

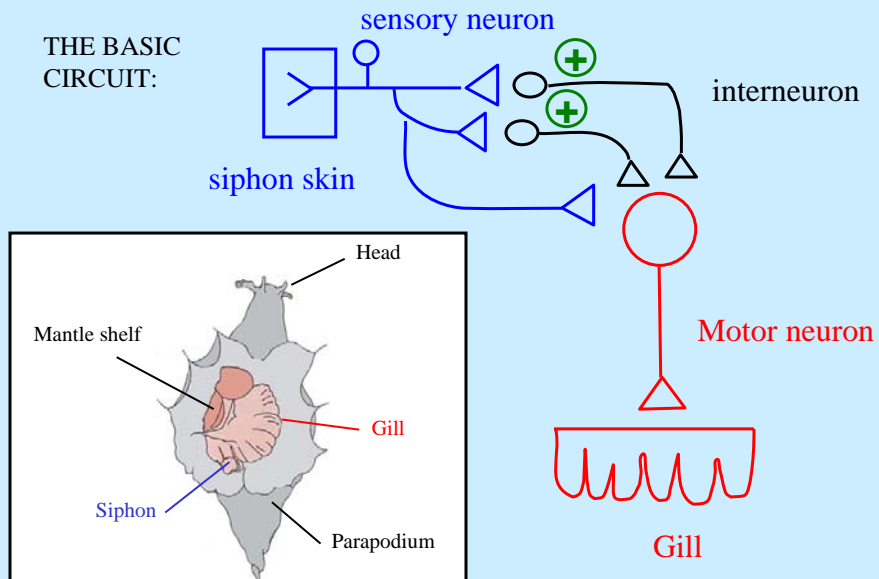
2. Mechanisms of Learning and Memory

A. Habituation

1. Involves depression of synaptic transmission.
2. Behavior: mild tactile stimulation of gill or siphon causes withdrawal of the gill. Repeated stimulation leads to habituation.

2. Mechanisms of Learning and Memory

THE BASIC CIRCUIT:



2. Mechanisms of Learning and Memory (cont'd)

A. Habituation (cont'd)

What happens?

- Sensory neurons in the siphon skin are stimulated → fire action potentials.
- EPSPs are generated in the postsynaptic interneurons and motor neurons.
- EPSPs summate → motor neurons fire → gill is withdrawn.

2. Mechanisms of Learning and Memory (cont'd)

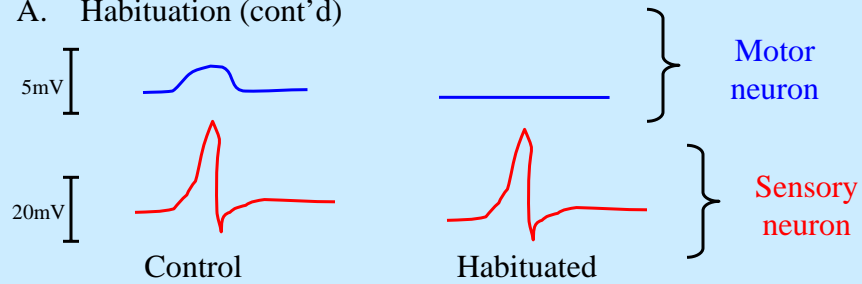
A. Habituation (cont'd)

What happens? (cont'd)

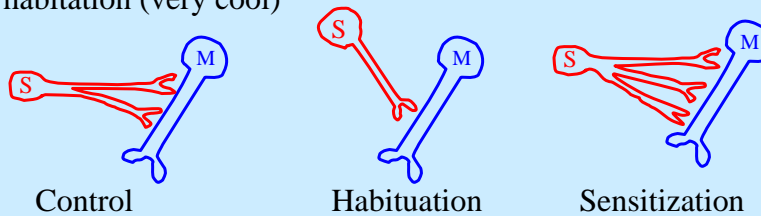
- If stimulus is repeated, the synaptic transmission between sensory neurons and motor neurons, as well as between interneurons and motor neurons, is reduced → the ability of these neurons to dump glutamate (i.e., NT) is changed.
- The mechanism is not yet understood (vesicle mobilization?).

