

Cell Types, Health, and Disease: An Interdisciplinary Exploration of Alzheimer's Disease

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About this unit:

The content of this unit strengthens students' understanding of the biological and social contexts of Alzheimer's disease. Prior to exploring the neuropathology of Alzheimer's disease, students are prompted to explore how brain donation plays a key role in neuroscience research and how studying the healthy human brain provides potential insights as to the pathology of Alzheimer's disease. This lesson aims to provide students with an interdisciplinary understanding of the role of bioethics, public health, and basic research in studying Alzheimer's disease pathology.

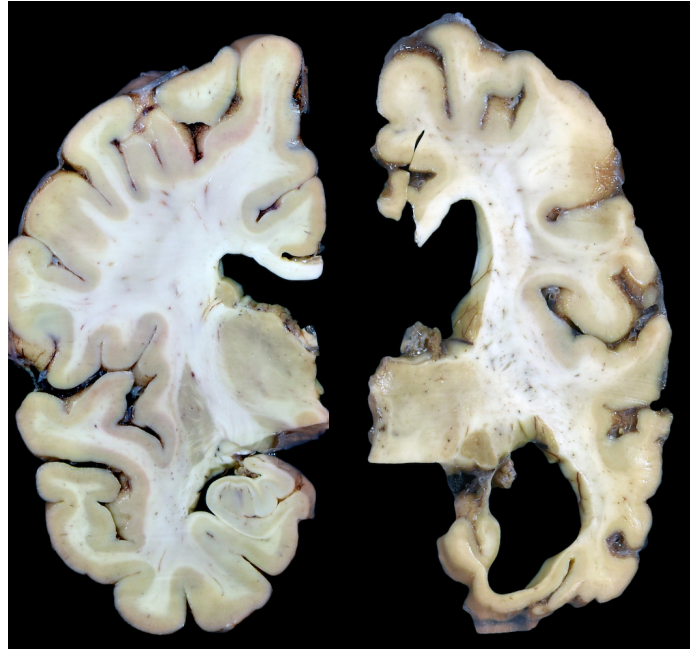
Grade level:

Advanced high school students (AP/IB Biology):

- Lesson 1
- Lesson 3
- *Note: Lesson 2 and Lesson 4 require a stronger understanding of transcription, transcriptomics, gene expression, and data analysis that high school students would likely not have encountered yet in their courses. Highly motivated students who are interested in independent study may be interested in exploring this material.*

Introductory to intermediate college-level cell science and/or neuroscience students:

- Lesson 1
- Lesson 2
- Lesson 3
- Lesson 4



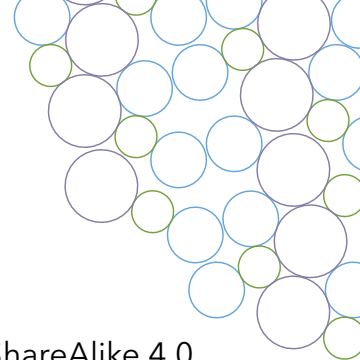
*Image from UW Medicine
Left: healthy brain
Right: brain with AD pathology*

Acknowledgements: Special thanks to Eitan Kaplan, PhD, Jeremy Miller, PhD, and Kyle Travaglini, PhD, and Shannon Reynolds for their help in the development of these lessons.

Data used:

These lessons use data made freely available to the public through the Allen Cell Types Database and the Seattle Alzheimer's Disease Brain Cell Atlas (SEA-AD). The SEA-AD is a collaborative project from the Allen Institute for Brain Science, the University of Washington Alzheimer's Disease Research Center (ADRC), and Kaiser Permanente Washington Health Research Institute (KPWHRI). This data is available at <https://portal.brain-map.org/explore/seattle-alzheimers-disease>.

	Lesson Summary	Topics Covered
<u>Lesson 1:</u> Bioethics and Brain Donation	Students are asked to explore the field of bioethics in order to understand the importance of consent within biomedical research.	<ul style="list-style-type: none">• Bioethics• Research consent policies• Post-mortem brain donation• Living brain donation• Why someone may choose to donate or not donate their brain to science• Neurodivergence
<u>Lesson 2:</u> The Importance of Basic Research in Brain Science	This lesson guides students to use their knowledge of transcription to explore gene expression between different types of cells within the healthy human brain.	<ul style="list-style-type: none">• Central dogma and transcription• Cell type identification• Heatmaps• Studying the healthy human brain
<u>Lesson 3:</u> Societal and Biological Perspectives on Alzheimer's Disease	This lesson explores the biological and social hall-marks of Alzheimer's disease. Students are guided through an exploration of real neuropathology images from donors with and without dementia in order to look for the presence and/or absence of neurofibrillary tangles.	<ul style="list-style-type: none">• Representation in biomedical research• Biological hallmarks of AD• Socioeconomic factors of AD• Process of immunolabeling• Analyzing neuropathology images of brain tissue
<u>Lesson 4:</u> Transcription and Alzheimer's Disease Pathology	This lesson challenges students to analyze transcriptomic data to search for possible biological markers of Alzheimer's disease.	<ul style="list-style-type: none">• Central dogma and transcription• Connections between gene expression and cell types• Analyzing UMAPs and identifying possible AD biomarkers



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Teachers are welcome to adapt the lesson to suit their classes and curricula. Teachers must indicate if changes were made to the lesson materials and may share their adaptations with attribution under the same license as this lesson, but may not use adaptations for commercial purposes.

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