Scaling Up Hydration

Water and lipid interactions in the stratum corneum of the American Alligator (*Alligator mississippiensis*)

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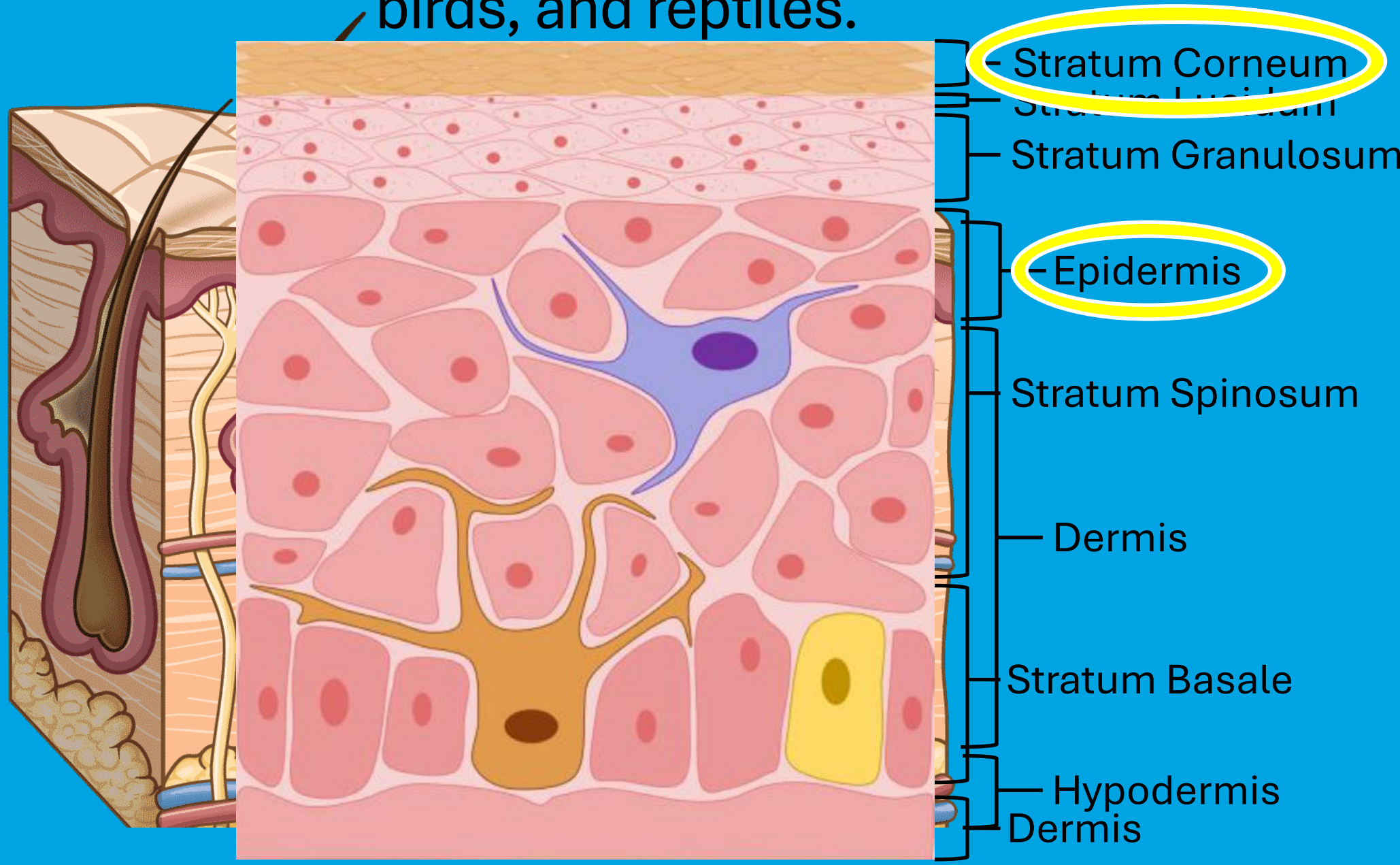
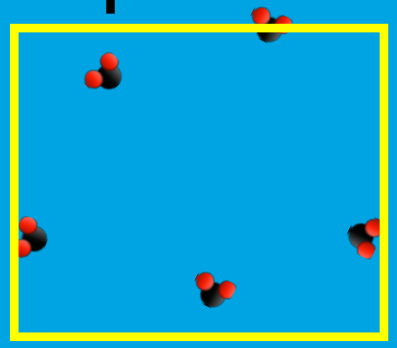
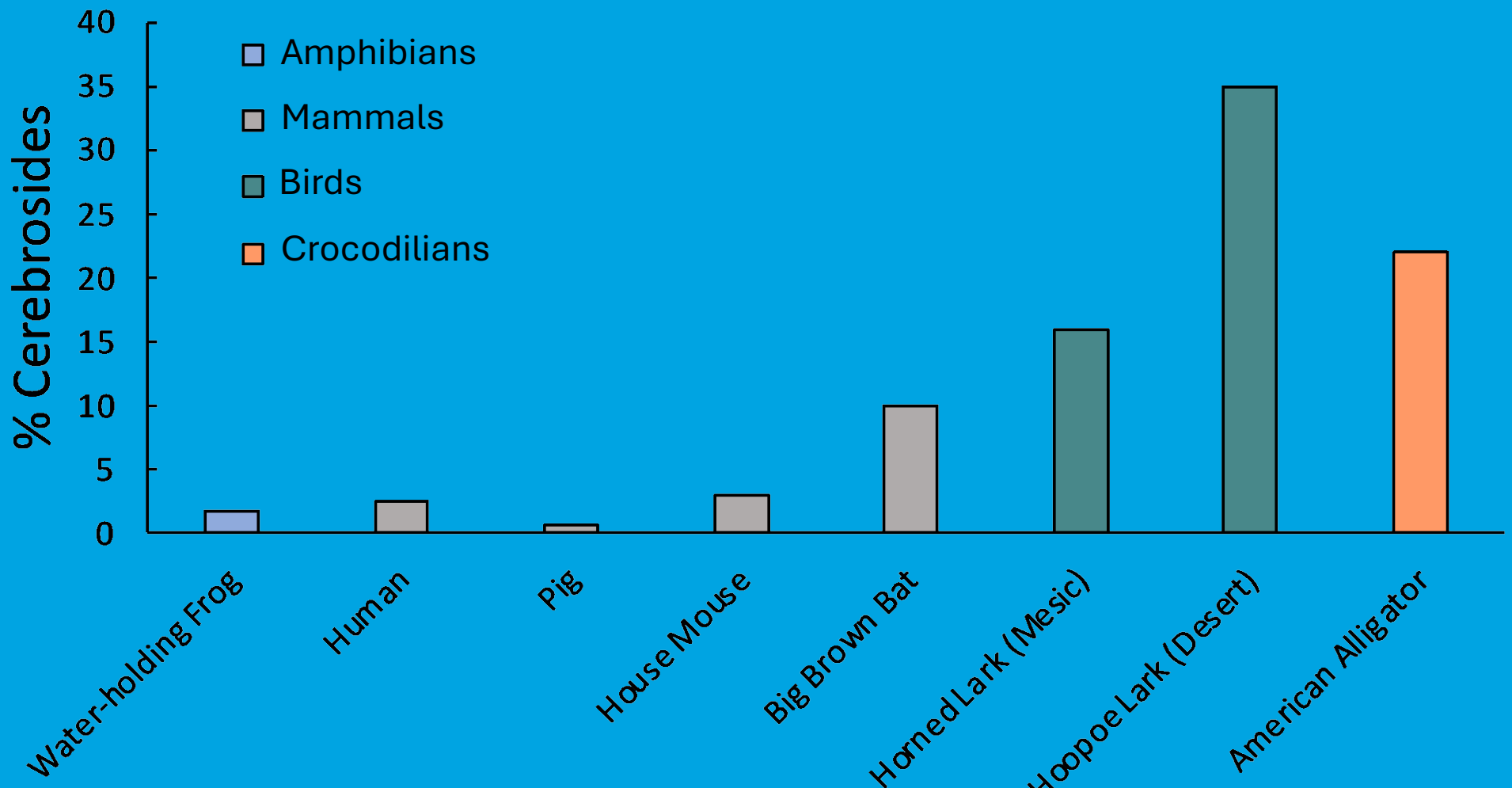
The stratum corneum is a characteristic feature of mammals, birds, and reptiles.

