



FLEAS: AMAZING JUMPERS THAT CAN CARRY PATHOGENS

Gustavo Seron Sanches, Lorena Freitas Neves, Daniel Antônio Braga Lee, Eliz Oliveira Franco and Marcos Rogério André*

Vector-Borne Bioagents Laboratory (VBBL), Department of Pathology, Reproduction and One Health, School of Agricultural and Veterinarian Sciences, São Paulo State University (UNESP), Jaboticabal, São Paulo, Brazil

YOUNG REVIEWERS:



ETHAN
AGE: 11



SUBHANG
AGE: 8

Have you ever seen some small dark brown bugs jumping off your pets? Those creatures might have been fleas. Fleas are insects specialized for feeding on blood, with long, strong legs for jumping and claws for holding onto your pet tightly. Fleas use many animals, including humans, as “hotels” and “restaurants”. Even if pets try to scratch and shake to kick out these unwelcome guests, it does not work! They hang on with their claws and keep eating for free. In addition to being nasty, fleas can carry diseases that they can transmit to animals when the fleas feed, or if the animal eats them accidentally. So be careful if these tiny insects decide to visit your pet’s skin! Do you want to learn more? Keep reading, and we will introduce to you some curious facts about the lives of fleas.

A BRIEF HISTORY OF FLEAS

Fleas are tiny incredible insects that live among us. Although the history of fleas is poorly studied, there are a few known fossils of

these organisms from the mid-Mesozoic Era, more than 66 million years in the past. The evolution of fleas is interesting since fossils from the Jurassic period of the Mesozoic Era show that the ancestors of fleas were nasty-looking creatures and, in some cases, these ancestors looked very different from today's fleas [1]. The fact that they may have been on Earth since the time of the dinosaurs makes fleas fascinating insects.

WHAT DO FLEAS LOOK LIKE?

Maybe you have never seen a flea up close—you might only know them as tiny, dark brown spots jumping off your pet. Fleas are small (1.5–3.2 mm long), dark brown, oval-shaped insects with thin, flat bodies. They cannot fly because they do not have wings, but they are among the best jumpers in the animal world [2]. Fleas have six long legs, and the hind pair is extra-long, giving fleas amazing jumping ability. Some species can jump up to 200 times their body length. In practical terms, if 1.5 m tall children had the same jumping ability as a flea, they could jump about 300 m into the air—the height of the Eiffel Tower!

Under a magnifying glass, you can see more details of the flea's body (Figure 1). The body is divided into the head, thorax, and abdomen. The head is helmet-shaped, with mouthparts that are specialized for piercing the host's skin, allowing the flea to suck blood. Fleas have two eyes that can detect light and a pair of antennae. Some species have rows of spines on their bodies, called the **ctenidium**. A flea's body is covered with hard, smooth plates, like armor, and they have bristles on those plates that all point in the same direction to move through the host's fur more easily. On both sides of the flea, there are pores called **spiracles** that the flea breathes through. Fleas also have a sensory structure called the **pygidium** that detects air currents.

CTENIDIUM

Sharp and pointy spines arranged as a comb, allowing the flea to hold onto their host while they feed.

SPIRACLES

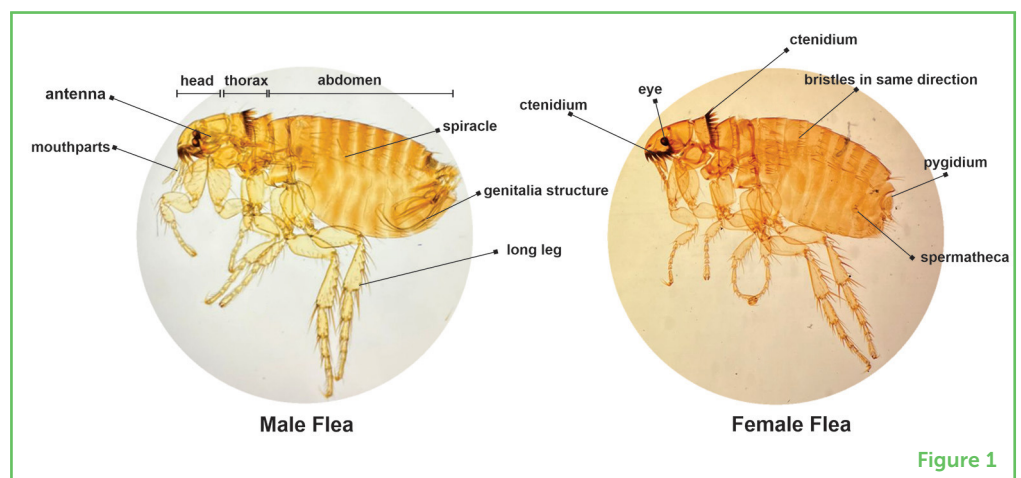
Tiny holes that many insects use to breathe, including fleas.

