APPLICATION JO84MECU

1. Describe the scientific problem that you propose to address. What is the question you are trying to answer? What makes it significant, relevant, and interesting?

Our project will address how microgravity impacts platelet count, cytokine production, and blood clotting efficiency. When you get an open wound, platelets go to the area and clump to form a blood clot. Then, these platelets would send cytokines to alert the immune system to scan for invaders and signal other integumentary cells to come to the area and help heal the cut. Not a lot of research has been done on injuries and treatment for injuries in space. Space injury research is critical to humanity's future because space colonization means numerous people will live in microgravity conditions. We need to know if there’s a major risk of injuries or fatality to ensure that these people are safe. We think that doing the proper research and sending our project to space could save lives because it allows scientists to find solutions to blood clot formations in the body and increasing the platelet count to normal levels in space.

2. State your hypothesis and explain your reasoning. Based on your background research, what results do you expect to see?

We hypothesize that in microgravity, the platelet and cytokine count will be significantly lower and the blood clotting will be not as efficient. We predict that the radiation that astronauts are exposed to could cause a decrease in platelet count. Our reasoning for this is that on earth, there is evidence that exposure to harsh levels of radiation has a side effect of a decrease in platelet count. The low platelet count will lead to low cytokine count as well because platelets produce the cytokines when a wound occurs. Because cytokines alert the immune system to scan for pathogens and signal other integumentary cells to heal the wound, a lack of cytokines could cause the astronaut to get infected or possibly bleed out.

3. Outline your experimental plan. How will you use the tools in the Genes in Space Toolkit to test your hypothesis? Be sure to specify the samples you will analyze, controls that you will use, and the possible experimental outcomes.

We plan to use the P51 Fluorescence viewer to see if there are fewer platelets in space than there are on Earth. To test our hypothesis, we’ll tag the platelets with a fluorescent marker and take samples from astronauts on Earth before takeoff and multiple in space. We plan on taking samples weekly for 3 months to determine a possible pattern or difference in the platelet count over time. We will put these samples in the P51 fluorescence viewer and compare the fluorescence. If the samples taken in space are brighter (contrary to our hypothesis), then platelet levels are higher in space. If the samples taken in space are dimmer compared to earth (in agreement with our hypothesis), then platelet levels are lower in space. As an additional feature to our project, we created a solution to our problem if our hypothesis is proven to be true. We would use the BioBits tool to synthesize artificial cytokines that would be injected into astronauts’ bodies when there is a wound.

4. Explain why you selected the tools you incorporated into your experimental plan. What makes them a good fit for your research question?

We selected the P51 fluorescence viewer because it allows scientists to compare the platelet counts from different test samples. The fluorescence viewer is a good fit for our research project because it's easy to visualize the difference in platelet count since you see which test sample is of higher fluorescence. If our hypothesis is correct and the sample taken in space aboard the ISS is dimmer (dimmer indicating fewer platelets and cytokines) than the one taken on Earth, we would use the BioBits tool as our solution. The BioBits tool is essentially a protein factory in a tube. Because cytokines are primarily made of proteins, this tool allows for us to make artificial cytokine proteins that will be given to astronauts. The artificial cytokines would alert the immune system to scan for invaders (preventing an infection) and tell other integumentary cells to come to the area of the wound (preventing a possible chance of bleeding out by helping to form a blood clot).

5. Justify your use of the International Space Station (ISS) by explaining how the unique environmental conditions found on board are essential for your experiment. Then explain what future space travelers stand to gain from your experiment. Write your answer as if you were speaking to an audience of non-scientists.

The ISS would be essential for our research project because the unique environment without gravity would allow us to test if our hypothesis is accurate. If our hypothesis is correct, future space travelers will benefit because scientists can develop a solution to the decrease in platelet and cytokine count. Even if our hypothesis is false, our experiment will still benefit these travelers because scientists are one step closer to understanding how injury healing functions in microgravity. Overall, our project allows us to know how dangerous injuries in space can be and how to efficiently treat these injuries. In the next couple of centuries, we expect to see numerous people traveling to space and our project allows them to endure space conditions safely.

6. How did you hear about Genes in Space?

Student/Friend

7. Citations

-https://askabiologist.asu.edu/explore/when-body-attacked
-https://www.news-medical.net/health/Blood-Clotting-Process.aspx