Cubelets

Brief Summary

You don’t need to know how to code or wire to construct robots with Cubelets. Snap the robot blocks together and the magnetic faces do the rest. Every unique arrangement is a new robot with novel behaviors emerging from the construction. Invention made easy.

Equipment Required

Black bin of cubelets

Cubelets

Main Teaching Points

- A robot does three things: sense, plan and act. You can build a simple robot with just 3 cubelets.
- Robots are used in many ways including space exploration. (For example, see *Robot Geologist on Mars Exhibit* near Planetarium).

Set Up

1. Cubelets are stored in the far left cabinet under the Experiment Bar.
2. Unplug all the battery cubelets, leaving charging cords in the cabinet.
3. Place black bin on counter and turn on battery cubelets. Begin building robots!

Suggested Ways of Presenting this Demo

Introduce the activity to guests by saying something like “Can you build a robot using these these blocks? All robots sense, plan and act. All cubelet robots must have a gray battery cube, a black Sensing cube, and a clear Action cube. Investigate how many different ways you can make your robot behave by changing the way you put the Cubelets together. If your robot doesn’t work right away, try putting the cubes in a different order. Investigate how many different ways you can make your robot behave by rearranging the Cubelets into different configurations. See if you can figure out what the robot is sensing. Try to make a theory and then try different ways of testing it.”

To facilitate more interaction with the guests, ask questions such as the following:

What do you think is causing your robot to move?
What could your robot be sensing?
How can you test for this? Encourage them to try something like clapping, speaking to it, etc.
Help them notice that whenever they come close to the black Sense Cubelet the robot moves
What makes your robot stop moving?
Your robot is moving forward, can you get it to move backward?
Can you get your robot to move in a circle?
How many different configurations can you make, and how does each effect the action of your robot?
Can you build your robot to be taller than one cube high?
Are there other ways to get your robot to move besides using your hand?
If you could use this robot for a task, what might you get this robot to do?
If you could add another act cube to this robot what might that act cube be, and what might your robot be able to do?

Take Down Procedure

- Turn off the battery cubelets
- Place all cubelets back in the black bin.
- Place the black bin of cubelets under the Experiment Bar in the far left cabinet.
- Plug the charging cords in the cabinet into all the battery cubelets.

Cubelet Blocks

 Battery	This battery cubelet provides the energy needed to make your robots spin, drive and squawk.

 Blocker	The Blocker Cubelet is a basic building block that "blocks" data from its neighbors. It still passes power, but effectively stops communication and can insulate one side of a robot from another.
 Brightness	Detects the amount of light hitting it's sensor. The Brightness Cubelet has a photocell that responds to varying light conditions. Expect values near zero in a dark room, and values near one when the sensor is in front of a bright light.
 Distance	The Distance Cubelet detects how far it is from an object. It uses infrared light and is accurate for distances between 10 and 80 cm. The sensor is directional, so it outputs the distance to the object in front of the sensor. At 10cm, the block will output values near 1, and toward 80cm it will output values near 0.
 Knob	The Knob Cubelet has a potentiometer embedded in one of its faces. It outputs a 0 when turned fully counterclockwise, and a 1 when turned clockwise.
 Drive	The Drive Cubelet contains a motor and roller wheels for moving on a horizontal surface. The Drive Cubelet only moves in one direction, slowing to a stop with a value of zero and moving faster with higher input values.

 Flashlight	The Flashlight Cubelet emits a focused beam of light from a powerful white LED. The light is off with a value of 0, and becomes brighter with higher input values.
 Bar Graph	The Bar Graph Cubelet displays the block's value as a light-up bar graph. The value is normalized to the number of points on the bar graph so that a maximum value results in a fully-lit bar graph.
 Inverse	The Inverse Cubelet calculates a value that is the opposite of the values it receives. Specifically, the Inverse Cubelet will calculate a weighted average of its inputs and then output a value of one minus that average.
 Passive	The Passive Cubelet is a basic building block. It carries power and data from its neighbors, but it basically acts like a smart brick. It doesn't move, sense, or change the data in any way.

