

CosmoVerse Adventures:
Expansion of the universe: Cosmic Redshift
Lesson Plan

Grade/ Grade Band:	Topic: Expansion of the universe: Cosmic Redshift	Lesson # ____ in a series of ____ lessons
Brief Lesson Description: This lesson aims to explore the fascinating concept of cosmic redshift and its implications for understanding the expanding universe. Engage in interactive activities and discussions that unravel the mysteries of light, motion, and the fabric of space.		
Specific Learning Outcomes: By the end of the lesson, students will be able to: (1) Understand and articulate what cosmic redshift is. (2) Describe how observations of redshift support the theory of the expanding universe (3) Interpret spectral lines and identify redshift in astronomical data.		
Narrative / Background Information		
Prior Student Knowledge: Students should have a basic understanding of: • Basic Understanding of Light and Waves: including an understanding of wavelength and frequency. • Fundamental Astronomy Concepts: Such as the nature of galaxies, stars, and the structure of the universe.		
Materials needed: • A compact disc (CD) • A cardboard tube that's at least 12 inches long (approximately 30 centimeters) and 3 to 4 inches (7.5 to 10 centimeters) in diameter • Two covers for the cardboard tube—we suggest two flat pieces of cardboard large enough to cover each end of the tube, or you can also use the plastic covers that come with a cardboard packing tube. • Razor knife such as an X-ACTO knife • Tape • Access to fluorescent light • Saw • Cutting guide (scaled for a 3-inch tube)—PDF included • Access to a printer		
LESSON PLAN – 5-E Model		
ENGAGE: To capture students' interest and connect their prior knowledge to the concept of cosmic redshift Activity: Play the sound of a siren from a speeding ambulance fade in and then out. Discussion: (1) What happens to the sound of a siren as an ambulance drives past you, and why does this change occur? (2) If we think of light as a wave, what do you think happens to the light from a star or galaxy as it moves away from us? (3) Have you ever heard of the universe expanding? What do you think this means for the light coming from distant galaxies? (4) Why do you think astronomers are interested in the colour of light coming from distant stars and galaxies?		
EXPLORE: Dive into the main content with the students through the story with Bunsen and Kirchhoff. Activity: Share/Read out the conversation with Bunsen and Kirchhoff. Discussion: (1) How does the movement of galaxies affect the spectral lines we observe from Earth? (2) Can you think of any other applications of spectroscopy in astronomy or other fields? (3) In what ways do the observations of redshift in distant galaxies help us understand the universe's history and future?		
EXPLAIN: Introduce hands-on learning with the Action Lab. Activity: Conduct the "Simple Spectrometer" experiment Discussion: (1) Why do different light sources produce different spectra when observed through the spectrometer? (2) How does this activity help us understand the work of astronomers in analyzing light from celestial bodies? (3) Can you explain how the design of the spectrometer allows us to see the spectrum of light?		
ELABORATE: Reinforce and deepen understanding. Activity: Introduce more complex concepts like the expansion of the universe and its relation to redshift. Discuss: Edwin Hubble's observations and how redshift supports the theory of an expanding universe.		
EVALUATE: Assess students' understanding and ability to apply the concept of cosmic redshift. Activity: Create an assessment that includes problem-solving and critical thinking questions. For instance, present students with a spectrum of light from a distant galaxy and ask them to infer the galaxy's movement based on the redshift observed.		
Homework/Extension: For those eager to dive deeper into this vast expanse, recommend the "Cosmic Library" section (as mentioned in the script) for further reading and exploration. • Utilize online tools where students can manipulate variables to see the effects of redshift in real-time • If possible, invite an astronomer or physicist to talk about their work related to cosmic redshift and the universe's expansion.		