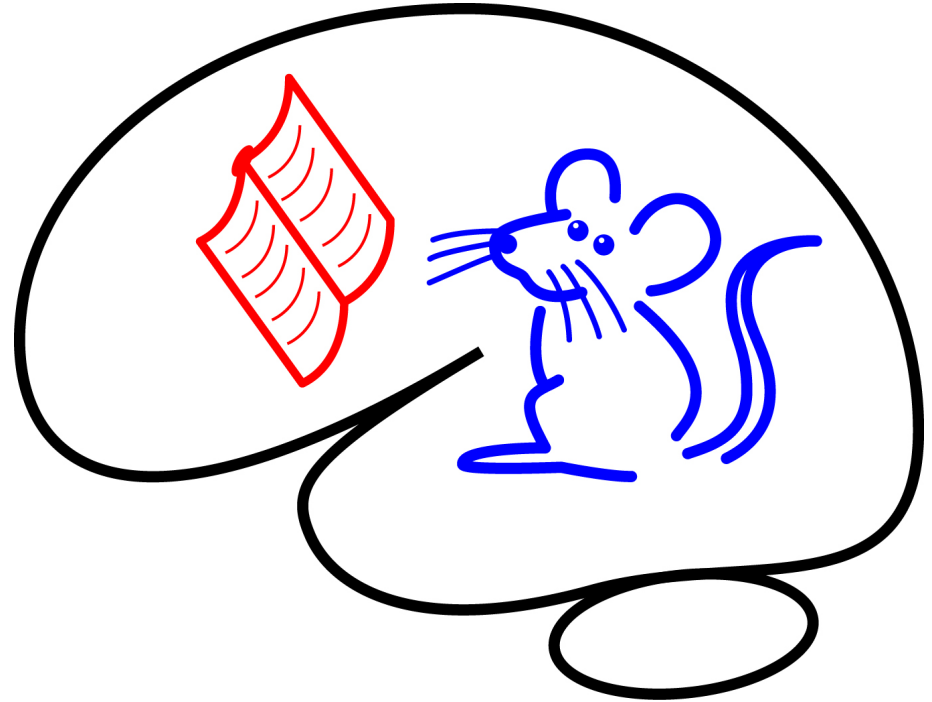# 7.3 Learning

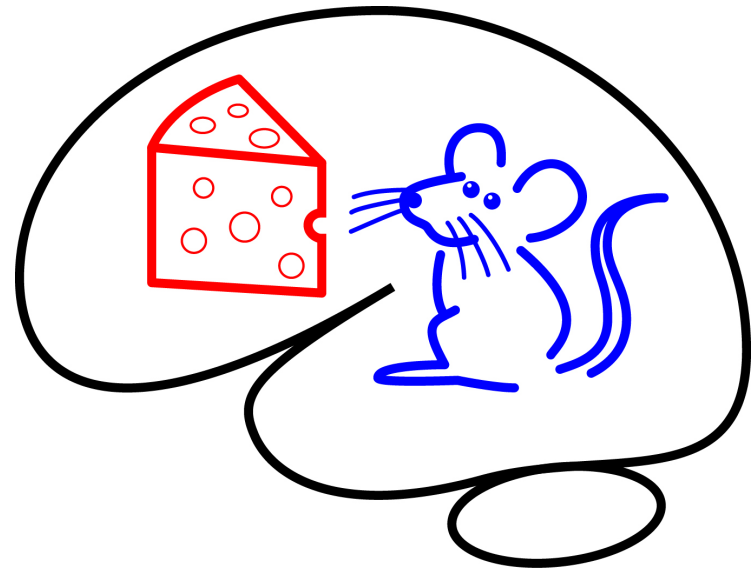**Cellular Mechanisms of Brain Function**

