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### Absorption

The process by which light transfers its energy to matter. For example, a gas cloud can absorb starlight that passes through it. After the starlight passes through the cloud, dark lines called absorption lines appear in the star's continuous spectrum at wavelengths corresponding to the light-absorbing elements.

### Absorption Line

A dark line in a continuous spectrum caused by absorption of light. Each chemical element emits and absorbs radiated energy at specific wavelengths, making it possible to identify the elements present in the atmosphere of a star or other celestial body by analyzing which absorption lines are present.

### Blueshift

The shortening of a light wave from an object moving toward an observer. For example, when a star is traveling toward Earth, its light appears bluer.

### Color

The visual perception of light that enables human eyes to differentiate between wavelengths of the visible spectrum, with the longest wavelengths appearing red and the shortest appearing blue or violet.

### Cosmic Rays

High-energy atomic particles that travel through space at speeds close to the speed of light; also known as cosmic-ray particles.

### Doppler Effect

The change in the wavelength of sound or light waves caused when the object emitting the waves moves toward or away from the observer; also called Doppler Shift. In sound, the Doppler Effect causes a shift in sound frequency or pitch (for example, the change in pitch noted as an ambulance passes). In light, an object's visible color is altered and its

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spectrum is shifted toward the blue region of the spectrum for objects moving toward the observer and toward the red for objects moving away.

### Electromagnetic Radiation

A form of energy that propagates through space as vibrations of electric and magnetic fields; also called radiation or light. All electromagnetic radiation is a form of light.

### Electromagnetic Spectrum

The entire range of wavelengths of electromagnetic radiation, including radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays.

### Emission Line

A bright line in a spectrum caused by emission of light. Each chemical element emits and absorbs radiated energy at specific wavelengths. The collection of emission lines in a spectrum corresponds to the chemical elements contained in a celestial object.

### Far-Infrared Spectrum

The region of the infrared spectrum that exhibits the longest wavelengths and the lowest frequencies and energies.

### Frequency

Describes the number of wave crests passing by a fixed point in a given time period (usually one second). Frequency is measured in Hertz (Hz).

### GRB990123

One of the most energetic gamma-ray bursts (GRBs) ever detected, occurring at 4:47 a.m. EST, January 23, 1999. The "burst" equaled the power of nearly 10 million billion suns. It became the first GRB to be viewed simultaneously in both gamma-ray and optical wavelengths.

### Gamma-Ray Burst (GRB)

A brief, intense, and powerful burst of gamma rays, the highest-energy, shortest-wavelength radiation in the electromagnetic spectrum. These bursts emanate from distant sources outside our galaxy and last only a few seconds. They are the brightest and most energetic explosions known.

### Gamma Rays

Light with the shortest wavelengths and the highest energies and frequencies in the electromagnetic spectrum; also called

gamma radiation.

### **Gravitational Redshift**

The reddening of light from a very massive object caused by photons escaping and traveling away from the object's strong gravitational field. An example of gravitational redshift is light escaping from the surface of a neutron star.

### **Infrared**

Radiation that has longer wavelengths and lower frequencies and energies than visible light.

### **Invisible Radiation**

Radiation that the eye cannot detect, such as gamma rays, radio waves, ultraviolet light, and X-rays.

### **Near-Infrared**

The region of the infrared spectrum that is closest to visible light. Near-infrared light has slightly longer wavelengths and slightly lower frequencies and energies than visible light.

### **Radiation**

The process by which electromagnetic energy moves through space as vibrations in electric and magnetic fields. This term also refers to radiant energy and other forms of electromagnetic radiation, such as gamma rays and X-rays.

### **Radio Waves**

Radiation with the longest wavelengths and smallest frequencies and energies in the electromagnetic spectrum.

### **Redshift**

The lengthening of a light wave from an object that is moving away from an observer. For example, when a galaxy is traveling away from Earth, its light shifts to the red end of the electromagnetic spectrum.

### **Spectral Line**

In a spectrum, an emission (bright) or absorption (dark) at a specific frequency or wavelength.

### **Spectrograph (Spectrometer)**

An instrument that spreads electromagnetic radiation into its component frequencies and wavelengths for detailed study. A spectrograph is similar to a prism, which spreads white light into a continuous rainbow.

### Spectroscopy

The study and interpretation of a celestial object's electromagnetic spectrum. A spectrograph or spectrometer is used to analyze an object's electromagnetic spectrum.

### Sprites

Gamma-ray flashes produced in Earth's atmosphere by severe lightning storms and upper atmospheric events.

### Ultraviolet (UV)

Electromagnetic radiation with shorter wavelengths and higher energies and frequencies than visible light. UV light is lower in frequency than X-rays.

### Visible Light

The part of the electromagnetic spectrum that human eyes can detect; also known as the visible spectrum. The colors of visible light are red, orange, yellow, green, blue, and violet, along with various combinations and shades of these colors. Within the visible part of the spectrum, red light has a longer wavelength than blue light.

### Wave

A vibration in some media that transfers energy from one place to another. Sound waves are vibrations passing in air. Light waves are vibrations in electromagnetic fields.

### Wavelength

The distance between two wave crests. Radio waves can have lengths of several feet; the wavelengths of X-rays are roughly the size of atoms.

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