

# THE BUZZ ON BEES

We don't give bees much thought unless they're terrorizing us at a picnic, but they're exquisitely complex creatures. *Nature* and *Science* reported last week that the genome of the honeybee has been mapped, making it only the fourth bug to be so sequenced. Researchers have already begun studying that genetic blueprint, providing new insights into our most valuable insect—and new strategies to save it from extinction.

—Graphic by Lon Tweeten and Ed Gabel.  
Text by Jeffrey Kluger and Kristina Dell

## Why bees are in danger

Over the past 50 years, the honeybee population in the U.S. has been cut in half. Here are some reasons:

- 1 THE VARROA MITE** A tiny killer first detected in the U.S. in 1987, the mite attacks honeybee adults and larvae, wiping out a generation of young bees before they hatch
- 2 TRACHEAL MITES** First spotted in the U.S. in 1984, tracheal mites attack the respiratory system of adult bees and can kill an entire hive in a matter of hours
- 3 PESTICIDES** The wax in beehives is a natural sink for airborne toxins, and the relatively weak bee immune system is no match for such concentrations of man-made poisons

## What we stand to lose

Honeybees are responsible for up to 30%\* of food in the U.S. diet that relies on pollination—and that includes alfalfa-fed beef

\*2005 production



**ORANGES**  
17.8 billion lbs.



**GRAPES**  
15.7 billion lbs.



**APPLES**  
9.9 billion lbs.



**WATERMELONS**  
3.8 billion lbs.



**CUCUMBERS**  
2.2 billion lbs.

## Inside the honeybee

It's not easy to build a bee, as new insights into its genes and anatomy are revealing

**Brain** Smaller than the period at the end of a sentence, the bee brain owes its versatility to perhaps 200 polypeptides that drive behavior. At least 36 genes produce those chemicals

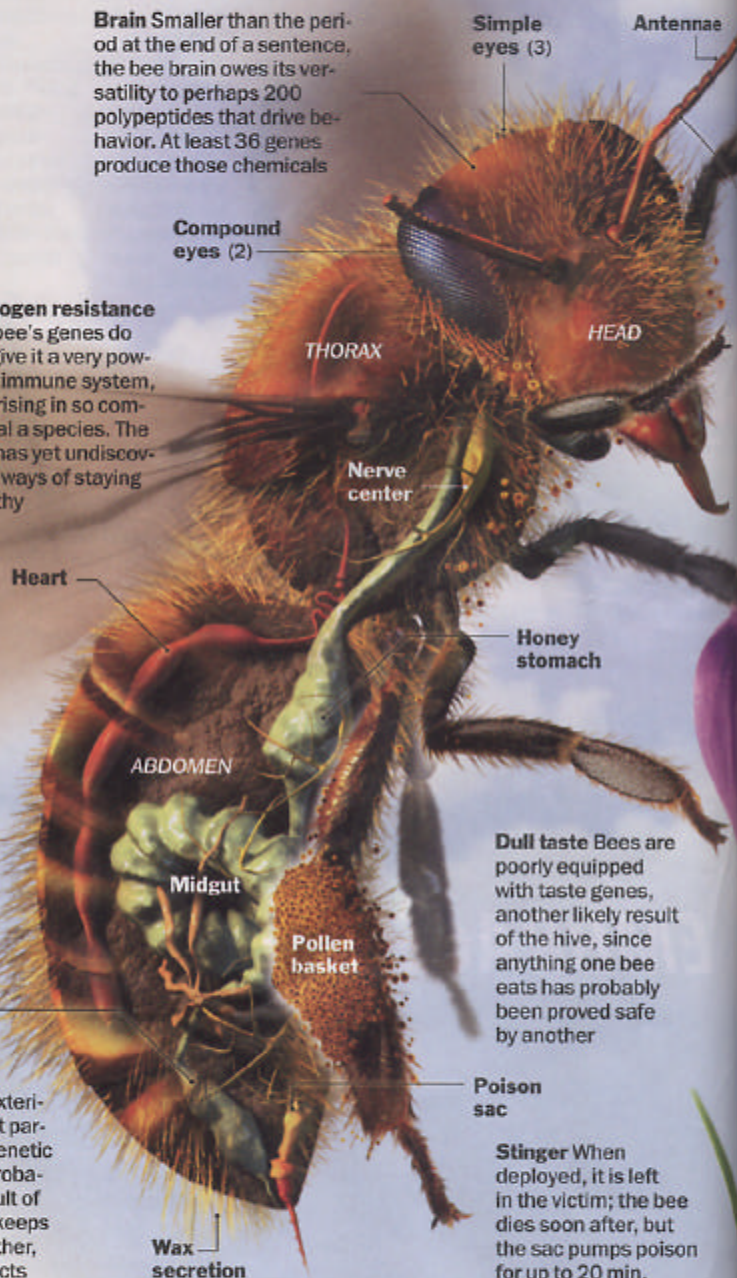
**Pathogen resistance** The bee's genes do not give it a very powerful immune system, surprising in so communal a species. The bee has yet undiscovered ways of staying healthy

