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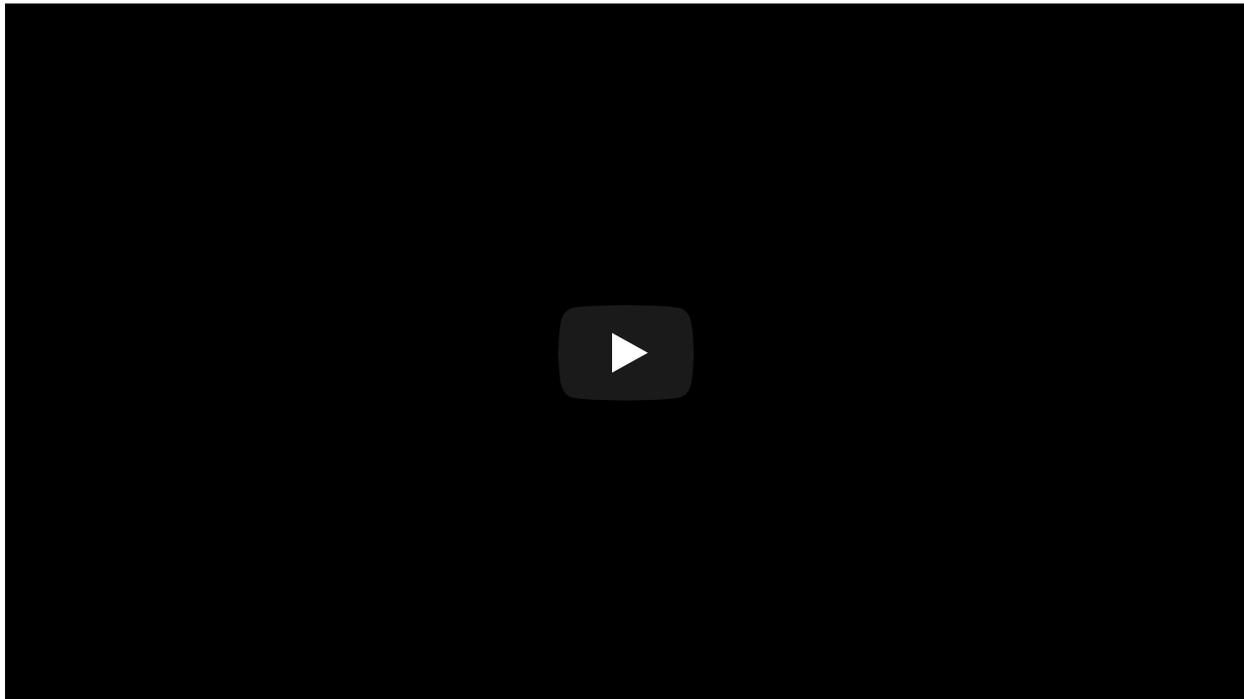
CU Boulder Today

