



**COLORADO STATE  
UNIVERSITY**

# Using Canine Cognitive Dysfunction as a Model for AD & ADRDs

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**PhD Student**

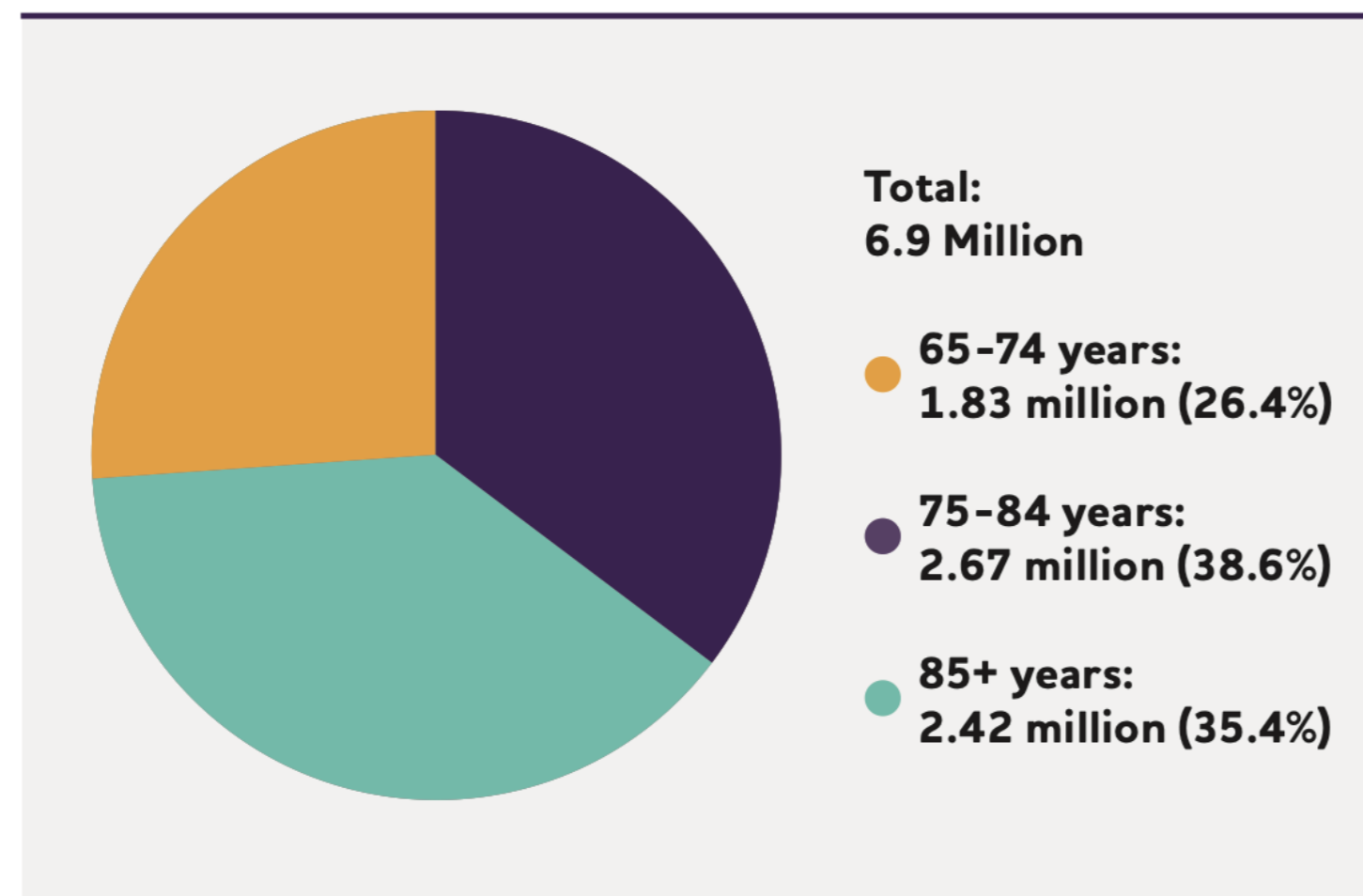
**Advisor: Dr. Julie Moreno**

# Alzheimer's Disease (AD)

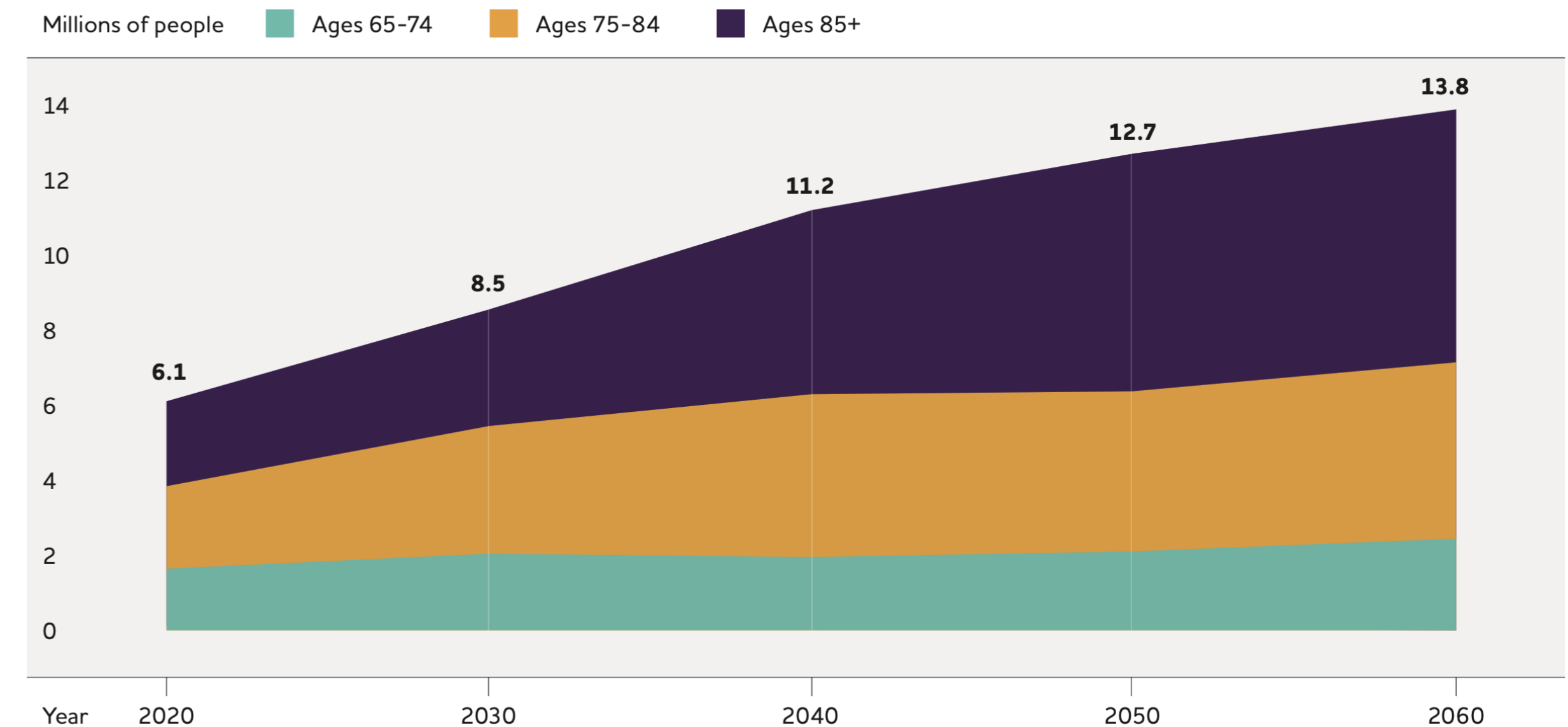


- AD was the sixth leading cause of death in 2019
- Aging is the greatest risk factor
- Diagnostic tools are limited
- Need for naturally occurring AD/ADRD models

