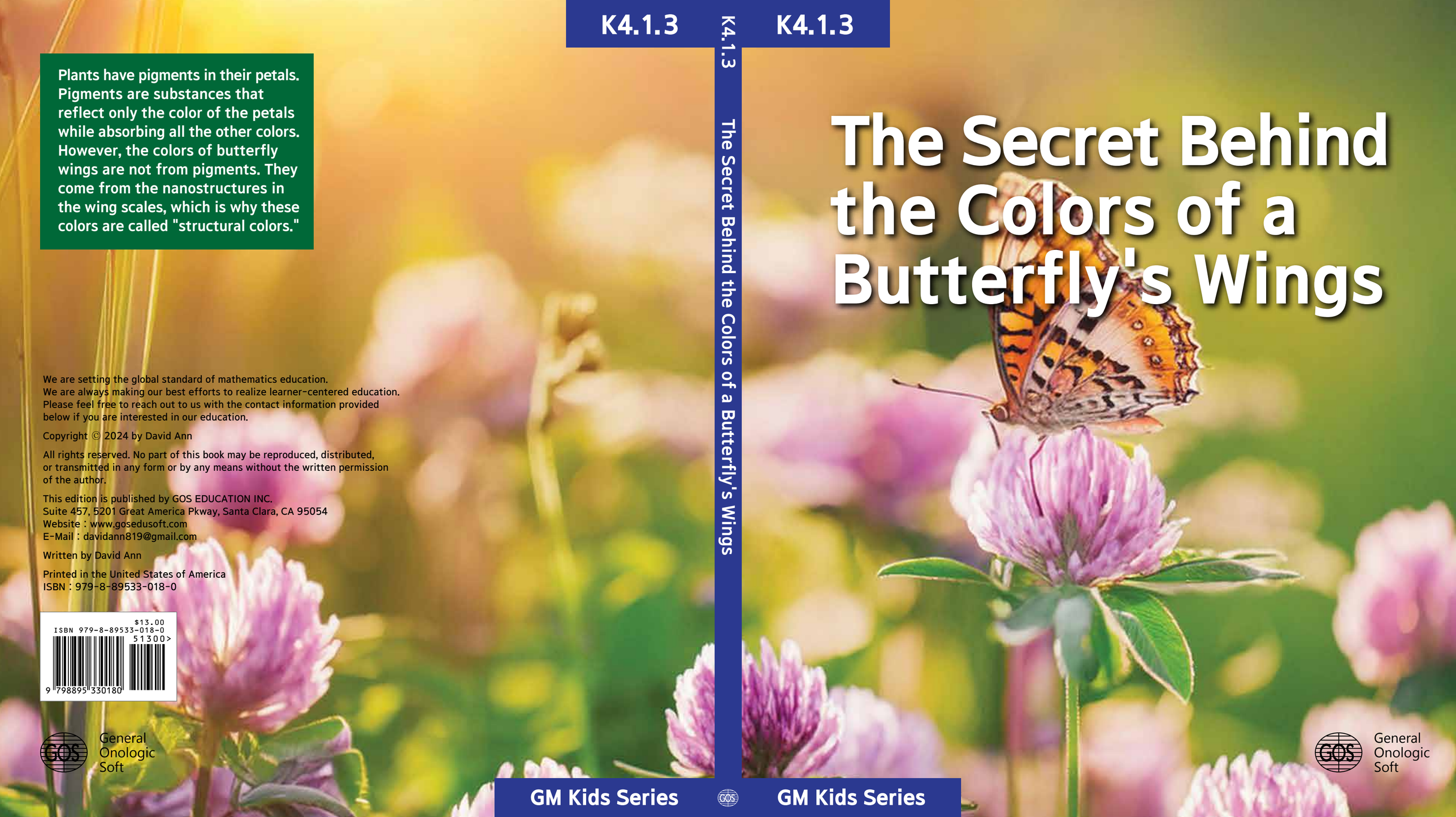

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K4.1.3

K4.1.3 The Secret Behind the Colors of a Butterfly's Wings

K4.1.3

The Secret Behind the Colors of a Butterfly's Wings

Plants have pigments in their petals. Pigments are substances that reflect only the color of the petals while absorbing all the other colors. However, the colors of butterfly wings are not from pigments. They come from the nanostructures in the wing scales, which is why these colors are called "structural colors."

