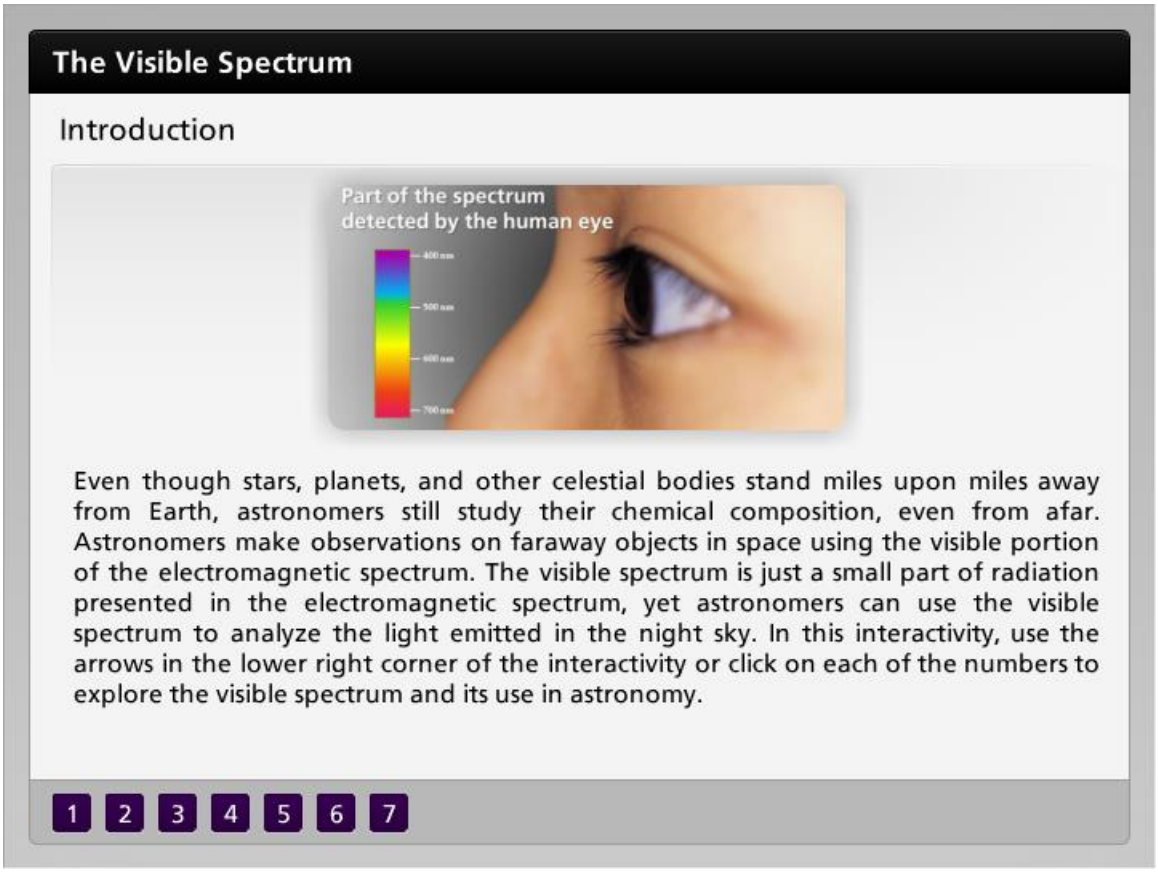
Module 4: Radiation and the Electromagnetic Spectrum
Topic 2: The Visible Spectrum Notes

Introduction



Even though stars, planets, and other celestial bodies stand miles upon miles away from Earth, astronomers still study their chemical composition, even from afar. Astronomers make observations on faraway objects in space using the visible portion of the electromagnetic spectrum. The visible spectrum is just a small part of radiation presented in the electromagnetic spectrum, yet astronomers can use the visible spectrum to analyze the light emitted in the night sky. In this interactivity, use the arrows in the lower right corner of the interactivity or click on each of the numbers to explore the visible spectrum and its use in astronomy.