Number and Ages of People 65 or Older with Alzheimer's Dementia, 2024\*

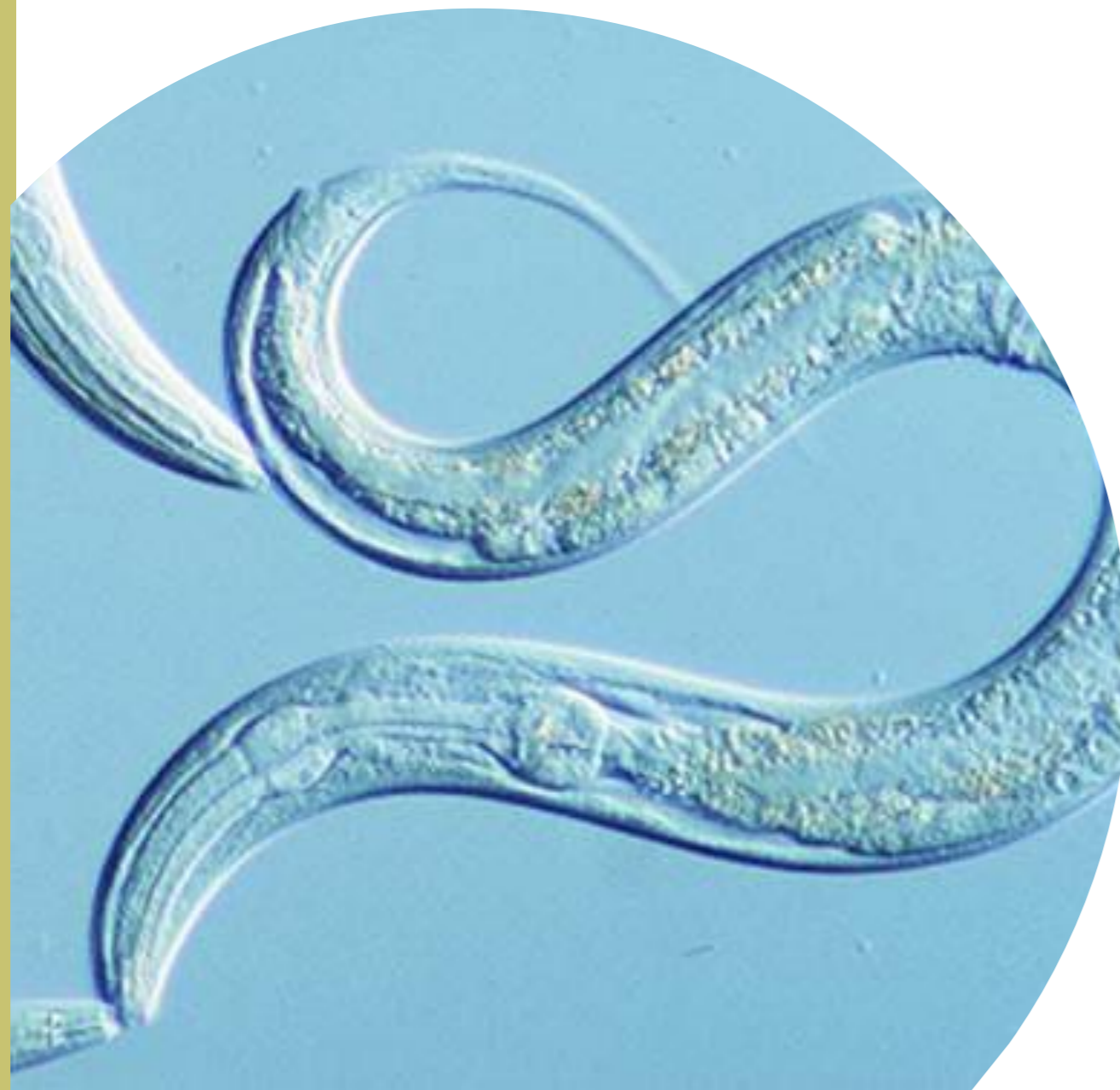


Projected Number of People Age 65 and Older (Total and by Age) in the U.S. Population with Alzheimer's Dementia, 2020 to 2060



# Current models for AD

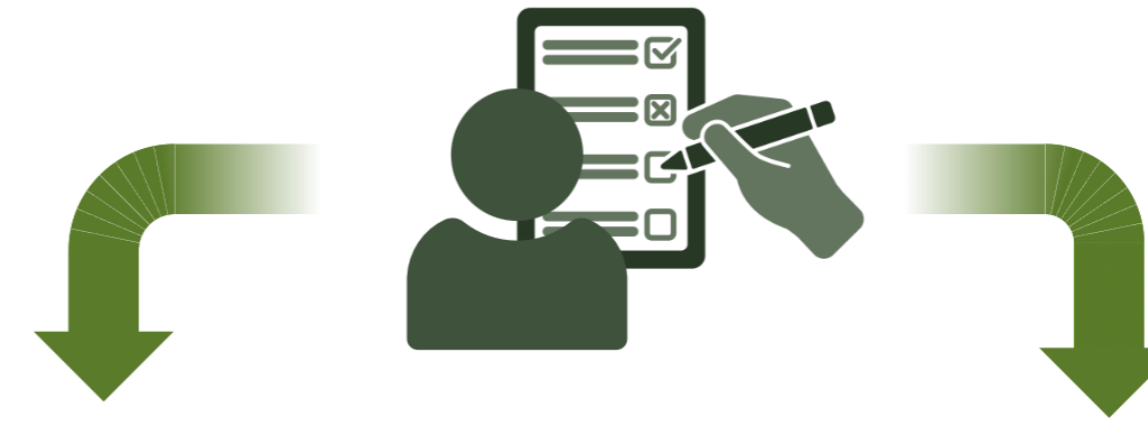
- **Neuroinflammation**
- **Accumulation of misshapen proteins**



# Canine Cognitive Dysfunction (CCD)

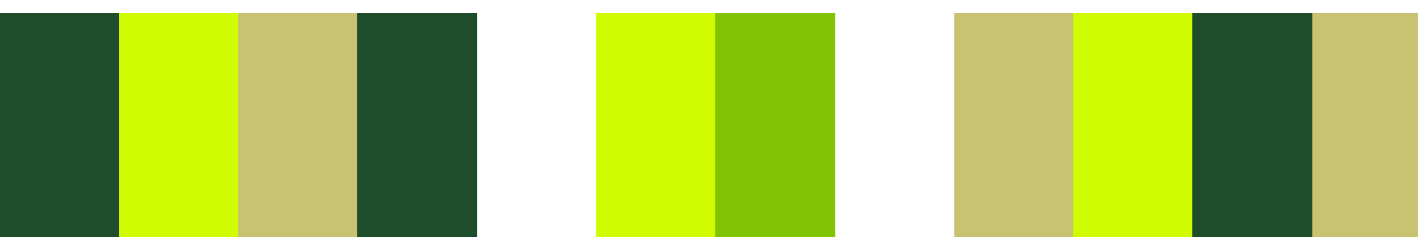
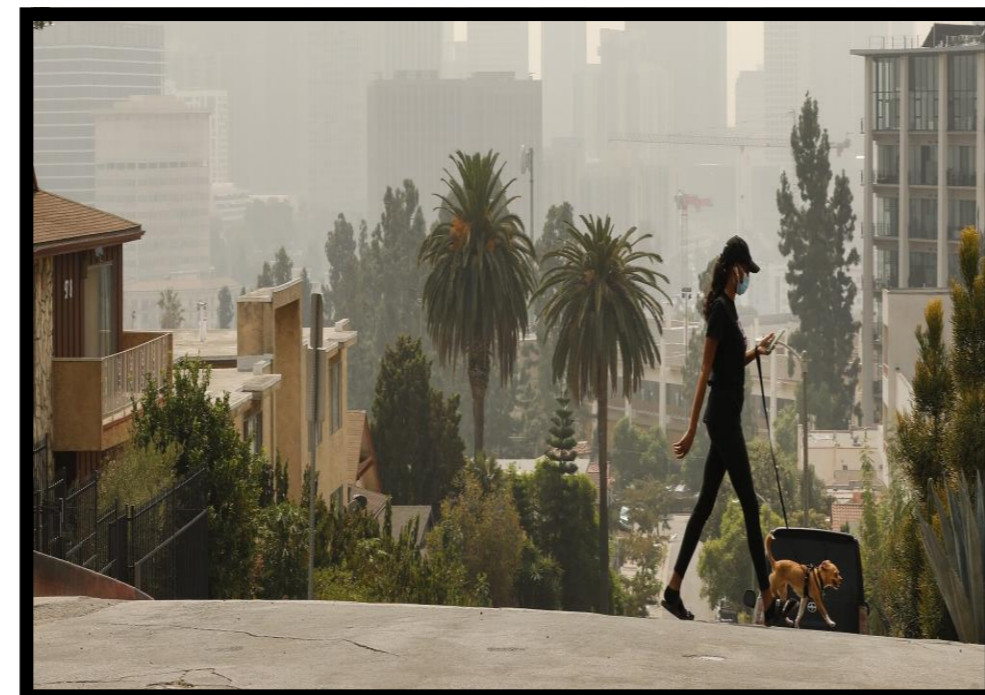


- Progressive neurodegenerative disease
- Why canines?
- Clinical CCD scoring is our only diagnostic tool