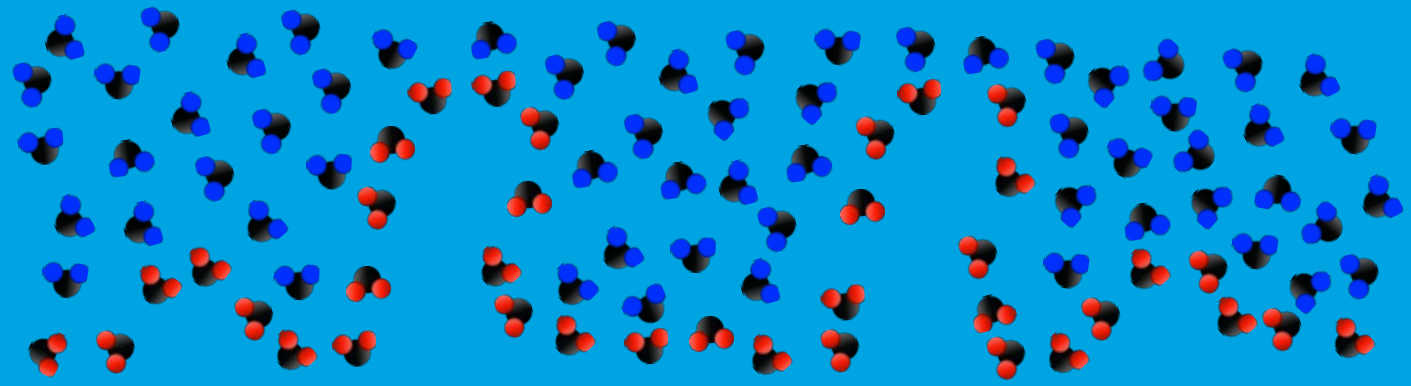


Birds and Alligators are unique in that they both contain a lipid called a cerebroside in their stratum corneum.

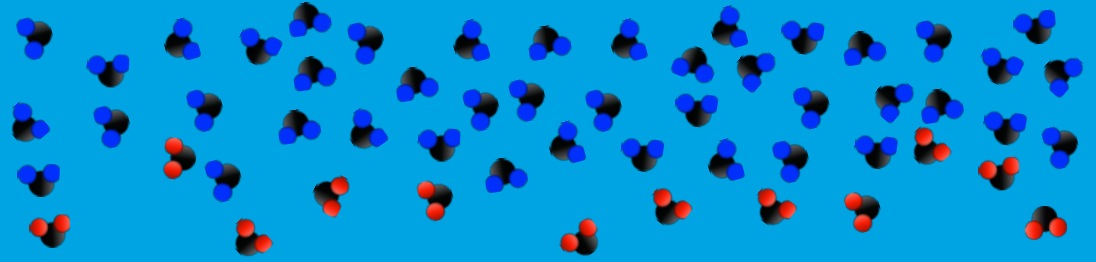




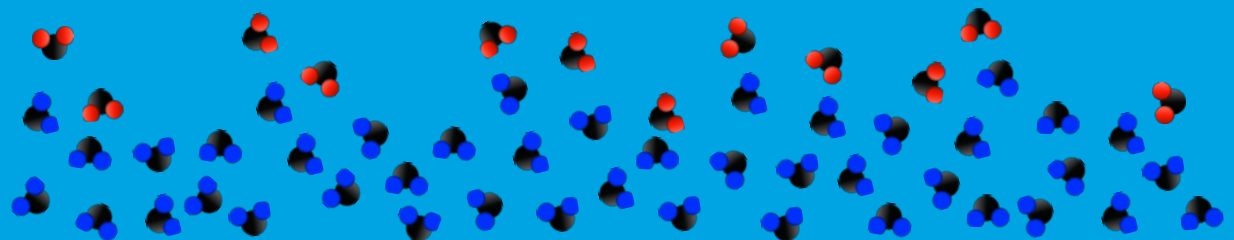
Cerebrosides in bird stratum corneum bind with water molecules outside of lipid layers.



Lipid tails are more ordered with hydration



In animals without cerebrosides (e.g. Mammals), water is disordered and permeates lipid layers.



