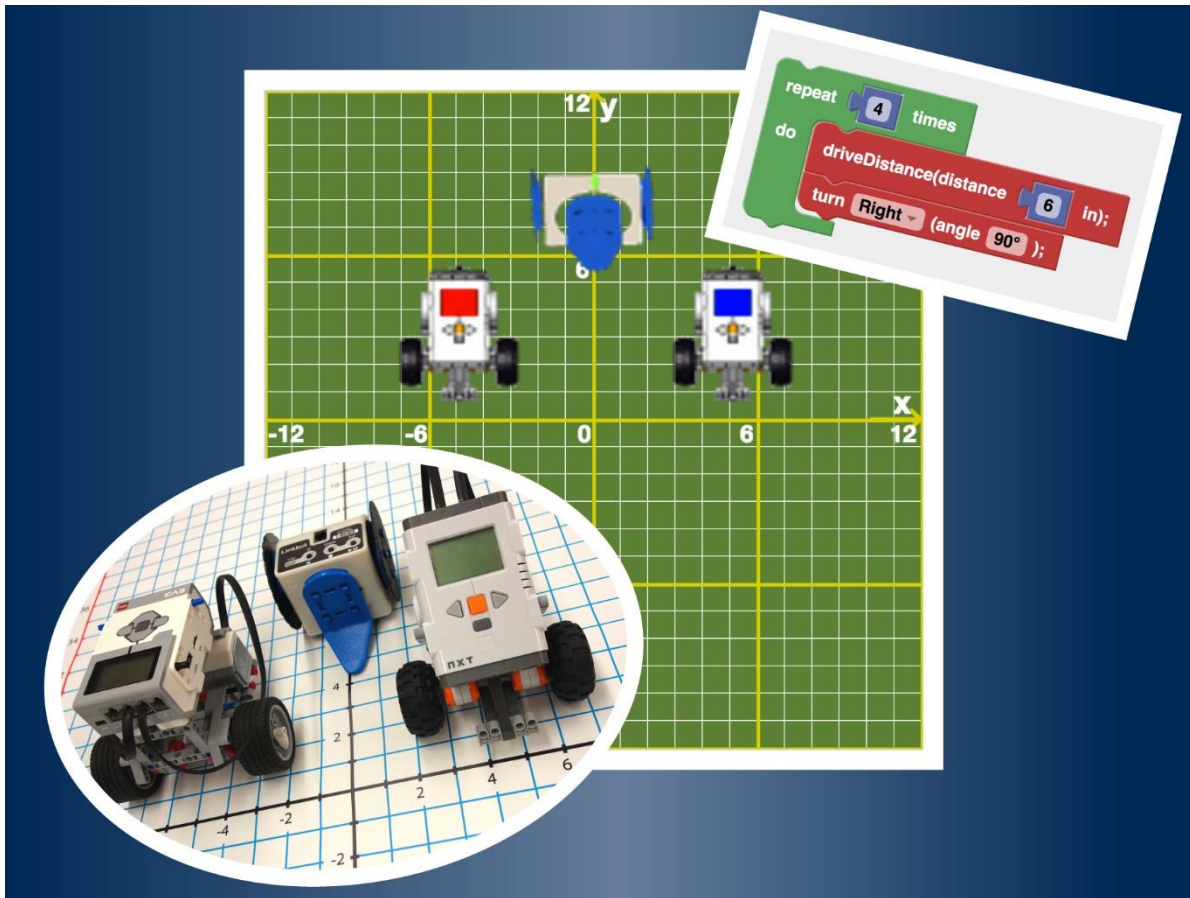


Learning Coding and Math with RoboBlockly

Teaching Resource for Grade 1 Math



Harry H. Cheng

UC Davis Center for Integrated Computing and STEM Education (C-STEM)

