**communications** biology

A Nature Portfolio journal

Q&A

https://doi.org/10.1038/s42003-025-08166-w

# Inspiring scientific wonder, curiosity and critical thinking in young minds: an interview with Audrey Dussutour

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**Audrey Dussutour is a Research Director at the National Center for Scientific Research (Toulouse, France), specializing in the adaptive behaviors of ants and slime molds. She has authored over 70 scientific papers and four award-winning science books. Dr. Dussutour has led two influential citizen science projects: "Raise Your Blob", engaging 350,000 students, and "Behind the Blob", mobilizing 15,000 volunteers to study climate change impact on slime molds. Her science communication efforts have been recognized with the National Order of Merit and the first CNRS Medal for scientific outreach. In this Q&A, she discusses the fascinating world of social insects and slime molds, the challenges of pursuing basic research outside mainstream funding priorities, and the importance of science education.**


Credit: Audrey Dussutour and David Villa

**You have worked with several species of social insects, including honeybees, ants, caterpillars, termites and fruit flies. Where does your passion for these small creatures come from?**

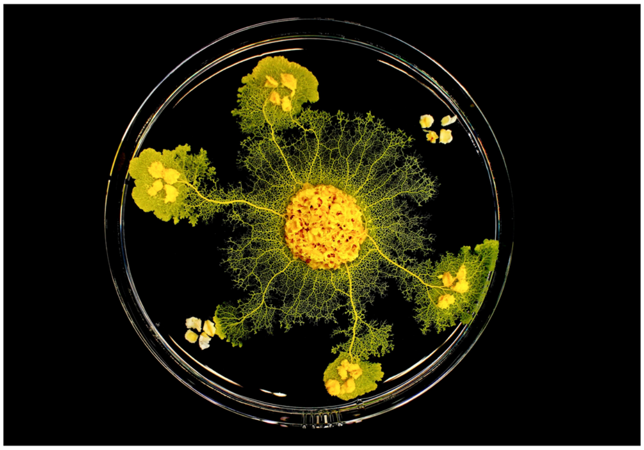
I come from a very modest family and grew up in an incredibly small village of just 150 inhabitants, so the natural world was my only playground. The countryside surrounding our village teemed with biodiversity, particularly insects that fascinated me from an early age. I would spend hours observing and collecting different species, carefully studying their behaviors and interactions (sometimes cannibalistic…). This childhood curiosity developed into a profound scientific interest as I pursued my education. What particularly draws me to social insects like ants, caterpillars, termites… is their remarkable collective intelligence. Despite their tiny size, these creatures create sophisticated societies that rival human organizations in complexity. I've dedicated my research to understanding how these small beings can together create such intricate and adaptive collective behaviors. I've also witnessed concerning declines in insect populations since my childhood explorations, which has added environmental urgency to my work. Studying these species isn't just intellectually fascinating but increasingly important for conservation and understanding ecosystem health.

**From your point of view, what is the most captivating thing that ants can do? Are there aspects of their collective behavior that humans could learn from?**

For me, the most captivating aspect of ants is their sophisticated interactions with other species. Leafcutter ants, for instance, have been cultivating fungi for over 50 million years - far longer than humans have practiced agriculture. What fascinates me is how they face remarkably similar challenges to human farmers yet develop entirely different solutions. Leafcutter ants cultivate their fungal gardens with incredible precision, managing the same fundamental problems we encounter: controlling and eliminating pathogens, maximizing yields. They've evolved impressive symbiotic relationships with antibiotic-producing bacteria. These bacteria, often carried on their cuticle, produce compounds that specifically target parasitic fungi that threaten their crops. The ant-fungi-bacteria relationship represents a sophisticated biological control system that has remained sustainable for millions of years. Humans could certainly learn from this approach to agriculture - particularly how ants have developed solutions that work with natural systems rather than against them. I believe ant colonies offer profound lessons in decentralized problem-solving and adaptive resource management. No single ant understands the colony's complete operations, yet together they create remarkably efficient systems through simple interactions and feedback loops. This decentralized intelligence demonstrates how complex, adaptable systems can emerge without central control, a concept increasingly relevant to human challenges from organization management to sustainable agriculture.

