Themes in Computational Neuroendocrinology

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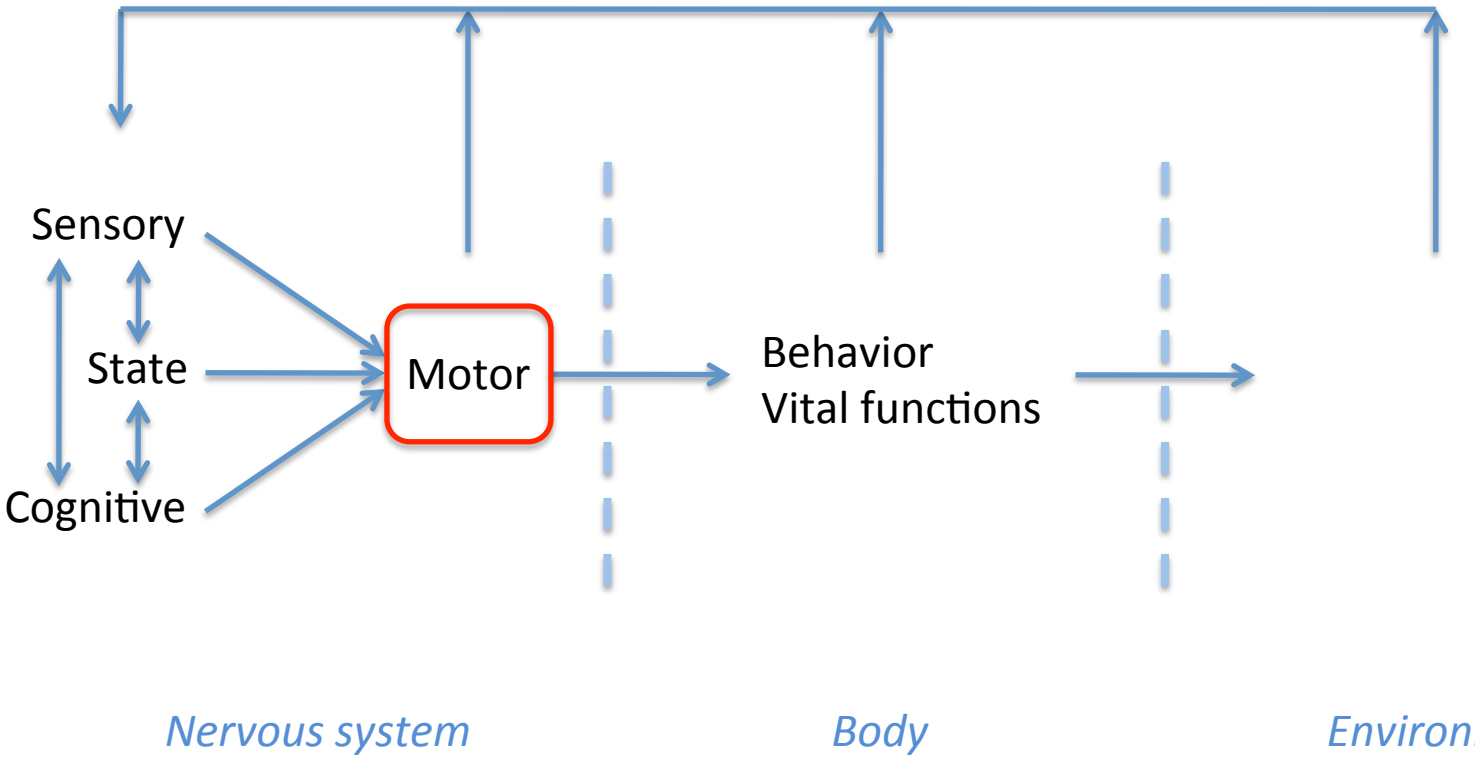
What is Computational Neuroendocrinology?

Use of mathematical models to answer questions in neuroendocrinology

What is Neuroendocrinology?