Paper robots teach kids basic engineering principles

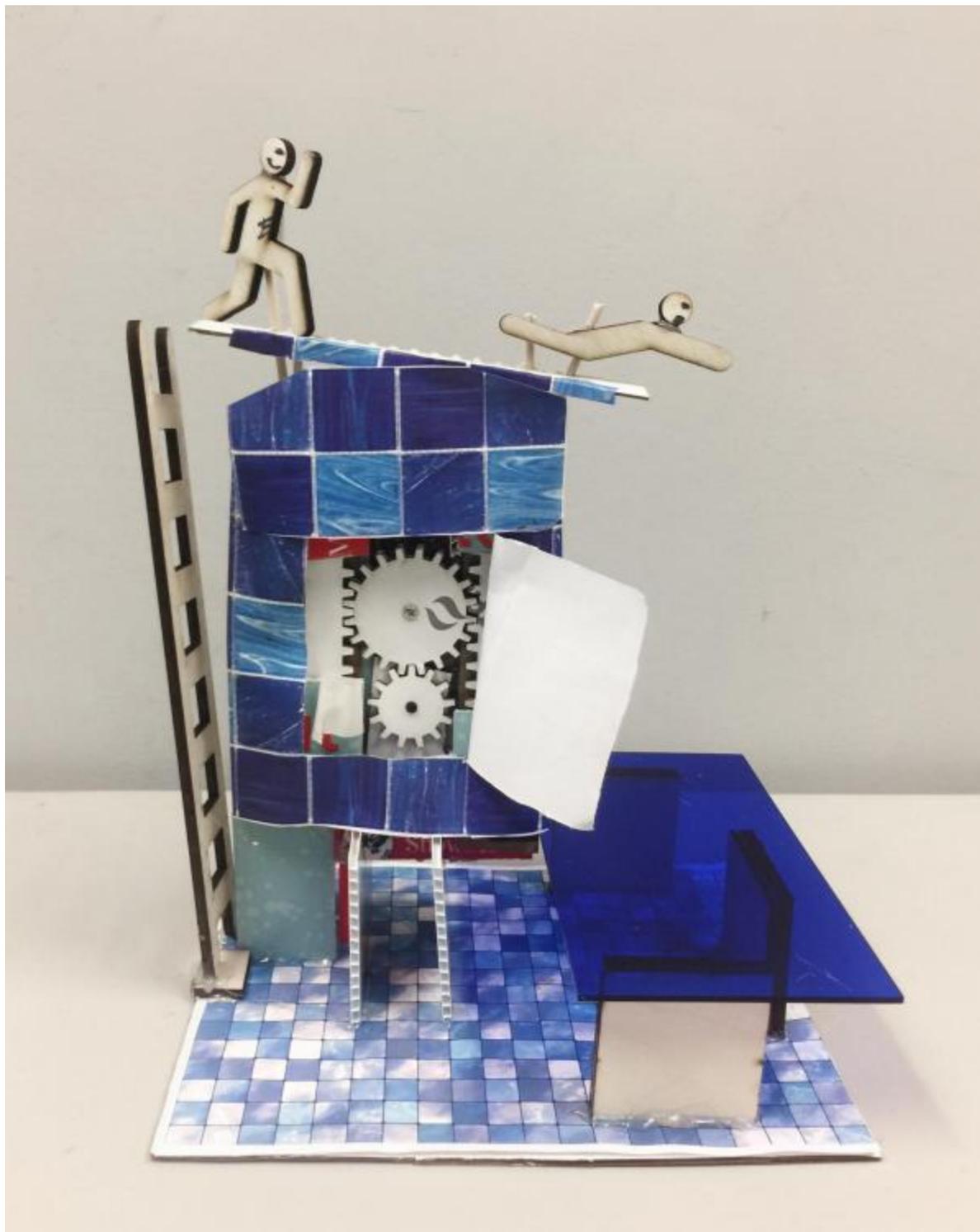Sept. 21, 2017 • By Ula Chrobak *(/today/ula-chrobak)*

Athletes jumping off a diving board. A duck circling a pond. Planets rotating in space. What do all these things have in common?

They—or at least, their robotic representations—are products of a two-day workshop at the Boulder Public Library, where high school students designed and assembled their own cardboard robots.
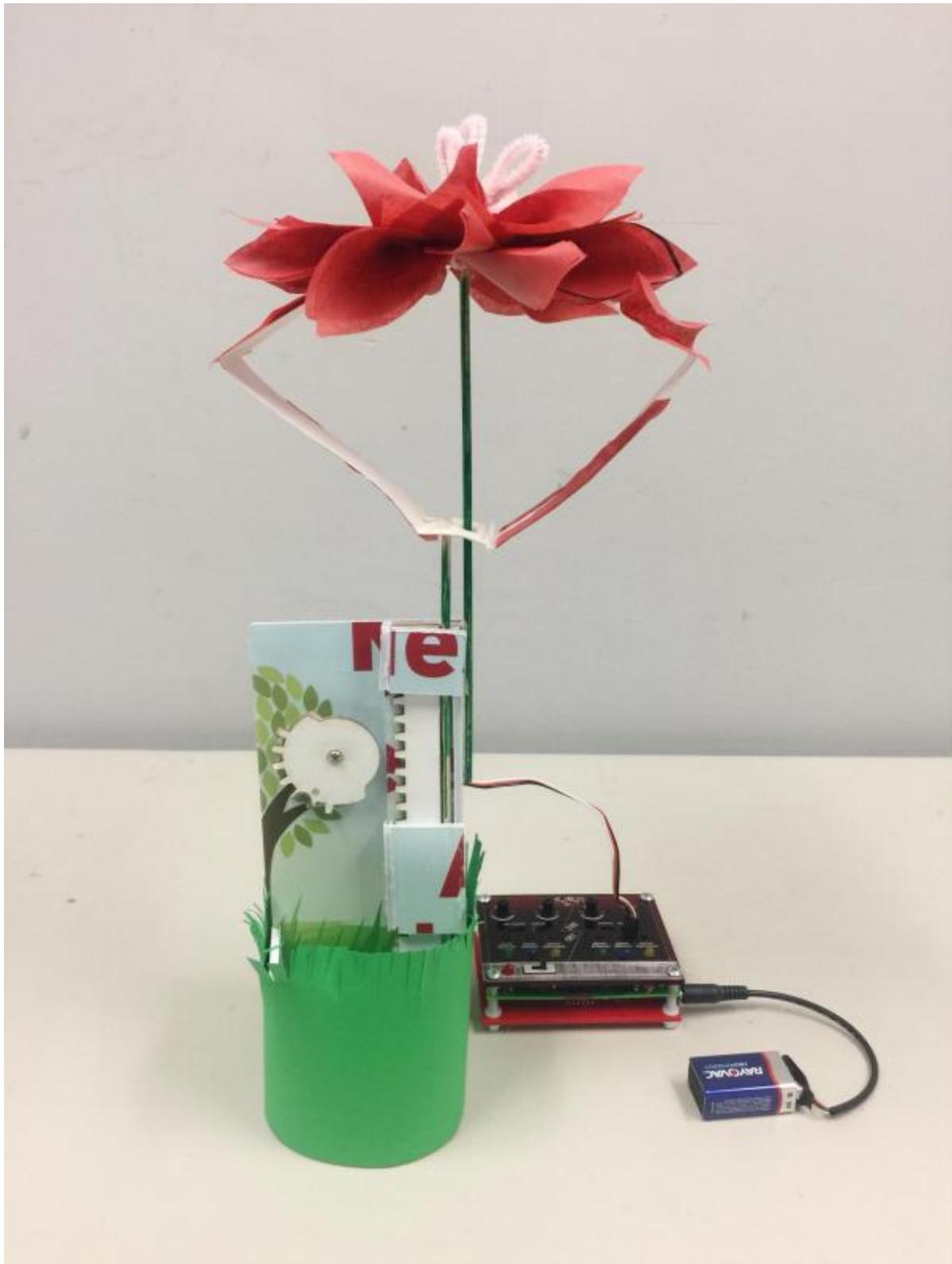
Paper robots created by students at the Boulder Public Library makeathon. Photos by HyunJoo Oh.

