# What determines a particular phenotype?

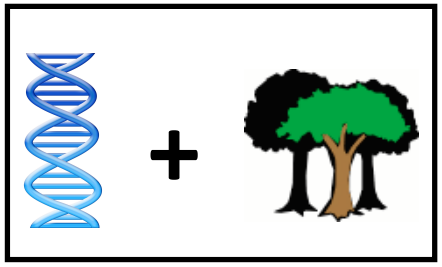
## Nature versus Nurture

*All behavior is the product of an inextricable interaction between heredity and environment during development, so the answer to all nature-nurture questions is "some of each."*

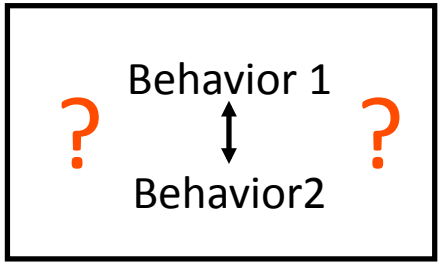
*-Steven Pinker*

# Development of Behavior

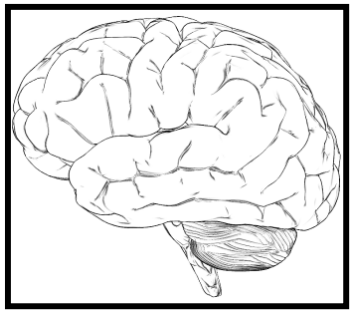
Lecture objectives:



1. Understand that behavior is a product of gene-environment interactions




2. Be able to figure out whether differences in a behavior arise from genetic and/or environmental differences



3. Understand features of development and the adaptive value of learning

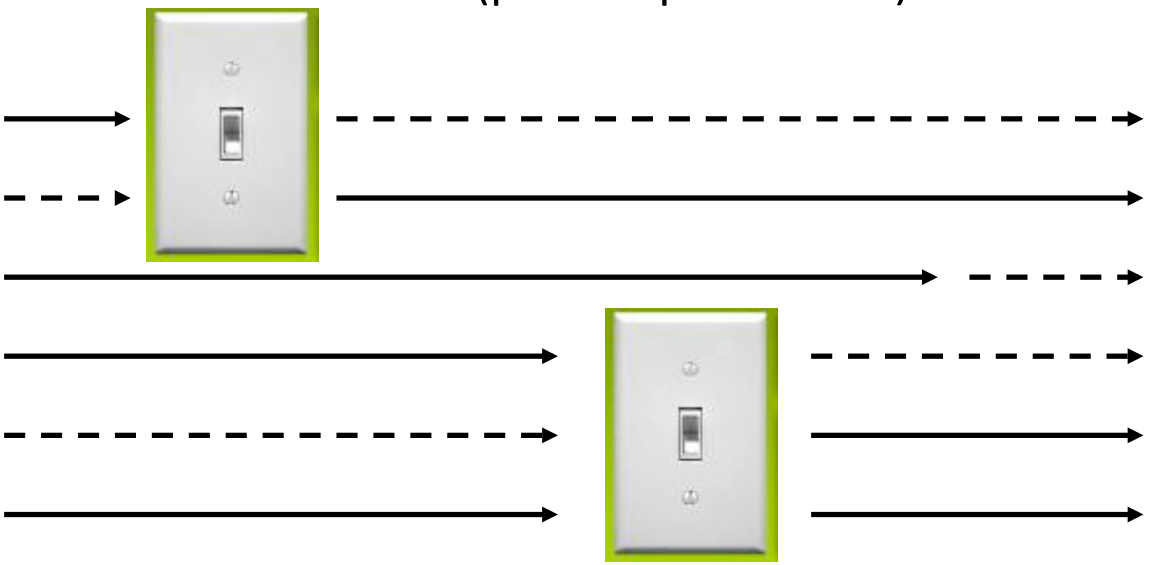
Behavior is a complex product of gene-environment interactions

## Environment

influences expression of genes
(protein production)