Research Questions

- **What effect does water have on the molecular interactions in the American Alligator stratum corneum?**

- **Do cerebrosides in alligators work similarly to those in birds?**

Methods

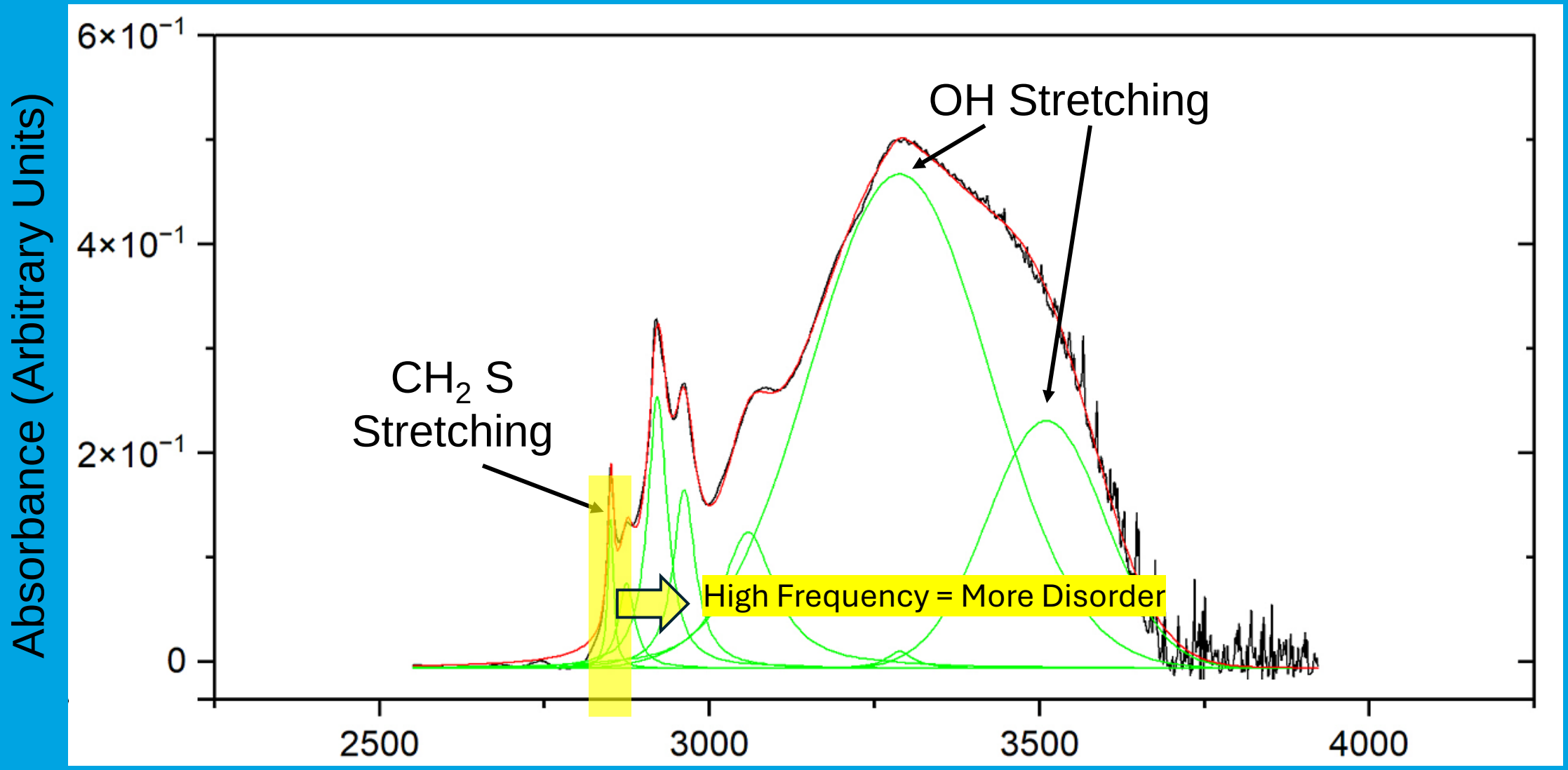
Hinge Region

Exposed to 0%, 75% & 100% H_2O RH at 33°C for 1 day.