<http://c-stem.ucdavis.edu>

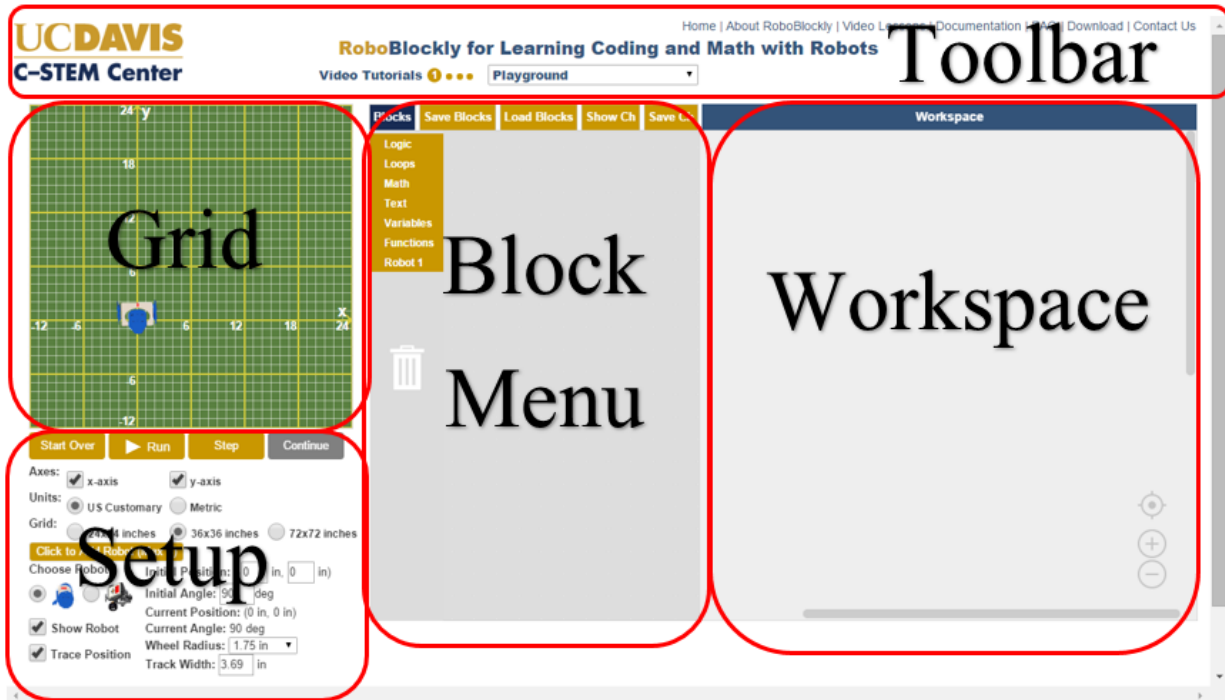
<http://roboblockly.ucdavis.edu>

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Additional Contributor(s):

Kayce Mastrup

How to Use RoboBlockly Activities in your Classroom

What is the purpose of RoboBlockly?

In RoboBlockly, students program a robot using a user-friendly drag-and-drop method. Students will complete basic problem solving to move a robot or multiple robots.

RoboBlockly is built to allow students to work at their own pace, but in general each problem should take approximately 5 minutes to complete each activity. We encourage you to give students additional time if needed or make it clear that they don't need to finish the entire set of activities during one class session.

General Computer Usage Requirements

Technology Requirements: Any modern browser on computers, laptops, tables, or smartphones with any type of operating system.

It is important to know that every browser functions differently. We encourage you to test RoboBlockly on the computers you will have students using *before* implementation. Please test out the following: audio and video streaming quality, default browser specific mechanisms for saving blocks and saving Ch code, etc. all so you are better able to support your students. Make sure that pop ups have been enabled on all computers.

You may wish to provide headphones or ask students to bring headphones to allow students to independently watch tutorial videos.

Prepare yourself

Go through the activities yourself so that you are familiar with what your students will be experiencing. The Teacher Resource Packet contains all the activities and solutions for the pathway. Please note that the activities build on previous activities in each pathways such that students may need to complete some or all activities prior to the activity selected.

1) Determine the purpose for students using RoboBlockly:

- To support student learning in Math,
- To support student learning in Computer Programming,
- To support student learning in Robotics.

