

# THE GENETICS OF LEARNING AND MEMORY

## Content Objectives

**What we know:** There are different types of memory. Memory for facts and events is different than memory for abilities and skills. Memories can be stored as short-term or long-term.

### How do we know it?

- Experiments on learning have shown that the *way* we learn determines whether that information will be stored in long-term or short-term memory.
- Genetic studies (with mutagenized animals) have shown that an animal's ability to remember can be disrupted without affecting learning, and that long-term memory can be affected without altering short-term memory. These studies also demonstrate that there is a genetic basis for memory.
- Studies of amnesiacs and human patients with brain injuries have allowed scientists to distinguish parts of the brain that store memories of facts and events from parts of the brain that store memories of abilities and skills.

*Sections that address this: Brain Injuries, Where Memory Lives, Flies Go To School, and Molecules and Memory.*

**What we know:** There is a molecular basis for memory. Genes and molecules are required for memory. These molecules make up the biochemical pathways that allow nerve cells to communicate. Nerves transmit different types of signals for different types of memories.

### How do we know it?

- Isolation of "memory" mutants has led to the identification of genes, and therefore molecules, required for memory.
- Comparison of a set of genetic mutants with similar memory defects can lead to the identification of a biochemical pathway important for that particular process.
- Isolation of different sets of genetic mutants has identified different biochemical pathways involved in short-term and long-term memory.

*Sections that address this: Flies Go To School and Molecules and Memory.*

**What we know:** Animals like flies, mice and slugs remember in ways similar to humans. Entire biochemical pathways are conserved from invertebrates to vertebrates. Thus, the search for genes in animal model systems is directly applicable to humans.

### How do we know it?

- Comparison of biochemical pathways at work in the nervous systems of flies, slugs, mice and humans has shown that similar pathways are important for memory in all organisms.
- Learning and memory experiments in fruit flies have shown that flies store short-term and long-term memories differently, as do humans.
- Isolation of memory mutants in flies can lead to a better understanding of human learning, memory and disease.

*Sections that may address this: Flies Go To School and Molecules and Memory.*

These objectives correspond with NSES Life Science Content Standards (p. 186-7):

1. All organisms have behavioral responses to internal and external stimuli. (Objectives 1 and 2).
2. Multicellular organisms have nervous systems that generate behavior. (Objective 2).
3. Nervous systems are formed from specialized cells that communicate with each other by secreting excitatory and inhibitory molecules. (Objective 2).
4. Behavioral biology has implications for humans. (Objective 3).