WHY I DO SCIENCE

Freedom to Explore

To many people science is just a series of repetitive and often mundane tasks, the endless mixing of chemicals or formulation of equations. But to me science is freedom—freedom to ask what I want, freedom to get answers. I am inspired by the natural world and driven to understand how and why animals behave the way that they do. As a behavioral and evolutionary ecologist, I study the causes and consequences of complex social behaviors in birds, reptiles, and crustaceans. My research combines mathematical theory, molecular biology, endocrinology, and other disciplines with extended behavioral studies of animals in their natural environments.

Much of my work involves traveling to exotic locales to study strange creatures like Galapagos marine iguanas, African starlings, or sponge-dwelling shrimp in the Caribbean. Sometimes my life seems straight out of a nature documentary: I've been chased by rhinos, elephants, and Cape buffalo, and stalked by lions, hyenas, and sharks. But as much as observing animals in the wild inspires me, my work requires equal amounts of time in the lab. With the explosion of new tools in molecular biology and neurobiology, the study of animal behavior is itself evolving. Long days in exciting field locations are replaced by even longer nights pipetting at a bench.

One of the author's research subjects, a bristle-crowned starling.

The freedom that science offers comes at a cost. All told, I've probably spent months simply waiting in the hot sun for animals to return to their territories. I've also spent a lot of time fighting—fighting with swarms of mosquitoes and biting flies, fighting with inclement weather that disrupts work at the most inopportune times, fighting to get research permits approved by slow-moving bureaucracies. But each time I discover something new. Whether while watching birds in Africa or examining crustacean DNA in the lab, I remember precisely why I became a scientist: the freedom to explore.

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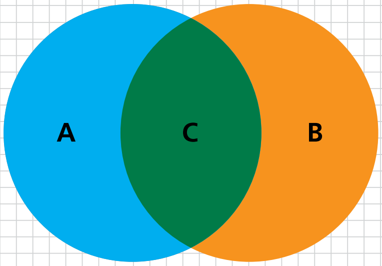
INTERSECTION

GENOPOLITICS[C] is the study of genes that influence a person's personality traits and cognitive strategies, which in turn affect their political behavior and outlook. Twin studies show associations between genes and political behavior, and genes influencing neurotransmitters have been linked to voter turnout and ideological affiliations. In the spectrum of scientific disciplines, genopolitics is the combination of **BIOLOGY**[A] and **SOCIAL SCIENCES**[B].



SCIENTIFIC METHOD

What is the ideal balance of sweet and bitter in flower nectar?

Flowering plants lure pollinators (the animals that distribute their pollen) using a smorgasbord of tastes, scents, and shapes. But some plants also infuse their nectar and flowers with bitter or toxic chemicals, repelling pollinators and raising the question of how this could boost their evolutionary fitness or number of offspring. Plant biologist DANNY KESSLER and his colleagues at the Max Planck Institute for Chemical Ecology recently tracked the effects that subtracting both bitter and sweet substances had on tobacco plant fertility, shedding light on why discouraging lingering pollinators can be evolutionarily beneficial.

Benzyl acetone is the most abundant attractant in tobacco flowers; nicotine is the most abundant repellent. Kessler and his collaborators created genetically modified (GM) *Nicotiana attenuata* tobacco plants (called CHAL, for the inserted genes) to inhibit the production of benzyl acetone, as well as plants with inhibited nicotine production (PMT) and plants where both benzyl acetone and nicotine production were inhibited (CP). These plants grew alongside unmodified plants (EV, for "empty vector"), which still produced benzyl acetone and nicotine. Kessler then trained cameras on them to see how many visitors each group attracted, while checking flowers daily to assess how much nectar remained in each; less nectar but fewer visits indicated that guests had gulped more per visit. A small number of visitors drained the benzyl acetone/non-nicotine flowers dry, while flowers with nicotine had more visitors but more nectar left over, indicating that each visitor had taken only a little of the sweet fluid. Thus, each nicotine-containing plant had more pollinators to carry its pollen to neighboring plants, which, in theory, would mean more offspring.

To see if this was the case, the team checked how many seeds in the test plot came from each genotype. Plants with nicotine and no benzyl acetone had slightly more offspring than plants with benzyl acetone and no nicotine, but each was handicapped by its inability to either attract pollinators or keep them drinking moderately. Flowers with neither were rarely visited by pollinating hawkmoths and hummingbirds, but were attacked by nectar-robbing carpenter bees, which usually avoid benzyl acetone and nicotine. Plants with both benzyl acetone and nicotine had far more offspring than any of the transformed varieties, perhaps because they could both attract pollinators and keep them from drinking too much nectar. —*Veronique Greenwood*