2) Based on your purpose, determine what additional resources your students will need for instruction. We do not recommend using RoboBlockly to introduce a mathematical concept but to rather use it for skill building or as a culminating performance task.

Use as skill building: We recommend that you provide your students with a worksheet that includes important related definitions, work space, leading questions, etc. and encourage your students to refer to their class notes which cover these topics.

Use as a culminating performance task: Carefully select which activity directly relates to the content you have taught, making note that the previous activities may be necessary to complete to build prior knowledge.

Prepare your students

Help students get excited about RoboBlockly by inspiring students and discussing how computer science impacts every part of our lives. As a class, list things that use code in everyday life, or discuss different ways technology impacts our lives etc.

When using RoboBlockly in class, first demonstrate to students how to navigate and use the RoboBlockly website. There are five Video Tutorials, along with a self-guided interactive non-video tutorial which should be used to help familiarize your students with the different functionalities of RoboBlockly. Helping students understand the functionality of RoboBlockly and which elements can be manipulated in which manners is very important to ensuring your students have full access to the content.

Pre-Requisite Skills

Math

We are currently developing a comprehensive wiring guide to assist you with your planning. Please refer to the Table of Contents Standard Mapping for a complete list of Common Core Grade 1 Math Standards addressed in the RoboBlockly activities.

Computer

- Basic computer skills:
 - Drag and drop using a mouse
 - Key boarding
 - Navigating a web browser
 - Zoom In/Out in a browser
 - Disabling or enabling pop-up windows
 - Adjusting volume for videos

Extension

Using hardwired robots, Linkbot Controller, RoboSim or Robot Controller to execute programs built in RoboBlockly.

All can be downloaded from the UC Davis C-STEM Center's webpage: <http://c-stem.ucdavis.edu/downloads/>

Learning Coding and Math with RoboBlockly

Teaching Resource for Grade 1 Math

Activity Description

Activity	CCSSM	Blocks Used
1. Applying Addition to Drive the Robot Forward	1.OA.1	driveDistance
2. Applying Subtraction to Drive the Robot Forward	1.OA.1	driveDistance
3. Applying Addition with Multiple Terms to Drive the Robot Forward	1.OA.1	driveDistance turnRight
4. Applying Subtraction with Multiple Terms to Drive the Robot Forward	1.OA.1	driveDistance
5. Length and Distance – The Pencil Problem	1.OA.1	driveDistance

Standard Mapping

Common Core State Standards for Mathematics – Grade 1	Activities
1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.	1 – 5

Textbook to Activity Alignment

<i>Learning Robot Programming with Linkbot for the Absolute Beginner 5th Edition</i>	Activities				
	1	2	3	4	5
Section 5.4 Move a Distance for a Two-Wheel Robot	X	X	X	X	X



Activity #1 Applying Addition to Drive the Robot Forward

Common Core State Standards - Mathematics:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.

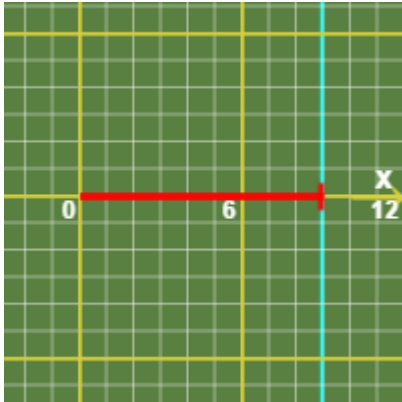
Objective: Students will apply their understanding of addition and subtraction to move the linkbot the specified distance.