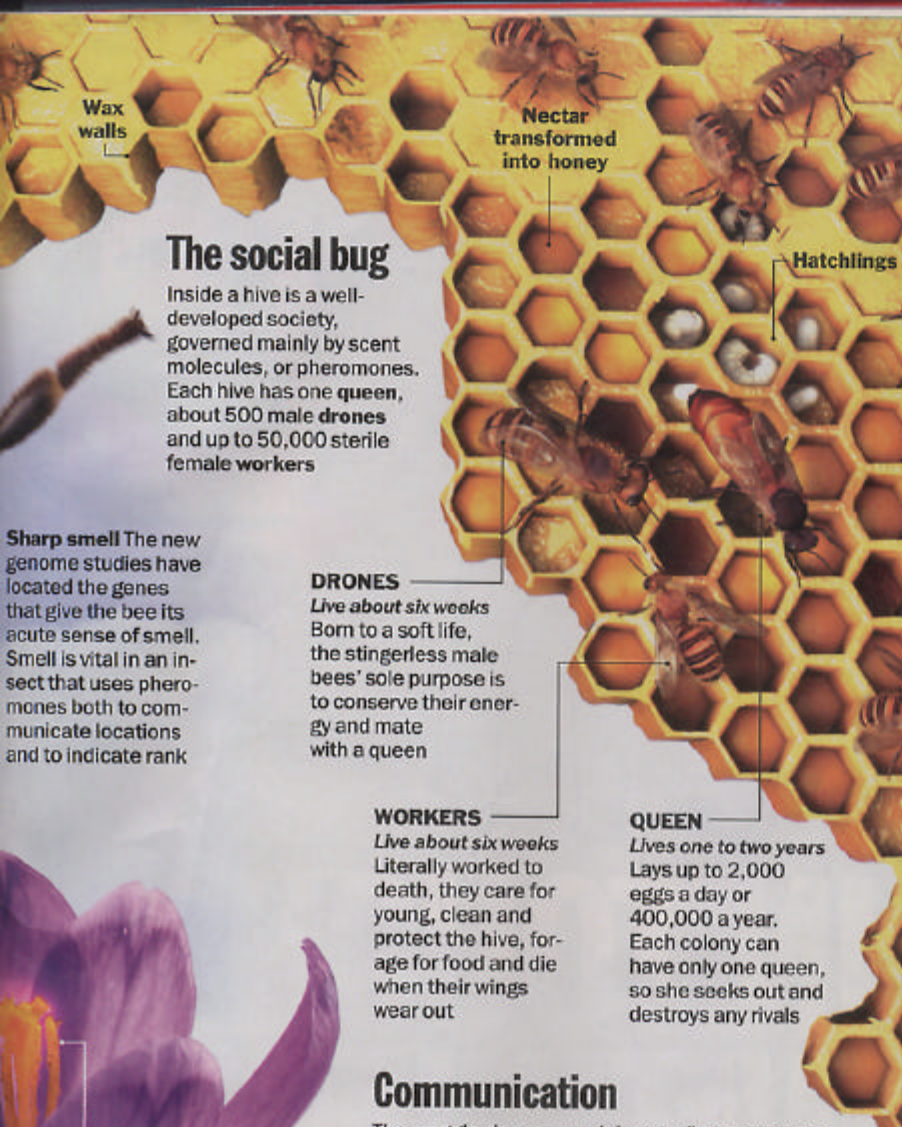
**Royal jelly** Adult bees secrete this protein mix, and all young bees are fed a portion of it. But an exclusive diet of royal jelly can transform an ordinary bee into an egg-laying queen

**Outer body** The exterior of the bee is not particularly thick, a genetic adaptation that probably arose as a result of hive living, which keeps bees safer than other, more solitary insects

