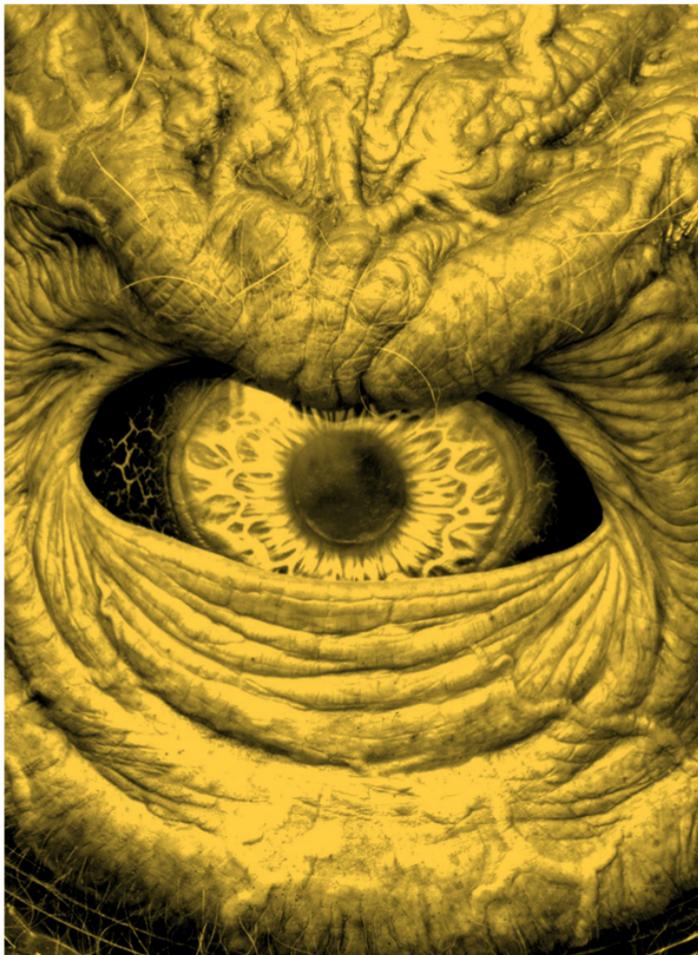


The Eyes Have It

With the help of eminent ophthalmologists, biologists, and concept artist and creature designer Jake Lunt Davies, naturalist Melissa T. Miller looks at the *Star Wars* galaxy from a new perspective—through the diverse eye types of its characters and creatures.

WORDS BY MELISSA T. MILLER

Thanks to hyperspace travel, a myriad of *Star Wars* species left their original worlds over many millennia, settling on a multitude of new worlds and making their homes in varied environments. Audiences were first introduced to this broad spectrum of species thanks to the Mos Eisley Cantina in *Star Wars: A New Hope* (1977), where an assortment of creatures with unique features spent their leisure time. Other locations teeming with exotic lifefoms have included Maz Kanata's castle on Takodana, and the Lodge at Fort Ypsa on Vandor, with each location providing us with ample opportunity for "people" watching. And watching back were a truly diverse set of eyes. ▶



► According to Dr. Derek Welsbie, an associate professor of ophthalmology at the Shiley Eye Institute at the University of California, San Diego, human sight evolved remarkable abilities over hundreds of thousands of years. Animals on Earth also have a remarkable variety of eye adaptations based on the survival needs of each species, many of which are beyond our comprehension. For example, many birds have two focal points in each eye, allowing them to map the

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Dr. Derek Welsbie

environment above, below, and to all sides around them during flight. “There’s a lot of sci-fi on our own planet,” says Welsbie.

Which poses the question, if the sight of Earthlings in all our forms evolved in so many ways, how different might the vision of the fictional creatures of the *Star Wars* galaxy be, how might their eyes actually function, and do they give any hints as to how their ancestors might have lived?

Predator or Prey?

A main driving factor of evolution is whether you are the hunter or the hunted. “Animals that have their eyes set on the side have more expansive peripheral vision than humans that have their eyes up front,” says Welsbie. “Predators tend to have more forward-facing eyes, whereas prey are going to have eyes at the sides.” Vertically slit pupils also assist predators with the depth perception needed to calculate their attacks, while horizontal pupils increase a prey’s ability to scan the horizon for threats.