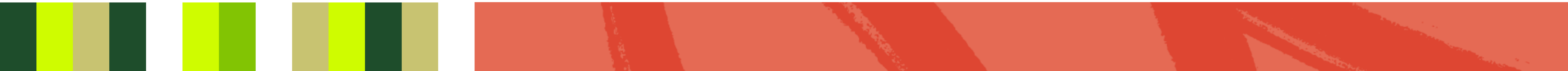
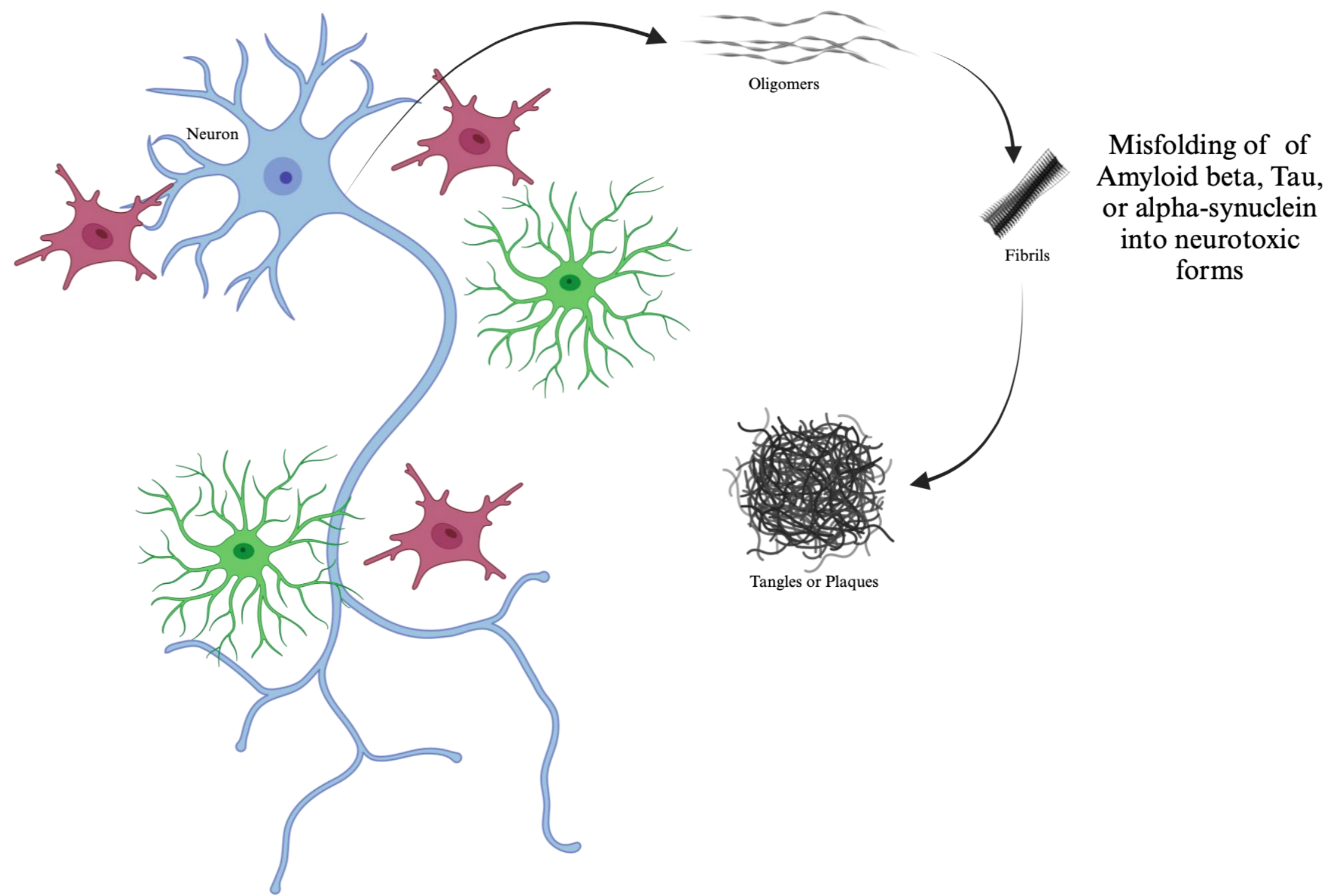
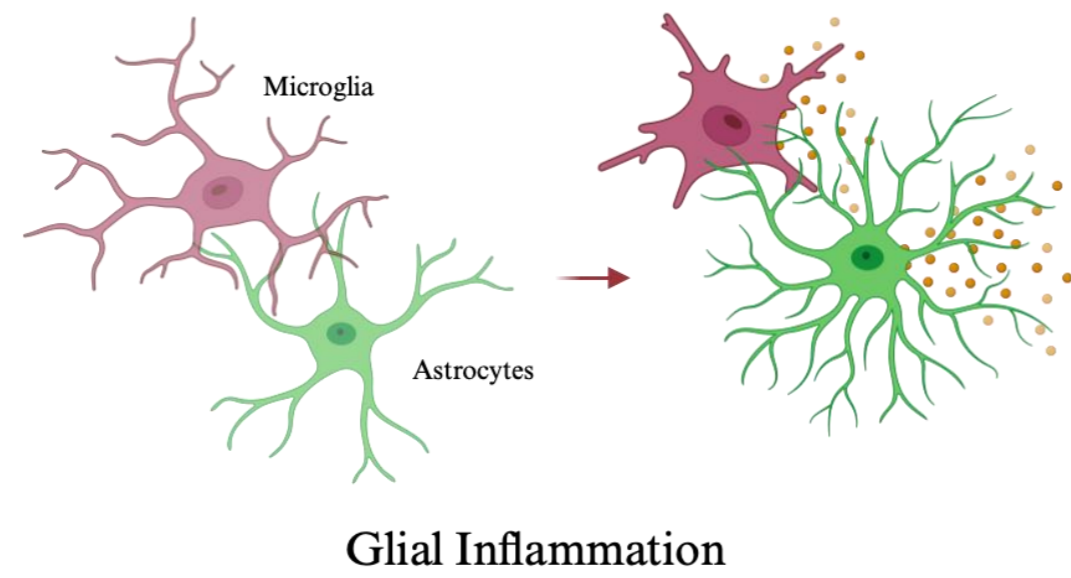


CADES  
Canine Dementia Scale

CCDR  
Canine Cognitive Dysfunction Rating Scale



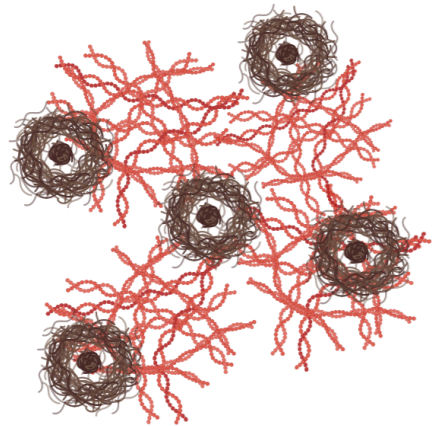
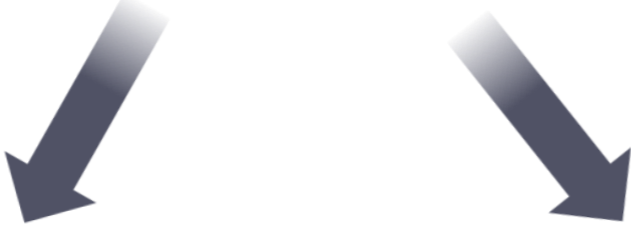
# Neuropathology