RoboBlockly Student Activity:

<i>Initial Student Prompt</i>	<p>To drive the robot forward you use the driveDistance() block:</p>  <p>driveDistance(distance 5 in);</p> <p>For your activities you will need to change the numbers inside the blue boxes in order for the robot to reach the correct stopping point. You also need to see what operation you will be using.</p> <p>Have Fun!</p>
<i>Pre-Placed Blocks</i>	 <p>driveDistance(distance 5 + 5 in);</p>
<i>Problem Statement</i>	<p>Modify the preplaced blocks so the robot will drive forward a total of 9 units. You can change one or both of the numbers, just make sure your numbers add up to 9.</p>
<i>Wrong Prompt</i>	<p>Sorry, you did not drive the robot the correct total distance. Please try again – use the Hint if you feel stuck.</p>
<i>Hint</i>	<p>You want to drive the robot a total of 9 units. The current block will drive the robot: $5 + 5 = 10$ units. Think “what should the values be to drive the robot 9 units?” OR “what two numbers add up to 9?”</p>
<i>Possible Solution in Ch</i>	<pre>#include <linkbot.h> CLinkbotI robot; double radius = 1.75; robot.driveDistance(4 + 5, radius);</pre>

Activity #1 Applying Addition to Drive the Robot Forward

Picture of solution in RoboBlockly



Problem Statement:

Modify the preplaced blocks so the robot will drive forward a total of 9 units. You can change one or both of the numbers, just make sure your numbers add up to 9.

driveDistance(distance + in);

Location of solution for “Load Blocks” tab in RoboBlockly

C-STEM Studio -> Teaching Resources -> TeachMath1->RoboBlocklySolution->m1.xml

Student Mathematical Calculations

Students will need to first see that the pre-placed blocks have a sum of 10: $5 + 5 = 10$

They then need to change the values to any two numbers that have a sum of 9. Here are all the possible combinations (for whole numbers less than 10):

$$\begin{array}{ll} 1 + 8 = 9 & 8 + 1 = 9 \\ 2 + 7 = 9 & 7 + 2 = 9 \\ 3 + 6 = 9 & 6 + 3 = 9 \\ 4 + 5 = 9 & 5 + 4 = 9 \end{array}$$

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a) Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)


Activity #2 Applying Subtraction to Drive the Robot Forward

Common Core State Standards - Mathematics:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.

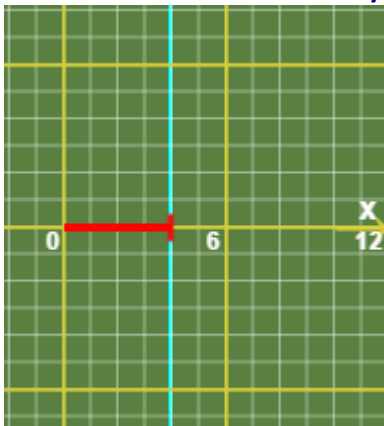
Objective: Students will apply their understanding of addition and subtraction to move the linkbot the specified distance.

RoboBlockly Student Activity:

<i>Initial Student Prompt</i>	Change the values in the driveDistance block so your robot drives the correct distance. This time you will be using subtraction.
<i>Pre-Placed Blocks</i>	
<i>Problem Statement</i>	Modify the preplaced blocks so the robot will drive forward 4 units. You can change one or both of the numbers, just make sure your numbers add up to 4.
<i>Wrong Prompt</i>	Sorry, you did not drive the robot the correct total distance. Please try again – use the Hint if you feel stuck.
<i>Hint</i>	You want to drive the robot a total of 4 units. The current block will drive the robot: $5 - 5 = 0$ units. Think “what should the values be to drive the robot 4 units?” OR “what two numbers can I subtract to equal 4?”
<i>Possible Solution in Ch</i>	<pre>#include <linkbot.h> CLinkbotI robot; double radius = 1.75; robot.driveDistance(5 - 1, radius);</pre>

Activity #2 Applying Subtraction to Drive the Robot Forward

Picture of solution in RoboBlockly

**Problem Statement:**

Modify the preplaced blocks so the robot will drive forward 4 units. You can change one or both of the numbers, just make sure your numbers add up to 4.

```
driveDistance(5 - 1);
```

Location of solution for “Load Blocks” tab in RoboBlockly

C-STEM Studio -> Teaching Resources -> TeachMath1->RoboBlocklySolution->m2.xml

Student Mathematical Calculations

Students will need to first see that the pre-placed blocks have a difference of 0: $5 - 5 = 0$

They then need to change the values to any two numbers that have a difference of 4. Here are all the possible combinations (for whole numbers less than 10):

$$10 - 6 = 4 \quad 9 - 5 = 4 \quad 8 - 4 = 4 \quad 7 - 3 = 4 \quad 6 - 2 = 4 \quad 5 - 1 = 4$$

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a) Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)


Activity #3 Applying Addition with Multiple Terms to Drive the Robot Forward

Common Core State Standards - Mathematics:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.

