

TITLE: Investigating the Developmental Effects of a Hypomagnetic Space Environment

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Earth's geomagnetic field averages 45 μT , while in space there is a near-zero magnetic field (MF) environment. Research into the health effects from microgravity has received much attention, but rarely are these experiments combined with hypomagnetic ($<10 \mu\text{T}$) field exposure as would be experienced in space. Recent work has shown that MFs can alter stem cell-mediated tissue growth in planarians (even in normal earth gravity), suggesting the need for investigating the effects of near-zero MF exposure alone. Interestingly, developmental defects have been observed when embryos of the African clawed frog, *Xenopus laevis* were cultured during space flights. We hypothesized that near-zero MF exposure may be one potential cause for the observed developmental disruptions. To specifically examine the effects from a hypomagnetic environment, we constructed a mu-metal enclosure (MagShield apparatus) which blocks external MFs. A triaxial Helmholtz coil was used to produce a 45 μT MF in one chamber of the MagShield box for controls. 2-cell stage *X. laevis* embryos were allowed to develop for 1-3 days either with or without MF exposure, after which embryos were examined for morphological defects. Our preliminary trials produced variable results, from no visible anatomical effects to embryonic abnormalities. The defects were also variable, ranging from craniofacial to axial malformations. While these experiments are still in progress, our initial findings are reminiscent of the variable results seen from testing microgravity exposure alone. This raises the possibility that health effects from the space environment may result from a combination of microgravity and the lack of MF. Currently, we are also characterizing the cellular and molecular changes that may occur following development in a near-zero MF environment. This work is funded by NSF grant #2105474 (WSB), NSF#1757316 (JG), and NASA grant #80NSSC20M0043 issued through the Nevada Space Grant Consortium (KT).