BILINGUAL TEACHING UNIT: **THE ELEMENTS AND ASTRONOMY** (PHYSICS AND CHEMISTRY)

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Abstract

We present a teaching unit on the International Year of Astronomy 2009, Atomic Physics and the astronomical rôle of the chemical elements in the Periodic Table.

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1 INTRODUCTION

Atomic Physics is a fascinating subject due to its interdisciplinar applications. The chemical properties of the elements are deeply related to their electronic configurations. Moreover, 2009 was selected by UNESCO as the International Year of Astronomy (IYA).

There are also some other logical reasons why we decided these hot topics as highly recommended lessons to be taught from an original and bilingual frame:

1. It is an interesting and motivating subject for the lecturer.
2. There are lots of resources available for the students both, in the web and inside of science books.
3. There are recent and nice news on the television, newspapers or the radio, motivated by the IYA.
4. The different relations between several concepts in Chemistry, Physics and Astronomy.
5. Having lots of audiovisual files, like videos, podcasts, pictures and images, something that, generally, can attract every student in the classroom.
6. It fits in the Spanish curriculum of 1º de Bachillerato, subject of Physics and Chemistry.

2 CLASS DESCRIPTION

The class to which the unit is approached has the following profile:

- *Age*: ranging from 16 to 20 years old students.
- *Level*: 1º de Bachillerato, science branch. Also suitable to Bachillerato, in general.
- *Learning styles*: Web based or self-taught students, collaborative students, traditional learning students by books and classroom lectures.
- *Lessons per week*: The class has at least four hours or lectures per week, including the practical sessions in the laboratory.

3 THE LESSONS

We have planned and scheduled our teaching unit splitting it in three different lessons or sessions, as follows:

- First session. See the video lectures and do some simple listening activities in groups. The videos can be seen individually at home too.
- Second session. Expose the images to each other. Explain and assess both individually and colectively.
- Third session. Test the new knowledge with a quiz and some short exercises (labelling, fill the gaps,...) .

The four C's for our unit have the following structure. Please, note I prefer lists to grids, but they are completely equivalent. The same information is displayed in a different way:

♣ CONTENT

★ Astronomical pictures.
★ Chemical elements (applications, main properties,...).
★ The Periodic Table.
★ Atomic Physics.
★ Astronomical applications of Atomic Physics and chemical elements.
★ International Year of Astronomy 2009.

♣ COGNITION

★ Learning the most important and impressive properties and applications of chemical elements.
★ Describing astronomical pictures.
★ Translating technical and scientific texts.
★ Relating Astronomy, Atomic Physics and Chemistry.
★ Astronomical applications of Atomic Physics and chemical elements.
★ Independent research and problem solving.

♣ COMMUNICATION

♡LANGUAGE OF LEARNING (BRICK LANGUAGE) :

Spectrum:Espectro.
Prism-like:Similar a un prisma.
Device:instrumento, dispositivo.
Nearly:casi.
Patch:parche,tira.
Majority:mayoría.
Horsehead:Cabeza de caballo.
Nebula:nebulosa (plural nebular).
Sky:cielo.
Indentacion: indentación, marca, hendidura.
Opaque:opaco/a.
Shape:forma.
Recombining:recombinando.
Nearby:cercano.
Fur:piel.
Glowing:brillante.
Colourful:colorida/o.
Faint:débil.
Fanciful:fantástico/a.
Jumble:revuelto,caos.
Dust:polvo.
Reddish:rojizo.
Newborn:recién nacido.
Wide:amplio.
Span:generar.
Pelt:piel.
Haze:neblina.
Sideways:de lado.
Apex:apex,ápice.
Broad:ancho.
Even though:aunque.
Surrounding:envolvente.
Flaming:llameante.
Knock:golpear.
Span:generar.
Charioteer:Cochero, auriga.
Trifid:Trífida.
Resemble: presentar.

Glow:brillo.
Instead:en su lugar, en vez de eso.
Scatter:dispersar.
Redden:enrojecer.
Emitter:emisor. *Tail*:cola.
Comet:cometa.
Currently: actualmente.
Fade over:desaparecer, alejarse.
Spiral:espiral.
Likely:probablemente.
Sprawling: expansionante, creciente.

♡LANGUAGE OF LEARNING (MORTAR LANGUAGE) :
★ Identifying. E.g., simple present sentences.
★ Describing. E.g., "Subject+are made/composed of+..."
★ Speculating. E.g., ...is probably/likely... is improbable/unlikely
★ Estimating. E.g., ...is about...

♣ CULTURE AND COMMUNITY

★ Knowing about the astronomical legacy of Galileo.
★ Respect for knowledge and achievement of present and past scientists.
★ Caring for our night skies (damaged by air and luminous pollutions) and knowing why can not see at present the beautiful full landscapes seen at the starry nights from everywhere on the Earth.

