Cultivating Curiosity with Life in the Universe and WorldWide Telescope

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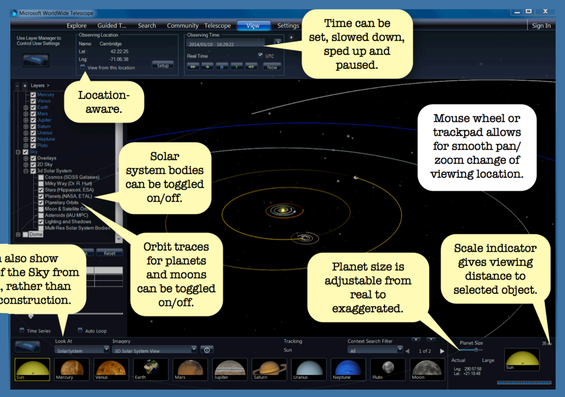
Project Overview

Life in the Universe (LITU) is an out-of-school or expanded-learning-time curriculum designed to engage middle school-aged youth in understanding the search for life elsewhere in the Universe.

Over ten 45-minute sessions, students explore:

1) **Astronomy Basics:** How are we situated in our solar system, galaxy, and universe?
2) **Exoplanet Basics:** How do astronomers find planets around other stars? Where are those planets? How do we know which planets could support life?
3) **Big Ideas & Questions:** Should astronomers be looking for life elsewhere? If we found life beyond Earth, would that impact me or my society?

Astronomy content is presented through WorldWide Telescope (WWT), an interactive visualization program. This annotated screenshot of WWT shows a view of the 3-dimensional "Solar System" mode. Features relevant to the design of the LITU Labs are highlighted.



Context

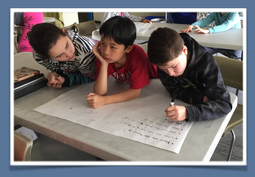
We implemented the LITU curriculum at a Boston Public School as an enrichment program during their expanded learning time in 2016 and 2017. Roughly forty students participated each year, drawn from 6th and 7th grade classes.

Members of the research team taught all lessons, with support from the classroom science teachers.

In 2016, LITU classes met once per week for 1.5 hours. In 2017, LITU classes met every day for 45 minutes. The results reported here are based on the 2017 implementation.

Curriculum Features

Asking Questions to Cultivate Curiosity

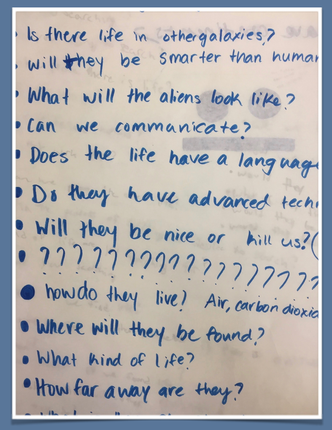


The LITU program gives students an opportunity to generate their own questions to guide their pathway through the curriculum. When driven by their own questions on a topic, students are inherently motivated to explore the topic deeply and search for greater meaning and connection to their own lives.

Asking questions is a skill, but one we are seldom taught. Learning to ask questions can help us to better understand what we know and don't know.

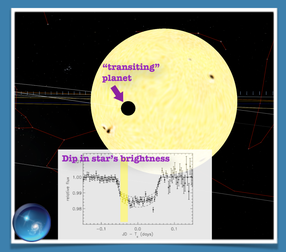
The LITU curriculum uses the **Question Formulation Technique** (QFT), devised by the Right Question Institute. See additional free resources on the Question Formulation Technique at www.rightquestion.org. We also highly recommend the book *Make Just One Change: Teach Students to Ask Their Own Questions*, (Harvard Education Press: 2011) by Dan Rothstein and Luz Santana.

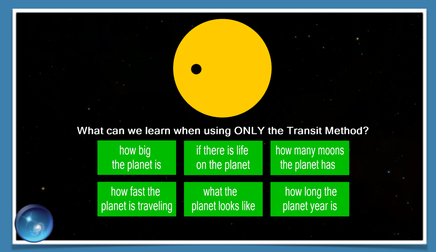
Sample questions generated by LITU students over a 5 minute period



Students can manipulate and interact with WWT, visualizing almost everything we know about our place in the universe.

Users can create "tours," or scripted pathways, through the Universe to guide users through specific views, and for storytelling purposes. The LITU curriculum is presented through WWT tours.



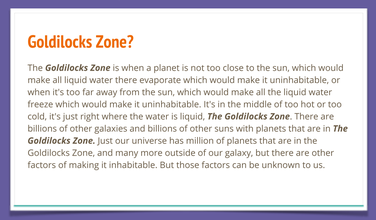


Screenshots of sample WWT tours in the LITU curriculum. On the left, we show how a planet transiting in front of its star will temporarily dim the brightness of the star. On the right, we show an example of linked-slides in WWT that allow curriculum designers to embed learning checkpoints for monitoring student understanding.

Student Capstone Projects

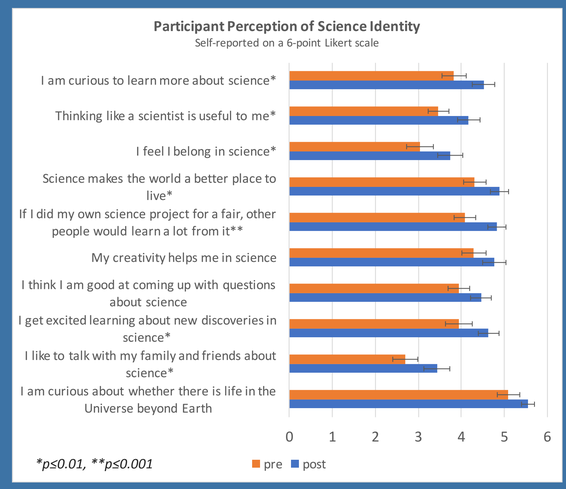
LITU students work in groups to share their ideas in a slideshow that will be presented to peers and instructors at a final celebration. Students develop 21st century skills - researching a topic, supporting ideas with evidence, and delivering findings through presentation slides.

Sample slides from student capstone projects, sharing some of the science concepts they learned, and some of the ideas they wrestled with.



Survey Results

This figure shows pre and post Likert results from student surveys, where participants self-reported their level of curiosity, interest, and self-identity in science. We had matched pre-post survey data for 35 students. t-test comparisons of the pre and post surveys show that students had statistically significant increases for almost every question asked, with mostly moderate effect sizes. (Cohen (1988) defined effect sizes as "small, d = .2," "medium, d = .5," and "large, d = .8". Education research projects that achieve medium or large effect sizes are generally considered highly successful). We see especially significant gains in participants' ability to see themselves as successful in science, and in their interest in and curiosity in science.



Informal student feedback, in these hand-made cards, was very positive:

"Thank you so much for teaching us about the universe - there was so much I didn't know! It was one of the best experiences of my life. Thank you for this opportunity"

"We all had a great time and learned lots of new things. P.S. I'm a future scientist"

Acknowledgments

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