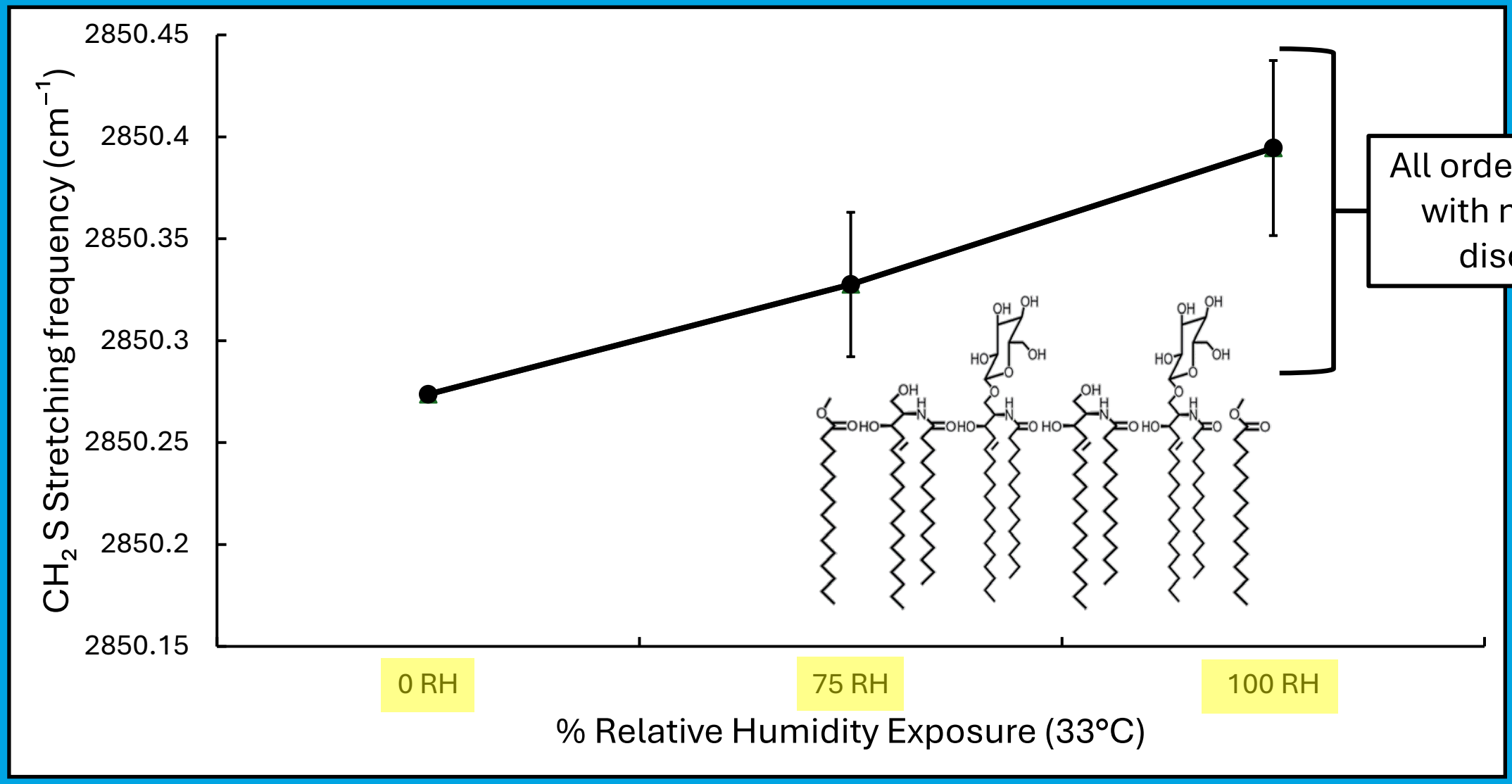
Freeze Dried to remove excess H_2O

IR Spectral analysis

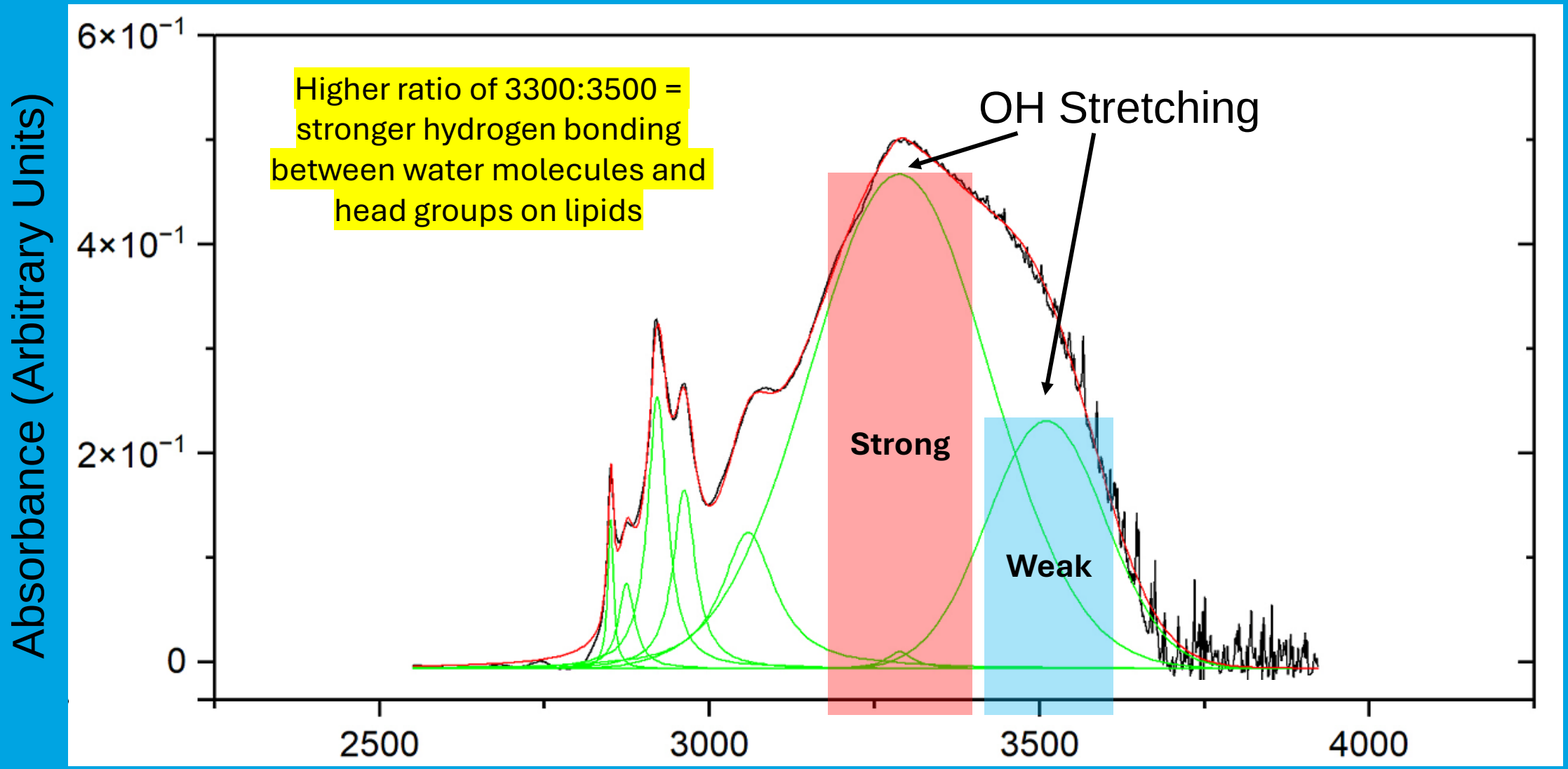
The frequency of the CH_2 stretching peak at ~2850 cm^{-1} is indicative of the lipid state



