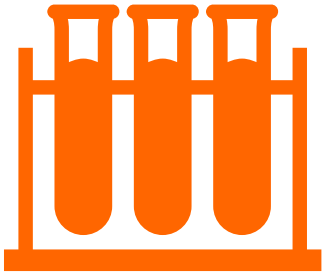
APPLICATIONS OF SPECTROSCOPY IN THE STUDY OF ELEMENTS OF THE PERIODIC TABLE

Col·legi Episcopal
Lleida

60 anys

"Applications of Spectroscopy in the study of elements of the periodic table". Didicatiic sequence, created by José Ignacio Álvarez Hernández
jalvarez@cepiscopal.org



WORKING BY PROJECTS

Col·legi Episcopal
Lleida

- Working instructions
  - The presentation of the work will be about the practice of design and construction of a spectroscope, the transformation of the mobile phone in a spectrophotometer, the x-ray diffraction spectra of observations made and conclusions.
  - Will be made in format presentation (PwP, Prezi...).
  - For 1 hour a week will be able to work entirely in the project using computer media.
- Parts of the presentation
  - Home (working title, authors, year).
  - Sections of the work:

a. THEORETICAL PART: FINDING INFORMATION

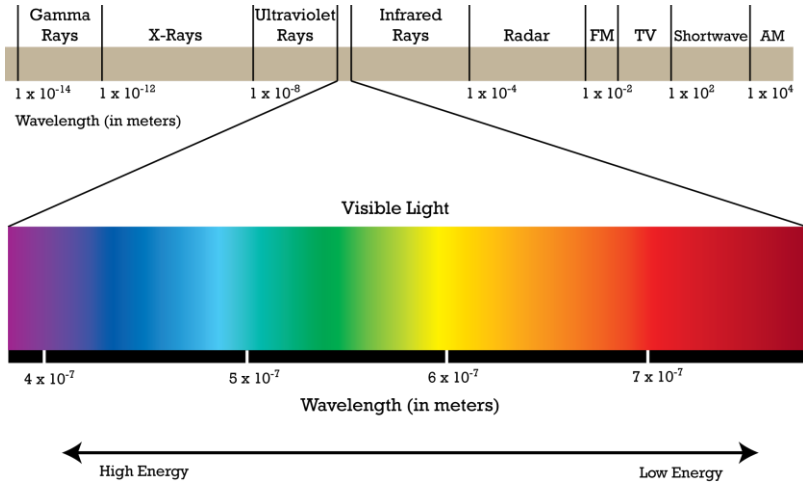
- The electromagnetic spectrum and the light spectrum.
- Concept of spectroscopy. Historical setting (important milestones: Newton, Wollaston, Fraunhofer, Kirchhoff and Bunsen).
- Concept of the spectroscopy. Utilities.
- Types of spectroscopes: prism and diffraction grid. How they work.
- Resolution of a spectroscope.

WORKING BY PROJECTS

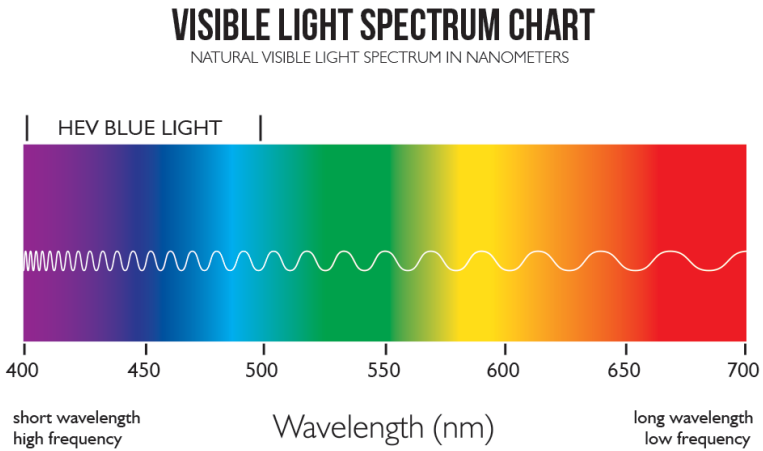
Col·legi Episcopal
Lleida

a. THEORETICAL PART: FINDING INFORMATION

- The electromagnetic spectrum and the light spectrum



Source: http://www.pion.cz/en/article/electromagnetic-spectrum



Source: https://gunnar.com/wp-content/uploads/2017/08/Visible-Light-Spectrum-chart.png