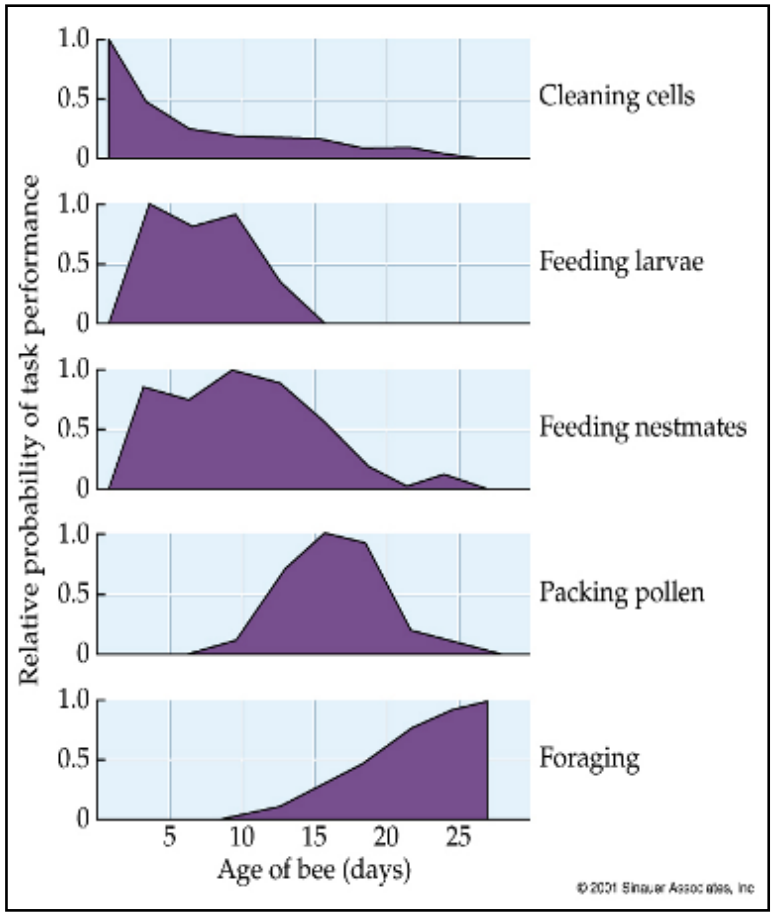
## Genes

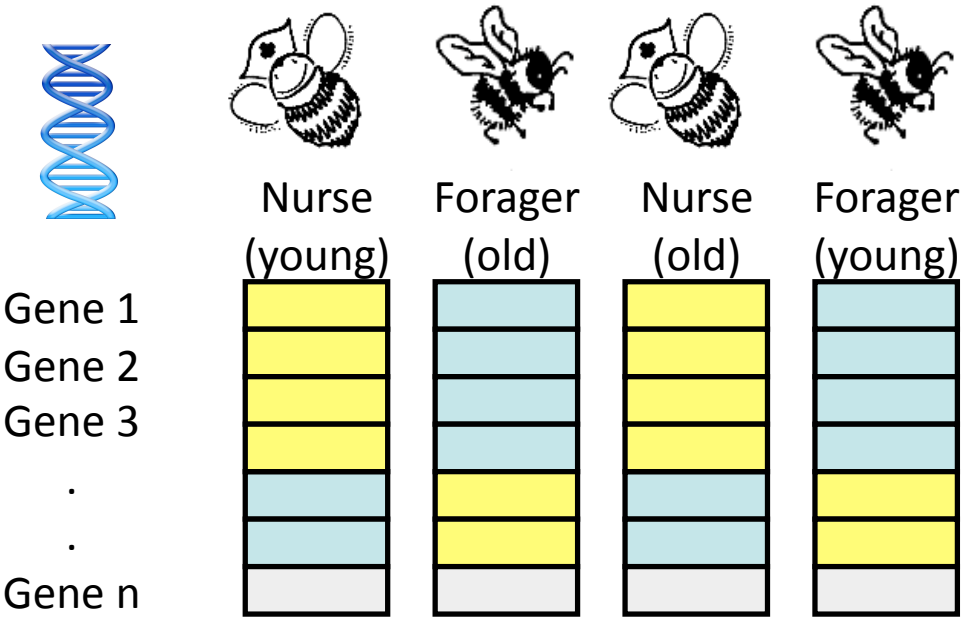
encode
information



Development unfolds over time

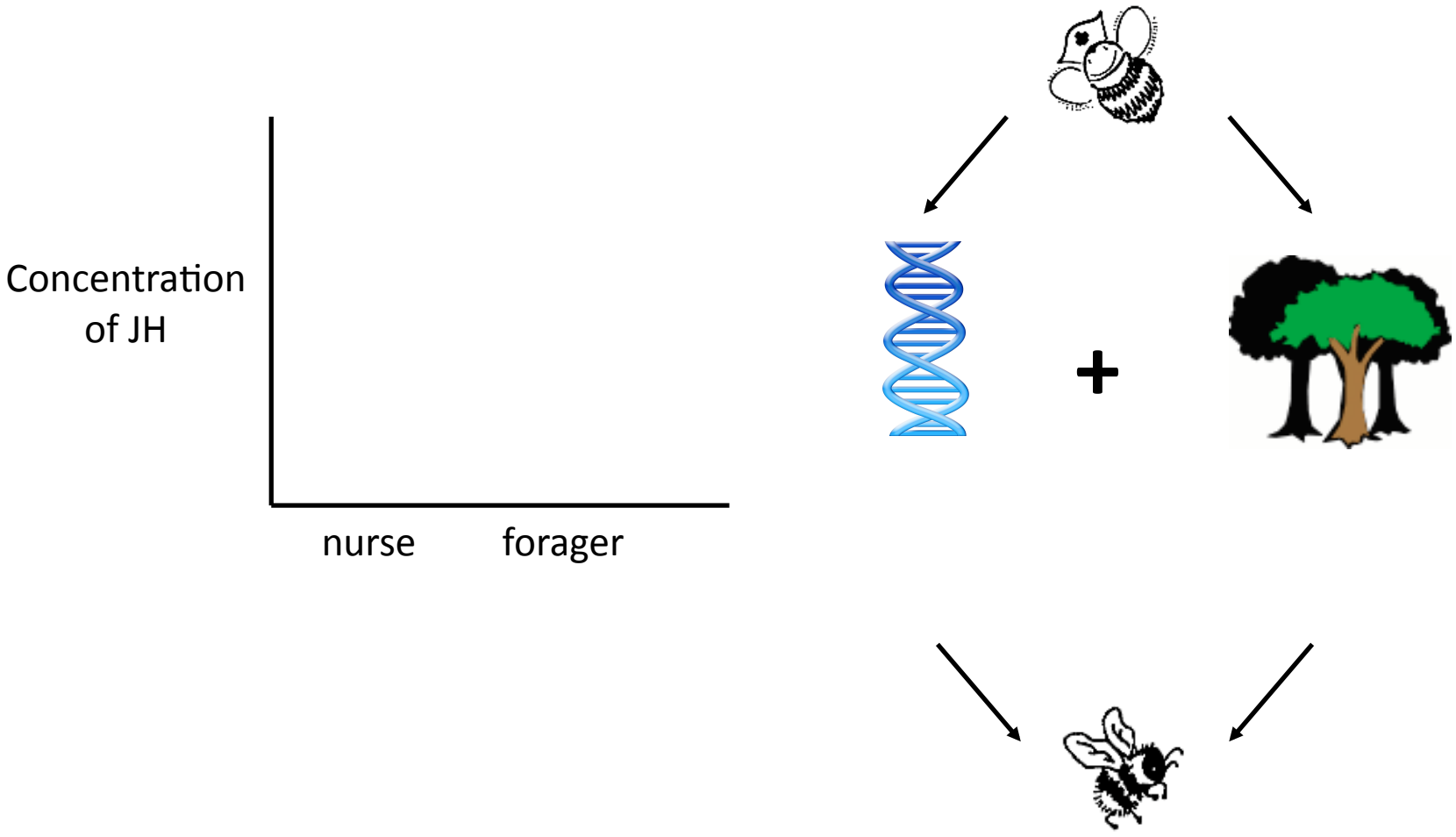
# Gene-env interactions underlie the development of honeybee foraging…



