



<http://lbym.sonoma.edu/i3>

What is Learning by Making?

Learning by Making is a two-year integrated STEM (Science, Technology, Engineering and Mathematics) course funded by the US Department of Education's Investing in Innovation program. The curriculum is being developed by a team at Sonoma State University, in partnership with six Mendocino county high schools and the Mendocino County Office of Education. The six partner high schools are: Anderson Valley, Fort Bragg, Point Arena, Round Valley, Ukiah and Willits.

What will the students learn?

In year one, the students will be building basic skills including programming in the Logo language, building circuits, conducting experiments, analyzing data and presenting experimental results. There are three major experiments that go into depth in topics in Earth/Environmental Science and Biology. Each experiment uses sensors to measure environmental or biological quantities, and is derived from ongoing scientific research into real world problems. The students and teachers will work together to conduct experiments that try to answer questions derived from their own interests. The second year course will further build the students' capabilities to conduct their own investigations, with a primary focus on Physical Science (Chemistry and Physics).

How was the course content determined?

The Learning by Making curriculum is one of the first to be aligned with the Next Generation Science Standards (NGSS). These standards were developed by a national committee of educators to bring STEM teaching into today's learning environment. Some of the most important differences between the NGSS and the previous standards include:

a) The recognition that disciplinary core areas (such as Biology, Chemistry, Physics, etc.) have many cross-cutting concepts that unify the process of doing science. These include areas such as Patterns, Cause and Effect, Systems and Models and more.

b) Scientific and Engineering Design practices – STEM learning is about doing things, not just memorizing disconnected collections of facts. These practices are evaluated through performance expectations. Students are expected to understand the work they are doing, and to demonstrate their understanding by explaining their work to others (including their peers) and completing tasks associated with designing, building and running experiments.

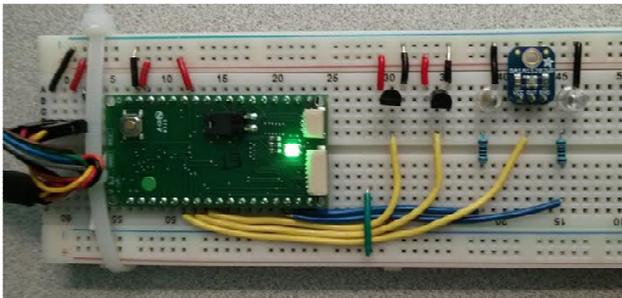
We also ensured that the LbyM curriculum would fulfill college entry requirements for the UC and CSU systems, and have been approved for area "D" – Laboratory Science.

How is the curriculum structured?

The year 1 curriculum consists of 13 units – each is expected to take 2-4 weeks. In broad categories, the curriculum includes:

Units 1 – 5: Basic skill building and introduction to experimentation

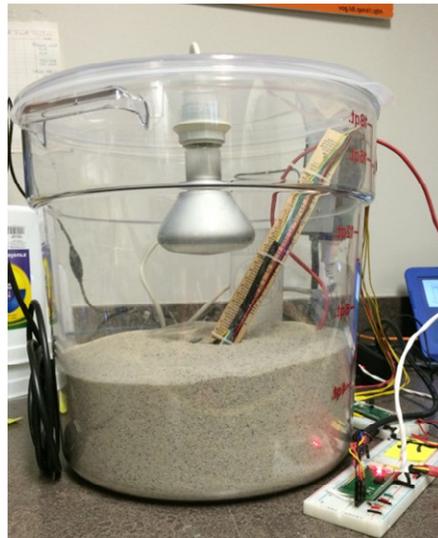
Students will learn the fundamentals of building circuits, writing Logo programs, building experiments, and plotting and analyzing data.



Basic Board with temperature and light sensors

Units 6 -8: Heat Diffusion

Students will design their own experiment to measure temperature at various depths of sand that is being heated by a light source that simulates the Sun. They will analyze data and present their experimental results to their peers.



Heat Diffusion Experiment

Units 9-11: Organism Growth in a Microbial Fuel Cell

Students will investigate microbial fuel cells to see how biological organisms can create electricity. They will work together to optimize the performance of a network of these cells, analyze their data and present their experimental results.



Network of Microbial Fuel Cells

Units 12-13: Environmental Quality

Students will choose between measuring air particulates or the local radiation environment. They will work together to analyze data and compare their local results to world-wide data bases.