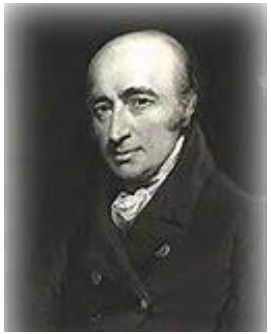
WORKING BY PROJECTS

Col·legi Episcopal Lleida

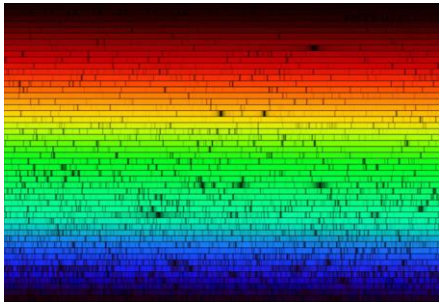
a. THEORETICAL PART: FINDING INFORMATION

– Concept of spectroscopy. Historical setting (important milestones: Newton, Wollaston, Frauenhofer, Kirchoff and Bunsen).

1666: Isaac Newton (1642–1727) shows that the white light from the sun could be dispersed into a continuous series of colors. He coined the word "spectrum." His apparatus, an aperture to define a light beam, a lens, a prism, and a screen, was the first spectroscope. He suggested that light was composed of minute corpuscles (particles) moving at high speed.



1802: English scientist **William Hyde Wollaston** (1766–1828) is the first to observe dark lines in the spectrum of the sun



Source: http://www.spectroscopyonline.com/timeline-atomic-spectroscopy

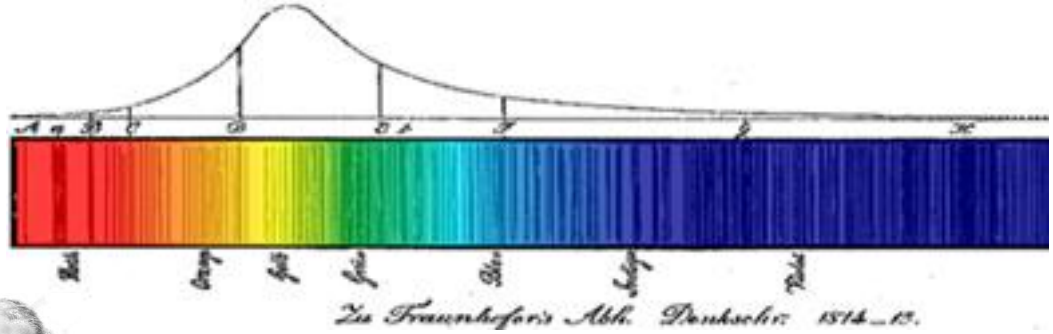
WORKING BY PROJECTS

Col·legi Episcopal Lleida

a. THEORETICAL PART: FINDING INFORMATION

– Concept of spectroscopy. Historical setting (important milestones: Newton, Wollaston, Frauenhofer, Kirchoff and Bunsen).

1814: The German optician **Joseph von Frauenhofer** (1787–1826) invents the transmission diffraction grating and makes a detailed study of the dark lines in the solar spectrum.



1859: The German physicist **Gustav Robert Kirchoff** (1824–1887) and chemist **Robert Wilhelm Eberhard von Bunsen** (1811–1899) discover that spectral lines are unique to each element.