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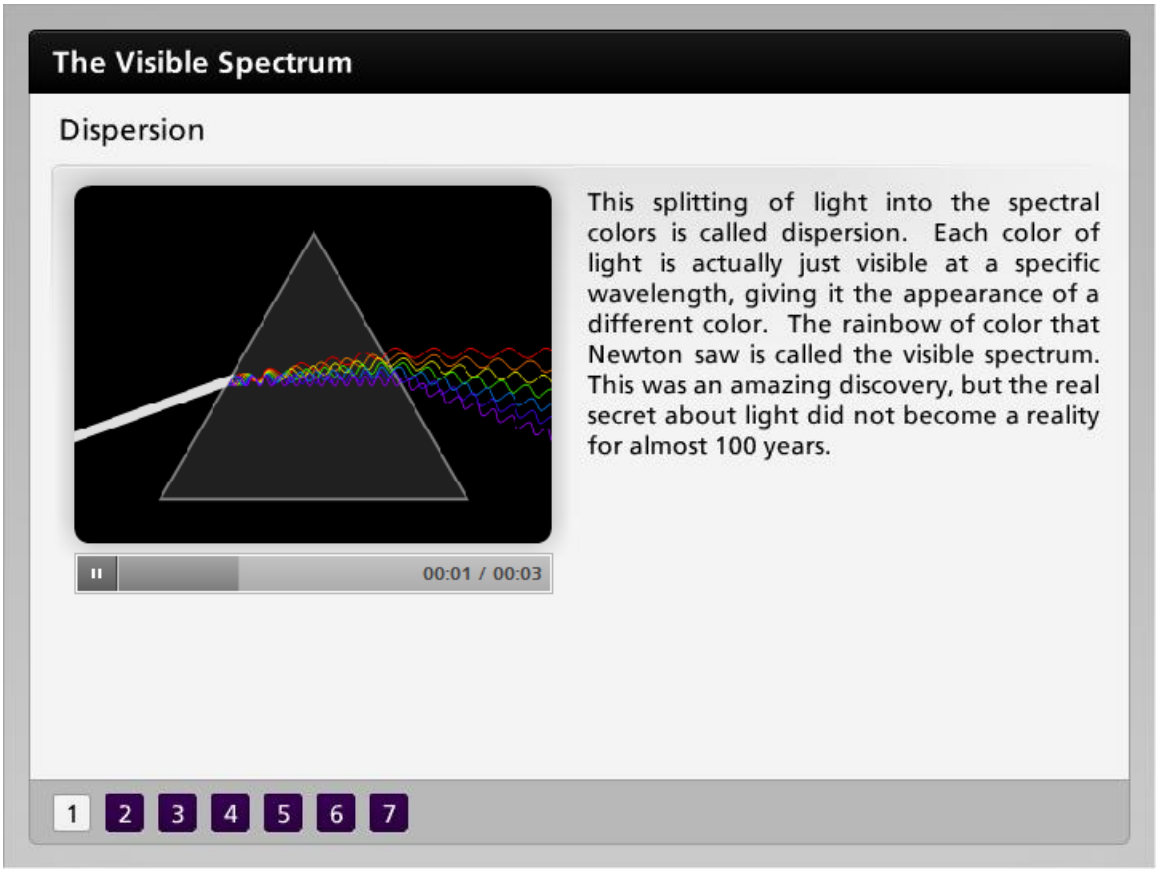
Dispersion



This splitting of light into the spectral colors is called dispersion. Each color of light is actually just visible at a specific wavelength, giving it the appearance of a different color. The rainbow of color that Newton saw is called the visible spectrum. This was an amazing discovery, but the real secret about light did not become a reality for almost 100 years.