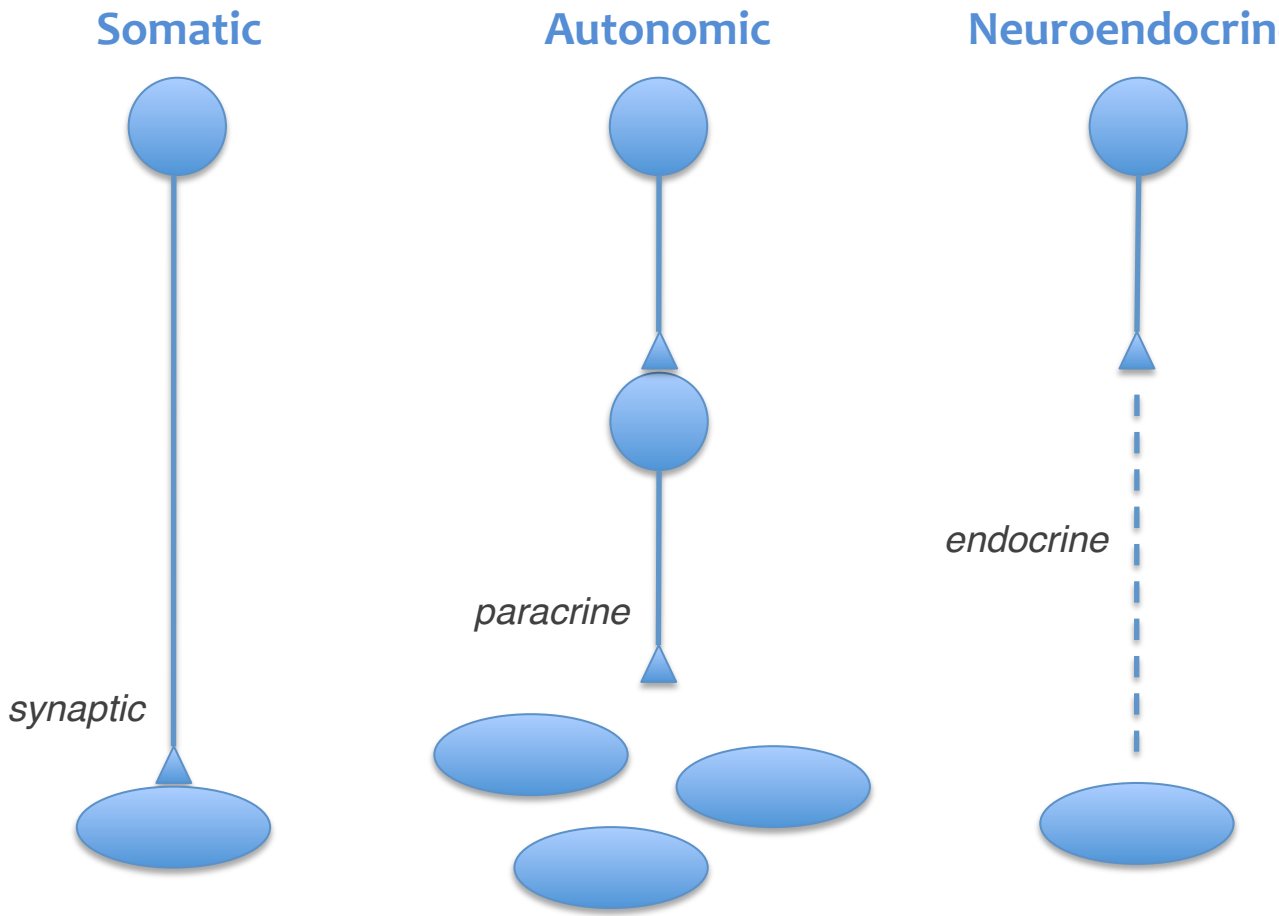
The study of the interaction between the brain and the endocrine system