Source: http://www.spectroscopyonline.com/timeline-atomic-spectroscopy

WORKING BY PROJECTS

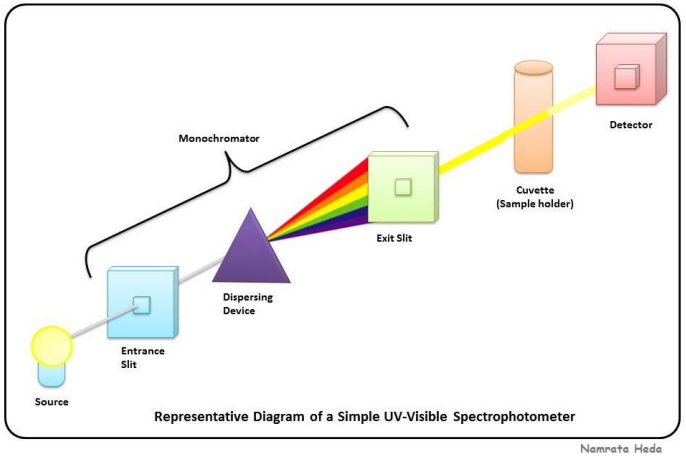
Col·legi Episcopal
Lleida

a. THEORETICAL PART: FINDING INFORMATION

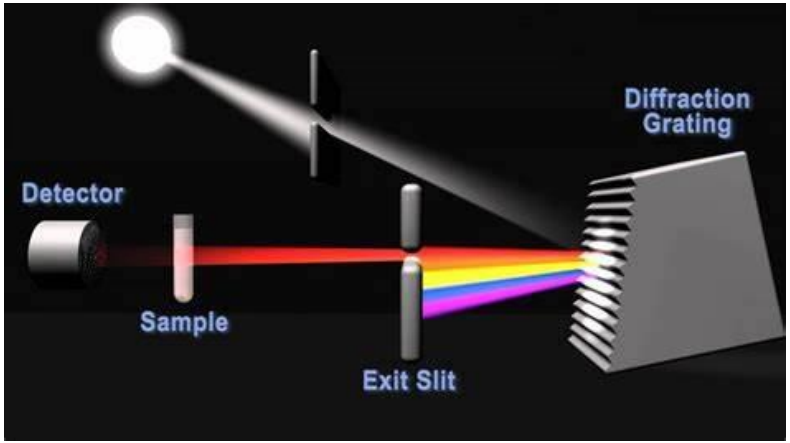
- Concept of the spectroscopy. Utilities.
  - Infrared spectroscopy serves as one useful tool in the chemist's toolbox for identifying compounds. It does not give the exact structure of a compound, but rather shows the identity of the functional groups, or moieties, in a molecule - the different segments of the molecule's composition. As such an inexact tool, IR spectroscopy works best when used in conjunction with other forms of analysis such as melting point determination.

Source: http://www.spectroscopyonline.com/timeline-atomic-spectroscopy

- Types of spectroscopes: prism and diffraction grid. How they work.



Source: http://namrataheda.blogspot.com/2013_07_01_archive.html



Source: https://www.youtube.com/watch?v=pxC6F7bK8CU

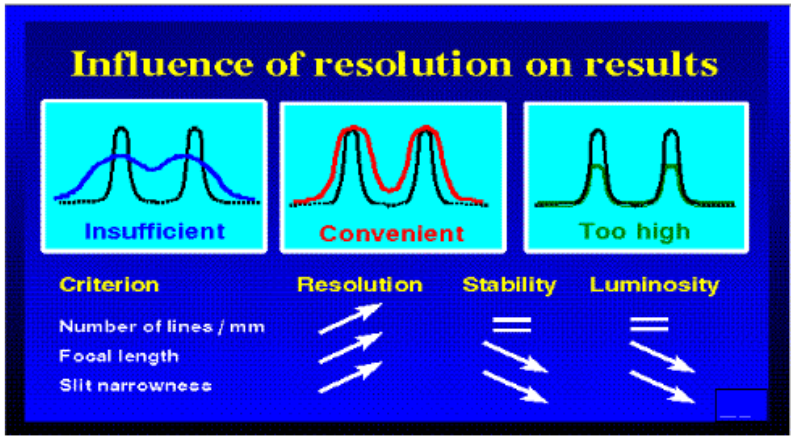
WORKING BY PROJECTS

a. THEORETICAL PART: FINDING INFORMATION

– Resolution of a spectroscope.

- One of the most important characteristics of a spectrometer is the spectral (or optical) resolution. The spectral resolution of a system determines the maximum number of spectral peaks that the spectrometer can resolve. For example, if a spectrometer with a wavelength range of 200nm had a spectral resolution of 1nm, the system would be capable of resolving a maximum of 200 individual wavelengths (peaks) across a spectrum.
- In dispersive array spectrometers, there are 3 main factors that determine the spectral resolution of a spectrometer: the slit, the diffraction grating, and the detector. The slit determines the minimum image size that the optical bench can form in the detector plane. The diffraction grating determines the total wavelength range of the spectrometer. The detector determines the maximum number and size of discreet points in which the spectrum can be digitized.