Prof. Carl Petersen
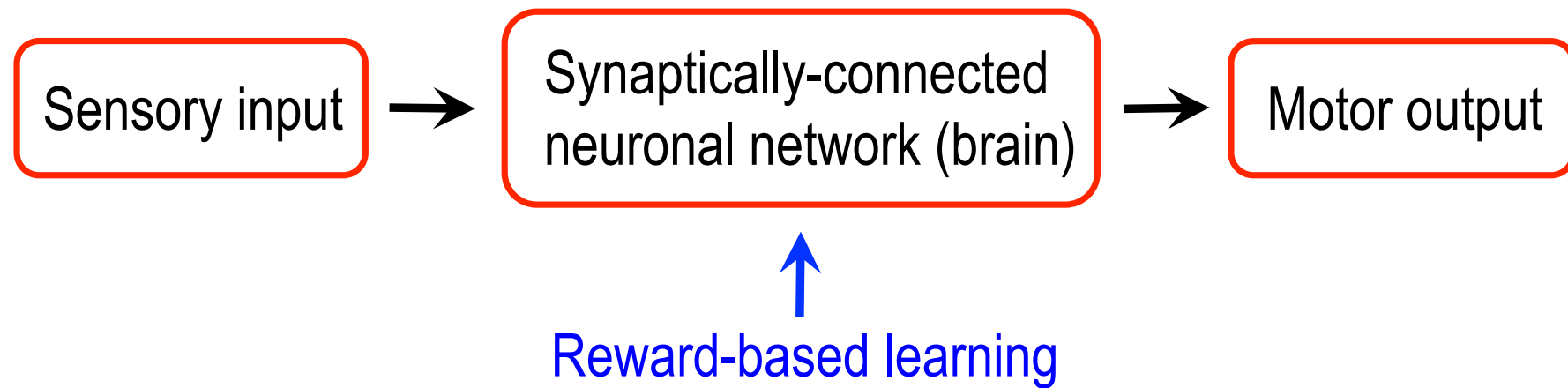
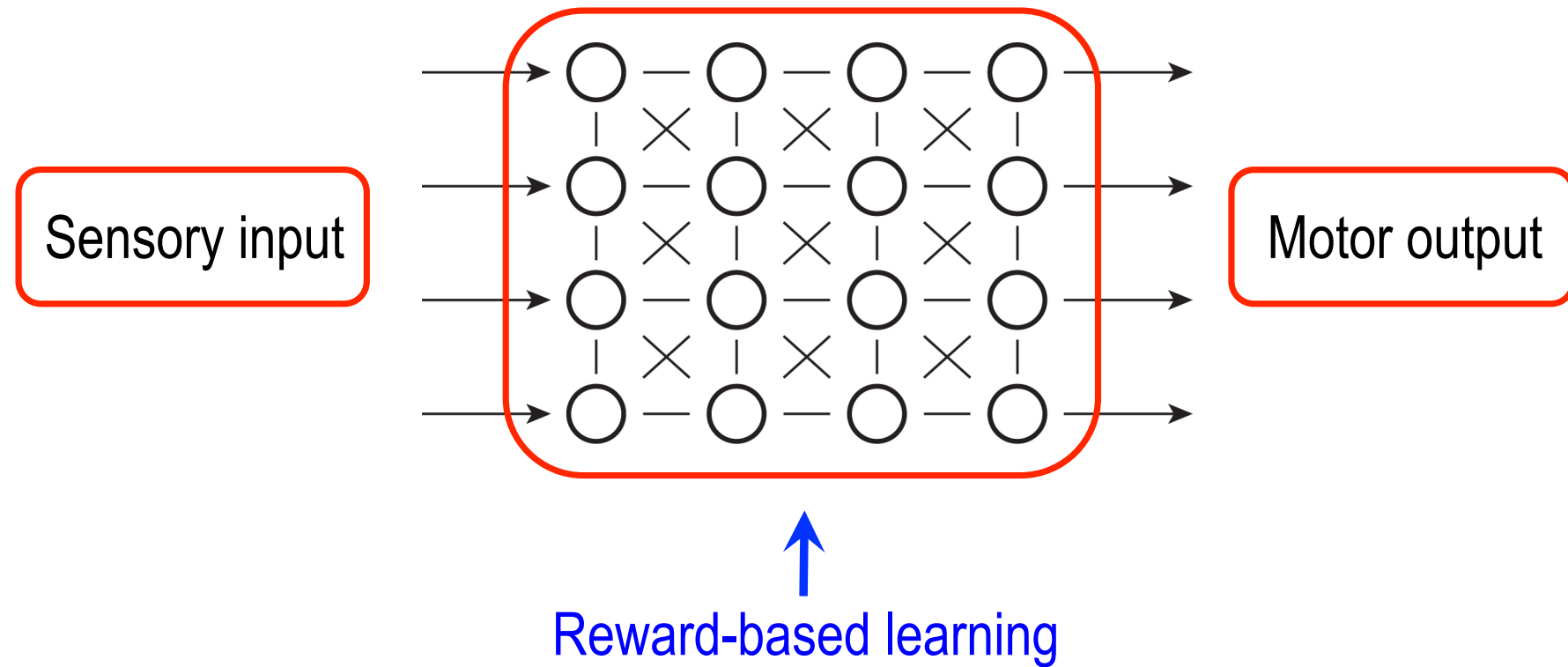# Learning

