



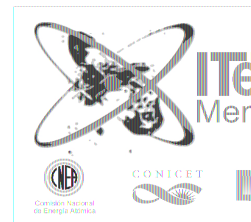
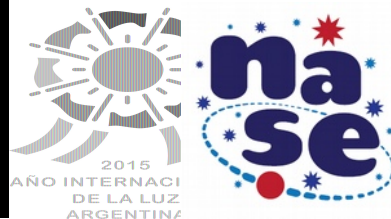
FM21 Network for Light Pollution education at secondary level

# Network for Light Pollution education at secondary level: the local solutions (Kit of practical activities – 2017 <sup>1</sup>)

Beatriz García<sup>a</sup>, Rosa Ros<sup>b</sup> (on behalf of....)

NASE WG and the Argentinean National Node for Astronomy Outreach

- a. ITeDA - UTN FRM, Mendoza, Argentina.
- b. Universidad Politécnica de Cataluña, Barcelona, Spain.



**UNIVERSITAT POLITÈCNICA DE CATALUNYA**  
**BARCELONATECH**

1. This material is available at:

<http://itedamza.frm.utn.edu.ar/wp-content/uploads/2017/12/KIT-LP-2017-ENG.pdf>

# LIGHT POLLUTION DEFINITIONS

## Some definitions

La Contaminación Lumínica es la emisión de flujo luminoso, por fuentes artificiales de luz constituyentes del alumbrado nocturno, con intensidades, direcciones o rangos espectrales inadecuados para la realización de las actividades previstas en la zona alumbrada”.

**Ley de Calidad del Cielo y Eficiencia Energética de Andalucía.**

La Contaminación Lumínica es el brillo o resplandor de luz en el cielo nocturno producido por la reflexión y difusión de luz artificial en los gases y en las partículas del aire por el uso de luminarias inadecuadas y/o excesos de iluminación. El mal apantallamiento de la iluminación de exteriores envía la luz de forma directa hacia el cielo en vez de ser utilizada para iluminar el suelo.

**Oficina Técnica para la Protección del Cielo (OTPC) del Instituto de Astrofísica de Canarias (IAC).**

Se entiende por Contaminación Lumínica la emisión de flujo luminoso de fuentes artificiales nocturnas en intensidades, direcciones y/o rangos espectrales donde no es necesario para la realización de las actividades previstas en la zona alumbrada.

**Departamento de Astronomía y Meteorología de la Universidad de Barcelona.**

Llamamos Contaminación Lumínica al brillo del cielo nocturno producido por la difusión de la luz artificial.

**Colectivo Cel Fosc.**

Emisión de flujo luminoso por fuentes artificiales de luz constituyentes de alumbrado nocturno, con intensidades, direcciones o rangos espectrales innecesarios para la realización de las actividades previstas en la zona alumbrada.

**Ley de Gestión Integrada de la Calidad Ambiental de Andalucía.**

# Light pollution IYL2015

## DIFFERENT ASPECTS

**SKY GLOW:** associated to public illumination which is projected to the sky. Produce a “bubble” which covers the city and it is visible at a great distance

Cut-off lamps.

- We can not see the stars!

**GLARE:** connected to the lights at the streets, bill boards, signals and cars. The light enters, suddenly, directly to the eyes

**TRESPASSING:** produced by exterior artificial light which enters to the house and it is not needed.

Black out intallation.

- We can not sleep!

# CONNECTIONS

## Connection Scheme



# Activity 1: Sky glow

## Objectives

**Show the effect of the light without cut-off on the sky.**

**Recognize the effects of a good luminary.**

**Recognize the benefits of a good practices in illumination to see the stars, illuminating the places where it is not possible complete darkness**