Putting the neuroendocrine system in context



L. Swanson

Three motor systems, three types of communication



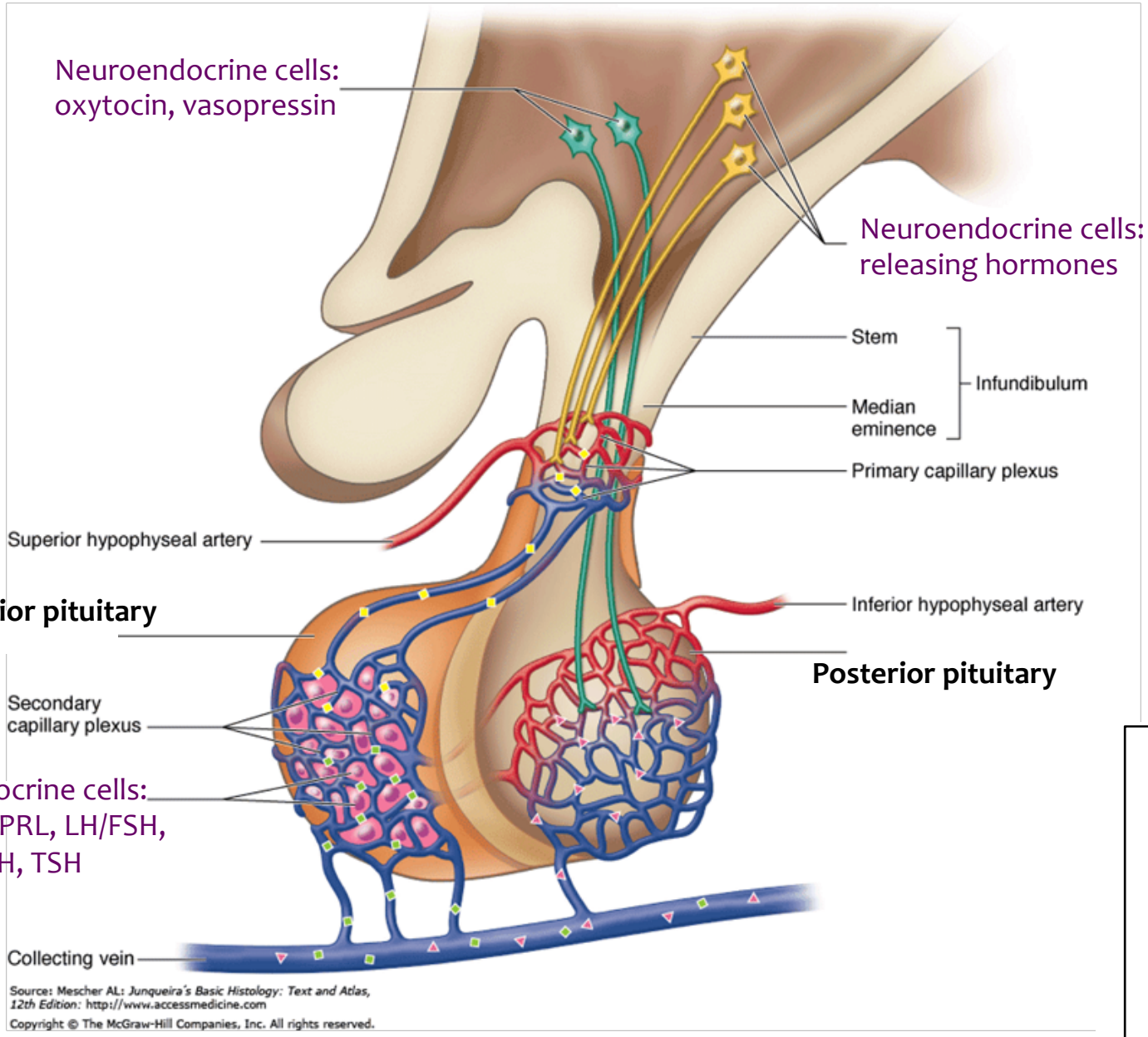
Locomotion
Respiration
Grasping
etc

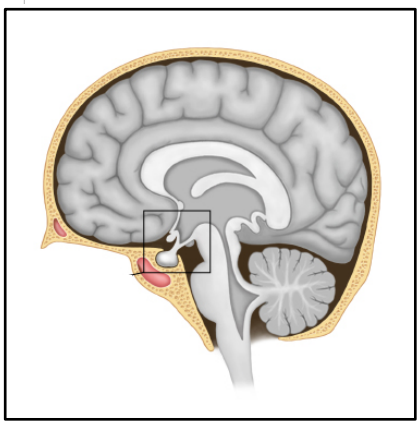
Fight or flight
Heart rate
Digestion
etc

