

LEVELED BOOK • P

Rainbows

MULTI
LEVEL
J•M•P

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Focus Question

How does a rainbow form?

Words to Know

angle
indigo
mediums

optical illusions
reflects
refraction

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Tricks of Light

When the Sun comes out after a rain shower, run outside. You may spot a giant rainbow curving across the sky like a big painting. When sunlight splashes through a window, you might see a small rainbow up close.



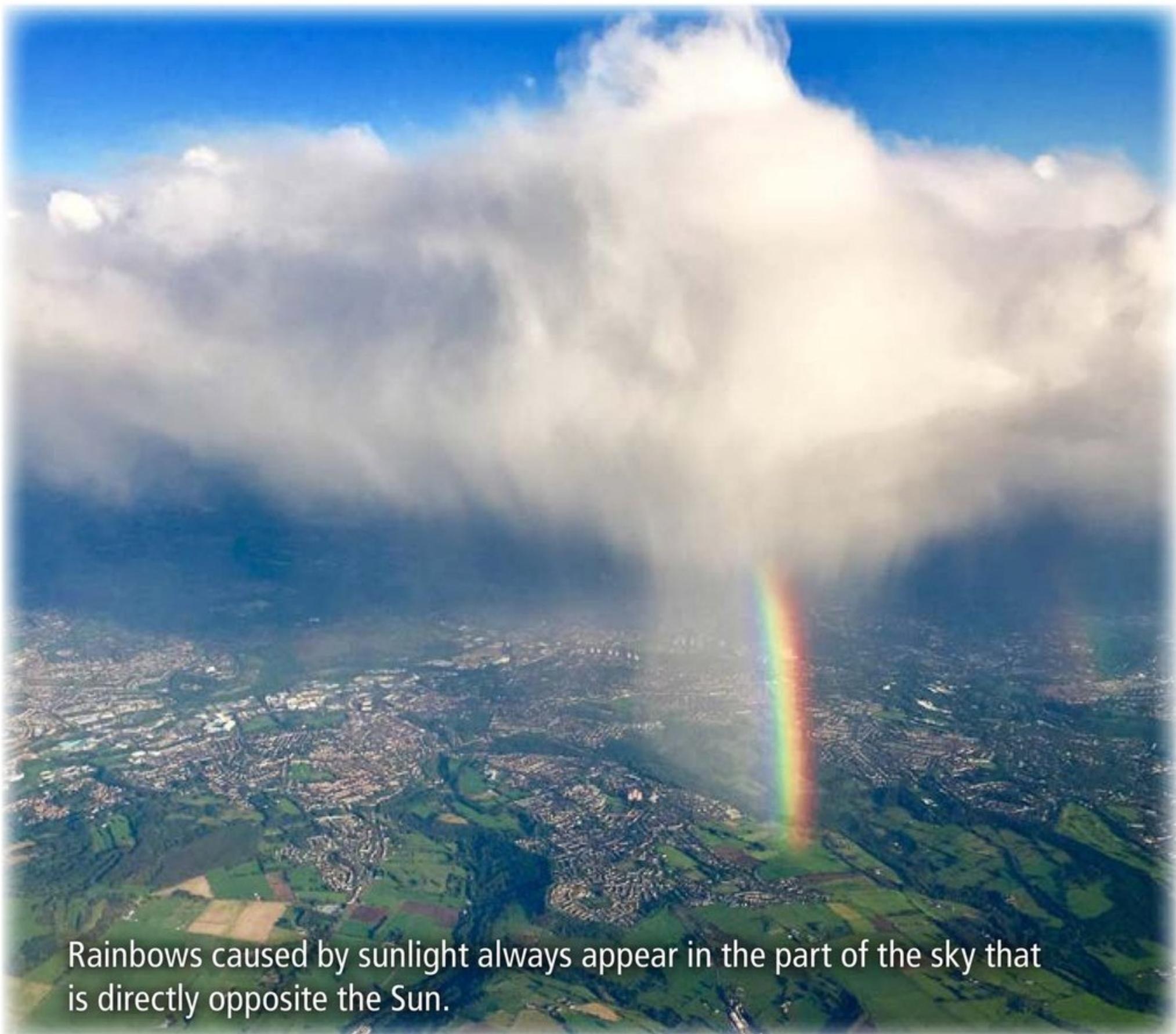
A rainbow appears near storm clouds.