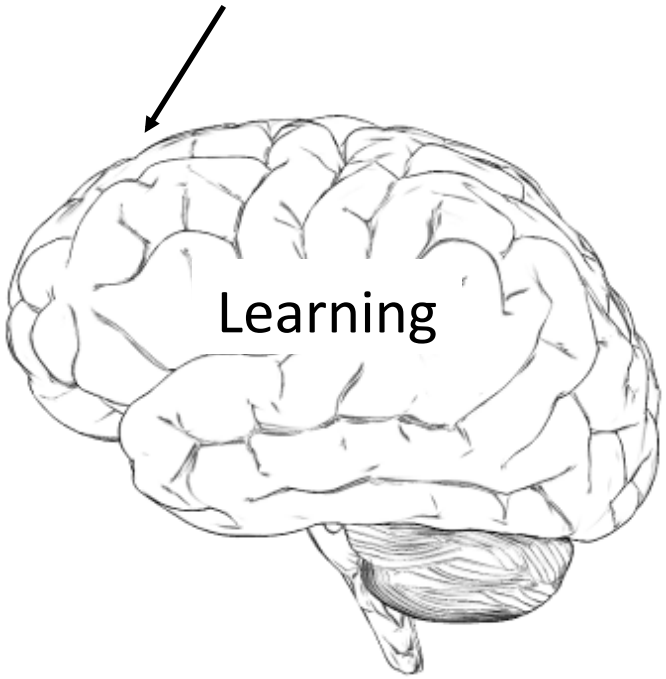

Effect of social environment:
When foragers (old bees) are scarce, young bees will rapidly become foragers

# Example cont: Gene-env interactions underlie the development of honeybee foraging



# Even learning has a genetic contribution

Gene-environment interactions




Example:

Different species show
different imprinting tendencies

Blue tit

Great tit

# What determines a particular phenotype?

**Nature** ~~versus~~ **Nurture**

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Info in genes is only expressed

Development & learning require the

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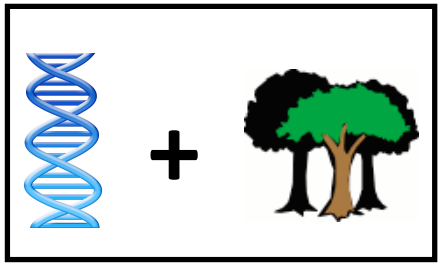

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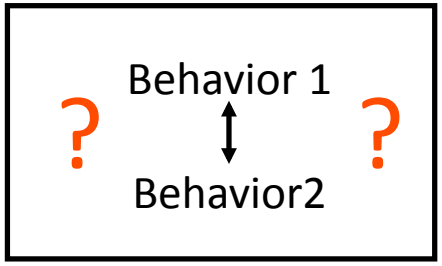


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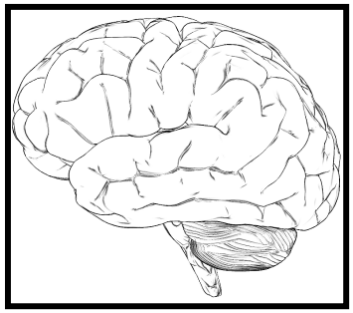
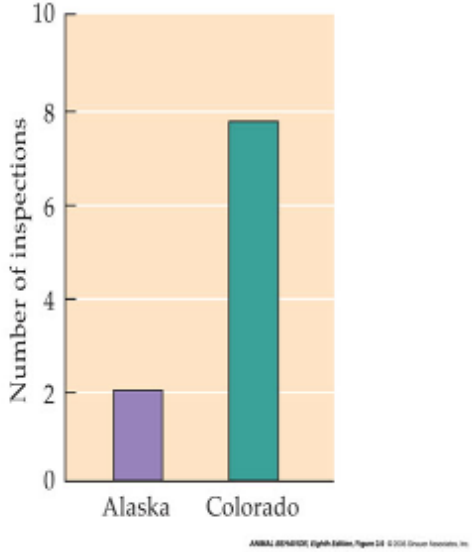
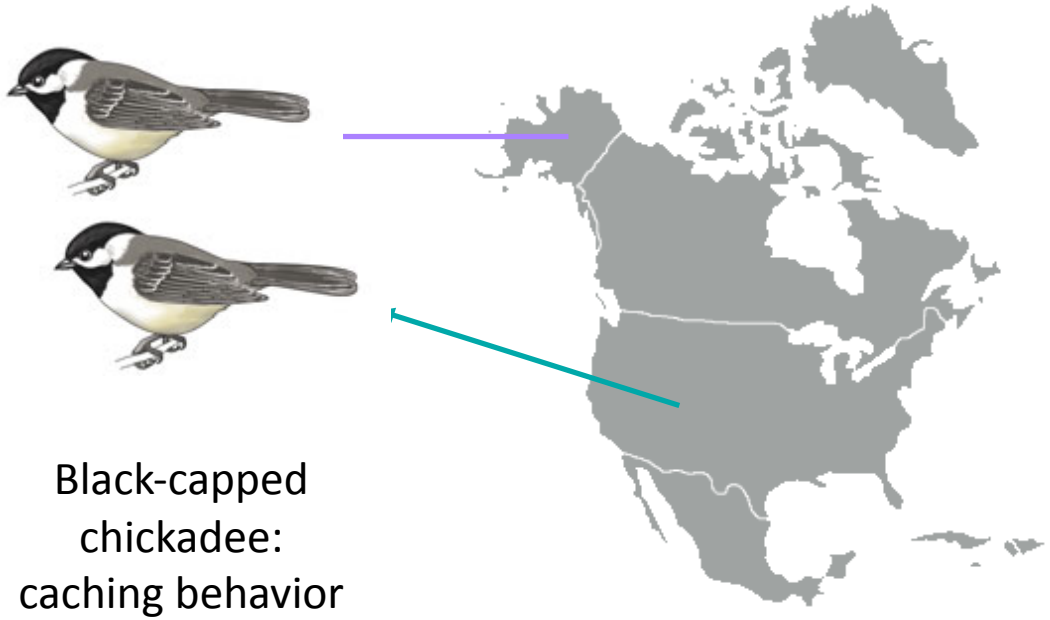