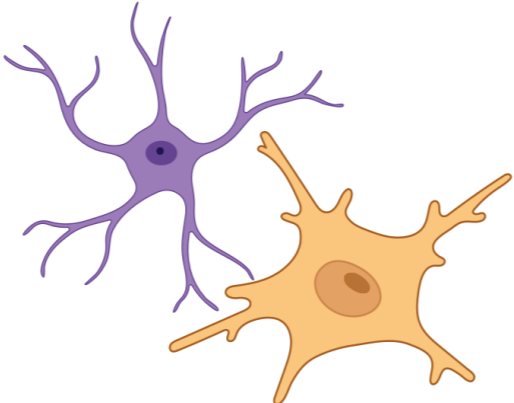
# Approach: clients owned dogs



Brain

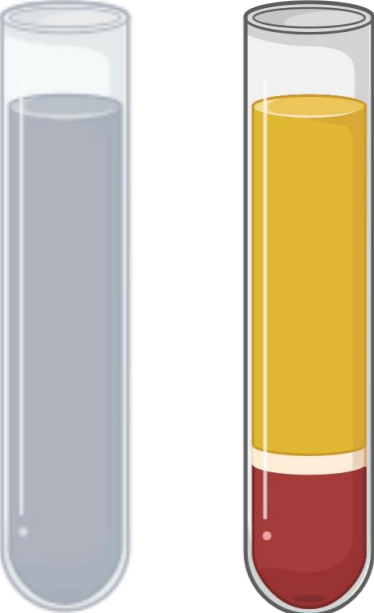


Misfolded Proteins



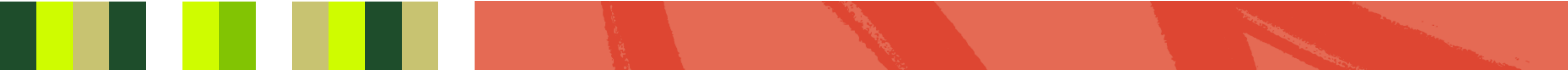
Neuroinflammation

Bio-fluids

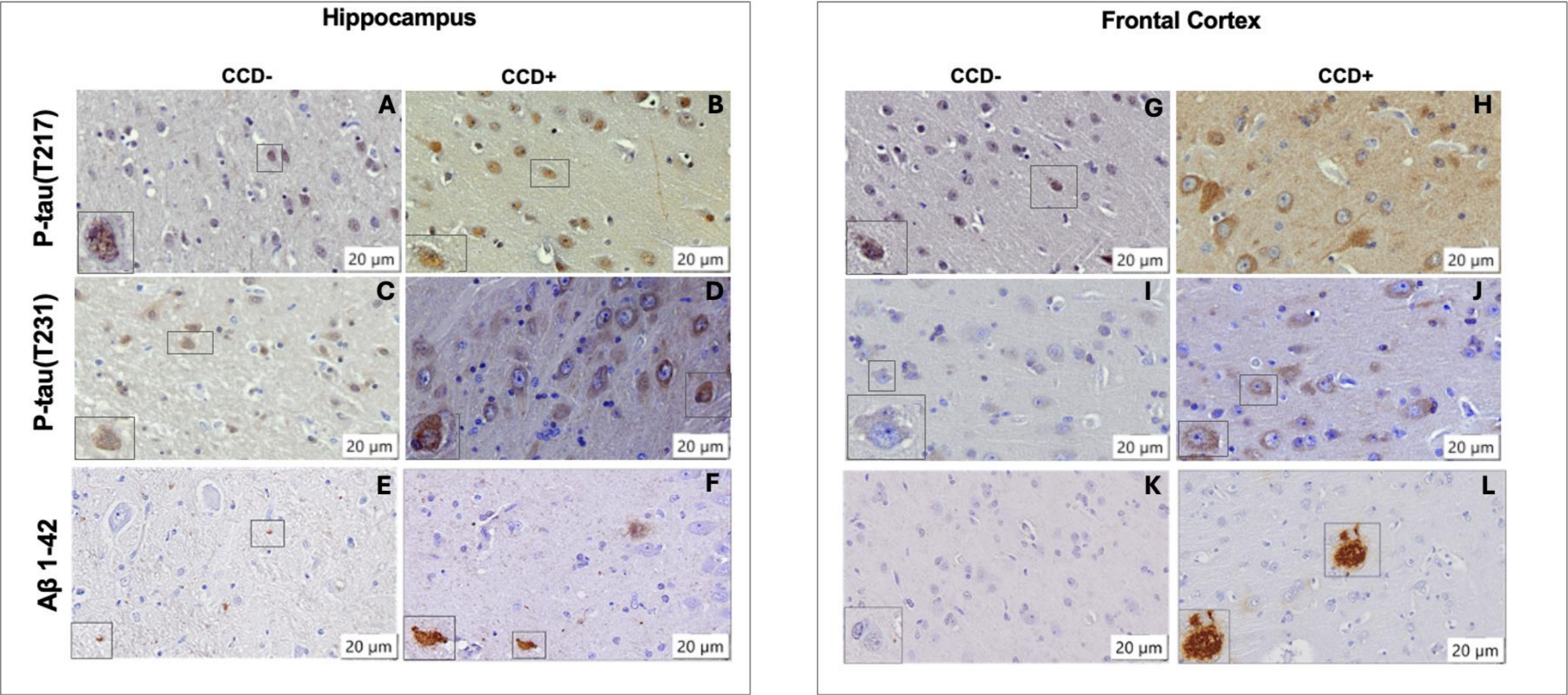


CSF

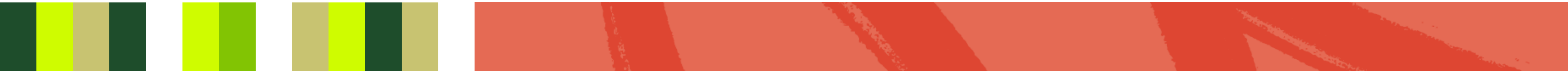
Plasma



# CCD Pathology: Misfolded Proteins



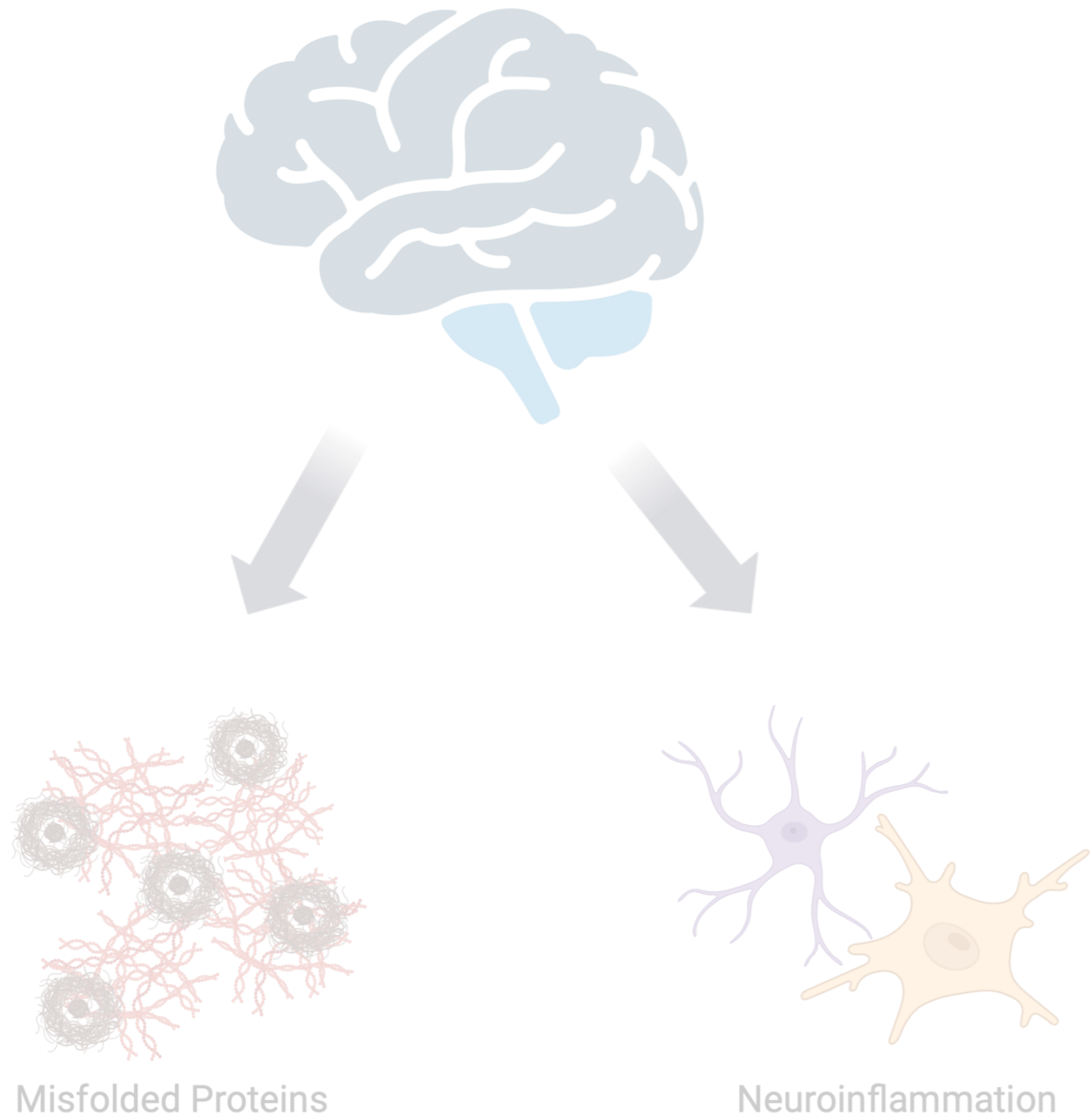
**Figure 1.** Increased accumulation of protein aggregates in the hippocampus and frontal cortex of CCD+ & CCD- canines. **A-F:** Hippocampal sections of CCD- and CCD+ dogs stained for anti-T217 (A & B), anti-T231 (C & D) and anti-Aβ1-42 (E & F). **G-L:** Frontal cortex sections of CCD- and CCD+ dogs stained for anti-T217 (D & H), anti-T231 (I & J) and anti-Aβ1-42 (K & L). Scale bar = 20μM.