CU Boulder scientists, in collaboration with Sherry Hsi at the Concord Consortium *(https://concord.org/)*, recently received a grant from the National Science Foundation to teach workshops through their Paper Mechatronics *(http://www.papermech.net/)* project. Not only are these "makeathon" events fun, but students also learn basic engineering

principles: design, build, test. The project is changing traditional models of education and helping shape these students' futures.

"The intent of our work is to provide things for kids to do," said Mike Eisenberg, a professor in the Department of Computer Science *(http://www.colorado.edu/cs/)* and the Institute of Cognitive Science (ICS) *(http://www.colorado.edu/ics/)*. "We think in those terms rather than thinking in terms of teaching skills or even teaching particular content."

HyunJoo Oh, a graduate student at the ATLAS Institute *(http://atlas.colorado.edu/)*, was inspired to launch the Paper Mechatronics project three years ago, after seeing a video of a robot paper horse online *(https://www.youtube.com/watch?v=HILp4VyEi6g)*. She thought such projects could have potential for education.

"What if we design tools to invite beginner artistic designers to explore this hands-on learning?" she recalls asking herself.

Oh created FoldMecha *(http://www.papermech.net/create)*, a program with templates for shapes and types of movements. She also created electrical parts and workshop formats so students can have everything they need to design and build their ideas.

Since then, Oh has taught seven Paper Mechatronics workshops around the country. Some are two-hour events, some last a whole week. At workshops, the students receive a brief instructional lecture. Then, they use FoldMecha to pick out a mechanical motion and parts for their robots. They print and cut out the parts and then get artistic. A simple motor animates their finished robots.

At an event at the Children's Creativity Museum in San Francisco, for example, a group of high school students created a "robot petting zoo." Starting with simple movement modules, the students made animals like a slithering snake and a duck that flapped its wings when fed.

Oh is impressed with students' creativity. "If we work with 10 people, 10 people interpret [the project] in 10 different ways," she said. "That's the most exciting part for me, because it's very diverse and expressive in a dynamic way."

The project has also welcomed girls who might otherwise be intimidated by programming and engineering, said Oh. She taught a workshop in 2016 to six middle school-aged girls at the Digital Youth Divas summer camp in Chicago. Oh noticed some of the girls seemed reluctant to participate at first.

"They already have a mental burden—they think it's cool, but they just don't think it's their thing," said Oh. But, the girls became more and more interested as the week-long workshop progressed.

"As they are really engaged in the activity in their own way and building up their story, they really make it work," she said.

The new grant will help the Paper Mechatronics team to improve these workshops and bring them to more museums, schools and libraries. In the future, Oh wants to create a paper mechatronics kit, with instructions, software and materials, in which the moving parts are already cut out, taking out the need for a laser cutter.

"The longer-term view is that what we really want is for kids to be interested in science, math, engineering," said Eisenberg. "Once they have a narrative story about who they are and what they're interested in, you can trust the process from that point—that they will learn the material."

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