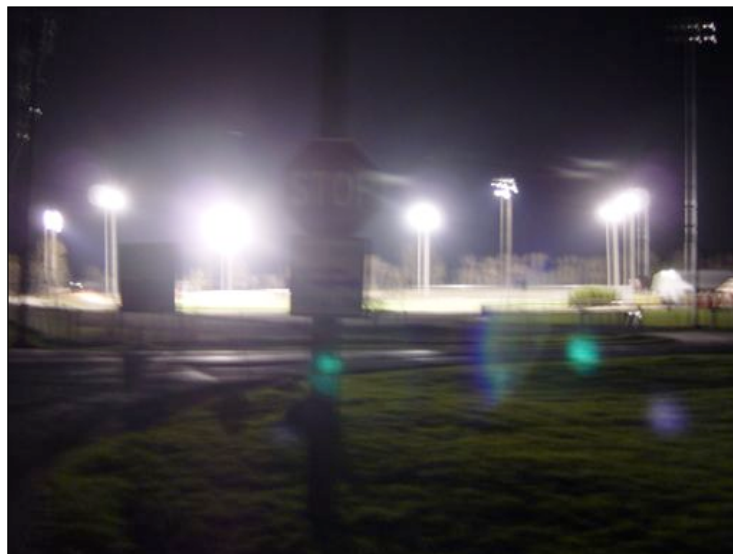
Materials

- Two “Mini-lights” (such as the Mini Maglite flashlight)
- Paper cube planetarium (cardboard cube with small hole on one side and pinhole “stars” on the opposite side)
- PVC cap or other items to act as shields
- City mat or white surface
- Optional - picture book with landscapes or city scenes, such as “There Once Was A Sky Full of Stars” by Bob Crelin
- Optional – figurines about 1.5 inches tall; matchbox cars

Background – Light Pollution

There are three main types of light pollution:

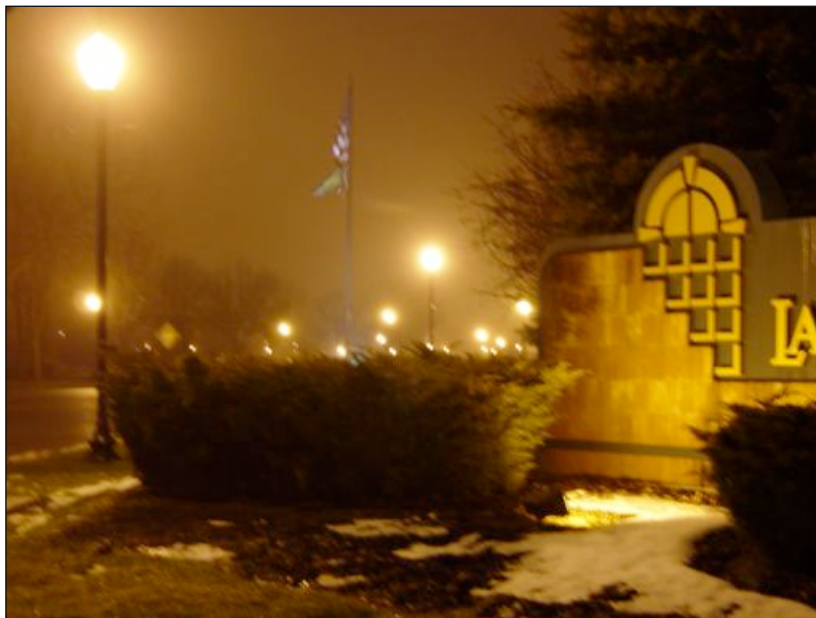
- *Glare* is too much background light. Can you see the stop sign or read the sign below it in this image?



- *Light trespass* is light that spills into an area where it is unwanted. Would you be able to sleep if your bedroom window faced this neighbor's light?



- *Sky glow* is lots of light scattering off particles in the air, giving the appearance of a glowing sky. Do you see any stars in this image?



These images, as well as others illustrating the effects of different types of lighting, can be found on the Nightwise website: <http://www.nightwise.org/examples.htm>
More background on light pollution can be found on the GLOBE at Night website: http://www.globe.gov/GaN/learn_light.html

Background – Lighting

Quality lighting should:

- Maximize the desired effects:
 - Good vision
 - Good night ambiance
- Minimize the adverse effects:
 - Energy waste
 - Glare
 - Light trespass
 - Sky glow

Keys to quality lighting:

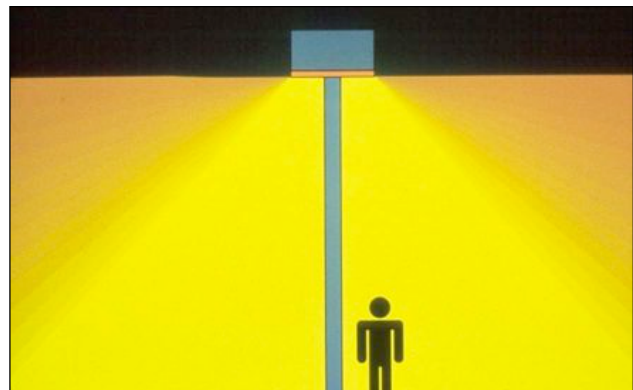
- See the effect, not the source.
- Shine the light down.
- No glare.
- Light only where and when needed.
- Don't over-light.
- Use energy efficient sources.