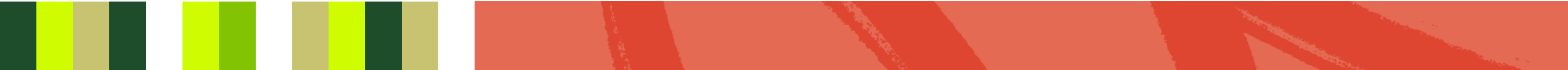
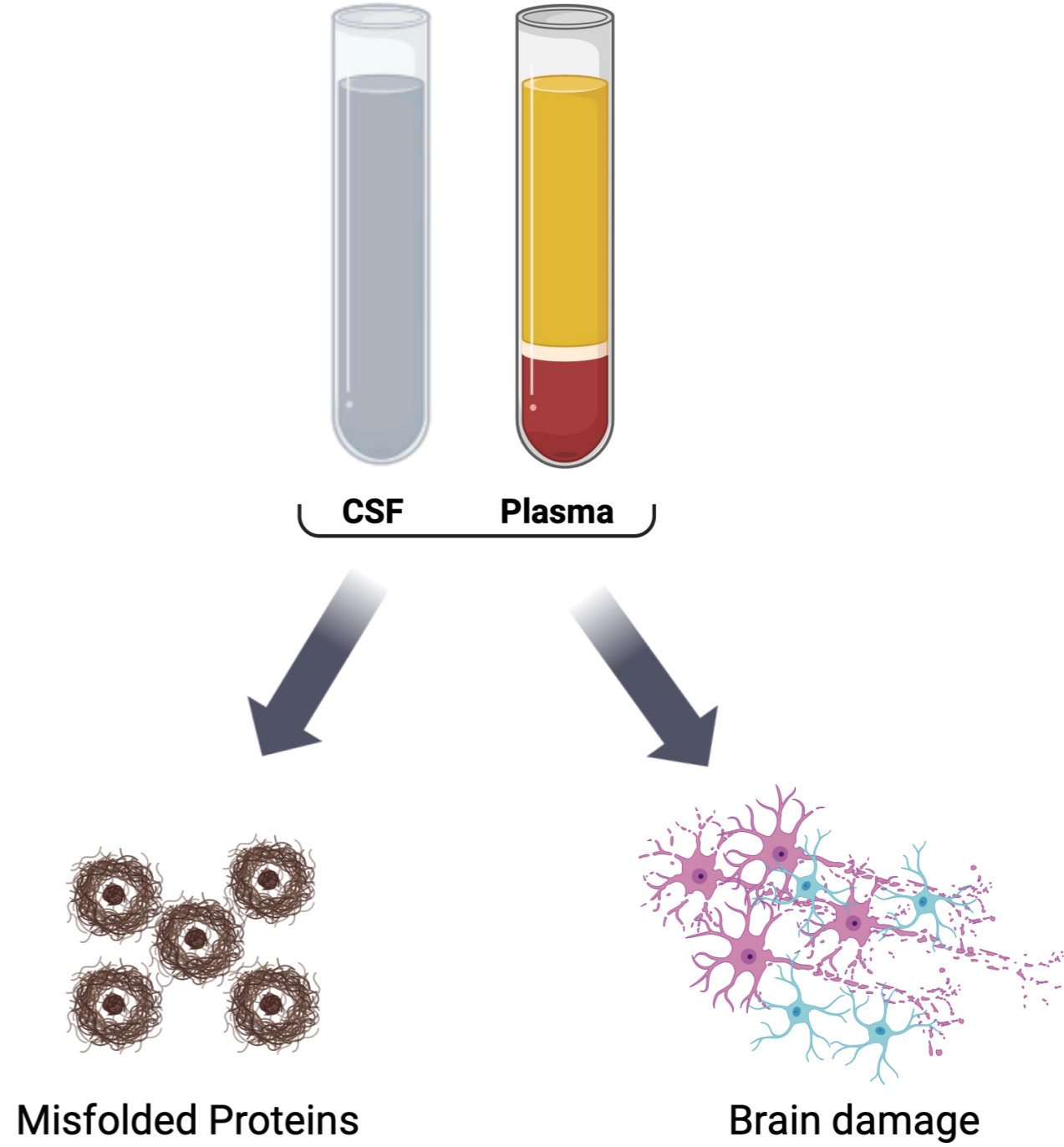
# Approach



Brain



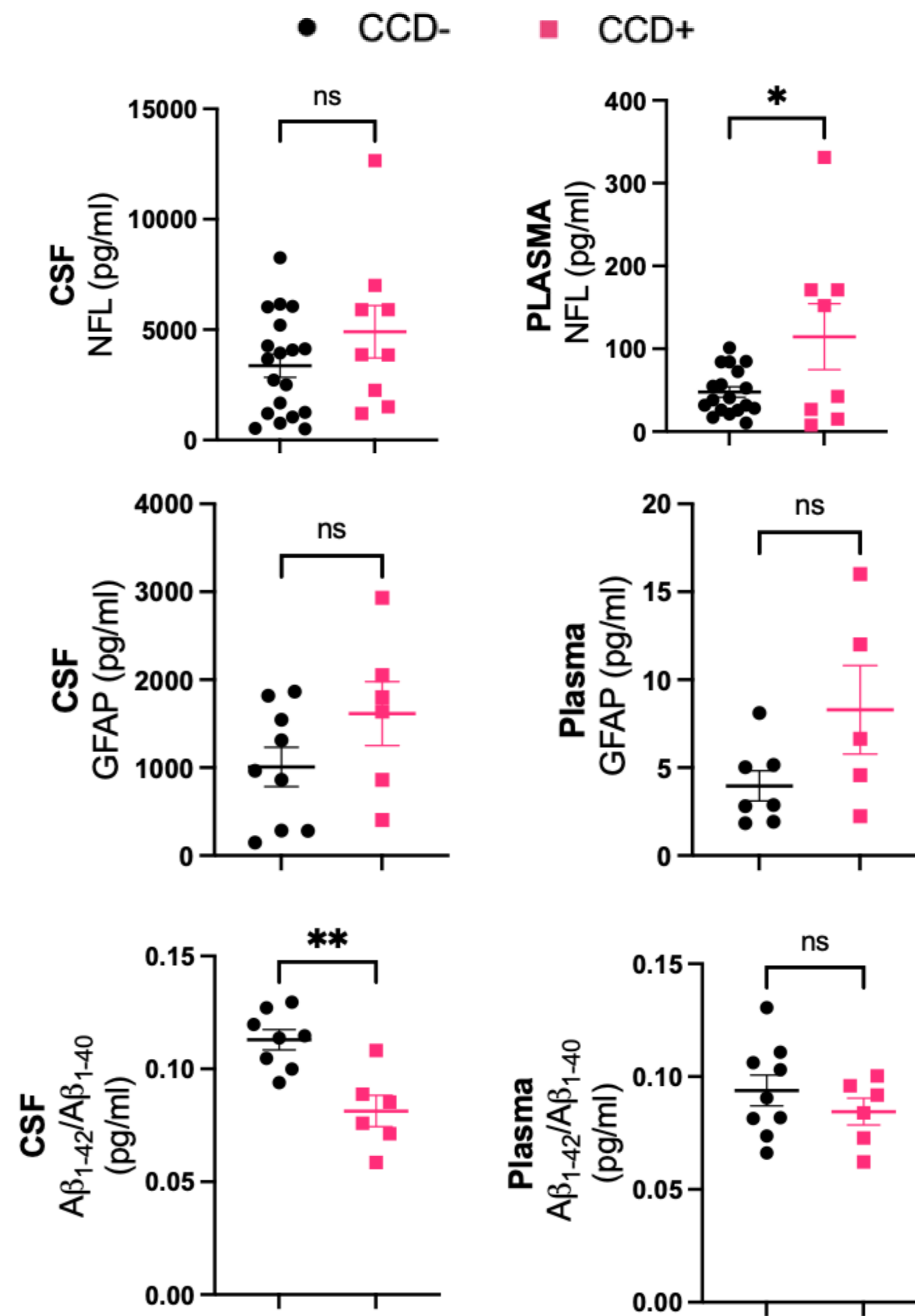
Bio-fluids





# NfL and A $\beta$ ratio changes in CCD+ dogs

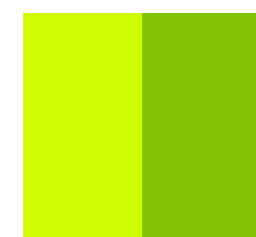
- Neurofilament Light chain (NFL)
- Glial fibrillary acidic protein (GFAP)
- Beta-amyloid (A $\beta_{1-42/1-40}$ ) ratio