4 ACTIVITIES

The procedure, from the viewpoint of Physics and Chemistry, is described by the following steps:

- Create small groups or teams of students, according to the total of the class. A good number can be in the interval between 3 and 6 people.
- Assign a chemical element per student and a text per group.
- Explain carefully the tasks of every bilingual lesson we are going to give. Put things as simple as possible, but no simpler.
- Watch the videos (see the appendix) about the elements assigned to every member of the team.

- Select one element and explain the properties, in Spanish, to the others as an exercise to guess what element is.
- Translate the text and present an oral report about it, showing if they are understood them. Ask for a written translation of the texts as well.
- Explain the relations between the astronomical pictures, the chemical elements and Atomic Physics as the ultimate goal of the lectures. Good relations during the oral expositions imply a good mark.
- Optional: include a small final test or fill the gaps exercise, in Spanish language, about the topics studied during the lessons.

In summary, we have reading texts on science, assignments related to heuristic translations, exercises attached to the scaffolding with brick and mortar language in this subject, listening and speaking during the videos, final reports, oral presentations and a final optional test, whenever it be possible.

5 CONCLUSION

The development of the present teaching unit has the following benefits:

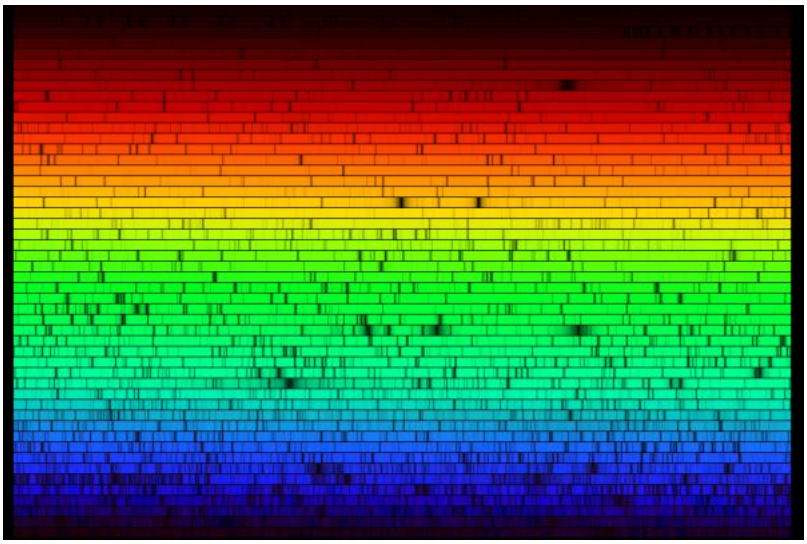
1. It fits the Spanish curriculum in Physics and Chemistry.
2. It is interdisciplar and bilingual from a wide perspective.
3. It can increase student's motivation and group collaborations.
4. It has lots of visual and different activities to like everyone at the classroom.
5. The final assesment is done by different methods, so students who are less gifted in one kind of exercise can excell in others. It´s unlikely a student does not obtain a good mark (positive feedback).

The concrete realization of the unit present some difficult challenges as well. Specially related to the traditional mobility and excitement of students. Problems that we faced when we did the present unit was mainly related to manage a serious behavior and attitude of some people.

In conclusion, this is a quite complete unit, but its own complexity

A Reading activities: texts

A.1 TEXT 1.The Solar Spectrum



Explanation: It is still not known why the Sun's light is missing some colors. Shown above are all the visible colors of the Sun, produced by passing the Sun's light through a prism-like device. The above spectrum was created at the McMath-Pierce Solar Observatory and shows, first off, that although our yellow-appearing Sun emits light of nearly every color, it does indeed appear brightest in yellow-green light. The dark patches in the above spectrum arise from gas at or above the Sun's surface absorbing sunlight emitted below. Since different types of gas absorb different colors of light, it is possible to determine what gasses compose the Sun. Helium, for example, was first discovered in 1870 on a solar spectrum and only later found here on Earth. Today, the majority of spectral absorption lines have been identified - but not all.

Vocabulary:
Spectrum:Espectro.
Prism-like:Similar a un prisma.
Device:instrumento, dispositivo.
Nearly:casi.
Patch:parche,tira.
Majority:mayoría.

A.2 TEXT 2. Orion's Horsehead Nebula

Explanation: The Horsehead Nebula is one of the most famous nebulae on the sky. It is visible as the dark indentation to the red emission nebula seen just below and left of center in the this photograph. The brightest star on the left is located in the belt of the familiar constellation Orion. The horse-head feature is dark because it is really an opaque dust cloud that lies in front of the bright red emission nebula. Like clouds in Earth's atmosphere, this cosmic cloud has assumed a recognizable shape by chance. After many thousands of years, the internal motions of the cloud will alter its appearance. The emission nebula's red color is caused by electrons recombining with protons to form hydrogen atoms. Also visible in the picture are blue reflection nebulae that preferentially reflect the blue light from nearby stars.

Vocabulary:
Horsehead:Cabeza de caballo.
Nebula:nebulosa (plural nebular).
Sky:cielo.
Indentacion: indentación, marca, hendidura.
Opaque:opaco/a.
Shape:forma.
Recombining:recombinando.
Nearby:cercano.

