ACTION POTENTIAL

OVERVIEW OF A NERVE IMPULSE

1. Resting potential – neuron is not stimulated at threshold level
2. Action potential – neuron responds to stimulus, sends "message" along axon
    a. Depolarization
    b. Repolarization

** Potential = difference in charge (measured in volts)

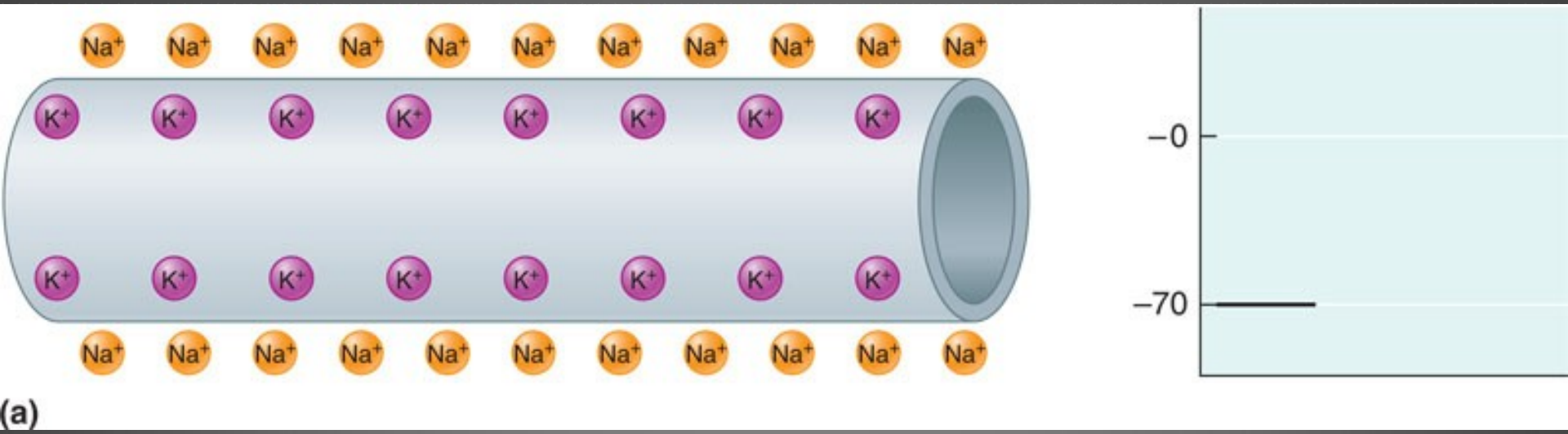
RESTING POTENTIAL

- Inactive neuron
- Inside cell membrane – more K^+ ions
- Outside cell membrane – more Na^+ ions
- Polarized cell membrane
  - Inside cell membrane – negative charge
  - Outside cell membrane – positive charge
- Cell membrane relatively impermeable to both ions

WHY IS MEMBRANE POLARIZED AT REST?

1. Na^+/K^+ pump maintains ion distribution - transports 3 Na^+ out and 2 K^+ in
2. K^+ diffuses out faster – membrane is more permeable
3. Na^+ is attracted to cell because of its concentration gradient
4. Membrane is impermeable to large negatively charged ions