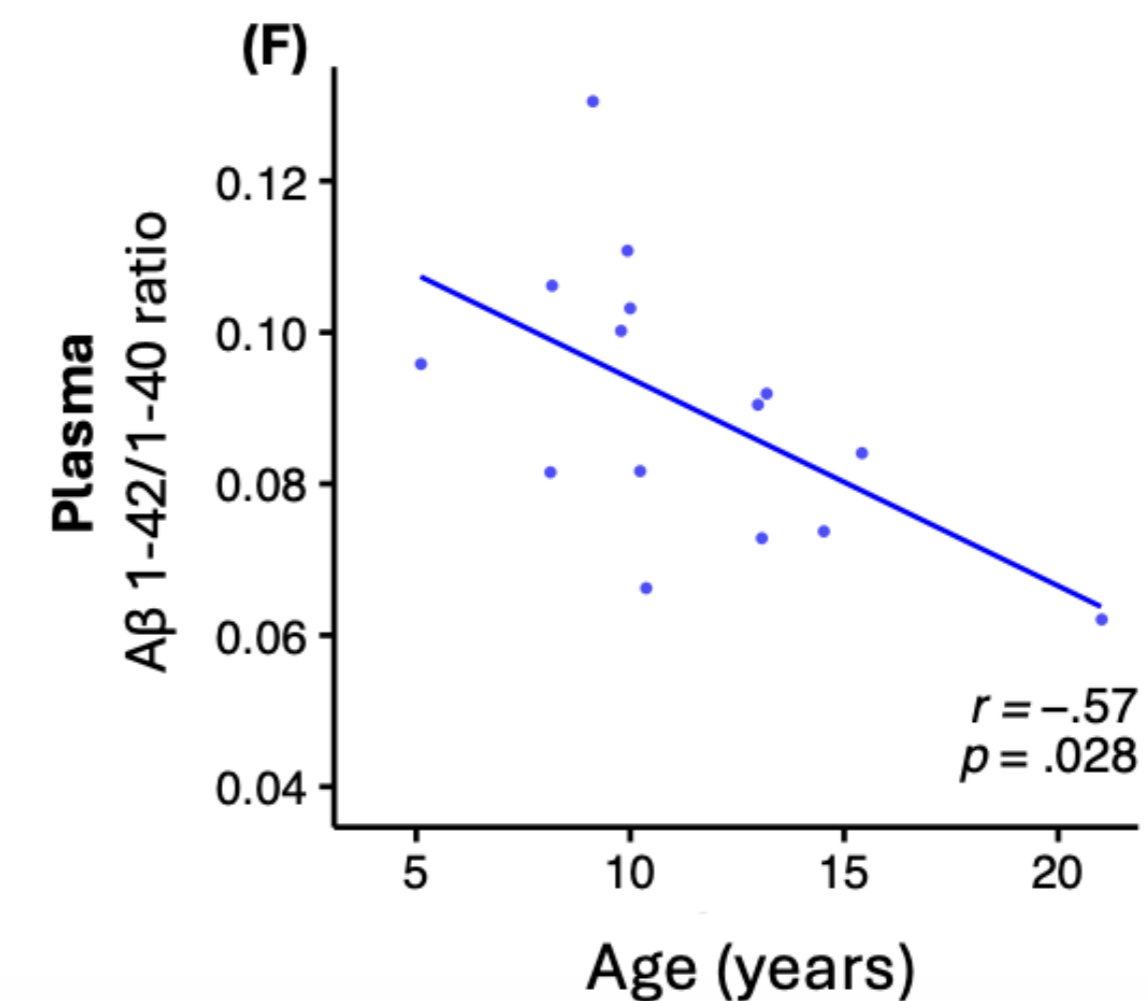
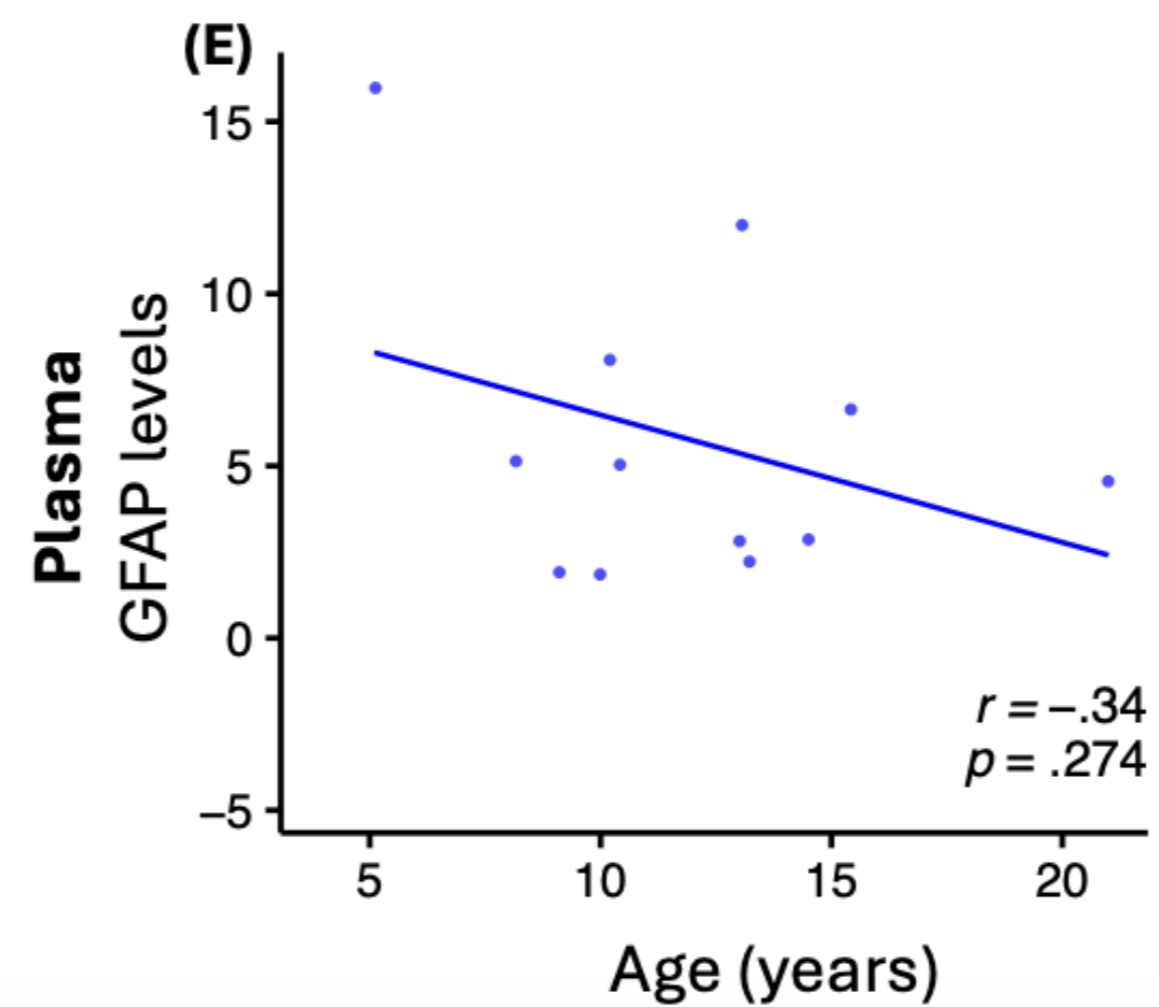
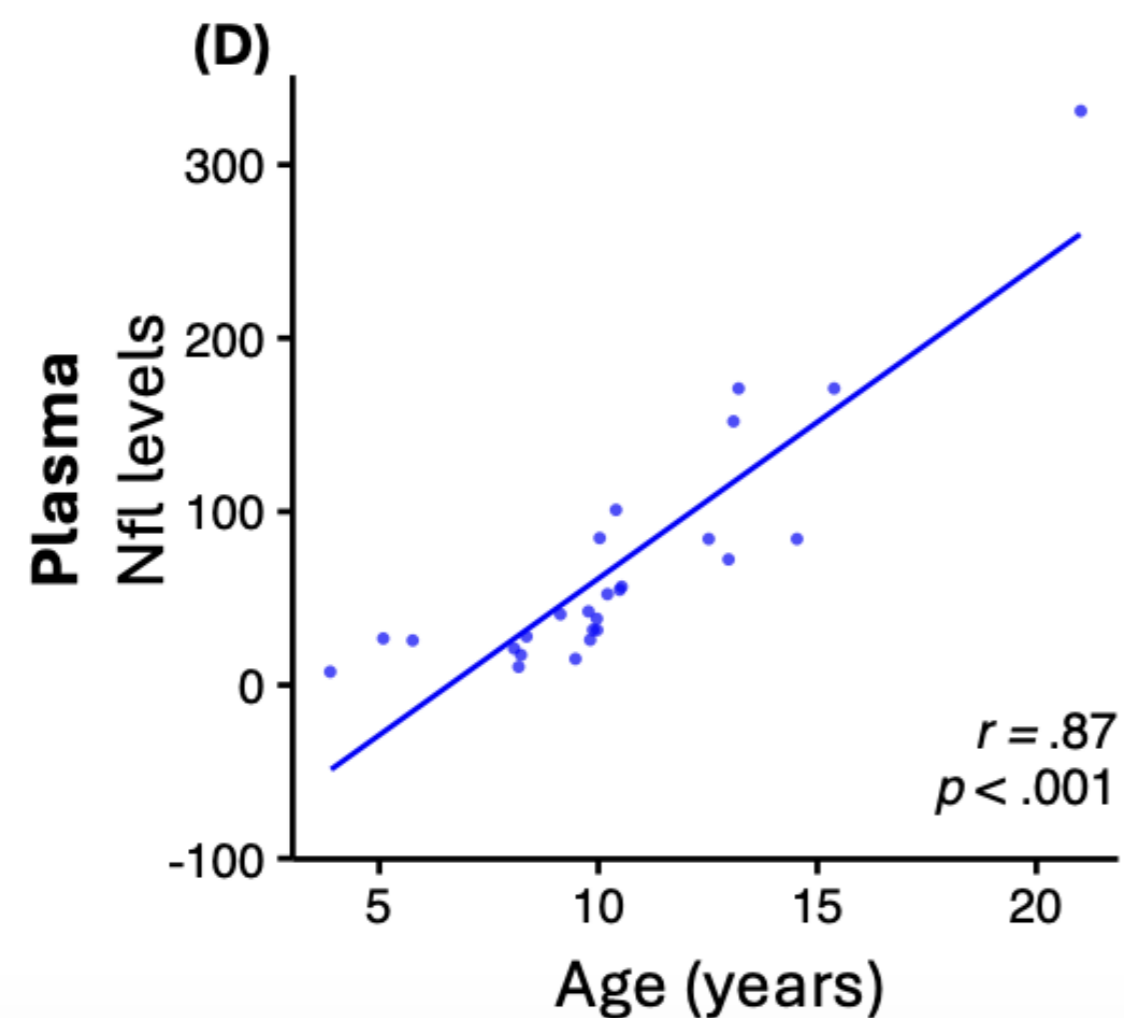
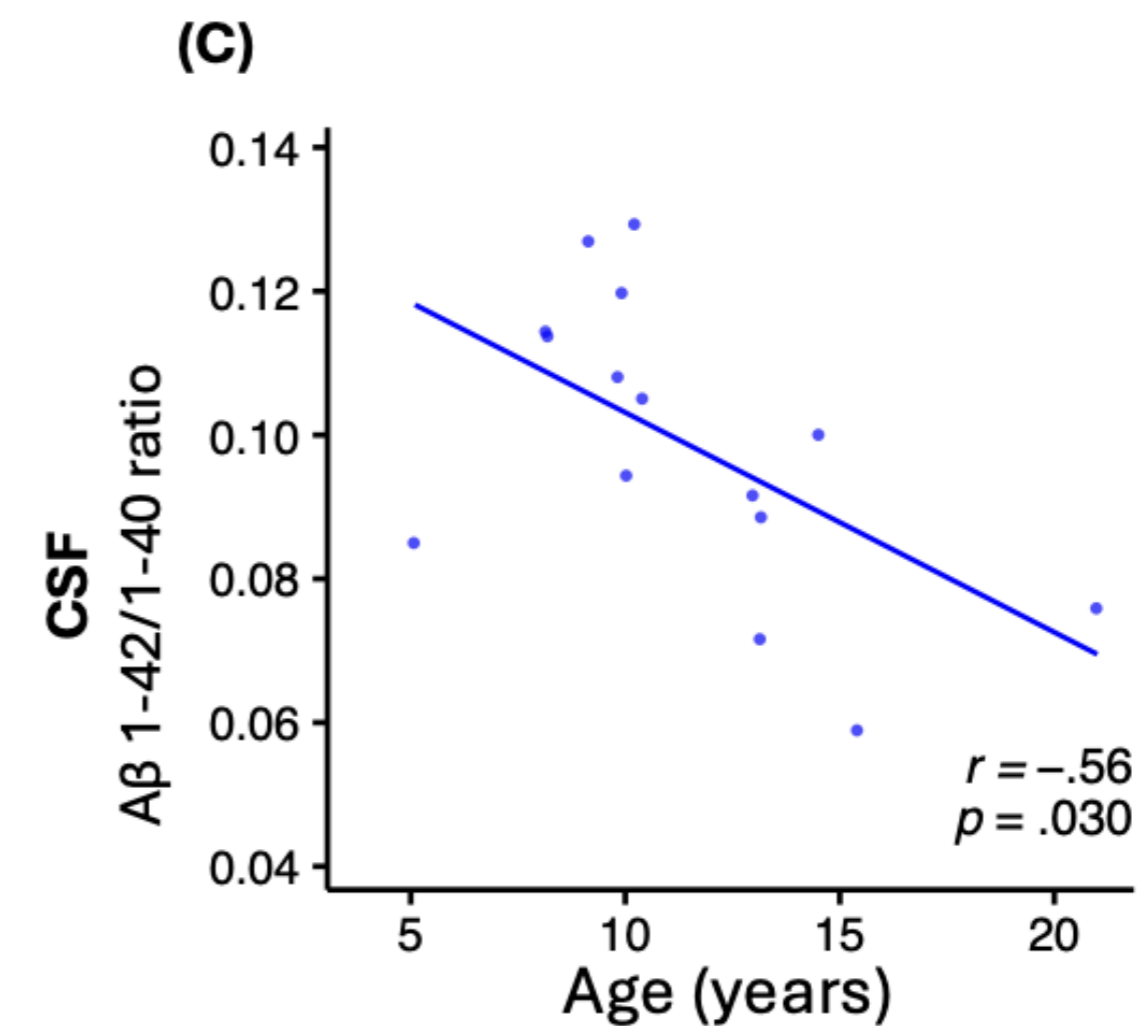
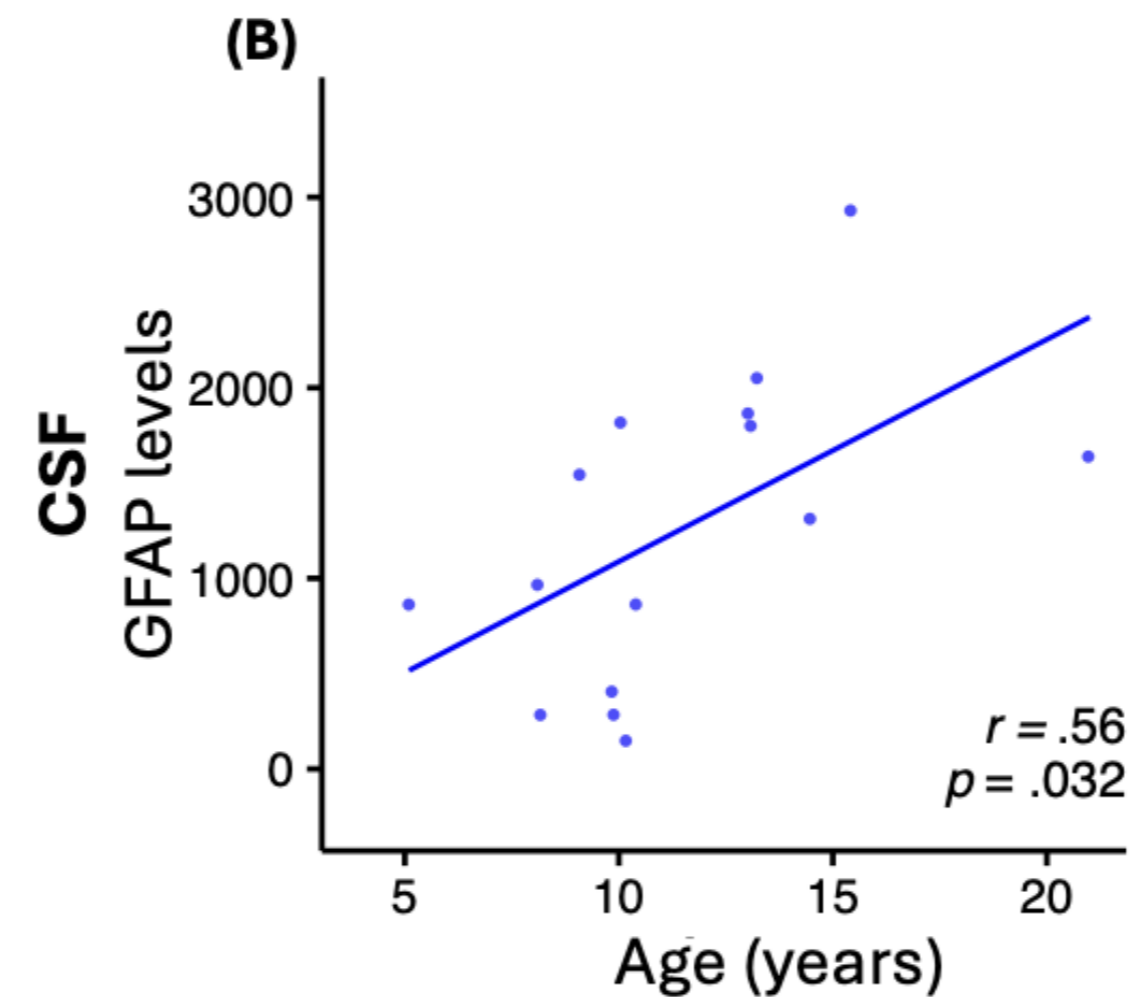
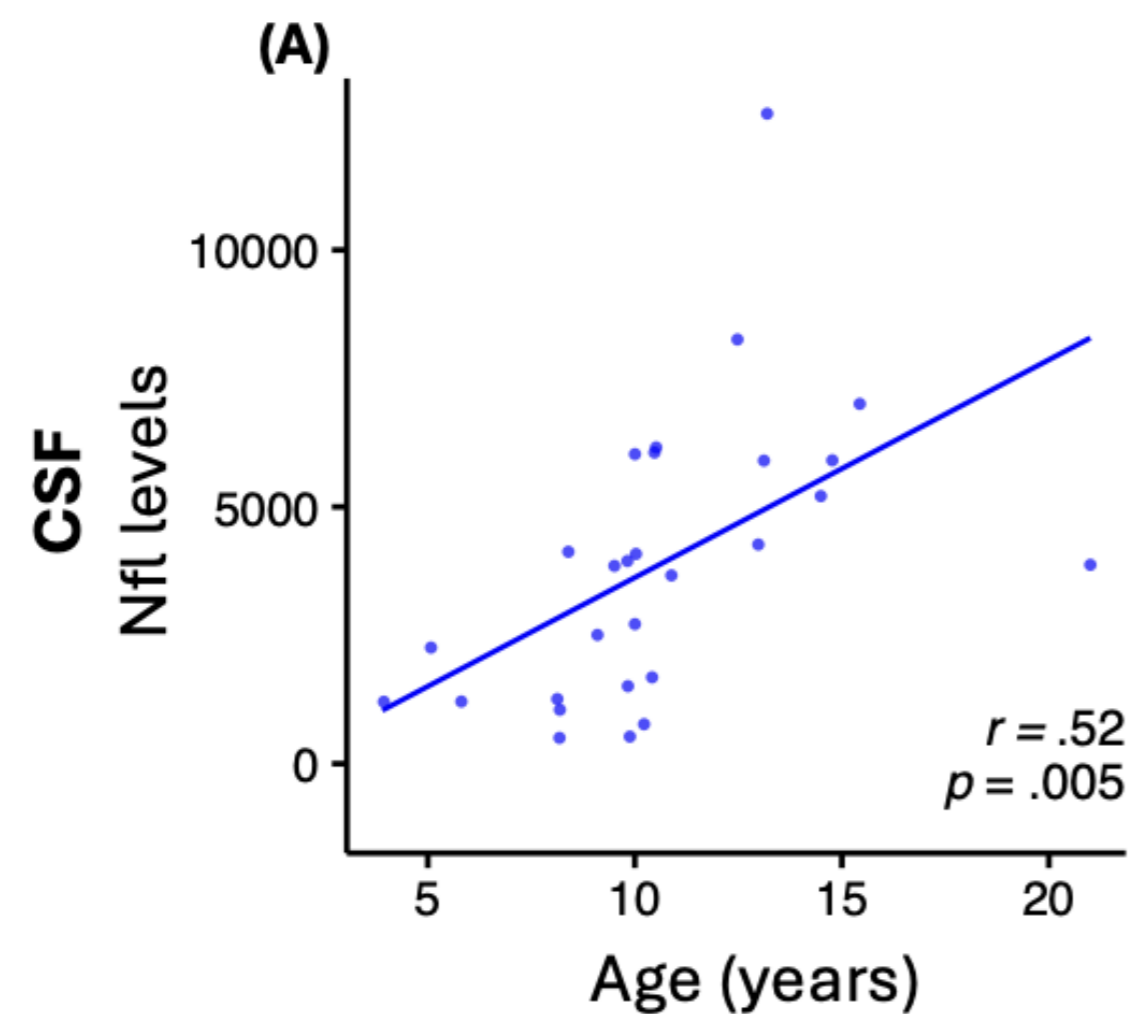
# Age is the greatest risk factor for CCD