Preparation of a dark box



**Test with luminaries without cut-off**

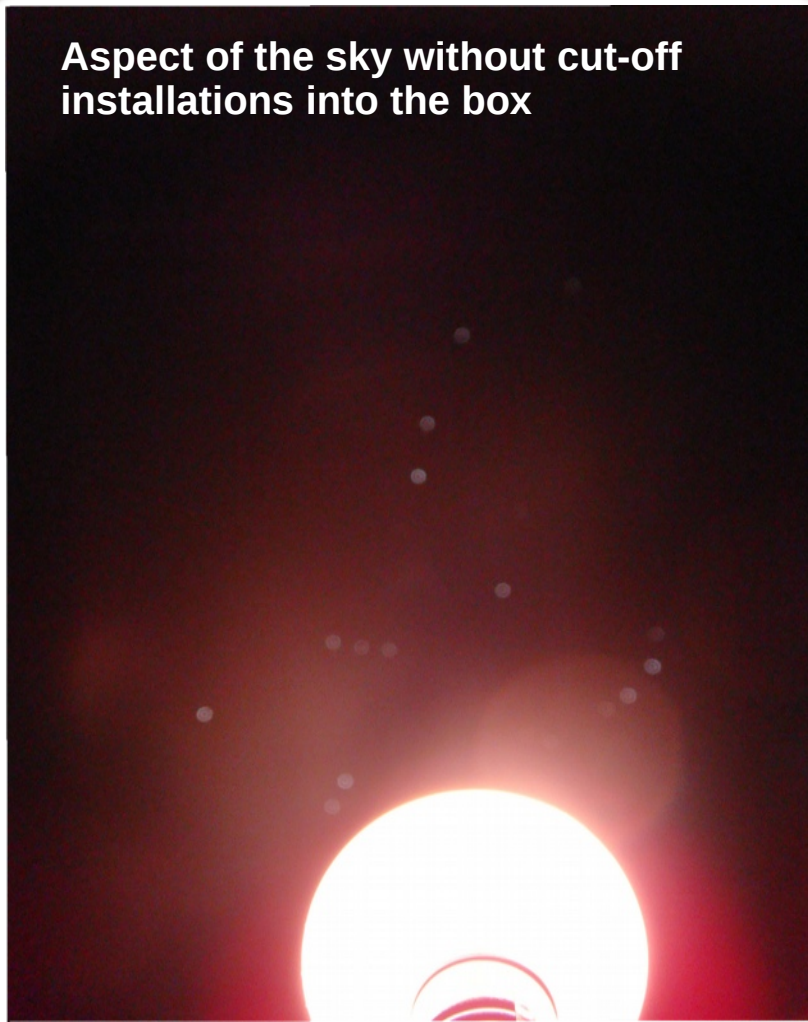


**Test of cut-off installations.**

**light pollution controlled!**

Demostration: the sky in a box: take a photo!

