K6.1.3 K6.1.3

K6.1.3 Various Light Scattering

Light scattering is a very interesting phenomenon. Tiny particles can scatter light coming from all directions. This is why small particles like dust look white. The reason milk appears white is because tiny nutritious particles scatter light everywhere in the milk.

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Various Light Scattering

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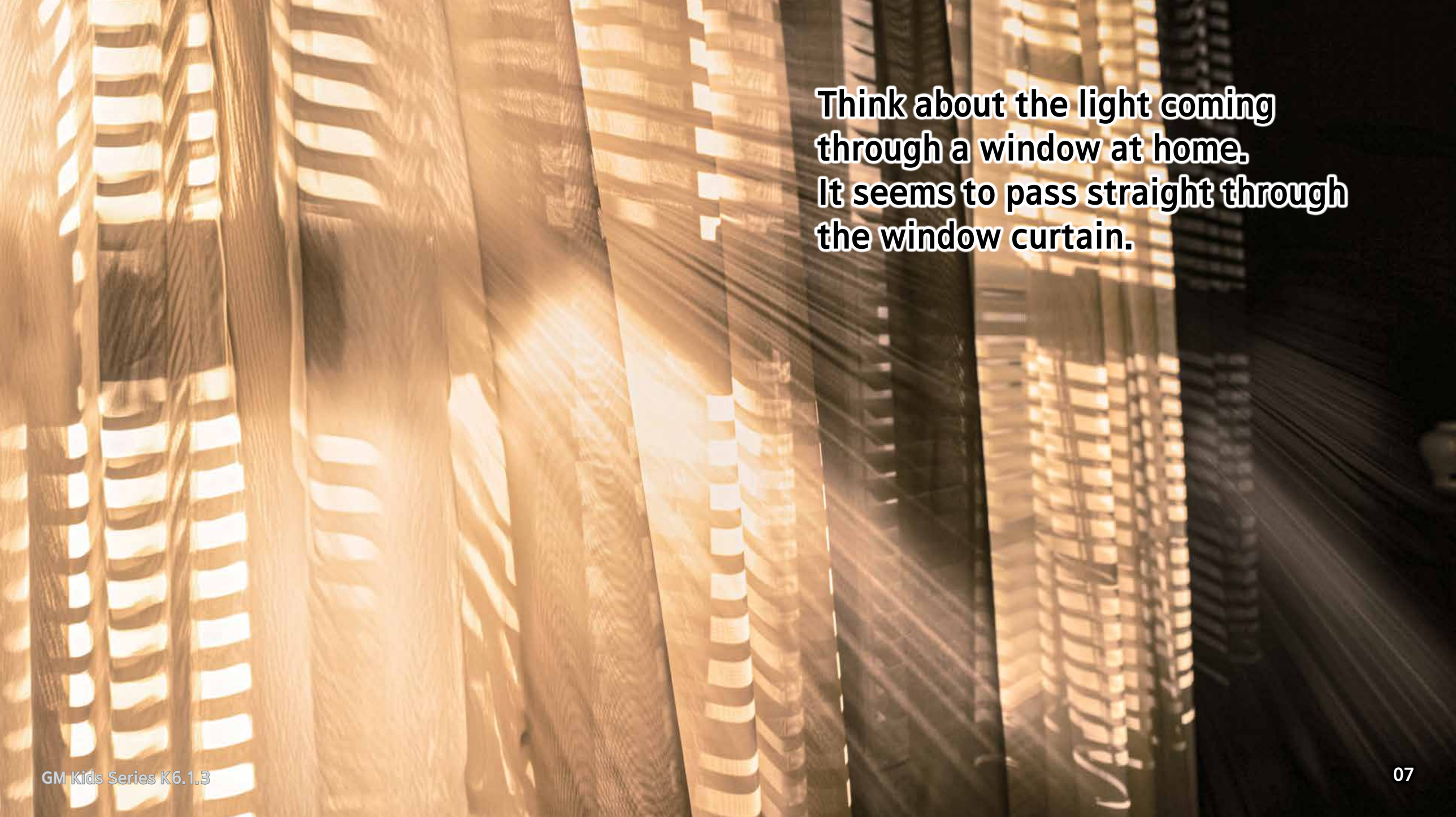
Now, let's move on from living things to non-living things that create structural colors.