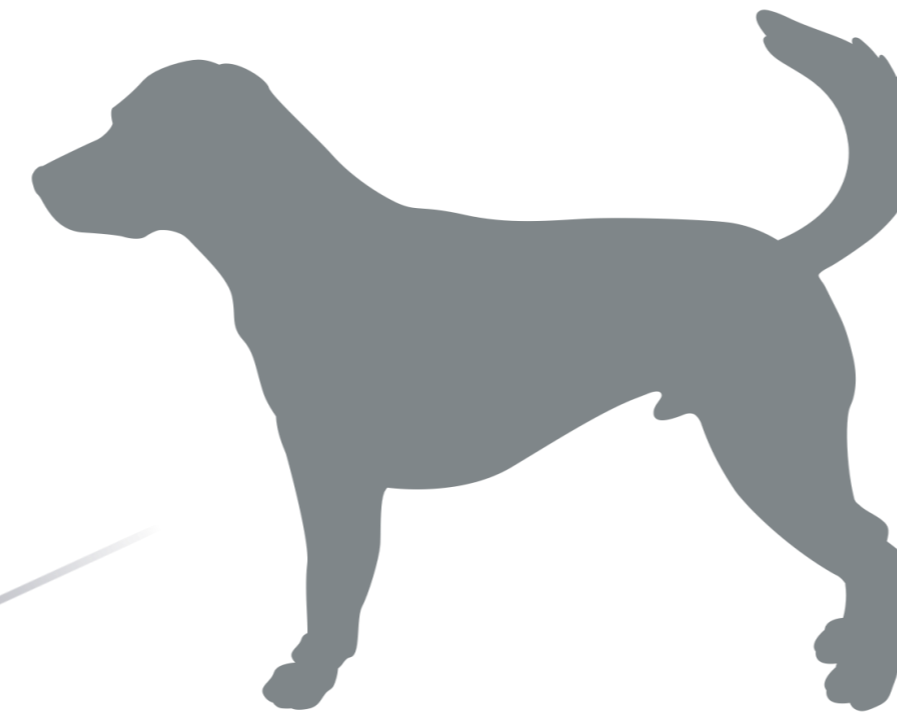
Do these biomarker changes correlate with age?