PYGIDIUM

A sensorial structure located in the rear end of fleas that help them feel the environment.

Figure 1

Main body structures of the cat flea, as seen through a laboratory magnifying glass.



SPERMATHECA

Kind of a storehouse where female fleas and other insects produce and keep their eggs.

SPECIES

Groups of living things that look similar to each other, like dogs or birds.

Some scientists believe that fleas may communicate with each other by producing high-frequency sounds through their spiracles. These sounds might be picked up as vibrations by the pygidium bristles of another flea. Generally, the backs of female fleas are convex (curved outwards), while males' backs are nearly straight. Male fleas have complex genitals, with the phallus (male sexual organ) normally coiled up within the abdomen [3]. When male and female fleas reproduce, the male's sex cells must reach the female's sex cells to produce eggs. Females have a structure called the **spermatheca**, which is responsible for storing the sex cells that are deposited by the male flea.

NOT ALL FLEAS ARE THE SAME

At first glance, all fleas look the same in body shape and coloration, but if we look more closely, we can see that some have different shapes and structures. Organisms that share common characteristics and can make babies together are considered the same **species**. Each species is given a scientific name. Currently, more than 2,500 flea species are known worldwide, most of which infest animals, including dogs, cats, rabbits, rats, foxes, pigs, goats, raccoons, and some birds. A few flea species even infest humans [4].

WHERE ARE FLEAS FOUND?

Most flea species live in tropical regions, where the warmth and humidity help them to develop. By hitching a ride on animals, fleas have been transported to various environments and have adapted to live in many conditions. Did you know that fleas can even live in very, very cold places like Antarctica? Although fleas prefer warm weather, there are some super-tough fleas that can infest seabirds, and they can be found in Antarctic and sub-Antarctic regions. In summary, while fleas are more common in areas with warmer climates, they are established in almost every environment on Earth. So, whether you are on a tropical sunny beach, high in a snowy mountain, deep in a humid rainforest, or a desert, there is a chance you might encounter these pesky little insects!

LIFE CYCLE OF FLEAS

Fleas go through a lifecycle that consists of four stages (Figure 2):

Egg

Female fleas lay up to 50 eggs per day on their host animal. Those eggs do not stick to the host and usually fall down. This means that flea eggs can be found anywhere inside our houses (for example, in carpets, sofas, or bedding) or in outdoor areas (in grass, sand, dirt, and nests). Flea eggs are tiny and hard to see, so it is almost impossible to

Figure 2

Life cycle of fleas, from eggs to adulthood. The entire life cycle generally takes 21–28 days.

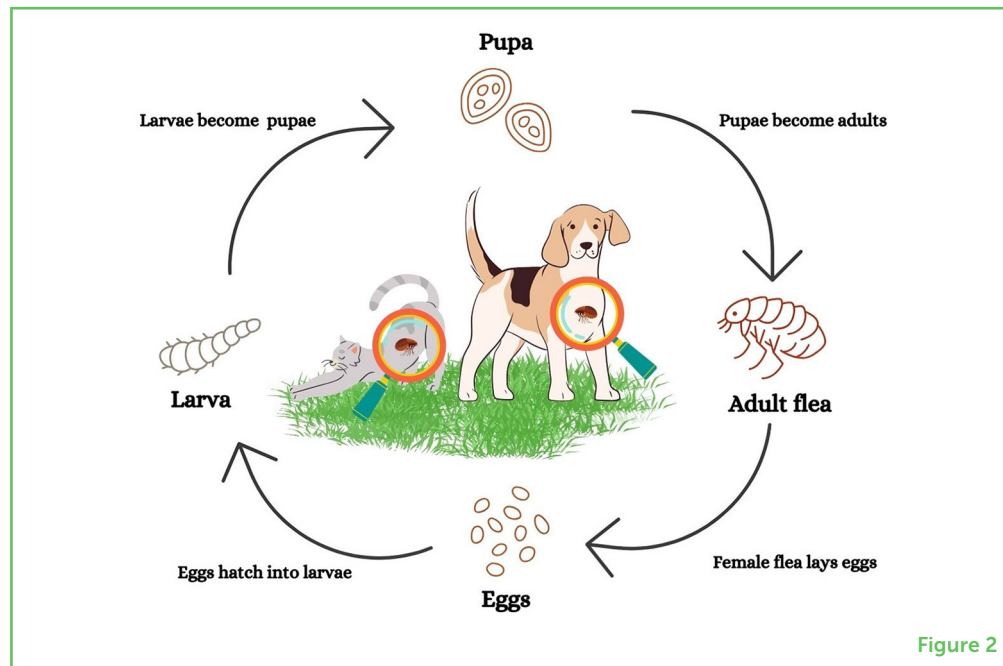


Figure 2

find one. When conditions of temperature and humidity are right, eggs hatch within a few days.

