**The Magical Rainbow Adventure**

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One sunny morning after a rain shower, a curious little boy named Liam and his playful dog, Max, stepped outside. As Liam looked up at the sky, he gasped. There, stretching from one end of the sky to another, was a beautiful rainbow! It shimmered with colours: red, orange, yellow, green, blue, indigo, and violet.

“Wow! Where does the rainbow come from?” Liam wondered aloud.

A soft voice whispered, “Would you like to find out?”

Liam spun around, and he saw a glowing mist near the rainbow’s end. Out of the mist stepped a tiny, sparkling fairy named Iris. She had wings as colourful as the rainbow itself.

“I can show you the wonders of the rainbow,” Iris said, smiling. “Rainbows are nature’s way of painting the sky with light!”

Liam’s eyes sparkled. “Really? How does it work?”

Iris waved her wand, and a gentle swirl of light surrounded them. Suddenly, they were floating high in the sky, near the rainbow!

“You see,” Iris explained, “a rainbow is made when sunlight meets tiny drops of water in the air. The sunlight enters a raindrop, bends, and splits into different colours. Then it bounces off the inside of the raindrop and bends again as it leaves. This bending and bouncing create the beautiful colours you see!”

Max barked excitedly as they floated closer to the rainbow’s glowing colours.

“But why are the colours always in the same order?” Liam asked.

“Great question!” said Iris. “Each colour bends differently because of its wavelength. Red bends the least, so it’s on top. Violet bends the most, so it’s at the bottom.” (The curious reader can see the Boxes for a more detailed explanation. Each Box congtains a little more material for the increasingly curious reader!)

Suddenly, Liam noticed another fainter rainbow above the first one. “Look, Iris! There are two rainbows! How is that possible?”

Iris clapped her hands. “Ah, that’s a double rainbow! It happens when sunlight bounces twice inside the raindrop before it comes out. The second bounce flips the colours, so the second rainbow has violet on top and red at the bottom. It’s fainter because the extra bouncing scatters more light.”

Liam’s jaw dropped. “That’s amazing! Can I take a piece of the rainbow home?”

Iris chuckled. “Rainbows are only for looking. They remind us of hope and wonder. But their magic stays in your heart forever.”

With a wave of her wand, Liam and Max found themselves back in their garden. The rainbow and its double were still in the sky, but Iris was gone. Suddenly the earth shook and Max barked loudly. Liam shut his eyes and ears, but the voice he heard did not stop. “Wake up, Max!” it kept saying, over and over. Liam opened his eyes and saw his mother by his bed, shaking him awake. “Time to go to school, Max!” she said, and left.

Liam sat up in his bed and thought about his dream. He smiled. They had learned about the rainbow yesterday, in class. It must have made a deep impression on him. He looked out of the window hopefully, but the sky was clear. He smiled at Max and said, “Never mind, Max. We’ll soon see a rainbow. Do you know what they are? Rainbows are more than just colours—they’re a magical surprise from the rain, the sun, and even science!”

From that day on, every time Liam saw a rainbow, especially a double rainbow, he remembered his magical dream and the fairy who taught him its secrets.

BOX 1: How do rainbows form?

Sunlight is made up of several colours. When sunlight is passed through a prism, for instance, it breaks up into several colours. This is called dispersion. In the rainy season, millions of water drops are to be found in the clouds. These drops disperse sunlight exactly like a prism does and form the rainbows we see.

END OF BOX 1

BOX 2: Sunlight and a raindrop: the physics of rainbows

When sunlight encounters a raindrop, part of the light is reflected and the rest enters the raindrop. The light is refracted (bent) at the surface of the raindrop because it is passing from air to water, with a different refractive index. When this light hits the back of the raindrop, some of it is reflected off the back. This is called total internal reflection and happens when the light falls on the back surface of the water drop at sufficiently large angles. (You may have noticed this yourself, in the evenings, when you can see your own reflection in transparent window-glass. Of course, glass always reflects a small amount of light, but when the room is well-lit and the outside is getting dark, this reflection is easier to see.)

When the internally reflected light reaches the surface again, once more some is internally reflected and some is refracted as it exits the drop. This refracted light is what causes the rainbow; the other light serves to light up the clouds.

A small calculation shows that the light is reflected back over the range of 0° to 42°, with the most intense light at 40-42°, depending on the colour of the light.

Now, we already said that red light is bent the least, and so if you look at the picture, it will seem as though the rainbow should have red on the inside and violet on the outside. But it is the other way around! Why is this? To understand this, look at the next box.

BOX 3: Sunlight and many raindrops: how the rainbow colours are arranged

Look at the sketch of the sunlight going through two drops, A and B. Now, we see only one colour from each raindrop, because the others reflect light at angles that do not fall into our eyes. So, when raindrop A disperses light, let us imagine that only the red light exits at the correct angle to travel to our eyes. The other coloured beams exit at a lower angle, so we don’t see them. The sunlight will hit all the surrounding raindrops in the same way, so they will all bounce red light onto our eyes, so we see a band of red colour from all the raindrops at that angle in the sky.

Raindrop B is much lower in the sky, so we can’t see the red light from it. Since it is lower, we will see light that has bent more, that is we will see colours like orange, yellow, green, blue, or violet. Let us imagine that this drop is at a height so that it sends violet light (the other end of the rainbow) into our eyes. All the drops surrounding raindrop B bounce light in the same way. The raindrops in between A and B all bounce different colors of light to us, so we see the full color spectrum from violet at the bottom to red at the top. If you were up above the rain, you would see the rainbow as a full circle, because the light would bounce back from all around you. On the ground, we see the arc of the rainbow that is visible above the horizon.

END OF BOX 3

BOX 4: How a double rainbow is formed

A fainter rainbow is sometimes seen above the usual rainbow. This happens when the light reflects twice inside the raindrop. Because of this double reflection, the light exits the raindrop at a different angle, so we see it higher up. If you look carefully, you'll see that the colors in the second rainbow are in the reverse order of the primary rainbow.

END of BOX 4

BOX 5: What is the best time to see a rainbow?

We know that when the Sun is 42 degrees up in the sky, the rainbow will be on the horizon or close to it (see Box 2). If the Sun gets higher, the rainbow will be below the horizon and you won't be able to see it. So the best time to see a rainbow (or even two!) is near sunrise or sunset. So you can’t see a rainbow in Tamil Nadu roughly between 09:30 to 14:30 in December and between 08:30 to 15:30 in June.

Sources: How Stuff Works, Wikipedia