Reward-based learning
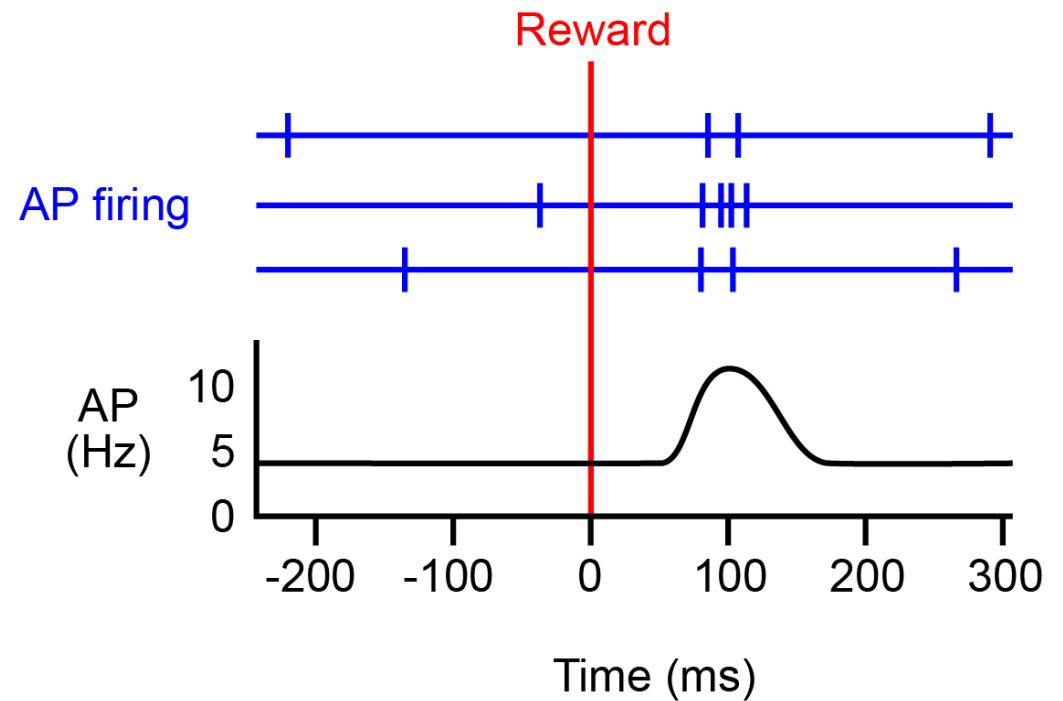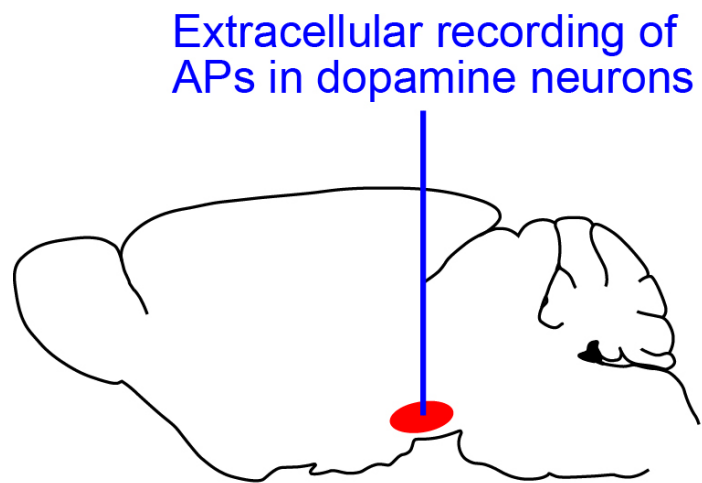
Reward-based learning