Larvae

Once the eggs hatch, they develop into larvae. Larvae look like tiny white worms, and they really do not like sunlight, so they crawl into dark, humid hiding places where they can have their favorite meal: **organic matter** from the environment. When the eggs do not fall off the host animal, the larvae feed on their parents' poop (yuck!) or skin cells from the host.

Pupae

After about 1–2 weeks of feeding, larvae start the **metamorphosis** into the pupal stage. Each larva spins a cocoon made of a silk-like material to protect itself. The cocoon is very sticky and helps camouflage the pupa. Pupae can remain in cocoons for several weeks to months since they do not have to feed and can wait until environmental conditions are perfect to emerge as adults.

Adult

The adult flea emerges from the cocoon once the weather is warm and potential hosts are nearby. At this stage, fleas are fully developed and ready to start looking for hosts to feed on for blood. Both male and female fleas take several blood meals daily. Once they enter their new home, they start the life cycle again by feeding, reproducing, and laying eggs.

Generally, adult fleas can live for 2 or 3 months, but they can only survive a few days or weeks without attaching to a host. The entire life

ORGANIC MATTER

Any material or residues from a living or non-living organisms.

METAMORPHOSIS

The period when an animal undergoes a transformation of their body; for example, when a caterpillar changes into a butterfly or when a pupae changes into an adult.

cycle of cat fleas, for example, usually is completed in 21–28 days. The cycle can be influenced by humidity, temperature, amount of light, and host availability. The knowledge about the lifecycle of fleas is essential for developing effective flea control and prevention.

PATHOGENS

Very tiny germs that can make humans or animals sick.

ARE FLEAS DANGEROUS?

Fleas can transmit **pathogens**, like harmful bacteria, to humans and their pets, and they can also cause itching and redness of the skin, called allergic dermatitis. Cat fleas are responsible for transmitting the bacterium *Bartonella henselae* to humans, which can cause an illness called cat scratch disease. In this case, the bacteria are released in flea poop when they take a blood meal from an infected cat, which usually is not sick. When the flea-infested cat scratches and grooms itself to get rid of fleas, contaminated flea poop get under its claws and into its mouth. The cat can then transmit the bacteria to humans through bites and scratches [4]. As you can see, fleas can be a health risk, and the close relationships between humans and animals create situations where these diseases are more likely to occur. In addition to bacteria, cats and dogs can be infected by parasites called tapeworms if they eat fleas that are infected with tapeworm larvae [5]. Infected pets can have diarrhea and they usually rub their butts on the floor to show they are not feeling well.

PROTECTING OURSELVES AND OUR PETS FROM FLEAS

Controlling the presence of fleas is essential to keep humans and their pets healthy and protected from flea-borne diseases. It is not enough to control fleas only on pets—fleas, eggs, and larvae must also be eliminated in the environment. So, it is important to clean indoor and outdoor spaces to remove the fleas at all stages of their life and organic matter that feeds flea larvae. Veterinarians can prescribe anti-flea sprays, soaps or shampoos, oral medications, and collars to prevent flea infestation [6].

TAKE HOME MESSAGE

Fleas have characteristics and a life cycle that allows them to survive in the environment and on animals. The adult fleas you may see on pets represent 5% of the fleas in the area where that pet lives. The remaining 95% of fleas are in the environment as eggs, larvae, and pupae. When these fleas become adults, they look for hosts to feed on. Therefore, to prevent flea infestations, it is important to treat pets and clean the environment where our pets live. When fleas are taking their blood meals, they transmit pathogens to animals and humans. But do not worry! Now you can recognize fleas and know how to prevent them. Be sure to inform your parents if there is any signs of fleas in

your home or on your pets. If you notice that your pet is sick after a flea infestation, you should visit the veterinarian to help your pet get healthy and prevent any problems.