Aspect of the sky without cut-off installations into the box



Aspect of the sky with cut-off devices into the box





# Activity 2: Trespassing

## Objetives

**Show the effect of the street lights with a bad design.**

**Recognize the beneffit of a good shaped luminary.**

**Remark the improvement of life quality if we avoid the trespassing.**

**Show that the historical buldings can be iluminated without LP.**

A C H L 1

F J Y M 2

P O E V 3

R T G W 4

Q S U K 5

N B C X 6

Ñ R H I 7

D G K A 8

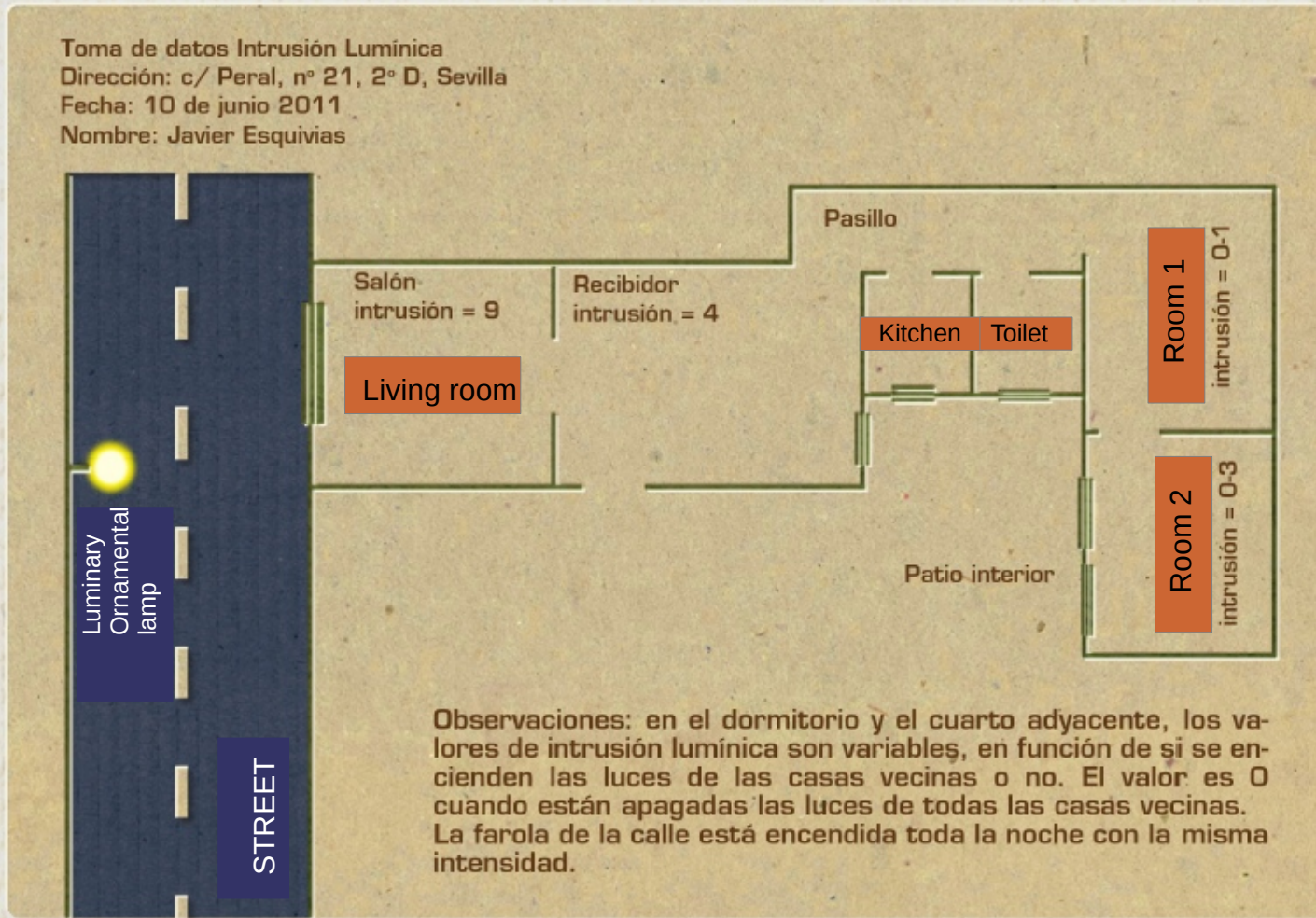
L N Q M 9

## TRESPASS-meter

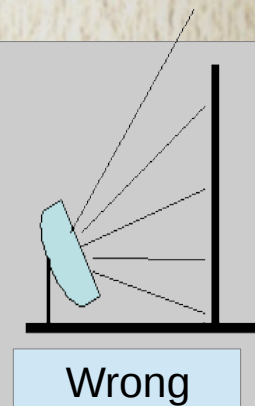
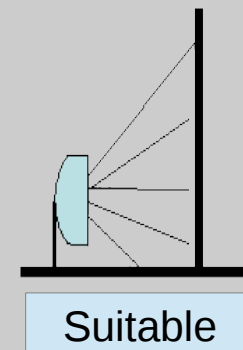
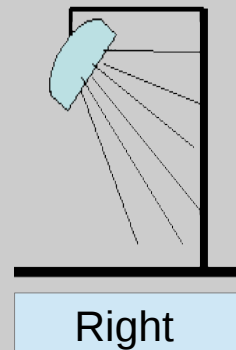
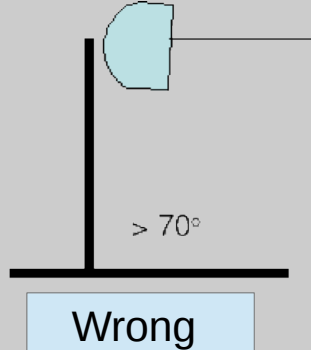
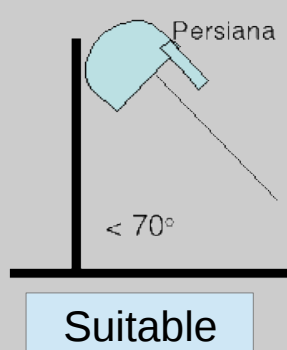
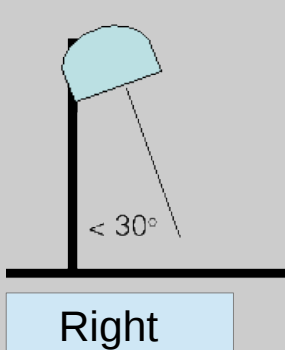
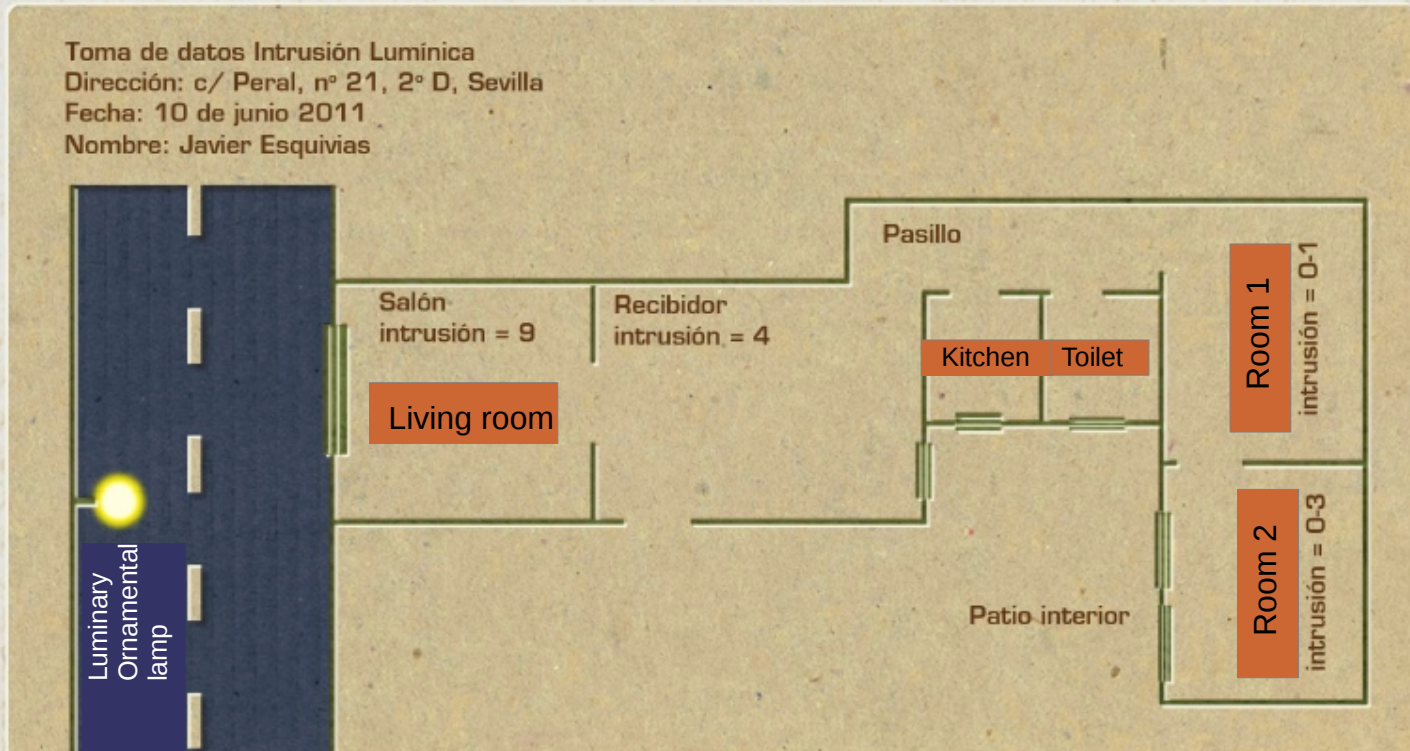
Check with light if you can see all letters with the Trespass-meter, reaching out everything you can.