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The butterfly is an insect that boasts the world's most beautiful colors.

There are about 20,000 different species of butterflies in the world.

Butterflies can be sorted into woodland and grassland butterflies.

Grassland butterflies have bright colors that catch people's eyes.

On the other hand, most woodland butterflies have dark-colored wings.

People used to gather pigments from different plants to dye their clothes in the colors they wanted.

A pigment is a substance that make something appear colorful.

For example, we see a flower as red because its pigments absorb all other colors of light and only reflect red.

People collected many different pigments from bright, colorful flowers.

They used these pigments as dyes for clothing or paints for artwork.

People also tried to extract pigments from the vibrant butterflies' wings to use as dye. They believed that the powder on the butterfly wings contained their beautiful pigments.

But no matter how hard they rubbed the wings, they could only get a dull, grayish powder, not the vibrant colors they were hoping for.

This was completely different from how they could get pigments from the uniquely colored petals of flowers.

So, where did all the beautiful colors on butterflies' wings go?

The answer lies in the special structure of the butterfly's wings.

We can see a uniquely layered nano-structures if we zoom in on a butterfly's wings through a microscope.

These structures, arranged in a pattern that looks like neatly laid roof tiles, are called a "photonic crystal."

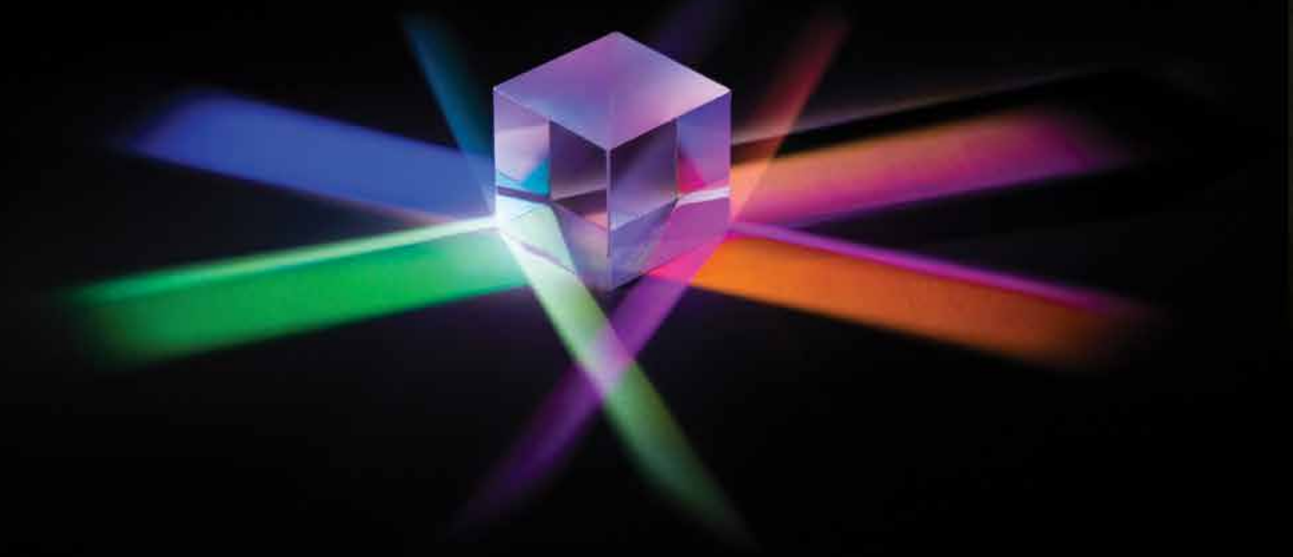
Photonic crystals reflect only certain colors of light and absorb the rest. The color we see on the butterfly wings is this reflected light.

Now we know why we cannot obtain the beautiful pigments from butterflies' wings.