Rainbows can be seen in a splash of water, but these rainbows usually don't last long.

Rainbows are **optical illusions**. We can see them, but they are impossible to touch. We can't walk around them or look at them from the side. The rainbows we see outside seem to move away if we go toward them for a closer look.

Rainbows are created by light shining through water or clear objects. In nature, rainbows usually appear where rain and sunlight meet. Rainbows are beautiful tricks of light. Science, though, has unlocked their mysteries.



Rainbows caused by sunlight always appear in the part of the sky that is directly opposite the Sun.

Where and When Rainbows Appear

Notice the weather the next time you see a rainbow. There will be rain or mist in front of you, and the Sun will be shining from behind you. The rainbow will appear in the rain or mist. Water in the air and direct light are the two things needed to see a rainbow in nature. A rainbow won't appear if the sky is too cloudy.

The best time to see a rainbow is usually in the morning or late afternoon. That's when the Sun is in the best place to create one. If you're lucky, you might see a double or even a triple rainbow.



For double rainbows, the colors of the outer rainbow are in the opposite order to the colors of the inner rainbow.

You can sometimes spot rainbows in the mist of a waterfall, too. A splashing fountain can create a small rainbow, and a sprinkler on a sunny day may put on a colorful show. Rainbows can even form under a bright moon. These special rainbows are called *moonbows*.



Moonbows are dimmer and much less common than rainbows.



Cameras were flown high above one of the world's biggest waterfalls to capture a full-circle rainbow.

To a viewer, a rainbow looks like a curved arch, or half circle. However, a rainbow actually forms a full circle. From the ground, most times we can only see a rainbow's top half. Sometimes, though, lucky airline pilots may see a rainbow's complete circle from the sky.

Rainbows in Myths and Tales

- In Viking myths, a rainbow bridge linked Earth to the kingdom where Viking gods lived.
- In Ireland, people told tales of leprechauns. These elves were said to guard pots of gold hidden at the ends of rainbows.
- The Hindu god Indra is shown using a rainbow as an archer's bow to shoot lightning arrows.

How Rainbows Form

René Descartes (re-NAY day-KART) was a French scientist. He was born over four hundred years ago. He was fascinated by rainbows and wanted to learn more about them. He used sunlight and a big globe of water to do experiments. Descartes discovered that to see a rainbow, the viewer must be looking at the light from the right **angle**.



People study and build on many of Descartes's ideas to this day.