Jar Jar Binks may not seem like an intimidating predator, but consider the coordination involved in grabbing food with his long tongue. Forward-facing eyes with vertical pupils allow Gungans to line up their target. Neimoidians, such as Nute Gunray, have long horizontal pupils, indicating superior peripheral vision. It seems likely that they evolved as a prey species, which could explain their tendency towards cowardly behavior.

Frank Santana, a herpetologist at the San Diego Natural History Museum, studies reptiles and amphibians. He points out that frog eyes adapt for every stage of their life cycle. “They go



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01 Nephran eyes suggest an aquatic evolutionary heritage.

02 Cyclorrians have eyes with multiple lenses, like Earth insects.

03 Trodatome eyes can rotate in various axis.

through this awesome transition where they totally change their eye structure and location,” he explains. “When they’re tadpoles, they have eyes on the side because they’re watching for predators. Following metamorphosis, their eye position shifts to the front and more on the top, because they’re more of a predator when they’re on land.” Such a change was seen during Season Two of *The Mandalorian*, when the Frog Lady’s eggs hatched into tadpole-like young.

Low Light

Large eyes and large pupils are adaptations for seeing in the dark. “The bigger the pupil, the more light it lets in,” says Welsbie. “If you’re an animal that lives in dim light, you often have bigger eyes and bigger pupils. I don’t know what Ackbar’s planet looks like, but I’m imagining it’s dark.” Dr. Amit K. Patel, a postdoctoral scholar and colleague of Welsbie, notes that Mon Cala is mostly underwater so likely a dim environment.

Another adaptation to see in low light is the *tapetum lucidum*—the area at the back of the eye that in humans flashes red in photographs, and glows in cats and other animals that see well in the dark. “Reindeer have this cool feature because they live in the Arctic,” explains Patel. “During the summer there’s more light and they have golden *tapetum lucidum*. But in the winter, they can physically change the color of



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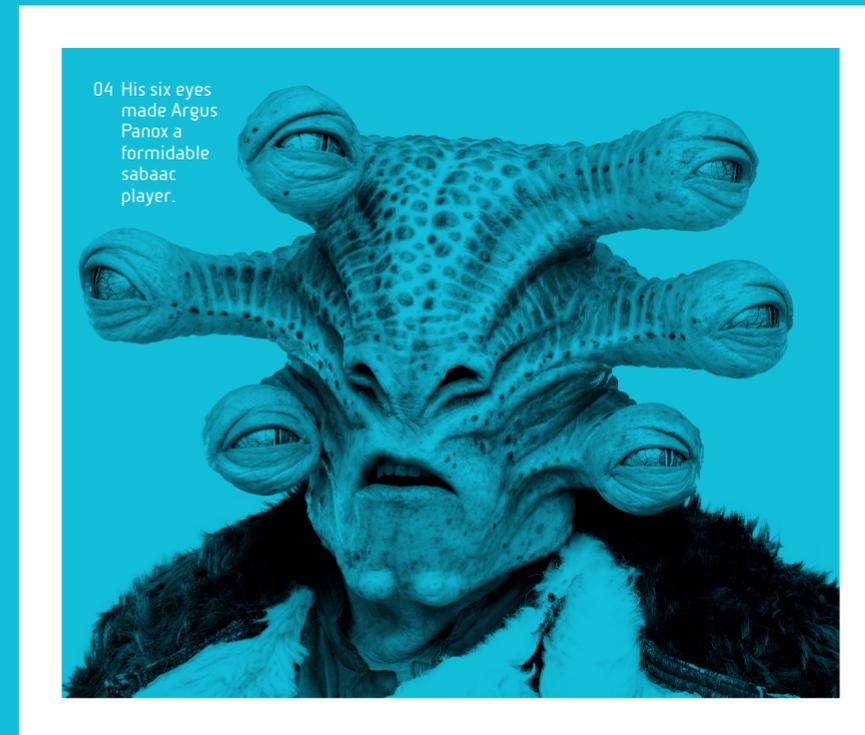
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it to blue in order to capture more light.” Welsbie adds, “If there’s color or a glow in the pupils of *Star Wars* characters, that could be indicative of a *tapetum* and a need to see in low light.”