Why is milk white? And why is the sky blue?

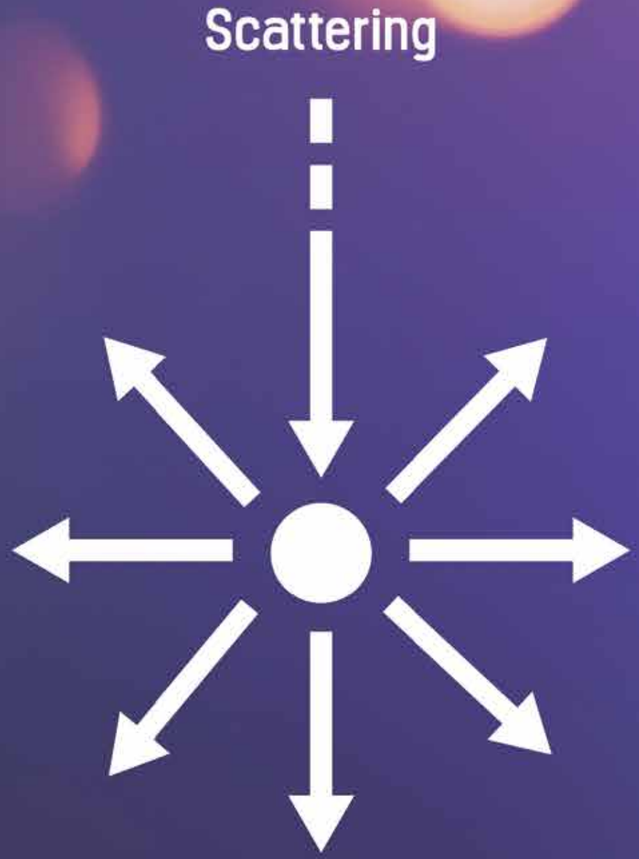

Light scattering happens when light
meets an object and spreads out
in many directions.



Think about the light coming
through a window at home.
It seems to pass straight through
the window curtain.

But because of the tiny streams of light coming through the small holes in the curtain, we can see the tiny dust particles floating in the room.

This is because when light meets the dust, it scatters, and the scattered light is what we see with our eyes.

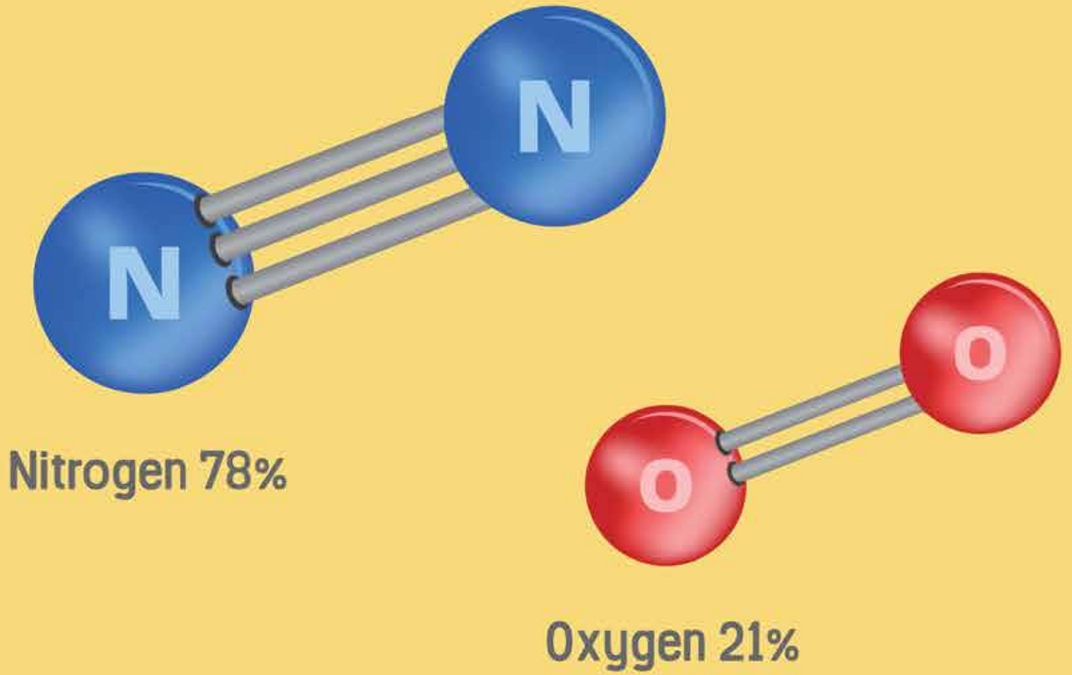



Tiny particles like dust scatter
light evenly from all directions,
making them appear white.

