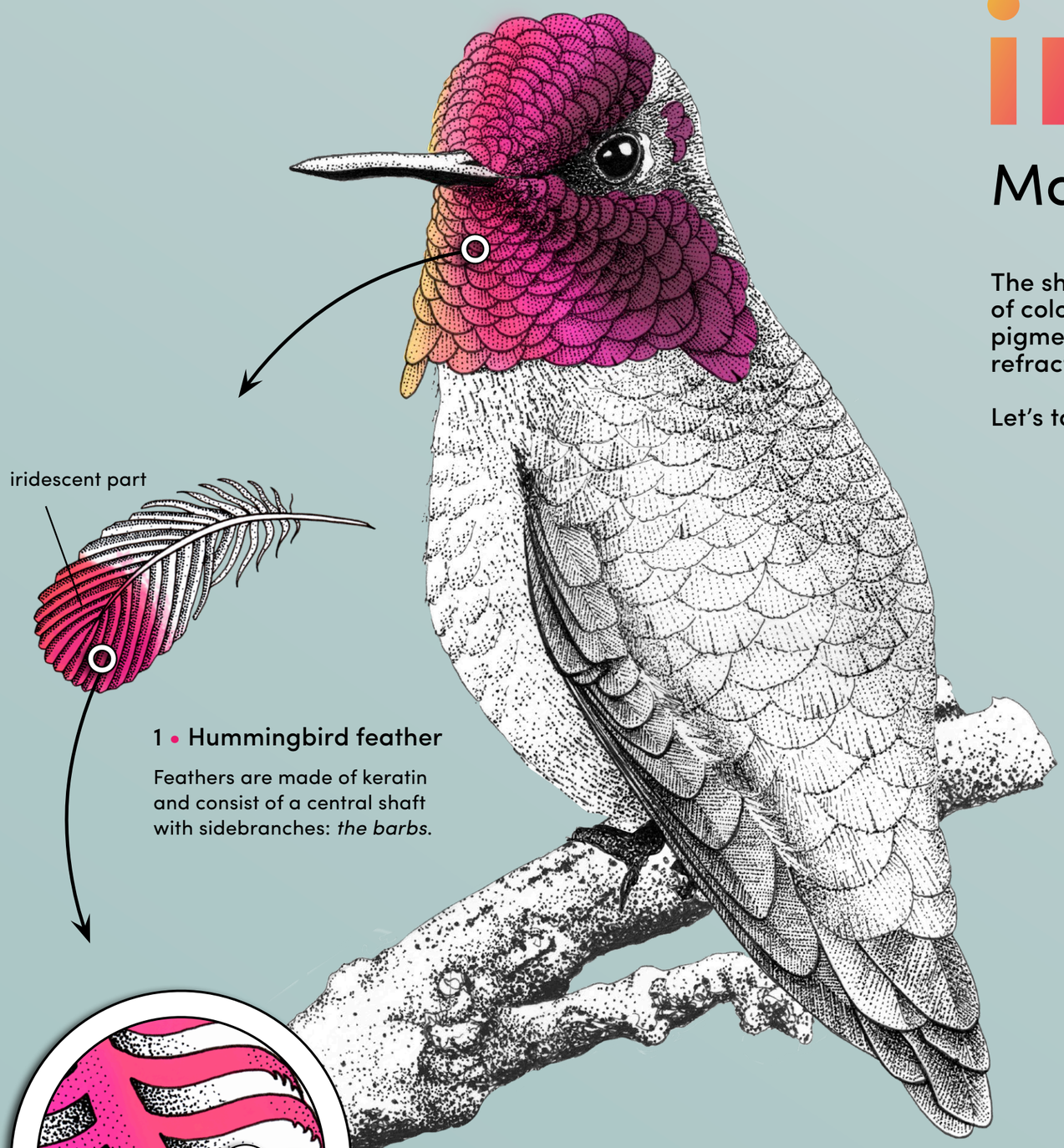
iridescence

Magical hummingbird colors

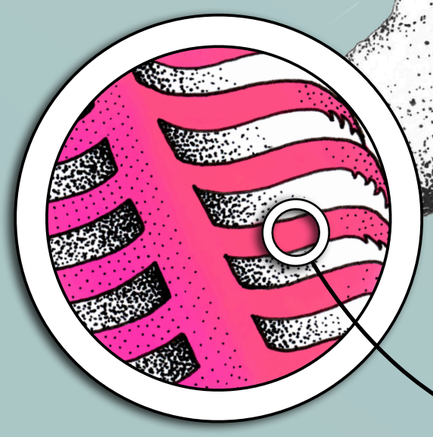
The shiny pink feathers of a male Anna's hummingbird are iridescent: they change of color when looked upon from a different angle. Iridescent colors are not made by pigment, but by layers in the microscopic strucure of the feathers that reflect and refract sunlight in different colors in the same way a soap bubble does.

Let's take a closer look...



