

Dan Salah Tawfik (1955–2021)

Dan Tawfik suddenly left us on 4 May, 2021. His scientific intuition led him to articulate, and solve, many key questions related to protein chemistry and molecular evolution. Although science, particularly for his students, postdoctoral fellows and colleagues, is dimmer after his loss, his legacy will persist.

Danny appreciated the complexity and simplicity of nature. He often referred to a quote from Charles Darwin: "...from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved". Like the proteins that occupied so much of his thought, his scientific interests continuously evolved over his career. He was trained as an organic chemist and subsequently moved into biochemistry, enzymology, and directed protein evolution, then combining these passions to study the chemistry that underlies the evolution of biological molecules and systems.

Danny was a unique, visionary and brilliant scientist. He continually sought new questions to investigate. His ability to broadly and deeply comprehend scientific questions enabled him to quickly distil their core elements and turn these ideas into research programs for his laboratory and beyond. Science was his identity rather than his occupation, and at times it was an obsession. In his own words, "doing science was very natural for me". Danny pioneered evolutionary biochemistry and he led the way to understanding many of the basic principles that underlie the processes of protein and enzyme evolution. He originated, explored and consolidated key concepts for protein evolution, such as the link between enzyme promiscuity, function–stability trade-offs, conformational dynamics and 'evolvability'. He extended and applied those theories to study the evolution dynamics of many natural proteins, and the development of the technologies and approaches used to engineer enzymes and proteins including emulsion-based laboratory evolution, protein stability modulation for functional evolution, and neutral drift. Most recently, his work was centered around the origin of life and the emergence of primordial proteins. He demonstrated how complex protein structure could emerge from "simple yet functional" short proteins.

Danny produced a striking number of influential scientific publications while maintaining a relatively small lab group throughout his career. He led a strong and productive group, largely by investing inordinate amounts of time into discussions



Credit: Itai Belson, Photography section, Weizmann Institute of Science

with his lab members almost every day. He was a humble and very approachable mentor who cared for, and deeply respected, those working with him. He instilled in each of us the idea that science should be pursued ethically, rigorously, and creatively, and that problems should be approached from different perspectives. The respectful way in which he engaged with his team facilitated broad discussions that could range from solving small technical issues to debating deep scientific questions and new ideas for future directions in the field. Research projects can also bring insurmountable obstacles and difficult times. On such occasions, Danny provided seemingly limitless time and unwavering support.

His enthusiasm for scientific problems was contagious, and as a result, many of us undertook research careers in academia or industry. He created a global scientific family that he continuously supported. Despite his extremely busy schedule, he was always available to chat about science and life with former lab members and frequently combined business travel with an extended visit to our respective institutions. His mentorship also extended to our own lab members, and he would generously offer his time and advice to them as well. He always maintained a wonderful humility and would

engage in long conversations with virtually anybody, from professors to undergraduate students who he'd only just met.

On a personal note, Danny was a wonderful person to spend time with: intelligent, knowledgeable, curious, funny, cynical, kind and thoughtful. He appreciated and believed in diversity and equity in the research environment and, more importantly, in life. He especially supported those who came from different scientific, cultural and ethnic backgrounds and welcomed and integrated us into his group like family members. Naturally, many of us became close friends, both with him and with each other. He fostered deep and meaningful relationships within his lab, commonly inviting lab members and colleagues to his house where he would cook delicious food (in addition to his scientific accomplishments, he was a very talented chef). Visiting him in his home and interacting with his family was wonderful. Danny was a lovely father, and he was deeply proud of his children. During these dinners, as well as the everyday lunches in the Weizmann Institute of Science, he shared stories from his childhood, discussed politics, and talked of hiking and climbing spots. Danny loved nature and was particularly fond of the Israeli desert.

Science teaches us that matter and energy are eternal and dynamic. Life breaks free, moves, and transforms. It passes through one barrier after another. Nature does not know extinction, only transformation: nothing disappears. Over the course of his life, Danny embodied this principle, ever evolving, yielding ideas, questions, and principles most wondrous and beautiful. Danny's impact in science will persist and his presence will never be lost. □

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