Stress
Blood pressure
Ovulation
etc

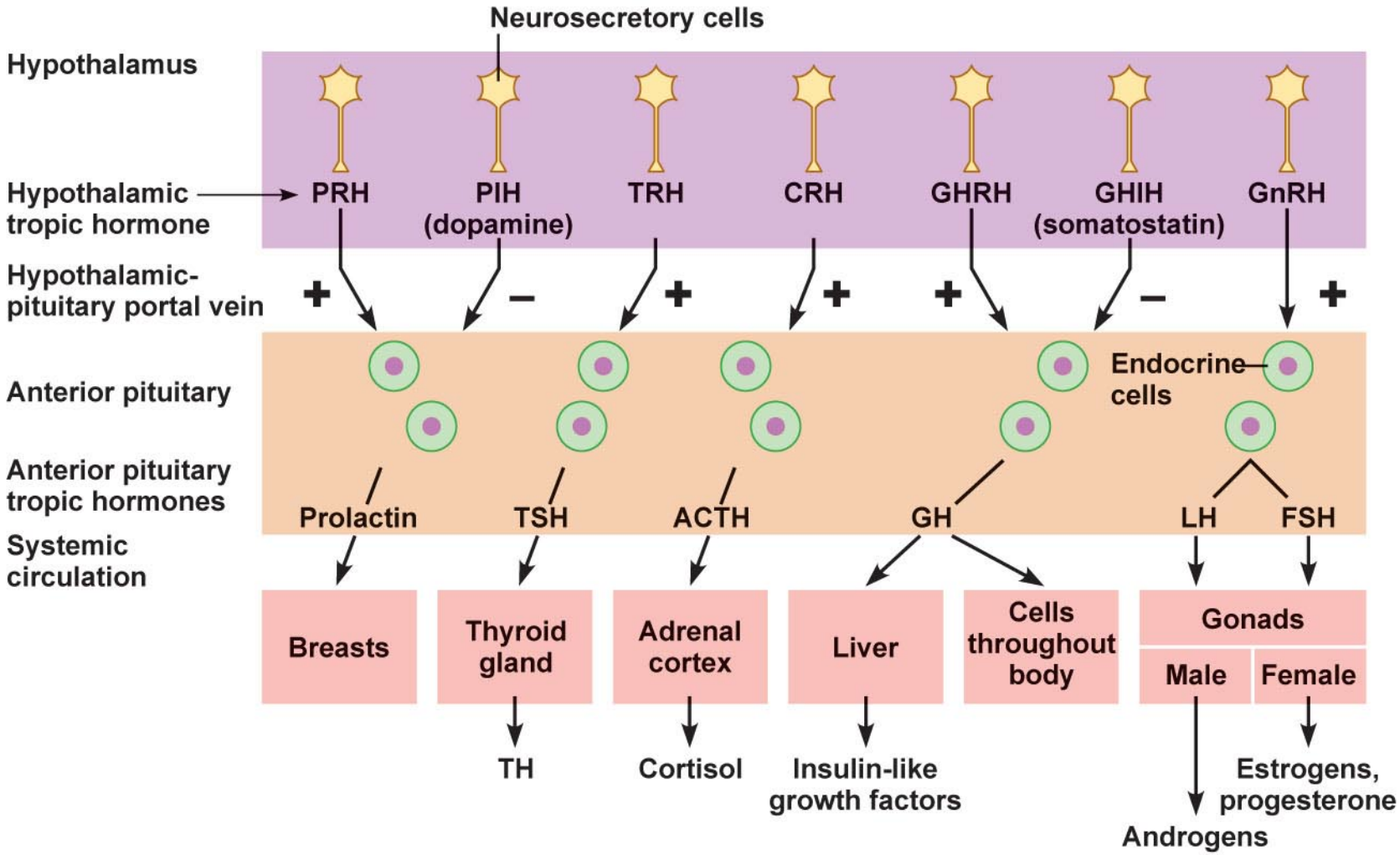
L. Swanson