2. Mechanisms of Learning and Memory (cont'd)

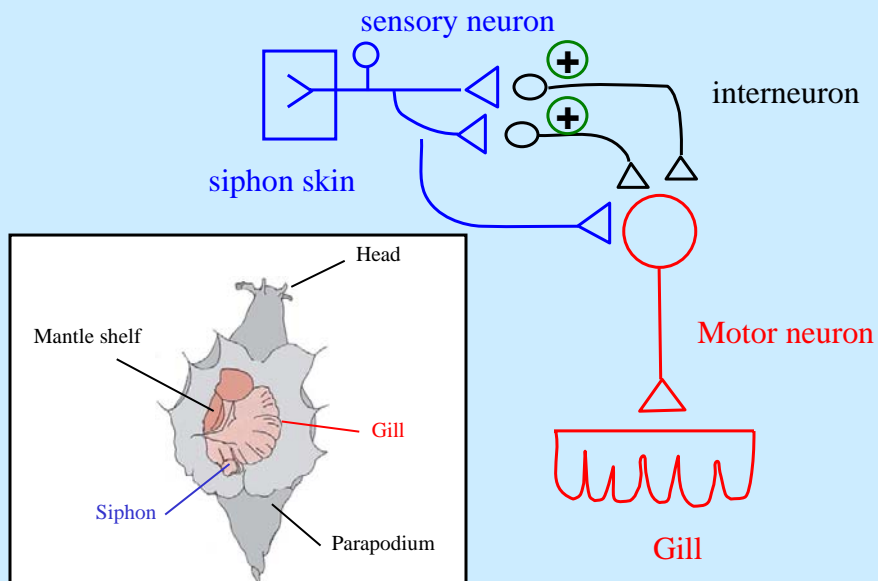
A. Habituation (cont'd)



- Also, the number of synaptic connections goes down with habituation (very cool)



2. Mechanisms of Learning and Memory



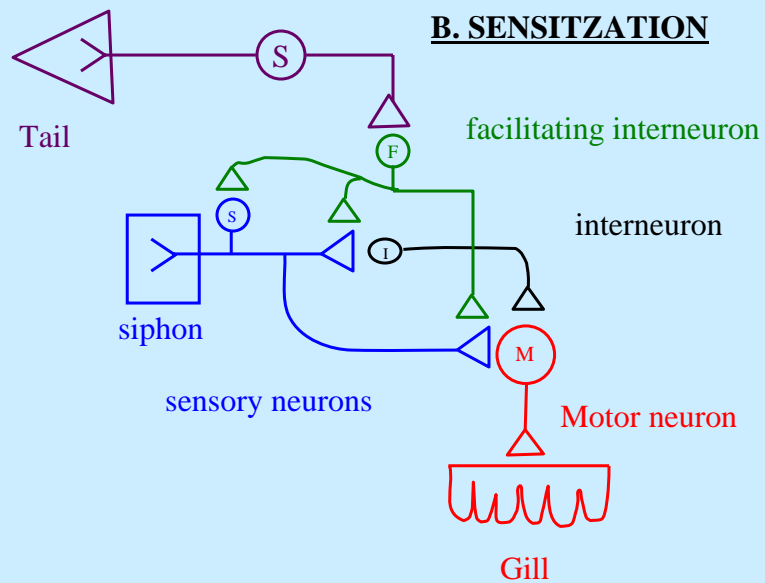
2. Mechanisms of Learning and Memory

B. Sensitization

1. Involves enhancement of synaptic transmission.
2. Involves *facilitating interneurons*.

2. Mechanisms of Learning and Memory

B. SENSITIZATION



2. Mechanisms of Learning and Memory

B. Sensitization

What happens?

- Sensitization of the gill withdrawal response is produced by stimulating the tail.
- The sensitizing stimulus at the tail activates a group of facilitating interneurons.