Sensory input → Synaptically-connected neuronal network (brain) → Motor output

Reward-based learning

Reward-based learning in neuronal networks

Sensory input
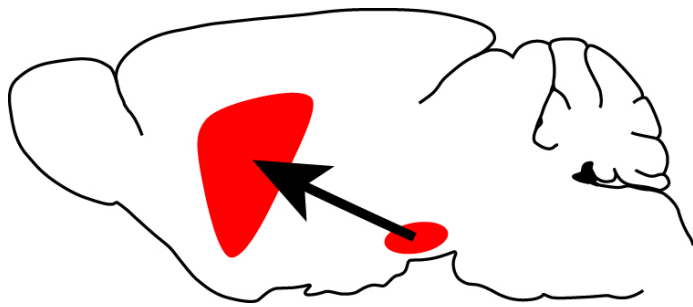
Motor output

Reward-based learning

Dopamine reward signal

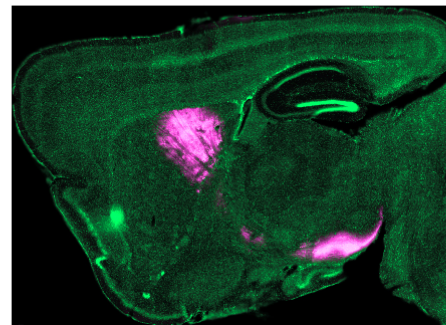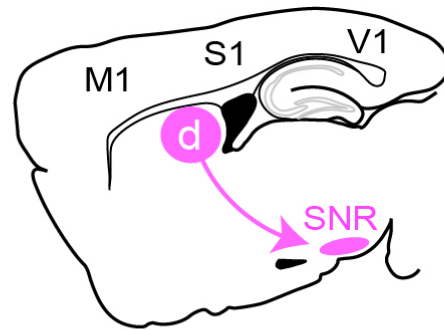# Dopaminergic innervation of striatum