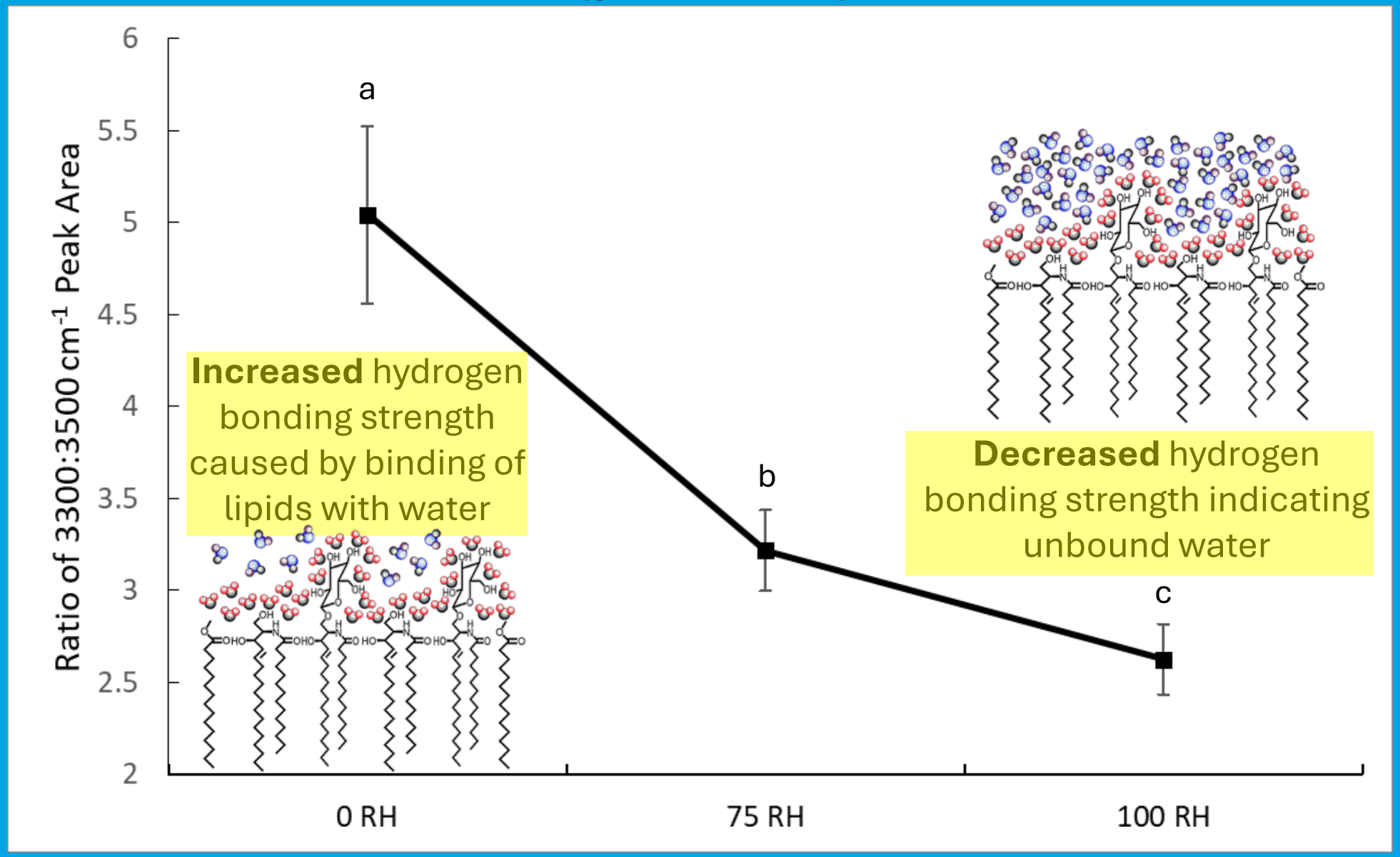
No significant shift to a higher frequency in the CH_2 S stretching peak, indicating no disordering following hydration (p=0.081)



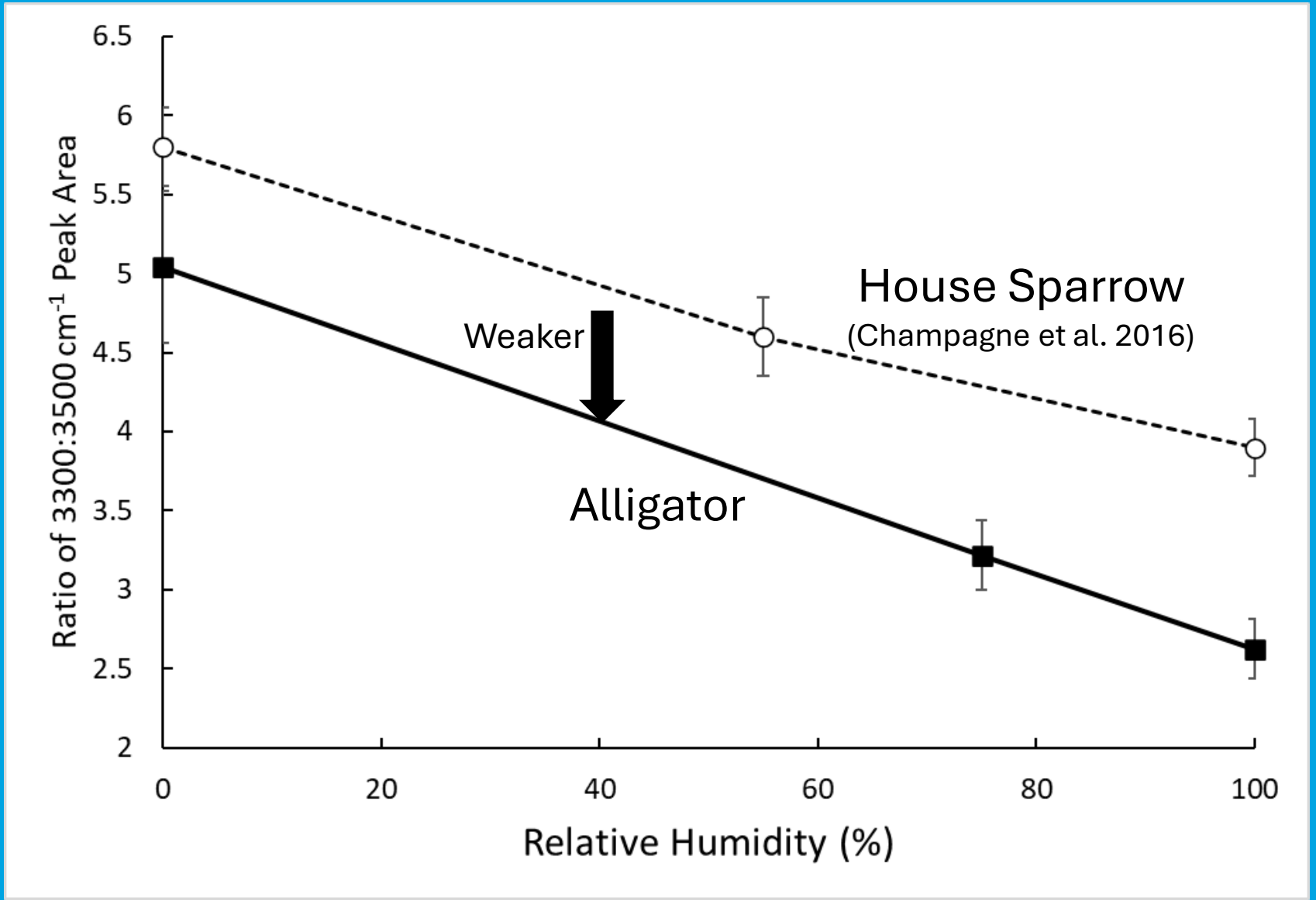
The areas of OH stretching at 3300 and 3500 cm^{-1} indicate the strength of hydrogen bonding.