Source: http://bwtek.com/spectrometer-part-5-spectral-resolution/



Source: http://www.thespectroscopynet.eu/?Spectrometers:Spectrometer_Resolution:Resolution

WORKING BY PROJECTS

Col·legi Episcopal
Lleida

b. PRACTICAL PART

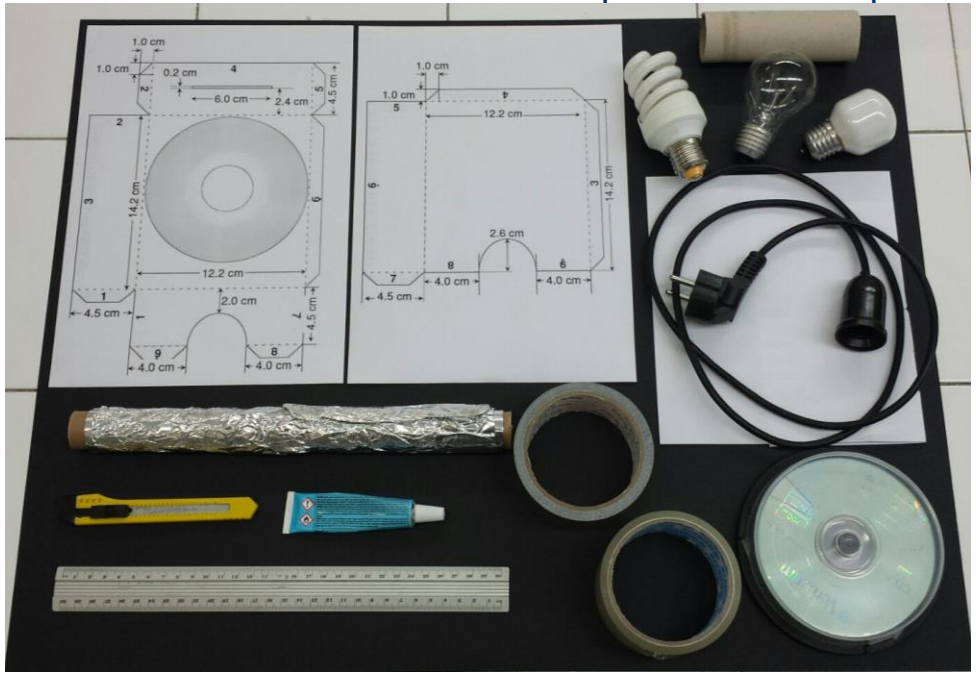
– Materials used in the design and manufacture of a spectroscope and in the transformation of the mobile phone into a spectrophotometer.

WORKING BY PROJECTS

Col·legi Episcopal
Lleida

b. PRACTICAL PART

– Materials used in the design and manufacture of a spectroscope and in the transformation of the mobile phone into a spectrophotometer.



WORKING BY PROJECTS

Col·legi Episcopal
Lleida

b. PRACTICAL PART

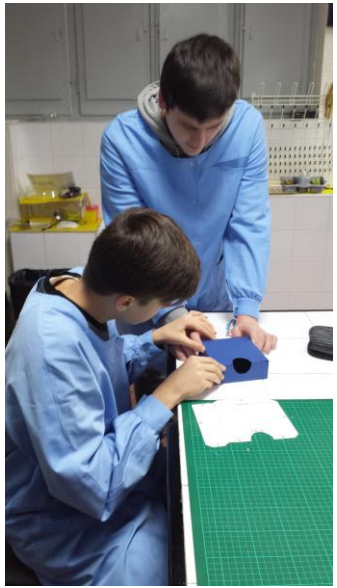
- Materials used in the design and manufacture of a spectroscope and in the transformation of the mobile phone into a spectrophotometer.
  - http://www.rsc.org/learn-chemistry/resource/res00002071/smartphone-spectrometer

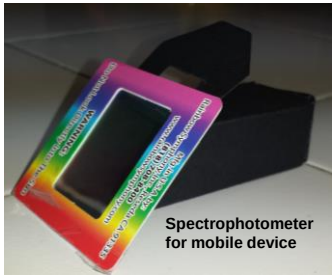
WORKING BY PROJECTS

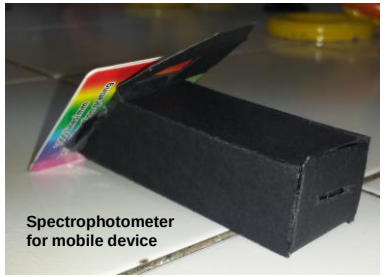
Col·legi Episcopal
Lleida

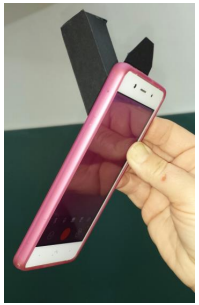
b. PRACTICAL PART

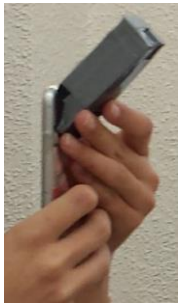
- Assembly Process.
  - https://www.cepiscopal.org/?s=espectroscopi









