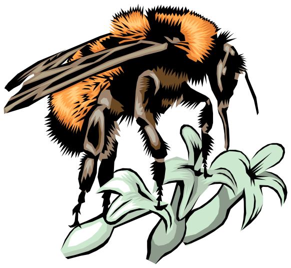

ScienceWatch – Busy Bees-It's All in the Genes

Social insects such as bees and ants form complex societies in which specialized individuals perform particular tasks. Colony members engaged in different "jobs" often differ physically from each other in obvious ways. For example, soldiers are generally much larger than workers and have huge jaws. However, this is not always so. In the honey bee (*Apis mellifera*) female workers perform two different age-related tasks for the colony. Young workers act as "nurses'" performing brood care and housecleaning within the hive. But after 2-3 weeks they undergo a behavioral rather than physical change, venturing out of the hive to forage for nectar and pollen. What is responsible for the behavioral transformation?

A report by Gene Robinson, an entomologist at the University of Illinois at Urbana, and colleagues from Dijon, France and Toronto, Canada, published in the April 26th issue of *Science*, demonstrates that the activity of a single gene is responsible for the behavioral change. For this study co-author Maria Sokolowski, a behavioral geneticist at the University of Toronto, brought to bear her many years of experience studying the behavior of the common fruit fly (the one that always finds your bananas) *Drosophila melanogaster*. Earlier she had found that a gene, called forager (*for*) affects fruit fly behavior. Two alternatives of *for* exist in fly populations. Flies with the for^R gene (rover) have higher levels of the gene product, are more active and collect food over a wider area than flies having the for^S gene (sitter). Taking their cue from Sokolowski's study, Robinson and his team searched and found the *for* gene in honey bees.

It has long been known that genes are not always active. The same gene may be "on" in certain cells and not in others. For example, the genes that make hemoglobin are only active in red blood cells, even though all our cells have those genes. Furthermore, different genes may be turned on or off during different times of an organism's life cycle. For example, we make a certain type of hemoglobin as a fetus and switch to another type when we are born. All this falls into the realm of gene regulation. When active, each gene produces a substance known as messenger RNA, which is used by the cell to make a particular protein that it needs (e.g., hemoglobin) to function.

Robinson, *et al.*, showed that levels of the messenger RNA made by the *for* gene were about eight times greater in the brains of forager bees as compared to nurse bees. They also found that the protein product resulting from *for* gene activity was about four times higher in the foragers. Thus it appears that an increase in *for* gene activity alters the behavior of worker bees, converting them from nurses to foragers.

Since bees normally become foragers as they age, it is also possible that older bees have greater *for* gene activity but the gene has nothing to do with switching jobs. The team tested this possibility by making an artificial colony in which all the bees were one day old. Desperate for food, the youngsters began foraging two weeks earlier than normal and also had greater *for* gene activity. Thus, age doesn't matter; only *for* gene activity determines whether or not bees become foragers.

What is the signal that turns on the *for* gene? Exactly how does the *for* gene product act to alter bee behavior? These questions remain to be answered, but this study offers a clear-cut case of a single gene controlling a complex insect behavior.

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