The neuroendocrine motor system

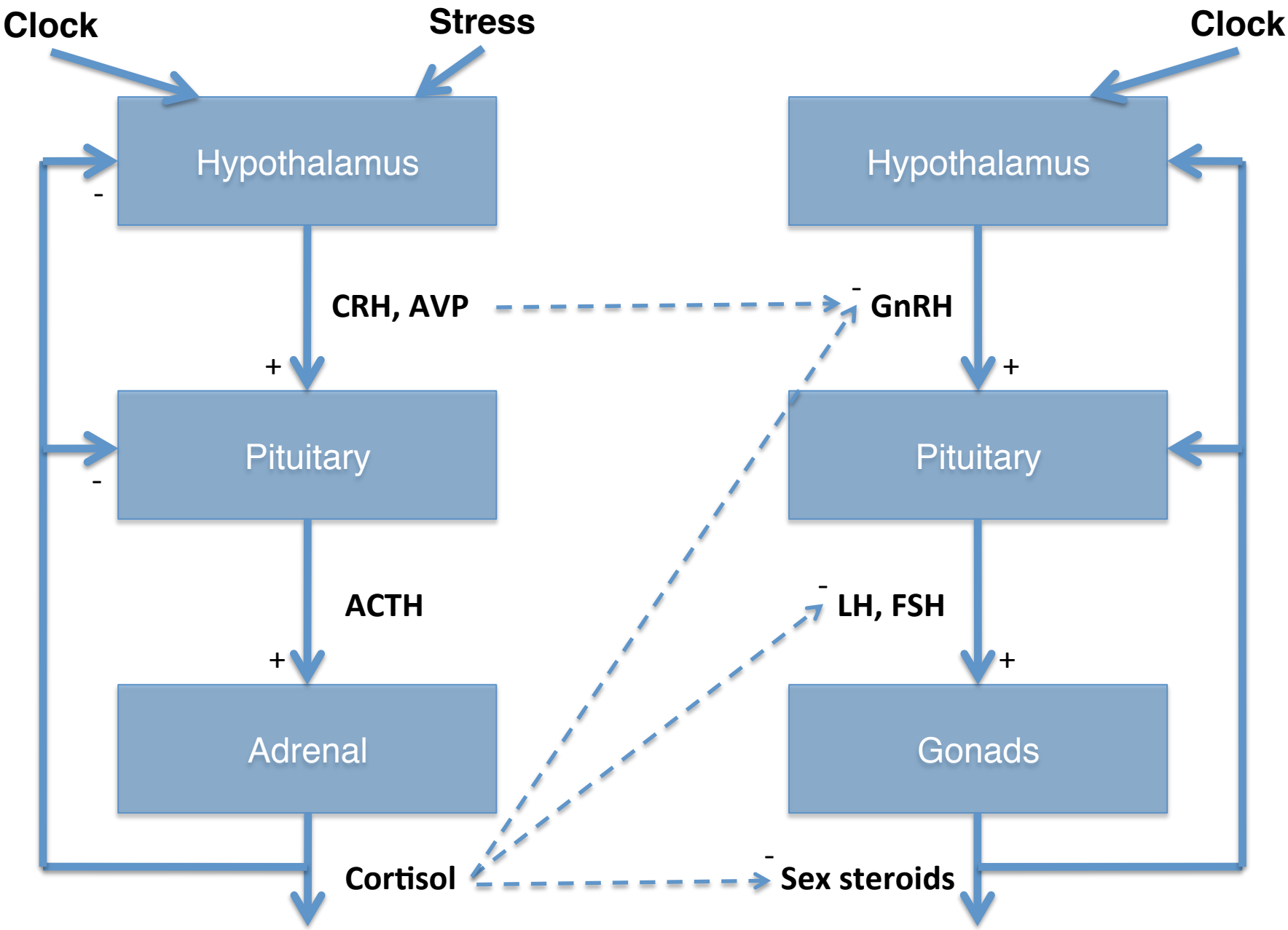




