



Memory Retrieval in Amnesic Mice with Electrical Stimulation

Yi Liu and Professor Ada Poon

Department of Electrical Engineering, Stanford University

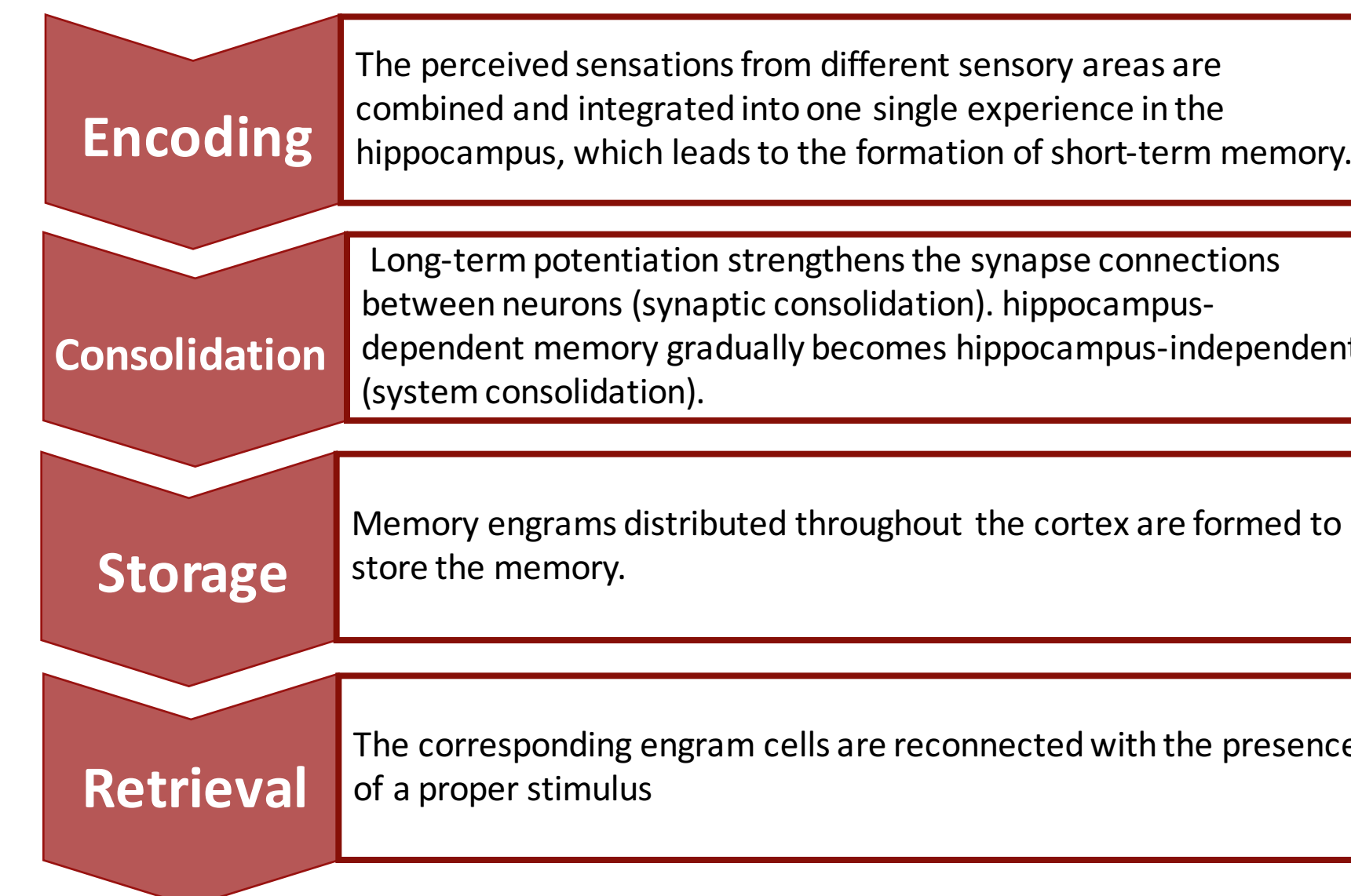
Motivation

Alzheimer's Disease (AD) is one of the most common brain degenerations, with a decline mainly in episodic memory at an early stage and loss of broader cognitive functions subsequently. Currently, there is no effective treatment for AD. Although early-stage AD have been cured in amnesic mice through optogenetic stimulation, electrical stimulation could be more viable for accomplishing a memory recovery device for AD patients. In this project, we aim to **retrieve memory** in amnesic mice by **electrical stimulation**, which facilitates future clinic trials and helps record time-evolution of memory when pairing with electrical recording.

