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Presentation Title: Oxygen Deficiency in Spaceflight & its Impact on Plants' Adaptive Changes

Research Focus: Analysis of past spaceflights experiments conducted with *Arabidopsis thaliana* and *Brassica rapa* using the NASA GeneLab database and TOAST database

School: University of Florida

Student Level: Undergraduate

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Abstract:

Oxygen Deficiency in Spaceflight & its Impact on Plants' Adaptive Changes

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The goal of this study was to investigate the effects of hypoxic conditions in spaceflight. The distribution of genes involved with hypoxia in *Arabidopsis thaliana* and *Brassica rapa* were analyzed with the results from past spaceflight experiments to evaluate genes for future studies.

Transcriptomes data of two different spaceflight studies of *Arabidopsis thaliana* from the NASA GeneLab database, GLDS-7 and GLDS-17, were compared. DNA microarrays were utilized for transcription profiling to conduct these studies. For GLDS-7, the response in spaceflight was studied with approaches that collected gene expression data. Leaves, hypocotyls, and root tissues were compared to the whole plant. For GLDS-17, seedlings and undifferentiated cultured cells were placed in the Biological Research in Canisters (BRIC), specifically BRIC-16. The genes related to hypoxia in *Arabidopsis thaliana* from these two studies were compared to genes in *Brassica rapa* with the TOAST database to evaluate similarities.

When transcriptomes were analyzed for GLDS-7 and 17, genes that were considered significant had p-values  $\leq 0.05$  and log fold change values  $\leq -1$  or  $\geq 1$ . Sixteen genes fulfilled the criteria. The genes related to hypoxia were alcohol dehydrogenase, elongation factor, ethylene-responsive factor, GUS, heat-shock proteins, NAP, RAP2.12, and RD20. The genes most impacted by spaceflight were heat-shock proteins. These genes were compared with *Brassica rapa* through Arabidopsis Ensemble Orthology from the TOAST Database. Similarities were seen in alcohol dehydrogenase, elongation factor, ethylene-responsive factor, heat-shock proteins, NAP, and RAP2.12.

Overall, transcription profiling indicates that plants' survival in spaceflight is dependent on adaptive changes with gene expression. This study also indicates that there are similarities in gene expression between *Arabidopsis thaliana* and *Brassica rapa* with comparable gene expression. Future studies could include analyzing additional species to understand which genes could be modified to ensure better yield of space crops amid hypoxic conditions.