Turn out the lights, draw the curtains and blinds up. Wait a few minutes for your eyes to adjust. Look the instrument again to see the letters. The smaller character that you distinguish indicates the level of light trespassing in the place. The maximum is 9 and the minimum is 0, in the case that you can not read any text (zero light pollution).

Example of Data acquisition for Light Pollution at home

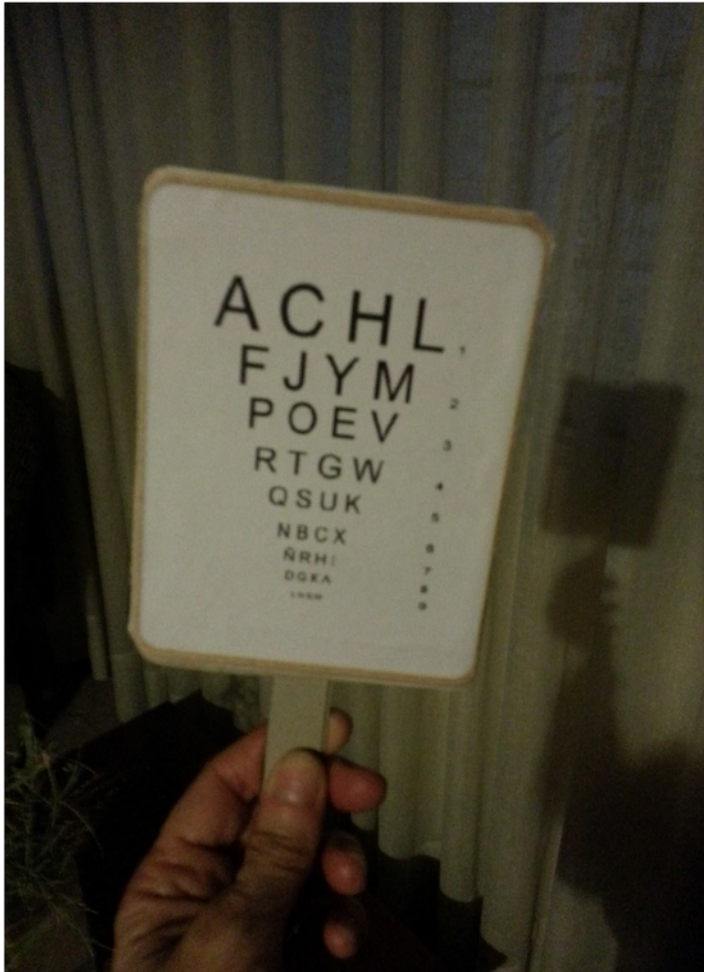


Example of Data acquisition for Light Pollution at home



Illumination at the street

Buildings illumination



1. Check if you can see all the letters with the trespass-meter at your hand and the arm extended.
2. Open the curtains, turn off all the light at the room.

Wait a few minutes (between 10 and 15) to adapt you eye to night vision.



3. Check again the trespass-meter.

The smaller letter that you can see, will indicate the level of light pollution by intrusion inside the room.

Maximum value is 9 (you can see all the letters): **High** light contamination.

minimum is 0 (you can not see any character): the **lower** light pollution that you can have

# Activity 3: Consumption

## Objectives

**Study the contaminating effect if we choose a bad luminary.**

**Shows the beneficial effect with a well selected luminary: reduction in the electric energy consumption and production of heat.**

**Recognize the improvement in the life quality if we avoid the contaminating lights.**



The inadequate use of light sources means economic loss and waste of millions of dollars a year.

The energy which is not transformed in light, is transmitted to the environment as heat

The incandescent lamps have an efficiency of 5%: **only 5% is transformed into light, the 95% of the electric energy is transformed in heat**



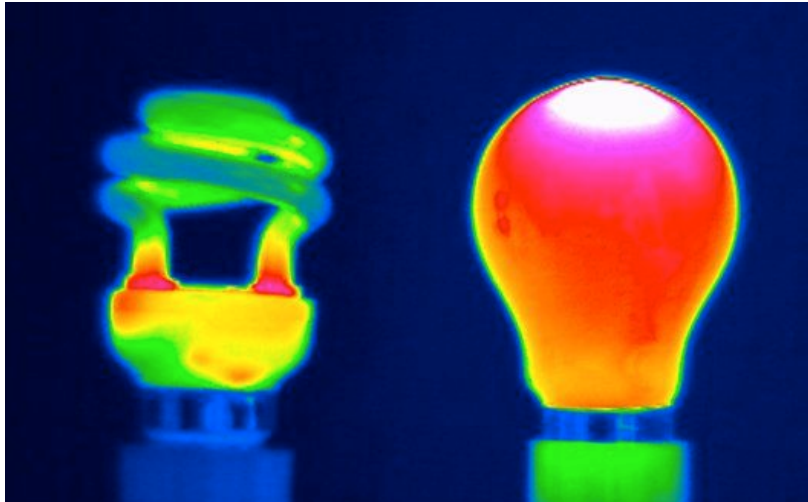


Imagen IR de lámparas bajo consumo e incandescentes



Según Bios Argentina

The electric energy that we use to illuminate which is not transformed into light, is transmitted to the environment as heat.

