RNA & Alzheimer's Disease/

In this lab, students learn how scientists at the Allen Institute study RNA to better understand Alzheimer's Disease. Students walk through a hands-on lab protocol where they can watch the steps of protein synthesis take place in real time through observing fluorescent samples.

The lesson concludes with a dry lab activity where students compare the gene expression of neurons from brain donors with and without Alzheimer's Disease.

This activity includes a protocol developed by miniPCRbio.



Human neuron imaged at the Allen Institute

Grade levels/ 9th – 12th grade

Total field trip time/ 3 hours and 15 minutes

Recommended pre-lab teaching/

- The basic function of DNA & RNA within a cell
- An introduction to the steps of protein synthesis (transcription and translation)
- Note: Students do not need previous neuroscience experience for this lesson

Learning objectives/

- **Predict** how manipulating steps of the central dogma will affect observations of gene expression
- **Examine** Why scientists study cells' RNA as one method to determine their gene expression
- **Analyze** RNA data to predict and compare gene expression patterns in brain donors with and without Alzheimer's Disease pathology

Lab skills/

- **Operate** a micropipette
- **Follow** a lab protocol that uses multiple reagents and incubation steps
- **Identify** when transcription and/or translation happens within a test tube
- **Analyze** fluorescent samples to identify presence of nucleic acids and proteins

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Next Generation Science Standards (NGSS)

Science and Engineering Practices/	**Developing and Using Models** Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Constructing Explanations and Designing Solutions** Construct an explanation based on valid and reliable evidence obtained from a variety of sources.
Disciplinary Core Ideas/	**LS1.A: Structure and Function** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (HS-LS1 – 1) **LS3.A: Inheritance of Traits** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet know function. (HS-LS3-1)
Cross Cutting Concepts/	**Patterns** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Scale, Proportion, and Quantity** Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.