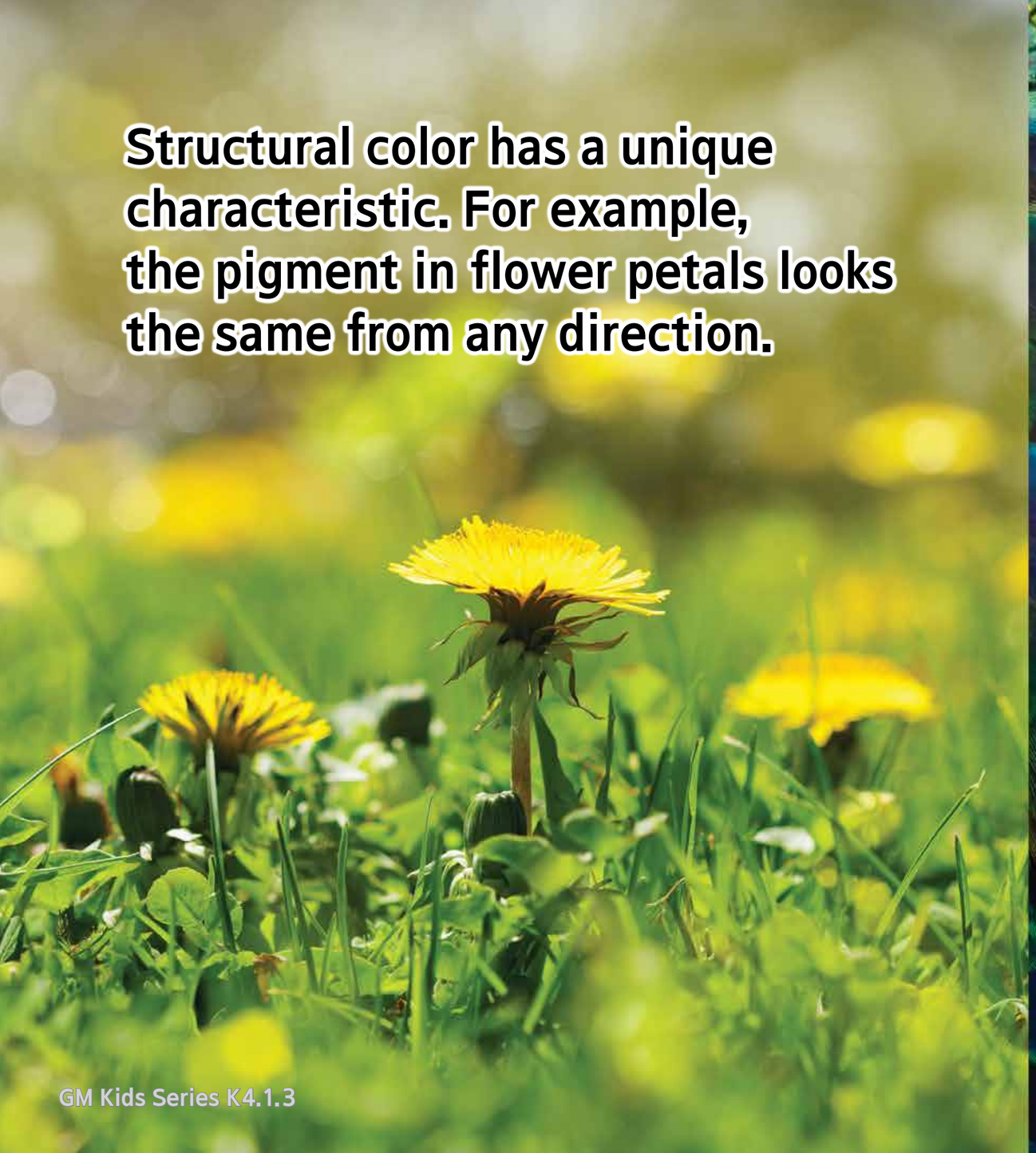
The color of butterfly wings comes from the unique structures in the wing scales, not pigments.

Colors that come from structure rather than pigments are called "structural colors."