3. Understand features of development and the adaptive value of learning

# Members of the same species often differ in behavior



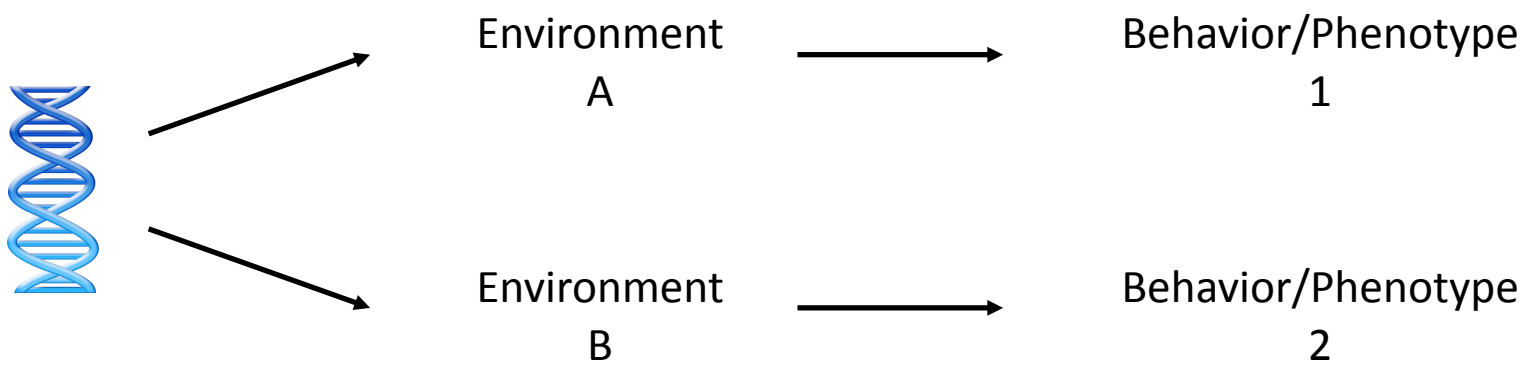
Black-capped chickadee: caching behavior

What underlies <u>differences</u> in development/behavior?

- differences in genetic info?
- differences in environmental inputs?
- both?

# Differences in development/behavior can arise from environmental differences

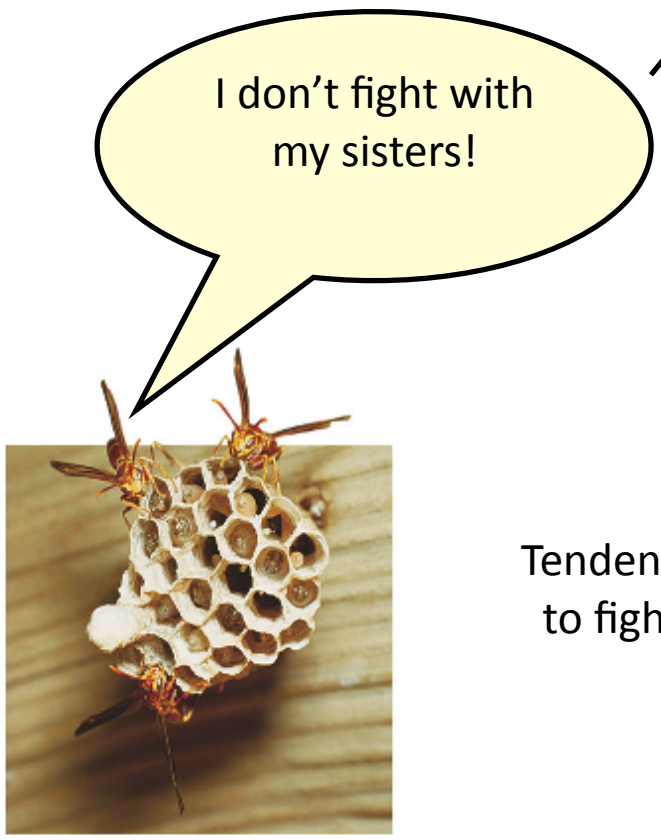
Idea:

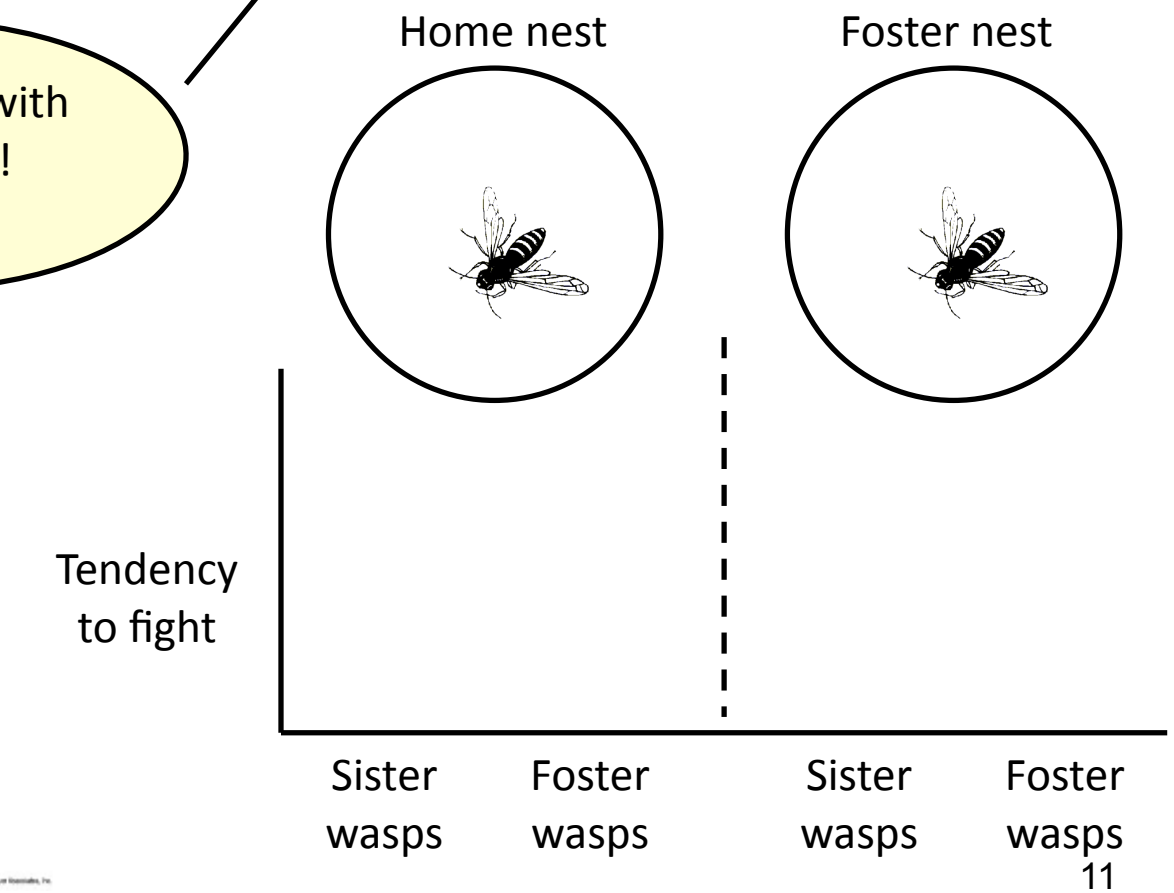


# Example: social behavior differences in paper wasps arise from early olfactory experiences

Demonstrated by manipulating

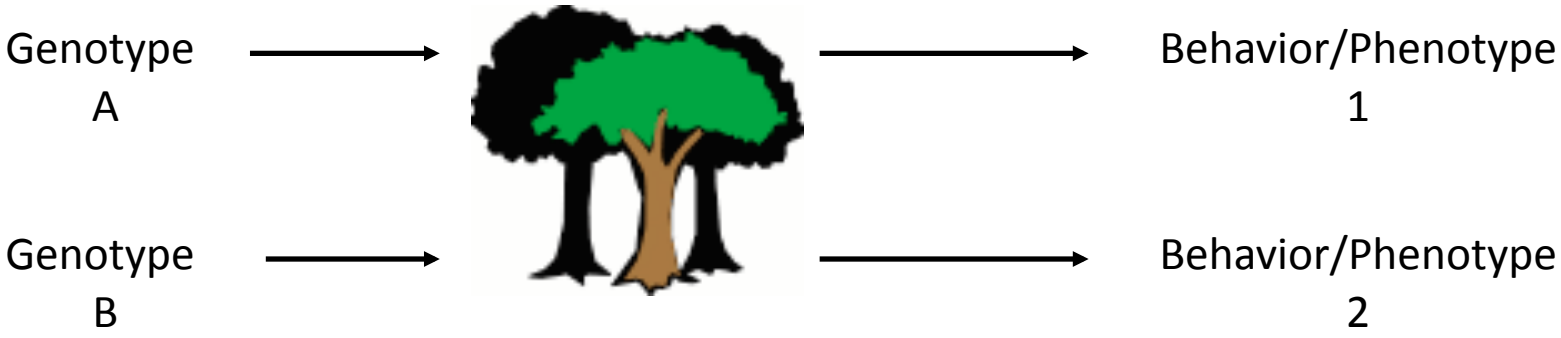
Can experience shape a wasp's tendency to tolerate unrelated wasps (nonkin)?



# Differences in development/behavior can arise from genetic differences

## Idea:



# Example: "Good mommy" behavior differences in mice arise from genetic differences

Demonstrated by a

_____

*fosB* ⟶

*fosB* ⟶ Expression is "knocked out"

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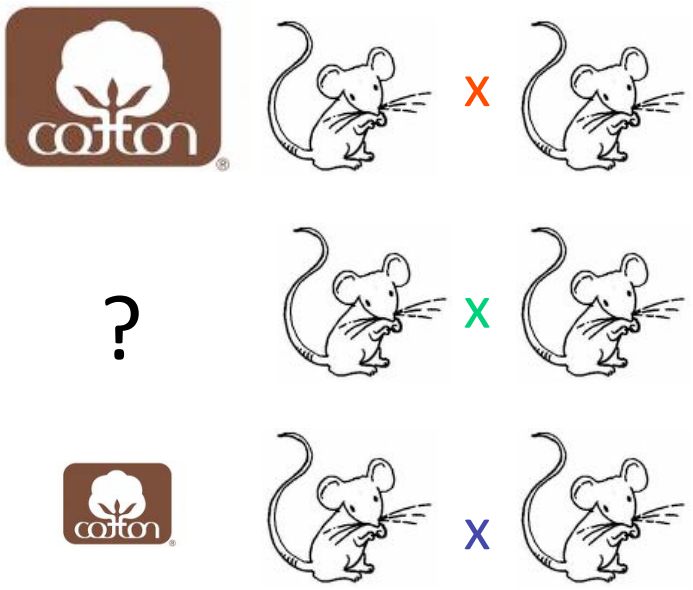
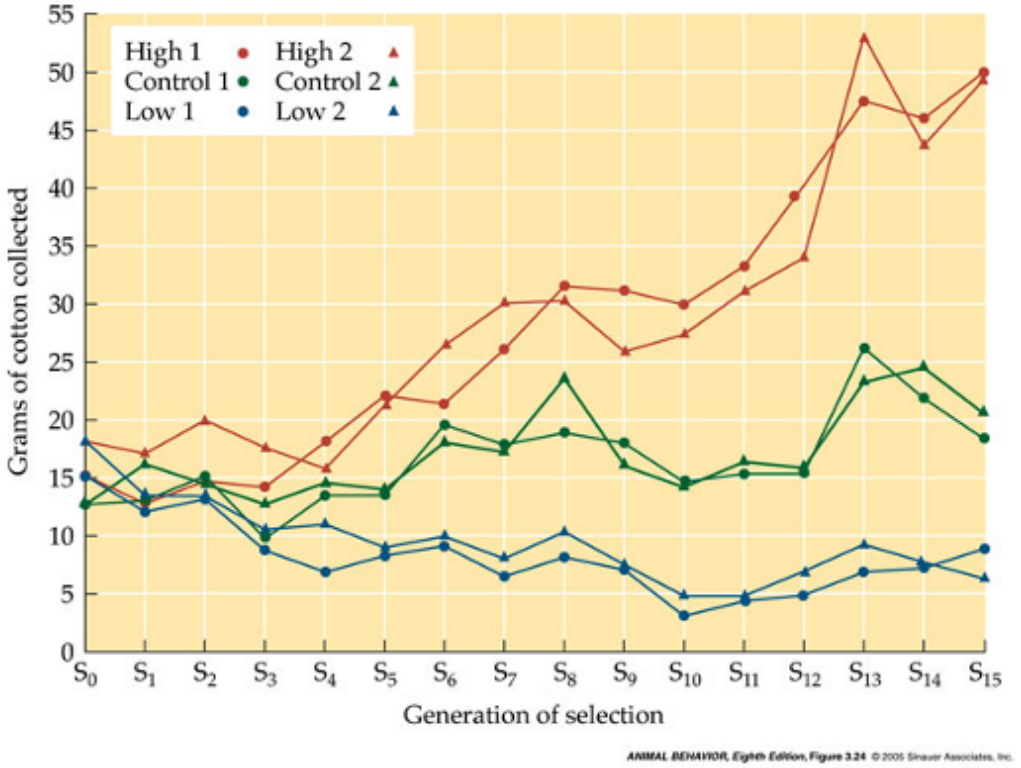
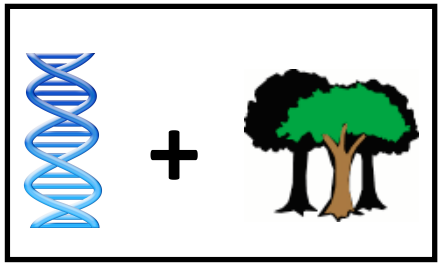
# Example: Cotton collection differences in mice arise from genetic differences