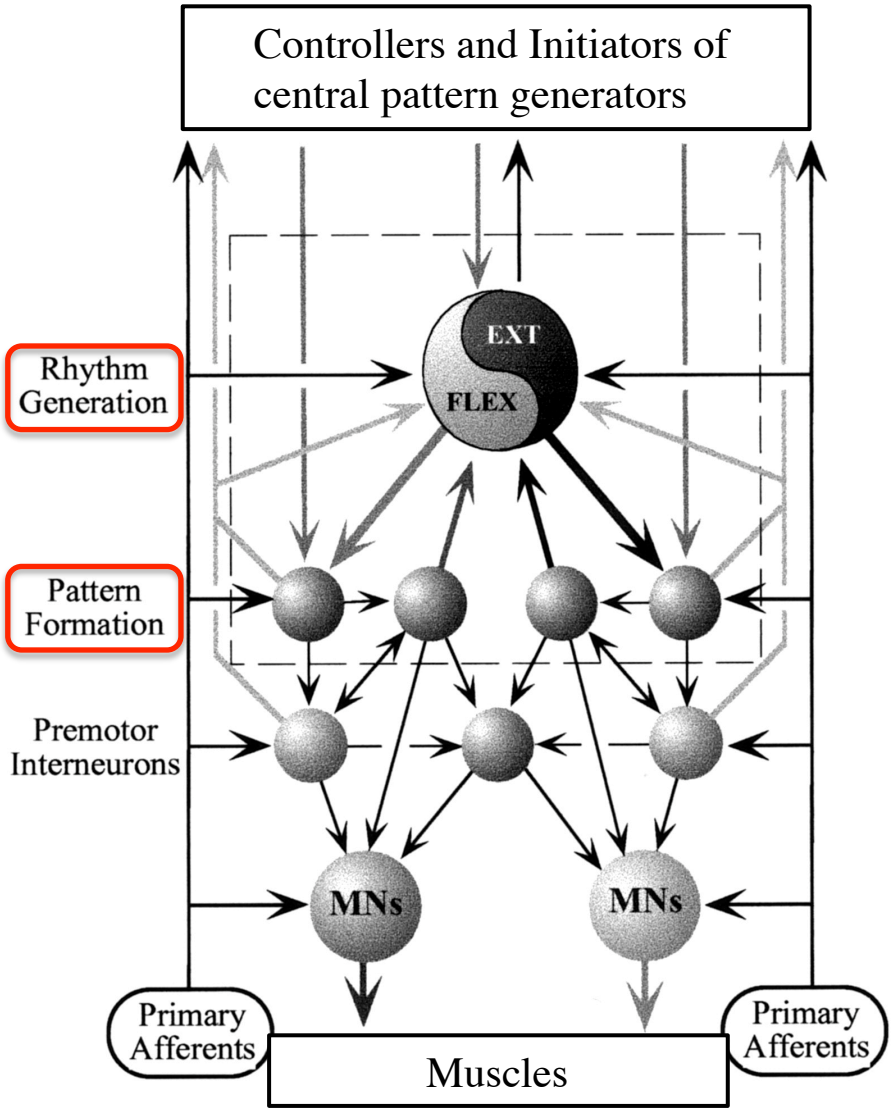
Specialized neuroendocrine cells regulate anterior pituitary hormones