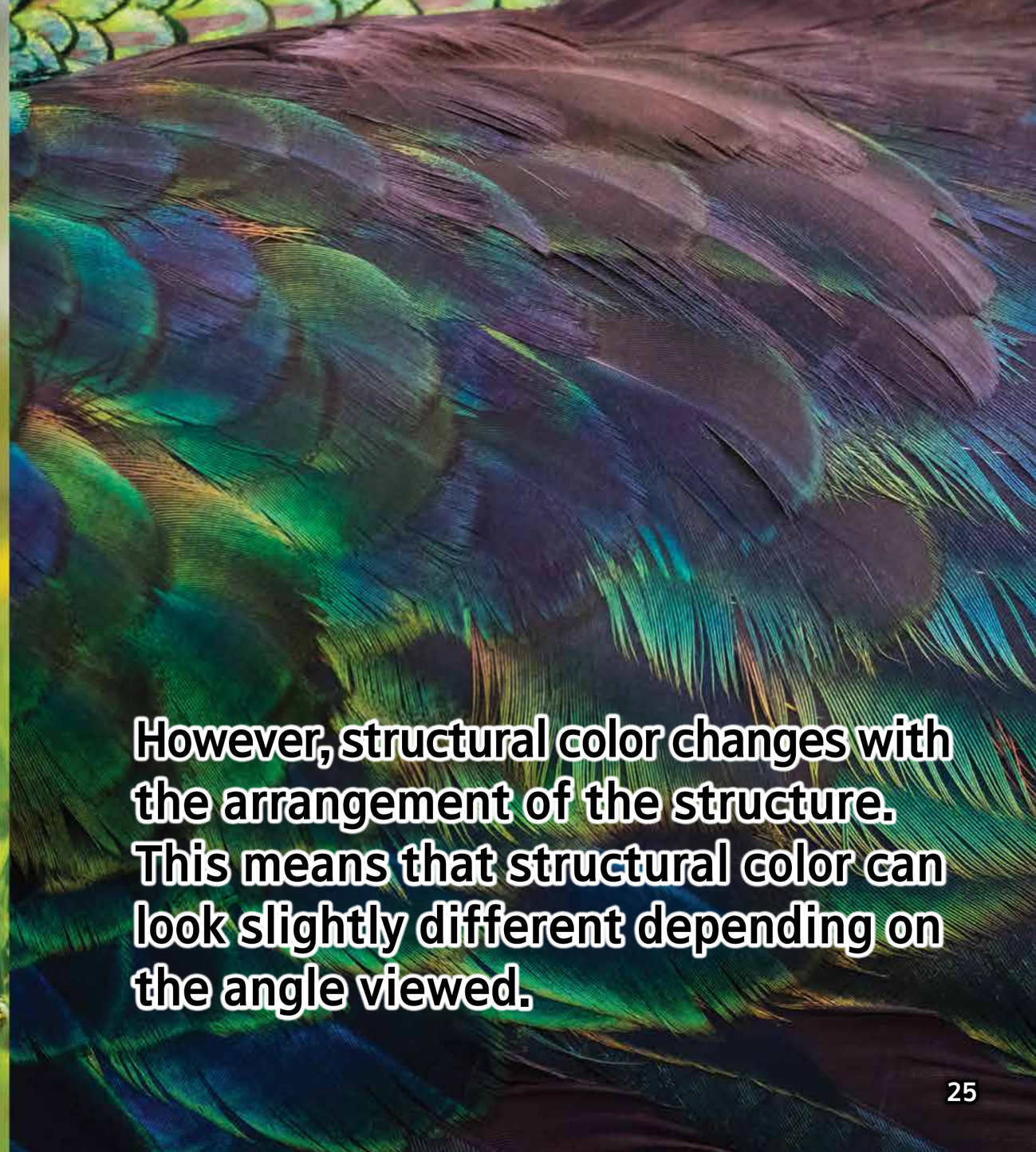
Structural color appears when light is reflected, scattered, or diffracted because of the shape or arrangement of particles on the microscopic structure of a surface.



Most colors created by dyes or chemicals are called "chemical colors." On the other hand, structural color, or "physical color," is created by the way light interacts with the physical structure of the material.



Structural color has a unique characteristic. For example, the pigment in flower petals looks the same from any direction.