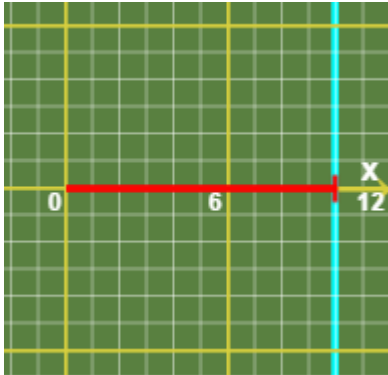
Objective: Students will apply their understanding of addition and subtraction to move the linkbot the specified distance.

RoboBlockly Student Activity:

<i>Initial Student Prompt</i>	This time you will have multiple operations happening in your driveDistance block. Operations will occur from left to right.
<i>Pre-Placed Blocks</i>	
<i>Problem Statement</i>	Modify the preplaced blocks so the robot will drive forward 10 units. You should use addition only. You can change all of the numbers or one, just make sure that all three numbers add up to 10.
<i>Wrong Prompt</i>	Sorry, you did not drive the robot the correct total distance. Please try again – use the Hint if you feel stuck.
<i>Hint</i>	You want to drive the robot a total of 10 units. The current block will drive the robot: $2 + 6 + 4 = 12$ units. Think “what should the values be to drive the robot 10 units?” OR “what three numbers can I add together to equal 10?”
<i>Possible Solution in Ch</i>	<pre>#include <linkbot.h> ClinkbotI robot; double radius = 1.75; robot.driveDistance((2 + 6)+ 2, radius);</pre>

Activity #3 Applying Addition with Multiple Terms to Drive the Robot Forward

Picture of solution in RoboBlockly



Problem Statement:

Modify the preplaced blocks so the robot will drive forward 10 units. You should use addition only. You can change all of the numbers or one, just make sure that all three numbers add up to 10.

driveDistance(distance + + in);

Location of solution for “Load Blocks” tab in RoboBlockly

C-STEM Studio -> Teaching Resources -> TeachMath1->RoboBlocklySolution->m3.xml

Student Mathematical Calculations

Students will need to first see that the pre-placed blocks have a sum of 12: $2 + 6 + 4 = 12$

They then need to change the values to any three numbers that have a sum of 10. There are a LOT of possible solutions.

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

- a) Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)


Activity #4 Applying Subtraction with Multiple Terms to Drive the Robot Forward

Common Core State Standards - Mathematics:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.

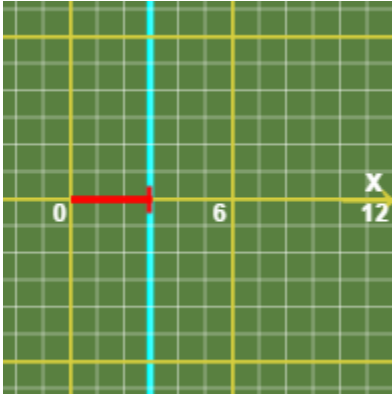
Objective: Students will apply their understanding of addition and subtraction to move the linkbot the specified distance.

