Today’s plan

• What are synapses good for?
  – Connecting neurons
  – Storing information
• Synaptic strength as a potential substrate for memory
• It all comes down to coding

What is learning?

• Acquisition of information
• Ability to perform new skills

• An experience-dependent change in behavior
Additional notes on our definition

• A flaw: it doesn’t include perceptual learning – but the only way to test this type of learning requires a behavioral output

• Includes addiction, PTSD etc…quite expansive

Study learning using a “simple system”

• *Aplysia californica*
  – A marine mollusk

• The behavior: Gill withdrawal reflex
  – Touch mantle shelf skin → gill withdrawal
Simple forms of learning

- Habituation
  - Reduction in gill withdrawal after repeated stimuli to mantle shelf
- Sensitization
  - Noxious stimulus to head or tail enhances reflex
- Both are non-associative
How do habituation and sensitization work?

- Need to know the anatomy first!

Take-home messages

- In *Aplysia*, synaptic depression mediates habituation, synaptic facilitation mediates sensitization
- Depression and facilitation involve changes in neurotransmitter release
- Sensitization: serotonin (5HT) $\rightarrow \downarrow K^+$ conductance $\rightarrow \uparrow$ action potential duration $\rightarrow \uparrow$ calcium entry $\rightarrow \uparrow$ transmitter release
- Other mechanisms may also contribute: e.g., changes in neuron excitability
Take-home messages (cont.)

- Synaptic change occurs in vertebrates, too, using some of the same mechanisms
- This work led to a Nobel prize for Eric Kandel in 2000 (http://www.nobel.se)
- This process is a leading candidate mechanism for information storage
  - Advantages – huge capacity, resists temporary changes in activity (e.g. sleep, anesthesia)