Pupil shape is also a factor. Slits have a wider range than round pupils and indicate that a species transitions between bright and dark environments. Jabba’s slit pupils indicate that the Hutts can see under a range of conditions, though likely prefer the dim lighting of

locations like his palace, perhaps explaining the coverings on his sail barge in the bright desert sun.

Some animals that live in the deep sea or underground are effectively blind, relying on other senses as their eyes shrink. “You don’t need to have good vision,” says Santana, who has studied snakes with similar adaptations. “If the krayt dragon spends most of its time underground, it makes sense that it has tiny eyes. In that respect it was biologically accurate.”



04 His six eyes made Argus Panox a formidable sabaac player.



Reaching New Sights

Humans can only see a narrow band of light, called visible light, which includes colors from red to purple, and excludes ultraviolet (UV) and infrared wavelengths. Mos Eisley miscreant Greedo and other Rodians have pupil-less eyes, with colorful areas that look like galaxies visible in their appearances in *The Clone Wars* (2008-2014, 2020). Their ability to see in the infrared spectrum means their vision is similar to the heat maps the Mandalorian sees through his helmet viewfinder. “Species like pit vipers can pick up infrared light,” says Santana. “They’ll find a good spot where there’s a scent trail of mice running by and sit there for weeks at a time waiting for prey. When they pick up the heat trail, they’ll strike.”

Salmon, which move between the open ocean and murky rivers, can see both visible light and

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infrared wavelengths. Some animals can even tune their ability to see infrared, optimizing their sight for different conditions. Bullfrogs, which sit at the water’s surface, are adapted so that the part of their eye that looks down into murky water uses infrared vision to see through the gloom while the part that looks up into the air sees the visual spectrum.

“It was only five years ago that we discovered that some frogs can see infrared light,” explains Santana. “There could be applications there for human use, but if they go extinct we might never be able to figure them out.”

While the “frog people” in *The Mandalorian* (2019-present) faced ►

► their own threats, amphibians on Earth are sensitive to many factors. “They tend to be the first ones to show any negative impacts from environmental pollutants,” Santana reflects, ruefully. “Most of the time, they have an aquatic life stage and a terrestrial life stage; that makes them really sensitive to pollution both on both land and in water.”

The Cone Wars

Mantis shrimp, which live in shallow water throughout the world’s oceans, can see nearly the entire spectrum of light and have eye stalks that move independently. They also have sixteen cones compared to a human being’s three, which relates to the number of colors they see. “They’re true

aliens. The fact that they can see UV blows my mind,” says Kaelie Spencer, an aquarist at the Birch Aquarium at Scripps in La Jolla, California. Scientists are studying mantis shrimp eye adaptations for technological advancements in everything from optical media to cancer detection.

Some marine species can see polarized light, allowing them to thrive in shallow, sunlit water. “I don’t know if it’s as acute, but octopus do have the ability to see in and out of water, which is pretty crazy,” says Spencer, who is also an animal enrichment coordinator. She says that the Giant Pacific octopus she cares for watches her as she prepares its food and puzzles.

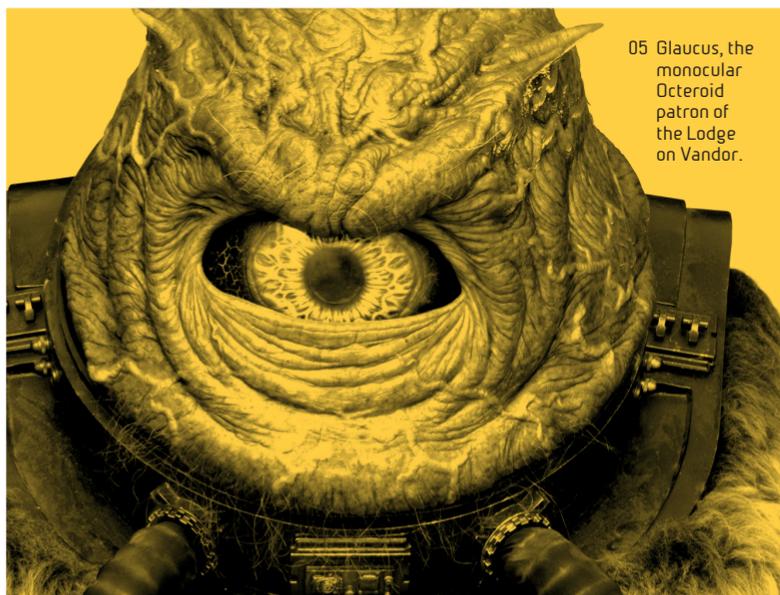
“Our brains can’t even imagine what it means to see polarization or magnetic fields, but other organisms can do this.”

