



Follow-up Activity: For Students

Scientific Method 6: Procedural Thinking

Teacher Note: The activity below can be used as a follow-up to the last lesson. Please use in class or as a homework assignment with or without parent involvement.

Introduction:

In class, we practiced writing clear, accurate, step-by-step directions to allow our partners to make an exact copy of a model made of building toys (i.e. Legos). This skill is useful in everyday tasks from cooking to carpentry, and is also the basis for learning to program computers. The following activity is adapted from Thinkersmith's *Traveling Circuits* lesson entitled "My Robotic Friends". The full lesson is available on the Hour of Code website at <http://csedweek.org/files/CSEDrobotics.pdf>.

Activity: My Robotic Friends

In this activity, you are the **programmer** and you get to use a set of five simple commands to direct your partner (the "**Robot**") to build a specific stack of cups. You and your partner then write a **program** in which these commands are sequenced appropriately in order to direct the Robot to produce the correct stack when it **runs** the program. Working in pairs, you can write a program for each other, and then take turns being the Robot and running your partner's program.

Materials:

- A buddy
- Symbol Key (see below: It's the fourth-to-last page of this handout, and translates the arrow "**commands**" into words.)
- Cup Stack Pack (see below: It's the last three pages of this handout.)
- Blank paper or note cards
- Pencils
- Disposable cups

Procedure:

1. To get ready: Cut out the pictures of the different ways to stack cups from the last three pages of this handout. You should have a set of "cards" for your "Cup Stack Pack".
2. Keep your Symbol Key handy until you get used to the "commands" you can use for your "program".
3. To begin: Choose a card from the Cup Stack Pack. This is the structure that you will use to write a program for your Robotic Friend to build. Work in such a way that you can't see each other's cards.
4. Write your program on a sheet of blank paper or index card, using the symbols on the Symbol Key. Your program will look like a series of arrows pointing in the directions you want the Robot to move its hand. An example is given below. When you're first getting used to the game, you can use cups yourself to help you figure out the right order of commands. For an extra challenge, try writing the program without handling the cups!
5. Give your program to your partner and watch them run it. (Silently! No coaching!)
6. Compare your Robotic Friend's cup stack to the one on your card. If they got it right, congratulations to both of you! If not, it's time for **debugging**: see if you can figure out which command is incorrect, or in the wrong order. Fix your program and try again!

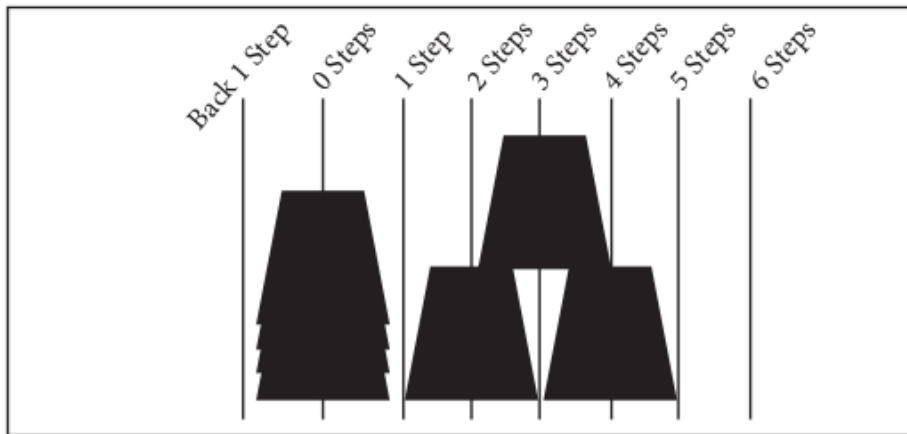
Example: Let's look at the first stack:





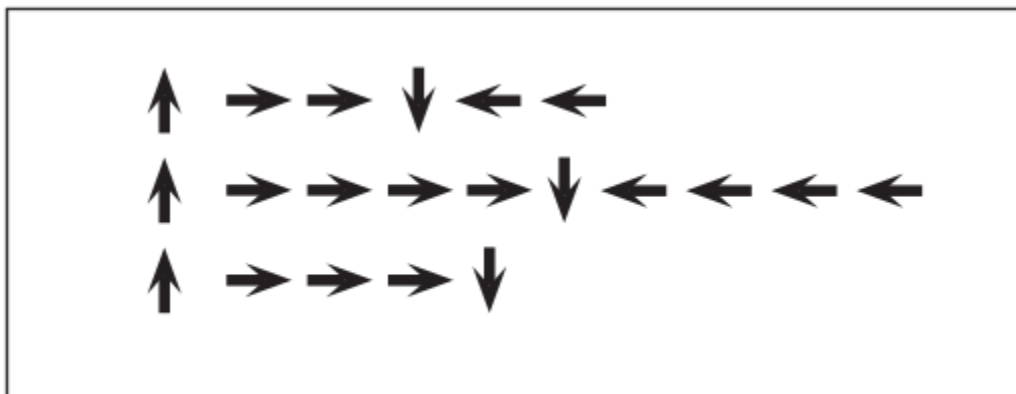
3 Cup Stack from Cup Stack Pack

Start with your cups all stacked on top of each other (see cups at the “0 Steps” position below). This will be your zero position, just like on a number line. Let a “forward” step be to the right (again, just like on a number line). Here’s the only tricky thing: each cup is two steps wide! That’s what allows you to write a program to stack them up! Look:



Step Guide

The program for the Three-Cup Stack looks like this:



One Solution for 3 Cup Stack

And if you were to speak it aloud, it would sound like this:

"Pick up cup", "Step forward", "Step forward", "Put down cup"
"Step backward", "Step backward"

"Pick up cup", "Step forward", "Step forward", "Step forward",
"Step forward", "Put down cup", "Step backward", "Step backward",
"Step backward", "Step backward"

"Pick up cup", "Step forward", "Step forward", "Step forward",
"Put down cup"

Once you get the hang of it, you can make up your own cup stacks to program! Or check out the full version of this activity, and other programming activities (both with and without computers) at the websites below.

Additional Resources:

- The original classroom version of "My Robotic Friends", by Thinkersmith:
<http://csedweek.org/files/CSEDrobotics.pdf>
- Another cool activity from Thinkersmith, created for the Hour of Code initiative (This one teaches a more advanced programming concept, so it's a good next step after My Robotic Friends):
<http://code.org/files/ConditionalsHoC.pdf>
- More online activities:: <http://www.codecademy.com>, <http://hourofcode.com/us>,
<https://www.commonsemmedia.org/blog/cool-tools-to-help-kids-learn-to-code>

Symbol Key



Pick Up Cup



Put Down Cup



Step Forward

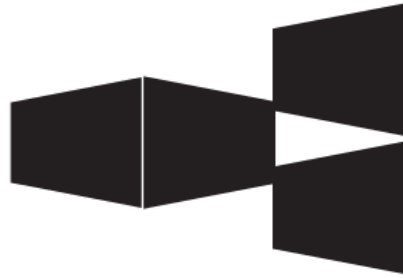


Step Backward



Turn Cup Over

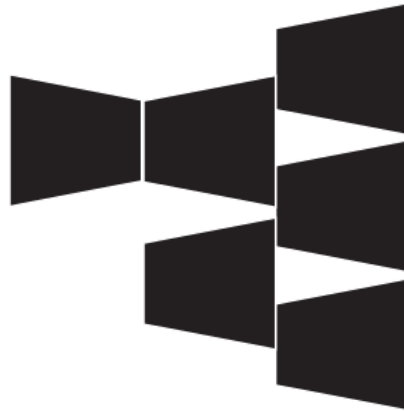
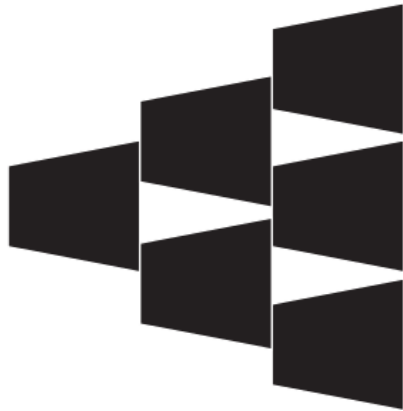
This Symbol Key is here to help you remember the different commands you can use in your program. Once you get used to the different commands and what they mean, you don't need to use it anymore.



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This is the first page of the Cup Stack Pack. You can cut this page into four cards, three with a cup stacking pattern and one title card.



This is the second page of the Cup Stack Pack. You can cut this page into four cards, each with a different stacking pattern.



This is the third page of the Cup Stack Pack. You can cut this page into four cards, each with a different stacking pattern.