**Slime molds are fascinating organisms and the discoveries that you and your colleagues have made are truly remarkable. Can you tell us a bit more?**

Cellular slime molds (*Physarum polycephalum*) are truly fascinating organisms. Despite being unicellular organisms, they're visible to the naked eye, and some can grow to cover several square feet (they look like scrambled eggs)! These organisms possess a unique architecture consisting of an elaborate network of veins that transport nutrients throughout the cell and serve as a locomotor system. The pioneering work of Toshiyuki Nakagaki (who I like to call "the master of slime molds") has demonstrated these organisms' surprising problem-solving abilities. His experiments revealed that slime molds can find the shortest path through mazes, anticipate events and even design optimized networks that often mirror human-engineered systems like railway networks or highway systems. My research specifically focuses on decision-making and learning capabilities in these organisms that



Credit: Audrey Dussutour

lack a nervous system. This work falls within the field of basal cognition, a discipline largely established by Michael Levin and Pamela Lyon, which investigates cognitive processes in organisms without conventional neural architectures. What's particularly intriguing is how these seemingly simple organisms can exhibit complex behaviors that are typically associated with brains. For example, we've discovered that slime molds demonstrate a form of learning called habituation, despite having no neurons. These findings challenge our traditional understanding of cognition and suggest that cognition might be a much more fundamental property of life than we previously thought - existing even at the cellular level. By studying these primitive forms of information processing, we gain insights into the evolution of cognition.

**The word *intelligence* is very popular these days. Could you explain the concept of "distributed intelligence" and how both ants and slime molds use it to solve problems and make decisions?**

The concept of "distributed intelligence" represents a paradigm shift in how we understand problem-solving. Unlike centralized intelligence, where a single brain or processing unit controls all functions, distributed intelligence emerges from interactions between multiple components without any central control. In ant colonies, this manifests through thousands of individuals following simple rules and responding to local information. No single ant comprehends the colony's complete operations or "plan", yet collectively they solve complex problems like finding optimal foraging routes, building sophisticated nests, and efficiently allocating labor. Each ant responds to chemical signals, physical encounters, and environmental cues, creating a system where intelligence emerges from their collective interactions. Slime molds also demonstrate distributed intelligence. *Physarum polycephalum* contains thousands of nuclei sharing a common cytoplasm. Information processing occurs across its network of veins, with different regions responding to local stimuli and communicating through rhythmic vein contractions and chemical signals. When encountering food sources or obstacles, these local responses propagate throughout the organism, enabling the slime mold to make decisions as a unified entity without any centralized control mechanism.

**What are you currently working on that you are particularly excited about?**

I'm particularly excited about two research directions that are pushing the boundaries of our understanding of unicellular biology. My primary focus is investigating how memory is encoded at the cellular level in organisms without neurons. This is a fundamental question that challenges our traditional understanding of learning and memory. I'm tackling this research in collaboration with Saad Bhamla and Wanze Chen, supported by Human Frontier Science Program funding. We're exploring the biophysical and molecular mechanisms that allow single cells (immune cells or ciliates) to store and retrieve information. This work could potentially reveal entirely novel mechanisms of information processing in biological systems. My second major research interest revolves around slime mold rejuvenation. We've already demonstrated this remarkable phenomenon at the behavioral level - showing that these organisms can essentially reverse aging processes under certain conditions. Now I'm eager to uncover the cellular and molecular mechanisms behind this ability, but this would depend on funding that I could acquire…

**Basic research projects are often deprioritized by governments and funding agencies in favor of innovative and therapeutic initiatives. How do you deal with these constraints to conduct globally competitive research? Does working with limited resources make you a more creative scientist?**

I'd like to be candid about the current situation. I cannot conduct globally competitive research right now because I lack essential technical support. In France, research funding should theoretically reach 3% of GDP, but we're far below that target and lagging behind other European countries. The reality is that researchers are drowning in administrative tasks and responsibilities that shouldn't be ours, but because support staff positions aren't being filled, we're stuck handling these duties ourselves. We also spend an inordinate amount of time searching for funding rather than conducting actual research. The 2025 Finance Act in France includes an unprecedented cut of more than 600 million euros to the public research budget. Our senate has explicitly stated that our future depends on targeted, sustained and strong support for nuclear, space and digital research… This means research focused on understanding life, protecting our ecosystems, studying climate change effects is clearly not considered a priority for "our future".