The ratio of 3300:3500 decreases as water is added ($p<0.001$)

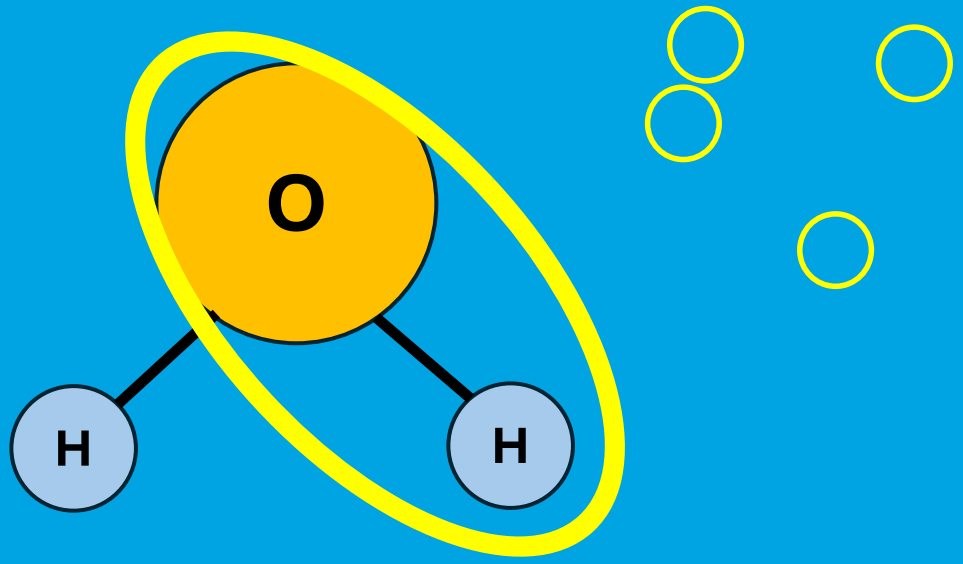


Water in alligator skin has weaker H-bonding than in birds, but shows similar changes with hydration

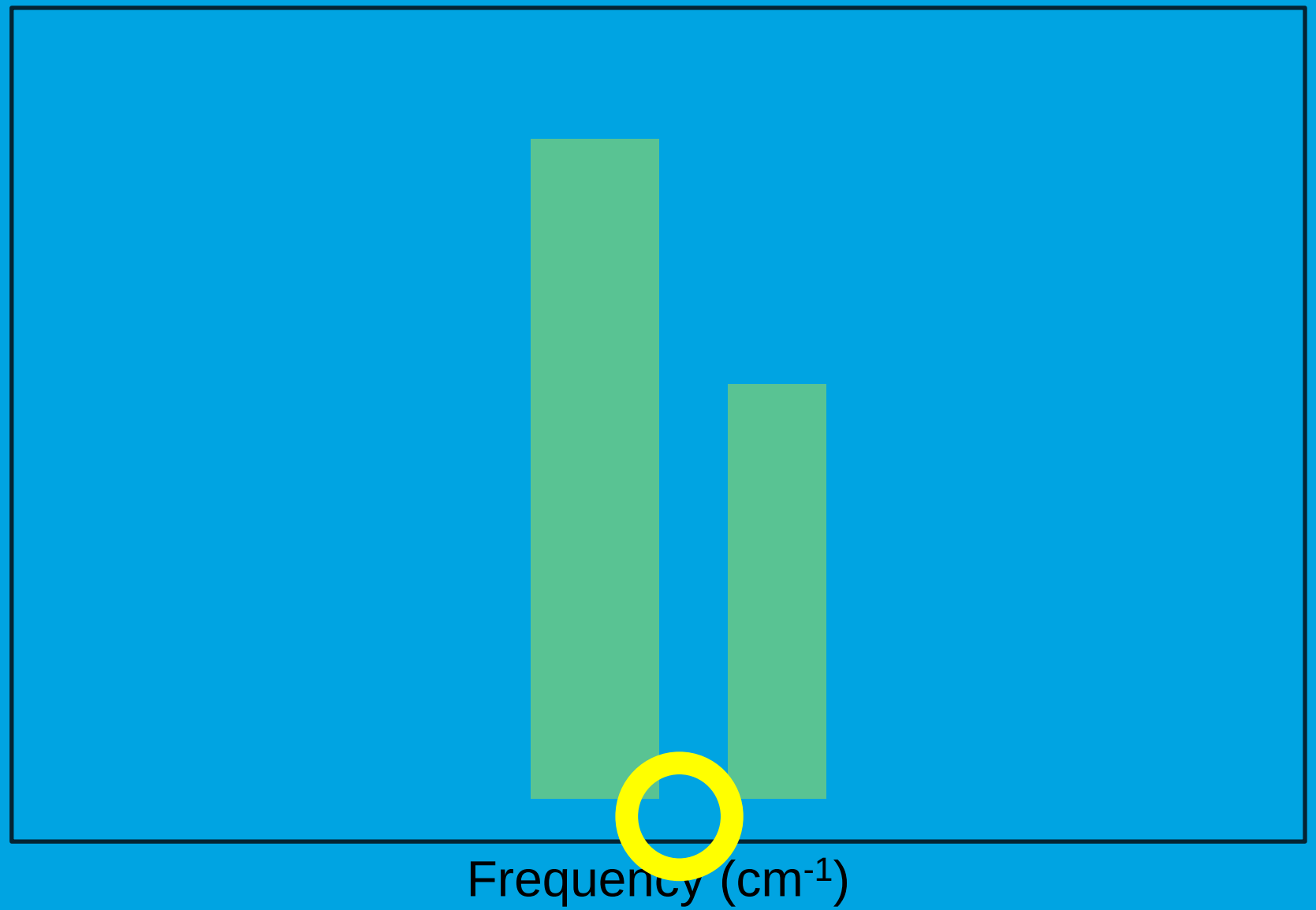


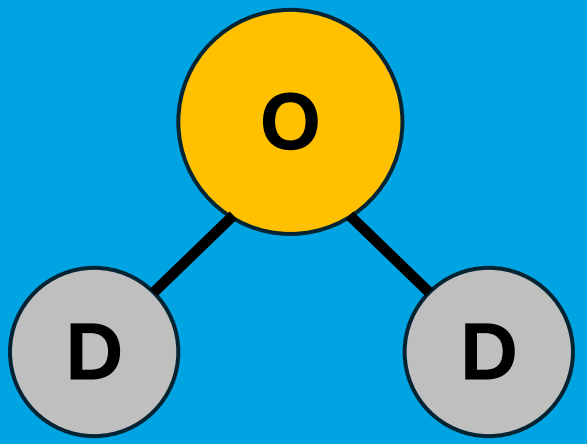
Hold up, wait a minute….

- Hydroxyl (OH) groups are present in various molecules located throughout the stratum corneum.