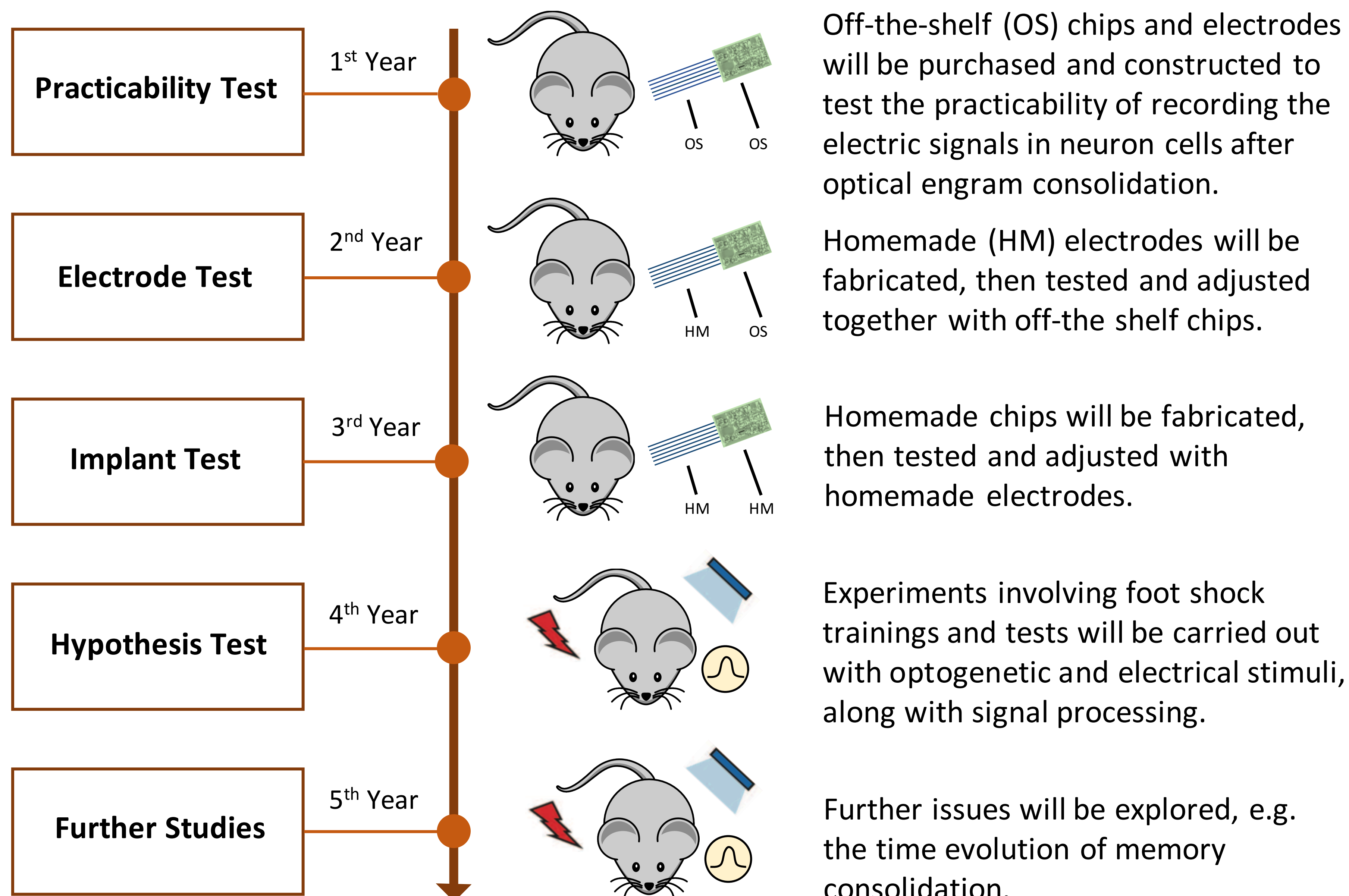
Early-stage AD mice have normal short-term memory but their long-term memory is impaired, which is attributed to deficits in the retrieval of the information. For early-stage AD, mounting evidence suggests that the retrieval of episodic memory is impaired due to synapse dysfunctions, while the encoding and consolidation processes remain largely intact. Therefore, the key to the treatment of AD at an early stage should be **the restoration and strengthening of the connectivity of engram cells**.