The reason milk appears white is because tiny nutritious particles scatter light everywhere in the milk.

However, if the size of particles is much smaller than the particles in the milk and dust, light scattering can change in a very interesting way.

The air we breathe is made up of nitrogen and oxygen molecules. These molecules are much smaller than dust particles.

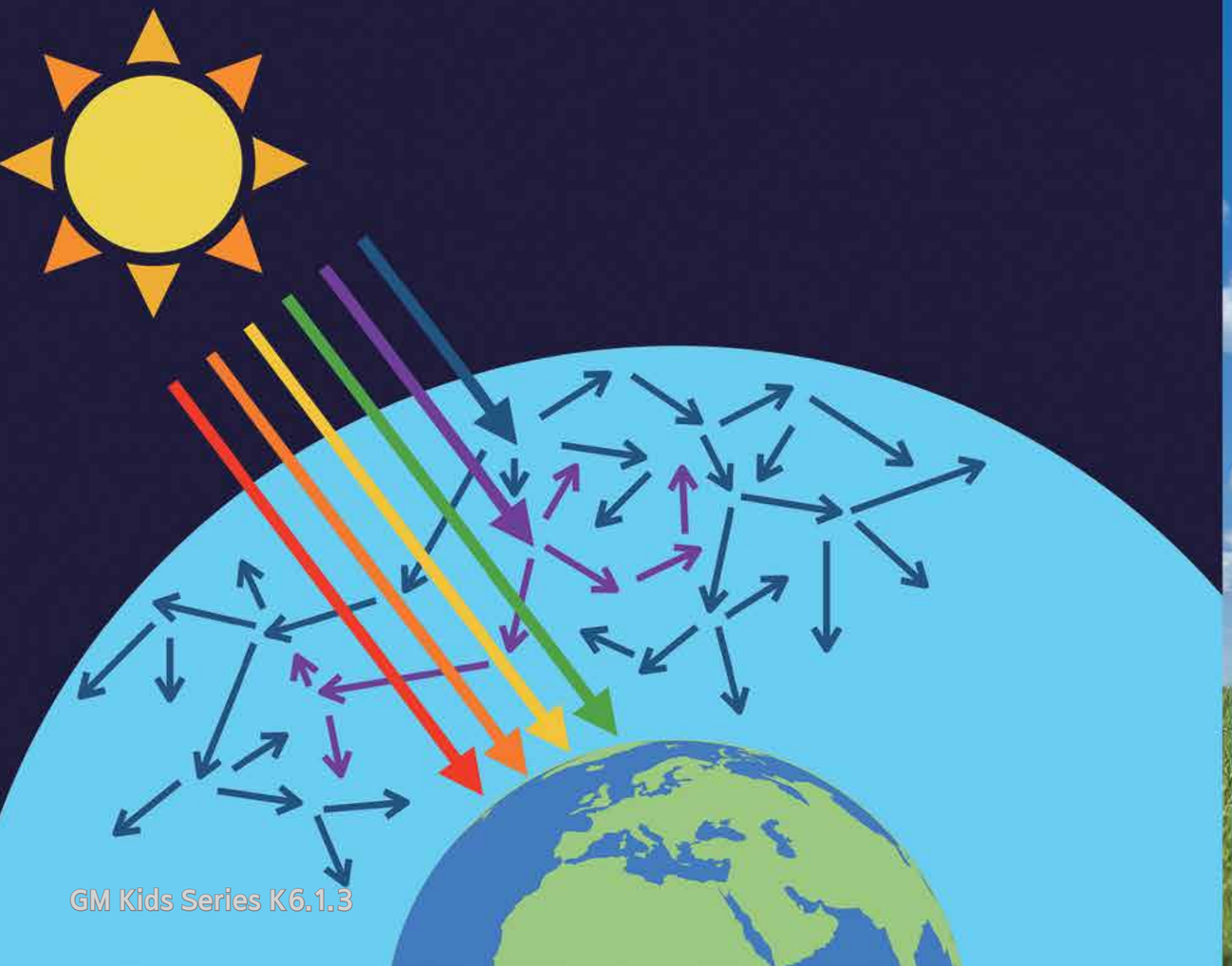


Nitrogen 78%

Oxygen 21%

These tiny molecules scatter certain colors of light and let other colors pass through, depending on how their atoms are arranged.