RoboBlockly Student Activity:

<i>Initial Student Prompt</i>	Just as before, you will have multiple operations happening in your driveDistance block. Operations will occur from left to right (important to note for subtraction).
<i>Pre-Placed Blocks</i>	
<i>Problem Statement</i>	Modify the preplaced blocks so the robot will drive forward 3 units. You should use subtraction only. You can change all of the numbers or one, just make sure that all three numbers have a difference of 3.
<i>Wrong Prompt</i>	Sorry, you did not drive the robot the correct total distance. Please try again – use the Hint if you feel stuck.
<i>Hint</i>	You want to drive the robot a total of 3 units. The current block will drive the robot: $8 - 5 - 2 = 1$ unit. Think “what should the values be to drive the robot 3 units?” OR “what three numbers have a difference of 1?”
<i>Possible Solution in Ch</i>	<pre>#include <linkbot.h> CLinkbotI robot; double radius = 1.75; robot.driveDistance((2 + 6) + 2, radius);</pre>

Activity #4 Applying Subtraction with Multiple Terms to Drive the Robot Forward

Picture of solution in RoboBlockly



Problem Statement:

Modify the preplaced blocks so the robot will drive forward 3 units. You should use subtraction only. You can change all of the numbers or one, just make sure that all three numbers have a difference of 3.

```
driveDistance(distance 10 - 5 - 2 in);
```

Location of solution for “Load Blocks” tab in RoboBlockly

C-STEM Studio -> Teaching Resources -> TeachMath1->RoboBlocklySolution->m4.xml

Student Mathematical Calculations

Students will need to first see that the pre-placed blocks have a difference of 1: $8 - 5 - 2 = 1$

They then need to change the values to any three numbers that have a difference of 3. There are a LOT of possible solutions.

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

- a) Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)

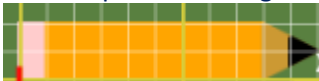
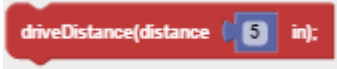
Activity #5 Length and Distance – The Pencil Problem

Common Core State Standards - Mathematics:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all position, e.g., buy using objects, drawings, and equations, with a symbol for the unknown number to represent the problem.

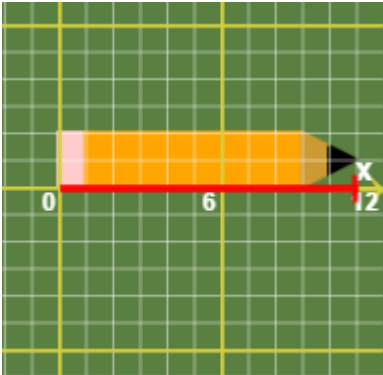
Objective: Students will apply their understanding of addition and subtraction to move the linkbot the specified distance.

RoboBlockly Student Activity:

<i>Initial Student Prompt</i>	<p>You can use RoboBlockly to draw (we will learn that later)! You will need to use your understanding of distance and length for this problem. Use the provided image of a pencil to help you find the correct answer.</p> 
<i>Pre-Placed Blocks</i>	
<i>Problem Statement</i>	<p>Drive the robot the same length as the pencil on the grid. You will need to change the number in the driveDistance() block to do this. Use the grid lines to help you determine how long the pencil is.</p>
<i>Wrong Prompt</i>	<p>Sorry, you did not drive the robot the correct total distance. Please try again – use the Hint if you feel stuck.</p>
<i>Hint</i>	<p>You want to drive the robot the same distance as the pencil. Try counting how long the pencil is and use that number in the preplaced driveDistance () block.</p>
<i>Possible Solution in Ch</i>	<pre>#include <linkbot.h> CLinkbotI robot; double radius = 1.75; robot.driveDistance(11, radius);</pre>

Activity #5 Length and Distance – The Pencil Problem

Picture of solution in RoboBlockly



Problem Statement:

Drive the robot the same length as the pencil on the grid. You will need to change the number in the `driveDistance()` block to do this. Use the grid lines to help you determine how long the pencil is.

`driveDistance(distance 11 in);`

Location of solution for “Load Blocks” tab in RoboBlockly

C-STEM Studio -> Teaching Resources -> TeachMath1->RoboBlocklySolution->m5.xml

Student Mathematical Calculations

Students can approach this problem in many different ways. Some might run the program first to see how close the robot is to length of the pencil. They can count, estimate, etc to find their solution.

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

- a) Section 5.4 Move a Distance for a Two-Wheel Robot. (`driveDistance` block)