The low consumption lights (as fluorescents) has an efficiency of 75%: 75% of electricity is transformed into light and 25% into heat, but...the light is produce by Mercury (Hg).



Which one I choose?



LEDs... yes, but avoid the  
withe ones!

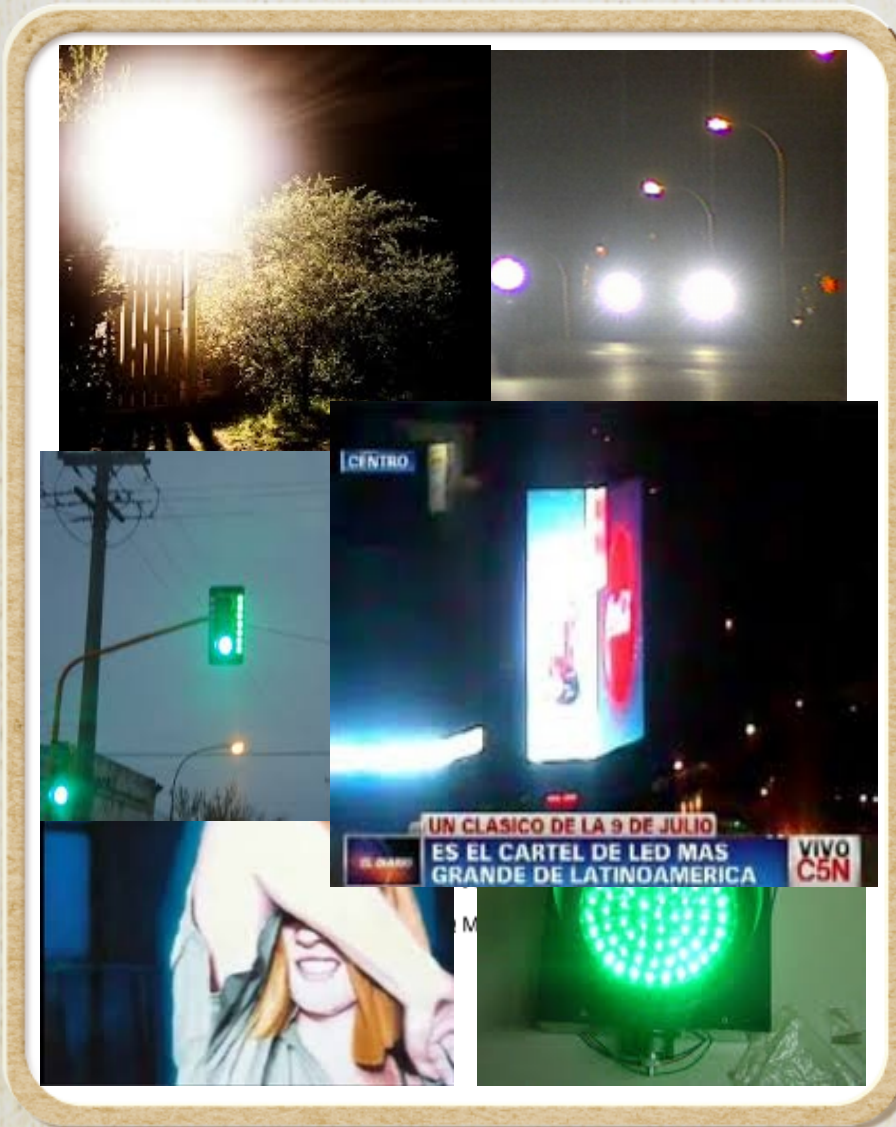
The Magic Box



Inside the box there are 3 lamps

Introduce your hand.

**Can you discover which is  
the best for the  
environment?**



This kind of light pollution can be produced for any light source.

Is more evident in a city with hills or different levels or slopes

Use LED technology can represent a risk if they are not well calibrated, because they have high intensity and directionality

Study the street lights at your town or city and discuss about the way to avoid the glare.