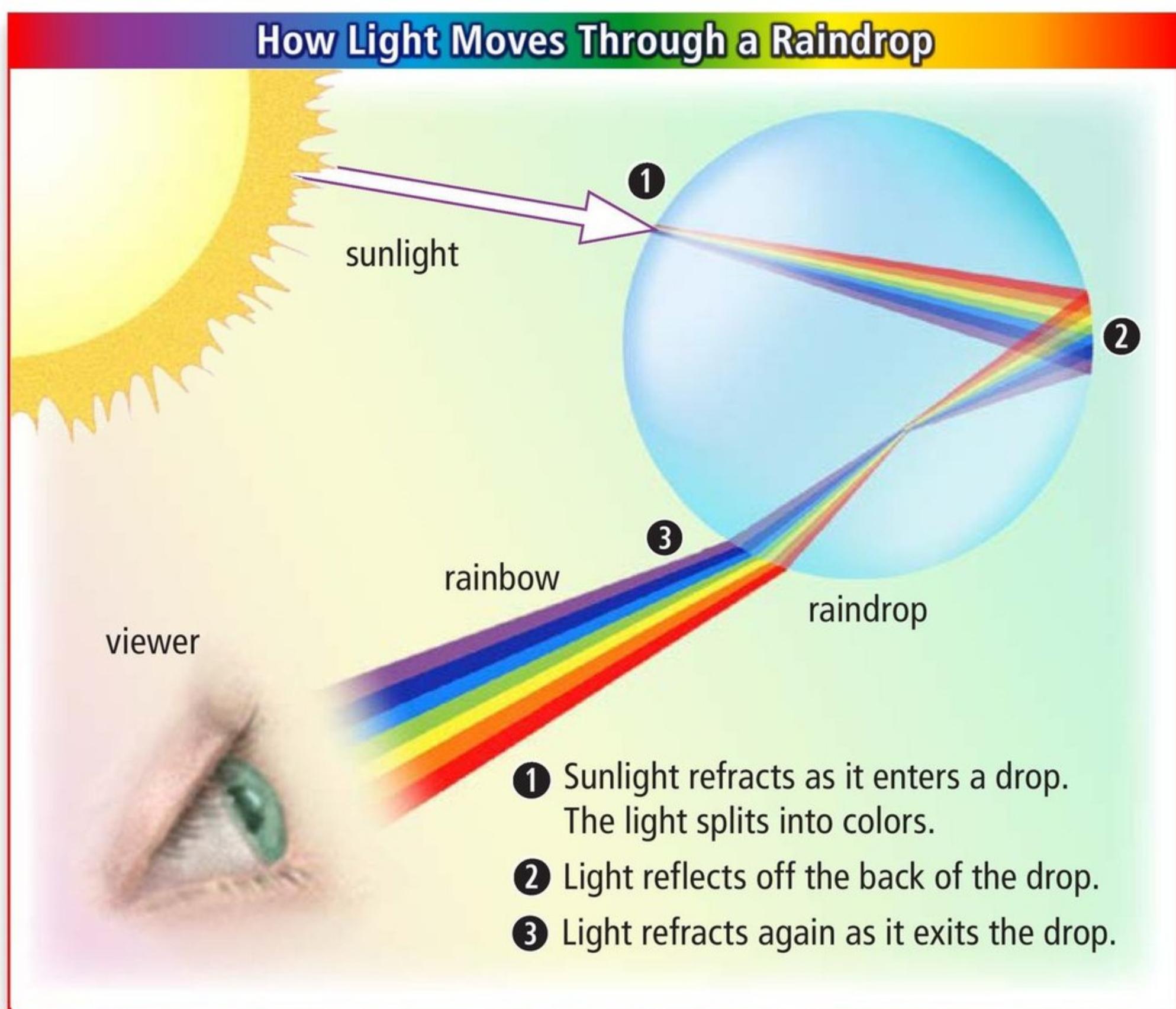
To understand rainbows, it helps to understand how light travels. Light moves at different speeds through different **mediums**.

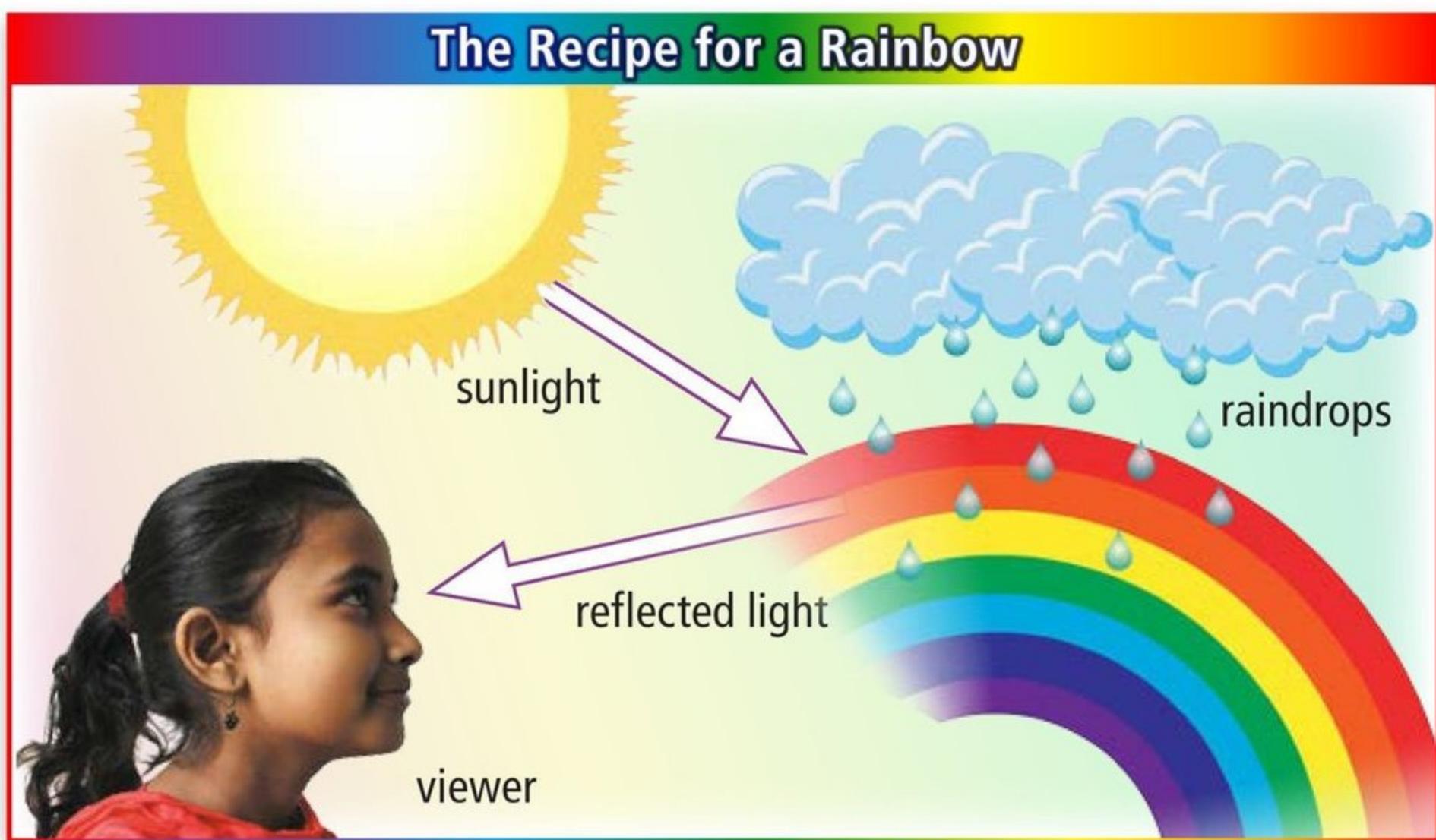
Think of running on land. Then imagine running in knee-deep water. You move slower through water. In the same way, light moves faster through air than through water. This happens because water is denser, or thicker, than air. When light enters water, it slows and bends away from its original path. Bending light is called **refraction**. This process makes objects, such as a pencil sitting in a glass of water, appear to bend.