Midbrain dopaminergic neurons
prominently innervate striatum

Striatal projection neurons
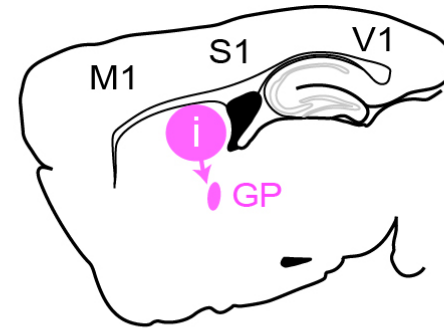

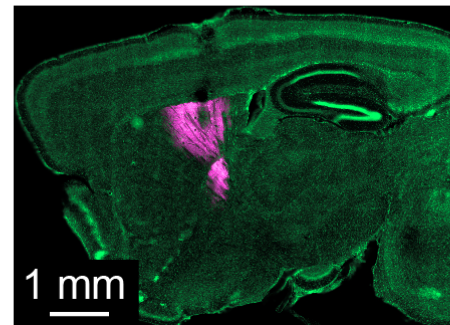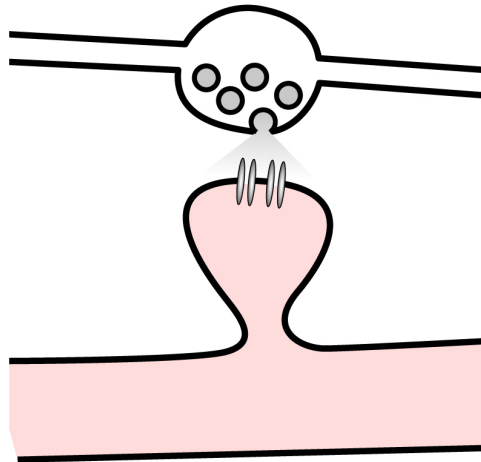Direct pathway striatal projection neurons (dSPNs)

Express D1Rs

Indirect pathway striatal projection neurons (iSPNs)

Express D2Rs
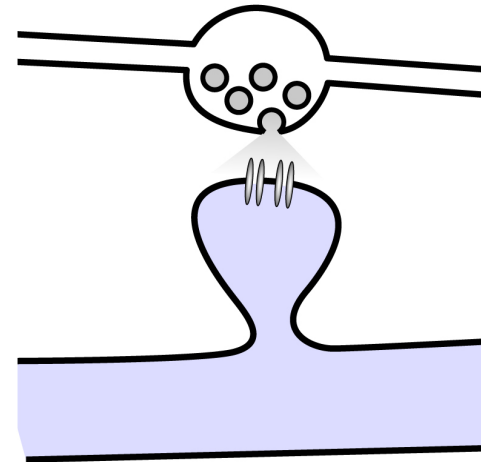
Sippy, Lapray, Crochet & Petersen
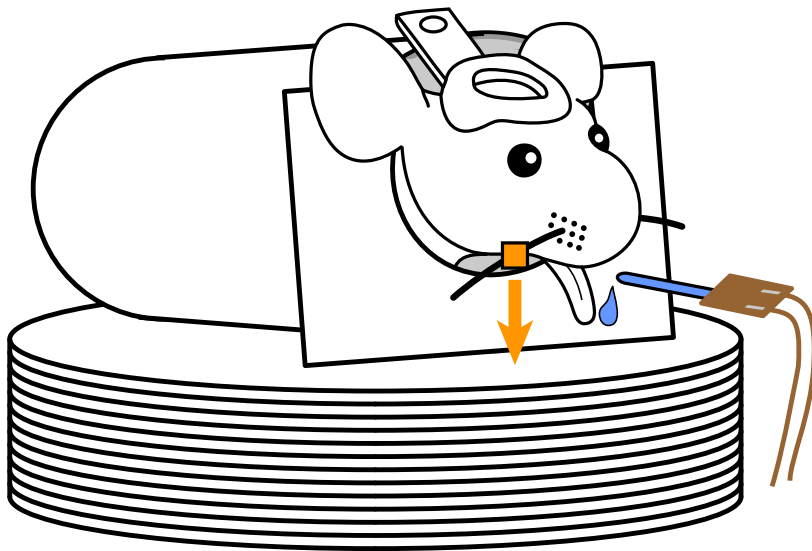
Dopamine modulation of synaptic plasticity