RESTING POTENTIAL



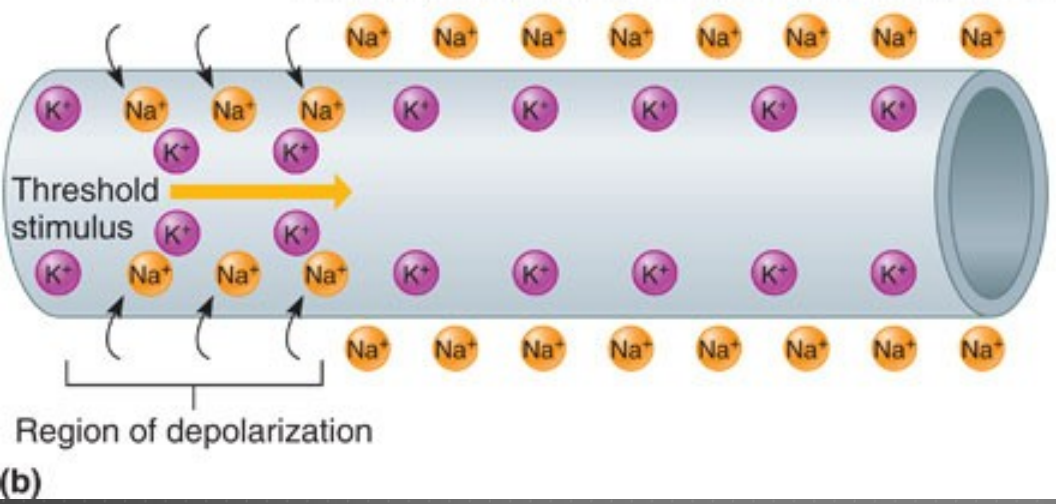
ACTION POTENTIAL = NERVE IMPULSE

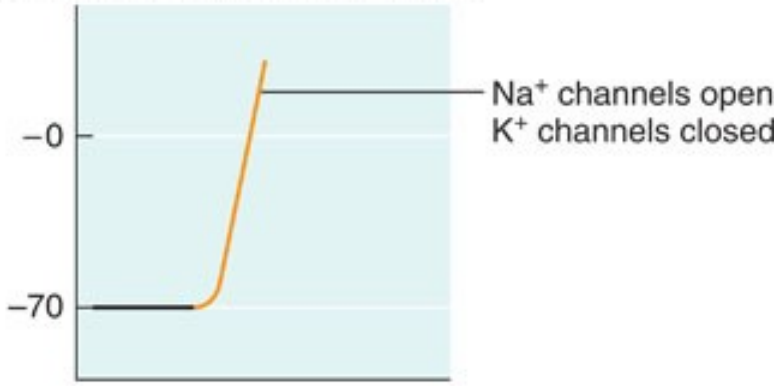
- Occurs in excitable membranes – neurons and muscle fibers
- Critical level must be reached ("threshold") before impulse is sent
  - Positive feedback mechanism
  - All-or-none response
- Lasts a few milliseconds
- 2 steps:
  - Depolarization
  - Repolarization

DEPOLARIZATION

- Stimulus causes adjacent Na^+ ion channels to open along axon
  - Na^+ ions rush into cell (high → low concentration)
- Movement of Na^+ ions reverses the charge of the membrane (depolarization):
  - Inside cell membrane – positive charge
  - Outside cell membrane – negative charge
- If threshold is reached, adjacent Na^+ ion channels to open along axon