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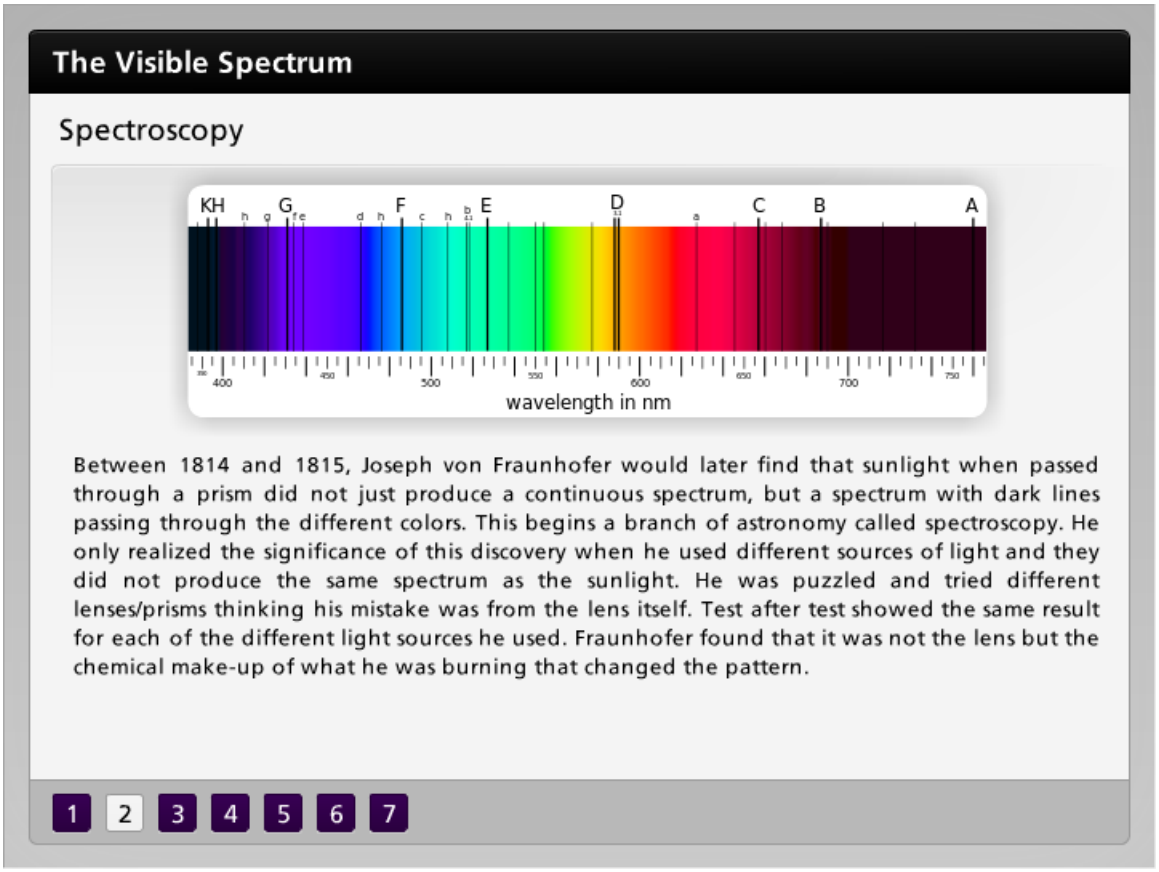
Spectroscopy



Between 1814 and 1815, Joseph von Fraunhofer would later find that sunlight when passed through a prism did not just produce a continuous spectrum, but a spectrum with dark lines passing through the different colors. This begins a branch of astronomy called spectroscopy. He only realized the significance of this discovery when he used different sources of light and they did not produce the same spectrum as the sunlight. He was puzzled and tried different lenses/prisms thinking his mistake was from the lens itself. Test after test showed the same result for each of the different light sources he used. Fraunhofer found that it was not the lens but the chemical make-up of what he was burning that changed the pattern.