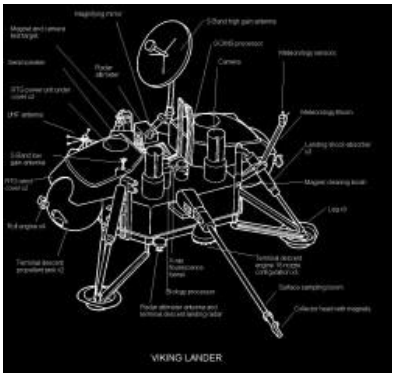
Robots in Space

(Article from Universe Today: http://www.universetoday.com/43750/robots-in-space/)

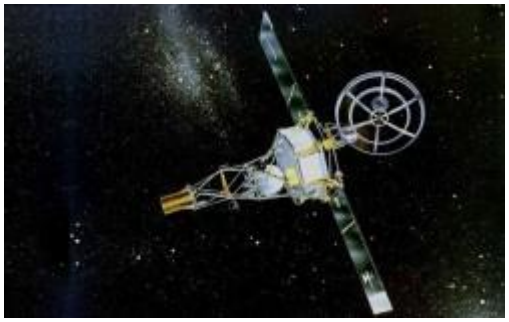
When it comes to exploring the hostile environment of space, robots have done a lot (if not most) of the exploring. The only other planet besides Earth that humans have set foot on is the Moon. Robotic explorers, however, have set down on the Moon, Mars, Venus, Titan and Jupiter, as well as a few comets and asteroids. Robotic missions can travel further and faster,

and can return more scientific data than missions that include humans. There is much debate on whether the future of space exploration should rely solely on robots, or whether humans should have a role.

As contentious as this issue is, there is no doubt that robots have and will continue to contribute to our understanding of the Universe. Here's a short list of past, current, and future robotic missions that have done or will do much in the way of exploration of our cosmos.



- The most famous robots in space have to be the series of orbiters, rovers and landers that have been sent to Mars. The first orbiter was Mariner 4, which flew past Mars on July 14, 1965 and took the first close up photos of another planet. The first landers were the Viking landers. Viking 1 landed July 20, 1976, and Viking 2 on September 3, 1976. Both landers were accompanied by orbiters that took photos and scientific data from above the planet. The landers included instruments to detect for life on the surface of Mars, but the data they returned is somewhat ambiguous, and the question of whether there is life on Mars still requires an answer. Currently, Spirit and Opportunity are roving away on the Martian surface, well past their expected mission lifetime, and the Phoenix lander returned a wealth of information about our neighbor.



- Mars isn't the only place to go in the Solar System, though. Both the U.S. and the Russians sent numerous missions to Venus, with a lot of successes and failures. The most notable firsts are: Mariner 2 was the first successful Venus flyby on December 14, 1962, and the Russian lander Venera 7 was the first human-made vehicle to successfully land on another planet and transmit data back to Earth on December 14, 1962.
- Sputnik 1, of course, was the first robot in space, and was launched October 4th, 1957 by the USSR.
- The Voyager missions are notable for the milestone of having a robot leave the Solar System. Voyager 1 and 2 were launched in 1977 are still making their way out of the

Solar System, and have entered the heliopause, where the solar wind starts to drop off, and the interstellar wind picks up.

- Dextre, a robotic arm developed by the Canadian Space Association, is a very cool robot aboard the International Space Station. Dexter allows for delicate manipulation of objects outside the station, reducing the number of space walks and increasing the ability of the ISS crew to maintain and upgrade the station.
- There are many, many future robotic missions in the works and still in the “dreaming” stage. For example, submarines may one day explore Europa, landers may crawl on the Moon, and spacecraft will orbit comets.

Background materials

- Getting Started With Cubelets
  https://www.youtube.com/watch?v=YPAOCOJibfQ&feature=youtu.be
- Cubelets Lesson Plans
  http://www.modrobotics.com/education/#lesson-plans
- Robots in Space
  http://er.jsc.nasa.gov/seh/robots_in_space.htm
- Robonaut 2
  http://robonaut.jsc.nasa.gov/R2/
- NASA Robotics
  http://www.nasa.gov/audience/foreducators/robotics/home/index.html#.V6IiRIMrJQI