Lighting the Way: Rural Schools and the Future of STEAM Education

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Rural Schools and Place-Based Mathematics

Mathematics teachers, curriculum reformers, and educational researchers have long sought strategies for making mathematics meaningful and accessible to all learners.

A challenge to these efforts is the disconnect between the abstract, theoretical qualities of mathematical concepts and the grounded, empirical realities of day-to-day life. Students on the receiving end of 'real world' mathematics instruction tend to find themselves in a bizarro world, in which they are asked to use mathematics to solve problems that no mathematician would use mathematics to solve. The goal of our work is to resolve this disconnect.

We are leveraging the unique geographical positions of rural schools in Maine to showcase how sunlight can be used for doing mathematical work.

Multiplication as continuous scaling

McLoughlin and Droujkova (2013) developed a geometric definition of multiplication that used parallel lines to continuously scale the length of one segment by the length of a different segment. Their treatment of the constructability of products takes as an axiom that rays of sunlight are parallel to each other.

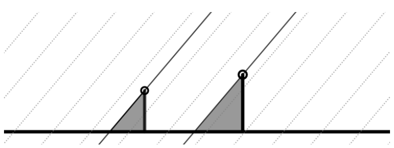


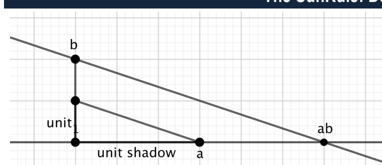
Figure 1: A representation of light rays striking two rods, each perpendicular to the ground, that have different heights.

Because sunlight is a readily available, renewable source of parallel lines, we take up here the design challenge of constructing a physical tool that that would harness the Sun's parallel rays and use them for multiplication.

Our motivation for this work was to provide a physical, manipulable tool that would realize multiplication as a continuous scaling operation as opposed to a repeated grouping operation.

Figure 2 (far left): Polished socket of a custom ball and socket joint. **Figure 3:** Pouring molten bronze in the UMaine foundry. **Figure 4:** Polished ball of custom ball and socket joint. **Figure 5:** Surveying the installation site to find true geographic South.

The SunRule: Design and Development of a STEAM Installation



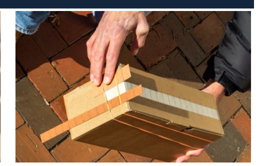
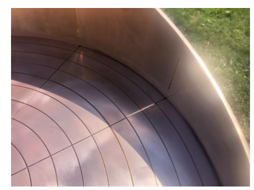
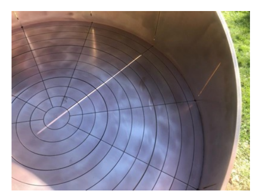


Figure 6 (far left): A multiplication diagram. **Figures 7,8, & 9: H**andheld SunRule prototypes showing various products.

With support from the University of Maine's ICORPS and MIRTA commercialization accelerators, we worked with artists and engineers to realize the mathematical idea of a solar calculator that represents multiplication (and division) by stretching and shrinking beams of the light.

Prototype Installation: Webster Park, Orono, Maine





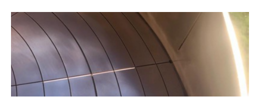


Figure 10 (far left): The SunRule at Webster Park. **Figure 11 (second from left, top):** People gathered around the SunRule at its unveiling. **Figure 12 (second from left, bottom):** Details showing that 1.5 times 4 is 6. **Figure 13 (third from left, top):** Detail showing 1 times 3 is 3. **Figure 14 (third from left, middle):** Detail showing 2 times 7 is 14. **Figure 15 (third from left, bottom):** Detail showing 2 times 3 is 6.

A Vision for the Future

This collaboration shows how ideas from science, technology, engineering, art, and mathematics (STEAM) can be synthesized to create new designs for learning.

The SunRule is designed to harness the hidden mathematical power of sunlight, an abundant, universally accessible source of parallel lines—that is, lines that do not intersect.

Our vision is to partner with rural schools across Maine to create site-specific landscape designs, where SunRule sculptures would be focal features in outdoor laboratory classroom spaces that would be designed to investigate the omnipresent power of sunlight from multidisciplinary perspectives.

These solar laboratories will integrate mathematics, biology (e.g., gardening, soil science), earth science (e.g., the daylight cycle, latitude and longitude), engineering (the design and installation of the device), and visual art.

Rural Resilience Through STEAM

Our work imagines how rural schools, which are often described in deficit language for being geographically or culturally isolated, could become leaders in transdisciplinary STEAM education. We are working to design a future where schools in Maine are the benchmark for innovative, integrated math and science education that is directly connected to our shared environment. In the age of social media, augmented reality, and AI, schools throughout rural Maine are in a unique position to provide exemplars of what it would look like to rediscover the educational power of grounding learning and teaching in being someplace together.

References

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