Air molecules scatter blue light more than other colors.



Therefore, when sunlight enters the atmosphere, only blue light scatters. This is why the sky appears blue to our eyes.

Scattering is a very fascinating phenomenon.

Even substances made up of the same molecules can sometimes cause scattering or not cause scattering depending on the situation. A classic example is water.

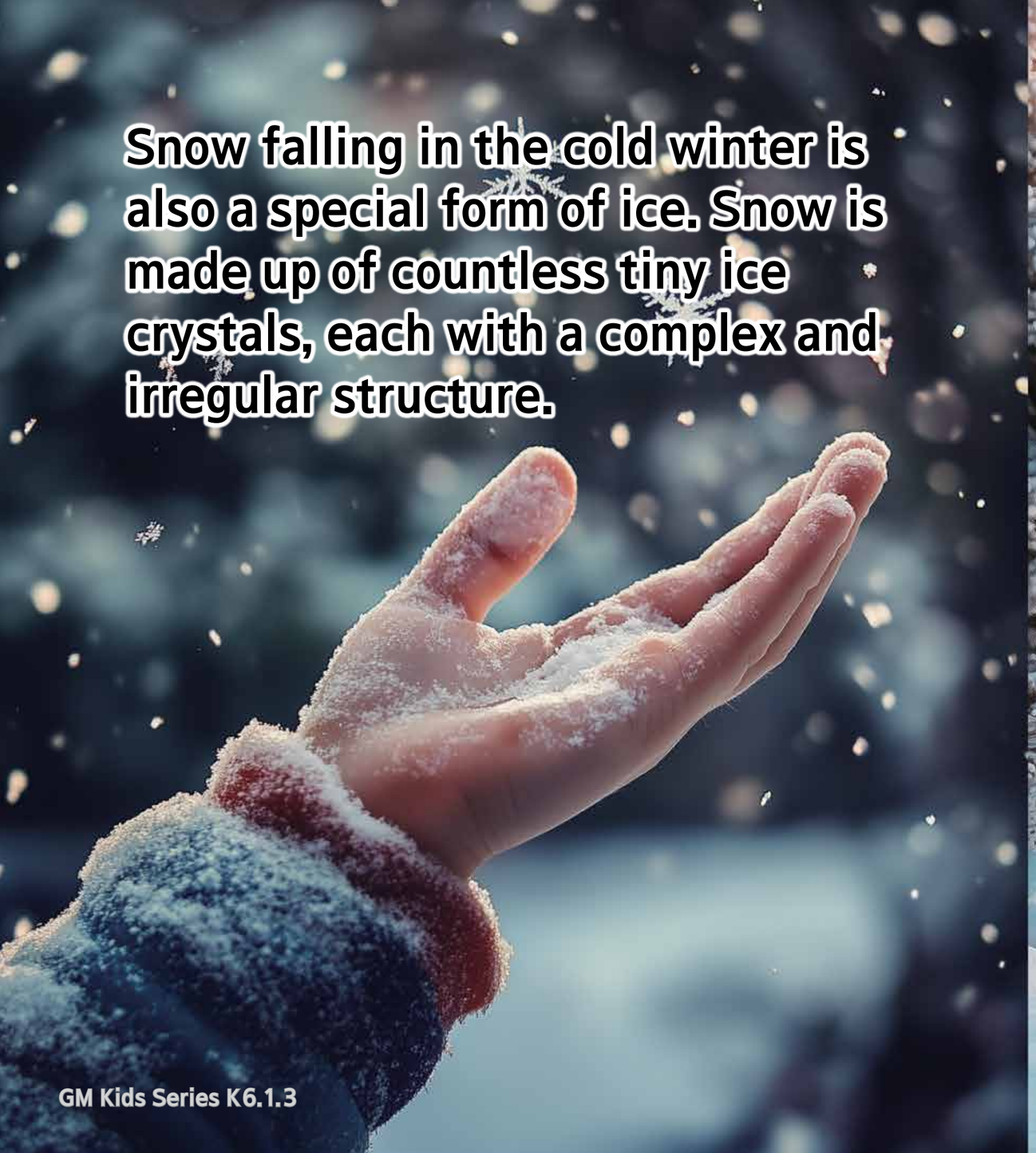
The water we drink is transparent, so light passes through it without scattering. Light passes through water without changing.