Dr. Derek Welsbie

Research suggests that octopus vision is highly dependent on oxygen levels, meaning it likely shifts as they travel from the surface to deeper water and move between tidepools. It also means that they are sensitive to low oxygen zones, called dead zones, that are increasing due to climate change.

“Our brains can’t even imagine what it means to see polarization or magnetic fields, but other organisms can do this,” says Welsbie. This potential takes on new meaning in *Solo: A Star Wars Story* (2018), during the sabacc game in Fort Ypsa. As Han and Lando banter, the rest of the table may be gaining an advantage. Is there a vision adaptation that could allow someone to cheat? If so, are sabacc cards printed on something

05 Glaucus, the monocular Octeroid patron of the Lodge on Vandor.



that would prevent that? “I don’t know if you could see the opposite face of the card, but you could see through it,” says Patel. “You could see the shadows of the numbers or shapes unless the paint on the card was made of some material that wouldn’t allow light to go through.”

More Eyes

Many species in *Star Wars* have more than two eyes. “I don’t know how it works out on a biological level, but it’s a device I’ve used many times,” says concept artist Jake Lunt Davies. His design options for the fish Luke caught on Ahch-To in *Star Wars: The Last Jedi* (2017) look similar to species here on Earth, just with more eyes. “A lot of it is thinking ‘Wouldn’t it be cool if...’ and asking myself, ‘How can I make this feel a bit more alien by adding more eyes,’” he says, admitting that he has trouble drawing fish because they already seem so alien.

As for the six-eyed vexis serpent in *Star Wars: The Rise of Skywalker* (2019), each set could specialize in a different type of sight—some perceiving visual light, others infrared, even a set with larger pupils to see in the dark—with all that information processed together. The 20-eyed Boosodian on Kijimi is an extreme case, shown in the movie for only a few seconds in a blink-and-you-miss-it moment.

There are species on Earth with more than two eyes, usually specialized so that some eyes perceive light and others movement. Starfish similar to the stowaway on the *Razor Crest* in Season Two’s episode “The Heiress” have eyes on each of their legs, though scientists are still learning about their vision. There are also fish called anableps that have four pupils, two per eye. “They sit up at the top of the water and they have two pupils above the water and two pupils below the water,” says Spencer.

Making a Spectacle

Presumably due to technological advancements, no one in the *Star Wars* galaxy ever had to wear glasses, but there are many reasons



ANIMAL ACTORS

Star Wars creature concept artist Jake Lunt Davies is encouraged to indulge his creativity, but also has to consider functionality when his designs will be turned into costumes for animal actors. The orbaks that Jannah and the other stormtrooper defectors rode in *The Rise of Skywalker* were really horses in disguise. Horses have panoramic vision, with large pupils in large eyes on the sides of their heads. Blinders help them focus but there’s a limit to how much of their vision they will tolerate being blocked. “There’s a minimum size aperture for a horse to look through and be happy and at ease,” says Lunt Davies. “So, we were left with this big hole to fill without resorting to CG.” In the case of the orbaks, that meant positioning their eyes upwards on their head and adding large nostrils through which the horses could see out of.

Horse actors also portrayed the kod’yoks in *Solo: A Star Wars Story*, although they only made an appearance on the movie’s poster. In order to leave their eyes relatively clear, Lunt Davies filled in the space with a compound eye similar to those found in insects.



corrective or protective eyewear could be needed. “The overall light intensity, UV exposure, or even keeping irritants out of your eye could be very important,” says Welsbie. Rey wore goggles during her scavenging days, for example. Made from the lenses of a stormtrooper helmet, which would have provided protection from the dry heat and sand of Jakku, and may also have had working tech that gave her an advantage.

