



Glial Cells

Psychology 372

Physiological Psychology

Steven E. Meier, Ph.D.

Listen to the audio lecture while viewing these slides

1

Psyc 372 – Physiological Psychology

Overview

- Are very important
- Are not neurons
- Have no action potentials
 - But have threshold charges
- Are there to help neurons
 - Act as a support function
- Greater numbers
 - 2-50 times as many glial cells than neurons

2

Psyc 372 – Physiological Psychology

Two Major Groups

- Microglia
- Macroglia

3

Psyc 372 – Physiological Psychology

Microglia

- Are phagocytes
 - Eat up dead material and things
 - Will migrate to damaged areas
 - With Lesions get Gliosis
 - Concentrate and clean up material
 - Forms scar tissue
 - Serve as part of the immune system

4

Psyc 372 – Physiological Psychology

Macroglia

- Types
 - Astrocytes
 - Oligodendrocytes
 - Ependymal
 - Schwann

5

Psyc 372 – Physiological Psychology

Astrocytes

- Hallow stars
 - Appear transparent and look like stars
 - Make contact with both white and gray matter
 - Do not migrate much
- Fibrous Astrocytes
 - Find in Myelinated Tissue
 - (but don't make myelin)
- Protoplasmic
 - Are star-shaped and have lots of cytoplasm
 - Make function with capillaries
 - Are phagocytotic.

6

Possible Function

- Take up material, digest it, and push it through the capillary blood stream for removal.

7

Oligodendrocytes

- Are located in the CNS
- Is a many branching cell
- In CNS, will myelinate 30-40 axons

Prob.- Do not regenerate well

8

Schwann Cell

- Are found in the PNS
- Also make myelin
 - One cell makes one myelin sheath
- Regenerate faster than Oligodendrocytes.
 - Provide conduits for an axon to follow.
 - Hypothesized why you get better neural regeneration when damage occurs.

9

Schwann Cell

- In CNS
 - When oligodendrocytes are destroyed, axon distribution becomes confused
 - No conduits
 - Growth cones are random

10

Ependymal

- Forms the lining of ventricles
- Has cilia
 - Appears to aid in the movement of CSF through ventricles
- CSF is made very fast and is very dynamic.
 - Diffusion cannot explain the speed of CSF

11

Glial Functions

- Myelination - Salutatory Functions
- NT uptake
- Ion uptake
- Glue
- Nutritive

12

Myelination

- Oligodendrocytes and Schwann cells
- Myelinates axons
 - Has a salutatory function
 - Allows electrical conductivity to jump from between Nodes of Ranvier.
 - Get a field skipping effect
- Result - makes action potentials go faster

13

NT Uptake and Degradation

- Removes NT after exocytotic release from presynaptic elements
- Will also provide compounds to degrade NT
 - Good evidence for uptake and storage
 - Glutamate and Aspartate
 - Weaker evidence for release

14

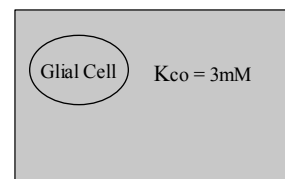
Ion Uptake Communication with Neurons

- Glial cells are only permeable to Potassium (K^+)
- Not permeable to Na^+ , Ca^{++} etc.
- Membrane potential (Inside to Outside difference) = -80 - -90 mv in a concentration of 3 mM of K^+ .
- Depends on ion concentrations and diffusion

15

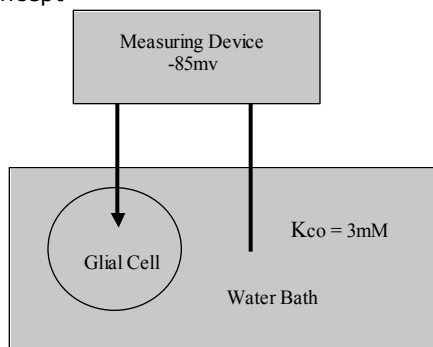
Concept

- Have a glial cell (Usually an Astrocyte) in a water bath of 3 mM
- Concentration outside cell is 3 mM