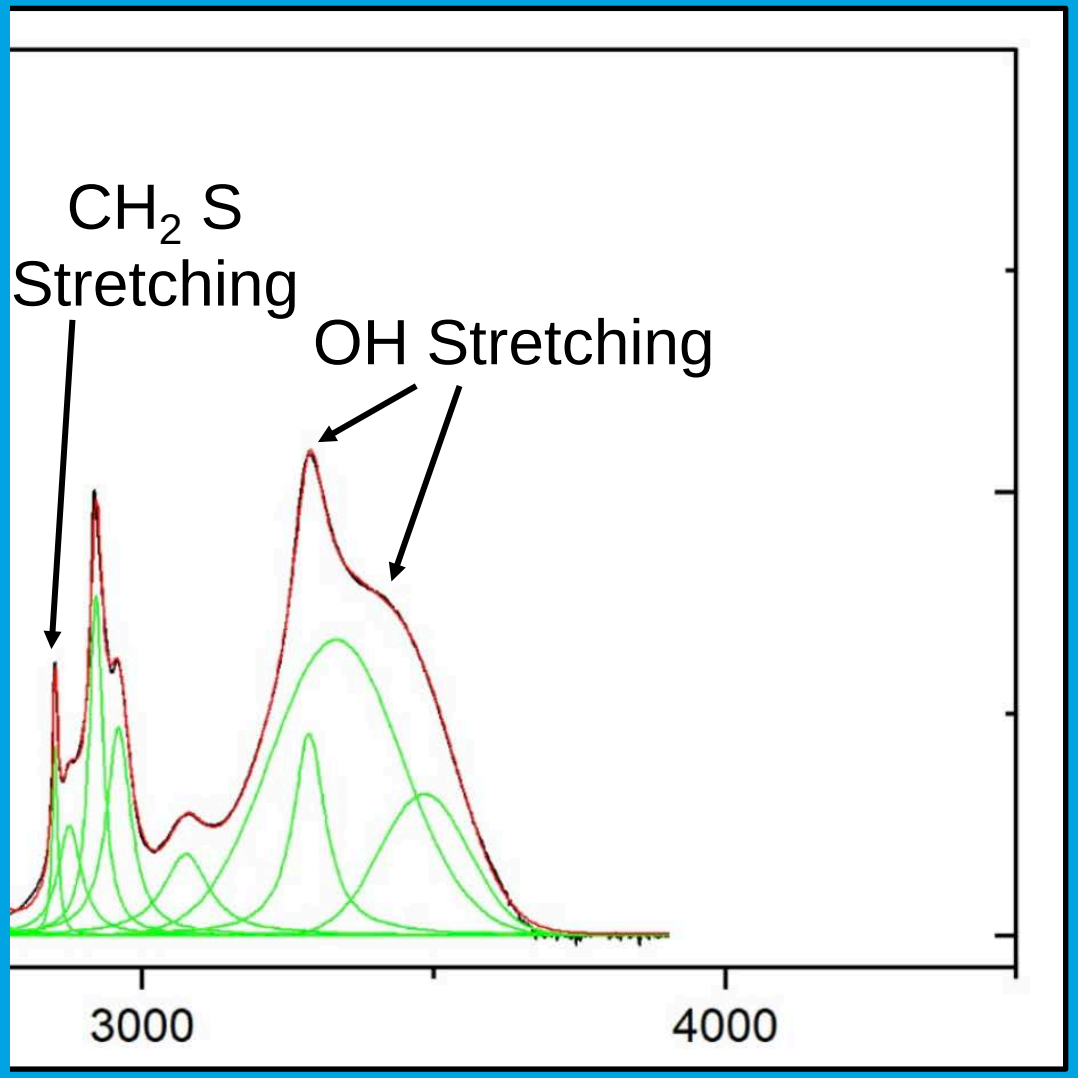
Deuterated Water (D_2O) produces different peaks in a different location.





Molar Mass:
20.0276 g/mol

Results of hydration with 100% RH D_2O



Absorbance (Arbitrary Units)

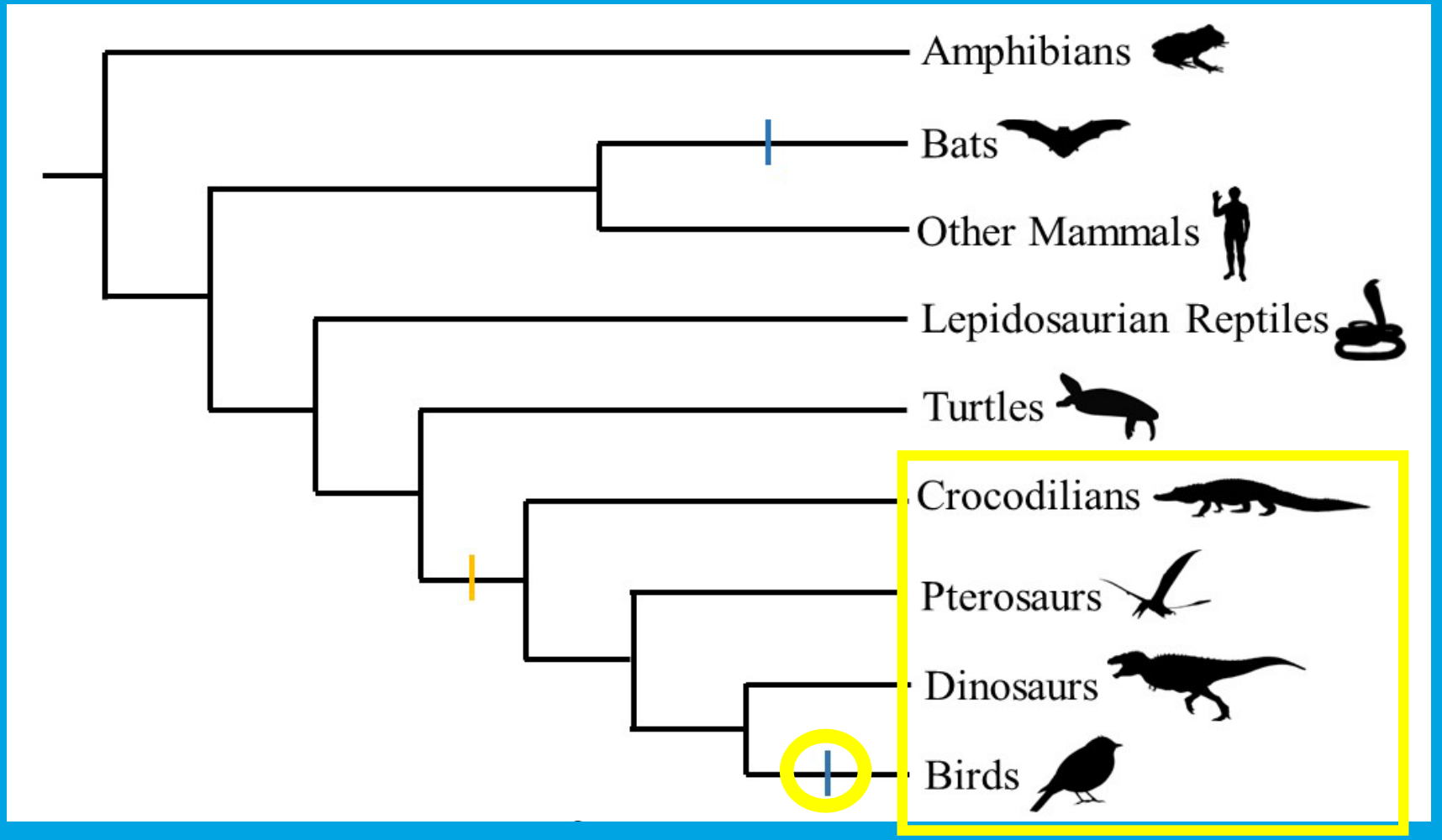
Frequency (cm^{-1})