Other factors include the atmospheric pressure on foreign worlds, and gasses or other substances that could be toxic to some species. Jedi Master Plo Koon wears both goggles and a respirator, indicating that these are necessary accommodations a specialized species might have to make to live in any number of different environments. It’s surprising that more *Star Wars* species don’t need such technology to travel freely about the galaxy. Maz wears goggles, but perhaps this is due to her age. ►

06 Octopus vision is affected by the level of oxygen in the water it inhabits.

07 Infrared light is visible to some species of Earthbound frog.

▶ Han Solo's imprisonment in carbonite lead to his own vision impairment. Welsbie's diagnosis: "Lenses become cloudy at cold temperature, so he could have had an opaque lens, and as he warmed back up, that could clear."

Mechanical Means

There is a wide array of synthetic photoreceptors found in droids. But are eyes on droids even necessary? Most likely not, though many robots both fictional and real have similar proportions and features to their makers. The bounty hunter 4-LOM has compound eyes similar to flies and, more importantly, to the Gand species who use the LOM-series droids. Indeed, when Jake Lunt Davies designs protocol droids for non-human species, he reveals that he gives them the characteristics of those they serve.

"Usually you see the two-eyed droids, like C-3PO, interacting with people," says Patel. "Although a droid doesn't need two eyes," adds Welsbie. "The only reason that you would do that is because you want the droid in question to look friendly."

Lunt Davies also designed D-O, whose odd number of photoreceptors were part of his original vision. "I loved the idea of him having this asymmetric amount of eyes," he says. "It



08 The design and arrangement of synthetic droid "eyes" can be arranged to suit the aesthetic or practical needs of their makers.

would have been too easy to give him two eyes, it would have been too anthropomorphic."

Glowing Eyes

There are also instances of electric eyes in seemingly organic life forms. Although it's a mystery what Jawas look like under their robes, they are known for the lights shining out from beneath their hoods. Interestingly, their eyes are yellow on Tatooine but red on Arvala-7. Lunt Davies assumes the difference was an editorial choice, putting a new spin on a legacy species. Patel, however, has a potential explanation. "They are different planets, so maybe their different atmospheres change how the Jawa's eyes appear," he says. "It's the reindeer thing!" adds Welsbie, referencing how they change the color of their *tapetum lucidum* according to environmental factors.

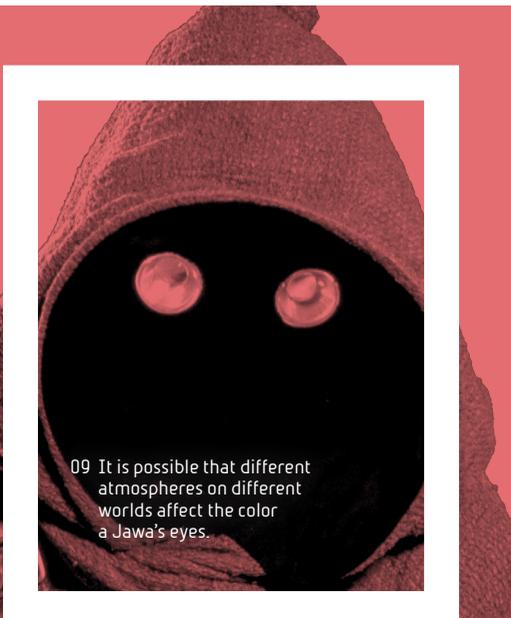
While it doesn't exactly glow, the Northern stargazer fish has organs in its eyes that produce an electric shock. "I remember learning that in school, and I was like, 'Life just

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keeps getting crazier,'" says Spencer. Another entry for Lunt Davies' assertion that fish seem like aliens.

There are many discoveries left to be made, and a rich diversity of life to be explored on Earth. The *Star Wars* galaxy is made up of species that evolved on their own worlds and now travel among the stars. Their advancement, like much of ours, is due to harnessing those adaptations into technology. After all, hyperspace travel was inspired by the natural ability of purrgil. An understanding of the natural world has the potential to advance civilizations. "There's so much more to learn," confirms Santana. 🌌



09 It is possible that different atmospheres on different worlds affect the color a Jawa's eyes.