A.3 TEXT 3. Fox Fur, a Unicorn, and a Christmas Tree

Explanation: Clouds of glowing hydrogen gas fill this colorful skyscape in the faint but fanciful constellation Monoceros, the Unicorn. A star forming region cataloged as NGC 2264, the complex jumble of cosmic gas and dust is about 2,700 light-years distant and mixes reddish emission nebulae excited by energetic light from newborn stars with dark interstellar dust clouds. Where the otherwise obscuring dust clouds lie close to the hot, young stars they also reflect starlight, forming blue reflection nebulae. The wide mosaic spans about 3/4 degree or nearly 1.5 full moons, covering 40 light-years at the distance of NGC 2264. Its cast of cosmic characters includes the the Fox Fur Nebula, whose convoluted pelt lies at the upper left, bright variable star S Mon immersed in the blue-tinted haze just below the Fox Fur, and the Cone Nebula at the far right. Of course, the stars of NGC 2264 are also known as the Christmas Tree star cluster. The triangular tree shape traced by the stars appears sideways here, with its apex at the Cone Nebula and its broader base centered near S Mon.

Vocabulary:
Fur:piel.
Glowing:brillante.
Colourful:colorida/o.
Faint:débil.
Fanciful:fantástico/a.
Jumble:revuelto,caos.
Dust:polvo.
Reddish:rojizo.
Newborn:recién nacido.
Wide:amplio.
Span:generar.
Pelt:piel.
Haze:neblina.
Sideways:de lado.

Apex:apex,ápice.
Broad:ancho.

A.4 TEXT 4. AE Aurigae and the Flaming Star Nebula

Explanation: Is star AE Aurigae on fire? No. Even though AE Aurigae is named the flaming star, the surrounding nebula IC 405 is named the Flaming Star Nebula, and the region appears to harbor red smoke, there is no fire. Fire, typically defined as the rapid molecular acquisition of oxygen, happens only when sufficient oxygen is present and is not important in such high-energy, low-oxygen environments such as stars. The material that appears as smoke is mostly interstellar hydrogen, but does contain smoke-like dark filaments of carbon-rich dust grains. The bright star AE Aurigae, visible near the nebula center, is so hot it is blue, emitting light so energetic it knocks electrons away from surrounding gas. When a proton recaptures an electron, red light is frequently emitted, as seen in the surrounding emission nebula. Pictured above, the Flaming Star nebula lies about 1,500 light years distant, spans about 5 light years, and is visible with a small telescope toward the constellation of the Charioteer (Auriga).

Vocabulary:
Even though:aunque.
Surrounding:envolvente.
Flaming:llameante.
Knock:golpear.
Span:generar.
Charioteer:Cochero, auriga.

A.5 TEXT 5. NGC 1579: Trifid of the North

Explanation: Colorful NGC 1579 resembles the better known Trifid Nebula, but lies much farther north in planet Earth's sky, in the heroic constellation Perseus. About 2,100 light-years away and 3 light-years across, NGC 1579 is, like the Trifid, a study in contrasting blue and red colors, with dark dust lanes prominent in the nebula's central regions. In both, dust reflects starlight to produce beautiful blue reflection nebulae. But unlike the Trifid, in NGC 1579 the reddish glow is not emission from clouds of glowing hydrogen gas excited by ultraviolet light from a nearby hot star. Instead, the dust in NGC 1579 drastically diminishes, reddens, and scatters the light from an embedded, extremely young, massive star, itself a strong emitter of the characteristic red hydrogen alpha light.

Vocabulary:
Trifid:Trífida.
Resemble: presenta.
Glow:brillo.
Instead:en su lugar, en vez de eso.
Scatter:dispersar.
Redden:enrojecer.
Emitter:emisor.

A.6 TEXT 6. Two Tails of Comet Lulin

Explanation: Go outside tonight and see Comet Lulin. From a dark location, you should need only a good star map and admirable perseverance – although wide-field binoculars might help. Yesterday, Comet Lulin passed its closest to Earth, so that the comet will remain near its brightest over the next few days. The comet is currently almost 180 degrees around from the Sun and so visible nearly all night long, but will appear to move on the sky about 10 full moons a night. In this image, Comet Lulin was captured in spectacular form two nights ago from New Mexico, USA. The central coma of the comet is appearing quite green, a color likely indicating glowing molecular carbon gasses. Bright stars and a distant spiral galaxy are clearly visible in the image background. The yellow dust tail, reflecting sunlight, is visible sprawling to the coma's left trailing behind the comet, while the textured bluish-glowing ion tail is visible to the coma's right, pointing away from the Sun. Over the past few weeks, from the current vantage point of Earth, these two tails appeared to point in opposite directions. Comet Lulin is expected to slowly fade over the next few weeks.

Vocabulary:
Tail:cola.
Comet:cometa.
Currently: actualmente.
Fade over:desaparecer, alejarse.
Spiral:espiral.
Likely:probablemente.
Sprawling: expansionante, creciente.

B Listening and speaking resources

Youtube videos from **www.periodictablevideos.com**