The Mechanism of Memory

The mechanism of episodic memory consists of four stages:

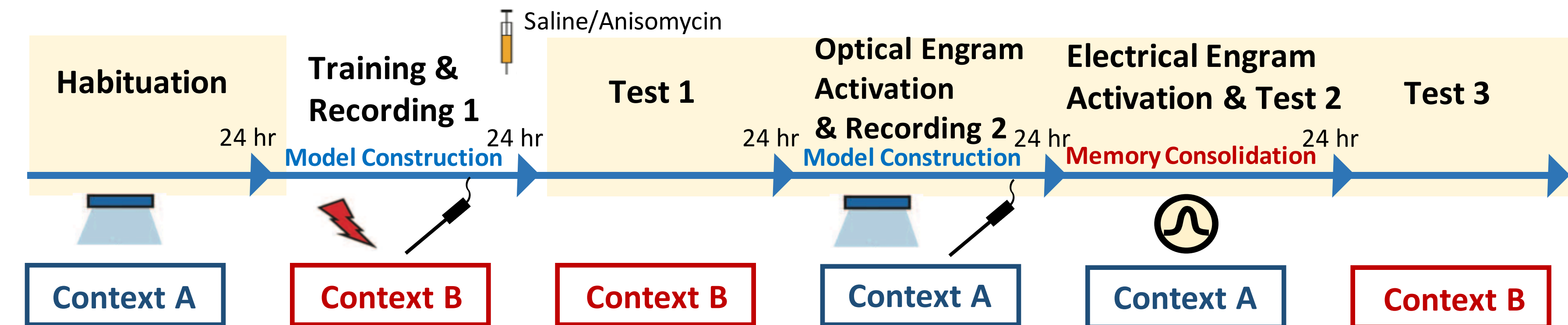


Project Timeline

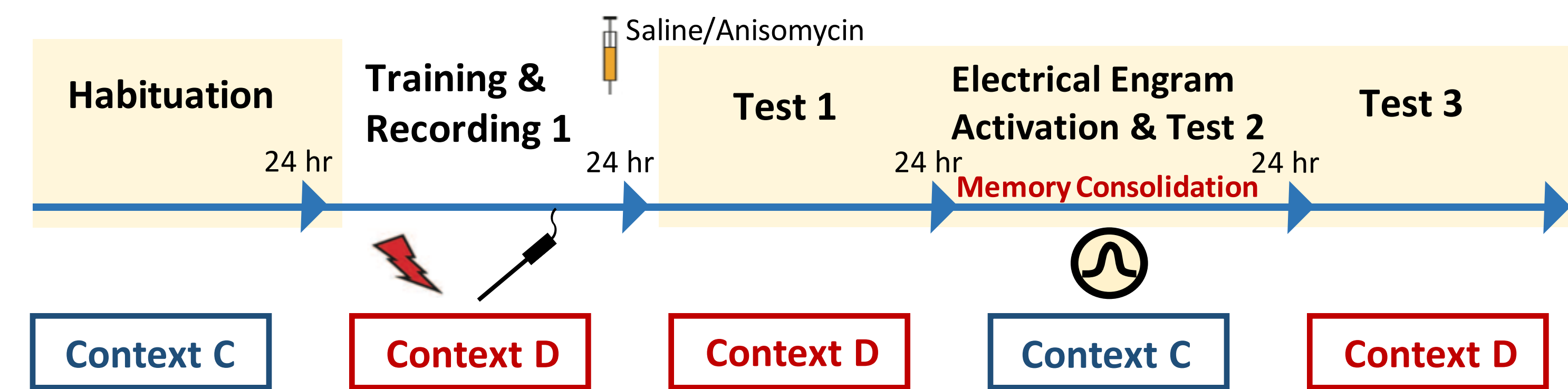


Experimental Plan

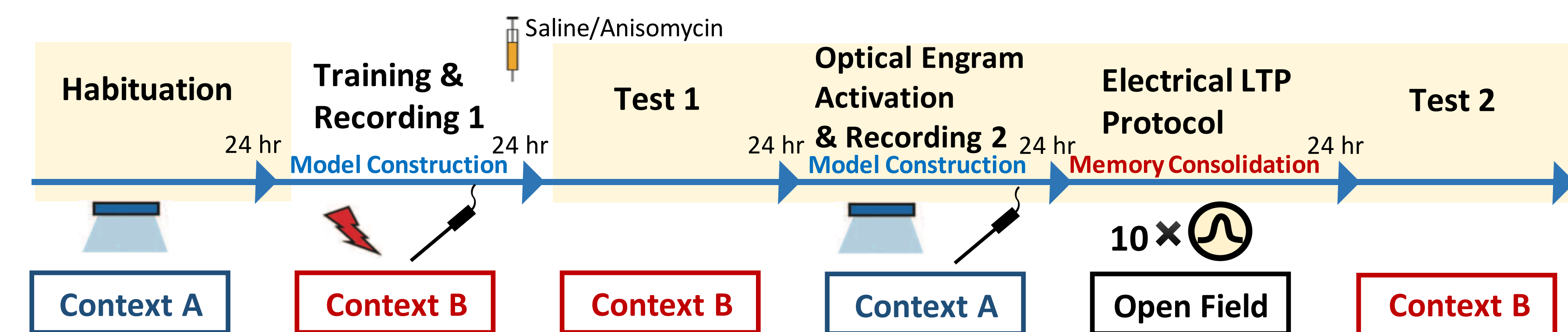
A. Artificial memory recall with optogenetics-assisted electrical stimulation



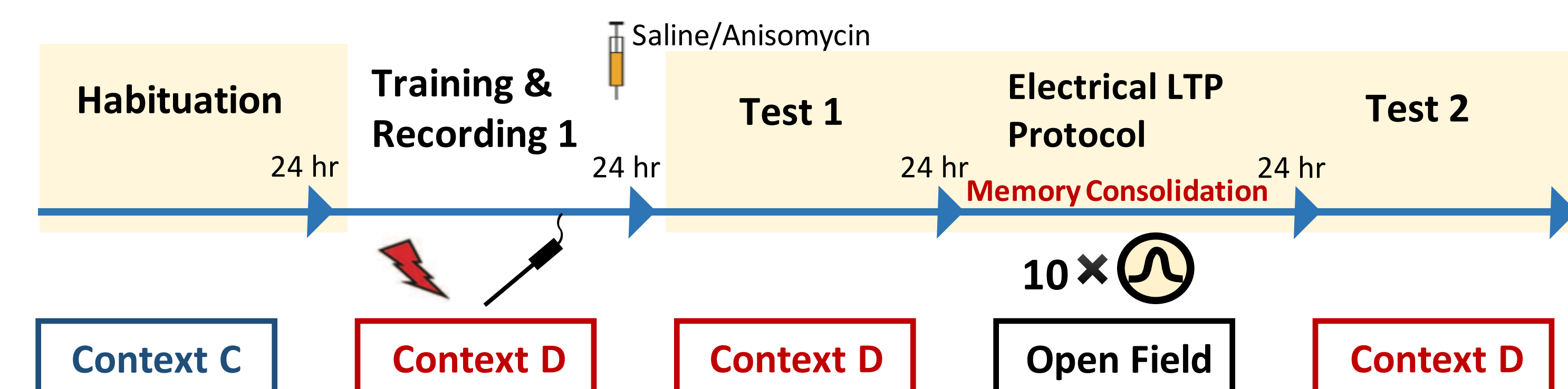
B. Artificial memory recall with electrical stimulation only



C. Natural memory recall with optogenetics-assisted electrical stimulation



D. Natural memory recall with electrical stimulation only



Conclusion

In this project, we aim to (1) **retrieve memory** in mice with early-stage AD, and (2) reveal **the time-evolution process of memory consolidation**.

A new way of electrically treating AD will be demonstrated, with the advantages of easy realization and control. Meanwhile, the chronic recording of memory consolidation will help unravel the mechanism of memory formation.