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REDSHIFT ACTIVITY FOR NASA'S JAMES WEBB SPACE TELESCOPE

**Abstract**

The James Webb Space Telescope will be the world's premier space science observatory when it launches in 2021. Webb will view the universe in infrared, a slightly longer wavelength light compared to visible light. In order to study the first visible light in the universe, emitted by the first galaxies formed after the Big Bang, you need to look in the infrared today. What started as visible light from these first galaxies has been traveling through an expanding universe for billions of years – expanding and stretching the light's wavelength beyond the visible into the infrared spectrum, in a process called redshifting.

The Webb outreach team designed and developed a “Redshift Activity” to explain how light from the past can be seen by Webb. The activity consists of two sheets of paper and an elastic band. The first piece of paper shows examples of waves of light of different lengths, and the second piece of paper shows how a single wave of light would be stretched by traveling through space for specific amounts of time. The piece of elastic has a blue light wave on it, but can be stretched to show how blue light can stretch over time to line up to the wavelength from 13.5 billion years ago.

For the Redshift activity, the staffer starts by explaining how visible light travels through space in waves along the electromagnetic spectrum, using the wave examples and elastic band to demonstrate. Then, the staffer physically stretches the piece of elastic to show how visible light traveling through an expanding universe can be stretched or redshifted over time into the infrared. The staffer then finishes the activity by explaining how Webb is optimized for the infrared and why it will see 13.5 billion years into the past and the first light after the Big Bang.

The Webb Outreach Team created this activity in summer 2018 and targeted a general public audience to explain the concept of redshift, how Webb will view the universe, and what the telescope hopes to discover. The activity has been successfully used at outreach events in Colorado, New York, New Mexico and Maryland. Children and adults have appreciated the visual and interactive activity and the numerous follow-up questions indicate enthusiasm and increased understanding. The activity effectively introduces a very complex concept of astrophysics and visually explains it for a wide audience to grasp and understand.