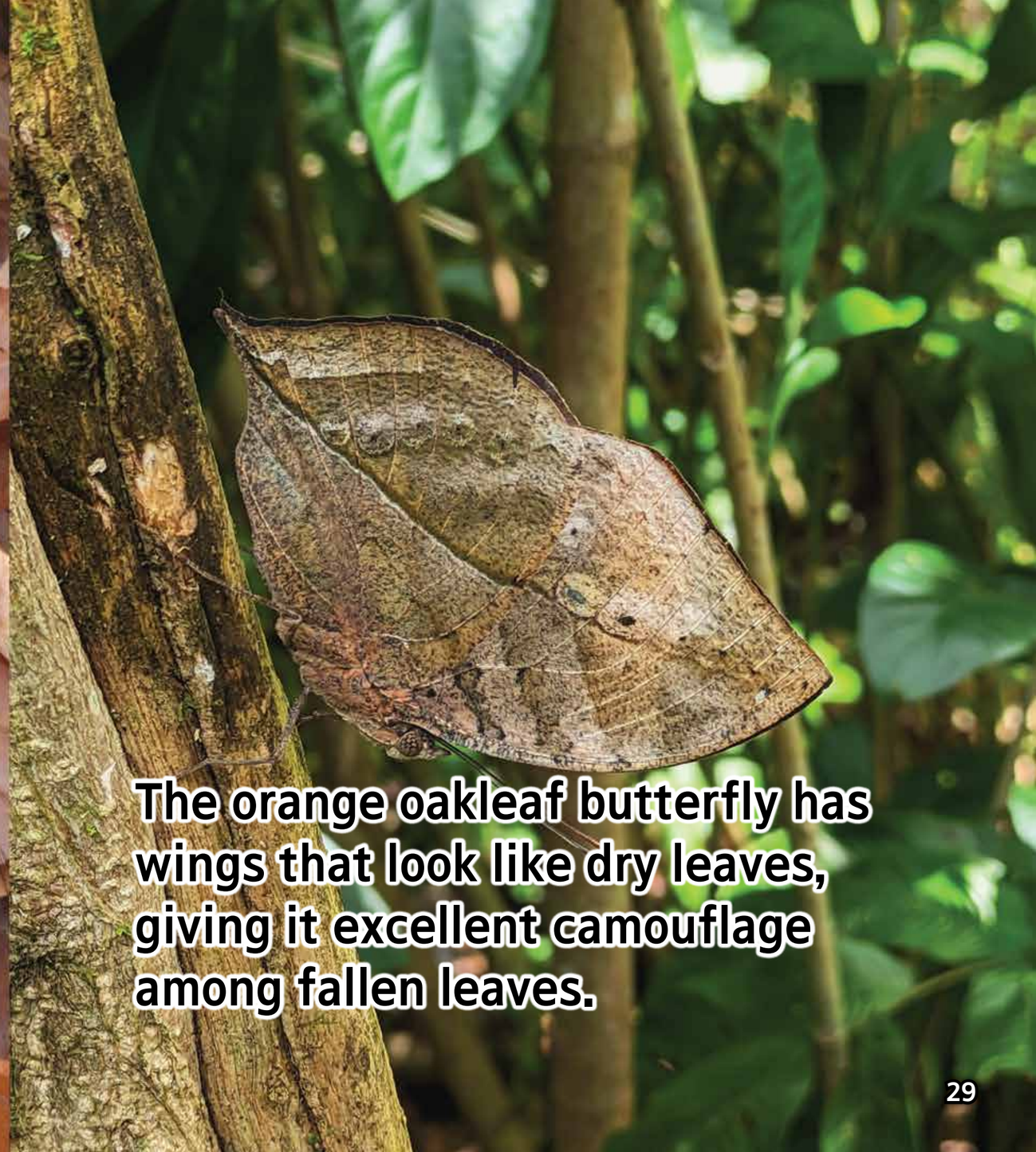
However, structural color changes with the arrangement of the structure. This means that structural color can look slightly different depending on the angle viewed.

In nature, we can find many examples of structural colors other than butterfly wings.

The bright feathers of a male peacock and the shiny shell of a beetle are well-known examples of structural color.

