- **Objective:** This project aims to uncover the role of Cajal bodies (CBs) in controlling nuclear mRNA retention in larch microsporocytes. CBs are small structures believed to influence RNA storage and processing. CBs are evolutionarily conserved structures in animal and plant cells, reflecting their fundamental role in eukaryotic cells. To understand this process, various advanced techniques in molecular biology will be utilized, including transcriptome analysis, quantitative proteomic analysis, FISH, and MERFISH. These techniques will help identify specific RNAs retained in CBs and shed light on the mechanisms responsible for this retention.

- **Significance:** This research has the potential to enhance our understanding of mRNA retention, a recently discovered mechanism that affects how cells manage mRNA export to the cytoplasm. This mechanism is crucial in various cellular scenarios, including cell development, differentiation, and stress response.

- **Methodology:** Four comprehensive methods will be employed to study CBs in larch microsporocytes:
    - Transcriptome analysis: This involves isolating different cell compartments and sequencing their RNA to find out which RNAs are retained in CBs.
    - Quantitative protein analysis: Isolation and sequencing of proteins will help identify proteins whose mRNA undergoes temporal storage in CBs.
    - FISH: By using specific probes, researchers will visualize the localization of various mRNAs in Cajal bodies in larch microsporocytes.
    - MERFISH: A cutting-edge technique that simultaneously visualizes multiple RNA molecules within intact cells, helping to understand the CB transcriptome.

- **Benefits:** This project advances our comprehension of mRNA retention, a common yet poorly understood process. It may also reveal new insights into CBs' function in post-transcriptional splicing. Such knowledge will contribute significantly to understanding germ cell maturation and mRNA regulation across all eukaryotic cells. Given larch's ecological and economic importance, especially in Europe, Asia, and North America, this project's findings could help address issues in larch cultivation, such as embryo abortion.

Overall, this project has the potential to make significant contributions to our understanding of mRNA retention and its role in various cellular processes. Additionally, this project could help to improve larch cultivation by providing insights into the mechanisms that regulate germ cell maturation.