Demonstrated by an



Lecture objectives:



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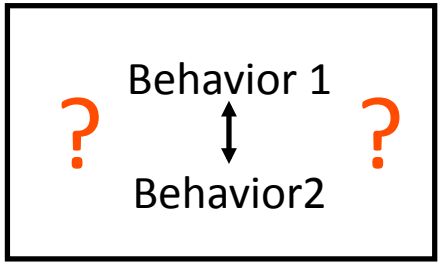


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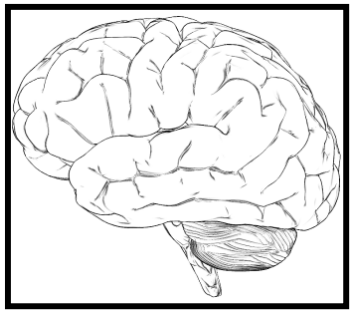
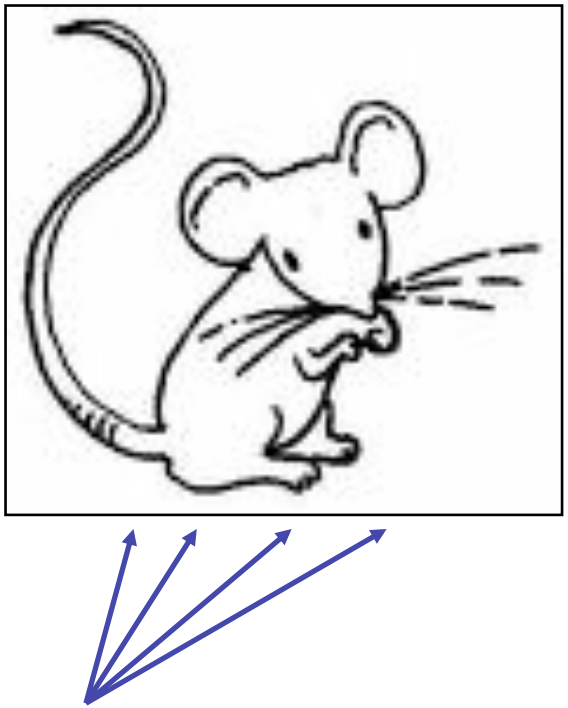