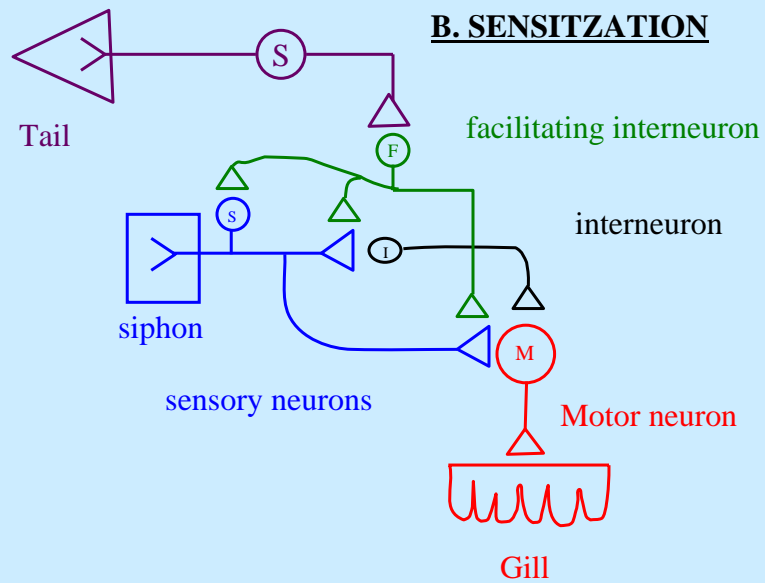
2. Mechanisms of Learning and Memory

B. Sensitization

What happens? (cont'd)

- These facilitating interneurons form synapses on sensory neurons innervating the skin and enhance transmitter release (serotonin: 5HT) from the sensory neurons by presynaptic facilitation.
- Long-term sensitization training is thought to lead to gene activation, and eventually, to an increase in synapses.

2. Mechanisms of Learning and Memory



2. Mechanisms of Learning and Memory

C. Classical Conditioning

1. Involves an associative enhancement of presynaptic facilitation that is activity-dependent.
2. The CS must precede the US by 0.5 sec for classical conditioning to work.

2. Mechanisms of Learning and Memory

C. Classical Conditioning

What happens?

- A CS to the mantle is paired with a US to the tail and / or siphon.
- The gill is retracted.
- BUT: shocking (or siphon) the tail excites facilitating interneurons.

2. Mechanisms of Learning and Memory

C. Classical Conditioning

What happens? (cont'd)

- These facilitating interneurons synapse on the presynaptic terminals of the sensory neurons innervating the mantle shelf and the siphon (like sensitization).
- BUT when the mantle is touched first, the mantle pathway gets activated.

2. Mechanisms of Learning and Memory

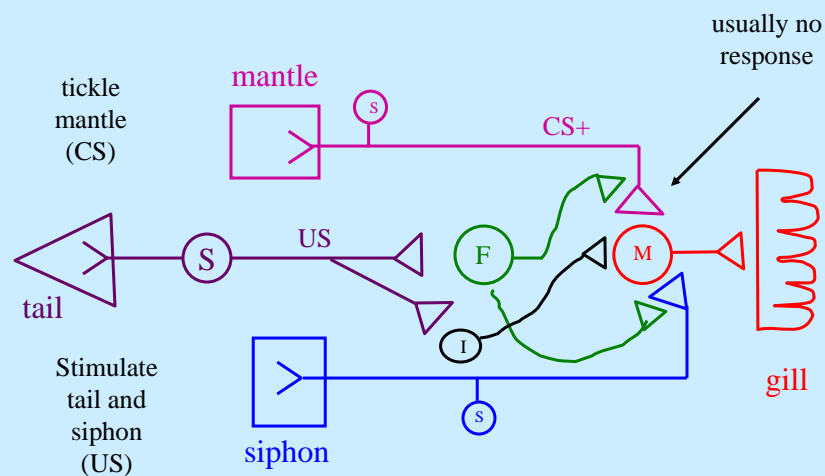
C. Classical Conditioning

What happens? (cont'd)

- Activity in the mantle sensory neuron PRIMES it so that it is more responsive to the facilitating interneuron.
- If the US comes before the CS, it does not work.

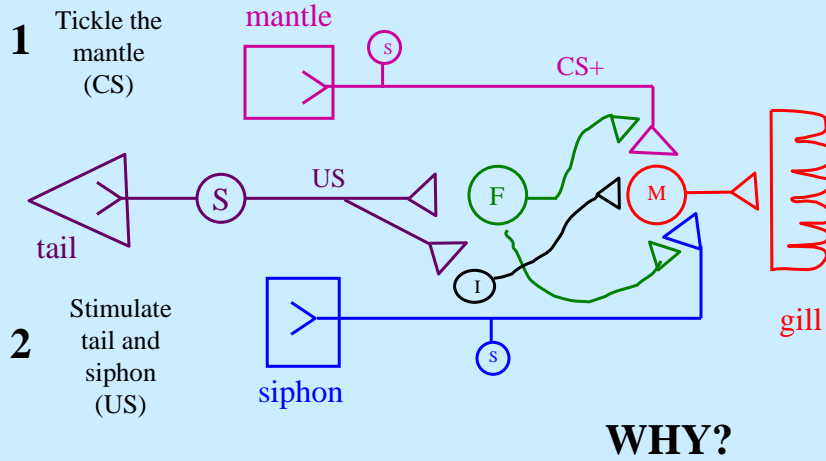
2. Mechanisms of Learning and Memory (cont'd)