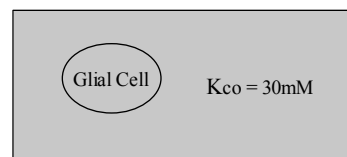


16

Concept

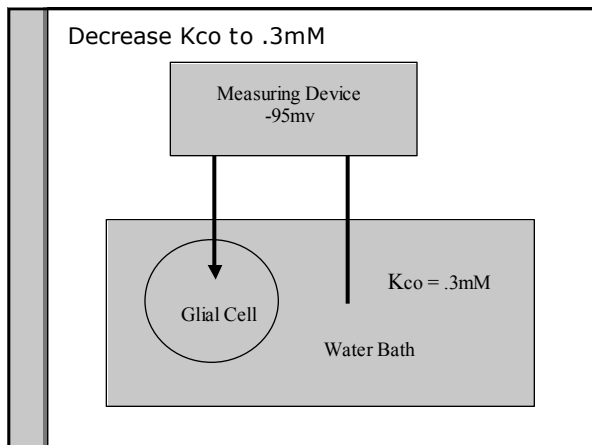
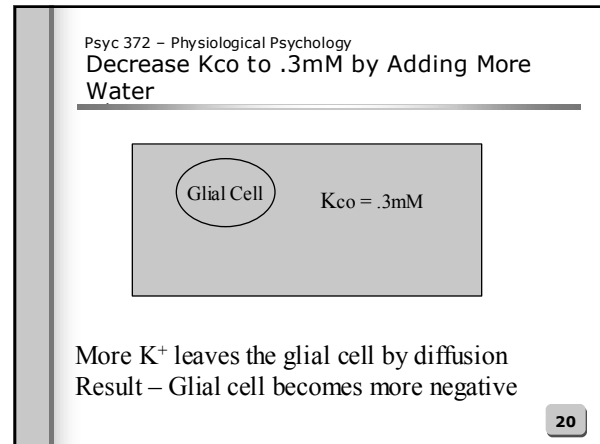
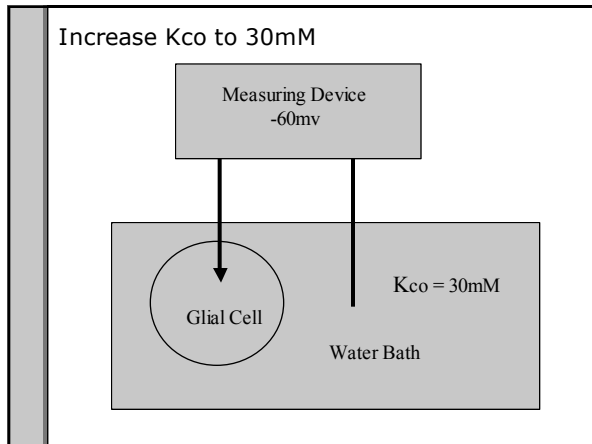


Increase K_{co} to $30mM$



More K^+ enters the glial cell by diffusion
Result – Glial cell becomes more positive

18



Psyc 372 – Physiological Psychology

Concept 1

Make the membrane more positive called
Depolarization

Make the membrane more negative called
Hyperpolarization

22

Psyc 372 – Physiological Psychology

Concept 2

- By manipulating the concentration of Potassium in the interstitial fluid, you can drive the glial cell.

HOW?

- Stimulate the Neurons around it.
- Neurons release Potassium
- More action potentials, more Potassium
- Get greater depolarization of glial cells
- As NaK pumps start, decrease K and glial diffuses from the glial and get hyperpolarization.

23

Psyc 372 – Physiological Psychology

Conclusion

- Glial Membrane Potential depends on the concentration of K^+ in the interstitial fluid
- Glial help to regulate the amount of K
- Helps to buffer the Neurons
- Prevents Seizures

24