

Rubric: Evaluate student understanding of how satellite data helps us understand weather.

Goal: Students will learn that electromagnetic radiation, including light and radio waves, bends when it passes through substances with different densities.

Ask students to explain how the bending of light tells them something about the air in each of the following situations:

- when the Sun looks like a squished oval instead of a circle at sunset or sunrise
- when the pavement in the distance appears to shimmer and looks like a silvery puddle of water on a hot summer day
- when stars twinkle at night

Situations	4 Advanced	3 Proficient	2 Partially Proficient	1 Novice
when the Sun looks like a squished oval instead of a circle at sunset or sunrise	<p>Explanations are complete and insightful.</p> <p><i>Light from the Sun travels through the largest amount of atmosphere at sunset and sunrise and the atmosphere is more dense near-ground, so the light undergoes maximum refraction near the ground compared with the less dense air higher in the sky. Because light from the Sun is traveling through these different air densities, the Sun will appear to be flattened as it approaches the horizon at</i></p>	<p>Explanations are complete and reasonable.</p> <p><i>The light from the bottom of the Sun is passing through lower and denser layers of the atmosphere than light from the top edge of the Sun, so light from different parts of the Sun is refracted differently and distorts the shape of the Sun.</i></p>	<p>Explanations are obvious.</p> <p><i>During a sunset the light from the Sun has passed through more of the atmosphere at the bottom of the Sun than at the top causing the shape of the Sun to look like a squished oval.</i></p>	<p>Explanation is irrelevant.</p> <p><i>The Sun has seems larger and appears to be darker red at sunrise and sunset.</i></p>

	<i>sunrise and sunset.</i>			
when the pavement in the distance appears to shimmer and looks like a silvery puddle of water on a hot summer day	<p>Explanations are complete and insightful</p> <p><i>In the summer, the warm air from the road rises and the cooler air above the road falls and mixes with the warmer air. When the light from the Sun travels through air of different temperatures and densities at different index of refraction and bends toward our eyes creating this effect.</i></p>	<p>Explanations are complete and reasonable.</p> <p><i>The hot air has a different density and index of refraction than normal, and refracts bright light from the sky towards our eyes, making the pavement appear to have water on it.</i></p>	<p>Explanations are obvious.</p> <p><i>When the light from the Sun hits the pavement and bends, it looks like water on the street.</i></p>	<p>Explanation is irrelevant.</p> <p><i>When pavement in the distance looks like water, this is a mirage.</i></p>
when stars seem to twinkle at night	<p>Explanations are complete and insightful.</p> <p><i>When starlight enters our atmosphere it is affected by winds in the atmosphere and by areas with different temperatures and densities. This causes the light from the star to twinkle when seen from the ground %.</i></p>	<p>Explanations are complete and reasonable.</p> <p><i>Air at different temperatures, with different index of refraction, in various places in our atmosphere moves around, so the path of starlight to our eyes shifts slightly from moment to moment.</i></p>	<p>Explanations are obvious.</p> <p><i>The light from a star passes through the Earth's atmosphere. The atmosphere bends the light causing the star to appear to twinkle.</i></p>	<p>Explanation is irrelevant.</p> <p><i>Twinkle, twinkle, little star, how I wonder what you are...</i></p>