This pencil appears to bend where it enters the water.

We can see rainbows in nature when direct light meets drops of rain. Sunlight refracts as it enters each drop. The light then **reflects**, or bounces, off the inside of each drop, like light off a mirror. The light refracts again as it exits the drop. Light refracts and reflects in millions of water droplets in the sky at the same time. This process makes all the colors of a rainbow.





The Colors of the Rainbow

Sunlight contains all the colors of a rainbow. Through refraction, raindrops disperse, or split, the sunlight into these colors.

Sunlight splits into colors in each drop of rain. Each raindrop reflects colored light toward the viewer at a slightly different angle. We see red light shining from the drops at the top of a rainbow. Those drops are in the right position to shine the color red back at us. In the same way, the only color we see shining from the bottom of a rainbow is violet.



Sometimes a rainbow's colors blend together, but all seven colors can be seen clearly in bright rainbows.

From top to bottom, colors in a rainbow always appear in the same order. However, the outside rainbow in a double rainbow breaks this rule. The name ROY G. BIV can help you remember the seven main colors of a rainbow: red, orange, yellow, green, blue, indigo, and violet.

Make Your Own Rainbow

1. Fill a clear glass about three-quarters full of water.
2. Place the glass where sunlight can pass through it.
3. Hold a white piece of paper so the light shines through the water onto the paper. Move the paper around until a rainbow appears.
4. Use colored pencils to mark the different colors on the paper. How many can you see? What order are they in?

Conclusion

Rainbows make most people pause in awe. These colorful displays have inspired art and poetry throughout history. They also appear in stories and fairy tales from all over the world.

Science explains how these optical illusions happen. Water drops bend, split, and reflect light, which lets us see a rainbow's many colors. Still, the surprising beauty of a rainbow is a magical sight to see.



Tourists admire a rainbow at the bottom of a waterfall in Iceland.