3. Understand features of development and the adaptive value of learning

# “Normal” development is often robust, even under adverse genetic or environmental conditions

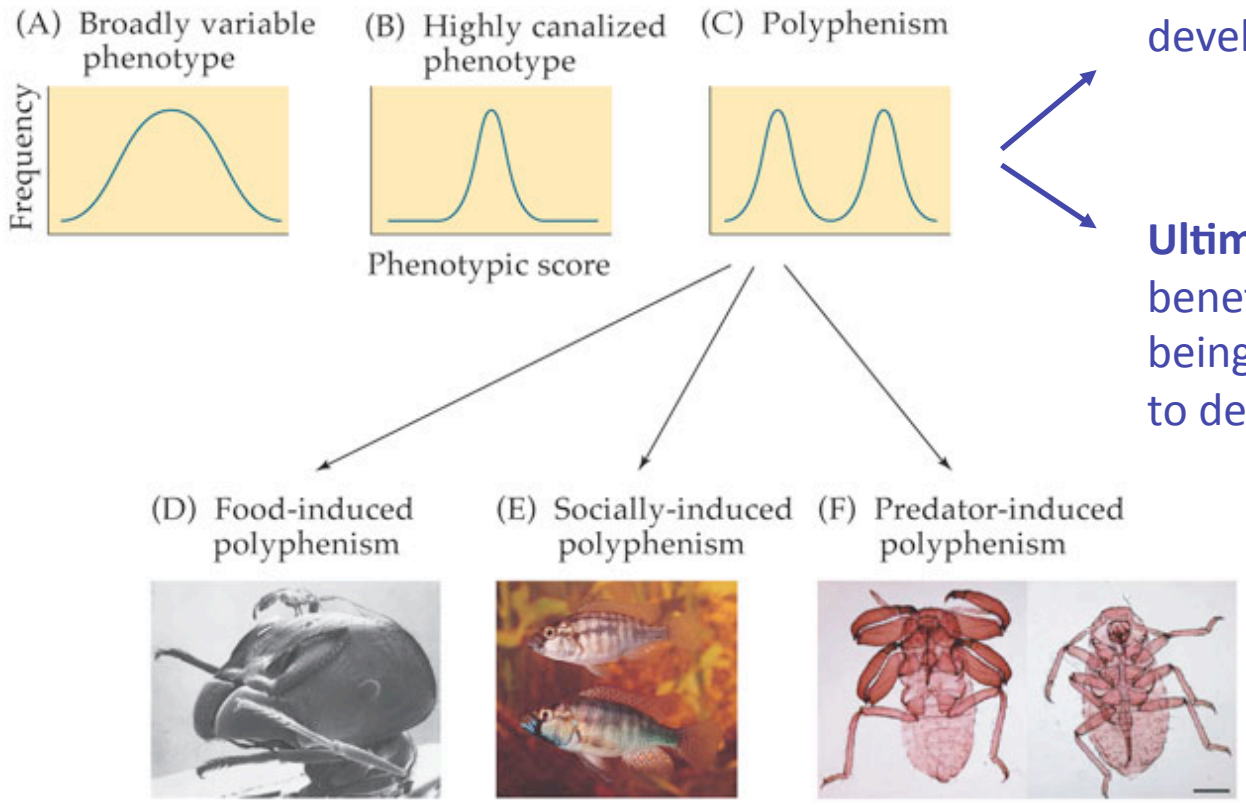


Gene knockouts

Genetic system likely has high informational redundancy

Rhesus monkeys develop normal social behavior with only 15 minutes of socialization/day

# Sometimes there is more than one form of "normal" development ( >1 discrete phenotype)




**Proximate**: what env. cues activate a different developmental pathway?

**Ultimate**: what fitness benefits do animals gain from being able to "choose" how to develop?

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# There are costs and benefits to learning

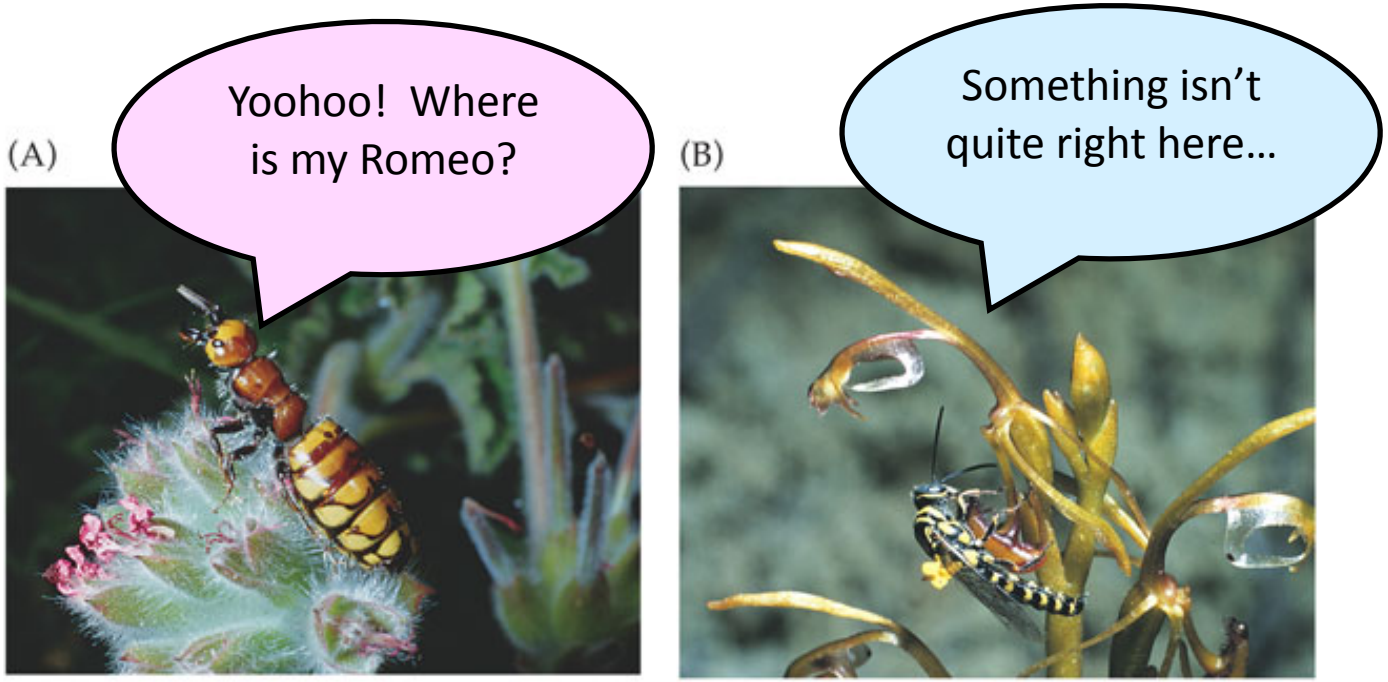
Adaptive modification of behavior based on experience

**Costs:**

**Benefits:**

# Natural selection favors investment in learning when the ability to learn confers reproductive advantages

Benefits > Costs




The ability to learn would probably be beneficial for male thynnine wasps.