# Activity 5: Chemical composition of the public luminaries

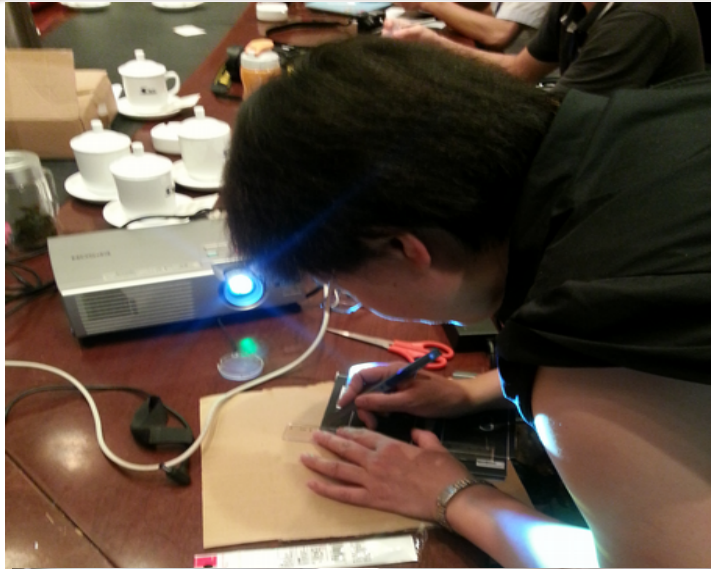
## Objectives

**Recognize different light spectra.**

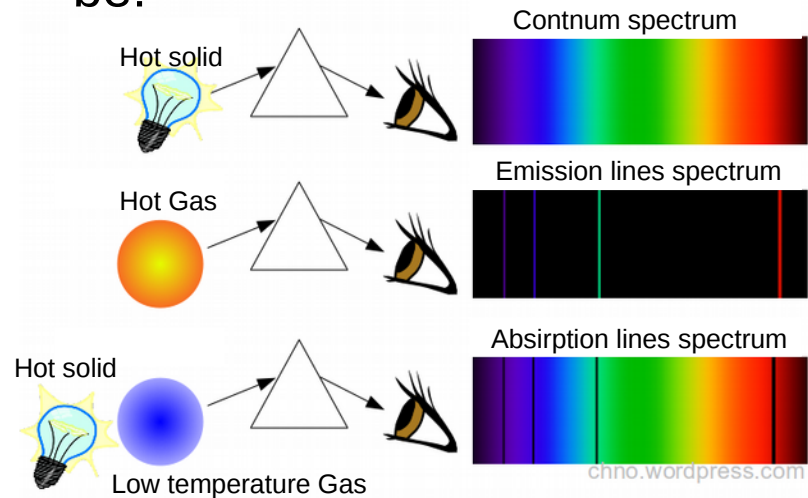
**Analyze differences between light spectra produce by incandescent lamps (solid filament), LED (diodes), fluorescent tubes, low consumption and Sodium lamps (gases).**

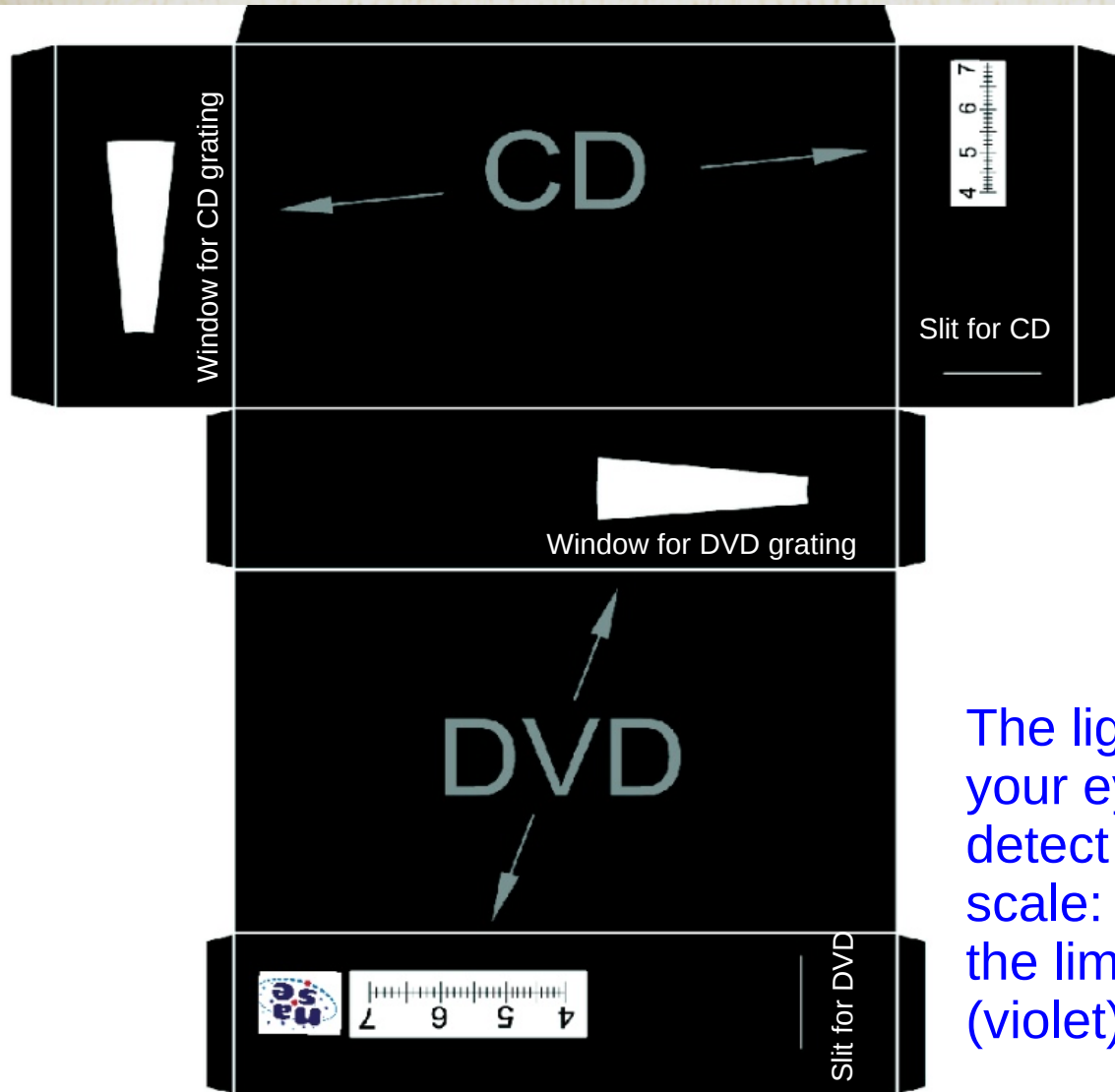
**Identify some chemical elements which are used at the street lights.**

**Compare risks and benefits of each light source.**



- To disperse the white light into the constituent colors, and obtain the spectrum in the visible region, we use a prism or a diffracting red.
- According to the material that emits light, the spectra can be:





Cut the model.