Organization into neuroendocrine axes



The types of questions we ask

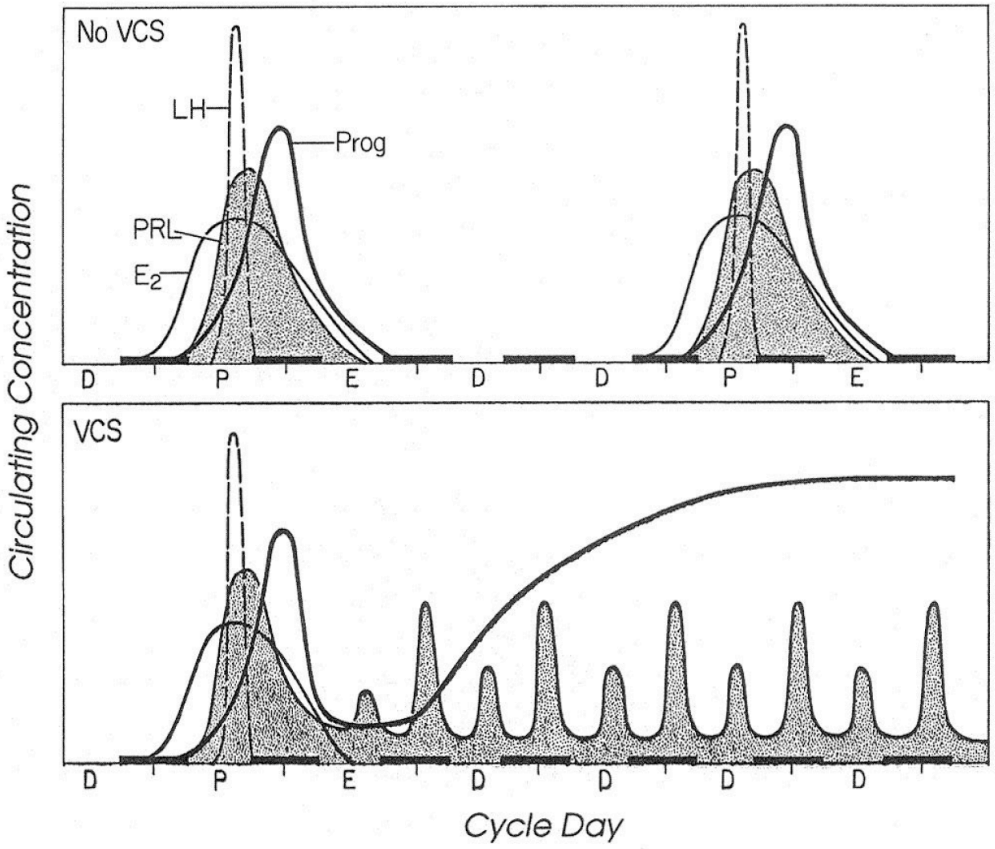


- What mechanisms produce the basic rhythms and patterns?
- How are the patterns of hormone release coordinated?

Burke et al (2001)