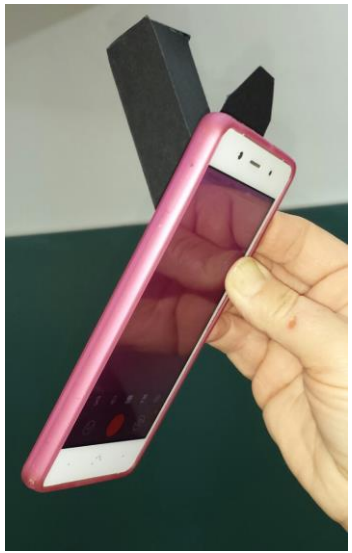


WORKING BY PROJECTS

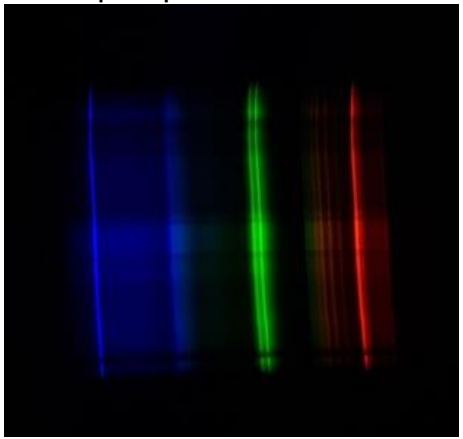
Col·legi Episcopal
Lleida

b. PRACTICAL PART

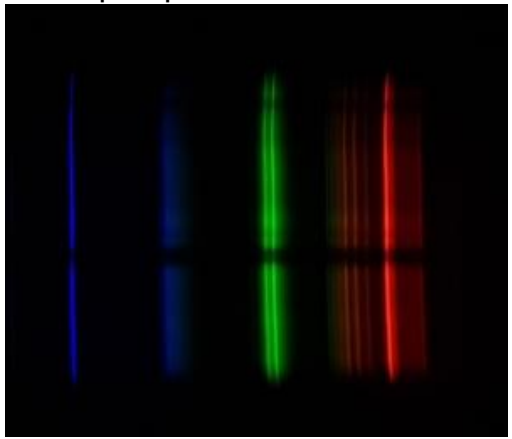
- Observations of emission spectra from different light sources with the mobile spectrophotometer, while taking photographs of them. (Ex: Low-cold and warm consumption light).
  - Emission diffraction spectrum photographs with the mobile spectrophotometer.



Light emission Spectrum of a low-consumption light bulb (cold light) obtained with the mobile transformed into a spectrophotometer.



Light emission Spectrum of a low-consumption light bulb (cold light) obtained with the mobile transformed into a spectrophotometer.



WORKING BY PROJECTS

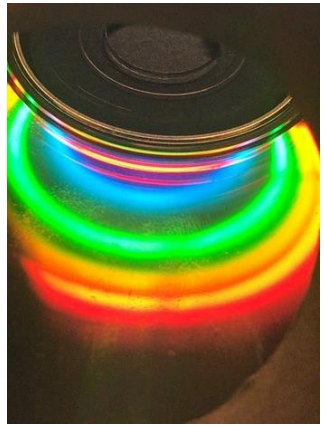
Col·legi Episcopal
Lleida

b. PRACTICAL PART

- Observations of emission spectra from different light sources with desktop spectroscope, while taking photographs of the same with mobile (Ex: Low power Light: cold and warm).
  - Emission diffraction spectrum photograph with desktop spectroscope.

Light emission Spectrum of a low-consumption light bulb (cold light) obtained with a desktop spectroscope.

Light emission Spectrum of a low-consumption light bulb (warm light) obtained with a desktop spectroscope.