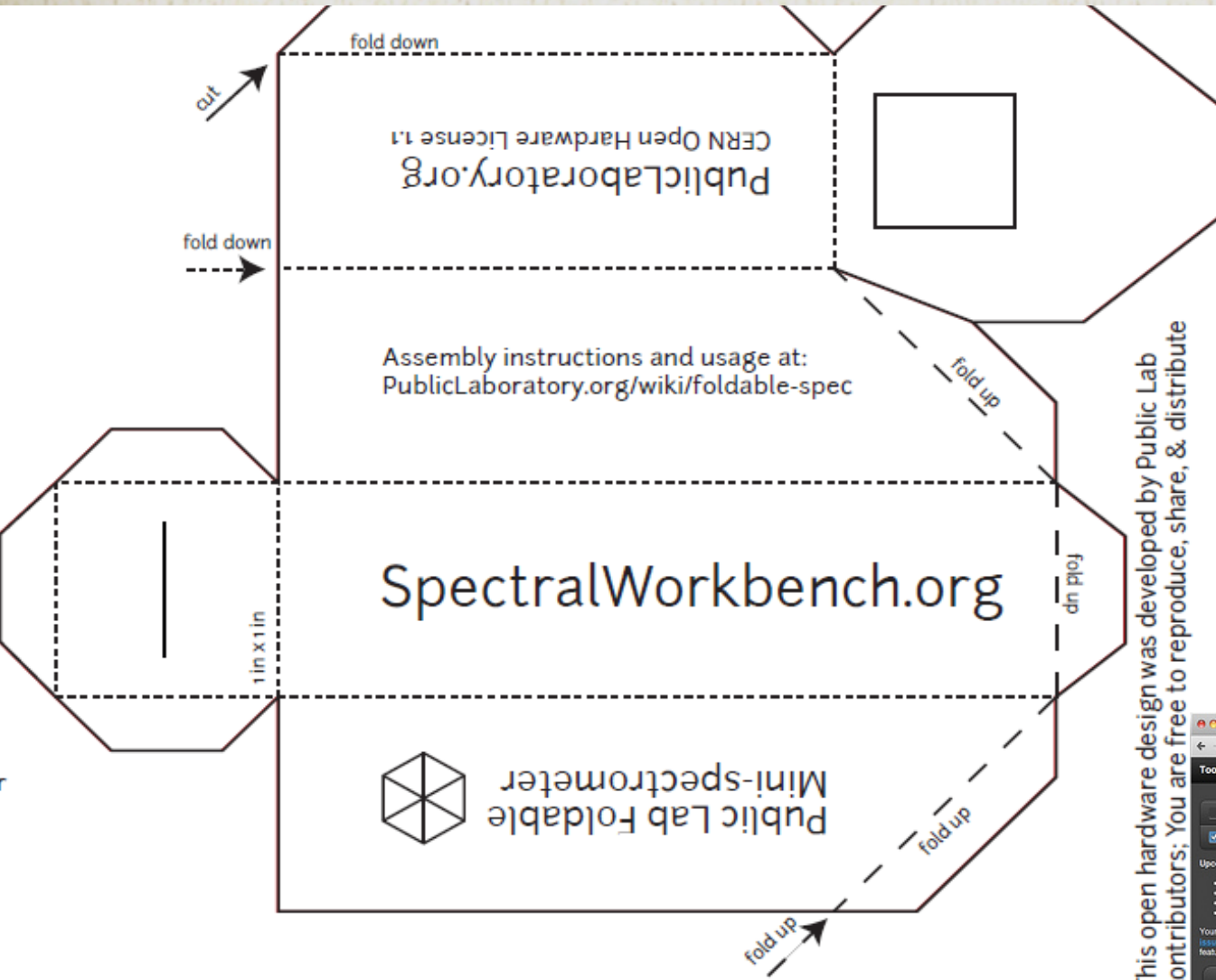
Choose the “diffraction grating” (CD or DVD)

Cut the correspondent “window” (only one), on it you must glue the grating.