However, when water changes into its gaseous state as vapor, it becomes different.

Let's think about clouds made of water vapor. Clouds appear white because they scatter all colors of light.

Then, what happens when water changes into a solid state like ice? Ice is very transparent. However, if air bubbles enter into the middle of the ice, scattering happens, causing it to appear cloudy.

Snow falling in the cold winter is also a special form of ice. Snow is made up of countless tiny ice crystals, each with a complex and irregular structure.



As sunlight enters the snow, it encounters numerous ice crystals. The light is scattered and reflected multiple times as it passes through and bounces off these crystals.

The irregular surfaces and numerous reflections cause the light to scatter in all directions, which make snow appear white.

If water droplets in the atmosphere are very small, light spreads in all directions.

In extreme cases, separated light can mix back together and return to white. This creates a wide and white rainbow.

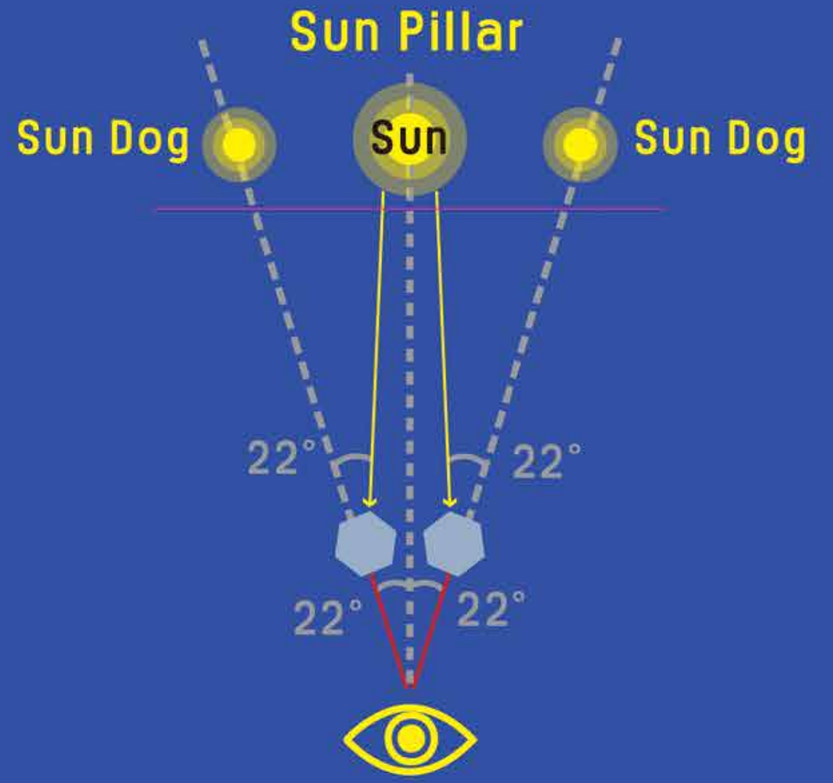
We learned that when the sun is low, the blue color goes away. That is why rainbows look reddish on the inside at that time.
It is like how the sky gets colorful at sunrise and sunset!

Near the surface in cold regions,
we can see a marvelous scene
created by ice crystals and sunlight.

Near the horizon, bright lights
sometimes appear on either side
of the brightly shining sun.
It can look as if three suns have
risen. This event is called a "sun
dog."