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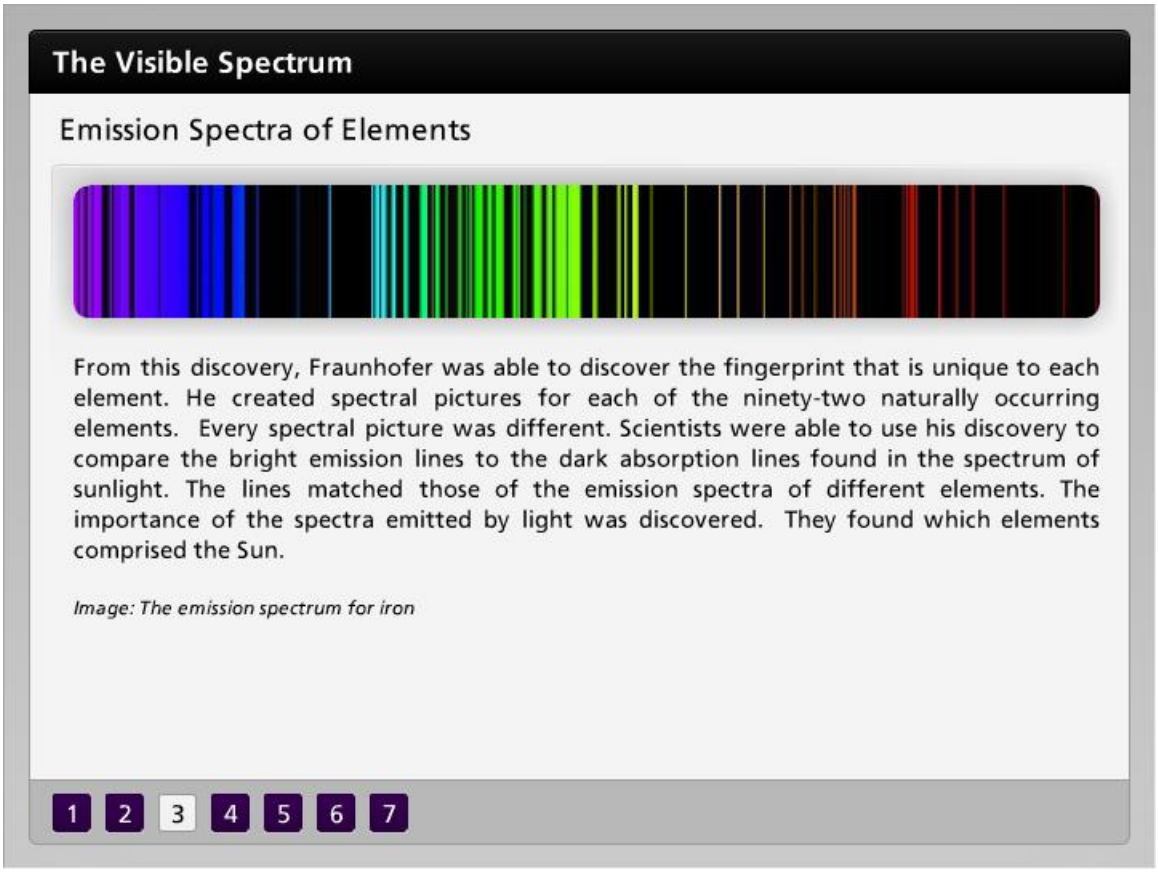
Emission Spectra of Elements



From this discovery, Fraunhofer was able to discover the fingerprint that is unique to each element. He created spectral pictures for each of the ninety-two naturally occurring elements. Every spectral picture was different. Scientists were able to use his discovery to compare the bright emission lines to the dark absorption lines found in the spectrum of sunlight. The lines matched those of the emission spectra of different elements. The importance of the spectra emitted by light was discovered. They found which elements comprised the Sun.

