This lesson’s learning target is **understanding code simply as a way that a device can follow instructions** using the functions it has, and the inputs it receives.

For each class/group, this lesson plan includes 3 parts, 10-20 Minutes each:

1. A review of robotics, and an activity to introduce code
2. A hands-on component using Cubelets to practice
3. An opportunity for educators to use a worksheet with students to assess their learning and progress while also having students practice applying new vocabulary

These lesson plans have suggested age levels, but it is possible to use the younger grade activities as a ramp up to older grades; e.g. use the 6 years old - 9 years old activities to ramp up and extend a lesson plan for a group of 10-12 year olds. Similarly, the activities suggested for older students can become a way to expand on challenges presented to younger learners if there is time and interest.

**Refresh some key concepts about robots:**

“We spent time in the last class to understand how robots have life-like behaviors and perform tasks. We came up with a one sentence definition that was simple, and explained how robots work and do jobs. It had three key words. Do you remember them? Let’s fill in this sentence frame:

Robots ________, ________, and ________. (Sense, Think, Act.)

Robots aren’t like people, they can’t decide to not listen to an instruction, or to change it. They have set functions that determine what kind of action or output they can have. We found out that Drive Cubelets only drive in one direction... but if we want to “program” our robot to go in the other direction, how can we do that? (By rebuilding the robot). They also have set inputs or things the robot could sense to make an action happen. What were some things the robot couldn’t sense? (color, voices/verbal commands). What were some things our robots could sense? (Light, distance)

Before we build Cubelet robots, we’re going to think about how robots have processes they follow, functions, and defined sets of instructions, and think about how we can build robots, or instructions for robots, so they do what we want them to do.”
### BASIC INSTRUCTIONS

1. Our “robot” assistant leaves the room (classmate, teacher, etc.)
2. Students will have 5 minutes to write a code for the “robot friend” to follow using the below arrows trying to get a line of cups to match a cup stacked shape
3. Student groups may “execute” their code to try and fix “bugs”
4. “Robot friend” comes back into the room, and receives code on the paper
5. “Robot friend” then executes code with no changes. Students are silent
6. “Did our robot code produce the result we wanted?”

### CODE Functions

<table>
<thead>
<tr>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pick Up Cup</td>
</tr>
<tr>
<td>Put Down Cup</td>
</tr>
<tr>
<td>Move 1/2 Cup Width Forward</td>
</tr>
<tr>
<td>Move 1/2 Cup Width Backward</td>
</tr>
<tr>
<td>Turn Cup Right 90°</td>
</tr>
<tr>
<td>Turn Cup Left 90°</td>
</tr>
</tbody>
</table>

### Example Cup stack shape - start with 4 cups in a line on table and end with this design

![Cup stack shape](image)

### Follow up questions:

1. What kind of mistakes did our “robot” make? Why did those mistakes happen - was it a matter of the robot having a robot-breakdown or because your code had an error or unintended result?
2. Can a robot decide to change it’s own instructions? How is this different than people?
3. Did we get more than one right result (cup stacking shape?) - does this mean there is more than one way to right a “code” for this robot job?
4. Did we see more than one kind of error? (Those are called bugs) What kinds of errors did we see?
6. How could you avoid errors in the future?

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**Concepts presented:** Code is a set of ordered instructions with defined functions, coded devices cannot deviate from it

**Vocabulary:** Code, functions, process, instructions, order/ordered, results, output, input, execute

**Standards Addressed:** CSTA computational thinking standards - algorithmic thinking

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1 [http://code.org/files/CSEDrobotics.pdf](http://code.org/files/CSEDrobotics.pdf)
Part 2: Hands-on robots, Think Cubelet exploration

Materials: KT06 kits, now with Passive Cubes included, as well as Blocker, and Inverse Cubelets from the KT01 in the Educator Pack; groups of 1-4 students using each kit.

This is going to involve Think Cubes that aren’t in the KT06 kit!

An opportunity for students to add excitement to their small robots while also exploring changing the data using Think Cubelets.

“In the last activity we used Sense Cubelets and Action Cubelets to build robots that drove and lit up. Today we’re going to make our robots a little smarter by using Think Cubelets with the senses and actions. Let’s see how this changes our robots.”

Suggested age variations/progression:

- **6 years old to 9 years old**: Students use the Battery, Brightness, Passive and Flashlight. “We built this robot before, but without the green Think Cubelet. Test out this Think component by putting it between the sense and the action - what do you think this Cube is doing to the information going from the Brightness sense to the Flashlight Action? Is getting the light to be brighter or dimmer any different? Has this Think component changed how information goes from this sense to this action - when does the light get bright? When there’s a lot of light on the black Cubelet or a little light? What does that mean?”

- **9 years old to 12 years old**: Swap the Passive for the Inverse Cubelet. “I’m passing out a Think Cubelet that sees information from the Sense Cubelet and then does work on that information before it goes to the Act Cubelet. Can you build robots with this Think Cubelet and test out what it does?” **What happens with the Inverse Cubelet?** Ask Students, “Before, the light came on when it was bright out. What happens now? What does it mean?” Have students practice using these two Think Cubelets by swapping senses and swapping actions. “what has changed - has the input changed? (No, the Brightness sense is still part of the robot.) Has the amount of input changed? (No, there’s still the same amount of light in this room). So what has changed? (The value is inverted by the new Cubelet, and so big input values become small outputs, and vice-versa.)”

- **12 years old and up**: Pass out the dark-green blocker Cubelet. Now, ask students now to consider what this might do when they build two small sense-action robots and use this Think function between them. Prompt them by reminding them, “You’ll need to build a small sense-act robot with one black Cube and one clear cube and put it on one side of this Think Cube. And then build another small sense-act robot with one black Cube and one clear cube and put it on the other side. Use what you know about how these sense act robots take input and turn them into action and see how this Think Cubelet in the middle is changing how these two small robots make one bigger robot.”

**Concepts presented:** Robotics and system building, Critical thinking, Using observations to support claims

**Vocabulary:** Sensing, inputs, response, reaction, action, predict

**Standards Addressed:** Making predictions, claims/evidence, algorithmic thinking
Part 3: Worksheet!  

Robots, Values, Code with Cubelets - Student reflection

Learning Objective: I can explain what a robot is, and how its behaviors depend on values and code.

Robots are special devices that __________, ____________, and ________________.

Circle words that could describe what code is:

- Mistakes
- Instructions
- Rules
- Crickets
- Colors
- Functions
- Ordered Steps
- Secrets
- Books
- Numbers
- Directions
- Programming

We worked with two flashlights. One of them fit this statement: “This flashlight likes to be on when it’s bright and off when it’s dark.” What is the input to this flashlight?

_________________________________________________________________________________________________________  

If it likes to be on when it’s bright, when is it’s input value highest?

_________________________________________________________________________________________________________  

When we added the Red Inverse Cubelet, did the input change? YES NO (circle)

When we added the Red Inverse Cubelet, did the amount of light in the room change (the value of the input in the robot)? YES NO (circle)

What is your claim about what the Red Cubelet does?

_________________________________________________________________________________________________________  

_________________________________________________________________________________________________________  

_________________________________________________________________________________________________________

What evidence do you have to support his claim?