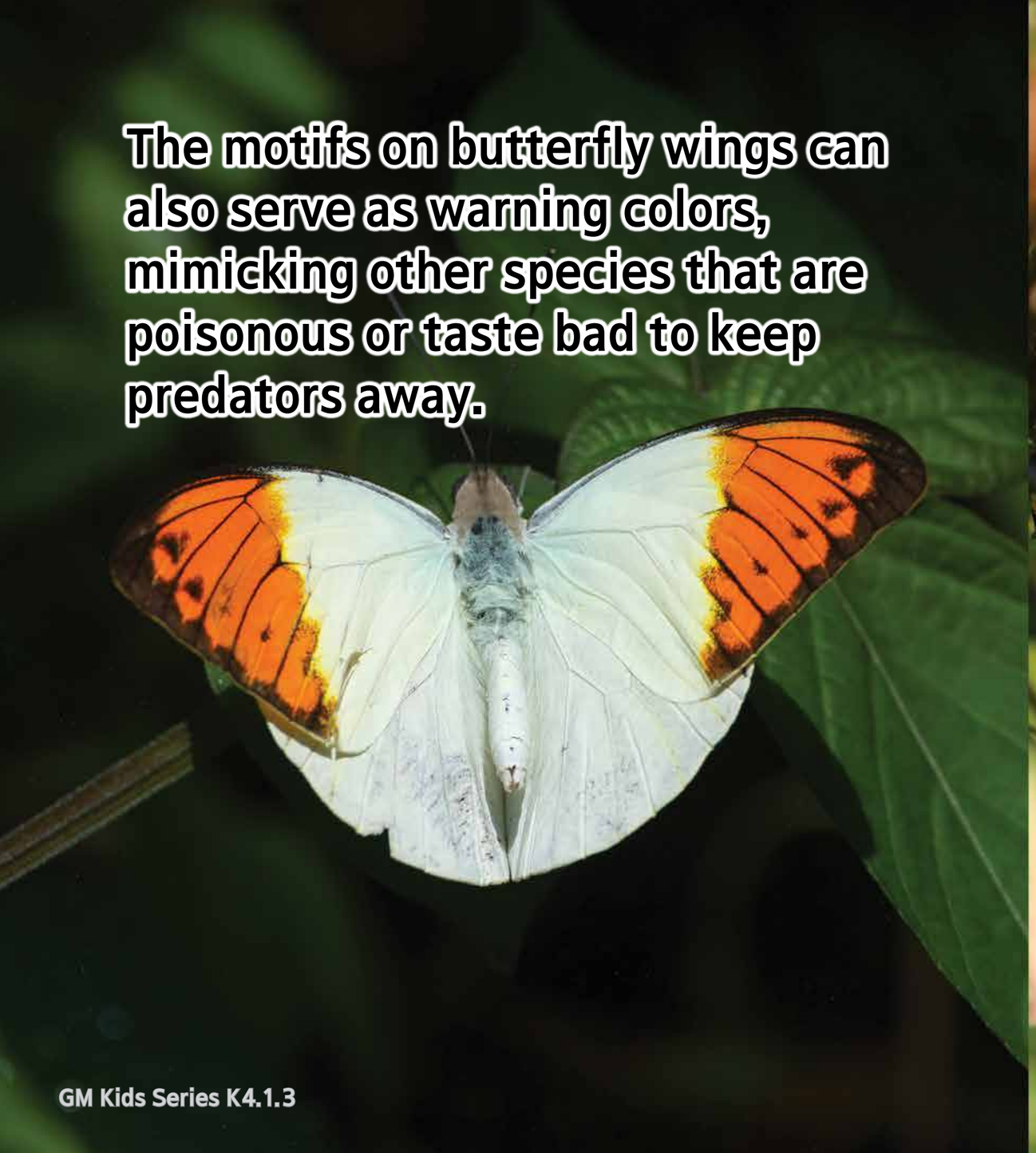
What role do the motifs on butterfly wings have?
The motifs on butterfly wings play various roles in its survival.

For example, the motifs on butterfly wings help them blend into their surroundings, acting as camouflage to avoid predators.



The orange oakleaf butterfly has wings that look like dry leaves, giving it excellent camouflage among fallen leaves.

The motifs on butterfly wings can also serve as warning colors, mimicking other species that are poisonous or taste bad to keep predators away.



The viceroy butterfly is not poisonous but imitates the toxic monarch butterfly, which feeds on milkweed, to avoid predators.

The motifs on butterfly wings also help regulate their body temperature.

The darker colors on their wings absorb more heat, which helps in cooler environments.
The lighter colors reflect heat, helping in warmer climates.

Finally, motifs on wings play a crucial role in ensuring the continuation of a butterfly's species.

Butterflies use the motifs on their wings to send mating signals and attract mates.