Title: Telomeres and the plant response to stress on Earth and in Space

Abstract: The ambition of NASA is to colonize the moon and Mars by the year 2050. Plants will be an essential component of this endeavor providing food, oxygen and carbon dioxide removal. Relatively little is known about plant responses to the extreme environment of space. We seek to understand how spaceflight impacts the dynamics of telomeres, the physical ends of eukaryotic chromosomes which are implicated as sentries of stress and biomarkers for proliferative capacity and lifespan. We report on the status of telomeres in *Arabidopsis thaliana* plants grown aboard the International Space Station. Unexpectedly, we found no changes in telomere length in space-flown seedlings, despite a dramatic increase in telomerase activity, the enzyme responsible for extending telomeric DNA tracts. Ground-based follow up studies showed telomerase is induced by a variety of environmental stressors, but in these settings its activity is uncoupled from telomere length. We also found genome oxidation was inversely correlated with telomerase activity levels. These data indicate that plant telomeres are remarkably resilient to spaceflight and suggest a non-telomeric redox protective capacity for Arabidopsis telomerase that may promote survivability during extreme stress. We are currently investigating if antioxidants can improve plant growth on Lunar and Martian regolith simulants. Our long-term goal is to provide new insight into plant adaptation to harsh environments on Earth and in Space.