BEAR, CH 2.

Nissl stain

Golgi stain

Cajal vs. Golgi – Cajal right abt contact –

neuron doctrine. cell theory applies to neurons as well

cell body / soma / perikaryon.

neurites – axon + dendrites

(out) (in)

long	<2mm

The Prototypical Neuron

1. SOMA

~20 μm diam.

cytosol, K-rich

everything floats as cytoplasm.

a. NUCLEUS.

5-10 μm diam.

double-membrane – nuclear envelope.

protein synthesis occurs in CYTOPLASM.

introns spliced out, alternative splicing.

gene copy number variations → genes missing or genes duplicated.

↑ occurs at moment of conception.

mutation – FRAGILE X – autism-like symptoms.

SINGLE NUCLEOTIDE POLYMORPHISMS. (SNPs)

minor misspellings.

knockout mice – remove gene

knockin mice – replace gene w/ different

transgenic mice – add gene to cause overexpression.

b. ROUGH ER

ribosomes are protein factories

mRNA + Ribosome ⇒ protein

ribosomes attach to rough ER → protein destination in membrane of cell/organelle

free ribosomes aren't attached to rough ER

polyribosomes work on same mRNA strand to make multiple copies of protein

protein destination in cytosol

c. SMOOTH ER & the GOLGI APPARATUS.

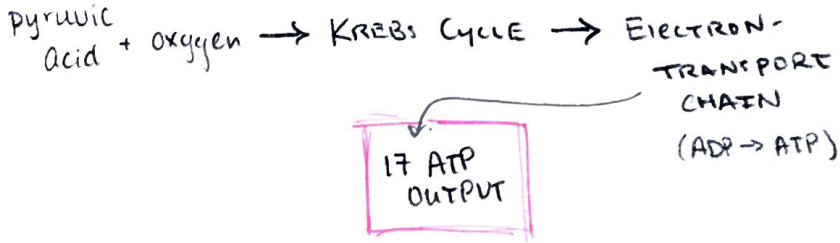
- regulate internal concentrations
- fold proteins that will jut out of membrane.

GOLGI APPARATUS —

- post-translational chemical processing of proteins
- helps sort proteins according to destination.

D. MITOCHONDRION.

Cristae + matrix (inside the cristae).



E. THE NEURONAL MEMBRANE

~5 nm thick.

proteins interspersed.

function of neurons cannot be understood w/o understanding structure & function of membrane and associated proteins.

F. CYTOSKELETON

microtubules — ~20nm diameter, runs down neurites made up of proteins called tubulin.
↓ polymerization & depolymerization can thus be regulated.

microfilaments — ~5 nm diameter. actin. anchored to cell membrane.

neurofilaments. ~10nm. — "bones & ligaments"

↓

microtubule-associated proteins, or MAPs.

ANCHOR microtubules to eachother / other parts of neuron.

axonal MAP is called tau — Alzeimhers

The Axon

- Axon hillock. (base)
- No rough ER in axon, & very few free-ribosomes.
- Axon membrane ≠ soma membrane.
- Branches are called AXON COLLATERALS
- Collaterals that loop back to same neuron — recurrent collaterals.
- larger diameter = faster nerve impulse.
- Axon terminal — point of contact is the synapse.
- Small branches at ends of axons — terminal arbor.
- Axon terminal cytoplasm is diff. from the rest of the axon.
  1. microtubules don't extend into the terminal.
  2. many synaptic vesicles, ~50 nm in diam. — contain neurotransmitter.
  3. synapse membrane has dense covering of proteins.
  4. axon terminal cytoplasm has lots of mitochon, — there are different kinds of neurotransmitter.

The Synapse

Synaptic cleft — space between.

Synaptic transmission is the transfer of info at the synapse.

AXOPLASMIC TRANSPORT

Wallerian degeneration — axon, w/o ribosomes, must degrade if detached from soma.

- fast axoplasmic transport: 1000 mm/day
- slow axoplasmic: 1–10 mm/day

material enclosed in vesicles, walk down microtubules of axon. legs = protein [kinesin]

soma → axon: anterograde transport

axon → soma: retrograde

↳ legs = protein [dynein]

DENDRITES

dendritic tree

retrograde transport — HORSERADISH PEROXIDASE (HRP)

dendritic spines - believed to isolate various chemical rxns triggered by some types of synaptic activity.

polyribosomes can be observed in dendrites, often right under spines.

synapses can drive protein synthesis

CLASSIFYING NEURONS

1. Classification based on neuronal structure.

1a. # of neurites.

unipolar	1 neurite
bipolar	2 neurites
multipolar	many neurites

← may or may not be spiny

1b. cerebral cortex: stellate cells, pyramidal cells.

spiny or aspinous.

↑ always spiny

1c. connections.

primary sensory neurons. → sensory surface of body

motor neurons → muscles

interneurons. → neuron to neuron

Id. AXON LENGTH

Golgi type 1, projection neurons (→ pyramidal) — long

Golgi type 2, local-circuit neurons (→ stellate) — stay in vicinity of cell body

CLASSIFICATION BASED ON GENE EXPRESSION

motor neurons → acetylcholine.

⇒ muscle cells are cholinergic (able to understand acetylcholine)

GFP allows for visualization which proteins are expressed.

GLIA

ASTROCYTES
- most numerous glia in the brain
- influence if glia can grow/retract
- regulates chemical content of extracellular space.

MYELINATING GLIA.

- oligodendroglial
  found only in CNS; myelin to many axons
- Schwann cells
  only in PNS; myelinates only single axon.
- provide layers of membrane that insulate axons.
- node of Ranvier — short length where axonal membrane exposed.

OTHER NON-NEURONAL CELLS.

ependymal cells — direct cell migration during brain development.

microglia — phagocytes to remove debris