Conclusions

Cerebrosides:

- Work similarly (With some differences) in birds and alligators
- Bind with water molecules
- Sequester water outside lipid layers

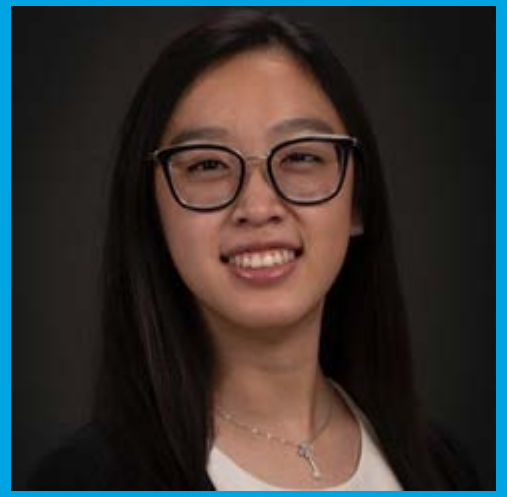
- Suggests similar function among Archosaurs
- Facilitate movement, flight, and water conservation



Collaborators

Dr. Alex Champagne

Frank Robb



Elissa Tam

Dr. Heather Allen

Questions?

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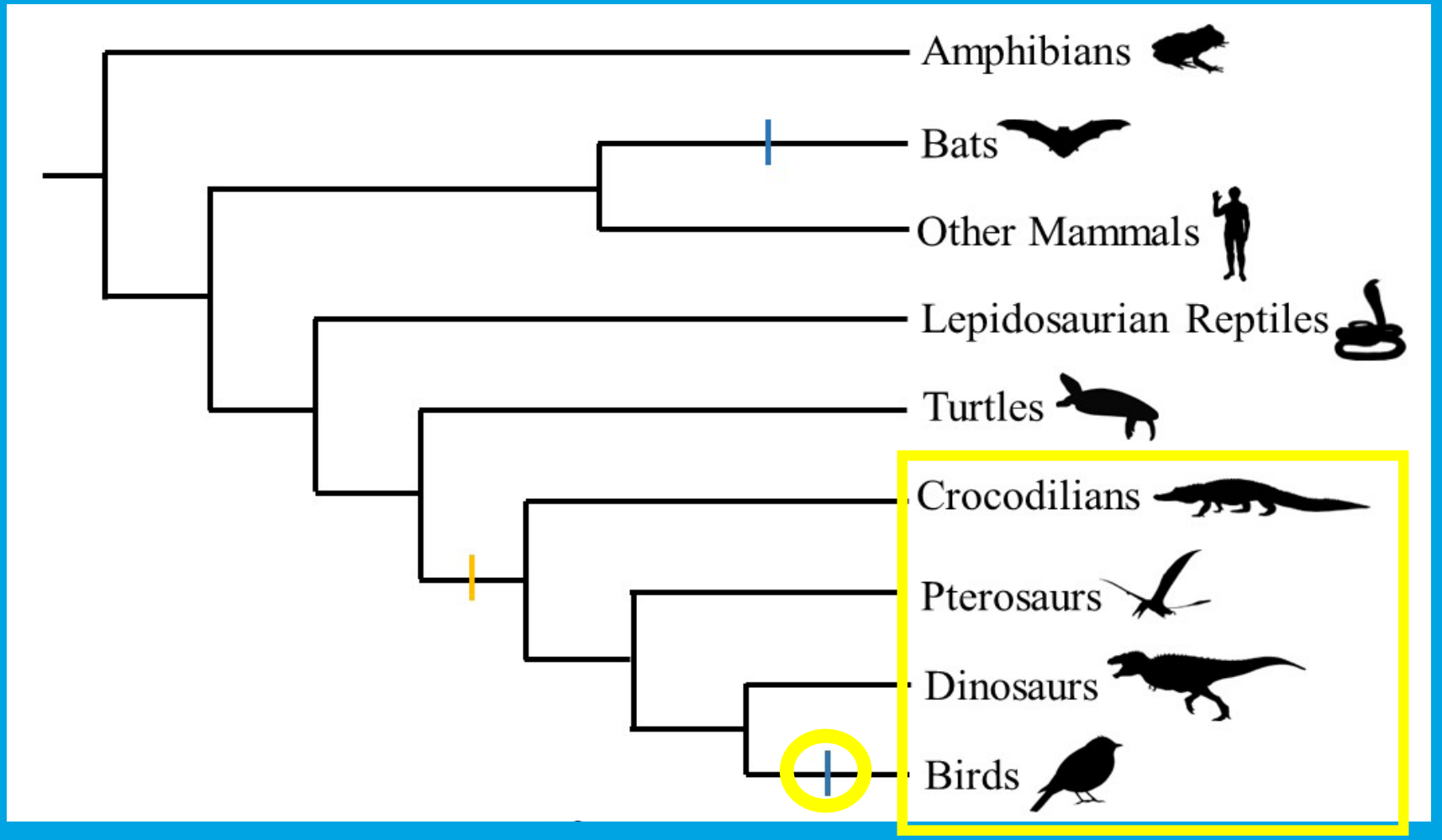

Hydration with D_2O indicated no change in CH_2 S Stretching frequency.