**Dull taste** Bees are poorly equipped with taste genes, another likely result of the hive, since anything one bee eats has probably been proved safe by another

**Stinger** When deployed, it is left in the victim; the bee dies soon after, but the sac pumps poison for up to 20 min.





## The social bug

Inside a hive is a well-developed society, governed mainly by scent molecules, or pheromones. Each hive has one **queen**, about 500 male **drones** and up to 50,000 sterile female **workers**

**Sharp smell** The new genome studies have located the genes that give the bee its acute sense of smell. Smell is vital in an insect that uses pheromones both to communicate locations and to indicate rank

### DRONES

*Live about six weeks*  
Born to a soft life, the stingerless male bees' sole purpose is to conserve their energy and mate with a queen

### WORKERS

*Live about six weeks*  
Literally worked to death, they care for young, clean and protect the hive, forage for food and die when their wings wear out

### QUEEN

*Lives one to two years*  
Lays up to 2,000 eggs a day or 400,000 a year. Each colony can have only one queen, so she seeks out and destroys any rivals

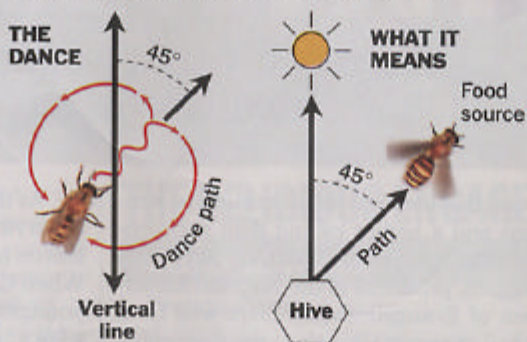


Pollen

**Pollen** As bees collect pollen for food, they also act as sex workers, scattering stray grain among male and female flower parts, allowing the plants to reproduce

## Communication

The waggle dance, an elaborate figure-eight performance, tells nearby worker bees the distance to food and its direction in relation to the sun



The number of waggles, or shakes, and the bee's pulsing sounds indicate to others how far to fly



**ALMONDS**  
915 million lbs.



**SQUASH**  
815 million lbs.



**CHERRIES** (sweet)  
502 million lbs.



**HONEY**  
175 million lbs.

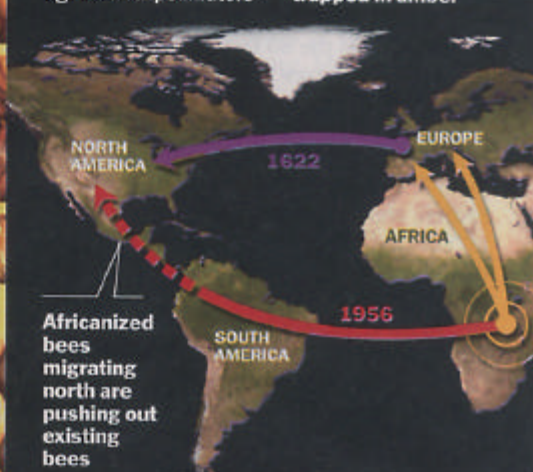
## WHAT THE GENES TELL US

### OUT OF AFRICA

Honeybees have been with us for a long time. Gene markers reveal that bees migrated from Africa to southern Europe in two waves about a million years ago. At the end of the last ice age, 10,000 years ago, they spread to northern Europe. More recently, European and African bees were imported to the Americas to serve as agricultural pollinators



**Found in Myanmar:**  
a 100 million-year-old honeybee trapped in amber



**A TALE OF THREE BUGS** Compared with the mosquito and fruit fly, whose genomes have also been sequenced, the honeybee has the best sense of smell and the worst sense of taste

	HONEYBEE	MOSQUITO	FRUIT FLY
Smell genes	163	79	62
Taste genes	10	76	68

**1 MILLION** Approximate number of neurons in the honeybee brain—about one-millionth the total in the human brain. Yet the two species are among only a handful of creatures that form large, complex societies

## Can the bees be saved?

China, where pesticides are overused and apple orchards are largely hand-fertilized by humans, gives us a peek at a beeless future. Cutting back on harsh agricultural poisons is a first step. Mites can be controlled with menthol vapor or mild pesticides that are safer for bees. Genetically engineering a sturdier bee is a real—if distant—possibility now that the genome has been cracked

Sources: Gene Robinson, University of Illinois at Urbana-Champaign; Neil Tsutsui, University of California at Irvine; USDA National Agricultural Statistics Service