# NfL and A $\beta$ ratio changes correlate with age



# Conclusion



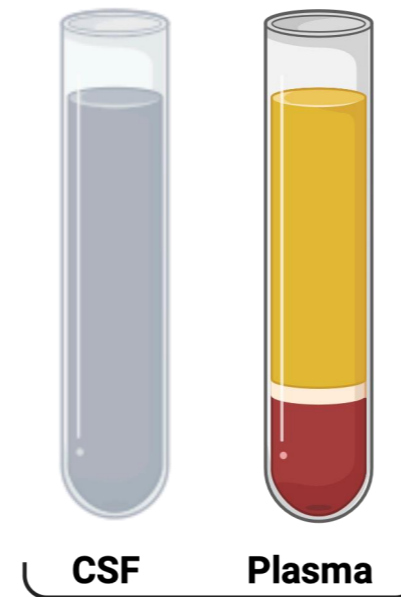
## Canine Cognitive Dysfunction (CCD)

Brain



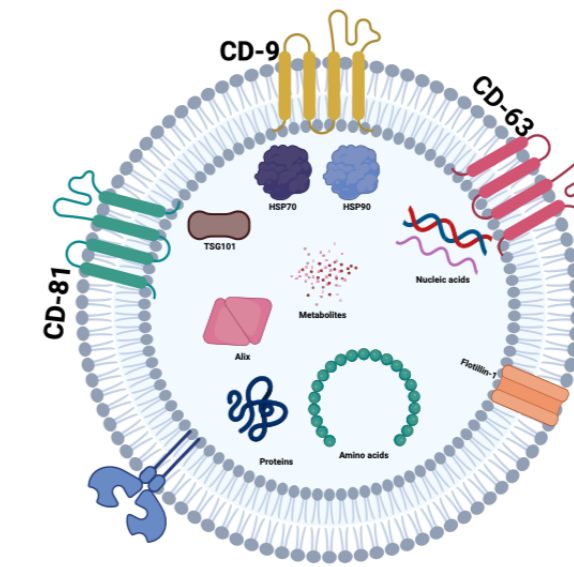
- Elevated neuroinflammation
- Increased accumulation of misfolded proteins

Bio-fluids

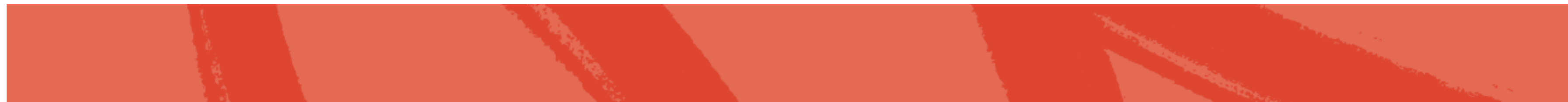
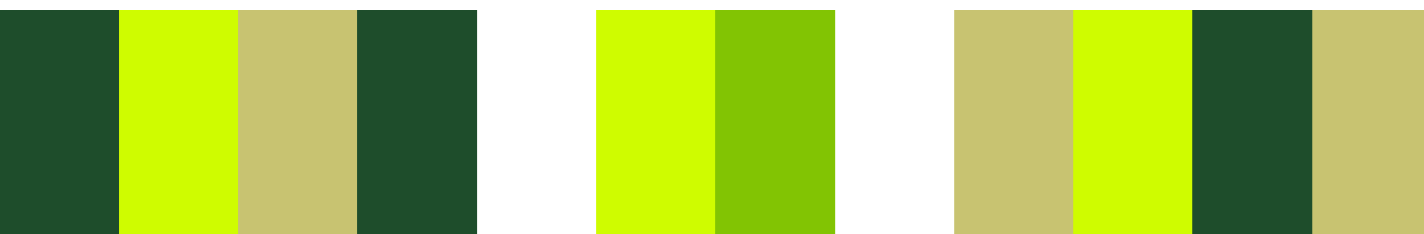


- Elevated NfL in plasma
- Worsened A $\beta$  pathology, increased plaques formation

Plasma Exosomes

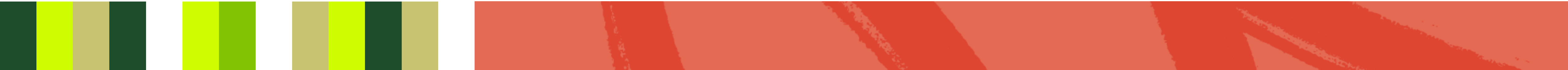


- Exosomes cargo
- Neuronal-derived exosomes



# Acknowledgments

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# Thank You

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