Spectral classification of stars

Evolution of Stars. Activity 4

Classroom Activity

Overview

Age Range:

14 – 17 years

Prep. Time:

Zero, if Activity 2 is done before

Lesson Time:

35 min

Cost per activity:

Printing of student's worksheets

Includes the use of:

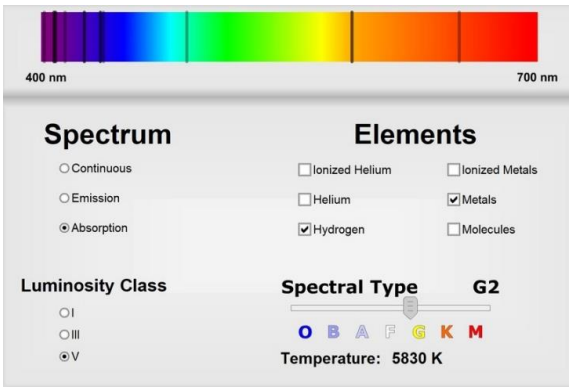
Computer for each group of students

Outline

By using computer animation students get knowledge about different spectral classes of stars and typical spectral lines of each spectral class. Then they explore the picture of real stellar spectra.

Pupils will Learn:

- That stars are divided in spectral classes according to their temperature.
- That stars are made mostly of hydrogen and helium.
- Absorption lines of different chemical elements are present in stellar spectra at different temperatures.



Screenshot of the animation used for this activity

The online observatory collaboration consists of the following partners:
Baldone Observatory, Brorfelde Observatory, Cardiff University, Harestua Solar Observatory, Helsinki Observatory

Lesson Plan:

Description	Time	Notes
Before the lesson: if the Activity 2 was not done before	15 min	Go to the download's page at http://astro.unl.edu/downloads to get the free *ClassAction* software. The software is courtesy of the Astronomy Education at the University of Nebraska-Lincoln Web Site (http://astro.unl.edu). Download and run the appropriate files for your system and follow the prompts to install the software on the teacher and students computers.
Pre-activity step	2 min	Divide students in groups
Introduction to the subject	3 min	Dialogue with the students
Activity 1	15 min	Students work with the animation *Light & Spectra/Spectrum Explorer* and fill the worksheet
Activity 2	10 min	Students discuss the results with the teacher and explore the picture *Stellar Spectra*
Assessment	5 min	Students answer the questions

Introduction to the subject:

The purpose of this lesson is to introduce students to the spectral classification of stars. Spectral classification is essential to understand different types of stars, their properties and their evolution.

Activity 1:

Students work with the animation *Light & Spectra/Spectrum Explorer*. Spectrum must be switched to *Absorption; Luminosity Class* must be switched to "V".

Teacher explains that stars are divided in seven main spectral classes O, B, A, F, G, K, M according to their temperature. Stars of the spectral class O are the hottest and the bluest. Stars of the spectral class M are the coldest and the reddest. This sequence of letters appeared after some historical development and is hard to remember therefore a mnemonic English expression is used: "O, Be A Fine Guy, Kiss Me". Each letter class is subdivided using a numeric digit with 0 being hottest and 9 being coolest (e.g. A8, A9, F0, and F1 form a sequence from hotter to cooler). For example Sun is the star of spectral class G2.

Now students explore the spectrum of the Sun and spectra of different stellar classes and fill the worksheet table.

Spectral class/Elements	**Temperature, K**	**Ionised helium**	**Helium**	**Hydrogen**	**Ionized metals**	**Metals**	**Molecules**
G2 (Sun)	5830			+	+	+	

O5	42800	x	x				
B5	15400		x	x	x		
A5	8160			x	x		
F5	6530			x	x	x	
G5	5680			x	x	x	
K5	4340					x	x
M5	3030						x

Activity 2:

Teacher shows to students the digital picture of real stellar spectra.

Teacher explains that stars are made mostly of hydrogen and helium but absorption lines of these elements are not always visible in spectra because of different temperature and different pressure in stellar atmospheres.

Using their knowledge of chemistry and physics students must explain why the lines of ionised metals are observed at higher temperatures than the lines of metals themselves and why molecular lines are present only in coldest stars.

Expected answers: At higher temperature atoms of metals start to lose electrons and become ionised. Only in the atmospheres of the coldest stars temperature is low enough that atoms can combine into molecules.

Assessment:

Questions for students:

1. O5 spectral class star has only helium absorption lines. Is hydrogen there? Yes.

2. K5 spectral class star has no helium and no hydrogen absorption lines. Are hydrogen and helium there? Yes.

3. B5 spectral class star has no metal absorption lines. Are metals there? Most probably.

4. What is the temperature of the Sun's atmosphere? 5830 K.

5. Sun has no molecule absorption lines in the spectrum. Are molecules there? No, temperature is too high.

Further Activities:

You may continue with the *Evolution of Stars*. *Activity 5*.

Background Material/Knowledge:

Stellar Classification. https://en.wikipedia.org/wiki/Stellar_classification