Image: The emission spectrum for iron

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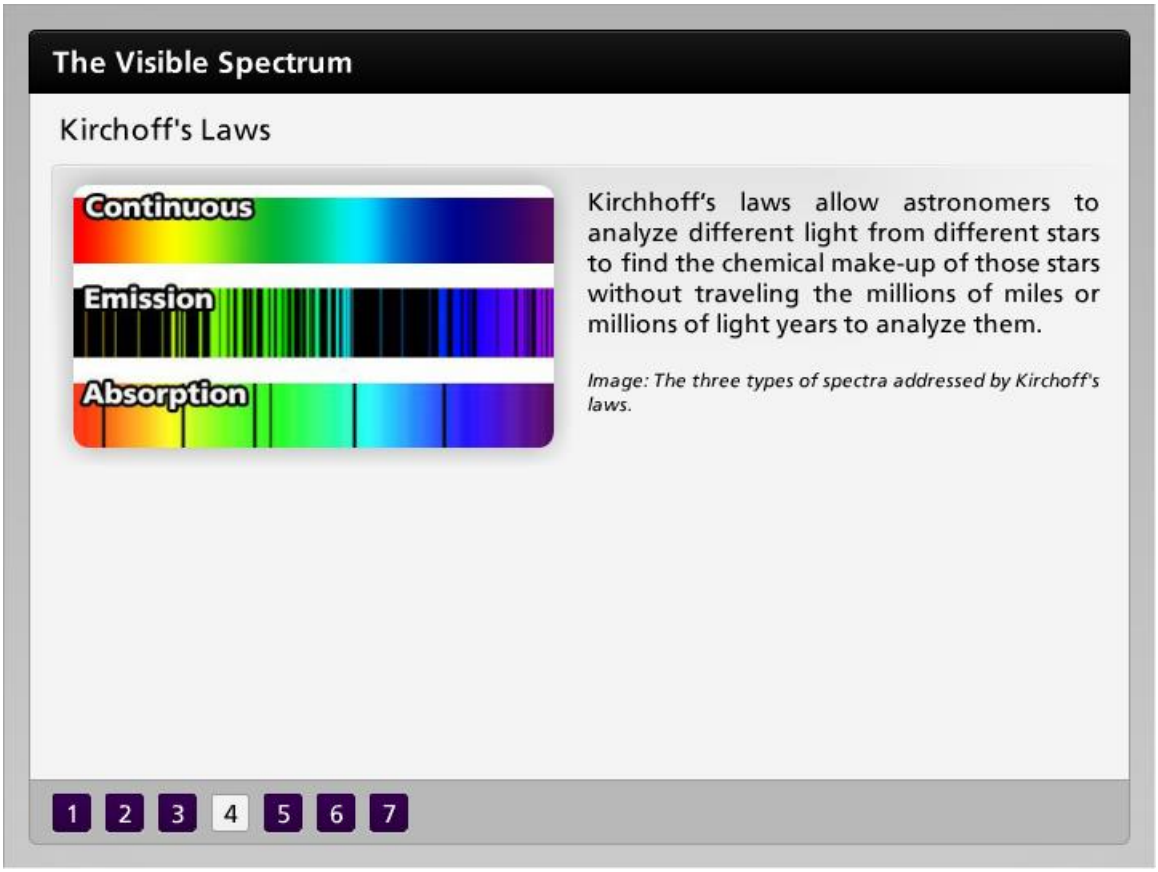
Kirchoff's Laws



Kirchhoff's laws allow astronomers to analyze different light from different stars to find the chemical make-up of those stars without traveling the millions of miles or millions of light years to analyze them.

Image: The three types of spectra addressed by Kirchoff's laws.

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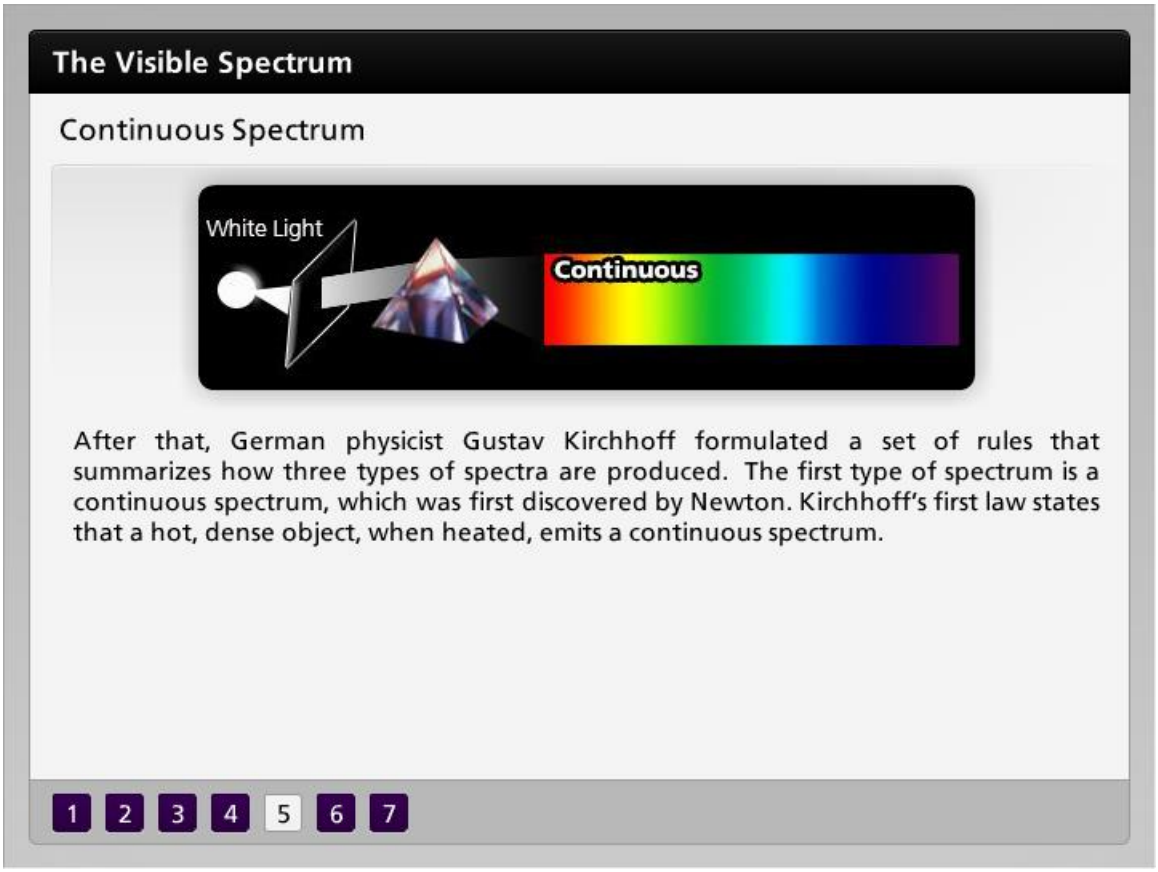
Continuous Spectrum



