A K-12 MICROGRAVITY EDUCATIONAL INTERVENTION FRAMEWORK. J. A. Carmona¹, S. L. Smith¹, J. York², R. Moore³, M. Clyat³, T. Buchs¹, R. Laufer¹, S. Attai¹, L. Matthews¹ and T. W. Hyde¹, ¹Center for Astrophysics, Space Physics, & Engineering Research, Baylor University, (Baylor University, Waco, Texas 76798, USA-Truell_Hyde@baylor.edu), ²Educational Service Center Region 12 (2101 W Loop 340, Waco, Texas 76712), ³Baylor School of Education (One Bear Place #97304, Waco, TX 76798-7304), ⁴La Vega Independent School District (555 TX-340 Loop, Waco, TX 76705).

Introduction: The CASPER educational research group and its partners at the Baylor Research and Innovation Collaborative (BRIC) are developing a multi-step educational intervention program intended to reverse K-12 students’ lack of interest in STEM fields [1]. This program is centered on CASPER’s recently constructed 1.5s drop tower which is designed for use in both scientific research and educational outreach. During the summer of 2018, microgravity camps were used to test the intervention, producing data that allowed researchers to improve on the intervention design. Details of both the intervention model and summer camp preliminary results are discussed below.

Interventional Program: The interventional program provides opportunities for participants to experience STEM activities at increasing levels of academic rigor with each tier level (see Fig. 2) and is designed to provide impactful experiences for all participants. Given not every student will choose a STEM career, the model also provides experiences which help children understand the impact that STEM fields have on their daily lives.

First tier. Participating students will have access to a mini drop tower (Fig. 3) in their school classroom while their teachers will have access to professional development employing a coaching model that provides the tools necessary to increase student interest in STEM. The Education Service Center Region 12, a CASPER partner in this effort, both developed this coaching model and aligned all curricular material to state and federal standards. The model also includes a growth mindset and workforce development component provided by our partners.

Participating students move up in tier level after successfully completing all tasks delineated for the previous tier while researchers, school teachers, and parents use a rubric to score students’ performance and attitude toward STEM fields. Students are promoted based on the results of the evaluation and recommendations from their school teachers, parents and researchers.

Figure 1. CASPER’s 1.5s drop tower housed at the Baylor Research and Innovation Collaborative (BRIC).

Figure 2. Tiered educational intervention model designed to increase interest in STEM fields.

Figure 3. Mini drop tower and capsule equipped with a video camera for data collection.
Second tier. Participating students will attend a full day camp on-site at the BRIC where they will experience an environment which includes both the CASPER drop tower and a series of NASA artifact exhibits (Fig. 4). Activities at the BRIC will include student observations on microgravity which will be used to produce a working hypothesis and a test of that hypothesis. As such, this concept is based on both the scientific method and a framework of active learning where students become builders of their own knowledge.

![Figure 4. An example of the NASA artifact exhibits distributed throughout the BRIC.](image)

Students will record their observations, predictions and hypothesis in a workbook prepared as part of a package that also contains related curricular material. These packages will be made available for all participating teachers and support staff. The second half of the day students will attend the Challenger Center located on the campus of the Texas State Technical College (TSTC) where they will participate in simulated NASA Command Center and Space Shuttle activities to promote their critical and creative thinking, communication and cooperation.

Third tier. The final tier is comprised of microgravity after school clubs where participating school staff and industry mentors support the students in the development of microgravity research proposals. Research proposals showing merit in both engineering and science will be selected for drop on the CASPER drop tower. Students will be responsible for data collection and analysis and present their results in front of their peers, parents, school staff and CASPER scientists.

The Framework: The intervention described is multi-dimensional and designed to increase both student interest in STEM as well as self-efficacy and teacher support. Specifically, the intervention provides support for self-efficacy, a known predictor of student success [2], through direct teaching, mentoring and the use of active learning pedagogy. Successful students will conceive learning as a flexible, multifaceted process that at any level may be interdisciplinary rather than a single linear path. Thus, the intervention should increase the student’s overall metacognition process regardless of the career path chosen by them in later life.

Teachers who affirm students’ talents have been shown to be significant factors in underrepresented students pursuing a college science major [3]. However, to increase overall interest in STEM, they must have sufficient and adequate support. CASPER’s professional development partner ESC Region 12 will help and support participating teachers by coaching them so that they can confidently guide and support their students who show interest in a STEM area.

First Microgravity Camp: During the summer of 2018, a pilot camp took place with the intention of testing the curriculum developed and to improve the overall design and logistics of the intervention. Students attending the one-week camp were given direct instruction on microgravity and its impact on multiple areas of research. They also went through the second tier (Fig. 5) where they observed, produced a hypothesis and tested their hypothesis on the impact microgravity has on certain objects. Finally, they attended the Challenger Center and on the last day dropped an experiment from the second floor of the BRIC.

![Figure 5. Students learning about the NASA artifacts and how they were used while under microgravity.](image)

Conclusions: In order to quantify the effectiveness of the described intervention, researchers must first develop rigorous measuring instruments and work on refining the current model. However, results from the intervention to date appear to have the potential to increase student interest in STEM.