REFERENCES

1. Rasnitsyn, A. P. 1992. *Strahshila incredibilis*, a new enigmatic mecopteroid insect with possible siphonapteran affinities from the Upper Jurassic of Siberia. *Psyche: J. Entomol.* 99:323–33. doi: 10.1155/1992/20491
2. Sutton, G. P., and Burrows, M. 2011. Biomechanics of jumping in the flea. *J. Exp. Biol.* 214:836–47. doi: 10.1242/jeb.052399
3. Saari, S., Näreaho, A., and Nikander, S. 2019. *Canine Parasites and Parasitic Diseases*. Cambridge, MA: Academic Press, 159–85. doi: 10.1016/B978-0-12-814112-0.00008-8
4. Bitam, I., Dittmar, K., Parola, P., Whiting, M. F., and Raoult, D. 2010. Fleas and flea-borne diseases. *Int. J. Infect. Dis.* 8:3667–76. doi: 10.1016/j.ijid.2009.11.011
5. Rousseau, J., Castro, A., Novo, T., and Maia, C. 2022. *Dipylidium caninum* in the twenty-first century: epidemiological studies and reported cases in companion animals and humans. *Parasit. Vectors* 15:131. doi: 10.1186/s13071-022-05243-5
6. Hnilica, K. A. 2011. "Hypersensitivity disorders", in *Small Animal Dermatology: A Color Atlas and Therapeutic Guide*, 3rd ed., ed. K. A. Hnilica (Oxford: Elsevier Saunders), 210–212.

SUBMITTED: 30 July 2023; **ACCEPTED:** 04 April 2024;
PUBLISHED ONLINE: 19 April 2024.

EDITOR: [Martha Helena Ramírez-Bahena](#), University of Salamanca, Spain

SCIENCE MENTORS: [Alejandro Acevedo-Gutierrez](#) and [Suhana Chattopadhyay](#)

CITATION: Sanches GS, Neves LF, Lee DAB, Franco EO and André MR (2024) Fleas: Amazing Jumpers That Can Carry Pathogens. *Front. Young Minds* 12:1269791. doi: 10.3389/frym.2024.1269791

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

COPYRIGHT © 2024 Sanches, Neves, Lee, Franco and André. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

YOUNG REVIEWERS



ETHAN, AGE: 11

My name is Ethan. I play the piano and go to middle school. I like video games and to read. My favorite thing to do is hang out with my friends, play video games, and read. I have a one-eyed pug named Loki. I love sharks and when I am older, I want to be a conservation biologist and swim with sharks. I also want to design electric and hybrid cars.



SUBHANG, AGE: 8

Subhang's fascination lies in the world of numbers and outer space. He enjoys learning about the earth, its diverse ecosystems, and the creatures that inhabit it. Maths is his favorite subject. He loves spending time with his LEGO constructions and perfecting his violin skills.

AUTHORS



GUSTAVO SERON SANCHES

Gustavo Seron Sanchez is biologist and postdoctoral researcher in the Vector-Borne Bioagents Laboratory (VBBL). Currently, he is working with tick cell cultures as a way to understand tick-pathogens interactions, and with molecular detection of pathogens in ticks. In his free time, you can find Gustavo at home with his two cats, playing with his dog, at the gym, or maybe traveling around the world.



LORENA FREITAS NEVES

Lorena Freitas Neves is a veterinarian and a master's degree student in veterinary sciences at Universidade Estadual Paulista/FCAV in Jaboticabal-São Paulo. Although Lorena is seeking to improve her knowledge, she also has diverse interests in her free time. Games, books, and writing are her favorite activities! Lorena also enjoys spending time with her friends and family, including her dog Theo and her cat Evie.



DANIEL ANTÔNIO BRAGA LEE

Daniel is a veterinarian who graduated from the Federal University of Sergipe (2022) and is currently working as a master's student at the Vector-Borne Bioagents Laboratory (VBBL) at the São Paulo State University (UNESP/FCAV). Daniel has experience in parasitology, molecular biology, and vector-borne diseases. In addition to working as a researcher, Daniel also enjoys playing the guitar, riding his bike around, going to the gym, and playing with his pets.



ELIZ OLIVEIRA FRANCO

Eliz Oliveira Franco is a veterinarian and is studying for a mast's degree in veterinary sciences at Universidade Estadual Paulista, Jaboticabal - São Paulo. Eliz is passionate about learning and teaching. In her free time, she likes to watch series, walk with her dog, Toby, and pet her cats, Silvinha and Vitória.



MARCOS ROGÉRIO ANDRÉ

Marcos Rogério André is an associate professor of veterinary parasitology at São Paulo State University, Jaboticabal, São Paulo, Brazil. He teaches veterinary undergraduate students about parasites of pets and farm animals. He is also the chief of the Vector-Borne Bioagents Laboratory (VBBL), where he mentors graduate biologists and veterinarians who seek to discover cool things about parasites. In his free time, you can find Dr. André playing with his French bulldog Peanut, working out in the gym, or traveling around the world. *mr.andre@unesp.br