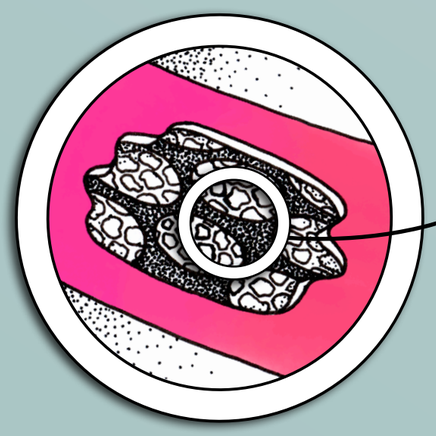
1 • Hummingbird feather

Feathers are made of keratin and consist of a central shaft with sidebranches: *the barbs.*



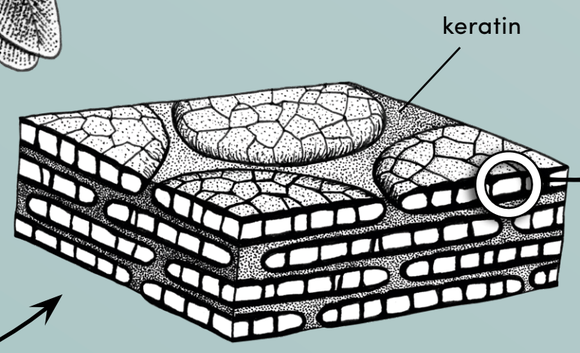
2 • Barb

The barbs (sidebranches) of the feather have twigs attached to them: *barbules.*



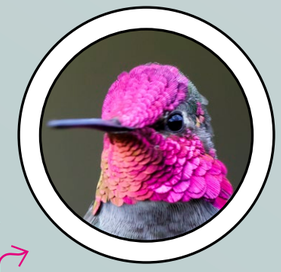
3 • Barbule

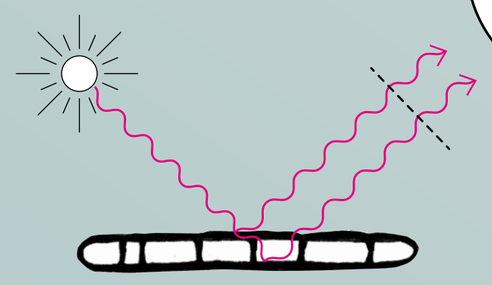
Beneath a translucent layer of keratin the barbules of an iridescent feather have 7 up to 15 layers of *melanosomes.* (view from above)



4 • Layers of melanosomes

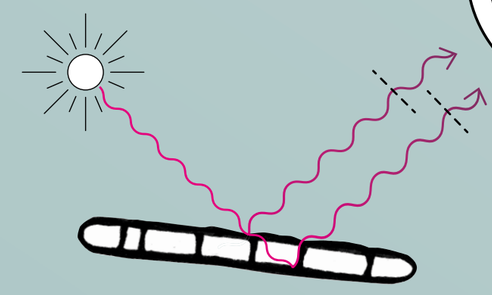
Melanosomes are pancake shaped melanin platelets filled with pockets of air that reflect and refract sunlight. (dorsal view)





5 • Melanosome with lightwaves *in phase*

A melanosome reflects and refracts sunlight like a bubble of soap: sunlight is reflected from both the outer ánd the inner surface. If a lightwave reflects from both surfaces in such a way that the waves' peaks are perfectly aligned, the waves are *in phase* and the result is an intense and bright pink color.



5 • Melanosome with lightwaves *out of phase*

When the light waves are *out of phase* they cancel each other out completely, and there is an absence of color which we see as black. When the waves are neither exactly *in* nor *out of* phase, a dull color will be produced.

Infographic & art work: www.jeannedesign.nl

These are a highly simplified visuals: the bright magenta pink color of the Anna's hummingbird's head isn't simply caused by the reflection and refraction of a magenta pink wavelength as shown in these simplified illustrations... magenta actualy is a mixture of mostly red light with a little bit of blue light. The light waves reflect and refract on each inner and outer surface of the air bubbles in all the layers of melanosomes. Some light waves even 'bounce around' a couple of times before they find their way out again. On top of that, the hue and saturation of the produced color is also influenced by the size of the airbubbles in the melanosomes, the platelet thickness ánd the shape of the barbules. This range of factors result in an incredible variety of iridescent hummingbird colors.

Sources:

- Bartley, G. , Swash A. (2022). Hummingbirds, A Celebration of Natures Jewels. Princeton University Press.
- The Cornell University. (2015). How Birds Make Colorful Feathers. The Cornell Lab of Ornithology , Bird Academy. https://academy.allaboutbirds.org/how-birds-make-colorful-feathers/
- Univeristy of Groningen (2018) Iridescent colouration of male Anna's hummingbird (Calypta anna) caused by multilayered barbules, https://research.rug.nl/en/publications/iridescent-colouration-of-male-annas-hummingbird-icalypte-annai-c