After that, German physicist Gustav Kirchhoff formulated a set of rules that summarizes how three types of spectra are produced. The first type of spectrum is a continuous spectrum, which was first discovered by Newton. Kirchhoff's first law states that a hot, dense object, when heated, emits a continuous spectrum.

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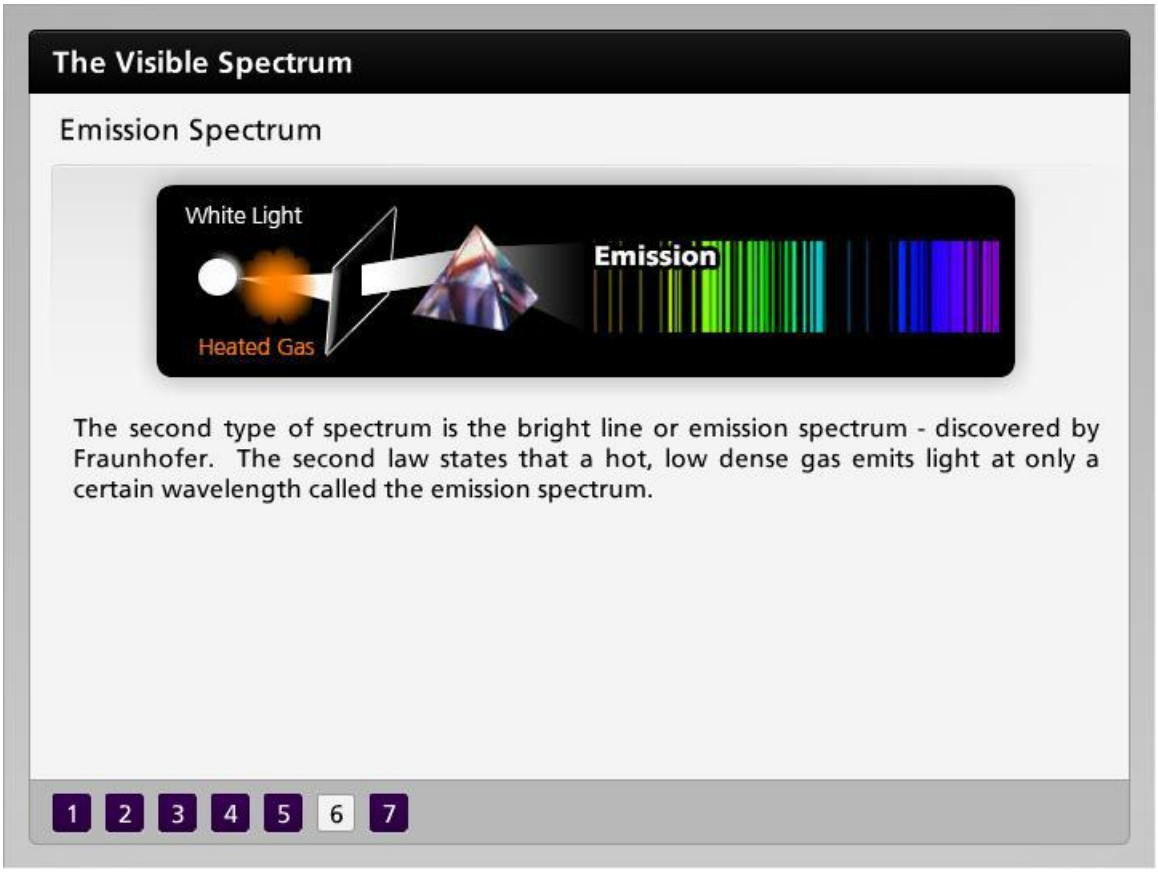
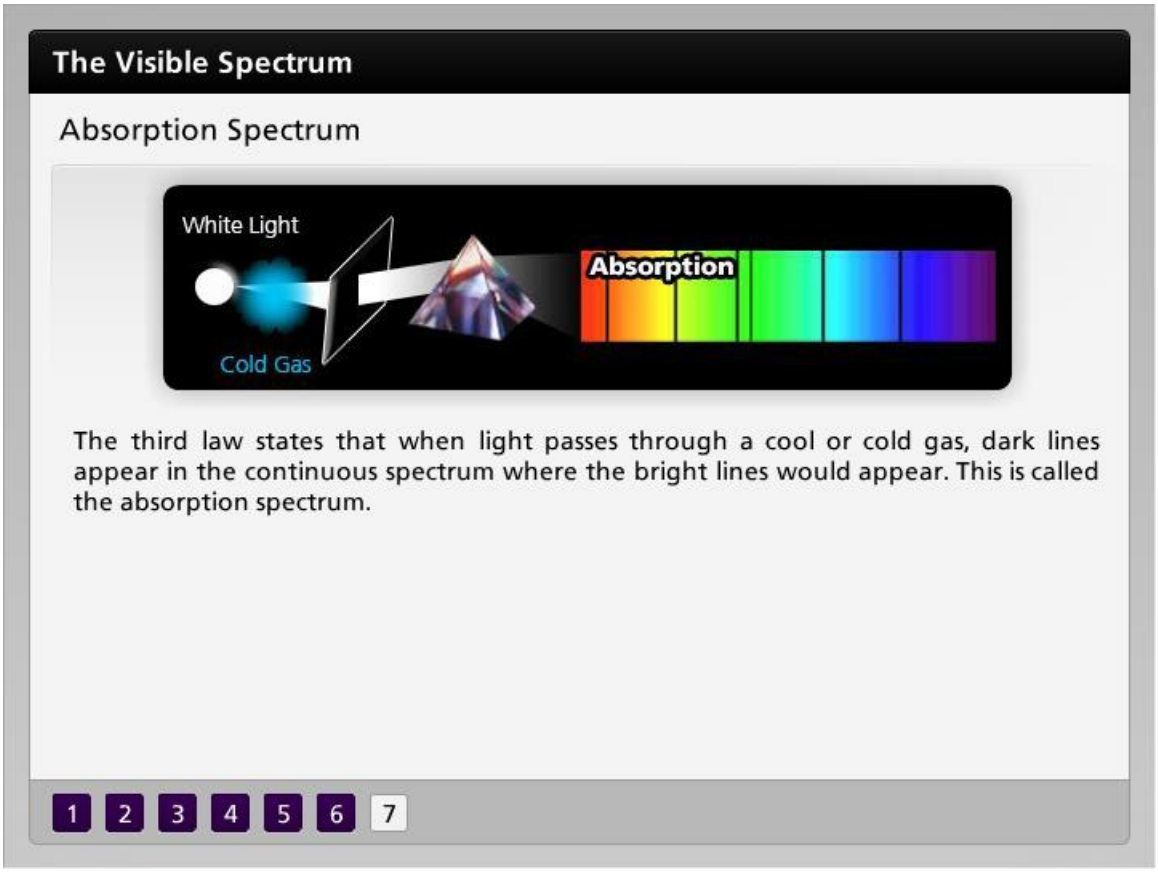
Emission Spectrum



The second type of spectrum is the bright line or emission spectrum - discovered by Fraunhofer. The second law states that a hot, low dense gas emits light at only a certain wavelength called the emission spectrum.

Absorption Spectrum



The third law states that when light passes through a cool or cold gas, dark lines appear in the continuous spectrum where the bright lines would appear. This is called the absorption spectrum.