Shielding can maximize the desired effects of lighting by controlling the light output and minimizing the glare, light trespass, and light that travels straight up, as illustrated below.

Unshielded fixture



Shielded fixture



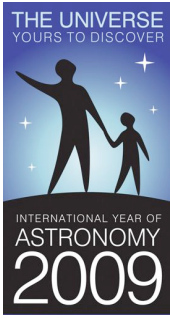
Doing the Light Shielding Activity

- Make sure you are in a very dark room with a low ceiling. Set up the activity on a table with a white surface.
- If you'd like to include a landscape or city scene as part of the demo, prop open the book to the page with the desired illustration.



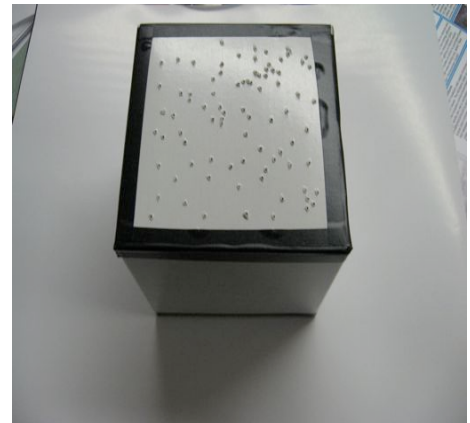
- Unscrew the reflectors from both “Mini-lights” and turn on one of them (“candle mode”). You can use the reflector ends as a base to stand the lights on the table.
- Place the bulb top of the “Mini-light” barely into the big hole at the bottom of the white paper cube.
- With the room lights off, project the “stars” from the white paper cube onto the ceiling. Observe how many stars you can see and how bright they appear.
- Using the second “Mini-light” as a “street light”, place it on the city mat on the table (in front of the open book if you are using it) and turn on the “Mini-light”.
- What do you notice about the number of stars?
- Now place the PVC cap (or another shield) above the second “Mini-light” to represent a shielded streetlight.
- What differences do you notice with and without the shield? How is your view of the stars affected? How does the lighting of the area directly under the lamp change?





Construction of the Planetarium Box

1) Construct the white 4-inch x 4-inch box into a cube by folding the flaps in. To do this, tuck in the flaps on the lid. The lid is the top side of the box that has punched out holes representing stars in Orion and surrounding constellations. On the bottom of the box (the other end of the box), tuck the flaps into the slots, making sure they lie flat.



2) Using the electrical tape, seal all three sides on the top of the cube (the side with the star holes punched out). Seal as tightly as possible to avoid any light leaks at the edges of the cube. Avoid covering the stars on the lid with tape, if possible.



3) Seal up the bottom of the box wherever there are seams in the folding. Make sure to put enough electrical tape not to allow any light to escape. Avoid covering the big hole on the bottom of the box with tape.

4) Test the planetarium box. In a very dark room, take the reflector off of the mini-flashlight, place bulb just inside the hole on the bottom of the box. Turn on the flashlight. Make sure no excess light escapes other than through the punched out holes at the top of the box.

5) You are done! Enjoy using the planetarium box in the "light shielding demonstration." Instructions for that are listed on a handout with a similar title.



Wrap Up

Discuss your observations and the benefits of shielded lighting. Note that shielded lighting improves our view of the stars (reduces sky glow), and is safer and more energy efficient, since it directs light down to the ground, where we want lighting rather than up into the sky. This improves the quality of life for people, animals, and plants; saves money and energy; and preserves our beautiful dark skies.

You may want to encourage participants to take part in citizen science projects to measure light pollution (see resources below) and to write letters to the local newspaper, government, and businesses to encourage the installation of shielded lighting in their community.

On-line Resources

- GLOBE at Night - <http://www.globe.gov/GaN/>
- IYA 2009 Dark Skies Awareness website – <http://www.darks skiesawareness.org>
- International Year of Astronomy - astronomy2009.org
- Earth Hour – <http://www.earthhour.org>
- Great Worldwide Star Hunt - <http://www.starcount.org/>
- How Many Stars? Program – <http://hms.sternhell.at/>
- International Dark Sky Association - <http://www.darks sky.org/>
- Astronomical League – <http://www.astroleague.org>
- Astronomers Without Borders – <http://www.astronomerswithoutborders.org/>
- American Astronomical Society – <http://www.aas.org>
- Astronomical Society of the Pacific – <http://www.astrosociety.org>
- The Let There Be Night Program – <http://www.lettherebenight.org>
- Nightwise.org – <http://www.nightwise.org>
- Unihedron, the makers of the Sky Quality Meter – <http://www.unihedron.com>
- National Park Service Dark Sky Team - <http://www2.nature.nps.gov/air/lightscapes/>