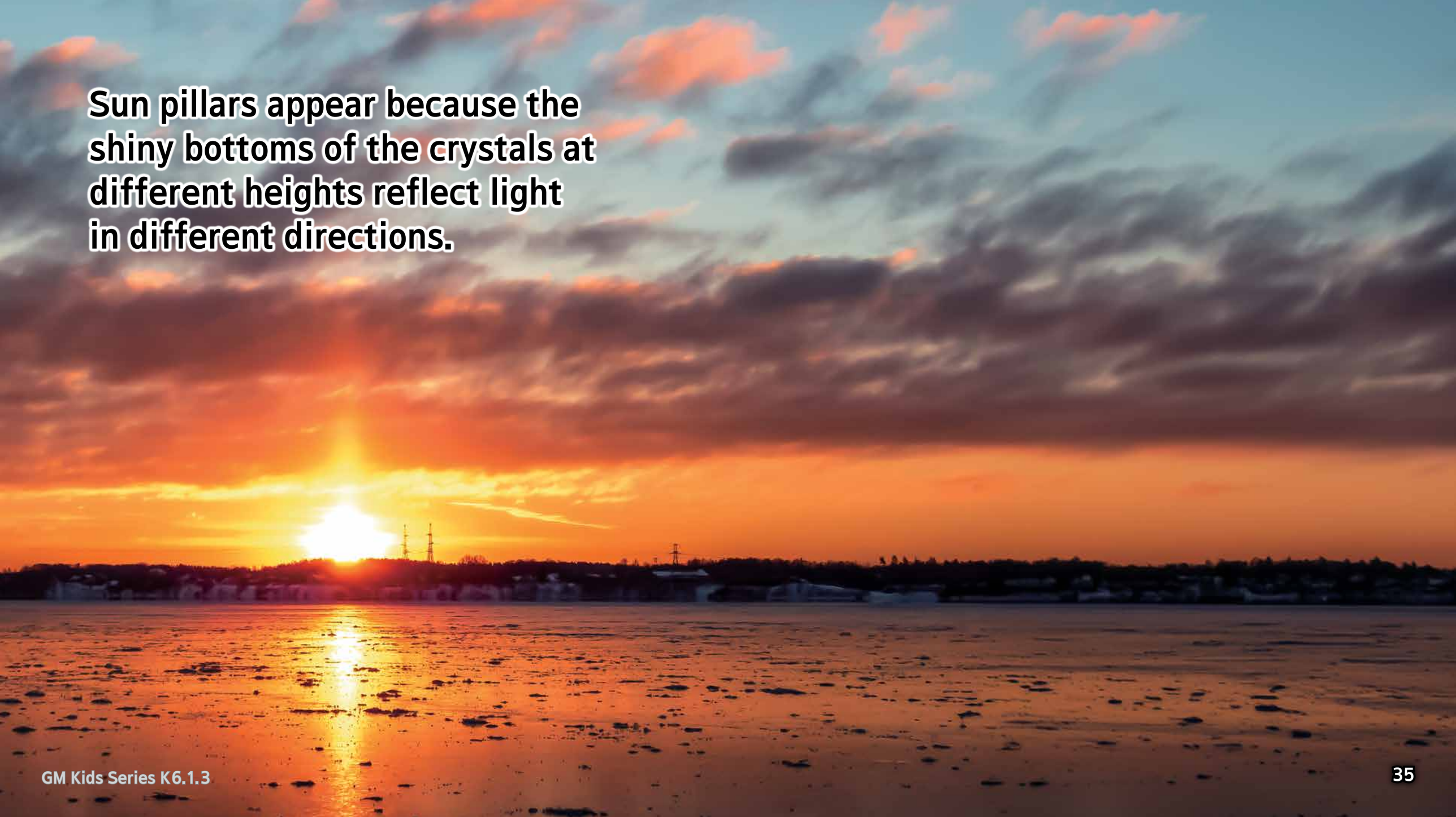
When the temperature drops, ice crystals form inside the clouds in the sky. At this time, the ice crystals often take the shape of hexagonal prisms.

When ice crystals get heavier, they spread out sideways instead of going up. Sunlight goes into the crystals and bends and bounces around inside, then comes out on either side of the sun.



All that light gathers around the sun's edges, making a pretend sun appear.

When a special event called a "sun dog" occurs, sunlight can stretch up and down, making a "sun pillar." Sun pillars are made by ice crystals shaped like six-sided plates.



Sun pillars appear because the shiny bottoms of the crystals at different heights reflect light in different directions.