I don't really buy into the romantic idea that financial constraints fuel creativity. In reality, limited resources don't spark innovation, they wear you down. When you can't cover basic needs or bring in the right expertise for your work, it's not inspiration that follows, it's frustration. And that stifles creativity more than anything. Fundamental research like studying slime mold cognition might seem esoteric, but it's precisely this type of curiosity-driven science that often leads to unexpected breakthroughs. Unfortunately, the current funding landscape makes pursuing such work increasingly difficult.

**What advice would you give to a young researcher interested in pursuing basic research that is not on the radar of most funding organizations?**

First, maintain your passion project in fundamental research while simultaneously working on adjacent questions that might attract more conventional funding. This isn't about compromising your scientific integrity, it's about creating financial stability that allows you to pursue your core interests. For instance, I worked with a company (LABSOFT) that was interested in applying slime mold network principles to telecommunication systems. This collaboration focused on finding nature-inspired solutions to reduce energy consumption and decrease the carbon footprint of telecommunications infrastructure. This partnership was mutually beneficial, as it allowed me to secure funding for student salaries and equipment while still exploring fascinating research questions.

Second, become resourceful! Learn to design elegant experiments that answer profound questions with minimal equipment. Some of the most groundbreaking discoveries came from remarkably simple setups. With slime molds, for instance, many fundamental experiments require little more than petri dishes, agar, and careful observation.

Third, build international collaborations. When resources are limited locally, partnerships across institutions can provide access to equipment, expertise, and sometimes funding opportunities you wouldn't have otherwise.

Fourth, explore alternative funding sources. Beyond traditional government grants, look into philanthropic foundations, crowdfunding platforms for science, and industry partnerships that might value your work from angles you haven't considered.

Finally, communicate your research passionately and broadly. Public interest can sometimes translate into support, whether through citizen science initiatives, private donations, or eventual policy changes. Make your fundamental questions accessible to non-specialists. You have to convince the public that basic research is the foundation upon which all scientific progress ultimately rests and that it expands our understanding of the world (which in itself should be enough…).

**You have received several prestigious awards for your research and your outreach activities like visiting schools with the aim of engaging kids in science. What is your motivation to invest so much time in science education?**

My motivation for investing significant time in science education stems from several deeply held convictions. First, I believe people would be more ready to defend scientific research and vote for positive change if they truly understand what scientists are doing. When the public comprehends the value and process of scientific inquiry, they become our best advocates. Second, our future challenges will be increasingly rooted in science. Take climate change, for example - understanding its mechanisms, impacts, and potential solutions requires scientific literacy. When citizens understand the science behind climate projections, they can make informed decisions about energy policies and adaptation strategies rather than being swayed by misinformation. By engaging with young people in schools, my goal is to prepare the next generation to approach these problems with critical scientific thinking. Third, I want to show girls that women can succeed in science. Despite progress, science remains largely a male-dominated field and most scientific institutions in France are still led by men for instance. By being visible as a woman scientist and directly interacting with young girls in classrooms, I hope to counteract stereotypes and encourage them to envision scientific careers for themselves. All the outreach activities I'm pursing (citizen science, school visits, conference for the public…) aren't separate from my scientific mission, they're an essential extension of it. Inspiring curiosity, critical thinking, and scientific wonder in young minds not only secures the future of science but also helps create a society better equipped to address the challenges we face.

**You have also written several books for a general audience about slime molds and ants. Could you briefly tell us about your new book?**

Actually, my new book was just released in mid-April 2025! It's a hybrid between science fiction and a scientific book. The book focuses on fungal parasites, exploring their evolutionary history, their remarkable ingenuity, and their many wonders. I wanted to create something that would convey the fascinating science behind these organisms while also capturing readers' imaginations through storytelling. My hope was to make the complex and often overlooked world of fungal parasites accessible to a general audience. These organisms have evolved extraordinary strategies for survival and reproduction - strategies that often seem like science fiction. In fact, they're not just like science fiction; they're better!

*This interview was conducted by Associate Editor Benjamin Bessieres.*

Published online: 13 May 2025