C. Classical Conditioning (cont'd)



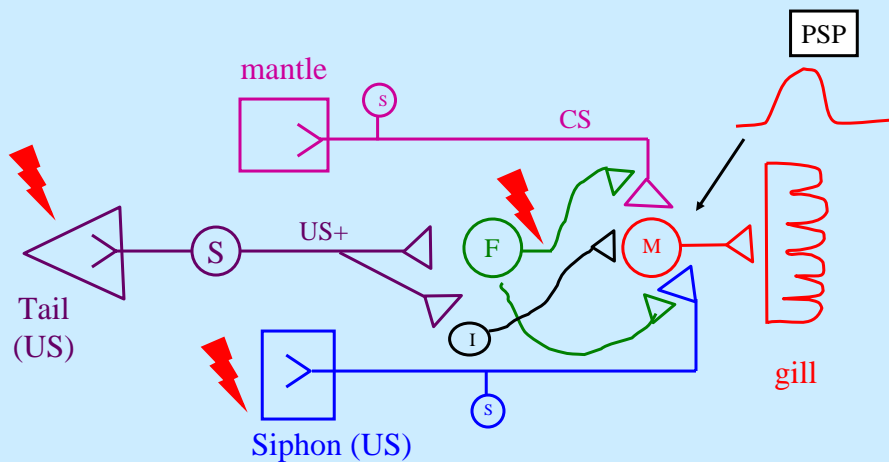
2. Mechanisms of Learning and Memory (cont'd)

C. Classical Conditioning (cont'd)



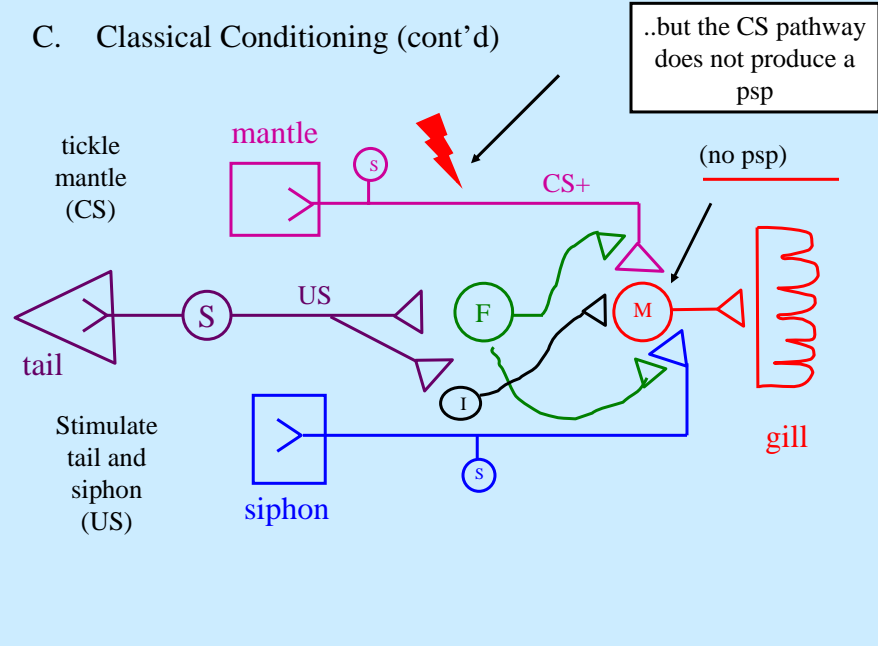
2. Mechanisms of Learning and Memory (cont'd)