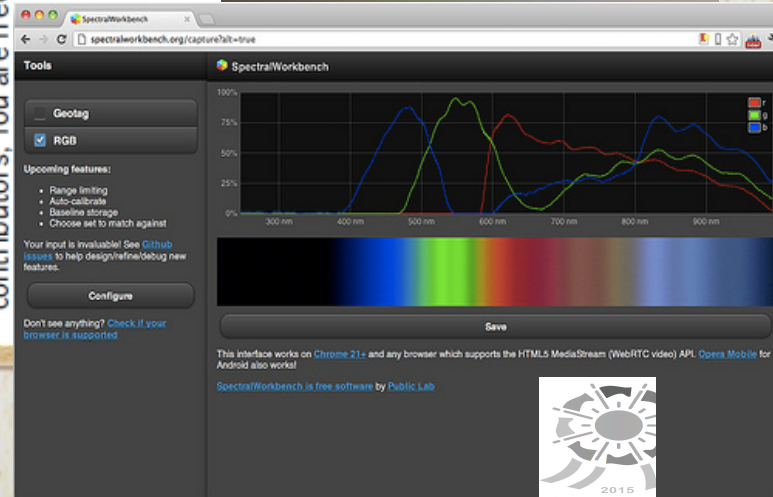
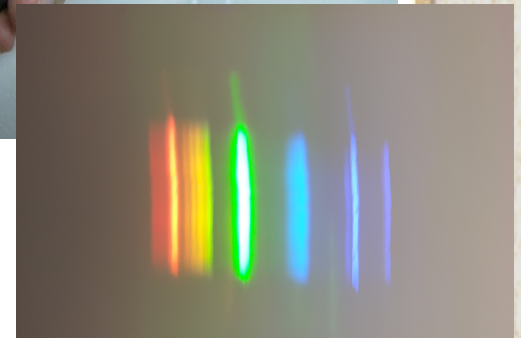
Cut the slit.

Construct the instrument, with the black inside.

The light must enter through the slit; your eye must see the window and detect the spectrum projected on the scale: the numbers (4 to 7) represent the limits of the visible spectrum: 400 (violet) to 700 (red) nanometers.



This open hardware design was developed by Public Lab contributors; You are free to reproduce, share, & distribute



Instructions at:  
<http://publiclab.org/wiki/foldable-spec>





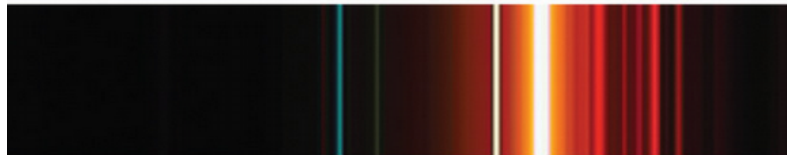
## Use the spectrometer to:

1. Observe different light sources in order to identify different spectra.
2. Determine the wavelength of the spectral lines.
3. Compare the spectra from known sources with those from the street light to deduce the chemical composition of it.

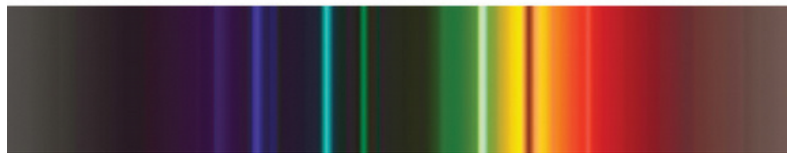




Hg vapor spectrum (350-700 nm)



Low-pressure Na spectrum  
(350-700 nm)

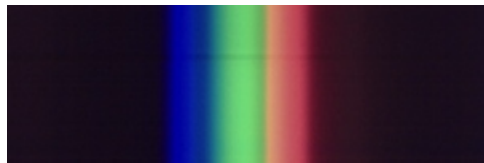


High-pressure Na spectrum  
(350-700 nm)

- In general, the street lamps have Mercury, Sodium or a combination of gases.
- The spectra of Act. 5.3 must be similar to some of the figures at the left.



Cielo



LED



Sodio

¿Which is the primary component of the street lights at your neighborhood?

- If you detect Mercury...

**DANGER:**

The Hg contaminates water and soil if the lamp breaks.

His light alters the behavior of insects and modifies the human biological clock.

- If there are LED, and they are withe..

**DANGER:**

in many countries they are forbidden to affect biological rhythms

# Kit LP-IYL2015-ARG

## Low cost materials

### ✓ **Activity 1. Sky glow**

Cardboard box (black inside).

knitting needle or punch (to create a constellation on one side of the box).

1 to 2 headlights (single bulb).

Two ping pong balls (one on top painted with synthetic enamel of any color, both must be pierced at the bottom to fit into the flashlight).

### ✓ **Activity 2. Trespassing**

Trespass-meter (cut the template, fold it in half and put together the instrument as in the figure).

Scissors.

Glue.

# Kit PL-IYL2015-ARG

## Low cost materials

- ✓ **Activity 3. Consumption**

1 box divided into 3 sections (can be 6 as in Figure 3 for lamps, which should not be and 3 to enter a hand).

1 incandescent or halogen lamp.

1 Low consumption lamp.

1 LED lamp (may be a flashlight).

Socket.

Scissors or cutter.

Glue.

- ✓ **Activity 4. Glare**

Street Lights.

# Kit PL-IYL2015-ARG

## Low cost materials

### ✓ Activity 5. Chemical composition of luminaries

Templates for the spectrograph (cut the paper of the printer)

To NASE-Spectrograph

1 CD or DVD in use or used

Packaging tape (CD, only a small piece of tape used)

Scissors and utility knife.

Glue stick.

To mini cell-phone spectrograph

(this template can be pasted on card)

1 DVD player

Scissors

Scotch tape (only small pieces of tape are used)

glue

# Conclusions

- A new kit for NASE courses permits to work at the classroom exclusively on LP.
- Part of the material is developed during NASE workshops (like the spectrometer).
- Low cost resources.
- NASE assures Local Groups in each country to maintain the activity.
- This proposal complements other initiatives on the Globe.