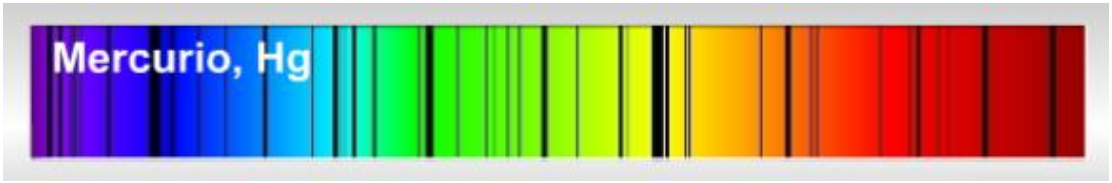


WORKING BY PROJECTS

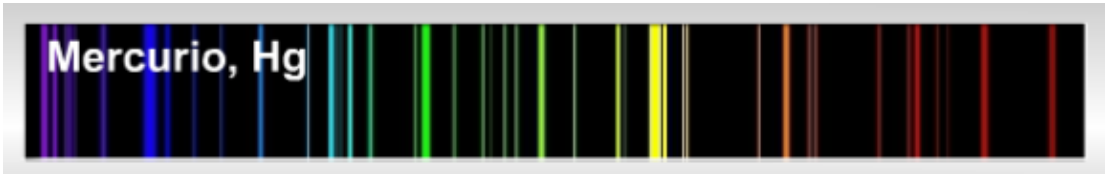
Col·legi Episcopal
Lleida

b. PRACTICAL PART

- Observations of emission spectra from different light sources with spectroscope and with the mobile, while taking photographs of the same:
  - Absorption Spectrum and emission of mercury light (material found in low-energy light bulbs in an amount between 3 and 6 mg), provided by :
    - **http://herramientas.educa.madrid.org/tabla/espectros/spespectro.html**



Absorption



Emission

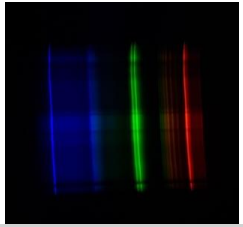
WORKING BY PROJECTS

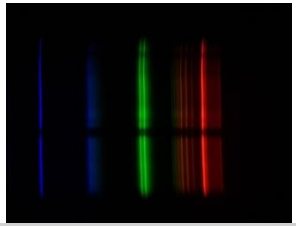
b. PRACTICAL PART

Col·legi Episcopal
Lleida

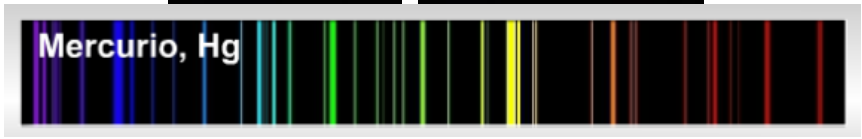
- Analysis of results: Comparison of emission spectra obtained through desktop spectroscope and mobile transformed into a spectrophotometer, and the emission spectra of the chemical components sought in the previous link, taking into account the chemical composition of the light sources used.
  - Ex: Comparison between the emission spectrum of a low-energy light bulb, with cold and warm light, obtained with desktop spectroscopy and mobile device spectrophotometer; with the real emission spectrum of mercury, as an element of the periodic table found in the interior of the bulb, to corroborate the existence of Hg inside the same.

Light emission Spectrum of a low-consumption light bulb (cold light) obtained with the mobile transformed into a spectrophotometer.





Light emission Spectrum of a low-energy light bulb (warm light) obtained with the mobile transformed into a spectrophotometer



Light emission Spectrum of a low-energy light bulb (warm light) obtained with the Móvil transformed into a spectrophotometer

Espectre d'emissió de llum d'una bombeta de baix consum (llum càlida) obtingut amb un espectroscopi de sobretaula

WORKING BY PROJECTS

Col·legi Episcopal
Lleida

- Finals questions to think:
  - What is the spectrum of sunlight? What does it depend on?
  - What aspect do the spectra of light emitted by the different sources of light analyzed? What do they depend on?
  - Do you think it is important to analyze the elements of the Periodic Table that exist inside certain artificial and natural light sources? Introduce future research lines that relate spectroscopy to the environment and Astronomy.

WORKING BY PROJECTS

Col·legi Episcopal
Lleida

- HOW CAN WE LOOK FOR THE INFORMATION?
  - Strict investigation of information.
  - It is forbidden to use direct (copy and paste) information on Wikipedia.
  - Use scientific publications.
  - Use literature with rigor.
- UTILITY TOOLS
  - Google scholar.
  - SciELO (Scientific Electronic Library Online).
  - Dialnet
  - WorldWideScience.org
  - Bibliography of Wikipedia.

Col·legi Episcopal
Lleida

LET'S GET STARTED