**1. Introduction**

**Background:** SMAD proteins are found in every mammalian cell and play important roles in stem cell differentiation and embryonic development.

**Motivation:** In learning more about this process, we hope to understand its intricacies and be able to have control over some of these processes and decide what types of cells we want. Little research has been done in the time it takes for these proteins to interact with the cell.

**Claim:** We expect the SMAD proteins shuttle in and out of the nucleus due to the fact that these proteins are needed as transcriptional cofactors.

**2. Methodology**

To visualize the dynamics of SMAD proteins, a construct was built to fluorescently tag SMAD proteins. With the use of a special microscope we will be able to analyze in real time their journey to the cell’s nucleus.

*Proposed methodology to tag and visualize SMAD proteins*

In this model, we used kidney cells instead of Stem cells. This is because of the conserved function and pathway of the SMAD proteins.

**3. Results**

Once we successfully cloned SMAD2 and the backbone containing the fluorescent tag, Gibson assembly is used to complete the construction of the plasmid.

*Diagram for the function of an Optogenetic tool which reacts to green light and combines SMAD proteins. In the absence of light, the optogenetic tool will separate SMAD proteins*

In using an optogenetic tool, we will be able to make different combinations of SMAD proteins and analyze the cell’s response to these changes. Moreover, we will be able to explore the significance of each protein as transcriptional cofactors.

**4. Future Plans**

Once we understand the time SMAD proteins take to reach the nucleus, we can start thinking about modifying their behavior using Optogenetics.

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