DEPOLARIZATION

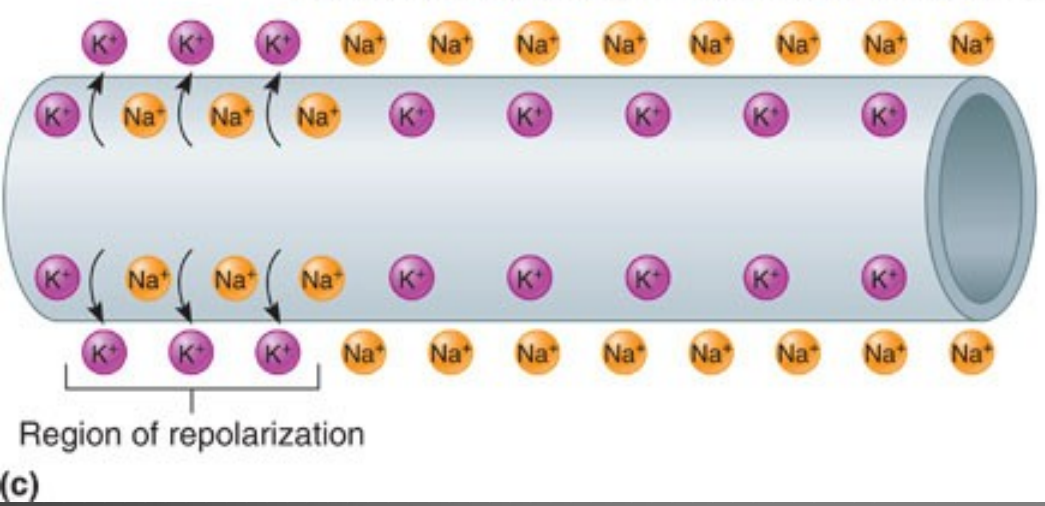


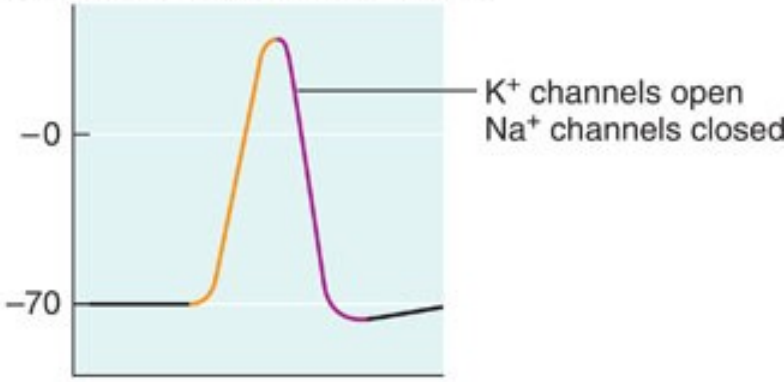


REPOLARIZATION

- K^+ ion channels open
  - K^+ ions rush out of cell (high → low concentration)
- Restores polarization of cell membrane
  - Inside cell membrane – negative charge
  - Outside cell membrane – positive charge
- Ion distribution is different than at resting potential – can't send another impulse yet
  - Inside cell – low K^+, high Na^+
  - Outside cell – high K^+, low Na^+

REPOLARIZATION



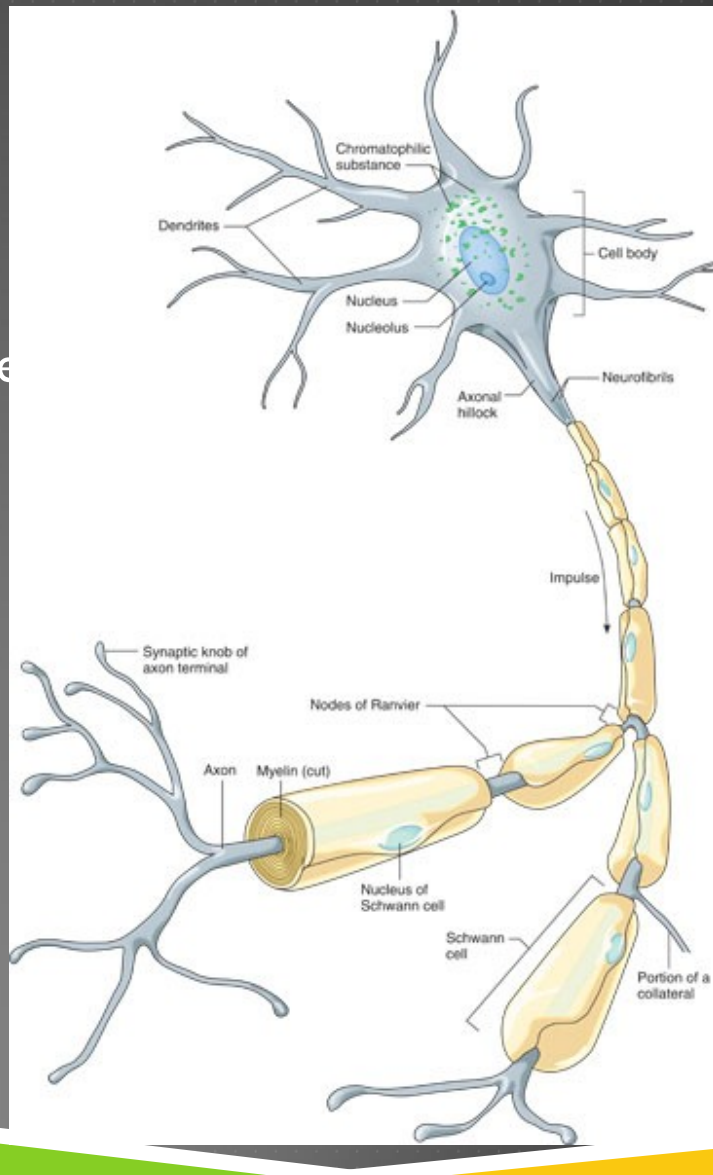


AFTER REPOLARIZATION

- Na^+/K^+ pump corrects ion distribution
  - Inside cell – high K^+, low Na^+
  - Outside cell – low K^+, high Na^+
- Another impulse can now occur

ROLE OF MYELIN

- Myelin insulates the axon
- Action potential must "jump" from node to node
  - Saltatory conduction
- Action potential is MUCH faster than along an unmyelinated axon



FACTORS AFFECTING NERVE IMPULSE

- Local anesthetics – block Na^+ channels – no Na^+ movement = no AP
- Continuous cold and/or pressure – blocks circulation (flow of nutrients and oxygen), so there is no energy for Na^+/K^+ Pump = no AP