

# *A Sting of Love*

Entomologist Gene Robinson:

*Exploring the Social Lives of Bees*

# Gene Robinson Studies Bee Societies

*He investigates how hormones and nerve circuitry influence honeybee social behavior.*



## Honeybees

- Exhibit complex social behaviors
- Cannot live without the social structure of a hive
- Change social role behaviors based on needs and environment

Question:

What do bees have in common with vertebrates?

# *Answer: Hormones*

Bees, like humans, are controlled in part by hormonal stimulation.



Bees exhibit many of the complex behaviors of vertebrates, such as foraging.

# *Do Honeybees Have Brains?*

Yes. Although not as complex as human brains, bee brains appear to respond to the coordinated action of brain genes.

*Question:* Can honeybees consciously “think” or plan their futures?



Honeybee brain.

Photo: Zachary Huang, <http://cyberbee.msu.edu/>

*Answer:* No evidence exists that bees are “conscious” or can think about the future.

# *Hive as Laboratory*



The beehive is a practical experimental system

- Available in the wild or lab
- Enables close watch of social behavior and signaling
- Lets researcher alter hive's social structure/environment to measure outcomes

# *Clear, Flexible Division of Labor*

## 1. *Social Buzz*

Hives have complex job roles and social orders: queen, caretakers, builders, gatherers, even undertakers!

## 2. *Live Like a Queen*

Queen's job is to make baby bees; she lives 2-5 years.

Female workers and male drones live 1 month.

Baby bees take 3 weeks to mature.

## 3. *Change Jobs*

Hives adjust workforce and job tasks to fit immediate needs, such as foraging, caring for young, protection.

Builders can become hunters and vice versa!

Forager bee



Undertaker bee

# Can Environment Influence Genes?

Robinson discovers that environment changes honeybee job tasks and how fast bees grow up.

When forager bees are taken from the hive, younger “nurse bees” suddenly become active foragers.



Given a shortage of nurse bees, some bees never grow up, becoming “Peter Pans” that care for young bees.

**Conclusion:** Social regulation and environment affect brain genes and growth.

# *Rhythm in the Genes*

Period gene controls bees' biological rhythms:



What is another name for biological rhythms?

1. Gene is socially regulated
2. Active in forager bees; inactive in nurse bees
3. Found in almost all animal species



Why might the period gene be more active in some bees than in others?



Which rhythmic activities might the period gene control in all species?



# How Is a Gene Affected by Social Activity?

| Hypothesis                                       | What Might Happen   | Type of Response |
|--|---|------------------|
| Bees detect food shortages.                      | With few foragers, hungry bees “gear up” to hunt.   | Decentralized    |
| Bees communicate by smelling <u>pheromones</u> . | Young bees detect absence of older bees through chemical signal systems.                            | Decentralized    |
| Leader says, “Do It!”                            | Queen or select group of bees with access to environmental information puts out a call to the hive. | Centralized      |

# *Findings: Pheromones Trigger Changes*

1. Decentralized hive activity—like stock market, in which individual actions affect stock prices, even though it appears that there is a general, integrated response.
2. Honeybees respond adaptively as an integrated unit, but it's not as if the queen or a “select committee” of bees in the know is sending out orders.
3. Robinson has found evidence that molecular signals, communicated via pheromones, cause direct changes in honeybee gene activity.

# *Research Applications*

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How might Robinson's sociogenomic findings help answer the question:  
“What makes humans unique—nature, nurture, or both?”