C. Classical Conditioning (cont'd)



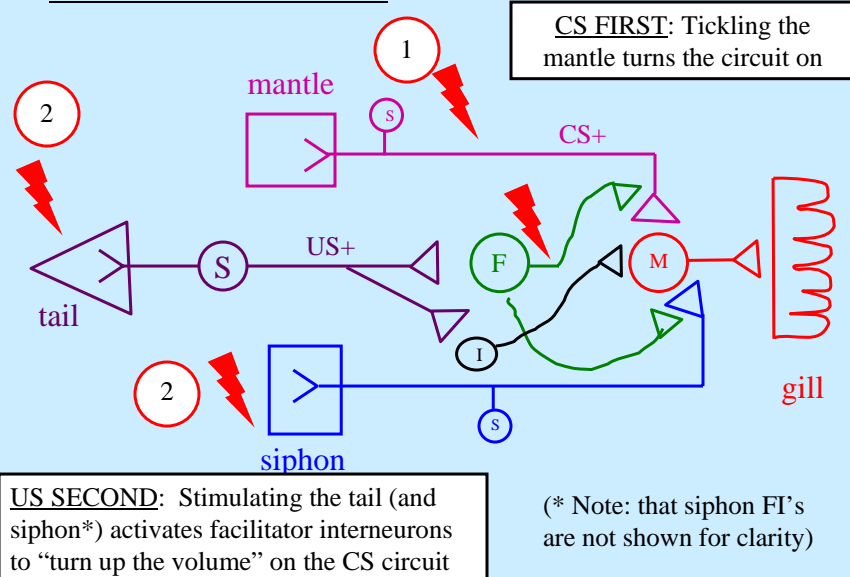
2. Mechanisms of Learning and Memory (cont'd)

C. Classical Conditioning (cont'd)



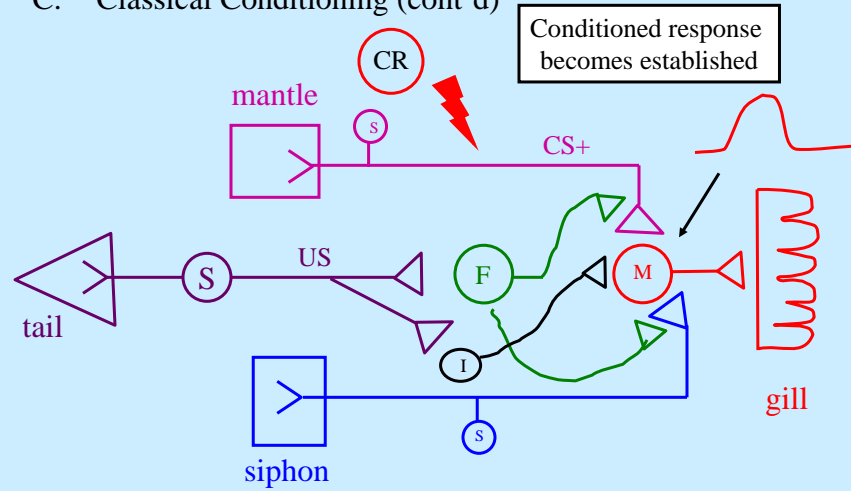
2. Mechanisms of Learning and Memory (cont'd)

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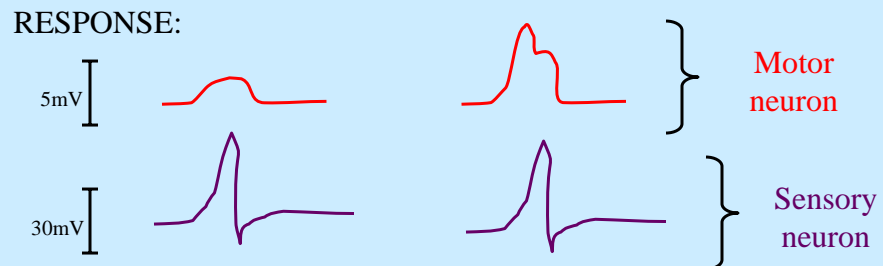
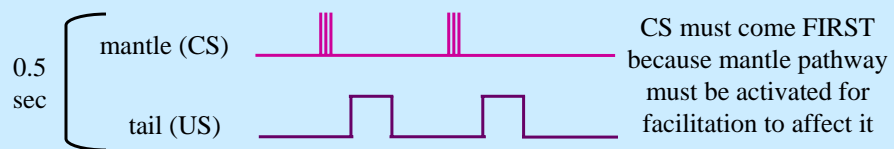
2. Mechanisms of Learning and Memory (cont'd)

C. Classical Conditioning (cont'd)



2. Mechanisms of Learning and Memory (cont'd)

A. Classical Conditioning (cont'd)



If not within .5 sec there will be no change in the motor neuron's response.