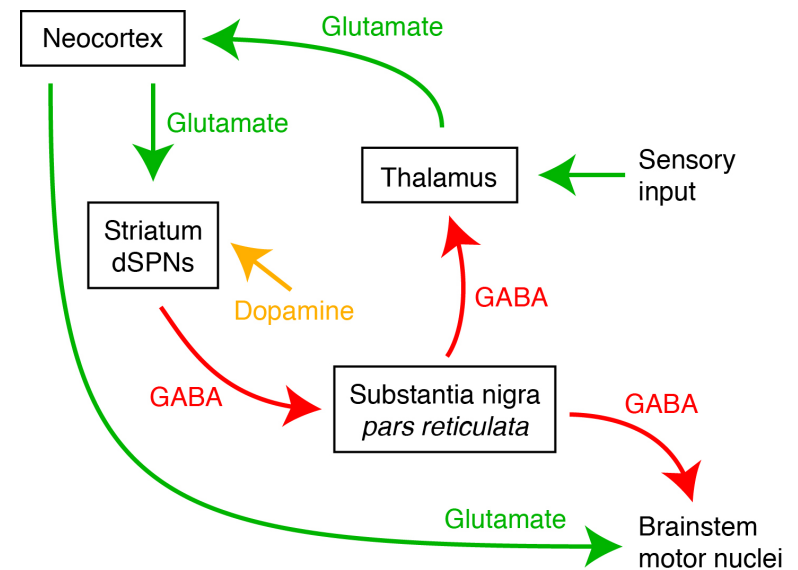D1 receptor expressing
striatal projection neuron
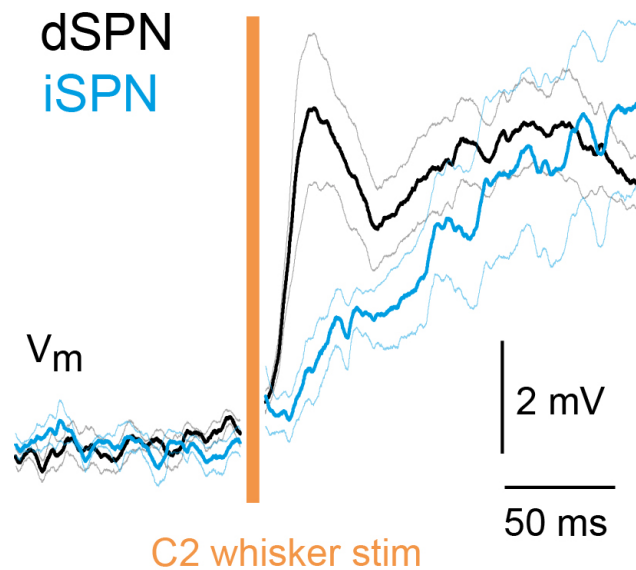
D2 receptor expressing
striatal projection neuron
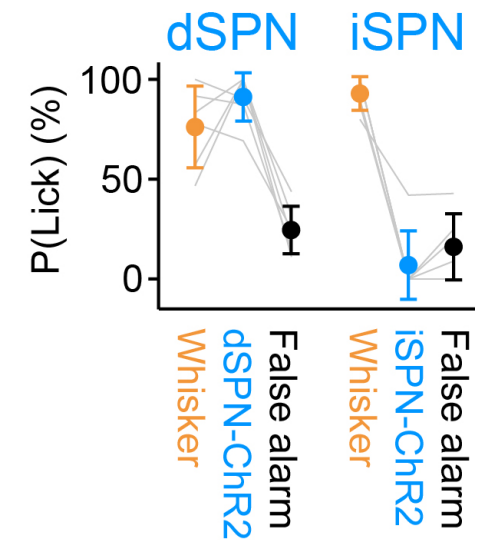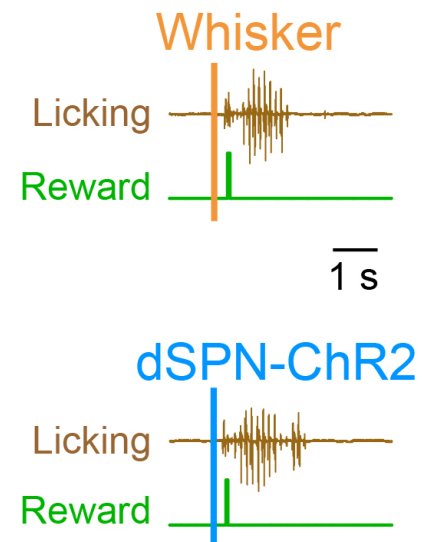
Whisker detection task

Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013
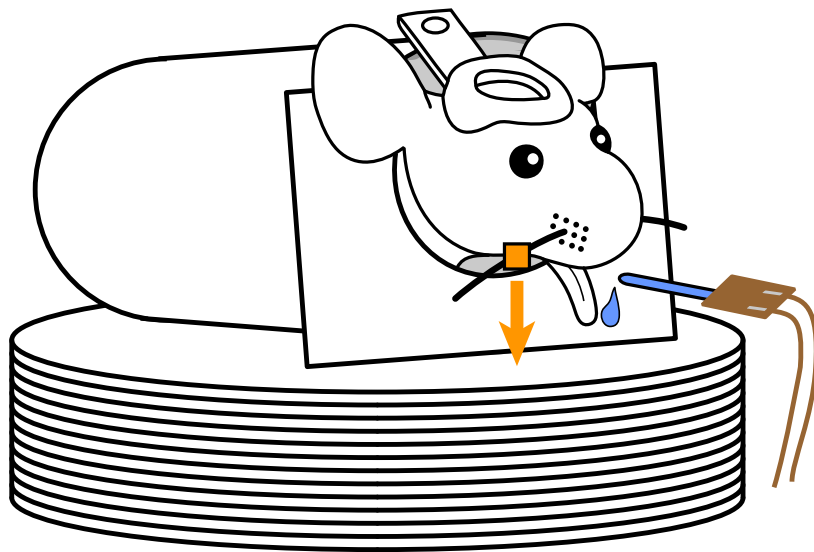
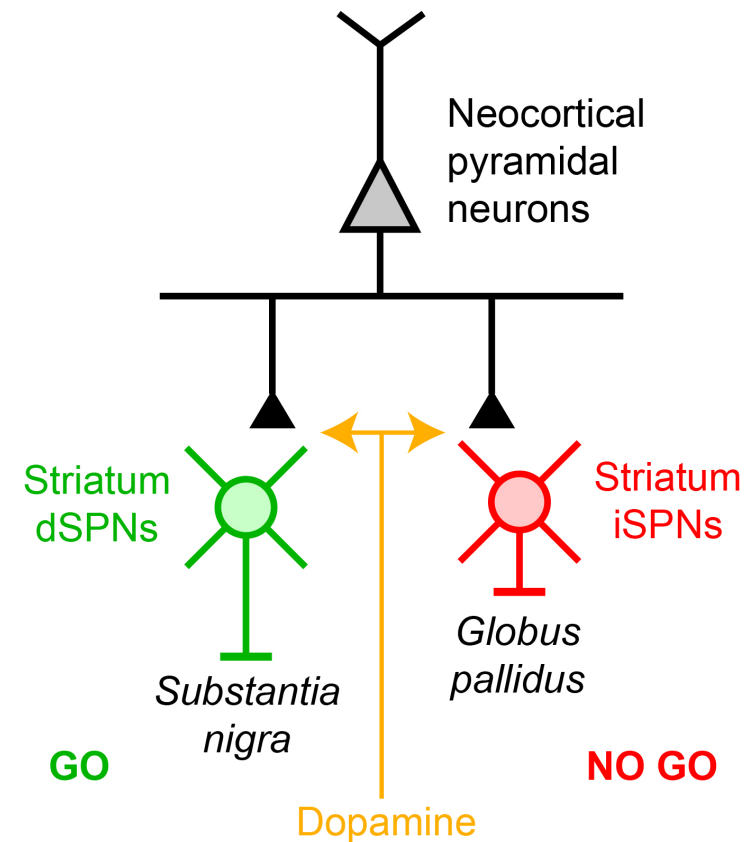# Cell-type-specific function of striatal neurons

Sippy, Lapray, Crochet & Petersen

Dopamine learning in the whisker detection task ?

Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

Neocortical pyramidal neurons

Striatum dSPNs

Striatum iSPNs

Substantia nigra

Globus pallidus

GO

NO GO

Dopamine

Cellular Mechanisms of Brain Function

Mechanisms underlying reward-based learning

- Reward-based learning likely reinforces the synaptic circuits driving goal-directed behavior.

- Transient action potential firing in dopamine neurons signals unexpected reward, an important learning signal. The released dopamine could drive synaptic plasticity underlying learning.