Some themes in (computational) neuroendocrinology

Pulsatile patterns of hormone secretion controlled by circadian clock

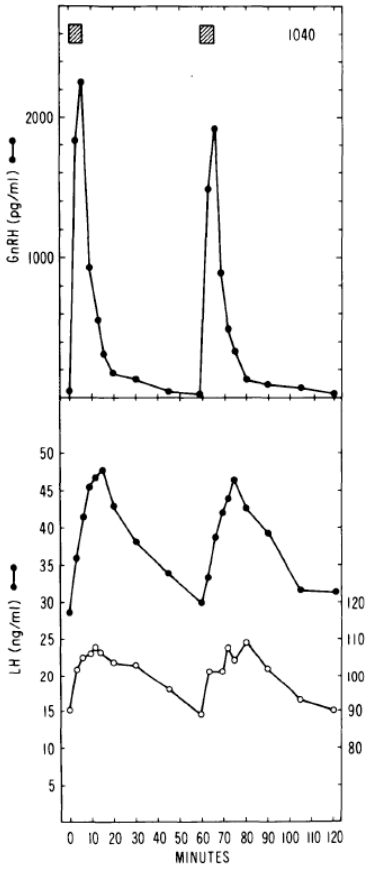


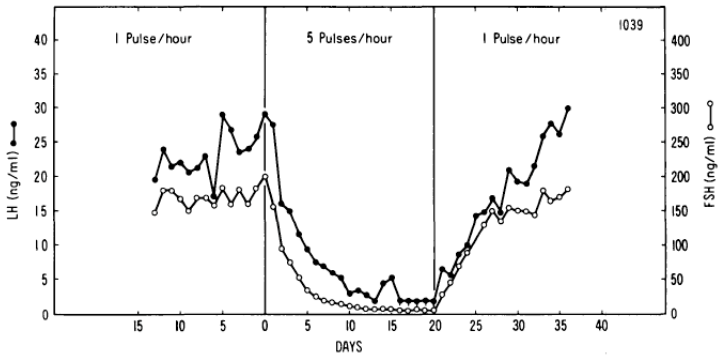
- What is the mechanism for the PRL and LH surges?
- How are PRL and LH synchronized? (see N. Toporikova's poster)
- What mechanism is turned on after mating to produce twice a day PRL surges?
- How is LH inhibited during pregnancy?

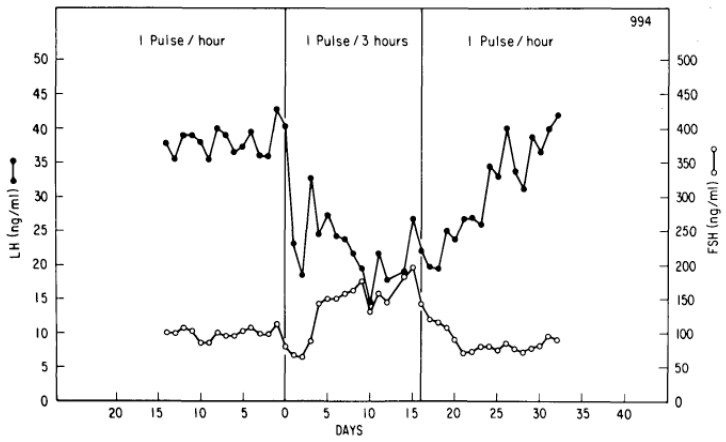
Erskine (1995)

Some themes in (computational) neuroendocrinology

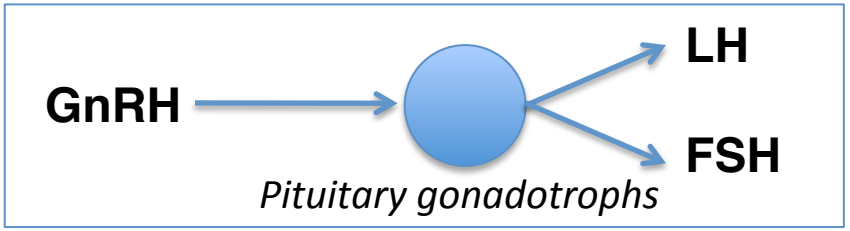
Encoding and decoding of hormone pulses







Wildt et al (1981)



- How do GnRH neurons synchronize?
- How is GnRH pulse frequency controlled?
- How does pulse frequency differentially regulate the production of LH and FSH

Models used in Computational Neuroendocrinology

Types of models

- Single cell models
  - pituitary cells, neuroendocrine cells
  - electrical activity, calcium, secretion
- Networks of neurons
- Mean field models

Differences with models used in computational neuroscience

- Action potentials are wider (pituitary)
- Synapses are slower (G-protein mediated)
- Feedback can be slower (through blood vessels)