Three Types of Spectra

Evolution of Stars. Activity 3

Classroom Activity

Overview

Age Range:

14 – 17 years

Prep. Time:

Zero, if Activity 2 is done before

Activity Time:

20 min

Cost per activity:

Printing of student's worksheets

Includes the use of:

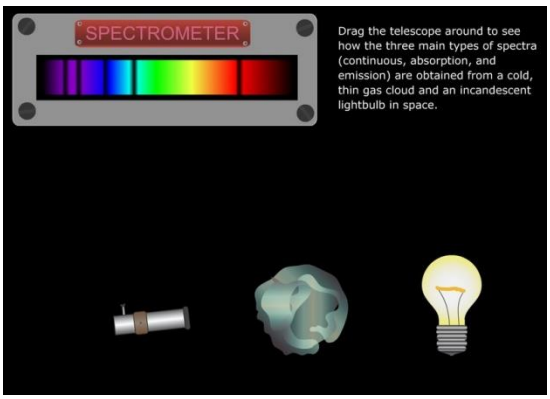
Computer for each group of students

Outline

By using a computer animation students explore different types of spectra. Later they explore the spectrum of the Sun.

Pupils will Learn:

- That there are three types of spectra: continuous, emission and absorption spectrum.
- Which chemical elements are present in the atmosphere of the Sun.



Screenshot of the animation used for this activity

Lesson Plan:

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

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	7 min	Students work with the animation *Light & Spectra/Three Views Spectrum Demonstrator* and fill the worksheet
Assessment	3 min	Students answer the questions
Activity 2	5 min	Students examine the picture of the *Solar Spectrum*, fill the worksheet and discuss results with the teacher.

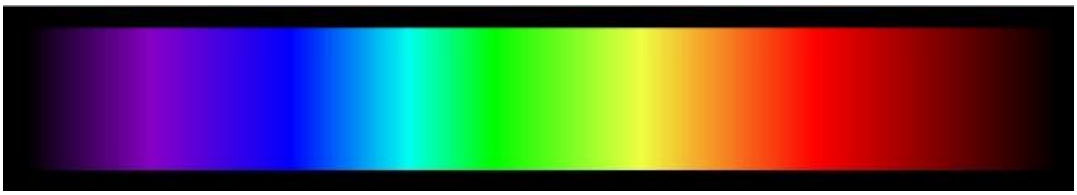
Introduction to the subject:

The purpose of this activity is to introduce students how spectra are used in astronomy and what they can tell about our nearest star - the Sun.

Activity 1:

Students work with the animation *Light & Spectra/Three Views Spectrum Demonstrator*.

1. If the telescope is pointed to the light source (incandescent light bulb), continuous spectrum is visible. Continuous spectrum is created when the light is emitted by atoms of glowing solid filament. The emissions from a heated solid come from individual atoms and interactions between atoms of the solid. There are many modes for atomic interactions and in total they produce the continuous spectrum of emission.

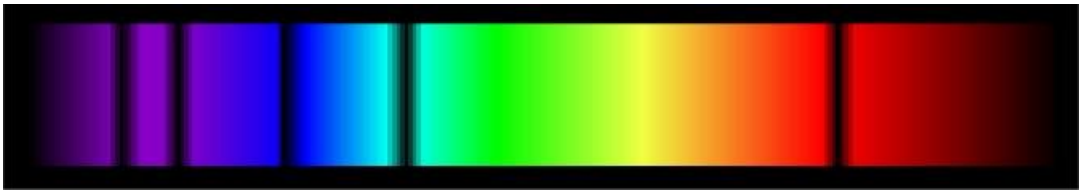


Screenshot of the animation used for this activity

2. It the telescope is pointed to the cold, thin gas cloud, emission spectrum is visible. Emission spectrum is created when an atom or molecule makes a transition from a high energy state to a lower energy state. Each transition has a specific wavelength and each element's emission spectrum is unique. Therefore, emission spectrum can be used to identify the elements.

Screenshot of the animation used for this activity

3. If the telescope is pointed so that light goes through the gas cloud, absorption spectrum is visible. Absorption spectrum is determined by the chemical composition of the gas cloud and can be used to identify the elements. Radiation is absorbed at frequencies that match the energy difference between two energy states of atoms. The absorption manifests itself as a dark absorption line over the continuous spectrum. Absorption spectrum is typically composed of many absorption lines.



Screenshot of the animation used for this activity

Assessment:

Questions for students.

1. If we consider a star just being a heated body, what kind of spectrum it would emit? Continuous spectrum.

2. Let's take into account that star is encircled by the envelope of colder gas (stellar atmosphere). What kind of spectrum we can expect then? Absorption spectrum.

3. Sometimes there are clouds of hot, glowing gas around the star. What kind of spectra we can expect from them? Emission spectrum.

Activity 2:

Students examine the digital picture of the *Solar spectrum* provided by the teacher, write down the wavelengths of different absorption lines to the table, answer the questions and discuss the results with the teacher.

Table

Designation	**Element**	**Wavelength, nm**
A	Oxygen	759
B	Oxygen	687
C	Hydrogen	656
D	Sodium	589
E	Iron	527

F	Hydrogen	486
G	Calcium and iron	431
H	Calcium	397
K	Calcium	393

Questions for students.

1. Name the chemical elements that produce these absorption lines! Hydrogen, oxygen, sodium, calcium, iron.

2. How do you think, in which part of the Sun are these chemical elements placed? In solar atmosphere, because stellar atmosphere is a thin envelope of gas that is colder than the internal layers of the star.

Further Activities:

You may continue with the *Evolution of Stars*. *Activity 4*.

Background Material/Knowledge:

Continuous spectrum. https://en.wikipedia.org/wiki/Black-body_radiation

Emission spectrum. https://en.wikipedia.org/wiki/Emission_spectrum

Absorption spectrum. https://en.wikipedia.org/wiki/Absorption_spectroscopy