Glossary

angle (<i>n.</i>)	the position from which something is viewed; the direction from which something is approached (p. 10)
indigo (<i>n.</i>)	the color of light between blue and violet (p. 14)
mediums (<i>n.</i>)	substances through which something is carried or passed on (p. 11)
optical illusions (<i>n.</i>)	images that trick the mind into seeing things differently than they really are (p. 5)
reflects (<i>v.</i>)	sends light, sound, or heat back toward where it came from (p. 12)
refraction (<i>n.</i>)	the bending of a light or energy wave when it passes through certain mediums (p. 11)

Rainbows

A Reading A-Z Level P Leveled Book

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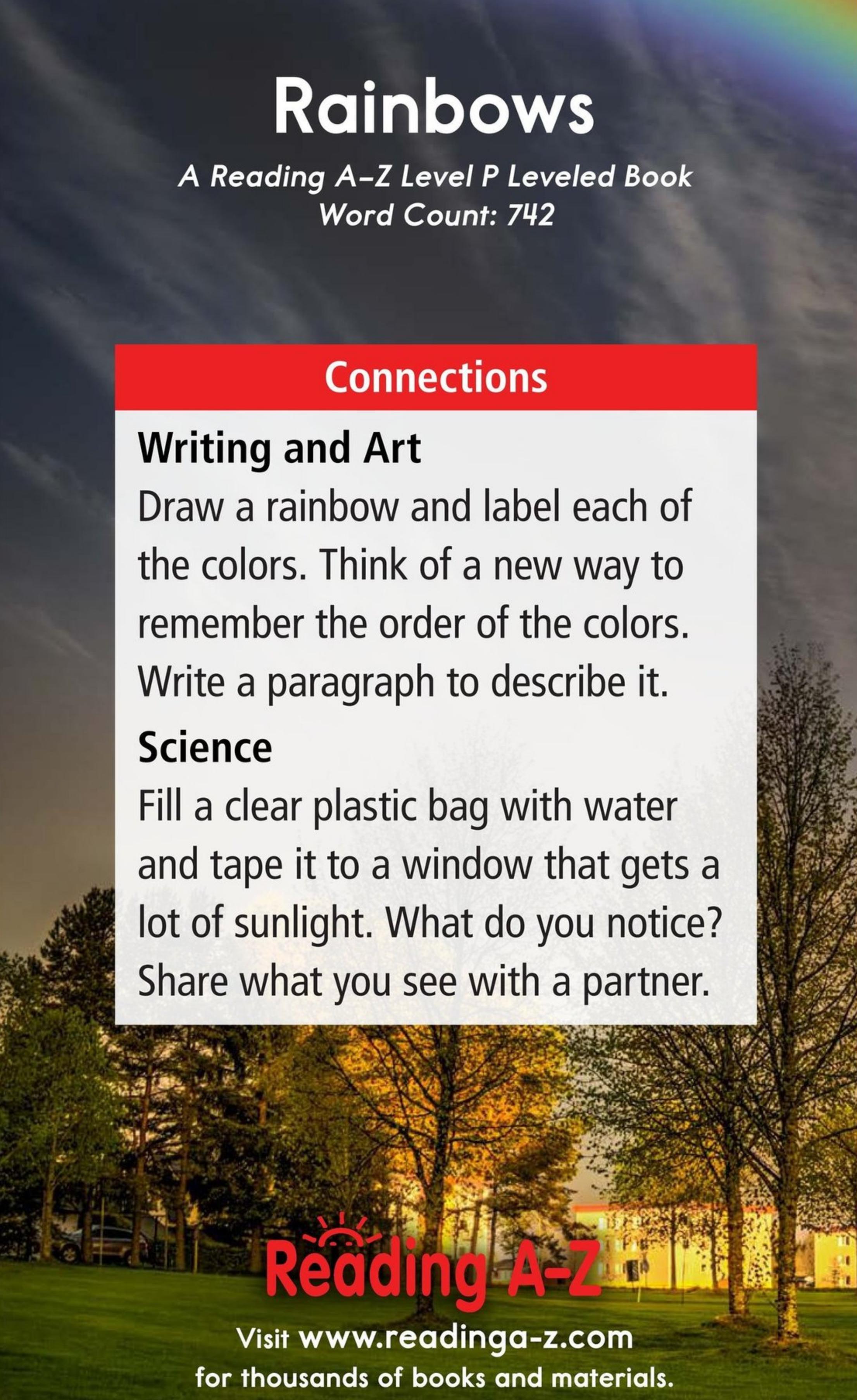
Connections

Writing and Art

Draw a rainbow and label each of the colors. Think of a new way to remember the order of the colors. Write a paragraph to describe it.

Science

Fill a clear plastic bag with water and tape it to a window that gets a lot of sunlight. What do you notice? Share what you see with a partner.



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