Stellar Fingerprinting

Lessons for Grades 9-12, Astronomy

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# OVERVIEW & PURPOSE

We will utilize prior knowledge of spectroscopy to understand the spectral class, chemical composition, surface temperature, mass, density, and relative movement of stars.

# EDUCATION STANDARDS

# Chapter 112. Texas Essential Knowledge and Skills for Science Subchapter C. High School

2 (I) use astronomical technology such as telescopes, binoculars, sextants, computers, and software.

5 (B) observe and record the apparent movement of the Moon, planets, and stars in the nighttime sky

6 (C) examine the scale, size, and distance of the stars, Milky Way, and other galaxies through the use of data and modeling

11 (F) relate the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; and

11 (G) use the Hertzsprung-Russell diagram to plot and examine the life cycle of stars from birth to death.

# OBJECTIVES

1. Describe the observations necessary for the determination of basic physical properties of stars, such as mass, temperature, luminosity, chemical composition, sizes, and motions.
2. Describe how spectroscopic analysis provides information about the chemical composition of celestial objects and indicate for which part of the object the information is valid.
3. Explain the classification of stars according to their spectra and their luminosity
4. Describe the H-R diagram and its usefulness for displaying physical properties

of stars and in expanding our knowledge about stellar sizes and distances.

1. State the Stefan-Boltzmann law and Wien’s law and explain their meaning in the context of blackbody radiation and temperature determination.
2. Describe the evidence for the particle nature of light and indicate how the energy per photon is related to the wavelength and frequency in the wave model

# MATERIALS NEEDED\*

**Flame test lab**

**Purpose- In this lab, we observe the color of the flame given off by various elements.**

1. Salts:

Sodium chloride (NaCl), lithium chloride (LiCl), Potassium chloride (KCl), Calcium chloride (CaCl2), Barium chloride (BaCl2), Copper sulfate (CuSO4), and lead nitrate (Pb(NO3)2).

1. Bunsen burner
2. Clean wire loops
3. Spectroscopes

**Spectroscopy lab**

**Purpose: To use a spectroscope to observe the light given off by various light sources and use the spectroscope to analyze an unknown star by its emission line spectrum.**

1. 7 color pencils (V-I-B-G-Y-O-R)
2. Light sources from the flame test
3. Spectroscope
4. Data table (Emission line spectra table/chart)

*(\*Note- Materials needed by students to perform the test in the lab – not a requirement for the attendees)*

# VERIFICATION

*Steps to check for student understanding*

1. Prior knowledge questions.
2. Activity (find the name and the composition of unknown star)
3. Post knowledge questions and feedback.

# ACTIVITY

*Activity that will reinforce the lesson*

5 min

Self-introduction and an ice breaker activity

15 min

Background of spectroscopy, spectral classification, history, equations and advancements. (a brief description using PowerPoint slides, video clips and discussion jam board)

10 min

Lab practice

Pre-recorded lab sessions (flame test and spectral analysis) completed by high school students

10min

Small self-study activity (data table and spectral chart - provided online) to identify an unknown star.

5min

Questions and feedback.