4-H Junk Drawer Robotics Curriculum

Background

Need for Science, Engineering, and Technology Education

- The need for improved scientific literacy, and yet the stagnation and decline in overall U.S. youth science achievement *(at least as measured by standardized tests)* is well documented and discussed.
- Scientific literacy helps youth become workforce ready, participate in civic debates, and be critical consumers of information.

Why Engineering & Technology?

- Engineering education helps youth improve problem solving skills, promotes creative thinking and collaboration, and connects scientific concepts with the real world.
- While science and engineering share similarities, they have several fundamental differences. Scientists strive to identify general rules of nature while engineers design solutions that satisfy particular needs. Engineering involves constraints in materials, finances, and aesthetics all of which often require trade-offs.

Role of 4-H Youth Development

- Out-of-school time programs, such as 4-H, can provide engineering and technology programs that extend science education.

Curriculum Development Process

- Junk Drawer Robotics was authored by UC ANR faculty and UC Merced students over a ten year period.
- Activities were developed through an iterative process that included pilot testing.
- Content was peer reviewed by engineers, youth development staff, evaluation experts, and by the 4-H National Headquarters.

"Design-based learning engages students as critical thinkers and problem-solvers and presents science and technology as powerful tools to use in solving some of the world's most pressing challenges." – Margaret Honey and David Kanter (2013, p. 4)

Curriculum

Designed for middle school youth to engage in science inquiry and engineering design through the use of common household items.

- Focus on scientific and engineering practices (NGSS, 2013).
- Frames activities in the experiential learning cycle and promotes inquiry.
- Promotes small group collaborative learning.
- Reinforces engineering design with a youth robotics notebook.

Activities within a module are framed around three phases:

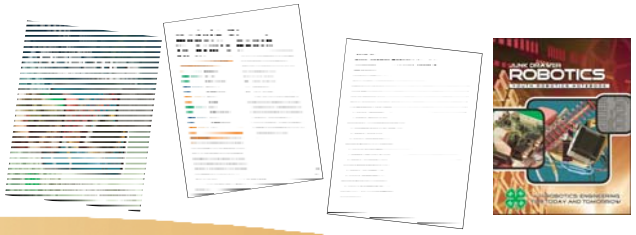
To Learn (Science) – Activities emphasize exploration and form the foundation upon which youth build conceptual understanding. *Youth explore!*

To Do (Engineering) – Activities build upon the knowledge gained in the exploration phase related to the concepts in the module. *Youth design!*

To Make (Technology) – Activities allow youth to build and test their design while solidifying their understanding of the concepts. *Youth build!*

Junk Drawer Robotics contains three levels:

- 1) Give Robots a Hand
- 2) Robots on the Move
- 3) Mechatronics



Evaluation

Methods for Formative Evaluation 2009-2010

- Implemented with 250 youth at club and afterschool sites in Merced, Santa Cruz, and Kern Counties, California.
- Survey administered at the conclusion of a module.
- N=250; ages 12-14.

Results

- Overall, the formative data seems to indicate the curriculum was well received by adult facilitators in establishing a productive learning environment for science, engineering, and technology.
- Youth rated engineering, on average, higher than science and technology concepts.

Evaluation results for Junk Drawer Robotics Level 1, "Give Robots a Hand"	Module 2 Arms
	Youth respondents n=40
Survey question for youth	Mean Values*
The lesson/activity helped me to learn about science or science concepts.	3.25
The lesson/activity helped me to learn about technology or technology concepts.	3.56
The lesson/activity helped me to learn about engineering or engineering concepts.	3.69
The lesson/activity helped me to learn about mathematics or math concepts.	3.62
I found the lesson or activity to be interesting.	3.55
I would tell my friends that the activity was a good one.	3.36

** Means are from Likert response values: 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly Agree*

Implementation

Curriculum is published by the National 4-H Council as part of a three track robotics program which also includes *Virtual Robotics* and *Robotics Platforms*. and available on their website for purchase. Programs are being implemented across the country in 4-H and afterschool programs.

Further information available from: Mahacek, R. and S. Worker (2011). Extending science education with engineering and technology: Junk Drawer Robotics curriculum. In A. Subramaniam, K. Heck, R. Carlos and S. Junge (Eds.), *Advances in Youth Development: Research and Evaluation from the University of California Cooperative Extension 2001 – 2010* (pp. 49-60). University of California Agriculture and Natural Resources.

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