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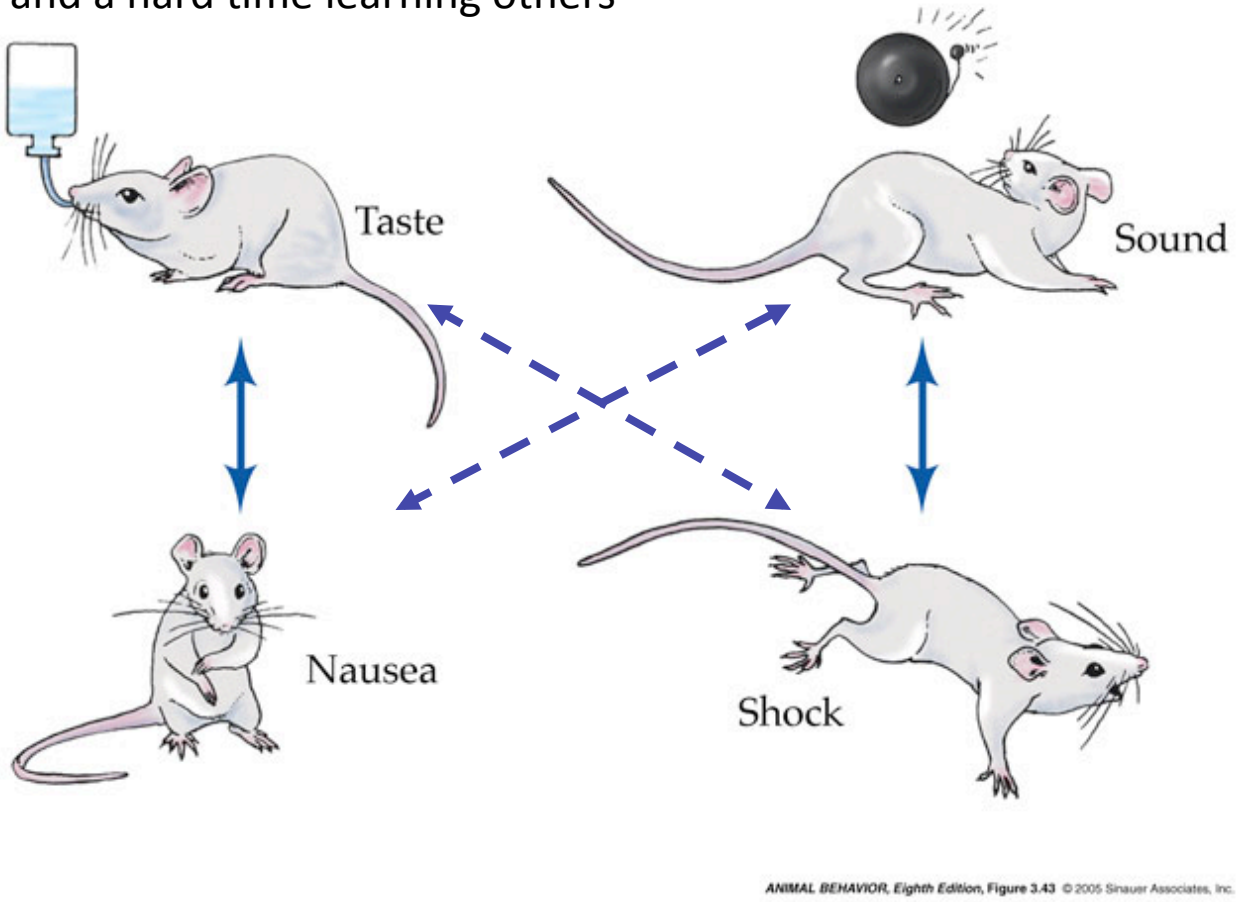
# An animal's ability to learn certain associations or solve certain problems often makes biological sense

Example: Rats have an easy time learning certain associations and a hard time learning others

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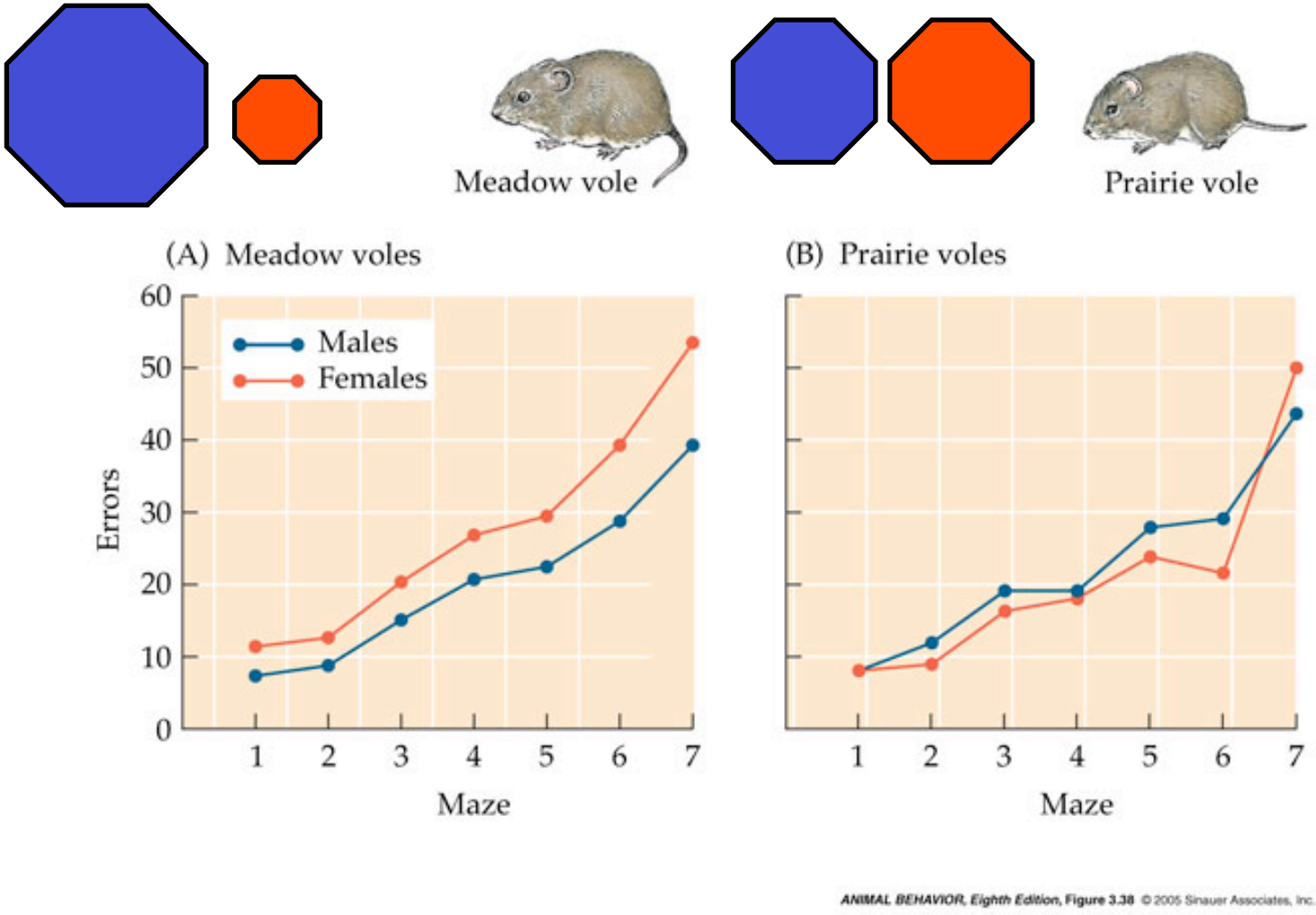
# An animal's ability to learn certain associations or solve certain problems often makes biological sense

Example: Sex differences in spatial learning ability are linked to home range size

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